Minutes of the 39th Meeting of the PRC

DESY 16th - 17th January 1996

PRC members present:

F.Barreiro (Madrid), W.Buchmüller (DESY), F.Eisele (Heidelberg,Wissenschaftlicher Rat), L.Foá (CERN), D.Froidevaux (CERN), U.Gensch (DESY), G.Heinzelmann (Hamburg), J.Jaros (SLAC), M.Kasemann (DESY), A.D.Martin (Durham), J.Rander (Saclay), D.H.Saxon (Glasgow), P.Söding (DESY-IfH Zeuthen), Y.Toksuka (Tokyo), D.Trines (DESY), A.Wagner (DESY), N.Wermes (Bonn), B.H.Wiik (DESY,chairman), C.Youngman (DESY,secretary)

Non PRC members present:

HERA-B - A.S.Schwarz (DESY), W.Hofmann (MPI-Heidelberg), B.Schmidt (Heidelberg), W.Schmidt-Parzefall (DESY), J.Spengler (DESY). [16th]
HERMES - R.Milner (MIT), A.Simon (Freiburg). [16th]
H1 - R.Eichler (ETH-Zurich), P.Biddulph (Manchester), M.Fleischer (Dortmund), M.Klein (DESY-IfH Zeuthen), Ch.Kiesling (MPI-Munich), C.Vallee (Marseille), W.Bartel (DESY). [16th]
ZEUS - R.Klanner (DESY), R.Cashmore (Oxford), A.Caldwell (Columbia), M.Derrick (Argonne) [17th]
HERA - F.Willeke (DESY) [16th]

The PRC received the following documents:

PRC 96/01
Upgrade of the H1 Forward Proton Spectrometer.

PRC 96/02
Upgrade of the H1 Backward Silicon Tracker.

PRC 96/03
Proposal to upgrade the LAr Calorimeter and trigger electronics of H1.

PRC 96/04
A presampler for the ZEUS Barrel Calorimeter.

Open session. Jan. 16th, 10:30, Main Auditorium

HERA-B status report. B.Schmidt (Heidelberg).

HERMES status report. R.Milner (MIT).

H1 status report. M.Fleischer (Dortmund).

ZEUS status report. R.Cashmore (Oxford).

HERA status report. M.Lomperski (DESY).

Closed sessions: Jan. 16th - 17th, 14:30-18:00 and 9:00-12:00, Sem. Rm. 1

1. Approval of the minutes and matters arising from the last meeting.

2. Review of HERA-B.

3. Review of HERMES.
4. Review of H1.
5. Review of ZEUS.
6. HERA running in 1996.
7. Miscellaneous.

Item 1. Approval of the minutes and matters arising.

The chairman introduced D.Froidevaux and Y.Toksuka as new members of the PRC. S.Bethke, who has also joined the PRC, could not attend.

S.Bethke and D.Froidevaux will act as referees for ZEUS and HERA-B respectively.

M.Kasemann was introduced to the committee as an Ex-Officio member in his capacity as the HERA-Experiment coordinator.

The minutes of the 38^{th} meeting of the PRC were approved.

Item 2. Review of HERA-B.

The chairman thanked B.Schmidt for his open session presentation.

The chairman proposed that the committee begin its deliberations of HERA-B by addressing the RF shield issues.

The RF characteristics of a 1/2 scale model of the proposed HERA-B shield have been measured in Naples. These tests indicate that shielding by wires or ribbons would solve the machine impedance problems. The HERA-B collaboration would pursue the wire option with further tests in 1996.

F.Willeke commented that the vertex tank (RF and vacuum technologies) remained a difficult issue. A simple comparison of the test results and Monte Carlo calculations, based on the Mafia program, agreed. All shielding solutions reduced heating by at least a factor of $\sim$20 and the residual would not be problematic for the machine. The wire insertion and extraction mechanism and cooling issues remain to be finalized. A fixed wire shield could be used in 96 with the final implementation in 97.

J.Jaros asked what tests should be made to the final tank in order to identify possible problems. F.Willeke stated that only the heating and mechanical issues could be tested, other problems might only be seen in poorer HERA performance. The 100 μ wires to be used in the 96 shield were chosen to minimize the risk of breakage. Transparent windows for camera monitoring and temperature monitoring were being discussed.

The committee's conclusion was that the 96 fixed wire shield should be instrumented to allow conclusions to be drawn w.r.t. the final shield. The HERA-B induced background to other HERA experiments was now discussed.

A.Schwarz stated that the conclusion, drawn at the previous PRC, that HERA-B can cohabit with the other HERA experiments had not changed. The required task force to investigate this had been formed (R.Klanner chairman) and will start work in February.

