Minutes of the 45^{th} Meeting of the PRC

DESY 8-9^{th} July 1998

PRC members present:

M.Albrow (FNAL), J.Arvieux (IPN-Orsay), J-J.Aubert (CPP-Marseille), S.Bertolucci (INFN-Frascati), W.Buchmüller (DESY), A.Buras (TU-Munich), D.Froidevaux (CERN), U.Gensch (DESY-Zeuthen), G.Heinzelmann (Hamburg), E.Hughes (Caltech), K.Jakobs (Mainz), T.Lohse (Humboldt Univ.,Wissenschaftlicher Rat), H.v.d.Schmidt (DESY), Y.Totsuka (Tokyo), D.Trines (DESY), A.Wagner (DESY), N.Wermes (Bonn), B.H.Wiik (DESY,chairman), C.Youngman (DESY,secretary).

Non PRC members attending closed session items:

HERA - F.Willeke (DESY).
HERMES - E.Kinney (Colorado), A.Bruell (MPI-Heidelberg), W.Lorenzon (Michigan), J.Steward (Liverpool) and J.Brack (Colorado).
H1 - J.Dainton(Liverpool), U.Straumann (Univ. Heidelberg), P.Biddulph (DESY/Manchester), F.Sefkow (Zurich), M.Fleischer (Dortmund), T.Greenshaw (Liverpool).
ZEUS - A.Caldwell (Columbia), Y.Yamazaki (Tokyo), B.Löhr (DESY), I.Brock (Bonn), P.Iacobucci (INFN-Bologna), B.Dolgoshein (MEPHI-Moscow), V.Bachkirov (MEPHI-Moscow).
AMANDA - C.Spiering (DESY-Zeuthen).
HERA-B - A.Schwarz (DESY), T.Oest (Hamburg), J.Spengler (DESY), A.Zoccoli (INFN-Bologna).
Polarization 2000 - F.Zetsche (Hamburg).

The PRC received the following documents:

PRC 98/05 Proposal for an Upgrade of the H1 Luminosity system and its Associated Electronics for HERA 2000.
PRC 98/06 Proposal for an upgrade of the H1 Forward Track detector for HERA 2000.
PRC 98/07 Polarization 2000.
PRC 98/08 A Straw-Tube Tracker for ZEUS.
PRC 98/09 The HERMES Charm Upgrade Program. Enhancement of the J/ψ Acceptance with Limited Streamer Tubes.

Agenda:

Open session. July 8^{th}, 10:00-12:30, Main Auditorium

HERA status report. F.Willeke (DESY).

HERA-B status report. T.Oest (Hamburg).

HERMES status report. E.Kinney (Colorado).

H1 status report. F.Sefkow (Zurich).

ZEUS status report. Y.Yamazaki (Tokyo) and I.Brock (Bonn).

Closed sessions: July 8-9th

1. Approval of the minutes and matters arising from the last meeting.
2. Review of HERA.
3. Review of H1.
4. Review of AMANDA.
5. Review of ZEUS.
6. Review of HERMES.
7. Polarization 2000 report.
8. Review of HERA-B.
9. Miscellaneous.

Item 1. Approval of the minutes and matters arising.

The chairman introduced eight new members to the PRC: Michael Albrow, Jacques Arvieux, Jean-Jacques Aubert, Sergio Bertolucci, Andrzej Buras, Emlyn Hughes, Luigi Rolandi and Hans v.d.Schmidt. The latter replaces U.Gensch as director of services at DESY. U.Gensch remains on the PRC as the replacement of P.Söding.

S.Bethke, L.Foá, M.Kasemann, L.Rolandi and D.Saxon could not attend this meeting of the PRC.

The minutes of the 44th PRC meeting were approved, subject to minor modification.

Item 2. Review of HERA.

The chairman thanked F.Willeke for his open session presentation.

