Minutes of the 49^{th} Meeting of the PRC

DESY 2-3^{rd} May 2000

PRC members present:

M.Albrow (FNAL), S.Bertolucci (INFN-Frascati), A.Buras (TU Munich), R.Cashmore (CERN), U.Gensch (DESY-Zeuthen), E.Hughes (Caltech), K.Jakobs (Mainz), R.Klanner(Hamburg), C.Kleinwort (DESY,HERA expt. coordinator), E.Reya (Dortmund), L.Rolandi (CERN), D.Trines (DESY), H.v.d.Schmidt (DESY), B.Spaan (TU Dresden), A.Wagner (DESY,chairman), N.Wermes (Bonn), C.Youngman (DESY,secretary).

Non PRC members attending closed session items:

HERA - F.Willeke (DESY) and T.Limberg (DESY).

HERMES - E.Steffens (Erlangen), J.Steward (Liverpool), A.Simon (Friburg), N.Makins (Illinois) and C.A.Miller (Triumf).

ZEUS - B.Foster (Bristol), L.Gladilin (DESY/Moscow) and R.Yoshida (Argonne).

H1 - E.Elsen (DESY), C.Niebuhr (DESY), R.Gerhards (DESY), and A.Schoening (ETH-Zurich), R.Roosen (Brussel), Ch.Pascauld (Orsay), and C.Vallee (CPPM).

AMANDA - Ch.Spiering (DESY-Zeuthen).

POL 2000 - T.Behnke (DESY), F.Zommer (Orsay), A.Simon (DESY), D.Barber (DESY), F.Willeke (DESY), H.Holzer (DESY), B.Foster (Bristol) and E.Elsen (DESY).

HERAB - A.Schwarz (DESY), J.Spengler (DESY), B.Schmidt (Heidelberg), and S.Masciocchi (MPI-Munich).

The PRC received the following documents:

PRC 00/01. Proposal for installation of a very forward proton spectrometer in H1 after 2000.

PRC 00/02. Letter of intent to upgrade the longitudinal polarimeter.

Agenda:

Open session. May 2^{nd}, 10:00-13:00, Main Auditorium

HERA status report. T.Limberg (DESY).

HERA-B status report. S.Masciocchi (MPI-Munich).

HERMES status report. C.A.Miller (TRIUMF/Alberta).

ZEUS status report. L.Gladilin (DESY/Moscow).

H1 status report. R.Gerhards (DESY).

Closed sessions: May 2-3^{rd}

Item 1. Approval of the last minutes and matters arising.

Item 2. News from the lab.

Item 3. Review of HERA.

Item 4. Review of HERMES.

Item 5. Review of ZEUS.

Item 6. Review of H1.

Item 7. Review of AMANDA.

Item 8. Review of POL 2000.

Item 9. Review of HERA-B.

Item 10. Miscellaneous.

Item 1. Approval of the minutes and matters arising.

The chairman welcomed the new PRC member R.Cashmore to the committee.

The PRC members J-J.Aubert and J.Arvieux could not attend the meeting.

The minutes of the 48th meeting were accepted subject to minor corrections.

The scheduled date of the 50th PRC was moved to the 19-20th October.

Item 2. News from the lab.

A.Wagner reviewed important developments, concerning the lab, which occurred since the last PRC.

The directorate decided to revert an earlier decision and continue positron running, at HERA, for the remainder of 2000. Arguments in favour of electron running were: 1) a doubling of the present H1 and ZEUS e^-p samples of 15 pb^{-1} thereby extending sensitivity to xF_3 and exotics, 2) extending the machines (reduced e^- lifetime, etc.) and the experiments (increased H1 tracking chamber currents) understanding of e^-p running, which is essential for HERA planning after the luminosity upgrade, 3) the possibility of measuring Deep inelastic Virtual Compton Scattering (DVCS) at HERMES, and 4) respecting decisions previously made. Arguments in favour of positron running were: 1) maximizing the overall luminosity before the luminosity upgrade shutdown, 2) extending the sensitivity to possible physics beyond the Standard Model, and increasing the DIS event sample at HERMES. The decision made was driven by the importance of providing optimum conditions for HERA-B during their commissioning and physics startup phases.