L.Foá pointed out that the statements made by the ZEUS spokesman, during the question and answer session following the HERA-B open session presentation, had not been so optimistic. The interpretation of the tests made in 95 was therefore not generally accepted.

B.Wiik emphasized that if dedicated machine studies were required then they should be requested as soon as possible. Ultimately HERA-B must be able to cohabit with the other experiments.

The committee concluded that the work of the task force should be strongly supported and that measurements with the new beam optics installed during the shutdown in the HERA-B region should be made.

A.Schwarz now summarized the detector status.

- **Inner tracker MSGC development.** Rate ($\sim$10$\times$HERA-B) and accelerated aging ($\sim$3 years HERA-B) tests, using 10$\times$10 cm^2 diamond coated chambers have been carried out in Heidelberg. The results are encouraging, but the design requires 30$\times$30 cm^2 chambers.

- **RICH detector.** At the HERA-B RICH workshop (Austin 30/10-4/11/95) a number of decisions were made concerning the mechanical design.
  The decision was also made to use TMAE as a photon detector. New insights suggest, however, that aging effects may be very dependent on the initial gas gain and that lifetime expectancies previously calculated from measurements may be too optimistic. In view of this and motivated by the results of Va'Vra at SLAC an R&D project has been started. The use of a photomultiplier based system is being investigated for use in the high rate regions. This system could also be a backup to the TMAE detector.
  Manpower and funding issues remain uncertain.

J.Jaros asked how many groups had verified the radiation hardness measurements with diamond coated MSGCs. B.Schmidt replied that three groups were known: F.Sauli's group (CERN), the CMS experiment and the HERA-B/Heidelberg group.

L.Foá stated that problems will be encountered in manufacturing larger chambers due to the difficulty of producing uniform strip patterns, particularly at chamber edges. Larger foto-resist facilities are not available at silicon foundries.

D.Froidevaux asked whether silicon detectors had been considered for the inner tracker design. B.Schmidt replied that the additional material involved due to supports and overlaps was considered a disadvantage as was the doubling of cost per channel. Using smaller MSGCs would also have the disadvantage of more material.

J.Jaros asked for a clarification of the number of photons seen in the RICH if the photomultiplier solution were used. W.Schmidt-Parzefall believed that the number of photons would be the same as in TMAE, with an uncertainty of 20%.

N.Wermes asked whether photomultiplier instability would be a problem and what was the entrance window material. It was stated that instabilities should not be problematic and that the window was extended UV glass. J.Jaros added that most of the photons seen would be Čerenkov and would therefore not damage the photocathode.

B.Wiik asked when decisions would be required, if the schedule was to be met.

W.Schmidt-Parzefall replied that tendering was required in June 96 for photomultiplier delivery by the end of 97.

J.Jaros then gave the referee's report.

- The dipole magnet and electron beam compensation coil have been installed and are being prepared for field measurement.
- It is clear that the detector development is the priority item, however trigger occupancy question should not be forgotten and will certainly be an issue for a forthcoming PRC.
- The background task force should be encouraged, whereby dedicated machine time with the fixed target and new optics is required.
- The MSGC developments are encouraging more results from prototypes should be expected in June 96. A backup detector design does not seem to be feasible.
- Full US funding w.r.t. RICH participation should not be assumed. Contingency solutions will be required.
- The technical difficulties associated with the production of the outer tracker and the intricate machining of the Tungsten calorimeter should be reviewed.

The committee concluded that the verification of coated diamond MSGC results was encouraging although the extension to larger size chambers was not guaranteed. DESY should actively support the technological investments required to achieve this.
The status of the RICH detector is of major concern. A decision about the readout has to be taken by June 96 in order to have a working photon detector at the end of 97. The collaboration is asked to study staging scenarios to gain money for additional RICH costs. The insufficient manpower and unclear US funding are major concerns.

Item 3. Review of HERMES.

The chairman welcomed the HERMES delegation and thanked R.Milner for his open session presentation.

D.Saxon then gave the referee's report.

- The collaboration should be congratulated for entering the data taking phase. During 95 running with ^{3}He more than 5 M events with polarization of both beam and target of about 50% were collected and are being analysed. The statistical errors are compatible and the systematic errors are better than those of E142.
- The collaboration should review its understanding of beam and target polarizations. Are the systematic and statistical errors understood and are the contacts with the machine groups sufficient.
- The detector generally worked well.
  The magnet chamber sustained two broken wires during the run and these are now being repaired. Failures in the serial readout system led to losses which increased

during the running period due to the inability to repair enough modules during the scheduled access time. A new chip is being tested which will correct the problem.
The new ACP chip used in the vertex chamber MSGC readout can now be produced with higher yield (15%). This will allow half the chamber to be instrumented for the 96 running.
A mini drift chamber, constructed in DUBNA, will be installed infront of the magnet during this shutdown.