D.Froidevaux restated the importance of the planned HERA-B tests, which required circulating protons, and asked when protons would be available. F.Willeke replied that the proton running scheduled for June had indeed been restricted to two days, as a result of technical difficulties (RF window replacement, etc.). Preparation for proton running in July was underway and beam should be available to HERA-B shortly. The proton energy would, initially, be 820 GeV, and would be increased to 920 GeV in the second half of July after additional cooling of the cryogenic systems. Running at 1 TeV is not considered.

D.Froidevaux asked whether any problems had been encountered during usage of electron beams in cleaning the vacuum. Note that in previous running periods electrons were not used due to beam losses observed at higher currents and associated, probably, with interactions with positively charged dust particles, instead positrons were used. F.Willeke stated that the rule of thumb requirement is that 30Ah of synchrotron heating will produce a good vacuum. Currently 1.5 Ah has been delivered and getter pumps have additionally been used. The 12 GeV electron beam running had been smooth and no unexpected problems were encountered. There is not enough experience to make a statement about higher energy running.

At the request of J.Arvieux, F.Willeke explained in detail the plots shown in the open session.

B.Wiik reviewed the current HERA schedule. Luminosity would be provided between mid-August and Christmas this year, and essentially continuously until the spring of 2000 when a long shutdown is required for upgrades associated with HERA 2000 higher luminosity operation. Short breaks are foreseen for HERA-B installation work. The longterm schedule would be finalized in a meeting of the directorate in September.

Item 3. Review of H1.

The chairman thanked the open session speaker for his presentation.

N.Wermes opened the discussion by pointing out that the observed large open bottom cross-section was interesting. J.Dainton replied that the measurement is a factor of five larger than the leading order calculation, although a number of theorists have expressed reservations w.r.t. the calculation. The effect is, however, interesting since a number of other experiments have made similar observations associated with bottom production. CDF and D0 see a larger contribution in leptonic P_t distributions, and ZEUS observe larger Υ production.

D.Froidevaux pointed out that this result has no significance for HERA-B, since the cross-sections used in their proposal were derived from measurements.

The referee's report was given by N.Wermes. Firstly the list of H1 proposals currently being processed by the PRC, or to be expected shortly, was reviewed. Then the BST and CIP related addenda, requested at the last PRC, and the two proposals submitted to this PRC were reviewed.

BST.
The issues outstanding, from the last PRC, were the low S/N ratio of 12 (17 had been expected), and the pad detector trigger efficiency of $\sim$50%.
The pad trigger efficiency problem has been traced to common mode noise. The Viking chip, used in the trigger evaluation, is particularly sensitive to baseline shift. H1 intend to correct the problem by on-chip subtraction of neighbouring channels. This requires a new chip design and production run which are challenging projects. The referee pointed out that a number of alternative actions should be considered before making such a decision. These are: finding the source of the common mode noise, a redesign of the frontend rather than the chip, and the use of discrete electronics to investigate the trigger problem.

In the following discussion J.Dainton agreed with the comments made and stated that the options outlined would be considered during the chip redesign evaluation.

CIP and Level 1 Vertex Trigger.
The simulation of background rejection capabilities and the cross-talk optimization of the strip line have been carried out. The results are acceptable. Some issues remain to be addressed and plots substantiating the results would be appreciated.

B.Wiik pointed out that for both the BST and CIP addenda the PRC expected a written document. This should be provided at the next PRC.

Forward Tracker Upgrade (PRC 98/06).
The objectives are to upgrade the forward detector for the HERA 2000 higher luminosity running. The existing MWPCs and TRD detectors would be replaced by planar drift chambers based on the existing design.
All physics requiring acceptance in the forward region will benefit from this upgrade. The referee pointed out that the existing planar drift chambers work well and that the additional chambers would increase the track finding efficiency. The 3 hit efficiency is calculated to increase from 41 to 91% with the upgrade. Issues surrounding the trigger upgrade are being addressed by a scintillator disk (hodoscope) upgrade.
The referee recommended that the proposal should be accepted. Additional studies w.r.t. increased rates and exposure to radiation should be made.

