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MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL

JULY 17-18, 1970

WASHINGTON, D. C.

The High Energy Physics Advisory Panel (HEPAP) met July 17-18, 1970, at 1717 H Street, Washington, D.C. The members present at the meeting were: Cool, Cork, Rosen, Sanford, Sessler, Snow, Tape Terwilliger, Treiman, Weisskopf - Chairman, Wenzel, Willis, and Hildebrand - Exec. Sec.

In addition, the following were present: AEC - Commissioner T. Thompson and J. Rosen, Special Assistant to Commissioner Thompson (Saturday), P. W. McDaniel, W. A. Wallenmeyer, R. L. Fricken, and C. Richardson (Research) and A. Friedman (International Affairs); NSF - E. Creutz, Assistant Director for Research (Friday), P. Donovan and M. Bardon; R. Sachs, Director, Enrico Fermi Institute; H. Taft (Yale), Chairman of the Subpanel on High Energy Physics Computing; Y. Shimamoto (BNL), Chairman Mathematics and Science Research Advisory Committee, and C. V. L. Smith (Research) during consideration of the work on HEP computing.

Welcome to New Members

Commissioner T. Thompson and P. W. McDaniel, for the AEC and V. F. Weisskopf as Chairman welcomed the new members of HEPAP. The importance of HEPAP's advisory function to the Division of Research at this time of difficult funding problems was stressed as was the privileged nature of the budgetary presentations.

Budgetary Considerations

P. Donovan for the NSF and P. W. McDaniel and W. A. Wallenmeyer for the AEC briefed the Panel on the FY 1971 and FY 1972 budget status.

The principal NSF funding problems continue to be: DOD terminations, the special needs of the Cornell and HEPL accelerators, the support of university groups for research at these accelerators as well as at the AEC National Accelerator Laboratories and the new user needs associated with planned use of NAL.

The AEC FY 1971 and FY 1972 operating, equipment and construction budgets (worksheets of 7/16/70) were considered. The FY 1971 budget was still in the legislative phase while the FY 1972 was being considered within the AEC Division of Research. The Panel considered the distribution of FY 1971 and FY 1972 funding.

Princeton-Pennsylvania Accelerator

The Panel considered the PPA in the context of possible NASA interest in the accelerator's heavy ion capability. Under these circumstances the possibility of completing high energy physics research should be reconsidered. (A letter dated July 18, 1970 from V. F. Weisskopf on this subject was sent to P. W. McDaniel.)

Distributions of National Laboratory Activities

Wenzel reported on the work of representatives from the various national laboratories at the SLAC meeting on June 22, 1970. The operations for ANL, BNL, LRL, and SLAC were intercompared using the categories: Operations, Research, Design and Development of Devices, Advanced Accelerator Research and Development, and Other. LRL is the only laboratory with a major effort in the Advanced Accelerator Research and Development category. Differences in these categories at the various laboratories were discussed. There was some uncertainty as to when a facility, such as a bubble chamber or spectrometer, is considered to be an in-house activity or a user service. Also reported were estimates of user equivalent research costs for in-house groups. Wenzel and Sanford are to report further on Distributions of National Laboratory Activities at the next HEPAP meeting.

HEP Computing

Sessler and Taft summarized the draft report on HEPAP Computing which had been mailed to HEPAP members. The Panel considered the computer usage survey results, university and laboratory facilities as well as future projections of computer usage. Y. Shimamoto and C. V. L. Smith

participated. The Panel conclusions and recommendations are summarized in Chapter VI of the report "Computer Usafe in High Energy Physics," August 1970. (The report was forwarded to the Division of Research by letter of August 14, 1970 from V. F. Weisskopf to P. W. McDaniel, and printed and distributed in early September.

Elementary Particle Subpanel of NAS Physics Survey Committee

R. Sachs briefed the Panel on the NAS effort. Discussion with the Panel concerned: projected budgetary needs for high energy physics, university participation in high energy physics, overall science policy, technological impact of high energy physics, and urgency of the funding problems. It is noteworthy that over half of the applied research proposals to NSF are from members of the high energy physics community. The NAS Physics Survey Committee is planning its report at mid-1971. The Subpanel aims to report by the end of 1970. It is anticipated that the HEPAP report on high energy physics computing will be useful to the NAS work.

Sachs welcomes an input and views from HEPAP members.

New Accelerator Technology Subpanel

Cork reported on the membership and plans of the Subpanel. (The first meeting was held at SLAC on August 13-14, 1970 on LRL, SLAC, and HEPL superconducting programs and included a visit to HEPL. The second was scheduled for October 8-9, 1970 at BNL and the third at NAL on November 5-6, 1970.)

Subpanel on Future Patterns of HEP Research

Sanford reported on the work of the Subpanel. (The latter has met April 28, 1970 at Washington, June 13, 1970 at Chicago, August 20, 1970 at Cambridge, September 19, 1970 at Chicago, and plans to meet November 6-7, 1970 at Batavia.) A briefing of the HEPAP on the work of the Subpanel by Sandweiss is scheduled for the next HEPAP meeting.

Participation of National Laboratories at NAL

The Panel considered the question of what policy, if any, be established as to what the role of National Laboratories, such as ANL, BNL, etc. should be relative to participation in experiments at NAL. This topic is to be continued at the next HEPAP meeting.

Serpukhov Collaboration

A. Friedman briefed the Panel on the status of the Serpukhov collaboration. While negotiations on a formal AEC-SCUAE protocol agreement on joint projects within the existing umbrella agreement resulted in an impasse, the suggestion by Seaborg to go ahead with the UCLA-Dubna-Serpukhov collaboration on an ad hoc basis was agreed to in principle via the letter of July 28, 1970, from Petrosyants to Seaborg. (A formal invitation to UCLA was extended by Serpukhov on August 11, 1970, and an agreement between the two institutions under Article IV of the AEC-SCUAE umbrella agreement was arrived at in September 1970. The UCLA group is presently at work at Serpukhov.)

International High Energy Physics

V. F. Weisskopf reported on the Western European High Energy Physics effort. The total number of dollars expended is about the same as in the U.S. However, the fraction of the budget going into salaries is higher in the U.S. than in Europe (60% versus 40%) with the numbers of Ph.D. equivalents the same. Present planning indicates that funds for the 300 GeV project would be an additional increment to Western European High Energy Physics funding.

W. A. Wallenmeyer briefed the Panel on the continued Canadian interest in NAL, at a proposed initial funding level of about $200,000/year.

Next Meeting

The Panel has scheduled the next meeting for October 11-12, 1970, at Batavia, Illinois, to consider: the NAL program and laboratory tour; distributions of National Laboratory activities; participation of National Laboratories at NAL; Report from the Subpanel on Future Patterns of High Energy Physics; NSF and AEC Budget Status; distributions of National Laboratory activities; Report from the NAS Subpanel on Elementary Particle Physics; and reports on International High Energy Physics.

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B. Hildebrand
7/13/70

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL

MAY 24-25, 1970

WASHINGTON, D. C.

Introduction

The High Energy Physics Advisory Panel met May 24-25, 1970, at 1717 H Street, Washington, D. C. All members of the Panel and B. Hildebrand, Exec. Secy., were present. V. F. Weisskopf was Chairman. Additional attendees were: P. W. McDaniel, W. A. Wallenmeyer, C. R. Richardson, and R. L. Fricken of the Division of Research; P. Donovan and M. Bardon of the Physics Section, NSF; B. McDaniel and A. Silverman, Wilson Synchrotron Laboratory, Cornell, for the Cornell synchrotron presentation; and H. Taft, Chairman of the HEPAP Computer Subpanel, for a report on high energy computing.

NSF Budget Report and University Support

P. Donovan and M. Bardon reported on the NSF elementary particle physics program. The total physics support for operating and equipment in FY 1970 has been $30M/year, and the expectation is for about $31M in FY 1971. The basic NSF problems are the incremental requirements for NAL users, the Cornell and HEPL laboratories, and the DOD terminated universities in the context of a relatively fixed budget. The NSF elementary particle physics FY 1970 support has been $14.1M which has the following components:

Accelerators	$5.9M	(Cornell $2.7M; Stanford $1.7M; Columbia $1.1M; Chicago $0.4M)
Acc. Users	$5.8M	(14 counter groups; 13 bubble chamber groups; with $1.0M in Science development monies included)
Theory	$1.4M	(54 grants)
Cosmic Rays	$1.0M	(7 groups)

Construction is supported out of the Facilities budget, which has decreased in recent years by a factor of four. Total physics Facility support fell from a previous level of $6-7M to $2.5M in FY 1970.

M. Bardon also reported on the status of the Stanford High Energy Physics Laboratory program on: nuclear and high energy physics; the Mark III accelerator; the superconducting accelerator which is planned to be initially available in 1971 at an energy of several hundred MeV; crystal spectrometer work; and cryogenic developments.

The Panel considered: the problems associated with $8M required by DOD terminations; the difficulty of small accelerator user groups remaining viable and coalition - collaboration possibilities; overall problems of basic research support at universities; and the need for NSF university support for NAL, Cornell, and HEPL work.

Cornell Electron Synchrotron Laboratory

B. McDaniel reported on the 10 GeV electron synchrotron (See special report - Cornell Electron Synchrotron - May 1970.): its history; beam and target sharing; the new slow resonant extracted beam; the experimental program; and the severe space and computer limitations. Proposals to the NSF for the Wilson Synchrotron Laboratory include: an increase in the energy of the machine to at least 15 GeV at a cost of less than $0.8M; doubling the experimental area at a cost of $1M; and expansion of the computer capability at a lease cost of $0.2M/year, or purchase at a cost of $0.5M.

The report was followed by a Panel consideration of: the unique capability of the high duty cycle combined with high energy; the possibility of enlarging the capability of the Laboratory for national purposes; the unique physics experimental opportunities such as works on deep inelastic electron scattering; the extent of outside interest; space, computer, and budgetary requirements; and relationship to SLAC and CEA programs. (The Panel plans to write the NSF via P. W. McDaniel on the importance of the Cornell high energy physics program and the need for the related major improvements.)

HEP Subpanels

The membership of the Subpanel on "Future Patterns of High Energy Physics Research" consists of: M. Deutsch, M. L. Good, R. A. Lundy, R. J. Plano, J. Sandweiss - Chairman, M. Schwartz, and M. L. Stevenson. (This Subpanel met on June 13, 1970, at O'Hare Airport. The next meeting is scheduled to be at the Massachusetts Institute of Technology on August 20, 1970.)

The membership of the Subpanel on "New Accelerator Technology" consists of: M. Q. Barton, B. Cork - Chairman, E. D. Courant, D. Keefe, G. R. Lambertson, G. Voss, G. Loew, and B. Birmingham. (The first meeting is scheduled to be at SLAC on August 13-14, 1970.)

(Announcements on the appointment of two HEPAP Subpanels were made in the June 5, 1970, Preprints in Particles and Fields, and in the June 1970 Physics Today.)

AEC Budget

P. W. McDaniel and W. A. Wallenmeyer reported that the FY 1971 budget status was still the same as reported at the LRL HEPAP meeting following the JCAE action. (Further FY 1971 appropriation action still awaits the Senate Appropriation Committee Report, the House-Senate Conference, etc.) Budget exercises were indicated which correspond to the possibility of reductions in FY 1971 HEP operating funds of $.4-1.3M, reductions in construction of $5-15M, and reduction in AIP funds of $1M. The approved projections level for FY 1972 operating funds for HEP is expected to be $136M.

C. R. Richardson reported on a dollar breakdown at the national accelerator laboratory activities. It was agreed that more information would be useful. (A meeting was held at SLAC on June 22, 1970, by representatives of each of the laboratories. A report on this subject is to be made at the next HEPAP meeting.)

B. Hildebrand reported on the AEC university program support which totaled approximately $26M in FY 1970. Charts were presented giving contract budgets, estimated university contributions, and number of senior and junior staff and graduate students for each research activity. It was estimated that AEC university funding had the following approximate ratio: theory:bubble chamber:spark chamber-counter = 1:2:3. The latest university publication lists were distributed.

The Panel considered: accelerator laboratory in-house support and university user research support; modes of reviewing research proposals and accomplished research; and the importance of the work of the Sandweiss subpanel.

Panofsky indicated that SLAC planned to consider increasing the bubble chamber production rate to 7.0×10^6/year in FY 1971. Cork indicated that ANL planned to consider the shutdown of the 40" ANL-Michigan HLBC after 1.0×10^6 pictures are produced in FY 1971, and that ANL planned to run the 30" HBC as part of a hybrid detector system. These plans are consistent with the Panel conclusions and recommendations of the previous meeting.

Subpanel on HEP Computer Usage

H. Taft reported on the work of the HEP Computer Subpanel which included a survey of laboratories and universities by Subpanel members. The principal topics considered were: university and national laboratory computer usage; estimates of future computer usage; central computing, medium size computers, and on-line computing by universities and laboratories; remote use of large computers; automatic film scanning and measuring system computing; and national data banks, mass stores, and publications.

The Panel considered possible conclusions and recommendations relative to university user and laboratory computing requirements; problems of mass storage; amortization and funding of computer facilities; cost of remote use of large computers; software problems associated with remote usage; role of medium size computers; and computer requirements of film measuring systems. A. Pevsner and A. Sessler agreed to participate in writing a draft summary HEPAP report and conclusions on the large amount of information assembled and work accomplished by the Subpanel. (A draft report by Pevsner, Sessler, and Taft has been mailed to HEPAP members for consideration at the July HEPAP meeting. Copies were also sent to members of the Division of Research - Mathematics and Science Research Advisory Committee (MCSRAC). C. V. L. Smith, Division of Research, and Y. Shimamoto, Chairman of MCSRAC, plan to attend the July meeting during consideration of the draft report.)

International Collaboration

W. A. Wallenmeyer reported on the possibilities of U. S. participation at IHEP - Serpukhov: R. Sard (Illinois) was planning to participate in the CERN-Serpukhov missing mass experiment: the D. Drickey group (UCLA) has had some informal encouragement to collaborate on the Dubna-UCLA-Serpukhov π-e experiment (A letter from Petrosyants to Seaborg received via telex at UCLA June 12, 1970, has recommended that the collaboration proceed under Article IV if agreement under Article VI cannot be reached in time.); Z. Guiragossian is seeking support from the AEC and the NSF to participate in a Yerevan-Serpukhov γ-p experiment which is understood to have been approved by IHEP.

Next HEPAP Meeting

The next meeting was scheduled for July 17-18, 1970. (This is scheduled to be the first meeting for five new HEPAP members.)

Corrections and Omissions in Minutes

Meeting of April 17-18, 1970, at LRL:

(1) Page 5 - line 7 should read: Plans for the Bevatron include acceleration of deuterons; bunching of beams for time-of-flight use; ....

(2) Please add to the LRL Host Presentation the three following paragraphs:

A. Rosenfeld discussed the LRL Data Center program: the total effort in the world involves 37 people with six at LRL with a total budget of ~ \$170K; the well known review of particle properties; the new UCRL 20,000 series of reports compiling cross sections - the first three reports for $K^{+}N$, YN, and NN compilations; special

compilations such as the recently completed "πn Partial Wave Amplitudes" and "Elastic Scattering Data;" and requests for data retrieval and bibliographical searches.

R. W. Birge reviewed the LRL computer facilities (Mathematics and Computing Group, LRL - R. J. Harvey, January 23, 1970; Lawrence Radiation Laboratory Computers - April 1970): the role of the two CDC 6600 computers and plans to acquire a computer of the CDC 7600 class. The latter should reduce the charge to outside users from the present $155/hour to $70-120/equivalent 6600 hours - expanded outside use with remote operation is anticipated; Physics Division use of the 6600 system is 70-45% bubble chamber, 10% counter/spark chamber, 10% math and computers, and 5% other; roles of other computers outlined; and policy not to use medium sized computers - PDP-10's.

D. Keefe reported on new accelerator technology at LRL (Research on the Electron Ring Accelerator - UCRL 19435, December 1, 1969, D. Keefe; Conceptual Studies for a New Technology Proton Accelerator (50-100 BeV) to Serve the Bevatron Experimental Facility, Example 1:A Superconducting Synchrotron, Example 2: An Electron Ring Accelerator - April 7, 1970): the ERA work has achieved 12 MV/m to date, compared to the current operating value of 40 MV/m for proton synchrotrons. Operations with the new high current injector are expected to begin in June 1970. Principal problems are expected to be instabilities and radiation effects; accelerator conceptual studies assume - the LRL new technology accelerator is to be located in hill tunnel, use is to be made of the present experimental plus Bevatron area, and design energy of ~ 100 BeV; the inital phase of the conceptual 50 Kg superconducting synchrotron assumes 50 MeV injection, a cycle time of 6-10 seconds, and an intensity of $\sim 3 \times 10^{12}$ ppp is estimated to cost ~ $20M; as an example, the cost estimated obtained for a conceptual ERA accelerator to operate initially at 65 BeV was estimated to cost $31M.

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B. Hildebrand
5/20/70

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL

APRIL 17-18, 1970

LAWRENCE RADIATION LABORATORY

Introduction

The High Energy Physics Advisory Panel (HEPAP) met April 17-18, 1970, at the Lawrence Radiation Laboratory (LRL), Berkeley, California. Present at the meeting were: Cool, Cork, Lederman, Lofgren, Panofsky, Pevsner, Sanford, Sessler, Tape, Terwilliger, Weisskopf - Chairman, Willis, and Hildebrand - Exec. Sec. In addition, the following were present: AEC - P. W. McDaniel, H. L. Kinney, W. A. Wallenmeyer, C. R. Richardson (Research), A. Friedman (IA), and J. Rosen (Special Assistant to Commissioner Thompson); NSF - P. Donovan and M. Bardon. Friedman, Panofsky, and D. Drickey (UCLA) reported on the negotiations on Serpukhov collaboration. Presentations on the Princeton-Pennsylvania Accelerator included contributions from M. White (Director), J. Cronin, V. Fitch, K. Goulianos, Wonyong Lee, A. Mann, and W. Wales. Presentations on the Cambridge Electron Accelerator included contributions from K. Strauch (Director), G. Voss, M. Deutsch, and F. Pipkin. The LRL Host Laboratory Presentation included contributions from E. M. McMillan (Director), T. Elioff, H. Steiner, G. H. Trilling, G. Chew, R. W. Birge, A. Rosenfeld, and D. Keefe. The host presentation portion of the HEPAP meeting was attended by the above contributors and W. Hartsough, D. H. Miller, M. Pripstein, D. L. Judd, F. T. Solmitz, W. Gilbert, L. J. Kerth, and E. Segre.