- The hydrogen target, to be used in 96, is being prepared.

R.Milner reported that the polarization anticipated in the proposal, 50% for beam and target, had been achieved. The understanding of the P_T measurement had progressively improved and a final report will be produced after an inspection of the polarimeter's calorimeter has been carried out. The resolution achieved should be <5%.
The P_L polarimeter, built by Penn and Freiburg Universities, will be installed during the shutdown. Measurement of both P_T and P_L will be made in 96, whereby the highest priority will be given to P_T. In the longterm P_L is more significant for HERMES and the responsibility for the P_T measurement will be given to other groups, possibly ZEUS or H1.

D.Saxon asked what would happen to the ^{3}He target. A.Simon replied that modifications were being discussed with the view of improving reliability and gas purity. The target might be used again in 97.

D.Trines asked whether the target safety would be improved by the removal of glass components. R.Milner replied that the situation was being reviewed.

P.Söding queried the plans for a deuterium target. Use of a deuterium target should be anticipated from 97 onwards.

B.Wiik asked when the first asymmetry results would be presented. R.Milner stated that a talk at Moriond was planned for the end of March.

J.Jaros reported on the E154 95 running which had started slowly but had ended well with 50% target and 80% beam polarizations. The resulting statistical errors should be a factor three better than E142 with a mean x of 0.018. L.Foá added that SMC will have one more running period and that some thoughts exists to carry on in the future.

Item 4. Review of H1.

The chairman welcomed the H1 contingent and thanked the open session speaker for his presentation.

The technical coordinator, P.Biddulph, reported that the average data taking efficiency, 50-60%, for 95 had been somewhat lower than anticipated. This was mainly due to startup problems (new detectors and a temporary short in the solenoid following the large HERA quench), high beam induced backgrounds (a 7mm kink in the beampipe led to high rates which where reduced by beam steering) and trigger problems (the first level trigger had been upgraded and, more significantly, DIS triggers from satellite bunches led to higher deadtimes).
A number of improvements are foreseen for the 96 running: a new straight carbon beampipe, SPACAL time of event measurement to veto satellite DIS triggers, the use of

the second level trigger, etc.. These should improve the efficiency to 70-80%.

N.Wermes asked when the carbon fibre beampipe would be installed. It was stated that the shutdown schedule foresaw installation in February. Many improvements had been made in the design. The failure of the first beampipe was now understood and the six month old test tube shows no problems.

The chairman suggested that the proposals submitted to the PRC should now be discussed.

Ch.Kiesling reviewed the upgrade of the LAr calorimeter and trigger electronics proposal. The principle reasons for the upgrade were:

- The white noise limit has been reached in the existing preamplifiers.
- New JFET hybrids developed during LHC R&D are available. These are faster devices with lower noise characteristics. The removal of a resistive noise source has led to a 30% reduction in noise.
- The JFET devices (with resistive component) have been tested in situ during the 95 running. The aim of reducing the noise by a factor of 2 was achieved.
- The trigger improvements are considerable, it is now almost possible to trigger on single min. ion. particles.
- Funding is available for installation by 97.

N.Wermes, the H1 referee, stated that the upgrade is completely justified from the physics aspect and should be supported.

A.Wagner asked whether the removal of the resistor would led to higher failure rates and whether the failed amplifiers could be replaced during running. It was stated that the amplifiers are mounted outside the detector and can be replaced as required.

P.Söding assumed that the new amplifiers would require more power and asked whether an upgrade of the power supply system was also required. It was stated that this had been investigated and that no new power supplies were required.

The chairman proposed that committee recommendations should be made for all H1 proposals at the end of the H1 review. The BST (Backward Silicon Tracker) was now reviewed.

M.Klein presented a summary of the proposal. This is a modification of the original BST proposal from 93 and is prompted by:

- Installing all r-strips in ϕ, currently only 2 regions are installed.
- The availability of the Si, now that production problems have been resolved.
- The physics improvements due to extending the tracking acceptance.
- The availability of funding for completion in 97.

N.Wermes reported that a number of issues had to be addressed before recommending the proposal. A statement concerning PAD operation and whether a PAD trigger was required should be made, the correctness of the S/N ratio measured should be reviewed and the use of double-sided detectors should be reconsidered.