M.Albrow asked whether issues such as backscattering had been studied and if charge division is useful in this environment. T.Greenshaw replied that MC studies had been made, and that charge division measurements were not so useful. In test beam the resolution, $\Delta l/l$, was typically 1%, but in realistic conditions this degraded to 20% for half of the hits.

There followed a long discussion concerning the tracking efficiency. The results used in the proposal were derived from a full GEANT simulation, and it was shown that the tracking efficiencies which result could also be reproduced by making some simple assumptions. D.Froidevaux was surprised by this agreement in view of the correlations which he expected to be present.

T.Lohse pointed out that the track finding efficiency as a function of chamber occupancy would be very useful to know.

J.Arvieux asked whether any trigger acceptance would be lost due to the upgrade. In reply it was stated that some acceptance loss would occur. The proposed scintillator disk trigger would improve acceptance below 12 degrees.

In reply to a question from E.Hughes, T.Greenshaw stated that the upgrade would function correctly for proton beam energies of 1TeV.

B.Wiik asked whether the design would have been different if more time and resources were available. In reply it was stated that the concentration on tracking information in the forward region had become a common feature of both H1 and ZEUS upgrade proposals. Time restrictions limit both experiments in the implementation of the tracking detectors to be used.

Luminosity Monitor Upgrade (PRC 98/05).
The proposal is to replace the existing monitor, with a new photon detector and additional electron tagger, and the repositioning of the existing tagger. The upgrade is motivated by HERA2000, both beamline changes and more stringent polarization/luminosity measurement requirements, and by the observed radiation damage of the the existing monitor.

The proposal foresees a fibre sampling calorimeter for photon detection and an additional Wolfram/fibre SPACAL tagger. The ADC and DAQ systems will also be upgraded.
The referee commented that the proposal was well justified in view of the increased demands of HERA2000. The proposed technologies are adequate and experience with them exists within the collaboration. Sufficient test beam time will need to be allocated to calibrate the detectors.

B.Wiik thanked the referee for his report and asked whether the 1-2% typically quoted for the accuracy of measuring the luminosity could be improved. P.Biddulph commented that the limit was currently set by the uncertainty in the contributions from satellite bunches. M.Fleischer added that the current uncertainty in the Betke-Heitlin cross-section was 0.5%.

N.Wermes asked for the reason why silicon detectors were now being used in the VLQ detector. J.Dainton replied that this was due to the production difficulties encountered with GaAs detectors.

The PRC continued its discussion of the proposals after the H1 representatives had left.

The PRC recommended the approval of the: Forward Tracker Upgrade, Luminosity Monitor Upgrade, and CIP and Level 1 Vertex Trigger.
The PRC did not recommend the proposed new chip for the BST pad readout and asked for an alternative proposal.

Item 4. Review of AMANDA.

The chairman welcomed C.Spiering who gave a status report on the AMANDA project.

AMANDA is a large cosmic-ray/neutrino experiment to be built at the south pole. The physics aims are the production of a neutrino map of the northern hemisphere, supernova searches, etc..

When fully deployed AMANDA-II will make use of:

- 1) SPASE-1 and SPASE-2 ground based shower detectors.
- 2) GASP a ground based Cerenkov telescope.
- 3) B4: a cylinder of three strings (200m long, each with 20 equally spaced PM detectors and cylinder radius of 30m) and an axis string (200,20,-), located between 800-1000m under the surface.
- 4) B10: two concentric cylinders of 4 (400,20,35) and 6 (400,40,60), and an axis string (400,20,-) strings, located between 1500-1900m.
- 5) 3 (1000,40) survey strings, located between 1300-2300m.
- 6) a cylinder of 8 (600,40,100) strings, located between 1400-2000m.