An open LRL-User-HEPAP meeting was held Friday evening. The lively discussion and question and answer session on the course of high energy physics was attended by some 200 people.

An Executive Session (Panel members only) was held late Saturday afternoon.

Budget Status for FY 1970, 1971, and 1972

P. W. McDaniel and W. A. Wallenmeyer presented the FY 1965 - FY 1970 history of federal funding for the U. S. High Energy Physics Program:

Total costs including other federal agencies for operating, construction equipment: costs at each of the AEC national laboratories and university funding. These included FY 1971 in terms of the current President's Budget. Funding of the SIAC storage ring program within expected equipment funds in FY 71 and 72 as recommended earlier by HEPAP, has been concurred in by the AEC and BOB and is looked upon favorably by the JCAE. Fabrication of the ring awaits further action by the Congress on the AEC's FY 71 budget request. The prospects for FY 1972 were presented and considered by the Panel. This included consideration of several funding distributions if the operating total were to be 136, 126, or 122M$. This is expected to receive further consideration in the May 24-25 Washington meeting.

NSF Budget Problems

P. Donovan indicated that the anticipated FY 1971 budget for physics at NSF would essentially be level without a cost of living increase. While some monies are included in this budget for DOD terminated work, the BOB has expressed concern on "starting new HEP projects." The principal problems in the NSF elementary particle program were expressed to be: Necessary machine improvements and expanded experimental area associated with the Cornell Synchrotron; experimental area needs of the Stanford High Energy Physics Laboratory; university user group requirements including support for the completed Development Grant programs. The next HEPAP meeting will include presentations on the NSF elementary particle physics and the Cornell Synchrotron programs.

Princeton-Pennsylvania Accelerator Plans

M. G. White, Director of the PPA, presented plans for operating the Laboratory at a level of $1.2M/year in FY 1972. This mode of operation could not permit synchrotron improvements or beam developments, but represents the minimal costs of running the machine about 2,000 hours/year. Of this annual level some $200K in funds would come from non-federal sources including Princeton, Pennsylvania, Michigan, Columbia, Rutgers, Yale, and others. A proposal is being prepared for the NSF and AEC for $1.0M in FY 1972. (This was received at the AEC on May 11, 1970.) An endorsement by HEPAP of the FY 1971 experimental program was requested, as well as endorsement for the new mode of operation in FY 1972 (see memorandum of April 15, 1970, from M. G. White to HEPAP with attachments).

W. Wales outlined the experimental program starting in May 1970 for FY 1971. Some 3,000 hours are required for six major experiments for completion about December 1970: η decay asymmetry; $np \rightarrow d\gamma$; Λ beta decay; dp elastic scattering; $d\alpha$ and $\alpha\alpha$ interactions; π beta decay.

Wonyong Lee discussed the η experiment emphasizing: the large statistics available at the PPA; the short set-up time; the decreased background and complexity of the PPA.

J. Cronin discussed a future experimental program which would emphasize the unique properties of the PPA: time-of-flights, deuteron beam and neutron beam. The relative competitiveness with other accelerators was discussed.

Goulianos discussed the improved $np \rightarrow d\gamma$ experiment; the future use of polarized neutron beams in a parity violation search and a $nd \rightarrow H^3\gamma$ experiment.

A. Mann and V. Fitch discussed future experimental possibilities including a neutral kaon experiment to test conserved vector current.

The Panel discussed the relative competitiveness of the PPA; the importance to graduate training; nuclear structure work; utility of PPA beam transport at other laboratories; the limited major research contributions of PPA in its formative years; the recent important experiments; and the possible September 30, 1970, shutdown.

The general consensus resulting from the executive session was that the closing of the PPA with no funding in FY 1972, is too abrupt and that the PPA should be given a year or two on a fixed budget to complete work on its most important experiments.

CEA Plans

K. Strauch presented the problems of survival and crises at the CEA which accompany a 30% decrease in the Laboratory operating budget with a 40% decrease in Laboratory personnel including elimination of the small theoretical group. (See exchange of letters between P. W. McDaniel and K. Strauch dated 2/2/70 and 2/11/70; handout charts and tables on history of CEA Funding, CEA Personnel, Experimental Program and CEA machine hours.) Continuation of both clashing beam development and photoproduction and electroproduction

experimental program can no longer be maintained. The latter program is being reduced to zero by June 1, 1970 and will be put on standby. If these experiments cannot be resumed within the year, the experimental groups may disperse. G. Voss reported on the progress on colliding beams development: multicycle injection has yielded 100 ma peak and 30 ma average electron currents. The design luminosity for e^+ and e^-, 2×10^{31} particles/cm^2/sec. at 3 GeV, a factor of 100 over that at Frascati, and a factor of 10 less than SLAC at 2 BeV, is within achievement range; to date, the CEA has accumulated $\sim$ 50% of the required electron current and $\sim$ 10% of the positron current for single beam storage electrons but no positrons had been through the by-pass to date.

K. Strauch discussed the planned by-pass experimental program with the Panel. This program is expected to begin when the equivalent of the Frascati luminosity is achieved. The first planned experiments are to be μ pair and two photon production. The principal wire spark chamber and counter detectors (non-magnetic field) are being assembled - one quadrant has been tested and this program is expected to start before the end of FY 1970. Should there prove to be a large cross section for hadron production, there will be an urgent need for the magnetic detector system. More RF is required to go up to 5 BeV; this and a revised by-pass requires $1M.

F. Pipkin presented details on the electroproduction experimental program which, under present funding conditions, cannot be executed (Pipkin notes - undated): the CEA duty cycle makes it possible to study photoproduction as a function of the virtual photon mass ($\gamma^* + p \rightarrow \pi$ + missing mass); the possibility of continuing these experiments at Cornell at higher energies.

LRL Host Presentation

E. M. McMillan chaired and introduced the individuals making LRL presentations to HEPAP. He noted that the recent LRL budgets have led to: reductions in bubble chamber pictures by 50%; releasing a film processing machine to SLAC and a reduction of $\sim$ 9% for the in-house group research efforts.

T. Elioff reported on Bevatron operations (memorandum of April 8, 1970 - The Bevatron Program - T. Elioff and W. D. Hartsough). The last major accelerator improvement program which was completed in 1964 led to 4×10^{12} ppp and led to the present important external proton beam (EPB) system. Total operating hours of experiments per year continue to increase as a result of increasing

ability to handle multiple experiments; the outside user operating hour percentage is 50-60%; the use of the Bevatron by some 110 Ph.D.'s and 80 graduate students per year resulting in some 100 published papers of experimental research per year (1,224 total to date). The EPB leads to the flexibility and high efficiency of Bevatron operations. Present EPB extraction efficiency is 50-55% and will aim for 80% in the fall of 1970. Plans for the Bevatron include acceleration of deuterons; excitation of horizontal natural frequency for time-of-flight use; possible use of BNL 50 MeV injector to achieve 10^{13} ppp in EPB at a total cost of about $2.0M ($0.5M in construction).

H. Steiner discussed Bevatron use. For orientation:

LRL HEP	Ph.D.	Grad. Student
Theory	26	21
Counter/Spark Ch.	42	30
Bubble Ch.	32	30
Accelerator	10	--
	110	81

The LRL counter-spark chamber program was summarized (LRL HEP Experimental Program - Counters and Spark Chambers - H. Steiner, April 17-18, 1970). The weak interaction experiments relate to searching for neutral currents in charged and neutral kaon systems, Ke_2 branching ratio, test of $\Delta S=\Delta Q$, $K_{\ell 3}$ charge asymmetry, Ke_3 and Ke_4 work, and an η_{oo} (for $K_L \rightarrow 2\pi^o$) determination all at the Bevatron. The electromagnetic interaction experiments are executed at both SLAC and the Bevatron. At SLAC time reversal symmetry in inelastic scattering of electrons from polarized protons, polarization in elastic e-p scattering and asymmetry of photoproduction of π^+ from polarized protons. At LRL K- and Σ- atomic x rays and Σ^+ and Ξ^- magnetic moments. The strong interaction includes work in the category $\pi^- p \rightarrow n$ + neutrals, diboson production, pp → d + missing mass (search for T=1 bosons), K^+p and K^-p scattering, σ(np) at 4 and 6 BeV, pd elastic and inelastic scattering, n polarized p charge exchange scattering. In addition, cosmic ray work in progress includes the balloon experiment to determine the primary spectrum of elements, the zenith angle distribution of muons (> 1,000 BeV), and search for monopoles in sundry matter. Development work includes wire spark chambers, solid and liquid state detectors, polarized targets, as well as electronic developments.

G. Trilling reported on the LRL bubble chamber experimental program (LRL High Energy Physics Experimental Bubble Chambers - undated). Turn off of the 25-inch bubble chamber is planned in the near future. Also reported on were: the continued efficient rate of measurement by the spiral reader, flying-spot digitizer and COBWEB systems; the measurement program associated with $\bar{p}$, π and K film from the 72-inch bubble chamber and the kaon and pion film from the 25-inch chamber; the baryon and boson spectroscopy programs at other accelerators - SLAC and BNL; polarized photon experiment at SLAC; future K^-p streamer chamber work at SLAC; and interest in strong and weak interaction experiments at NAL.

G. Chew outlined the theory program (Review of LRL Particle Theory Research Program - G. F. Chew, April 7, 1970) involving 30 Ph.D.'s (13 faculty and senior LRL members) and about 20 graduate students. Some 15% of theory support is from the Air Force. The principal efforts involve strong interactions: phenomenology, linearized bootstrap models, multiperipheral models, and threshold resonances. It was emphasized that on the basis that the strong interaction S matrix is an analytic function with Regge asymptotic behavior, there may be no sharp distinction between the importance of what can be learned at very high as opposed to lower energies.

LRL-Users-HEPAP Meeting

Some 200 physicists and guests met at LRL at a session chaired by V. F. Weisskopf. The latter presented the major problems facing the HEP community. The information exchange included a question and answer period with HEPAP and AEC participants.

AGS Conversion

Cool reported that costs of the AGS conversion program will cause problems in FY 1971. Not only have conversion costs increased (by about $1M) but special problems arise in the operation costs such as the need to bring people under the operating budget following conversion and the costs for termination costs of about 60 people ($0.50M).

Bubble Chambers

Terwilliger and the Panel considered the planning for small and large bubble chamber operations. (Memo of April 13, 1970 from K. Terwilliger to HEPAP members.)

Concerning the operation of existing small bubble chambers: It was agreed that under present fiscal circumstances, fuller operation of a small number of such chambers covering the required beam energies was most efficient. Consequently, the program should move in FY 1971 toward case #5 operation for FY 1972. The latter case is: Operation of the SLAC 40-inch and 82-inch chambers at a combined level of 10 M pictures and the BNL 80-inch chamber at a 5 M picture level. Individual laboratory efforts such as the use of such bubble chambers in hybrid experiments as well as other high priority experiments should, of course, continue to be the decision of laboratory directors. It was anticipated that the ANL 30-inch chamber may be operated in this kind of mode in FY 1971.

Concerning large bubble chambers, the importance of the large chambers to the ANL and BNL experimental programs versus moving one of them to NAL was considered. It was generally agreed that a 15-foot bubble chamber at NAL with its long path, higher field and capability to operate neon-hydrogen mixtures had advantages over the use of the 12-foot ANL chamber. It was generally agreed that NAL proceed with the 15-foot bubble chamber; that the BNL program required the use of its intermediate size chamber; and that the high cost to move and install the ANL 12-foot chamber negated this option. Plans for operating the large chambers as well as construction were of importance in achieving overall reductions in cost.

GAO Studies

W. A. Wallenmeyer and the Panel discussed the recent GAO recommendations: that AEC personnel attend Laboratory Program Advisory Committee meetings; that laboratories should review major new data analysis programs where substantial costs are involved and request AEC Headquarters for concurrence before proceeding. A major GAO effort at each laboratory, except CEA, is proceeding in conjunction with an overall AEC-HEP management study. The investment of HEP personnel time and energy is considerable. Also considered was the GAO request for copies of the HEPAP minutes from January 1968 to date. (A letter from V. F. Weisskopf to P. W. McDaniel dated April 27, 1970 agreed to the forwarding of minutes to the GAO with deep reservations. The minutes were sent to the GAO on May 18, 1970.)

Report on Serpukhov Collaboration

A. Friedman with W. K. H. Panofsky and D. Drickey reported on their visit to Serpukhov and Moscow and on the uncertain status of the Serpukhov collaboration arising in large part from the Soviet request for equipment. The latest communication of April 16, 1970, from Seaborg to Petrosyants recommending joint experiments at NAL and the rapid initiation of joint experiments at Serpukhov. (The newly arrived letter, dated April 7, 1970, from Petrosyants to Seaborg, vaguely hopes for eventual agreement between the U. S. and U.S.S.R.)

Next HEPAP Meeting

The next HEPAP meeting is scheduled for May 24-25, 1970, at Washington, D. C., to consider: HEP Crises; NSF program; Cornell Synchrotron Presentation; and the HEPAP Computer Subpanel Draft Report.

April 7, 1970

TO: HIGH ENERGY PHYSICS ADVISORY PANEL MEMBERS

R. L. Cool	J. R. Sanford
B. Cork	A. M. Sessler
L. M. Lederman	G. F. Tape
E. J. Lofgren	K. M. Terwilliger
G. E. Pake	S. B. Treiman
W. K. H. Panofsky	V. F. Weisskopf, Chairman
A. Pevsner	W. J. Willis

FROM: Bernard Hildebrand, Executive Secretary

SUBJ: JANUARY 12-13, 1970, WASHINGTON HEPAP MEETING MINUTES

The draft minutes of the last HEPAP meeting are enclosed. Please bring any errors or omissions to my attention.

REMINDERS:

Next Meeting - April 17-18, 1970 - LRL.

E. M. McMillan has invited HEPAP members to his home the evening of April 18th.

Open LRL-User-HEPAP Meeting - April 17th (evening).

D R A F T
B. Hildebrand
4/7/70

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL

JANUARY 12-13, 1970

WASHINGTON, D. C.

The first meeting of 1970 was held on January 12 (Monday) and 13 (Tuesday), at the Atomic Energy Commission, Washington, D. C., 1717 H Street, Room 1046. Members of the Panel present were: R. L. Cool, B. Cork, L. M. Lederman, E. J. Lofgren, W. K. H. Panofsky, A. Pevsner, J. R. Sanford, A. M. Sessler, G. F. Tape, K. M. Terwilliger, S. B. Treiman, V. F. Weisskopf (Chairman), W. J. Willis, and B. Hildebrand (Exec. Secy.). Also present were: P. W. McDaniel, H. L. Kinney, W. A. Wallenmeyer, R. L. Fricken, R. P. McGee, and C. R. Richardson from the Division of Research; and W. Gruner and P. Donovan from the National Science Foundation. In addition: E. Goldwasser (NAL) and H. Ticho (UCLA) made presentations and participated in the discussions on high energy physics user activities in the 1970's (January 13); and C. York from the Office of Science and Technology and the Panel discussed federal funding of science research (January 13).

Budget - General

P. W. McDaniel and W. A. Wallenmeyer presented the latest details on the FY 1970, FY 1971 budgets, and the recommended Five-Year Projections. The operating, equipment, and AIP budgets of each of the laboratories and the integral university funding were traced from FY 1965 through FY 1971. The problems of manpower and funding needs associated with the conversion of the AGS were introduced. (This will be a topic at the next HEPAP meeting.) The possibility of FY 1971 budget cuts was considered and the special need to protect the BNL, NAL, and SLAC budgets was reaffirmed. (The FY 1971 JCAE Hearings were held on March 3, 1970; report has as yet not been issued by the Committee.)

Colliding Beams

The Panel discussed the SLAC-SPEAR project in the context of the limited equipment budgets. W. K. H. Panofsky did not participate in the SPEAR fraction of the Panel meeting. Factors considered were:

1) A SPEAR commitment becomes a community priority because of the effects of shortage of equipment funds on other laboratory

programs. As an example, in the context of $7.5M in equipment funds scheduled for FY 1971 at NAL versus a need for $21M, it will be possible to begin equipping only two of the three planned experimental areas.

2) More equipment cuts could reduce even further the scope of the initial complement of experimental beams and detectors. Establishment of the full significance of the CEA colliding beam capability by means of the By-pass is anticipated in the fall of 1970. At this point the future U. S. colliding beam programs should be considered again.

3) The research programs at the other electron accelerators - CEA, Cornell, HEPL; the importance of the physics of colliding electron-positron beams and the negative effects of another year's delay on the SPEAR project.

V. F. Weisskopf and W. K. H. Panofsky participated in a separate meeting with the AEC Controller. On the basis of these discussions and the HEPAP recommendation, as expressed in the October 23, 1969, letter from V. F. Weisskopf to P. W. McDaniel, and HEPAP's continued high priority for the colliding beams, the AEC is planning to allocate some $1.6M in FY 1971 equipment funds plus $1.05M already allotted to SLAC in FY 1970 equipment funds, the latter to be carried over into FY 1971 for the SPEAR project.

Five-Year Budget Projections

G. F. Tape chaired the Panel during a major fraction of these considerations on the five-year budget projections. A suggestion was made that the projection format should be in terms of both funding and manpower. It is planned to include manpower in future projections presented to HEPAP. The essential program needs and the mix of optimism and reality of the projections, as well as the balance between the funding of various parts of the program, were discussed.

The equipment funding projections were considered and the Panel suggested several ajustments:

1) The addition of a general purpose computer for the program in FY 1976 in addition to the plans for a NAL/ANL computer in FY 1972 and one in FY 1974 for Users.

2) The addition in FY 1976 of some $10M in equipment for the work associated with the NAL energy expansion to 400 BeV.

3) Revision of the FY 1971 total funding and distribution.