M.Klein replied that the PAD system had been tested for one week at the end of November. The results were difficult to interpret due to the lack of time available and the bad discrimination due to common mode problems. If the problems can be solved then an additional 4 planes will be asked for. The PAD trigger is required to add redundancy and give additional selectivity.
At the time of the original proposal double-sided devices could not be produced. In the BST environment multiple scattering is not important and single sided devices can be used.

A.Martin asked whether H1's desire to measure F_L in 97 was due to the BST's high y measurement capabilities not being available until then. It was stated that this was certainly a contributory factor. N. Wermes added that the prime reason for the ϕ strips was their use in rejecting photo-production backgrounds in the F_L measurement; was it now possible to measure F_L without these strips. M.Klien replied that the current understanding suggests that this is possible. J.Rander asked whether half the ϕ strip installation still allowed F_L to be measured. It was stated that this was correct since the full Q^2 range is covered, albeit with smaller acceptance.

U.Gensch asked what priorities the experiment set on the ϕ strip installation. It was stated that the r-strip priority is higher if a trigger is provided.

L.Foá asked whether the SPACAL derived triggers were sufficient and if additional funding requests would be made later. R.Eichler stated that at HERA the bunch length was 50cm and that an additional BST based pointing trigger would add selectivity.

W.Bartel now reviewed the Upgrade of the H1 Forward Proton Spectrometer proposal. The proposal was motivated by:

- The requirement of installing the mechanical elements for two horizontal stations at 63 and 80m before the end of the current shutdown.
- The results of analysing the 95 data from the existing system, which indicate that the performance is as good as expected.
- The increase in the $\log(x_p)$ acceptance.
- The new pots will have scintillator fibre trigger hodoscopes as already used. Either pixel or strips detectors will be used in the pots.
- A comparison with the ZEUS LPS shows that the acceptance is slightly lower but that the momentum resolution is essentially the same.
- Funding plans exist, whereby $\sim$50% remains to be authorized by the respective funding agencies.

D.Saxon asked whether a single horizontal pot at 90m remained an option. It was stated that this was possible but required the pixel detector.

In response to F.Eisele's question, W.Bartel replied that the 95 running had shown no background problems in the vertical pots. Excessive rates were not seen during the HERA-B target tests.

B.Wiik asked whether the FPS was comparable in performance with the ZEUS LPS. N.Wermes replied that it was essentially comparable whereby the LPS had a factor of 2 better momentum resolution.

L.Foá pointed out that the pixel detector technology was relatively new and consequently building detectors might take longer than required. C.Vallee replied that prototype tests could be made by the end of the year, using the DELPHI/LHC design experience, and that production could start in 97. The initial requirement is PRC encouragement for the prototype which would allow the Marseille group to join the H1 FPS effort.

D.Froidevaux stated that it was difficult to justify a decision between strips and pixel detectors. The LHC/ATLAS pixel tests in 95 were not fully functional due to the readout used. C.Vallee replied that this was true but the H1 specifications were different. The newly developed readout chips should be available in March and these will solve the readout issues. The pixel detector has a better radiation hardness and strips require more associated readout electronics. D.Froidevaux added that the availability and better accuracy of strips should not be forgotten.

The chairman thanked the H1 members present for their contributions. The committee now discussed its recommendations w.r.t. the proposals made. The following recommendations were made:

- Proposal to upgrade the LAr Calorimeter and trigger electronics.
  The PRC considers the physics case to be very convincing, leading to a considerable improvement of the detector performance. The present upgrade foresees a replacement of the front end electronics of the electromagnetic calorimeter. The technical solution was successfully tested in part of the experiment.
  The PRC recommends the approval of the proposed LAr upgrade.

- Upgrade of the H1 Backward Silicon Tracker.
  In modification of the original proposal H1 wants, after completion of the present 4 layers with r-strips and pads, to add 4 layers of r-strips in 1997. The PRC expresses its disappointment about the general progress, and the lack of results on the pad performance and asks the group to report on it at the next meeting. The PRC recognises that in order to guarantee a reliable delivery of the silicon wafers for the requested 4 additional r-strip layers an order has to be placed in the near future.
  The PRC recommends the approval of the upgrade of the BST with 4 layers of r-strips.