First evidence of Laser behaviour at X-ray wavelengths has been seen at the Tesla Free Electron Laser test facility (SASE-FEL). The lasing wavelength, initially observed at 109 nm and since at 80-180 nm, is tuned with the electron beam energy. The observation is an important milestone for the TESLA XFEL project.

Item 3. Review of HERA.

The chairman thanked the open session speaker for his presentation.

F.Willeke summarized the operational developments at HERA.

The improvement in overall luminosity running efficiency (40 to 60%) results from many different improvements and the new control systems introduced and will remain after the upgrade. Some aging effects are being observed and addressed. The 100 mA maximum proton current has not been improved, a bottleneck exists at the DESY III synchrotron. No limit has been observed in the positron current and after machine conditioning the intensity is being slowly increased. The design peak luminosity of 1.5×10^{31} cm^{-2} s^{-1} is regularly surpassed during luminosity running. The electron lifetime problems, previously observed, cannot be addressed without electron running, the installation of the NEG pumps has certainly helped, but the problem is not fully understood. A feedback system is being implemented to control observed increases in proton beam emittance, but the system may not be ready for commissioning immediately after the luminosity upgrade. The kicker system, introduced to reduce coasting proton beam, cannot be used since it excites the proton beam and a solution using collimators is being investigated.

In the ensuing discussion the following points were raised.

The DESY III bottleneck causes a 30% reduction in the proton current and systematic studies are required to understand the problem. Assuming the bottleneck can be removed and that no adverse beam-beam effects are seen the HERA luminosity will increase by 20-30%. Downstream losses in PETRA and HERA would remain small.

The electron lifetime problem will remain unclear until systematic measurements with electrons are made with the improved monitoring system.

Experience with coasting beams at other accelerators is mixed. The Tevatron is not effected, possibly due to the different machine parameters, whereas the SPS had many problems. The HERA machine is measured to have low initial noise and solving the problem at source is, therefore, assumed to be difficult. The kicker system implemented is excellent for removing coasting beam, but the beam excitation introduced causes large backgrounds at HERA-B.

The worries of HERA-B concerning proton bunch-to-bunch target rate fluctuations can be addressed by dedicated proton running. Lepton beam operation has a good influence on the proton beam removing protons which diverge significantly from the mean.

The PRC was impressed by the continued improvements achieved and made no specific recommendation to HERA.

Item 4. Review of HERMES.

The chairman thanked the open session speaker for his comprehensive presentation.

The referees report was given by S.Bertolucci.

In the ensuing discussion the following points were raised.

The full installation of the Λ-Wheel silicon tracker may have to be delayed until the lepton beam dump is operational at HERA as large (10μA) jumps in the leakage currents of installed detectors has been associated with beam loss.

Funding for 50% of the recoil detector is proving difficult to acquire as money previously earmarked is having to be used on other detector components. A number of technical questions remain open including the thermal runaway of the thin silicon detector signal and the re-design of the warm transverse magnet which did not provide a sufficiently strong field.

In view of the published ΔG data the availability of theoretical input regarding next to non leading order calculations is an issue. The non availability of predictions from a model tuned to the HERMES energy region remains a problem.

The particle identification upgrades are working well and the RICH charged pion and kaon identification efficiencies are 95 and 80-85%, respectively. The additional information is useful, but the statistics in the strange channels remain limited.

The longitudinal polarimeter (LPOL) resolution cannot be further improved, if higher accuracy is required later TPOL measurements will be used.

The PRC continued the discussion in closed session where the manpower situation was the principle issue.

The PRC made no specific recommendation to HERMES.

Item 5. Review of ZEUS.

The chairman thanked the open session speaker for his detailed presentation.

B.Foster summarized the operational and upgrade status of the experiment.