All cylinders share the same axis. Currently items 1 to 5 have been installed. Items 1 and 2 will be used by AMANDA II, but were installed by AMANDA.

The status of the B4 analysis is summarized. The PM position calibration is currently better than 2m. and the time calibration is typically 5ns. The measured flux of atmospheric muons agree with predictions and a paper describing the detector and it's calibration will be available in September.

The B10 analysis is progressing. Two months are required to finalize the position calibration and, currently, the timing calibration is ~10ns. Event reconstruction results are now available and neutrino candidates can be expected in the autumn.

The 3 long strings, installed in the 3 month installation season which started last November, are now being tested. The light fibre transmission system shows little signal distortion, but failure rates on freezing remain high (10%). Drilling efficiency and light scattering problems observed indicate that the final 8 strings, required by AMANDA-II, should not exceed depths of 2000m. The Zeuthen DAQ system has worked well.

Y.Totsuka asked what was the data taking efficiency in 1997. It was stated that an up time of 80%, over 365 days, had been achieved.

In reply to D.Froidevaux, it was stated that the number of ν's expected in B10 was 2/day, i.e. ~500/year. The AMANDA-II rates would be a factor of 5 higher. Currently neither the muon threshold nor the angular resolution as a function of angle could be measured, due to the lack of statistics.

B.Wiik pointed out that a 3 month installation season could be used to install the remaining 8 strings provided one week per string were required following an initial one month drilling preparation period.

The PRC requested a presentation of the physics programme, the status of the experiment and a comparison to other neutrino experiments at its next open session.

Item 5. Review of ZEUS.

The chairman thanked the open session speakers for their presentations.

W.Buchmüller opened a lively discussion of the $dF_2/d\ln Q^2$ results presented. A.Caldwell stated that the observed discrepancy is also present in the plots of F_2, but that optically the effect is washed out by the large number of measurement points. The inability of the GRV model to explain $dF_2/d\ln Q^2$ for $Q^2<4$ GeV^2 probably reflects the original assumptions w.r.t. perturbative QCD. The belief that $1<Q^2<4$ GeV^2 could be handled appeared later and is probably incorrect. Agreement can be regained, but requires modifying the parton densities with the gluon contribution going to zero, which seems unlikely. More work is required with F_2^{cc} and F_L, as well as an understanding of the H1 data.

In reply to a question from D.Froidevaux, it was agreed that the contact terms presented were the same as those being measured by CDF and the LEP experiments, and that the results are very competitive.

B.Wiik asked whether ZEUS could confirm the enhanced H1 open bottom cross-section. A.Caldwell stated that an analysis has just been started and would require 2-3 months to finalize.

The status of the ongoing upgrade program was then reviewed by A.Caldwell followed by the discussion of the Forward Straw Tracker proposal. The referee, S.Bethke, could not be present but had provided the committee with a written report.
The proposal foresees replacing the transition radiation detectors of the current forward detector by new straw tube tracker (STT) detectors. These and the existing FTD (Forward Tracking Drift chambers) will provide a system which concentrates entirely on track information.
The experience of the Moscow-MEPHI collaborators with this technology and the reuse of the existing flash ADC and DAQ systems make it likely that the detectors can be produced within the time available. This could be accelerated by early procurement of the materials required.
N.Wermes asked whether more of the FTDs could be built to upgrade the detector rather than using a new technology. I.Brock replied that the occupancy in the long wires of the FTD would be problematic as was their efficiency.

M.Albrow asked whether fringe field effects had been considered in the MC simulations. It was stated that this had not been done and it was felt that the effects would be small.

B.Wiik queried the ability of the experiment to hold the time schedule and whether the STT was the best design possible. It was stated that the time schedule was indeed tight and that a possibly better design would, almost certainly, require more time and other resources.

The ZEUS participants left and the committee continued its deliberations.

The PRC recommended the approval of the STT proposal.