Principal construction projection topics were the AIP requirements, the 200 BeV expansions, and the need for some $2.0M in initial construction funds for a new technology accelerator in FY 1972 with $58M in FY 1973 at either LRL or BNL. To be in consonance with the budget cycle a decision on this should be made if possible by the summer of 1970. The Panel believed that technically there is room for two accelerators in the next five years; one started about FY 1973 and another about FY 1975. B. Cork has agreed to chair a HEPAP subpanel on accelerators to consider the status of new accelerator technology and make recommendations. Preliminary accelerator design reports from LRL and BNL are anticipated in a few months.

NSF Considerations

P. Donovan and W. Gruner informed the Panel on the following matters: A Cornell proposal has been submitted to the NSF to triple the experimental area at a cost of $3-4M over a period of years. Its five beam lines would be expanded to 15 and the machine energy increased to ~ 15 GeV. The High Energy Physics Laboratory at Stanford University plans for a 15 GeV superconducting accelerator. While ONR expenditures are continuing for the basic end station, NSF funds are required for the 147" radius spectrometer.

It was indicated that the basic problems of NSF in the field of elementary particle research are: the essentially constant dollar level of present funding; the addition of DOD terminated programs; the prospects of further DOD cut backs; the requirements for new facilities at the NSF accelerators; and the uncertainties in funding for user groups. Donovan indicated that they would like HEPAP to consider some of their problems in more detail from time to time. (HEPAP, of course, is already working on the problems raised by W. Gruner with regard to User groups at the December 7-9, 1969, meeting and part of the task of the HEPAP Subpanel on Future Patterns of HEP Research is related to those questions.)

Preprints in Particles and Fields

The Panel unanimously recommended that SLAC have the funding responsibility for Preprints and Anti-prints and agreed that this important activity should be continued.

Large and Small Bubble Chambers

K. Terwilliger reported for the Bubble Chamber Subpanel on the state of large and small bubble chambers. The costs and significance of the following options for meeting the need for an early NAL bubble chamber program were considered by the Panel: (1) moving the ANL

12' 18 kg chamber; (2) moving the BNL 7' 30 kg chamber and stretching it to 12'; and (3) building an NAL 12' 30 kg chamber and an NAL 25' chamber. Also considered in this connection were the ANL and BNL neutrino physics program options. Moving the ANL 12' or BNL 7' chamber to NAL would directly affect these neutrino programs. The Bubble Chamber Subpanel plans to present recommendations at the next HEPAP meeting.

The Subpanel presented and the Panel discussed the possible ways of optimizing bubble chamber physics output within the context of reductions in program funds. A chart and tables were presented on the particle - momentum range coverage and picture production and cost reductions possible for alternative programs. While it was agreed that reductions in the number of operating bubble chambers appears desirable under present circumstances, it was considered necessary first for each laboratory to consider the alternatives in the context of each overall laboratory research program. The small bubble chamber planning of each laboratory is to be reported at future HEPAP meetings. (Laboratory plans are scheduled to be formally documented in the AEC Schedules 189.)

HEP Articles

Concern was raised that the physics community was not fulfilling its responsibility of communicating with the public. W. K. H. Panofsky indicated that several Scientific American articles were planned by SLAC physicists.

Future Patterns of HEP Research

J. R. Sanford summarized the problems to be considered by a HEPAP Subpanel on Future Patterns of HEP Research as follows:

> "How is research in high energy physics to be organized in the future? What changes of organization or style may be required during a period of constant dollars while maintaining the ability to do important HEP experiments? What changes will result from the operation of higher energy accelerators?
>
> "Note the present national HEP budget trends, examine the costs and manpower needs for doing new experiments, and the possible overpopulation of the field; study the possible responses to the present circumstances of constant dollars and rising demands indicating the advantages, disadvantages, and implications of each response; consider the feasibility of new methods of organizing physicists to do experiments (methods that conserve money but make it possible for physicists to have the opportunity to do experiments); and grade the possible ideas and discuss the matter with HEPAP at a future meeting."

E. Goldwasser, Associate Director at NAL, presented the organizational plans for use of the 200 BeV accelerator. He noted: the appointment of a Program Committee (first meeting was held March 6, 1970); the expectation that proposals will be invited this summer (NAL issued a call for preliminary proposals on March 26, 1970, with a deadline for submission of June 15, 1970, for initial consideration by the Program Advisory Committee - August meeting.); the NAL staff limitation to participation in $\leq$ 25 percent of the research program; continuation of the policy which encourages NAL staff to collaborate with other groups; continuation of the policy that NAL physicists participate in the service functions; division of the Laboratory into three sections - Accelerator, Facility, and Physics Research.

H. Ticho, Chairman, NAL Users, who was present during these considerations, endorsed the need of the above Subpanel on Future Patterns of HEP Research study; indicated that the NAL collaboration policy was received favorably by the NAL User Executive Committee; questioned the present manner of funding user groups and whether rigid groups were necessary; questioned whether with budget reductions groups should be eliminated or cut down in size (He argued for wide support of user groups at lower funding levels versus elimination.); and questioned the balance between laboratory and user support.

The Panel considered some of the above problems: the necessity of funding major projects adequately as against wider lower level of research support; encouragement required for innovators for the development of new techniques and execution of unique experiments; the case against making across-the-board uniform budgetary cuts in the best interest of the overall program; the required encouragement of young people; the need for smaller groups to collaborate; the extent to which new Ph.D.'s should be retained in the HEP program; and the trend which makes it increasingly impossible to have each graduate student with an independent or even semi-independent experiment.

The Panel made recommendations for organizing the HEPAP Subpanel on Patterns of HEP Research. J. Sandweiss has since accepted the Chairmanship. Other members are: J. Sanford, M. Good, L. Stevenson, M. Schwartz, R. Lundy, and M. Deutsch. The first meeting is planned during the week of the Washington APS.

Next HEPAP Meeting

The next meeting is scheduled for April 17 and 18, 1970, at the Lawrence Radiation Laboratory.

Future Meetings

The Computer Subpanel plans to meet during the Washington APS meeting, and Taft plans to report to HEPAP following the April meeting.

Privileged
Information

December 31, 1969

TO: HIGH ENERGY PHYSICS ADVISORY PANEL MEMBERS

R. L. Cool
B. Cork
L. M. Lederman
E. J. Lofgren
G. E. Pake
W. K. H. Panofsky
A. Pevsner
J. R. Sanford
A. M. Sessler
G. F. Tape
K. M. Terwilliger
S. B. Treiman
V. F. Weisskopf, Chairman
W. J. Willis

FROM: Bernard Hildebrand, Executive Secretary

Enclosed are the draft minutes of the December 7,8,9, 1969, HEPAP meeting. Please bring any omissions or required additions to my attention.

Enclosure:
Minutes of HEPAP Mtg.

Privileged Information

D R A F T
B. Hildebrand
12/31/69

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL

DECEMBER 7,8,9, 1969

BROOKHAVEN NATIONAL LABORATORY

The December 7-9, 1969, sessions of HEPAP were held at Brookhaven National Laboratory, Upton, New York. All Panel members were present: R. L. Cool (Sun.-Mon.), B. Cork, L. M. Lederman (Mon.-Tues.), E. J. Lofgren, G. E. Pake, W. K. H. Panofsky, A. Pevsner, J. R. Sanford, A. M. Sessler, G. F. Tape, K. M. Terwilliger, S. B. Treiman, V. F. Weisskopf (Chairman), and W. J. Willis; and B. Hildebrand (Exec. Secy.). Also present from the Division of Research were: P. W. McDaniel (Sun.-Mon.), H. L. Kinney, W. A. Wallenmeyer, and C. R. Richardson. W. R. Gruner (NSF) made a presentation the evening of December 7, and R. Rau was present for the Bubble Chamber Subpanel report. The Director of Brookhaven National Laboratory, M. Goldhaber, his staff, and the Manager of the AEC Brookhaven Office, E. L. Van Horn, were present for the BNL presentation and evening informal meeting. Some 100-150 BNL staff attended the evening session.

The principal topics considered at the meeting were:

1. Concentration vs. Dispersal of HEP Research Support at Universities and Pedagogical Considerations. (Sun. eve.)
2. ZGS Intensity Improvement Program. (Sun. eve.)
3. FY 1970 and 1971 - Budget Status. (Mon.)
4. International Collaboration. (Mon.)
5. Host Laboratory Presentation of Research Programs. Included also was a tour of principal facilities and an informal meeting with BNL staff. (Mon.)
6. Report on the Work of the Computer Subpanel. (Tues.)
7. Report on the Work of the Bubble Chamber Subpanel. (Tues.)
8. Next HEPAP Meeting.

1. Concentration vs. Dispersal of HEP Research Support at Universities and Pedagogical Considerations

W. Gruner elaborated upon his letter of October 10, 1969, to V. F. Weisskopf concerning the questions:

1. Would cost-effectiveness really be maximized by concentrating research in the hands of 20 very large and powerful groups? Or would it be about the same if the work were distributed to "50 ... 90 groups?"

2. "What about absolute scientific effectiveness as distinct from cost effectiveness?"

3. "What about the bottom 45 of the 125 participating institutions?"

4. Is a "reorganization of the profession" necessary?

The following table was presented indicating a declining support of university physics.

				$Millions			
FY	64	65	66	67	68	69	70 (est)
"Univ. Physics"	120	130	143	150	143	141	135?(DOD ~ 26)
1969 Dollars	141	149	159	164	150	141	130.5?
"Univ. HEP"	60	64	68	77	51.5	70	67.3?

It was predicted that in the next four to five years there would be 40% more physicists. (Total number of physicists at this time: 14,000. Ph.D. production rate: 1,300/year and going to 1,500/year.) With the following distribution of physicists: Academic 62%; Industry 21%; Gov. and Non-profit 17%, W. Gruner stated that the projected increase in Ph.D.'s cannot be justified in terms of pedagogy. (Total physics faculty in U.S.: 10,000. Of these, 5,800 hold Ph.D.'s.)

Gruner asked: What should be the policy of the AEC and NSF toward small and large groups in view of the financial restrictions and pedagogical pattern? Should small groups be combined into larger groups? He remarked that HEP is the only field where persons come to the NSF and say they need additional monies in order to compete.

The Panel considered: scientific and industrial as well as pedagogic needs for Physics Ph.D.'s; the importance of maintaining a strong flow of valuable scientific results; the associated problems of user utilization of NAL; feasibility of small group collaborations; importance of not losing talented people; changing user patterns of operation; the importance of quality research; the need to re-examine aspects of the HEPAP report in the light of a changing fiscal situation. Sanford has taken the task of formulating the problems discussed and to make recommendation for a HEPAP subpanel at the next meeting.

2. ZGS Intensity Improvement Program

B. Cork presented the ZGS plans for increasing the ZGS intensity. The plan is based upon the increasing need to perform simultaneous experiments. The Cornell 2.2 GeV synchrotron is being set up at ANL with studies proceeding on negative ion injection with the goal of injecting into the ZGS. The entire program is estimated to total $3.55M spread as follows (in $K):

FY 71	FY 72	FY 73	FY 74	FY 75
500	850	750	950	500

The overall goal is to achieve an intensity of 3×10^{13} ppp.

The Panel considered: the required typical shutdown periods of one-two months; the number of simultaneous experiments ~ seven-eight; the ZGS as a kaon factory; the estimate that a factor of four in intensity would be gained from the FY 1971 work alone; the four-month shutdown starting May 1, 1970, to install the titanium tanks.

3. FY 1970 and 1971 - Budget Status

P. W. McDaniel and W. A. Wallenmeyer presented the status of the budgets and the changes implemented since the last HEPAP meeting. No further decreases in FY 1970 were anticipated, however, the BOB had as yet not made the required apportionment.

The FY 1970 PPA reduction has taken effect with some 100 people required to be released (179 remaining).

The FY 1971 operating budget aims at some increases for BNL and SLAC consistent with the 200 BeV growth maintained at a viable level. This budget was further discussed in great detail on the assumption of possible further reductions (see below).

The FY 1971 equipment budget was considered by the Panel. There was still uncertainty in the mode of funding the SLAC storage rings. If the equipment mode were valid then only $2M was available for this work in FY 1971. The principal emphasis at NAL will be put on using initial equipment monies for beam line (~ 2/3) and detectors (~ 1/3). The latter includes work on the stopgap bubble chamber and a spectrometer system. Another principal item considered was the LRL computer (7600) requiring $8.7M at this time of stringency. The extent to which it could be utilized as a regional computer facility like the NYU CDC 6600 was considered as was the extent to which the facility cost could be reduced. The latter was to be determined by the AEC. The principal concern was the extent to which the

equipment needs for the remaining program had to be reduced to meet the computer cost. It was estimated that 75% of the 7600 would be used for HEP purposes. ANL has been badly cut in 1971, principally on the grounds that it has a good complement of beams.

Accelerator Improvement Program (AIP) funds for 1970 and 1971 represent investments on accelerators which yield returns about three years in the future. FY 1970 and 1971 funding represent reductions of nearly 50% below monies expended in FY 1965-66. On the 1971 AIP: ANL must decide whether $500K will go toward the booster program. SLAC AIP includes funds for the storage rings. About 50% of LRL funds are for HEP and the remaining for cyclotrons and the HILAC.

In the light of limited FY 1970 construction funds for NAL, it is anticipated that $112M will be required in FY 1971 rather than the planned $86M.

The Panel considered the program adjustments which would be necessary in the event of a reduction in the FY 1971 operating budget from $125M to $121M. Stress was placed on maintaining a viable program and emphasis was on the future requirements at NAL and the new work at BNL and SLAC. The consequences of a uniform reduction at all labs were considered. In order to provide required increases at NAL, BNL, and SLAC selective reductions were recommended for the remaining laboratory and university programs. Some of these reductions are expected to have very grave consequences.

4. International Collaboration

W. A. Wallenmeyer reported on and the Panel discussed the communication of November 21, 1969, from Seaborg to Petrosyants on Serpukhov - 200 BeV collaborative work. A new USAEC-SCUAE Memorandum Agreement is presently being considered with the possibility of some enlargements for joint experiments and exchange financing and the addition of NAL and Novosibirsk as collaborating laboratories. (The negotiations are taking place in Washington at this time.)

V. F. Weisskopf reported that: a site for the European 300 BeV laboratory was expected to be chosen in two months; the existing funding picture for European basic science was relatively bright with the major Nations (Britain, France, and Germany) expecting to increase obligations at least 5% above inflationary increases; there is an increasing trend toward European basic science collaboration with plans for an International Microbiological Laboratory and an Optical Observatory Center at Geneva.

Privileged Information

5. Host Laboratory Presentation

Neither rain nor a full schedule deterred the the Panel from a tour of BNL facilities.

R. Rau introduced the following set of BNL speakers in R. Cool's absence (due to appendicitis): Green - Accelerator Operations and the AGS Conversion Program; Berley - Experimental Facilities; Rau - Counter Spark Chamber and Bubble Chamber Experimental Programs; Samios - Bubble Chamber Research Progress; Collins - Counter Research Progress; Shutt - Future Bubble Chamber Plans; Blewett and Courant - Future Accelerator Plans. M. Goldhaber chaired an evening session of the Panel with BNL staff. Some 100-150 persons were present to hear a presentation of HEPAP considerations and concerns by V. F. Weisskopf followed by an informal discussion period.

Material distributed to Panel members at meeting:

a. Plans for Future Accelerators at BNL - J. P. Blewett, E. D. Courant, A. VanSteenbergen - 12/3/69.

b. Report on BNL's Future Bubble Chamber Program - R. P. Shutt - 12/1/69.

c. Report on AGS Experimental Areas to HEPAP - D. Berley - 11/25/69.

6. Report on Work of the Computer Subpanel

H. Taft reported on the results of the efforts of the subpanel. (The subpanel met August 26, 1969, and December 6,7, 1969.) The principal goals are to report on the status of HEP computer usage and to make a five-year projection of future needs.

There has been a 90% response of HEP groups to the subpanel survey which indicates:

1. Universities - Of the total budget of $28M/year by the university experimental groups (66 AEC and NSF groups responded), about $4M/year or about 15% goes toward computing (general purpose and on-line). The computer capital investment of these groups is $12M. Yearly computing is 12,000 hours (CDC 6600 equivalent). K. Curtis has estimated that small universities contribute ~ 50% of the computer costs, however, computer hourly rates exceed those at national labs by about a factor of three (average lab rate ~ $310/6600 hour).

2. Laboratories - About 10-20% of the total budget is for computing. (There was some feeling by Panel members that this estimate may be high). The total laboratory capital investment is $34M. Yearly computing is 35,000 hours (CDC 6600 equivalent). Operating cost - $150/6600 hour.

Subpanel predictions: Theory computer use is presently about 2% of the total and may be expected to continue at this level. Some 10-20% of the total research funds are presently used for computing and may be expected to continue at this level. Computer time requirements will increase.

Subpanel recommendations:

1. Computer proposals should compete with other research needs.

2. There should be a federal policy leading to fuller utilization of university computers.

3. There should be centralization of computing because it is technically and economically feasible. User groups should increasingly operate in a remote batch mode.

4. AEC should acquire a 7600 for HEP users at an existing lab for such remote usage.

The subpanel is also considering a number of special problems: replication of POLLY and PEPR systems for user groups; software engineering; data banks, input-output hardware; microprogramming; remote usage technology.

The Panel discussed: remote usage hardware costs; the desirability of reducing computer costs to 10% of the total costs; remote entry possibilities at LRL and Oak Ridge as well as NYU.

The subpanel plans to submit its report by March 1, 1969.

7. Report on the Work of the Bubble Chamber Subpanel

K. Terwilliger gave a preliminary report on the work of the subpanel and submitted a draft report to the Panel. It is planned that the problems be further considered by the Panel at the next meeting.

The principal points discussed were: the requirements of NAL and BNL which would result in a 12' BC at each of these laboratories in addition to the existing ANL 12' BC; the difficulty of increasing the field of the ANL 12' BC for neutrino work - the 18 Kg field appears satisfactory for strong interaction work; the limitations on form factor work due to deuteron ambiguous neutrino events which may reduce the large BC requirements; the good momentum coverage with a minimum of duplication for pion, kaon, proton, and antiproton interaction work at existing U.S. laboratories with existing bubble chambers; the possibility of turning off the LRL 25", BNL 31", and ANL 30" chambers to reduce operating expenditures an estimated $900K.