A significant number of publications are in preparation or have been published since the last PRC. At the DIS 2000 conference many new results were presented including a first measurement of xF_3 and updated measurements on F_2 and $\sigma^{\gamma p}{}_{tot}$. The ZEUS detector is performing well and running is smooth with high, data on tape, efficiency. The LPS cohabitation issue has now been resolved, mostly due to correct LPS positioning w.r.t. the beam, and data taking is possible at the highest HERA-B target rates.

The directorates decision to continue with positron running was criticized, since the experiment still considers that more interesting physics is accessible with an increased electron data sample.

The upgrade projects are progressing:

- Beampipe. The central Be/Al section of the beampipe has been delivered ahead of schedule. Some delays have been experienced with the electron beam welding of the forward and rear Al sections.
- Luminosity monitor. The design and production of the conversion pair spectrometer, the photon calorimeter and 6m tagger are progressing. Identical DAQ electronics will be used in all three detectors and the decision has been made to use analogue signal transmission for the photomultipliers. The aim is to have prototypes available for testing in HERA by August.

- Silicon Micro Vertex Detector (MVD). Detector production is well underway and the Helix chip probe problems, mentioned at the last PRC, have been resolved - the yield is 70%. Hybrid production is slower than expected due to yield problems (30%). The project is on track, but no contingency is available for additional delays.
- Straw Tube Tracker (STT). Four production sites have been established and 50% of the wiring is complete. Argonne and Tel Aviv are now participating in the electronics design and production. The electronics will be mounted directly onto the detector sectors in September followed by testing and installation into ZEUS in March 2001.

The ZEUS referees report was given by E.Hughes.

Critical items exist w.r.t. most of the upgrades. The MVD hybrid card and the STT channel multiplexer should be watched carefully. The luminosity monitor concept looks good, but beam testing remains an issue and the possibility of testing at SLAC in January 2001 should not be ignored.

In the ensuing discussion the following points were raised.

The LPS cannot be used after the luminosity upgrade due to incompatibilities with the new beam optics and no manpower is available to build a new detector.

It was recommended that tests on MVD complete ladders be done before the arrival of the completed detector halves at DESY.

In the event of breaking a wire in the STT a per wire fuse can be blown to reduce shorting effects.

The worries concerning the minimal beam time available for testing the luminosity monitor were shared by the experiment, but sufficient end points exist in the electron and photon energies to provide a calibration.

An excess in high P_t lepton events, as seen by H1 (8 events), is not present in the ZEUS data. A working group has been established to compare the results and Monte Carlo expectations of the two experiments.

The difference seen in the diffractive J/ψ production plots, shown by H1 and ZEUS, is being investigated.

The PRC made no specific recommendation to ZEUS.

Item 6. Review of H1.

The chairman thanked the open session speaker for his detailed presentation.

A.Schoening presented an overview of the FTT and reviewed the results of work related to the L1 and L2 breakpoints defined at the last PRC meeting.

The referees report on the FTT was given by M.Albrow.

The first breakpoint (completion of Level 2 studies by January which should demonstrate that the timing performance can be reached and that the software issues associated with the FPGA chips are soluble) has been achieved.

The second breakpoint (completion of the Level 1 system, including the ALTERA chip programming, by March 2000) has not yet been achieved primarily due to the non availability of the Quartus software required for the FPGA studies using the VHDL description language. Timing assumptions about elements of the algorithm have be verified, but a complete algorithm is not yet available. The full code is expected to require 1 man year. Although the breakpoint was not satisfied the referees consider that there is no reason to stop the development at the moment. It remains to be demonstrated that an accept/reject decision can be used already at the L1 stage.

The third breakpoint (availability of hardware prototypes by October 2000) has been delayed by 3 months. This is not considered to be a serious problem and may be advantageous since bigger and cheaper chips will become available.

Initial UK funding for the L2 phase will be committed in the summer.

In the ensuing discussion the following points were raised.

The availability of pin compatible higher performance chips should allow a reduction in the minimum track P_t used and the use of more complicated algorithms.

The existing DCR-phi trigger will be kept if the FTT cannot provide a L1KEEP decision.