- Upgrade of the H1 Forward Proton Spectrometer.
  The PRC takes note of the comparison of the performance of the present H1 FPS and the ZEUS LPS. The H1 performance numbers are based on 3 pb^{-1} of data collected in 1995. The performance is close to the one outlined in the original proposal. The comparison with ZEUS shows that the performance of both setups is similar when adding the 2 requested stations with horizontal pots in H1. H1

requests to install in addition to the fibre detectors silicon pixel detectors in order to increase the acceptance and resolution of the spectrometer. The PRC discussed extensively if double-sided silicon strip detectors would provide an interesting alternative to pixel detectors, also in view of the tight time schedule.
The PRC recommends the construction of two additional stations, at 63 and 80m, with horizontal pots and the installation of the same detectors as in use in the present vertical pots. It recommends further the construction of a prototype of a silicon pixel detector tile for installation in the 90m vertical pot for the 1997 date taking period.

Item 5. Review of ZEUS.

The chairman welcomed the ZEUS representatives and thanked the open session speaker for his presentation.

R.Klanner reviewed the upgrade status of ZEUS and the future luminosity requirements.

- The 44m photon tagger, installed for 95, has been taking data. During the shutdown a moveable beampipe will be installed to increase the acceptance.
- The 8m tagger to be used in tagging background photo-production events to high y DIS events will be installed in April. The electronics will be installed by the summer.
- The luminosity detector will be upgraded during the 96/97 shutdown. Radiation harder scintillator will be used and the position detector system will be replaced by one based on minaturised photomultipliers.
- A Forward Plug Calorimeter (FPLUG) proposal is being prepared and may be presented at the next PRC. The FPLUG will extend the forward calorimeter acceptance in the beampipe region.
- Ideas concerning a μ-vertex chamber are converging. A workshop is planned for February.
- The proposal for the barrel presampler (BPRES) has been presented to the PRC.
- ZEUS requires 30pb^{-1}/year from 97. The 96 running period of 5 months should allow HERA to deliver 15pb^{-1}. ZEUS requests 5pb^{-1} at 820Gev and 3pb^{-1} at 450Gev.

The chairman proposed that the non BPRES related issues should be discussed first.

B.Wiik asked when the collaboration would want the rotators installed. It was stated the 97/98 shutdown would be sensible if sufficient luminosity had been delivered. It was assumed that the 96/97 shutdown would be used for electron run preparation. At least 20pb^{-1} of luminosity, with polarization, was required before useful results could be expected.

F.Eisele inquired as to the differences that would be expected between the LPS and the H1 FPS in terms of beam related accidentals and radiation damage. Being immediately downstream of the HERA-B target was likely to be the major difference.

D.Froidevaux asked whether the $15pb^{-1}$ requested included inefficiencies. R.Klanner replied that this was the HERA delivered luminosity, typically ZEUS could use 73% of this with an efficiency of 80% for the detector online and writing to tape after which 8% is removed as bad during analysis. Thus the $15pb^{-1}$ would reduce to $8pb^{-1}$ of analysed luminosity.

J.Rander now gave the BPRES referee's report.

- The forward and rear presamplers have been installed and are working successfully.
- The physics benefits of the BPRES are modest since the inhomogeneity of the material preceding the calorimeter is lower (1-$2X_0$).
- Jet energy resolution will improve for those jets overlapping the various calorimeter regions.
- Monte Carlo results show modest improvements in many parameters. The jet energy resolution improves by 15%. The e/π separation is improved by a factor of 3. The π^0/γ resolution will be improved.
- The BPRES design exploits techniques and electronics already widely used in ZEUS.
- The funding is organized, subject to PRC recommendation.

In conclusion the sum of a number of modest improvements is an advantage that the PRC should support.

N.Wermes asked whether an alternative exists by reinstrumenting the initial layers of the existing calorimeter. It was stated that this was not possible.

The chairman thanked the ZEUS members for their contribution. The committee now discussed its recommendations w.r.t. the proposal made. The following recommendation was made:

- The improved detector performance (improved jet energy resolution, considerably better e/π and π^0/γ separation) and the benefits for the physics were recognised. The design and installation were considered safe. **The PRC recommended approval subject to clarification of funding.**

Item 6. HERA running in 1996.

After hearing the report on the expected machine performance by F.Willeke the PRC took note of the proposals of H1 and ZEUS for running in 1996. While H1 would like to run only at 820 GeV, ZEUS would like to collect $5pb^{-1}$ at 820 GeV and $3pb^{-1}$ at 450 GeV in order to make a first measurement of R.

The PRC supports the proposal of the Directorate to postpone the decision about the amount of low energy running until July/August 1996 when more information is available about the HERA performance and possibly new date on R will be known from NMC.

Item 7. Miscellaneous.

The next PRC meetings have been scheduled for:
1-2^{th} July 96 and
7-8^{th} October 96.

(C.Youngman - 14^{th} May 1996)