It was planned to have an estimate made by P. Hernandez on the cost to move the ANL 12' BC to NAL by the next meeting.

8. Next HEPAP Meeting

The next meeting is planned to be held at Washington, D. C., January 12-13, 1970 (Monday-Tuesday). The planned meeting agenda includes: Budget Status - with special attention to be given to the five-year projections; Large Bubble Chamber Problems (K. Terwilliger and P. Hernandez findings); Formulation of Subpanel on the Centralization Problem and Use of the 200 BeV Accelerator (J. R. Sanford); Report on the 200 BeV (R. Wilson).

December 4, 1969

Privileged Information

TO: HIGH ENERGY PHYSICS ADVISORY PANEL MEMBERS

R. L. Cool
B. Cork
L. M. Lederman
E. J. Lofgren
G. E. Pake
W. K. H. Panofsky
A. Pevsner
J. R. Sanford
A. M. Sessler
G. F. Tape
K. M. Terwilliger
S. B. Treiman
V. F. Weisskopf, Chairman
W. J. Willis

FROM: Bernard Hildebrand, Executive Secretary

MINUTES OF OCTOBER 13-14, 1969 - WASHINGTON MEETING

Enclosed are the minutes of the HEPAP meeting of October 13-14, 1969, at Washington, D. C. The minutes have been intended to be a reminder communication to the HEPAP membership of meeting contents, including the major conclusions and plans, resulting from each meeting. The HEPAP minutes are the property of the HEPAP membership. They are not submitted to any other group or institution, including the AEC. The contents should be treated as PRIVILEGED. The minutes are issued in draft form to help preserve a non-official character which permits both an openness of communication of membership opinions as well as speculations. Changes in the minutes are incorporated in those of the following meeting. Comments, suggestions, the noting of errors and omissions are, of course, invited. It has been the intent to submit the minutes a few weeks after each meeting in order to incorporate the final recommendations of the panel as submitted to the AEC. The extreme lateness of this material results largely from personal reasons and, I hope, won't be repeated.

The communication of HEPAP recommendations is usually in the form of written communications (letters and reports) from the HEPAP Chairman to the Director of the Division of Research. At times, particularly on international matters, communication is with the AEC Chairman. HEPAP, via its members, also makes presentations to such bodies as the President's Science Advisory Committee, National Academy of Sciences, Division of Particles and Fields of the American Physical Society, Accelerator Laboratory User Groups, as well as the Commissioners of the AEC.

Please communicate any suggestions, comments and views on the matter of minutes to Chairman Weisskopf and me.

Enclosure:
Minutes of HEPAP Mtg.

Privileged Information

DRAFT
B. Hildebrand
12/4/69

MINUTES
HIGH ENERGY PHYSICS ADVISORY PANEL
MEETING OF OCTOBER 13-14, 1969

WASHINGTON, D. C.

The October 13-14, 1969, meeting was held in Washington, D. C., at the AEC, 1717 H Street. All Panel members were present: R. L. Cool, L. M. Lederman (Tues.), E. J. Lofgren, G. E. Pake (Tues.), W. K. H. Panofsky, A. Pevsner, A. M. Sessler, G. F. Tape, K. M. Terwilliger, V. F. Weisskopf (Chairman), and W. J. Willis; and B. Hildebrand, Exec. Secy.

Also present at appropriate times during the meeting were:

Commissioner T. J. Thompson
J. Rosen, Special Assistant

Office of the General Manager -

S. G. English, Asst. General Mgr. for Research and Development
E. DeRenzis

Division of International Affairs -

A. S. Friedman, Deputy Director
V. H. Hudgins
J. F. Kratz

Division of Research -

P. W. McDaniel, Director
D. R. Miller, Deputy Director
W. A. Wallenmeyer, Asst. Director for HEP
A. R. Van Dyken, Asst. Director for Chemistry
R. P. Epple, Chief, Nuclear, Structural and Inorganic Chemistry Br.
G. L. Rogosa, Chief, Physics Branch
D. A. Lind, Physics Branch
R. L. Fricken, High Energy Physics Program
R. P. McGee, High Energy Physics Program
C. R. Richardson, High Energy Physics Program

U. S. General Accounting Office -

D. K. Crowther, Asst. Director
P. A. Bernstein, Supervisory Auditor
E. L. Hessek, Supervisory Auditor
T. Melloy, Supervisory Auditor

Princeton-Pennsylvania Accelerator -

M. G. White, Director
W. Wales, Associate Director
A. Mann (Pennsylvania)
V. Fitch (Princeton)

The principal topics considered at the meeting were:

1. Status and Briefing on HEPAP Work.
2. General Accounting Office Management Study of the HEP Program.
3. International Collaboration - Status and Problems.
4. Presentation on the Princeton-Pennsylvania Accelerator.
5. Budget and Associated Problems.
   (A) HEP Operating Budgets.
   (B) PPA Budget.
   (C) Coordination of Operating Bubble Chambers.
   (D) Equipment, Accelerator Improvement Projects, and Construction Budgets.
   (E) Storage Rings.
   (F) Large Bubble Chambers.
6. Future HEPAP Plans.

1. Status and Briefing on HEPAP Work

P. W. McDaniel indicated that the general fiscal climate for HEP was bad in FY 1970 and that more of the same should be expected in FY 1971. Other areas of science, such as Chemistry, were doing even worse. Optimum use of existing funds is required and good advice from HEPAP was more necessary than ever before.

V. F. Weisskopf defined the principal role of HEPAP as giving advice and adding its weight in the support of research programs. HEPAP activities have included reviewing the status and priorities of existing programs and assisting in the planning of future programs. As part of these efforts HEPAP issues reports (The printing and mailing of the Report on HEP, 1969, has been completed.) via the work of the Panel and Subpanels, reviews the work at laboratories, makes recommendations to the Director of Research, and makes presentations on HEP problems to the Commissioners and other groups. Currently a HEPAP Computer Subpanel is studying the role of laboratory and university computers in HEP today and the computer requirements for the future. Three new HEPAP members were anticipated. (B. Cork, J. R. Sanford, and S. B. Treiman have since accepted appointments.)

2. General Accounting Office Management Study of the HEP Program

The Panel was briefed by representatives of the GAO (P. A. Bernstein, D. K. Crowther, E. L. Hessek, and T. Melloy) on its planned review of accelerator program management and operations at ANL, BNL, PPA, LRL, and SLAC. The GAO indicated primary interest in the decision making mechanics and processes involved in the HEP program, especially in relation to percent decreases, or increases, in funding, and how such changes effect the efficiency of operations. The GAO aims to complete its review in the spring of 1970.

As part of these considerations the results of the LRL and SLAC studies on operating costs as a function of operating shifts per week were transmitted to GAO. The similarity of these results is remarkable in spite of major differences in the accelerators.

Members of the Panel pointed out that: HEP planning was long range and required one or two years of commitments; shifting experiments from one accelerator to another due to differences in particle identity, intensity, momenta, resolution, and particle background may cost more or not even be possible; operation of accelerators required experimental priority judgments and could not be understood in terms of a factory operation producing particles; commitments of laboratories and universities in other categories such as scanning, measuring, computing, analysis, and installation problems were involved in the accelerator use decision making process; HEPAP is not involved in the daily maintenance-shutdown process; the decisions of laboratory committees help to optimize the program; a transfer of the large 12 ft. BC involves such factors as cost, timing, technical capability, measured against the alternatives. This problem is under consideration.

3. International Collaboration - Status and Problems

W. K. H. Panofsky reported on the visits of A. Krisch (Michigan) and D. J. Drickey (UCLA) to Serpukhov. Reception was very good. The latter π-e experiment involves the use of a small computer. Beam scheduling at Serpukhov requires that this experiment be on the floor in January or February. Some haste in negotiations is required in order to make the collaboration meaningful. Two levels of U. S. participation were emphasized: participation by individuals under the present agreement, and more extensive collaboration involving a major U. S. equipment contribution requiring a supplementary agreement.

A. Friedman briefed the Panel on foreign travel cost limitations and foreign assignment ceilings. Historically, the BOB imposed the travel restrictions. However, this source of foreign travel limitation is no

longer in effect. Currently the JCAE has imposed a financial foreign travel ceiling on the AEC via authorization bill limitations. Limitations on total dollars to be expended on foreign travel restrict both short and long visits. The long-term assignment definition has been eased; while the former definition was for travel exceeding eight weeks the new definition involves travel exceeding one year with the AEC bearing essentially all of the costs.

J. Kratz briefed the Panel on the status of the computer study relative to the informal request from the U.S.S.R. for a large computer for the Serpukhov laboratory. The Panel urged that the decision be made rapidly.

The Panel considered: the monetary advantages of having the receiving laboratory paying exchange costs with the sender country continuing to pay transportation costs, during which discussion it was pointed out that the present agreement has a permissive clause which would allow this mode of exchange; the spectrum of possible exchange offers to the U.S.S.R. - large computer, on-line and smaller computers, and participation in the 200 BeV experimental program; the important role of foreign travel; the costs of U.S.-U.S.S.R. experiments at Serpukhov relative to costs of similar experiments at NAL; the decreasing technical importance of Serpukhov collaboration as time passes.

The principal Panel positions were: identification of two levels of Serpukhov collaboration; endorsement by HEPAP of a U. S. level of effort of several hundreds of thousands of dollars; indication of the U.S.S.R. need for large computer capability and urging a rapid decision on the major computer to clear the way for a U. S. position; the need for rapid initiation of negotiations. (These positions were presented by letter of October 15, 1969, from V. F. Weisskopf to P. W. McDaniel. A meeting of AEC and HEPAP representatives, V. F. Weisskopf, W. K. H. Panofsky, and G. F. Tape, with L. A. DuBridge, H. Heffner of the Office of Science and Technology, and State Department representatives, including H. Pollack, took place on October 24, 1969. A letter from G. T. Seaborg to A. M. Petrosyants, dated November 21, 1969, urged that formal negotiations on collaboration on the Serpukhov and NAL accelerators be initiated on a quid pro quo basis.)

4. Presentation on the Princeton-Pennsylvania Accelerator

M. White, W. Wales, A. Mann, and V. Fitch participated in a review of the activities and capabilities of the PPA and discussed the operating levels as considered in the M. White to P. W. McDaniel letter of September 19, 1969. M. White stressed the national character of the PPA in providing beams for 74 outside experiments and having non-local science committee members; having a backlog of $\sim$ 15 approved experiments; the PPA beam capability permits young people to share the machine; the addition of a heavy ion capability; the Booster proposal to increase current by factors of 20-30 for heavy ion and HEP work.

The three annual budget levels considered were:

$M	Shifts	Experiments	Staff Reductions
4.75	17	~ 17	--
3.5	15	~ 13	~ 25% (75)
2.5	10	~ 8-9	~ 40% (120)

W. Wales discussed the PPA Report "Survey of Experiments Run at the Princeton-Pennsylvania Accelerator, 1963-1969."

Highlights of the discussion with the Panel: There are seven experimental proposals under consideration at the PPA. To date, the rejection rate has been close to zero; an increase of intensity of ~ 30, as proposed, would make the PPA neutral kaon beam competitive with the present beam at the AGS. The time-of-flight capability at the PPA is of significant value for neutral kaon and neutron experiments; the unique PPA capability to accelerate polarized particles; the strong belief by M. White that the future of PPA is in the heavy ion work and that a $3.5M budget does not permit such work; the small liklihood for federal support of the heavy ion proposal. (AEC and NSF have been considering such support.)

5. Budget and Associated Problems

(A) HEP Operating Budgets

P. W. McDaniel and W. A. Wallenmeyer briefed the Panel on the state of the FY 1970 and 1971 operating budgets. While the FY 1970 AEC legislation is not final yet the total planned operating budget for HEP represents about a $2.0M increase over FY 1969. This sum must accommodate a $2.6M increase for the 200 BeV work and permit extremely nominal increases for the work at BNL and SLAC. This FY 1970 situation plus the dire state of the FY 1971 budget, which has been submitted to the BOB for markup, requires consideration of a departure from the FY 1970 financial plan. The strong probability of future budgetary cuts in the FY 1971 budgetary process must be folded into the planning process.

(B) PPA Budget

The Panel considered an alternate FY 1970 budget which would reduce the PPA to an annual effective operating level of approximately $3.5M by the end of FY 1970. Essentially under consideration was the point of view that major reductions be taken at one or more laboratories rather than giving more uniform treatment. The

Panel considered alternative budgetary actions at ANL, CEA, and LRL and the relative capabilities of the associated laboratories including the possible future confederation of ANL-NAL. The Panel concluded that a viable PPA operating at a reduced level was feasible. The Panel reiterated the view that none of the HEP accelerators should be shut down in the immediate future. (These views were communicated by letter of V. F. Weisskopf to P. W. McDaniel - October 15, 1969.)

(C) Coordination of Operating Bubble Chambers

R. Cool, by memo of October 6, 1969, has recommended consideration of closer coordination of the 82" and 80" bubble chamber experimental programs in order to reduce expenditures and optimize the experimental output. The Subpanel on Bubble Chambers was initiated to report on HEP bubble chamber coordination at the next meeting.

(D) Equipment, Accelerator Improvement Projects, and Construction Budgets

W. A. Wallenmeyer briefed the Panel on the status of the FY 1970 and FY 1971 equipment, AIP, and construction budgets.

Equipment - Total FY 1970 equipment, $13.8M, funds are some $8M (~ 35%) below the FY 1969 level with prospects for further decreases. The total FY 1971 equipment funds as submitted to the BOB was $27.7M and includes a major computer request of some $9M. With the continuing severe limitations in equipment funds the Panel felt that a re-definition of the uses for such funds offers a possibility of optimizing the use of available funds. R. Cool is to study this matter and draft a new definition.

AIP - Total FY 1970 funds in this category, $2.87M, are to date $2.9M (~ 50%) below those for FY 1969. As submitted to the BOB $4.0M is in this category for FY 1971.

Construction - The only construction item for HEP, other than AIP, is the 200 BeV accelerator. The FY 1970 request of Congress was $96M. The House Appropriations Committee pared this to $64M. As submitted to the BOB there is $86M in this category for FY 1971 for the 200 BeV. (Since the HEPAP meeting following an appeal the Senate Appropriations Committee increased the FY 1970 200 BeV construction figure to $89M.)

(E) Storage Rings

W. K. H. Panofsky reported on progress in Europe with storage rings:

The report of October 2, 1969, by B. Richter - "Storage Ring Developments in Europe and the U.S.S.R.," was distributed to the

Panel. Panofsky covered progress in Germany, where 80 million marks plus 20% overrun have been made available for the DESY storage ring program (3.5 GeV), Italy (1.5 BeV), France (550 MeV), and the three U.S.S.R. projects (750 MeV, 3.5 GeV, and 25 GeV).

In order to increase the financial feasibility of initiating storage ring work in the U. S., SLAC has proposed a modified SPEAR effort. Panofsky reported on progress (memo of October 9, 1969). The full SPEAR program is estimated at ~ $9M and the half SPEAR program is estimated at ~ $7M. With contingencies removed this requires a total of ~ $5.5M in FY 1971 and FY 1972 equipment.

The Panel discussed the storage rings, along with other HEP projects, and considered: the modes of principal funding construction-equipment; the long interval of time since the original proposal for this and other projects; the incremental operating costs/year ($2-3M); the existence of the r.f. requirements for half SPEAR from surplus; the uniqueness of the work and the associated experiments. The Panel concluded that the project be funded in FY 1971 even at the expense of other work. (See letter of October 23, 1969, from V. F. Weisskopf to G. T. Seaborg. V. F. Weisskopf met on this problem with G. T. Seaborg, T. J. Thompson, and P. W. McDaniel on November 13, 1969.)

(F) Large Bubble Chambers

R. Cool briefed the Panel on the large bubble chamber problems. The joint NAL-BNL 100 m^3 BC proposal assumed FY 1971 funding ($15M). With NAL estimated to be ready for BC work in early CY 1973, without FY 1971 funding the BC would be 1.5 years late. Consideration must be given to NAL constructing the BC alone if funding is in FY 1972. Important technical feasibility questions are still unanswered and without funds work at BNL is coming to an end.

Stop gap alternatives were considered by the Panel for the large BC requirements at NAL. Some possibilities: (1) Moving to NAL the - (a) ANL 12' BC (20KG); (b) ANL 12' BC (30KG) - estimated additional cost to achieve 30KG-$3M; (c) BNL 80" BC; (d) BNL 7' BC; (e) expanded 7' BC to NAL; and (2) Build a copy of the expanded 7' BC for NAL.

BC	Visible Liters	~ Moving Cost
12' ANL	20,000	$ 5-6M
80" BNL	900	1
7' BNL	6,000	< 1
Expanded 7'	24,000	2

The Panel determined that: The stop gap alternatives for the 200 BeV required further rapid study; the important BC needs at ANL and BNL required simultaneous consideration; and the intrinsic nature and advantages of each of the associated neutrino experimental programs at ANL, BNL, and NAL required simultaneous consideration. On this basis the Ad Hoc Bubble Chamber Subpanel was also asked to report on these matters at the next HEPAP meeting.

6. Future HEPAP Plans

V. F. Weisskopf and the Panel summarized: The necessary recommendations resulting from the meeting to be made by HEPAP on the PPA storage rings and international collaboration; the problems associated with present and planned bubble chambers and the need for studies by the Ad Hoc Bubble Chamber Subpanel for the next meeting; the importance of priorities in optimizing the HEP research program; the need for studies on computer requirements (Subpanel work is in progress.); and the need for new accelerator technology and superconductivity and cryogenic reviews.

The next meeting is planned for December 7 (Eve.), 8, and 9, 1969. The meeting will include: a host presentation by and tour of BNL; a report by the Ad Hoc Bubble Chamber Subpanel; a report on the ZGS Booster Program (which is associated with neutrino experimental capabilities); a report on the work of the Computer Subpanel; budget status and associated urgent and longer range problems.