R.Roosen then reviewed the Very Forward Proton Spectrometer (VFPS) proposal. The proposal forsees the installation of 2 Roman Pots equipped with 2 scintillating fibre detectors (u,v) similar to those of the FPS locate 220m downstream (proton beam direction) of the H1 interaction point in the horizontal plane. At this position the full t-distribution has left the beamline envelope. A detector spatial resolution of 100μ gives a resolution of x_{Pom} of 7×10^{-4} independent of t. The use of FPS type detectors would also allow the reuse of the existing DAQ hardware and software systems. A comparison with the Forward Proton Spectrometer (FPS) (horizontal and vertical plane detectors at 63,80 and 81,91m respectively) shows that smaller x_{Pom} ranges can be measured with almost 100% acceptance. The VFPS would therefore offer higher statistics diffractive physics than the FPS (and ZEUS-LPS). The VFPS would also improve measurements of open charm production, high E_T jets, DVCS, ${F_2}^{D(4)}$, F_L, etc.. Calculation of beamgas backgrounds indicate that the rates to be expected are similar to those already seen in the FPS which are acceptable. Coasting beam backgrounds are however likely to be more problematic, a solution would be to increase the separation of the detectors from the beam - a 3mm increase would reduce the acceptance by 35%.

The referees report on the VFPS was given by M.Albrow. The physics case (see above) is considered to be good and an improvement in statistics by a factor of 6 over the FPS and LPS in three years of running should be possible. The ability of the VFPS to measure the t-distribution will produce clean "elastic" physics. Existing FPS technology is being used and it is assumed that it will work. Major additional items will be the modifications to the beamline, including a cold bypass, and the associated 2-5 month shutdown for installation after 2001. The background issues have been addressed whereby coasting beam seems to be the most problematic. Radiation damage of the detectors is probably acceptable barring accidents. The referees recommend the approval of the proposal.

In the ensuing discussion the following points were raised.

The expectation that QCD parameters can be extracted from measurement of DVCS is too optimistic since the loop potential cannot be extracted. This applies to both VFPS and HERMES although something can be learned about the model used. The acceptance of DVCS events is also likely to be small and has not be studied in detail for all processes.

The physics improvement quality factor of 6 applies to the currently available LPS and FPS data samples, but does not include the data which will be taken before the shutdown.

The pot positions to be used by the VFPS were not included in the original FPS proposal because the FPS technology was unproven at the time and it was thought unlikely that the extensive beamline modification required would have be accepted.

It is expected that the beam and scattered proton trajectory envelopes will move if the beamline optics is modified, but changing the geometry of a single octant is extremely unlikely.

The coasting beam aperture is defined by the WL 150 collimator and evolving this aperture to the VFPS position cuts heavily (5mm) into the acceptance. The plan is to move the collimators so that the 3mm increased separation, mentioned above, is guaranteed without risks. Then the only questions remaining are what happens to the interaction debris after 2-3 orbits and what is the effect on HERA-B.

Calculation of possible cohabitation problems with HERA-B are difficult because this requires a precise knowledge of the fringe fields which are not well known. Experience of cohabitation of LPS, FPS and HERA-B suggest that an acceptable compromise could be found.

The cost and manpower requirements required for the modification of the beamline were required.

The status of the other upgrades (BST, FST, CIP, Forward Tracker, Jet Trigger, Luminosity detector, ETAG, and L4/L5 merger) was reviewed by M.Albrow, all should be in time for the luminosity upgrade.

The committee continued its discussion in closed session.

The PRC make the following recommendations

FTT. The committee takes note of the progress made and asked the collaboration to present at the next PRC a "close to full" simulation of the L1 part of the FTT algorithm including the current understanding of the L1-KEEP abilities. This study should aim to be as close as possible to the final implementation and should allow assessment of the feasibility and

performance of the FTT at the L1 stage.

VFPS. The PRC requested that the physics case be quantified including a detailed comparison to the results expected from data taken with the existing forward proton spectrometers (FPS and LPS) until the 2000 shutdown. Additionally the sensitivity of the proposed VFPS to backgrounds, in particular out-of-time coasting beam, and possible changes in the acceptance resulting from changes in the beam optics and a shift (3-5mm) due to coasting beam should be presented at the next PRC.