Item 6. Review of HERMES.

The chairman thanked the open session speaker for his presentation.

M.Albrow opened the discussion by asking how high x_B could be measured. A.Bruell replied that the acceptance reaches 0.9, but here the statistics were dying out quickly.

J.Arvieux asked when the Λ data results would be available. In reply it was stated that if the currently available data sample could be understood then this data could be used immediately, otherwise data using the Λ wheels would be required and this would be available in 1999. In addition it remains uncertain whether polarization will lead to a cancellation of systematics, a workshop in August will target this question.

The referee, D.Saxon, could not attend the PRC but had provided a written report. His comments were summarized by B.Wiik. The experiment should be congratulated for finishing the RICH installation. The proposal contained in the Charm Upgrade proposal note, PRC 98/09, should be approved. The use of H1 LST (Limited Streamer Tube) detectors is cost effective and these are immediately available and satisfy the physics requirements.

A.Bruell then summarized the contents of the Charm Upgrade proposal.

J-J.Aubert asked whether hadron punch through and subsequent muon missidentification in the range $140<\theta<170$ mradians was a problem. E.Kinney replied that the simulations made for the original proposal, PRC 97/03, had shown a $\sim$1% probability at high momentum. The low momentum region was dominated by muons produced by pion decay.

N.Wermes queried the J/ψ mass resolution. A.Bruell replied that for $\theta<140$ and $\theta>170$ mradians, the resoltion was 1-2 and 15-20% respectively.

E.Hughes asked how many J/ψ events were expected on the polarized target. In reply it was stated that 10 and 30 events/year are expected for $\theta<140$ and $\theta>170$ mradians, respectively. This results in 100 J/ψ in 2-3 years (the time available before COMPASS startup) and a $\Delta G/G$ measurement of 25%.

In reply to J-J.Aubert, it was stated that the e^+e^- decay channel could only be used in the more limited main acceptance region.

A.Wagner questioned the status of the program to increase the target densities. It was stated that one of the two methods which had been looked into had failed to produce significant density improvements. Other strategies, like decreasing the target size, have not been excluded. A 50% increase can be expected in the short term.

B.Wiik and E.Hughes asked for information concerning the funding and installation schedule for the Charm upgrade. It was stated that funding was thought to be under control, Illinois and Zeuthen will contribute. The most expensive item is the electronics. The LSTs could be installed in Dec. 1998 when two weeks would be required.

In reply to a question from N.Wermes, it was stated that the recoil detector had not been delayed, but the funding agency will only meet in October.

W.Lorenzon then gave a detailed review of the P_l polarimeter and the results so far obtained.
The detector works and the measured P_l value tracks the P_t measurement to within 2.7%. There is however a 25% scale discrepancy between the two measurements. After a long series of investigations the photon calorimeter has been found to be radiation damaged. This is believed to be the source of the discrepancy, or at least a major part of it. The damage is presumed to have occurred before 1997. In the 1998 running two calorimeters will be available for use, a copy of the original and a Wolfram/scintillator sandwich calorimeter.

B.Wiik announced that J.Arvieux and S.Bertolucci had agreed to be referees for HERMES.

The PRC recommended the approval of the charm upgrade proposal.

Item 7. Polarization 2000 report.

F.Zetsche then reviewed the status of the Polarization 2000 group.

The aim of this group is to provide a 1-2% measurement of the electron beam polarization for all HERA users, with the P_t and P_l polarimeters providing the input raw data. This facility will be of particular importance to ZEUS and H1 after the installation of their spin rotators during the HERA 2000 luminosity upgrade and will allow precise electroweak measurements.
The group is responsible for organizing an upgrade of the P_t polarimeter where the entire DAQ and electronics systems will be replaced. Currently two implementations have been proposed, one by Yale and another by Orsay.

J.Arvieux opened the discussion by asking how quickly the polarization could be reversed. D.Trines replied that 15 minutes was required followed by 1-2 days of machine tuning.