PRESENT HEPAP SUBPANELS

HEPAP BUBBLE CHAMBER SUBPANEL

(Initiated at Oct. 1969 meeting.)

A. Pevsner
K. M. Terwilliger, Chairman
G. H. Trilling
W. J. Willis

HEPAP COMPUTER SUBPANEL

(Initiated at May 1969 meeting.)

A. E. Brenner
R. M. Brown
K. Curtis
T. B. Day
T. H. Fields
R. I. Hulsizer
L. T. Kerth
L. B. Leipuner
D. W. G. S. Leith
H. D. Taft, Chairman

D R A F T
RLFricken
7/8/69

MINUTES OF MAY 23-24, 1969 HEPAP MEETING AT SLAC

Members present: Weisskopf, Fowler, Lederman, Lofgren, Panofsky, Sachs, Symon, Terwilliger, Walker, and Yang.

Acting Executive Secretary: Fricken.

AEC Staff Present: Kinney, Wallenmeyer.

A. SLAC Briefing

Panofsky opened the presentation with a brief review of the history and present performance of the accelerator. The energy creep-up program, storage ring project and proposed cryogenic conversion were discussed.

Richter gave a summary of physics results from work in End Station A which includes elastic and inelastic electron scattering experiments and photoproduction experiments.

Ballam described the bubble chamber and streamer chamber experiments and the special K^{o}, annihilation photon and polarized (back scattered laser light) photon beams available to serve these devices.

Caldwell described the SLAC-UCSB program to determine total hadron photoproduction cross-sections.

Leith described the wire spark chamber program at SLAC and plans for a new facility using a triggered bubble chamber to get time-of-flight data on K^{o}.

Schwartz described the K^o decay research and plans for a large new wire spark chamber facility for K^o decay, $K^o p$ and neutron induced experiments.

B. Budgets

Wallenmeyer distributed a compendium of impact letters received from Lab Directors and Principal Investigators with regard to the FY 1970 budget, a set of tables which give the FY 71 - 75 five year projections, a summary of recent budget history, and a detailed breakout of the Washington Administered program for FY 1968 and 1969. He indicated the current status of the budget projections for FY 1971-1975 and described the various steps in the projection cycle. A lengthy discussion pursued about the relation between the HEPAP report recommendations and the AEC projections. There was a discussion of the priority given to several construction projects (the PPA booster and AGS Conversion - Phase II) in the AEC projections. The question of getting HEPAP input into the projection feedback to the laboratories was raised. It was suggested that the AEC should get the projection input earlier (November) so that HEPAP would have adequate time to review the projections and have input before the AEC processes and distributes feedback to the field. It was stressed that meaningful feedback to the field was essential for better long-range planning. Wallenmeyer said he would do this, and also would indicate to Professor White that HEPAP did not place as high a priority on the PPA booster as implied by its FY 72 position in the projections.

With regard to the FY 1971 equipment projections, HEPAP questioned the $8.5 million computer for LRL in comparison with needs for computers elsewhere in the program and the overall need for other types of equipment. A general recommendation that the equipment budget should be as high as possible was made and it was suggested that an attempt be made to obtain the flexibility to convert the computer money to general equipment for the base program. No specific comments were offered with regard to the operating fund distribution. A priority rating of FY 1971 construction priorities was discussed and the consensus gave top priority to the 200 BeV and SLAC Storage Ring respectively. The need and timing for the 25' bubble chamber was discussed. It was suggested that a good estimate of the cost of moving the 12' ANL bubble chamber to NAL should be obtained.

C. HEPAP Report

The report was discussed and gone through for substantive criticism and comments. The appendices were reviewed by designated committee members. Substantive changes in the main text were made by the Chairman or designated panel members. The report was transmitted officially to AEC on June 13, 1969. The report was reproduced and available for distribution on June 30, 1969.

D. Large Cosmic Ray Facility

Jones gave a brief presentation concerning the proposed $24 million cosmic ray facility. He was questioned with regard to the justification for the facility. The panel suggested that Jones document

the areas where cosmic rays are unique in comparison with storage rings. The timing of the project was questioned and the matter of a less expensive version of the facility was raised. After some discussion the panel decided not to change the specific negative recommendation in its report with regard to a large national cosmic ray facility.

E. Computer Committee

A list of possible members was drawn up and discussed. It was decided that Hulsizer, Taft, Leith, Kerth, Curtis, Day, and Leipuner should be asked to be members. Taft has agreed to be Chairman of the Committee. He will be free to choose additional members if he deems it necessary. HEPAP feels that more computer experts should be on the Committee.

F. Committee Rotation

The Chairman noted that the original charter of HEPAP called for rotating membership on the panel. He indicated that some of the members could expect not to be reappointed but noted that specific changes had not been decided yet.

G. Serpukhov Briefing

Panofsky gave a report on the recent visit to Serpukhov and the activities which have transpired since his return. Wallenmeyer distributed a package of material with regard to the Serpukhov visit and noted that the AEC had distributed this information to the field.

The proposed method of collaboration might involve the following steps: a US group makes a proposal for an experiment at Serpukhov; a joint team is formed with the US group and Soviet physicists; the Soviet contingent comes to a US lab and participates in design of experiment and preparation of equipment; the experiment is then done at Serpukhov. A major problem at the moment is the Soviet request for the US to provide a large computer (CDC-6600). The difficulty results in part from export restrictions on computers which presently limit exports to Soviet bloc nations to computers of a much lesser capability. An NAS Committee under Oettinger as well as the AEC, itself, is presently looking into this matter. Panofsky urged that negotiation should move rapidly so as to phase the research properly with the 200 BeV schedule, i.e., before the 200 BeV operation. A major subject of discussion was the funding of the computer. It was observed that since the value of Serpukhov collaboration transcends high energy physics attempts should be made to get special money for this purpose. Wallenmeyer stated his view that funds for the Serpukhov computer should not be taken from the normal high energy physics budget. The consensus of the Panel members opinions was in agreement with this position. The possibility of negotiating a trade for Soviet participation at Batavia was raised. To let the Soviets know that the Serpukhov collaboration was still under active consideration here, it was suggested that AEC send a thank you letter to the SCAE for their reception of the Panofsky group and state that the wheels are turning.

PRIVILEGED INFORMATION

B. Hildebrand
May 15, 1969

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL MEETING

January 31 - February 1, 1969

Massachusetts Institute of Technology

The High Energy Physics Advisory Panel met at the Massachusetts Institute of Technology, Cambridge, Massachusetts, on January 31 and February 1, 1969, in the Kolker Room (Friday) and in the Theoretical Institute Conference Room (Saturday).

The Panel members attending were: V. F. Weisskopf, Chairman; R. Cool; E. Fowler; L. Lederman; E. Lofgren; R. Sachs; W. Panofsky; K. Symon; K. Terwilliger; R. Walker; C. N. Yang; and B. Hildebrand, Executive Secretary.

Also attending were: H. Blewett, Aide to Chairman; D. Keefe, LRL (for briefing on Electron Ring Accelerator); Col. J. Rosen, Special Assistant to Commissioner Tape; and H. Kinney, Special Assistant to the Director; and W. Wallenmeyer, Assistant Director for High Energy Physics, of the Division of Research.

Meeting Agenda

I. Budget.
II. SLAC Colliding Beam Facility.
III. HEPAP Report.
IV. Electron Ring Accelerator.
V. International Collaboration.
VI. Next and Future Meetings.

I. Budget

W. A. Wallenmeyer briefed the Panel on the status of the FY 1970 budget (Privileged Information). At the time of the meeting the new administration had not had any impact upon the budget. Effects on the research program imposed by the funding limitations, especially for equipment and accelerator improvement funds, were considered. As an example of the limitations imposed on the national laboratories is the inability of BNL:

PRIVILEGED INFORMATION

(1) to utilize more fully the improved AGS at the end of CY 1969 (with its repetition rate increased by a factor of two and its large new experimental area); (2) to initiate the new neutrino beam in conjunction with its new 7' chamber facility which is coming into operation; and (3) to fully exploit its next 18-month running period starting in the Fall of CY 1969 (in part due to the limited funds for services) with the result that many good experiments can not be scheduled. (The V. F. Weisskopf letter of February 13, 1969, to P. W. McDaniel discusses the serious FY 1970 funding problems including the lack of funds for colliding beam work. P. W. McDaniel replied to V. F. Weisskopf by letter of February 26, 1969.)

The Panel, via V. F. Weisskopf, sent the following telegram to Chairman Seaborg:

> HEPAP aware of 1970 budget re-examination and possible effect on 200 BeV accelerator. Most important that this project be fully authorized and that appropriation of 102 million be obtained this year. Adherence to the schedule set by Laboratory Director crucial to success of this most important project. Urge that you and fellow Commissioners support this project now as vigorously and as valiantly as you have so often done these past few years.
>
> Viki
> January 31, 1969

(Chairman Seaborg replied with a letter of February 6, 1969, to V. F. Weisskopf.)

II. SLAC Colliding Beam Facility

W. Panofsky briefed the Panel on the most recent redesign work at SLAC which has resulted in an ISR-type design for a colliding beam facility. The advantages relative to elimination of the long-range interaction between beams and the additional capabilities of such a colliding beam facility were discussed. The progress at Frascati and Orsay, clarification of instabilities and new funding for the DESY storage ring, were considered. The large reduction in required funds for the presently contemplated SLAC colliding beam facility was recognized as an important funding consideration. A quandary is the continued inability to fund the SLAC project after five years of technical review and endorsements.

As part of the funding considerations the possibilities for initiating the SLAC colliding beam facility were discussed both within the President's (Johnson) FY 1970 budget and in terms of needed additional funds in all

three categories (accelerator improvement project, equipment, and operating). Consideration was also given to the extent to which currently planned work at SLAC could responsibly be cut back.

Because of the existing grave limitation in research laboratory funding, further reductions in their funding to meet these additional colliding beam needs in FY 1970 were considered overly damaging to the research program. (The V. F. Weisskopf letter of February 13, 1969, to P. W. McDaniel discusses the HEPAP conclusions and recommends to the AEC that additional funds be obtained in FY 1970 to initiate this SLAC project. The P. W. McDaniel letter of February 26, 1969, to V. F. Weisskopf includes a response to this problem.)

III. HEPAP Report

Special attention was given to the sections of the report on conclusions and recommendations. Differences in the extent of uncertainty between recommending for the immediate and distant future were emphasized. In particular, consideration was given to: new technology; unique physics opportunities; small funding reductions accompanying shutdowns; regional accelerators; options open for important research utilizing a 100 BeV proton beam; machine obsolescence; revitalization of existing accelerators; and projecting to 2,000 BeV physics.

During a portion of these considerations R. Sachs acted as HEPAP Chairman.

Communications on the HEPAP report writings by Panel members were to be channeled through V. F. Weisskopf's office at MIT, with the assistance of H. Blewett. (R. Blumberg also assisted in this effort. In spite of valiant efforts, some slippage in the schedule of completing this work has taken place.)

The Panel also concluded there was a need to make a thorough study of the computer needs of the high energy physics program. Plans were made to initiate a computer sub-committee at the next HEPAP meeting. The work of this sub-committee would go beyond that of the HEPAP report.

(V. F. Weisskopf and W. K. H. Panofsky made a preliminary report on High Energy Physics to the President's Science Advisory Committee March 18, 1969.)

IV. Electron Ring Accelerator

D. Keefe gave a status report on the electron ring accelerator work at LRL. As background a comparison was made of the energy/meter attainable with the proton linac, the proton synchrotron, and the potential promise

of a future ERA system. The hardware development program plans include the following stages: electron ring formation; proton loading of the electron rings; ion focussing; and ion acceleration. These current and planned programs presently using the Astron injector were discussed as was the importance of becoming Astron independent. Such independence would be achieved by fabricating an injector for the ERA work. Also discussed were details on: the microwave horn and probe detection techniques; ring formation; ring compression; ring stability; ring survival time; ring dumping; ring size; and magnetic field shaping. The extent to which protons could be stored and the ability to accelerate the rings longitudinally using first magnetic and later electric fields was still experimentally uncertain. Success of such work would be expected to lead to a conceptual design of a future accelerator.

The Panel also examined the planned funding for the ERA work and concluded that the program as currently planned in the AEC's FY 1970 budget was appropriate.

V. International Collaboration

W. Panofsky led the Panel in the consideration of problems associated with the planned visit to Serpukhov by the U. S. scientific groups. These included: U. S. experiments of potential interest at the 76 BeV accelerator; the facility investment of CERN and France at Serpukhov and expectations of a U. S. contribution of similar magnitude; the CERN commitment which can be expected to total $8M at a rate of about $2M/year; the problems of U. S. funding of a similar effort at Serpukhov; anticipation of a request to the U. S. for computer capability; the bubble chamber picture at Serpukhov; the possibilities of a U.S.-U.S.S.R. online facility for a series of experiments; the role of a U. S. laboratory during the experimental preparation period of a joint U.S.-U.S.S.R. team; and manpower requirements, working and living conditions at Serpukhov. It was agreed that the visit of the U. S. group would be exploratory with a major goal of defining the areas of U.S.-U.S.S.R. interest and clarifying the problems to be solved for possible collaboration.

(The U. S. group, Panofsky, Cool, Fields, Wenzel, and Yuan, visited CERN, Moscow, and Serpukhov on February 25 - March 5, 1969. Panofsky reported on the trip to the U.S.S.R. on Serpukhov collaboration to the Commission on March 11, 1969, and to PSAC and the State Department on March 18, 1969.)

VI. Next and Future Meetings

The Panel considered the request for a hearing by HEPAP of the proposal for a Cosmic Ray Facility submitted by the University of Michigan. (An invitation was extended to L. W. Jones to make a presentation at the next HEPAP meeting.)

The next meeting was scheduled for May 23 and 24, 1969, at SLAC. Considered for the agenda of that meeting were: SLAC Host Presentation; International Collaboration; Computer Sub-committee; Budget Status; and Cosmic Ray Facility.

Topics for consideration at a future meeting include: Review of Superconductivity Activities in HEP; and BNL Host Presentation.

Correction to Minutes of December 6 and 7, 1968, HEPAP Meeting

Topic: NAL - BNL 25' Bubble Chamber

Page 3, first paragraph - item number (4) should be changed to read: There is some uncertainty concerning problems associated with inhomogeneity of the magnetic field due to the iron yoke if the magnet of the 12' chamber is converted to a 40 kilogauss magnet.

Enclosures:
1. Ltr. dated 2/26/69 fm. McDaniel to Weisskopf.
2. Ltr. dated 2/6/69 fm. Chairman Seaborg to Weisskopf.
3. Research Contracts in the Physical Sciences, 7/1/68.

Professor Victor F. Weisskopf
Department of Physics
Mass. Institute of Technology
Cambridge, Massachusetts 02138

Dear Viki:

In your letter of February 13, 1969, referring to the FY 1970 budget submitted to Congress, you express the gratification of PSAC with the inclusion of a substantial sum of construction funding for the 200 Bev project, but point out the deep concern of PSAC with the alarming downward trend in the funding of the remaining base program - a decrease of over $12 million or about nine percent from the FY 1969 funding. We too are deeply troubled by the funding levels in the FY 1970 budget and recognize that they pose many serious problems for the high energy physics program as well as for other basic research programs. We will continue to seek opportunities to secure relief from this situation. However, I must point out that in all reality the likelihood of further decreases far outweighs the possibility for any increase.

As you are aware, we too place high priority on establishment of a colliding beams research program at SLAC and we continue to seek means to start the project as early as possible. Again, however, I am discouraged about the probability of providing any additional funds to SLAC in FY 1970 for this effort. On the other hand, we are most encouraged about the prospects for including a reduced scope colliding beams project in the FY 1971 budget and I would expect the Commission to give the project very high priority for that year. In the event that FY 1971 funding is the only alternative, I sincerely hope we can give the SLAC design group adequate support and assurance so that they will continue to push ahead for one more year.

I am directing your letter and a copy of my reply to the Commission for their information.

With warm regards and best wishes.

Sincerely,

Original Signed by
Paul W. McDaniel

Paul W. McDaniel, Director
Division of Research

FEB 6 1969

Professor Victor F. Weisskopf
Department of Physics
Massachusetts Inst. of Technology
Cambridge, Massachusetts 02138

Dear Vicki:

Thank you for your timely and encouraging telegram of January 31, 1969, concerning the 200 Bev Accelerator. The Commission has long recognized this new high energy facility as its most important construction project. I can assure you that the Commissioners and I will continue to make every effort to fund this project to meet the Laboratory Director's schedule.

Cordially,

(Signed) Glenn T. Seaborg

Chairman

DRAFT
B. Hildebrand
12/20/68

MINUTES

HIGH ENERGY PHYSICS ADVISORY PANEL MEETING

December 6-7, 1968 - Washington, D. C.

U. S. Atomic Energy Commission

1717 H Street - Room 1022

The High Energy Physics Advisory Panel members attending were: V. F. Weisskopf, Chairman; R. Cool; E. Fowler; L. Lederman (12/6); E. Lofgren; G. Pake; R. Sachs; W. Panofsky; K. Symon; K. Terwilliger; R. Walker; and B. Hildebrand, Executive Secretary.

Others present were: H. Blewett, Aide to Chairman; and E. Goldwasser, NAL (for briefing on 25' bubble chamber on 12/7).

AEC attendees: Commissioner Tape (12/7); P. W. McDaniel; A. Ruark; H. Kinney; W. A. Wallenmeyer; J. Rees; C. Richardson; and A. Greene.

Present for the joint TCHEP-HEPAP Meeting: TCHEP members - R. M. Robertson (NSF), Chairman; J. H. McMillen (NSF), Executive Secretary; H. Harrison (NASA); P. W. McDaniel; W. A. Wallenmeyer; and E. Weigold (AFOSR). Also attending were: A. Schardt (NASA); H. Talkin (NASA); P. F. Donovan (NSF); W. Wright (NSF); J. Snow (NSF); W. Gruner (NSF); R. Denfield (AFOSR); and W. Baer (OST).