Item 7. Review of AMANDA.

Ch. Spiering reviewed the current status of AMANDA and ICECUBE. In the 1999/2000 summer season 6 additional strings where deployed whereby one reached only $2/3^{rd}$ of the proposed depth before freezing in. The strings contained a mixture of readout technologies (dAOM and DOM). Progress is being made on understanding the properties of the ice, calibration and tracking efficiency. A number of preliminary analysis results were shown (point sources, galactic supernova monitoring, WIMP/monopole searches). No significant clustering is observed in the point source search. A proposal for ICECUBE has recently been submitted to NSF. The deployment of three additional strings at AMANDA is planned as a test bed for ICECUBE.

In the ensuing discussion the following points were raised.

A precise definition is required of what the participating groups are committed to w.r.t. the additional three strings, in particular what are the funding arrangements.

It was restated that participation in ICECUBE could only be considered once AMANDA II data analysis was consolidated and results published.

A scenario is required for a continuing commitment to AMANDA II if participation in ICECUBE is not possible.

The committee took note of the progress of AMANDA and the development of the planned ICECUBE experiment. The collaboration was urged to analyse the data taken after 1997 to assure the quality of the data.

Item 8. Review of POL 2000.

T.Benke summarized the TPOL status. A prototype DAQ system has been setup at DESY using a slow ADC/TDC system provided by H1 and tests are being made. Progress has be made on improving the polarization analysis, MC simulations with L+R circular and linearly polarized light agree with measurements. A TPOL $\Delta P/P$ systematic error of $<2\%$ seems feasible, in comparison the LPOL uncertainty is currently 1.8%.

F.Zommer reviewed the information contained in the PRC 00/02. The proposal is to upgrade the LPOL by adding a Fabry-Perot optical cavity with the aim of measuring the polarization/bunch/minute with a statistical accuracy $\leq 1\%$ and a systematic uncertainty of a few per mille. A challenging feature of the proposal is the requirement of tuning the laser frequency to compensate the thermal expansion of the cavity. The analysing calorimeter would be calibrated using fits to the Compton and bremstrahlung spectra.

E.Hughes gave the referees report on behalf of J.Arvieux. A precise measurement of polarization is a prerequisite for future physics analysis at HERA (u+d vector couplings to Z^0, W mass measurements, right handed current searches, etc.) and the upgrade will provide a significant improvement to the LPOL. The proposal should be supported whereby the physics justifications for better than 1% polarization measurements should be reviewed. It should be noted that the now operational CEBAF cavity was considerably delayed by technical difficulties.

In the ensuing discussion the following points were raised.

The CEBAF cavity resolution is limited to $\sim$3% by the performance of the analysing calorimeter.

Funding for an optical engineer is available, but considerable engineering work is also required (eg. optical table inside the beampipe) which will require assistance from the machine group.

The commissioning scenario would be to finish the TPOL as specified, run the LPOL as is and develop the cavity which when available would replace the LPOL multi-photon measurement mode. HERMES are satisfied with this provided the LPOL performance is not compromised.

Radiation damage to the system has to be studied as non linearities in the systems performance bias the polarization asymmetry.

Estimate of the operating manpower and funding requirements are required.

The PRC continued its discussion in closed session.

The PRC made the following recommendations:

LPOL. The PRC accepted the letter of intent for the LPOL upgrade and is now expecting to receive a final proposal. It is considered important that the operability of the present LPOL be maintained during the commissioning phase of the new LPOL.

The committee consider the Fabry-Perot project to be an important step in the development of precision polarimetry at high energies with importance beyond HERA. The following points should be clarified for the next PRC: 1) motivate more clearly the need for a precise measurement of single bunch polarization on the timescale of minutes, 2) the radiation damage issues, 3) the requirements placed on the HERA machine groups, and 4) address the questions of longterm running and maintenance.

Item 9. Review of HERA-B.

The referees report was given by K.Jakobs.