N.Wermes pointed out that if the DAQ and electronics systems did not have to process data on an event by event basis, then the integrating silicon detectors used at the Bonn synchrotron might be worth considering.

D.Froidevaux asked whether the P_l DAQ system required an upgrade. W.Lorenzon replied that this was not the case provided the measurement mode was not changed. Currently the gas laser pulse time window gives a very large suppression of background, in continuous mode this is lost and the measurement is liable to be swamped.

The PRC recommended that the inter-collaboration working group should continue defining the project and establish a management structure for the group. It asked for a proposal including costing and time schedules.

Item 8. Review of HERA-B.

The chairman thanked the open session speaker for his contribution.

The report of the HERA-B referees was given by K.Jakobs.

Si-vertex detector. Of the 64 double sided detectors needed, 12 from MPI-Munich have been installed. Additional detectors from SINTEF will be installed during the August break provided they are delivered on time, a three month delay has already occurred. The MPI detectors are readout by HELIX 2.1 chips.
Helix. The HELIX development is progressing and version 2.2 is available. Some concern exists w.r.t. the radiation hardness of the chips and the effects of cross talk when used in generating a trigger. These and other problems (linearity, pulse shape, noise) must be systematically looked at by HERA-B or one of the other chip users (ZEUS,H1,.).
Inner tracker. Mass production of the MSGC/GEM chambers has begun. Some concern exists w.r.t. the version of the HELIX chip to be used and the fact that no tests have been made on a complete system.
Muon system. MU1 has been installed and MU3 and 4 will be installed in August on the -x side of the beam. MU2 will be installed in April 1999 and the system should be completed during 1999. The first pre-trigger modules are expected to be delivered in

November allowing first tests of the trigger already in 1998.
Outer tracker. The referees acknowledged the substantial progress made since the last meeting, due to an intensive and systematic R&D programme. The current honeycomb chambers can operate in a test beam up to an integrated charge deposit of 0.3 C/cm, when the G10 strips become conducting and the dark current increases, corresponding to 1-1.5 years of operation in the hottest HERA-B regions.
The proposed strategy to reach a working detector with mixed technology, i.e. straw detectors in the hottest regions, is fully supported by the referees. The parallel development of straw detectors should be strengthened and the honeycomb chamber production started as soon as possible as chambers are required for first level trigger tests in 1999.
Conclusions and time schedule. After the short break in August 1998 a shutdown in the spring of 1999 should be used to install the PC1, PC4 and TC chambers in honeycomb technology to allow debugging and tests of the first level trigger and to demonstrate that the higher level triggers work as well. A second access will probably be needed in 1999 to install the full outer tracker. The usage of mixed technologies in the outer tracker needs to be reviewed as soon as results from the honeycomb R&D and the design review of the straws becomes available. The HERA 2000 shutdown should then be used to consolidate the HERA-B installation.
Physics in 1998. Interesting measurements of J/ψ production, excited charmonium and possibly the measurement of the b cross-section should be performed in 1998 with one or two months of data taking. These measurements are considered very important as they provide competitive physics results and will prove the functionality of the experiment.

The chairman thanked the referees for their report. During the ensuing discussion of the time schedule and availability of resources it was stated that HERA-B are preparing a document outlining the resources which were now needed to complete HERA-B.

The PRC agreed with the specific recommendations and comments made by the referees.

Item 9. Miscellaneous

The next meeting of the PRC will be on January 13-14th 1999.

In the interim HERA-B and its referees will review the status of the experiment.

The current list of PRC referees is:

H1 - N.Wermes and M.Albrow
HERA-B - D.Froidevaux and K.Jakobs
HERMES - D.Saxon, S.Bertolucci and J.Arvieux
ZEUS - S.Bethke and E.Hughes
AMANDA - Y.Totsuka and J-J.Aubert

(C.Youngman - 15th July 1998)