Meeting Agenda

I. Budget.
II. Joint Meeting with the Technical Committee on High Energy Physics.
III. NAL-BNL 25' Bubble Chamber.
IV. SLAC 1½ Bev High Intensity Colliding Beams Experiments.
V. HEPAP Report.
VI. Next HEPAP Meeting.

I. Budget

P. W. McDaniel and W. A. Wallenmeyer briefed the Panel on the status of the FY 1970 budget emphasizing the privileged nature of the information. Progress in the 200 Bev program was noted. Of particular

concern, however, was the injurious effects of the very limited Accelerator Improvement Project and Equipment (including computer) funds.

A letter from HEPAP to the AEC emphasizing the needs and problems associated with the shortage of equipment and AIP is to be considered for transmittal to the AEC (Cool and Panofsky).

II. Joint TCHEP-HEPAP Meeting - Dec. 6, 1968 (1:30-4:30 p.m.)

V. F. Weisskopf briefed TCHEP and guests on the data gathering work of the sub-panels and the planned HEPAP Report.

R. Robertson briefed HEPAP on the history of TCHEP, an interagency coordinating committee for the Federal Council on Science and Technology. The role of TCHEP has been policy recommending rather than policy making, dealing with such problems as: handling of proposals and phaseout by the Department of Defense of their major work in high energy physics.

Summaries of the high energy physics work of the NSF, AFOSR, and NASA were given by W. Wright, E. Weigold, and A. Schardt. McMillen spoke on the ONR program for the ONR representatives who were unable to attend the meeting.

The discussion period considered: NSF expenditure limitations, the uncertain funding state of the Stanford High Energy Physics Laboratory, and the role of cosmic ray research in elementary particle physics.

III. NAL-BNL 25' Bubble Chamber

E. Goldwasser updated the Panel on the plans for the NAL-BNL 25' bubble chamber since briefing HEPAP at its meeting of April 20-21, 1968, at Princeton. Since that meeting an NAL-BNL cooperative agreement has been signed and the Aspen Summer Study has been completed. The major conclusions relative to the execution of physics with large bubble chambers at NAL are: (1) Large bubble chambers are required for work in the 20-80 Bev region. (2) For neutrino physics the 25' bubble chamber has an advantage over the 12' bubble chamber by about a factor of 4-5 in effective interaction volume which shortens the exposure time required by such a factor. (3) For hadron physics the 25' bubble chamber may only have a slight advantage over the 12' bubble chamber with a 40 kilogauss magnetic field. (4) Traditional exploratory bubble chamber experiments at energies $\gtrsim$ 100 Bev appear to be difficult.

NAL is requesting the rapid initiation of the NAL-BNL 25' bubble chamber project.

Some relevant points arising out of the Panel discussion: (1) Present goal for the initation of the ν experiment in order to determine the weak interaction, axial vector form factors, is one year after beam turn-on in CY 1972. (2) Assuming that a ν experiment goal of 3,000 events in the 5-10 Bev region requires 10×10^6 bubble chamber pictures and assigning 1/3 of the total proton beam time to this work results in stretching the experiment out three years using the 25' bubble chamber. (3) Building a steel shield ($8M), rather than having an earth stopper as assumed above, reduces the ν beam diameter and doubles the data rate resulting in a major reduction (x 1/2) in the ν experiment cost. (4) There is some uncertainty in the convertability of the 12' bubble chamber to a 40 kilogauss field due to the iron yoke.

HEPAP continues to strongly recommend the NAL-BNL 25' bubble chamber project and the long-range plans to move the 12' ANL chamber to NAL.

IV. SLAC 1½ Bev High Intensity Colliding Beam Experiments

W. K. H. Panofsky gave the state and a brief history of colliding beam work in the world to date.

Because of the high priority of both the physics and the technology, SLAC is proposing to locate the colliding beams equipment in the experimental area initially running experiments with 1½ Bev beams with the capability to later operate with 3 Bev beams. This would be appreciably cheaper than the proposed 3 Bev storage ring, in part, because power needs for the magnet can be satisfied with existing facilities; the r.f. can be supplied from existing radar supplies; and an additional building is not required. B. Richter would be in charge of the program.

It was estimated that total costs for such a program would be $8.3M with $3.0M required in FY 1970. Of the latter sum some $1.2M could come out of the anticipated SLAC FY 1970 budget. The SLAC program would require reductions in planned advanced technology work (except in storage ring and superconductivity) and decreasing research funds for inhouse groups of about 10% with no reductions in shifts, bubble chamber work, and user facilities. The additional $1.8M required of the AEC includes ~ $.9M accelerator improvement type funds which are in particularly short supply.

Initiation of the project in FY 1970 would permit the initiation of physics experiments in 2-2½ years, some 2 years after the CEA experiments begin and about ½-1 year before the DESY storage ring is expected to produce results.

The colliding beams physics problems were discussed with the Panel and included: baryon form factors in the region of time-like momentum transfer, a region relatively inaccessible by other techniques; vector meson production with emphasis on small branching ratio decays; production of recurrence vector mesons, proton - anti-proton and hyperon - anti-hyperon production; and C, P, and T violation work. The important role of intensity and advantages over existing facilities were noted.

The Panel considered the new proposal a significant improvement in approach toward colliding beams work recognizing the importance of the uniqueness of the physics.

The AEC should look at the overall program and determine the places in the program it would assess to make it possible to proceed with the colliding beams effort at SLAC in FY 1970. The Panel plans a letter to the AEC on this subject.

V. HEPAP Report

The Panel discussed the planned HEPAP Report with Commissioner Tape. The topics considered were: purpose and utility of the present Report; need for the HEPAP Report; timing of the Report; history of previous panel work; and the roles of high energy physics in science, education, and technology.

The sub-panel drafts have been the informational basis for the HEPAP Report. The major work of the sub-panels are to be incorporated into the Report proper and the appendices. However, increasing the bulkiness may make it desirable to publish the HEPAP Report in two volumes. The data gathering work of the sub-panels can be highlighted in the transmittal to the AEC.

The major portion of the meeting was devoted to the details of the HEPAP Report, especially in regard to modifications in the sections on Conclusions and Recommendations.

The planned DEADLINES for completing the HEPAP Report are:

December 12, 1968

Conclusions and Recommendations to VFW (Sachs, Symon, Terwilliger).
Budgetary Implications (Hildebrand).

December 18, 1968

Circulate Revised Conclusions and Recommendations to Members.

January 2, 1969

Chapters and Appendices to be sent to Weisskopf:

Chapter I - Introduction Including Status and Goals of HEP (Weisskopf)

Chapter VI - Accelerator Technology - Status and Future (Panofsky)

Chapter VIII - Data Analysis (Fowler)

Chapter IX - Cosmic Rays (H. Blewett)

Chapter X - Education, Users, Labs and Universities (H. Blewett)

Chapter XI - International Science (H. Blewett)

Chapter XII - Computers (Fowler/Curtis)

Appendices:

A: New Technology and Storage Rings (Panofsky/Sessler/J. Blewett)

B: Manpower (Reardon)

C: Data Analysis (Fowler)

January 2, 1969

Comments on Revised Conclusions and Recommendations to be sent to Weisskopf.

January 11, 1969

Circulate Draft of Total Report to Members.

January 18, 1969

Deadline for Comments on Total Report to be sent to Weisskopf.

January 31 - February 1, 1969

HEPAP Meeting at Cambridge, Mass., to Consider Total Report.

February 14, 1969

Transmit Final Report to the AEC.

The HEPAP Report is still in need of a refreshing TITLE.

VI. Next HEPAP Meeting

The Panel's next meeting is scheduled for January 31-February 1, 1969 at Cambridge, Massachusetts. The principal items on the agenda are expected to be: (1) SLAC 1½ Bev High Intensity Storage Ring; (2) HEPAP Report; and (3) Budget Status.

Distributed at the December 6-7, 1968 Meeting:

(1) Zero Approximation Draft of HEPAP Report (11/26/68).

(2) Chronology for Preparing HEPAP Report (12/7/68).

(3) Report of Group A - Large Hydrogen Bubble Chamber Study - G. Trilling (8/14/68).

(4) Agreement Concerning Scientific and Technical Cooperation Between the National Accelerator Laboratory and Brookhaven National Laboratory (5/29/68).

(5) Physics Discussion for 1½ Bev High Intensity Storage Ring - W. K. H. Panofsky (2/1/68).

(6) Memorandum on Cooperation in the Peaceful Uses of Atomic Energy Between the United States Atomic Energy Commission and the Committee for Nuclear Energy of the Socialist Republic of Romania for 1969-1970.

Privileged Information

DRAFT
B. Hildebrand
10/28/68

MINUTES

TENTH HIGH ENERGY PHYSICS ADVISORY PANEL MEETING

OCTOBER 4-5, 1968

Cambridge Electron Accelerator Meeting

HEPAP held its tenth meeting at the Cambridge Electron Accelerator, Cambridge, Massachusetts, in the third floor conference room on October 4-5, 1968.

The following were present: Chairman Weisskopf; Members Cool, Fowler, Lederman, Lofgren, Pake, Panofsky, Sachs, Terwilliger, Walker, and Yang; and Executive Secretary Hildebrand. Symon was absent. H. Blewett attended to assist with the High Energy Physics Report. Attending for the Division of Research were: McDaniel, Kinney, and Wallenmeyer. In addition, the participants and attendees from the CEA, Harvard, and MIT during the CEA Presentation included: R. J. Averill, M. Deutsch, R. Fessel, D. Frisch, R. Krisciokaitis, F. E. Low, D. Luckey, G. Murphy, J. M. Paterson, F. M. Pipkin, K. W. Robinson, K. Strauch, R. Wilson, H. Winick, C. W. Wooldredge, Jr., and G. A. Voss.

Principal Topics Covered

I. Cambridge Electron Accelerator Presentation
II. Budget Status
III. Sub-Panel Draft Reports on High Energy Physics
IV. Next HEPAP Meeting

I. Cambridge Electron Accelerator Presentation

The presentation of the morning of October 4, 1968, consisted of the following briefings: (1) An introduction by K. Strauch, Director. Approximately 50 Ph.D.'s and 42 graduate students from universities (primarily Harvard and MIT) are involved in research associated with the CEA, at an overall annual operating, equipment, and construction cost of $6-7 million, including an estimated $2 million funded directly to the associated university programs. Very little research has been carried out by in-house CEA physicists to date, however, more will be done in the future, mostly with respect to the colliding beams studies. (2) H. Winick discussed the accelerator characteristics, the ongoing

and planned improvement programs and operation of the accelerator. (3) J. M. Paterson discussed the experimental and support facilities with emphasis on the available beams, on-line computers, and laboratory services. (4) G. A. Voss outlined the CEA accelerator physics program of work on beam storage and the bypass for colliding beams. (5) F. E. Low discussed the electron and photon physics problems especially suited for the CEA. These included: programs related to the possible violation of CP in weak interactions due to electromagnetic effects; fundamental questions of quantum electrodynamics associated with the photo and electro-production processes, electron and muon pair experiments, wide angle photon work, and problems of the radiative corrections of e^+, e^- scattering; systematics of particle states including transition moments, form factors, and the use of polarized beams; and basic questions on strong interactions especially via the study of photopion production. (6) K. Strauch completed the presentation with a history of the major CEA experiments completed, those presently underway, and the planned experiments. Colliding beams experiments are expected to represent a major part (40 to 50% of total beam time once in operation) of the CEA program for the next 4-5 years. It is considered important, however, to also continue a good program of conventional photon physics where the field is still very rich.

Discussed also with the Panel were: the demands on the accelerator which exceed the time available by nearly a factor of two; the high demand for the polarized photon beam; and the competitive position relative to other electron machines (the effective DESY budget exceeds that at the CEA by a factor of ~ two).

The Panel also toured the machine and the experimental facilities.

II. Budget Status

McDaniel and Wallenmeyer briefed the Panel on the status of the FY 1970 budget as it was included in the AEC's presentation to the Bureau of the Budget. In addition to the general stringencies, the continuing underfunding and imbalance of the equipment category with respect to the needs and operating part of the program remain a particular concern to the Panel. A modification in the definition of equipment was thought of as a possibility which might assist, in part, in mitigating the difficulties of the imbalance. Wallenmeyer is to look into the possibilities for changes in the definition.

The Panel discussed the budgetary impact upon: the limited U. S. storage ring program, contrasted with DESY, etc.; the requirement for high momentum beams at BNL and the effect of the lack of such beams upon experimental proposals; effects toward conservatism on the part

of university groups on their proposals for experiments; and the effects of budgetary limitations relative to accelerator shutdowns. A discussion was held with regard to the distribution of operating funds between the various budget categories. There appeared to be a consensus that the BNL AGS should have increased funding; however, there was no consensus that the funding distribution presented should be changed in BNL's favor, in view of the overall budget stringencies and the needs and other high priorities of other parts of the program. The Chairman summarized that newer parts of the program should, in general, receive priority over older parts of the program.

A communication to the Division of Research on the budget will be considered at the next meeting.

III. Sub-Panel Draft Reports on High Energy Physics

GENERAL - The Panel discussed the philosophy of its report on high energy physics. It was agreed that the report should emphasize the need for frontier research and, in particular, high energy physics research in the U. S., its role in education, the importance of discovering new phenomena and the historic consequences of such basic research, its connection with other parts of society, and its attractiveness to creative people. The report should give the present general situation of high energy physics and recommend a minimal but healthy development of the field presenting a general plan for the next five to ten years. The following points were considered as being of particular value for inclusion in the report:

(1) What high energy physics does for the country.

(2) Cost of being second in the field versus cost of remaining first.

(3) Useful things which may result from high energy physics studies.

(4) General education and training of physicists.

(5) The continuing attractiveness of this field of research to creative people.

(6) More recognition and open-minded attitude toward other fields.

(7) The breadth of the discipline.

As previously agreed, the Sub-panel reports (PRIVILEGED) are to be submitted to HEPAP only and will cease to have an independent existence thereafter. The final HEPAP report target date presently is by the time of the Congressional Hearings on the AEC budget, next February.

The budgetary implications of the work of the sub-panels should be put in chart form in each sub-panel report. This work of each sub-panel will be incorporated into an integral budget chart for HEPAP use by B. Hildebrand.

At the next HEPAP meeting (December 6-7, 1968, AEC, Washington, D. C.) the Panel is to write a first order draft of the HEPAP report. A zero order draft for this meeting is to be prepared by Weisskopf, Panofsky, Lofgren, Terwilliger, Blewett, and Hildebrand in November. Consequently, it is imperative that all sub-panel reports be completed and submitted to HEPAP prior to the November gathering. (The latter is presently scheduled for November 25-27, 1968, at SLAC.)

The importance of user and accelerator laboratory physicists input into sub-panel work to date was discussed, as well as future user input. It was concluded that there should be further opportunities for users and laboratory physicists to contribute to the HEPAP report. One consideration was that the Chairman initiate a general letter to the scientific community, perhaps to the APS Division of Particles and Fields membership. Consideration also was given to briefings on the work of HEPAP at user's meetings. After the meeting it was decided that briefings at user meetings were the best approach: giving a description of the planned report and its purposes, conducting a discussion, and inviting letters and remarks. R. Sachs gave the first such briefing at the SLAC User Meeting on October 24-25, 1968. V. Weisskopf is planning to give two more; one at the NAL User Meeting early in December, and the second at the BNL User Meeting in the middle of December.

SUB-PANEL A - The Sub-panel report discussion was led by Panofsky. To date the following reports have been submitted by the Sub-panel to HEPAP:

(1) June 11, 1968 Report of Sub-panel A dealing with Major Construction, Storage Rings, and Electron Storage Rings.

(2) July 22, 1968 Report to HEPAP on Accelerator Improvements.

(3) August 1968 Report of HEPAP Sub-panel A on Colliding Beams.

(4) September 19, 27, 1968 Draft Report on Construction and Shutdown Schedules.

The Sub-panel recommendations (September 19, 1968 Report, Page 12) and the Construction Schedule were considered by the Panel and led to deliberations on the following specific items:

(1) Non-conventional accelerator possibilities - Cryogenic AGS, Superconducting AGS, Superconducting Linac, Electron Ring Accelerator, and Superconducting FFAG. Present cost estimates are considered unreliable.

(2) The relative priorities of ANL, BNL, LRL, and SLAC Laboratories in relation to experimental physics and accelerator research potential, institutional strength, and educational role.

(3) The importance of higher energy experiments and the need to emphasize the use of higher energy beams at BNL.

(4) The present capability and productivity of lower energy machines. Coordination between the various accelerators should lead to greater use of the available lower energy beams at the smaller machines rather than similar beams at the larger machines.

(5) The administrative, technical, and social problems associated with a continuous construction schedule at NAL and the concentration of all physics > 30 Bev at a single laboratory.

(6) Assessment of the future role of smaller accelerators under the circumstances whereby NAL can only handle a fraction of the necessary physics experiments. The relative priority of an additional experimental hall at NAL versus the use of lower energy machines.

(7) The relationship of NAL to ANL and the possibility of greater coordination of the high energy work of these laboratories. It was tentatively concluded that a "confederation" of the ZGS and NAL Laboratories was highly desirable and should be looked in by the two laboratory managements.

(8) The pros and cons of the use of other accelerators by national laboratory user groups today and in the future.

(9) The importance of the research role of large university laboratories like Nevis and the need for strong university research programs.

(10) The high probability of success of one of the non-conventional accelerator possibilities strengthens the probability for a recommendation of an intermediate energy accelerator (~ 100 Bev) as an early application of a newly developing technique.

(11) The importance of an accelerator in the 2,000 Bev range and the need for new and more economical acceleration techniques, as well as the timing for such a machine.

(12) The importance of quantifying the early years of construction and other cost, schedules up to about 1980. Longer extrapolations tend to be much too unreliable.

SUB-PANEL B - Fowler discussed the work of the Sub-panel and the report of October 1, 1968 to the Panel on "Film Data Analysis" dealing with the use, status, and recommendations on bubble chamber and spark chamber film analysis. The Sub-panel plans to additionally report on major computers and on estimates of the budgetary impact which follows from the analysis.

SUB-PANEL C - Lederman discussed the Sub-panel C preliminary report of September 1968, "The Future of Cosmic-Ray Particle Physics". The Sub-panel plans to submit shortly an abbreviated version with budgetary consequences.