Significant progress has been made since Nov. 1999. The detector is now ready for physics and the collaboration is now required to demonstrate the detector's operational stability, trigger performance, and their ability to analyse the data.

Significant hardware problems still exist:

- ITR (MSCG/GEM Inner Tracker). Chamber efficiencies (50-90%) are too low and the associated trigger system is not operational.
- OTR (Honeycomb Outer Tracker). Chambers are breaking at a rate of ~15/100hrs of operation. The reason for the problem is unknown and the long-term survival of the OTR is not yet guaranteed.
- Operation of 11% of the 2000 trigger systems optical links are unstable, at any given time 2% of the links are not functional. The problems are probably connector related and affected channels have to be run in a pass all mode which has an impact on the FLT rate.
- High P_t chambers and trigger. The chambers must be installed before the shutdown to allow testing with the trigger.

Status of the milestones set for January 2000:

- "Measurement of chamber efficiencies and resolutions, the overall tracking performance, etc.". This milestone has not been met and progress on measuring detector alignment and performance is too slow. Initial measurements made by January have not be improved. The availability of chamber alignment and efficiency numbers is a prerequisite for correct FLT operation.
- "Complete ITR installation and demonstration of stable running in HERA conditions". This milestone was achieved.
- "Perform FLT slice test (ie. evaluate electron trigger efficiency, measure rates and track occupancies per chamber etc.)". This milestone has not been achieved and it is not clear what can be expected. The collaboration has to demonstrate that the required trigger efficiencies and rates can be handled.

Both milestones set for April 2000, "Complete evaluation of the FLT performance for running in 2000" and "Measurement of the B cross-section", have not been met. ECAL pretrigger noise and timing problems meant that the J/ψ -> ee online signal disappeared for 3 months and the last months of data taking must now be used to achieve the April milestone.

In the short term it is recommended that the collaboration:

- measure and optimize the pretrigger/FLT performance for physics.

- accumulate as much B-physics data as possible using e/μ/high P_t pretrigger and the SLT.
- establish the ability to stably operate the detector at high target rates.
- determine whether the ITR operation is acceptable for FLT operation.
- improve the understanding of the detector (chamber alignment, efficiency, resolution).
- improve the coordination of both online and offline activities.

In the long term the collaboration has to establish a list of requirements (priorities, costs, manpower, and scheduling) in preparation for the work to be done during the luminosity upgrade shutdown.

HERA-B cannot now compete with BABAR/BELLE w.r.t. CP violation measurements, but if it can approach the design performance before the shutdown it can compete in the non CP violation sector with CDF/D0. The DESY management has requested a written document by Oct. 2000 outlining the remaining physics potential of the experiment.

It is recommended that HERA-B prepare a status report for the next PRC outlining the modified physics potential of the experiment, which should be extended into a more comprehensive document, including performance figures and physics priorities, by the spring of 2001.

In the ensuing discussion the following points were raised.

The collaboration is satisfied that the FLT will reach the design performance.

The experiment is encouraged to develop their non CP violating B physics strategy as significant measurements can still be made.

The manpower situation needs to be reviewed. Senior physicists have to move from hardware to offline tasks and the coordination of the various activities must be improved.

The discussion continued in closed session.

The PRC made the following recommendations:

The committee took note of the progress on commissioning the experiment and the detailed report of the referees. It recommended that the close contact between HERA-B and the referees and DESY management be maintained.

For the next PRC HERA-B is expected to provide a document reviewing the status of the experiment, the upgrades, and the physics performance for a limited number of significant physics channels based on realistic simulation.

Item 10. Miscellaneous.

The next meeting of the PRC is scheduled for the 19-20th October.

The current list of PRC referees is:

H1 - N.Wermes and M.Albrow
HERA-B - D.Froidevaux and K.Jakobs
HERMES - S.Bertolucci and J.Arvieux
ZEUS - E.Hughes
AMANDA - J-J.Aubert and L.Rolandi
Polarization 2000 - J.Arvieux

(C.Youngman - 2^{nd} September 2000)