SUB-PANEL D - Cool led the Panel discussion of the interim report of Sub-panel D (September 30, 1968). The interim report is on: bubble chambers and bubble chamber beams (I); other major detection devices (III); instrumentation development (V); and supplemental and operational equipment needs (VI). The remaining topics to be completed are: new counter beams and experimental areas (II) and on-line data facilities (IV). (Sub-panel B is handling major computers.)

The major considerations were:

(1) Major bubble chambers are necessary for exploratory work and neutrino physics at higher energies (200 Bev). Utility beyond 60-80 Gev for strong interaction physics is uncertain.

(2) The increasing fraction of beam taken by such devices as pulsed bubble chambers.

(3) The relative priorities of new bubble chambers, new bubble chamber beam projects, and the disposition of existing bubble chambers.

(4) The relative priorities of external beam projects at the major laboratories.

SUB-PANEL E - Walker led the discussion of the September 27, 1968 draft submitted by the Sub-panel. Some of the major considerations included:

(1) An agreed upon emphasis on the importance of the educational objectives of high energy physics, as well as the research purposes.

(2) The total cost implications on the high energy physics program of an average additional university accelerator user group to the high energy physics program. The present estimate, at equilibrium, is $300K funding for the user group with about $400K in incremental associated accelerator laboratory costs.

(3) The relative overall laboratory-university levels of effort which are considered in balance at present.

(4) The need for better estimates of the present level of effort of in-house user groups.

(5) Major laboratory policies in regard to the use of laboratory computer centers by university user groups.

(6) The trend toward large user groups and the viability or lack thereof of smaller user groups.

(7) The need to make laboratory facilities more easily available to university user groups and associated problems of implementation.

(8) Collaboration with laboratory groups as a catalyst toward initiating new university user groups.

(9) The need to increase the budget by 1½ - 2% per year for new university groups. Considered also was the letter of June 26, 1968, from A. K. Mann to Chairman Weisskopf on funding new university user groups.

SUB-PANEL F - Lofgren submitted a preliminary draft of the Sub-panel report on "Manpower" (October 1968). A preliminary estimate indicates that over 1,000 new Ph.D.'s in high energy physics are expected in the next three years. The Sub-panel report of September 23, 1968, "International Collaboration in High Energy Physics," has been previously reported to the Panel.

SUB-PANEL G - Weisskopf asked for comments on the basic arguments relevant to the role of high energy physics contained in his review of "The Politics of Pure Science" by Greenberg. (A copy of the review was sent to Panel members with the Weisskopf letter of October 9, 1968.)

IV. Next HEPAP Meeting

The next meeting is scheduled for Friday and Saturday, December 6 and 7, 1968, at AEC Headquarters, Washington, D. C. The principal items on the agenda are:

(1) THE HEPAP Report.

(2) Budget Status.

Oct 4 Mtg

DRAFT
B. Hildebrand
Sept. 20, 1968

MINUTES OF HIGH ENERGY PHYSICS
ADVISORY PANEL MEETING

June 20 & 21, 1968

HEPAP MEETING - WASHINGTON, D. C.

The HEPAP meeting of June 20, 21, 1968, was held at AEC Headquarters, 1717 H Street, Washington, D. C., in conference room 1062. The following were present: Chairman Weisskopf; Members Cool, Fowler, Lederman, Lofgren, Panofsky, Sachs, Symon, Walker, and Yang; and Executive Secretary Hildebrand. Pake was absent. Also attending were H. Taft who was Acting Chairman of Sub-Panel B during E. Fowler's absence; H. Blewett who is to assist in assembling the Panel Review Report; Col. J. Rosen, Special Assistant to Commissioner Tape; P. W. McDaniel, W. A. Wallenmeyer, R. L. Fricken, J. R. Rees, and C. R. Richardson of the Division of Research; M. B. Kratzer (Director), A. S. Friedman (Deputy Director), and M. Abrahams (Chief, Assignments Branch) of the AEC Division of International Affairs.

The topics covered were:

I. Budget Status
II. Sub-Panels on High Energy Physics
III. International Collaboration
IV. Next HEPAP meeting

I. BUDGET STATUS:

McDaniel and Wallenmeyer reported on the House Appropriation Bill of June 19, 1968, and the FY 1969 and FY 1970 budgets. A major consideration was the limited construction appropriation for the 200 Bev accelerator and the restriction to architecture-engineering work only in the House Bill. The potential effects of these limitations on staffing and management, delay in beams, increase in cost, effect on morale, and loss of project momentum were discussed. The panel reiterated its commitment to the 200 Bev accelerator. (A partial restoration of funds and alleviation on restrictions was made, following the Work of the Senate Appropriation and House-Senate Conference Committees, in the final AEC Bill.) The effects of Congressional action on the National Science Foundation were also considered.

A principal problem is that of limitations in the projected operating and equipment funds for FY '69 and '70. Both direct and laboratory support for users are in jeopardy. The equipment limitations, in particular, remain a most serious problem.

The work in progress at CEA on colliding beams although deemed important and a significant contribution represents a severe limitation to colliding beams physics in the USA and was considered insufficient. The importance of the SLAC storage ring project was reemphasized. Progress at Frascati, Orsay, Novosibirsk and the CERN ISR was contrasted with the low level of effort in the U. S. It was noted that the HEPL storage ring was being taken out of mothballs to perform an $e^+e^- \rightarrow \mu^+\mu^-$ experiment. Also discussed was the difficulty of including general purpose laboratory and university buildings in the AEC construction budget. It was noted that the possibility exists to fund the latter buildings with matched federal-university funds, however the probability although greater than for full funding, is still considered to be low.

II. SUB-PANELS ON HIGH ENERGY PHYSICS

General - M. H. Blewett has agreed to assist HEPAP to pull together the work of the sub-panels into a review report. The initial reports of the sub-panels should be mailed to members of the panel and M. H. Blewett prior to the next meeting (October 4-5, 1968). Further consideration is required relative to the general and detailed goals and timing of a HEPAP report on the U. S. elementary particle physics program.

SUB-PANEL A - Future accelerator projects, new ideas and improvements - Panofsky reported on the work to date. Accelerator improvement plans have been received from the major laboratories relative to current upgrading programs, substantial additions based upon current technology, and long range plans based upon new technology. The June 11, 1968 sub-panel draft report to HEPAP on the next steps to higher energy dealing with major construction of accelerators and storage rings was discussed by the panel. The next sub-panel meeting planned was to be concerned with the program needs and relative priorities from the accelerator user point of view. H. Blewett is in the process of assembling data on the properties of available accelerator beams at each of the major laboratories for accelerator users. (The sub-panel subsequently met July 19, 20, 1968 at BNL).

SUB-PANEL B - Film data analysis, including bubble chamber and spark chamber films - Taft and Fowler reported on the work of the sub-panel. The Bubble Chamber survey is in progress. The survey will assist in answering the question as to how well matched the data analysis capability is to the data production capability. The spark chamber survey is in a preliminary stage. The establishment of film libraries did not appear to be feasible because of limitations of information on chamber and magnetic field conditions, as well as storage requirements. Information on "spin off" from HEP data analysis is being assembled. There is a need for scanning machines to handle film from the large bubble chambers. Existing types of measuring machines appear adequate.

Some of the problems discussed and requiring further consideration dealt with: the cost and rate of growth of bubble chamber interaction studies; present trends in bubble chamber and spark chamber physics and event analysis; the viability of smaller user groups and advice to universities; the requirements for semiautomatic data analysis; the use of large versus small bubble chambers; and visible future developments in data analysis and bubble chamber, spark chamber physics. (The sub-panel subsequently met September 13, 1968 at BNL).

SUB-PANEL C - Cosmic Rays - Lederman reported on the efforts of the sub-panel to determine the accomplishments to date and future role of cosmic rays in elementary particle physics. Included in the sub-panel considerations are: future research objectives; relationships to accelerator research programs, major facilities and the application of new techniques. The sub-panel planned to gather more information from experimentalists and consider the first draft at the next meeting. (The sub-panel met August 8, 1968 at Denver).

SUB-PANEL D - On-line data handling, large ancillary equipment, and beamology - Cool reported that the sub-panel was in the process of gathering information primarily from laboratories. Although requested, there has been only little response from universities. The sub-panel study includes consideration of: major construction items including the expansion of experimental plant facilities at existing accelerators; experimental facilities - bubble chambers and bubble chamber improvements, spectrometers and other devices; on-line data facilities and major computer facilities; beam transport requirements;

developmental programs such as superconducting beam transport systems, R.F. beam separators and streamer chambers; policies on construction and use of major equipment. (The sub-panel subsequently met on June 27, 28, 1968 in New York; July 23, 24 at ANL; and August 19, 1968 at BNL).

SUB-PANEL E - University participation and national laboratory-university relationships - Walker reported on the principal questions considered. These were: relative funding needs of laboratories and user groups; the problem of increasing costs of experiments and the ability of university groups to be competitive; university building requirements; the minimal funding requirements and problems of universities in order to initiate a high energy physics research program; the extent of the demand at universities for the initiation of high energy physics programs; the extent of interest of young people in science, especially in experimental work; and the educational role of research at universities. (The next sub-panel meeting is scheduled September 23, 24 at ANL).

SUB-PANEL F - Manpower and International Collaboration - Lofgren reported on the work of the panel. The International Collaboration portion of the work is in the most advanced state. The draft report to HEPAP deals with the role of high energy physics in international collaboration; the history and current status of such collaboration; formal and informal arrangements; experimental and accelerator construction collaboration; and recommendations relative to formality and access. The manpower study is in the data gathering stage. The budgetary processes aspect of the sub-panel work will not be pursued further at this time. (The sub-panel subsequently met on July 26, 27, 1968 at Berkeley and another meeting is scheduled for September 20, 21, 1968 at ANL).

III. INTERNATIONAL COLLABORATION

Kratzer, assisted by Friedman and Abrahams, briefed the panel on the progress in Moscow of the negotiations on the latest general US-USSR exchange agreement and the AEC-SCUAE exchange agreement. (The latter agreement was signed July 29, 1968 following the signing of the overall agreement). The U. S. institutions specifically mentioned in the new agreement relative to the exchange of specialists are: ANL, BNL, LRL (Berkeley), SLAC, PPA and CEA. The Soviet institutions

are: Inst. of Theoretical and Experimental Physics (Moscow), the Inst. of High Energy Physics (Serpukhov), the Physics-Technical Inst. of the Ukrainian Academy of Sciences (Kharkov) and the Institute of Physics of the Armenian Academy of Sciences (Yerevan). Possibilities of individual exchanges, exporting equipment and an international accelerator were considered. Serpukhov collaboration and the latest letter to Logunov from Goldhaber was discussed.

IV. NEXT HEPAP MEETING

The Panel is next scheduled to meet on October 4, 5, 1968 at the Cambridge Electron Accelerator, Cambridge, Massachusetts. The planned agenda includes: CEA Host Laboratory Presentation; Budget; Sub-Panels on High Energy; and International Collaboration.

[redacted]

B. Hildebrand
June 7, 1968

MINUTES OF HIGH ENERGY PHYSICS
ADVISORY PANEL MEETING

APRIL 20 & 21, 1968

HEPAP MEETING - PRINCETON, NEW JERSEY

The April 20, 1968 High Energy Physics Advisory Panel meeting was held at the Princeton-Pennsylvania Accelerator (PPA), and the April 21, 1968 meeting was held at the Princeton Inn, Princeton, New Jersey. Present were Chairman Weisskopf; Members Cool, Fowler, Lederman, Lofgren, Pake, Panofsky, Sachs, Symon, Walker, and Yang; and Executive Secretary Hildebrand. Present also for the Atomic Energy Commission (AEC) were P. W. McDaniel, H. L. Kinney, W. A. Wallenmeyer, and J. R. Rees. H. Taft was present primarily to report on the activities of Sub-panel B. Goldwasser was invited for the April 20 meeting to brief the Panel and participate in the discussions of large bubble chambers for the National Accelerator Laboratory (NAL). M. Goldberger participated on April 21 to brief the Panel and participate in the discussions on the scheduled 1968 International High Energy Physics Conference at Vienna.

In addition, the April 20, 1968 morning PPA presentation had the following in attendance from Princeton University and the University of Pennsylvania: H. Brody, J. Cronin, V. Fitch, G. Garvey, J. Halpern, K. Lande, A. Lemonik, A. Mann, P. Piroue, H. Primakoff, G. Reynolds, W. Selove, F. Shoemaker, T. Thomas, W. Wales, and M. White. L. Pondrom from the University of Wisconsin also attended.

The topics covered were:

(1) Princeton-Pennsylvania Accelerator Laboratory Presentation.
(2) Budget.
(3) National Accelerator Laboratory Bubble Chamber Requirements.
(4) Sub-panels on High Energy Physics.
(5) International Collaboration.
(6) Next HEPAP Meeting.

PRINCETON-PENNSYLVANIA ACCELERATOR LABORATORY PRESENTATION

The presentation consisted of the following briefings: (1) M. G. White, Director: gave a short history of the synchrotron operations and cost history noting that the increase in machine operating and user hours

in the period 1964-1968 brought the ratio of synchrotron operating cost to user hours down to $250/user hour; described the Laboratory improvements on the external beam, beam sharing, and flat topping; discussed planned improvements in beam bunching and debunching; described plans for a new 75 Mev high current injector capable of puting about 10^{12} protons per pulse into the PPA; the interest in polarized target work; a capability for the proposed new injector to handle polarized protons (The PPA permits acceleration of protons up to 2.8 Bev without depolarization.), deuterons, tritium, helium-three, and heavier nuclei; discussed the possible future use of the PPA as an injector for a higher energy accelerator; emphasized the capability of the PPA to average ten experimental setups simultaneously and the availability of multiple beams; and stressed the importance of the unique rf bunching feature which permits time of flight work with neutral particles. (2) W. Wales, Associate Director: surveyed the approximately 42 experiments on strong and weak interactions performed at the PPA in the interval CY 1963-1968 by groups from Pennsylvania, Princeton, and other universities; summarized the bubble chamber multipulsing operation by which six experiments were completed and 10^7 pictures will have been taken by July 1968 at which time the bubble chamber will be considered for deactivation; and discussed waiting times for accelerator user groups. (3) Piroue reviewed: the effectiveness of the PPA from the educational-training point of view, with an average of two students involved in each experiment; the opportunity for post-doctorals and junior faculty in the planning and executing of experiments; the importance of using the PPA to perform high risk experiments and as a staging area for higher energy machines. (4) Pondrom discussed the PPA from an outside user point of view and stressed: accessibility; the capability of running simultaneous experiments; and the facilities available. (5) Brody reported on the conclusions of the PPA Long-Range Planning Committee: the need for an increase in intensity; the potential capability of the PPA to accelerate polarized protons; the use of higher intensity for such weak interaction work as kaon beta decay, $\gamma\gamma$ and 3π and K_{e2} decays, Λ-Σ asymmetry and relative parity studies; and the use of higher intensity for strong interaction work, especially missing mass experiments. (6) Primakoff discussed the theoretical significance of experiments likely to be performed at the PPA with higher intensity, especially noting: K_{e2} work as a test of μ-e universality; K_{e3} and $K_{\mu 3}$ work to test $\Delta S = \Delta Q$ and $\Delta I > \frac{1}{2}$ and study of the muon spectrum to obtain a better limit on the mass of the muon neutrino; K_{e4} work to help determine the $\pi\pi$ phase and test T and CP non-invariance; K^o beta decay work to test Conserved Vector Current; strong interaction work; and the use of d and α beams for large momentum studies to obtain nucleon-nucleon correlation information.

Written material presented to the Panel included: (1) Report to the High Energy Physics Advisory Panel on the Princeton-Pennsylvania Accelerator, April 20, 1968, M. G. White; (2) Summaries of Experiments Performed, in Progress, and Planned at the PPA and Publications and

Research Work in Progress, W. D. Wales; (3) Progress in High Energy Physics Research, University of Pennsylvania, March 1968, S. Frankel; and (4) Current Status of High Energy Physics Research, Princeton University, March 1968, G. T. Reynolds.

HIGH ENERGY PHYSICS BUDGET

McDaniel and Wallenmeyer briefed the Panel on the FY 1969 budget status and the five-year budget projections for Operations, Equipment, and Construction. While Congress is expected to act early this year, there are major uncertainties in the FY 1969 budget at present.

The five-year projections were considered generally low, and the Panel especially noted the imbalance between the equipment and operations budget. While part of the equipment budget has a relationship to new facilities under construction, a major fraction of the equipment budget must also be strongly coupled to the regular operating budget in support of the accelerator, experimental, development and data analysis operating programs. As presently projected the equipment funds are definitely inadequate to comply with the needs of NAL and the base operating program. The Panel concluded that this matter is of immediate urgency and required the prompt attention of the AEC. (A letter dated May 3, 1968, from V. F. Weisskopf to P. W. McDaniel represented the views of the Panel on the budget forecasts. P. W. McDaniel responded to the Panel by letter of May 15, 1968, to V. F. Weisskopf.)

NAL BUBBLE CHAMBER REQUIREMENTS

N. Goldwasser, Associate Director of NAL, reported to the Panel on the bubble chamber needs of the Laboratory at Weston. Because of the lead time involved and the problems of assembling staff at NAL at this time for such a major task, the bubble chamber requirements have been considered in collaboration with representatives of other national laboratories, primarily Argonne National Laboratory (ANL) and Brookhaven National Laboratory (BNL).

The Panel discussed the physics, the available options, and the need for specific recommendations to the Division of Research. Major bubble chambers are required for both neutrino and strong interaction physics at the high energies available with the 200/400 Bev accelerator. NAL-ANL considered the transfer of the ANL 12' BC to NAL after two-three years operation of the chamber at ANL, and the possibility of further bubble chamber design work at ANL for NAL. It was estimated that approximately one year and $4-5M are required to move the 12' BC to NAL. Also under consideration is the possibility that the 7' test facility

at BNL be transferred to NAL, and that BNL redirect its large bubble chamber program toward the design of a large cryogenic hydrogen chamber specifically for use at NAL. A preliminary design of such a chamber having an effective length of 25' is estimated by BNL to cost $12M.

Parameters of Bubble Chambers Under Consideration

	7 ft.	12 ft.	25 ft.
Total Volume	9.4×10^3 l	26.3×10^3 l	100×10^3 l
Visual Volume	6.0×10^3 l	20.0×10^3 l	
Diameter	7 ft.	12.7 ft.	15 ft.
Height of Visual Vol.	5.2 in.	6.5 in.	12 in.
Mag. Field	22 kg.	20 kg.	40 kg.
Max. Mag. Field	30 kg.	25 kg.	40 kg.
Lens to Center	5.5 ft.	4.5 ft.	

It was estimated that the relative efficiencies for neutrino interaction studies was 7'BC:12'BC $\simeq$ 1:3. A 25' BC, of course, would have a large advantage over the 12' for both neutrino and strong interaction physics from considerations of increased volume and path length.

In order to have the 25' chamber ready to accept an NAL beam in FY 1973 it would be necessary to immediately initiate a crash construction program. A somewhat slower construction schedule would permit a fuller exploitation of the experience gained with both the 7' and 12' chambers, as well as the folding in of the recommendations of the NAL Summer Study Program.

Goldwasser indicated that NAL leaned toward moving the 12' BC to NAL for early operation and have BNL develop and build the 25' chamber for NAL on a non-crash basis.

The Panel considered the possible alternatives and concluded that the transfer of the 12' chamber and the NAL-BNL collaboration on a new major chamber are required for the proper exploitation of the NAL 200/400 Bev accelerator. It was estimated that approximately $3M in obligational authority was required for this effort in FY 1970. (The recommendation of the Panel is contained in the letter of May 17, 1968, from V. F. Weisskopf to P. W. McDaniel. The latter has responded to the HEPAP recommendation by letter of June 3, 1968, to Chairman Weisskopf.)

Written material presented to the Panel on these matters were: Background Paper on the National Accelerator Laboratory Problem with Respect to the Need for and the Provision of a Large Hydrogen Bubble Chamber - April 12, 1968, E. L. Goldwasser. Attachment A: Letter of 12/6/67 from I. A. Pless to N. L. Goldwasser; B: 9/8/67 Draft by R. G. Sachs and E. L. Goldwasser on ANL-NAL Understanding; C: 4/10/68 Draft of BNL-NAL Agreement; and D: Letter of 3/12/67 from R. B. Duffield to R. R. Wilson.

SUB-PANELS ON HIGH ENERGY PHYSICS

SUB-PANEL A - Future accelerator projects, new ideas and improvements - Panofsky reported on the work of the first Sub-panel meeting and plans for the next: A table listing the Western Europe and U. S. high energy physics accelerators illustrated the relatively serious funding problem in the U. S. since with the funding approximately the same the pairing off of major U. S. - Western Europe accelerators leaves the U. S. with two additional major machines. Expectations of new technologies included consideration of the feasibility of superconducting pulsed and DC synchrotrons, superconducting electron linac work at HEPL and SLAC, storage rings, electron ring accelerator (ERA), and the prospects for the next major step in accelerator energy. Future possibilities of proven feasibility included storage rings at SLAC, BNL, NAL, and work at the CERN-ISR and conventional 1000-2000 AGS and circular 30 Gev electron accelerator. Future possibilities with yet to be documented feasibility included a superconducting AGS, a FFAG (cascade) machine, superconducting electron linac and ERA (70 and 1000 Bev). Improvement programs at the major accelerators and proposed regional accelerators were to be considered in depth with testimony at future meetings. A history of the phaseout of accelerators was summarized in a table.

The question of how to correlate research and training productivity with incremental and/or major changes in the funding of accelerators required more effort. An additional effort is required to funnel experiments to the laboratory where they can best be executed. A conventional second step in accelerator energy would incorporate new technology. The feasibility of such a step is anticipated in three to four years. (Sub-panel A met on May 17, 18, 1968, at the Massachusetts Institute of Technology and plans a meeting at BNL on July 20 and 21, 1968.)

SUB-PANEL B - Film data analysis, including bubble chamber and spark chamber films - Taft reported on the BNL Data Analysis Meeting of January 24 and 25, 1968, the Sub-panel meeting on January 25, 1968, and subsequent activities. Conclusions of the BNL meeting were that: the Spiral Reader and FSD systems continue to dominate in terms of production; the POLLY and PEPR type Cathode Ray Tube devices have become operational; but automatic scanning is a distance away. A new survey of bubble chamber groups has been initiated and a survey of spark chamber groups is planned. The Panel plans to study: the future role of the

bubble chamber technique in high energy physics; present and future computer usage; possibilities for standardization of film formats and effects of demagnification; new modes of event processing; impact of data analysis in high energy physics on other fields; and the role of university groups. The Panel considered the balance and pros and cons of bubble chamber and spark chamber-counter physics at laboratories and universities. There is a need for recommendations on data analysis equipment and consideration must be given to the match between analysis equipment and picture production. (A meeting was held in Washington on April 24, 1968. Another meeting is planned at the end of the summer.)

SUB-PANEL C - Cosmic Rays - Lederman reported that: J. Bjorken (SLAC) has accepted membership on the Sub-panel, and that V. Fitch could not accept membership; the federal agencies were funding about $3.5M for high energy physics related to cosmic ray work with about $1.1M from the AEC; a first meeting is planned at the time of the American Physical Society Meeting at Washington. (The Sub-panel met on April 25, 1968 at Washington, D. C., and plans a meeting about July 2, 1968 in Colorado.)

SUB-PANEL D - On-line data handling, large ancillary equipment, and beamology - Cool reported on plans and work of the Sub-panel. At the first meeting the Panel planned to convene three information meetings, one in the East, Midwest, and West, plus one or two meetings to prepare the report to HEPAP. The topics for future consideration included: new cryogenic bubble chambers and heavy liquid bubble chambers and relative merits; large spark chambers inside magnetic fields; large spectrometers outside of magnetic fields; operation of large equipment as facilities; funding of research and development of devices; superconducting beam transport systems; on-line computing facilities; and the possibility of a Canadian experimental area and associated facilities at major U. S. accelerators.

The usefulness of having equipment lists exchanged between national laboratories was indicated. Similarly a listing of available beams with fluxes would be very useful. (Meetings of the Sub-panel were held on May 5, 6, 1968, at SLAC, and May 17, 18, 1968, at ANL. Meetings are scheduled for June 27, 1968, in New York, and July 11, 12, 1968, at ANL.)

SUB-PANEL E - University participation and national laboratory-university relationships - Walker reported on the Sub-panel meeting of April 5 and 6, 1968, at Pasadena where the problems considered were divided among the Sub-panel members for work and distribution. The outline of topics included: general questions on the role of university participation in high energy physics; modes of university participation; national laboratory-university relationships; and accelerator user and theory groups.

The Panel considered the question of balance between theorists and experimentalists; the administration of laboratory science advisory committees; university computer needs; university participation at laboratories on the creation of facilities; and the role of the various federal agencies. (The next meeting is planned in late summer.)

SUB-PANEL F - Budgetary processes, manpower, and international collaboration - Lofgren reported that D. R. Getz was added to the Sub-panel membership. The goals established at the first Sub-panel meeting of April 5, 6, 1968 were: to assess the manpower needs of the present and future U. S. high energy physics effort and to determine the coupling of trained high energy physicists to other scientific and technical activities; to assess the role of international collaboration in high energy physics and to determine methods of strengthening such collaborations. Admission policies to National Laboratories and State Department policies on exchanges will be considered; to assess the present budgetary processes, the balance of efficiency and control, and seek constructive methods to optimize the process. Statements from laboratory directors on the budgetary process, as well as testimony from the AEC and NSF, are planned. Some flexibility in the specification of operating versus capital equipment funds appears desirable. The role of accelerator physics programs at universities, as well as the role of engineers, was considered. (A meeting of the Sub-panel with the State Department took place in Washington, D. C., on April 22, 1968. The next Sub-panel meeting is scheduled for June 10 and 11, 1968, in Washington, D. C.)

INTERNATIONAL COLLABORATION

The Mirabelle bubble chamber for Serpukhov is expected to be delayed. It is behind schedule at this time; there are problems with the optics and the safety of the vessel.

The CERN-Serpukhov collaboration is working well. The European collaborative experiments for Serpukhov are progressing. By letter of May 3, 1968 from Goldhaber to Logunov, it has been suggested that a U. S. scientific delegation visit the Serpukhov Laboratory and plan for U. S.-Soviet collaborative experiments.

M. Goldberger reported to the Panel on the plans of the International High Energy Physics Conference. 227 U. S. participants have been invited to Vienna. It is estimated that about 145-150 physicists will receive federal travel support. The AEC plans a support ceiling of about 110. By letter Goldberger has suggested that the invitees make their travel requests early and also look for other sources of support.

NEXT HEPAP MEETING

The next HEPAP meeting is scheduled for June 20 and 21, 1968, in Washington, D. C. (Room 1062, 1717 H Street, AEC Headquarters. Accommodations for Panel members have been arranged at the Hotel Lafayette.) The planned agenda includes:

(1) Budget Considerations
(2) Sub-panel Reports
(3) International Collaboration

REMINDER: Minutes of the Sub-panel meetings, just as minutes of HEPAP meetings, are the property of HEPAP and should be considered and marked "Privileged".

D R A F T
B. Hildebrand
3/11/68

MINUTES OF HIGH ENERGY PHYSICS ADVISORY PANEL MEETING

JANUARY 19 & 20, 1968

HEPAP MEETING - AEC (WASHINGTON, D.C.)

The first meeting of the year of the High Energy Physics Advisory Panel was held on January 19, 1968, at the U. S. Atomic Energy Commission Headquarters, Germantown, in Room A-416, and on January 20, 1968, at N. W. Washington, D. C., in Conference Room 1030. The following were present: Chairman Weisskopf; Members Cool, Fowler, Lederman, Lofgren, Panofsky, Sachs, Symon, and Walker; and Executive Secretary Hildebrand. Pake, Wilson, and Yang were absent. Also attending at various times for the AEC were: McDaniel, Director, Division of Research; and Kinney, Wallenmeyer, Fricken, Greene, Rees, and Richardson of the Division of Research; and Chairman Seaborg, Commissioner Tape, and Colonel Rosen on Saturday, January 20, 1968.

The topics considered were:

(1) FY 1968 and FY 1969 High Energy Physics Budgets.
(2) Sub-Panels on High Energy Physics Program Studies.
(3) 200 Bev Accelerator Report.
(4) Report on Status and Problems of High Energy Physics.
(5) U. S. Participation at the ISR.
(6) Foreign Conference Travel.
(7) New Acceleration Studies.
(8) Next HEPAP Meeting.

BUDGET UPDATING REPORT

McDaniel and Wallenmeyer briefed the panel on the FY 1968 Apportionment Budget and the FY 1969 President's Budget for Operations, Equipment, and Construction. The Panel discussed the relative reasonableness of the budgetary decisions and the need to do more long range planning under various fiscal assumptions. Also considered were the possibilities of reducing costs via such procedures as centralized equipment procurement, rescheduling equipment purchases, optimization of number of accelerator shifts, and optimization of physics research and technological development productivity.

SUB-PANELS ON HIGH ENERGY PHYSICS

The chairmen of the various Sub-panels reported on the proposed membership topics and procedures. There resulted amalgamation, elimination,

and addition of Sub-panel topics. Sub-panel membership lists were presented.

SUB-PANEL A - Future accelerator projects, new ideas and improvements.

Chairman: W. K. H. Panofsky

Membership: J. Blewett (BNL), R. Garwin (IBM), R. Hildebrand (U. Chicago), D. Z. Robinson (New York U.), J. Sakurai (U. Chicago), and A. Sessler (LRL).

In addition, R. Blumberg (SLAC) will assist the sub-panel in collecting data.

Phasing out of old projects was removed as a topic of this sub-panel. It will be considered as a separate item by HEPAP.

(A meeting is planned for March 16 and 17, 1968 at SLAC.)

SUB-PANEL B - Film data analysis, including bubble chamber and spark chamber films.

Chairman: E. C. Fowler

Membership: T. Fields (ANL), P. Franzini (Columbia), P. Hough (BNL), L. Lederman (Columbia), R. Plano (Rutgers), A. Rosenfeld (LRL), J. Snyder (Illinois), and H. Taft (Yale). (Taft is expected to report on the work of the sub-panel at the next HEPAP meeting as acting chairman in Fowler's absence.)

Computer facilities has been added as a topic insofar as they relate technically to film data analysis.

(A meeting on automatic data analysis techniques was held on January 24-25, 1968 at BNL and the sub-panel met on January 25, 1968. Another sub-panel meeting is planned at the time of the Washington APS meeting.)

SUB-PANEL C - Cosmic Rays.

Chairman: L. Lederman

Membership: Camerini (Wisconsin), Fitch (Princeton), Greisen (Cornell), Jones (Michigan), Keuffel (Utah), and Piccioni (UC, La Jolla).

The former topic of Sub-panel C, computer facilities, was divided between Sub-panels B, D, and E, as related to analysis of data (B), on-line data handling and ancillary equipment (D), and university participation and laboratory-university relations (E).

(A meeting is planned in early April 1968.)

SUB-PANEL D - On-line data handling, large ancillary equipment, and beamology.

Chairman: R. L. Cool

Members: T. H. Fields (ANL), E. C. Fowler (Duke), W. F. Fry (Wisconsin), L. M. Lederman (Columbia), J. Murray (SLAC), A. Pevsner (Johns Hopkins), H. P. Samios (BNL) - Secretary, and A. V. Tollestrup (Cal. Tech.).

Computer facilities as it relates technically to on-line data handling needs is included in the province of the panel.

(The sub-panel has met on March 1,1968. The next meeting is scheduled for April 8, 1968 at SLAC or LRL.)

SUB-PANEL E - University participation, and national laboratory-university relationships.

Chairman: R. L. Walker

Members: T. Elioff (LRL), A. D. Krisch (Michigan), L. Lederman (Columbia), R. G. Sachs (ANL), and W. Willis (Yale).

Computer facilities have been included as a topic of this sub-panel insofar as it is related to university participation and laboratory-university relations.

(A meeting is scheduled for April 5-6 at Cal. Tech.)

SUB-PANEL F - Budget handling, manpower, and international collaboration.

Chairman: E. J. Lofgren

Members: M. L. Goldberger (Princeton), L. J. Laslett (LRL), W. K. H. Panofsky (SLAC), P. Reardon (MIT), R. G. Sachs (ANL), and H. K. Ticho (UCLA).

(A meeting is planned for April 5-6, 1968.)

SUB-PANEL G - Purposes of high energy physics.

Chairman: V. F. Weisskopf

No formal organization is planned at this time.

It is planned that Chairmen of sub-panels report to HEPAP at the next meeting following one or two sub-panel meetings. The possibility of a coordinator devoting substantial time to the effort was discussed and is under consideration. An underlying and fundamental consideration on future planning are the premises made relative to static versus growth of future budgets. Various assumptions were discussed and the consequences considered.

200 BEV ACCELERATOR REPORT

Changes in the draft of the HEPAP 200 Bev report were considered and entered into the report. It was planned to issue the final report in time for possible use at the FY 1969 Congressional Hearings. (V. F. Weisskopf transmitted the "Report in Response to Questions Pertaining to the Scope of the 200 Bev Accelerator" to the AEC via letter of January 29, 1968, to P. W. McDaniel.)

REPORT ON STATUS AND PROBLEMS OF HIGH ENERGY PHYSICS

Changes in the draft of the "Status" report were considered in both the January 20 and January 21 meetings and entered into the report. It was planned to issue the final report in time for possible use at the FY 1969 Congressional Hearings. (V. F. Weisskopf transmitted "The Status and Problems of High Energy Physics Today" to the AEC via letter of January 30, 1968, to Paul W. McDaniel in time for use at the JCAE hearings.)

U. S. PARTICIPATION AT THE CERN-ISR

Weisskopf briefed the panel and discussion followed on future U. S. participation at the CERN-ISR including the possibility of: individual U. S. user group activity; U. S.-European experiment collaboration activity; and U. S.-European joint facility activity.

FOREIGN CONFERENCE TRAVEL

The importance to the high energy physics program of the coming 14th International Conference on High Energy Physics at Vienna (August 28 - September 4, 1968) and the High Energy Physics Instrumentation Conference at Versailles (September 10-13, 1968) was discussed in the light of the recent Presidential directive to minimize foreign travel. As planned by IUPAP, there would be a total of 800 attendees: 400 Western Europeans, 200 Americans, 80 Soviets, 45 Dubna and Eastern Europe, and 75 from the rest of the world at the Vienna meeting. In addition, the rapporteurs and chairmen planned at this meeting included about 25 Americans. A need for clarification on the possible impact of the travel directive was expressed. Possible use of excess currency funds and the impact on foreign exchange was considered.

NEW ACCELERATION STUDIES

Lofgren briefed the panel on the status of studies on acceleration by the coherent field of an electron ring and the need for an accelerator development study. A proton energy of about 900 Mev has been achieved in the U.S.S.R. by the transformation of transverse energy to longitudinal energy. R.F. acceleration has not been claimed by the U.S.S.R. as yet. It is this next step which especially requires development work. The acceleration technique has promise for the achievement of an accelerator in the 100 Bev range and higher. (Later information indicates that no acceleration of the protons has yet been accomplished by the Soviets.)

The panel discussed the acceleration concept and the LRL proposal for development studies. The panel concluded that the work was potentially very important for the future of high energy physics and should be pursued at LRL. (The recommendations of the panel were transmitted to the AEC by letter of February 1, 1968, from V. F. Weisskopf to P. W. McDaniel.)

NEXT HEPAP MEETING

The Panel scheduled the next HEPAP meeting on April 20 and 21, 1968, at Princeton, New Jersey. The planned agenda includes:

(1) The Host Laboratory Presentations of the PPA and the Pennsylvania and Princeton research groups.

(2) Reports of Chairmen of Sub-panels on High Energy Physics Program Studies.

(3) Budget considerations.

(Preliminary arrangements include holding the Host Presentations on Saturday morning at the PPA, and a Saturday evening and Sunday morning meeting at the Princeton Inn.)