Minutes of the 35^{th} Meeting of the PRC

DESY 31^{st} May 1994

PRC members present:

F.Barreiro (Madrid), W.Buchmüller (DESY), R.Felst (DESY), L.Foá (CERN), R.-D.Heuer (CERN), G.Heinzelmann (Hamburg), W.Hofmann (MPI-Heidelberg), J.Jaros (SLAC), A.D.Martin (Durham), J.May (DESY), J.Rander (SACLAY), D.H.Saxon (Glasgow), R.Sosnowski (Warsaw), P.Söding (DESY-IfH Zeuthen), G.-A.Voss (DESY), A.Wagner (DESY), D.Wegener (Dortmund,Wissenschaftlicher Rat), J.Wess (Munich,Wissenschaftlicher Rat), B.H.Wiik (DESY,chairman), N.Wermes (Bonn), C.Youngman (DESY,secretary)

Non PRC members present:

HERA - F.Willeke (DESY). [31^{st}, closed session reports and open discussion]
HERA-B - A.S.Schwarz (DESY), J.Spengler (DESY), J.Szweizig (UCLA). [31^{st}, HERA-B referees report and open discussion]

The PRC received the following documents:

PRC 94/02
The HERA-B proposal - An experiment to Study CP Violation in the B System Using an Internal Target at the HERA Proton Ring.

Open session. May. 31^{st}, 9:00, Main Auditorium

Technical review of HERA-B J.Spengler, DESY.

Physics aims of HERA-B A.S.Schwarz, DESY.

Closed sessions: May. 31^{st}, 10:30 - 15:00, Sem. Rm. 1

1. Approval of the minutes and matters arising from the last meeting.
2. HERA status report.
3. Report on the status of the H1, ZEUS and HERMES detectors.
4. HERA-B - HERA interfacing requirements.
5. Referees report on the HERA-B proposal.
6. Future PRC schedule and summary of recommendations made.

Item 1. Approval of the minutes and matters arising.

The 35^{th} meeting of the PRC was dedicated to reviewing the HERA-B proposal.

The chairman welcomed two new members to the PRC. N. Wermes from the University of Bonn and G. Heinzelmann from the University of Hamburg.

The chairman reported that the proposal, of the ZEUS collaboration, to build a presampler had been approved by the directorate.

The minutes of the 34^{th} meeting of the PRC were approved subject to corrections.

Item 2. HERA status report.

G.-A.Voss reported on the HERA machine status.

Luminosity running for the H1 and ZEUS experiments started in the week before the PRC meeting. Currently 170 proton bunches and 168 electron bunches are used.

The improvements to the DESY III proton injector allow 160 mA to be stored. It is currently possible, for PETRA, to accelerate 160 mA to the HERA injection energy. New instabilities seen at these currents will require an additional feedback system.

The peak HERA instantaneous luminosity sofar seen is 1.5×10^{30} cm^{-2} s^{-1} which is 10% of the design value. The electron beam lifetime instabilities seen during 93 are still present.

The 93 winter shutdown was used to prepare the east straight section for the installation of HERMES. The spin-rotators were installed and vacuum pumps rewired. No unexpected problems were encountered during the rebuilding operation and the spin-rotator system has been successfully operated.

Item 3. Report on the status of the H1, ZEUS and HERMES detectors.

A. Wagner reported that during the winter shutdown ZEUS had installed and upgraded a number of detector components. In particular the Small Rear Tracking Detector (SRTD) is installed and working. The Rear and Forward Tracking Detectors (R/FTRD) have, finally, received their electronics which should improve the tracking abilities of ZEUS at small angles.

The H1 collaboration also made a number of upgrades to the detector. The CJC1 tracking chamber was fully rewired and reinstalled in the detector. Optimization of the P_t trigger is currently being carried out.

Both H1 and ZEUS have experienced problems with satellite bunches during this years luminosity running. HERA has delivered 127 nb^{-1} during the first week of luminosity and both experiments have started analysing the data.

HERMES have installed a test experiment which consists of: the calorimeter setup, target chambers with wake field suppressors and one element of each detector component. Studies with single and colliding beams show that the collimators remove the proton induced background. The electron beam lifetime has not been influenced by gas introduced into the target cell. The electron beam backgrounds seen are being investigated.

Open discussion

The chairman requested that HERMES provide detailed information about the tests made at the next PRC.

Item 4. HERA-B - HERA interfacing requirements.

F. Willeke reviewed the interfacing required between the HERA machine and the HERA-B experiment.

A comparison of the machine performance obtained in 92 and 93 was made with the expected performance for 94 and the design values. The current HERA operating conditions of good beam stability and small continuous growth of emittance are good for HERA-B.

The effect of HERA-B on the other HERA experiments has been tested by inserting a target into the proton beam during luminosity running in 94. Small increases in the counting rates at the other experiments were seen when the target was moving otherwise no other effects were seen in particular the luminosity remained constant. More test should however be made since the original tests were carried out with the target close to the main collimator which is not the case in the installed experiment. Without the close proximity of the collimator higher background rates might be expected in the other experiments.
In general the beam collimation remains a problem. HERA-B will require a new lattice for which it will be difficult to find optimum collimator positions upstream of the detector. More calculations are required.
The positioning of the proton beam dump is also problematic. A location downstream of HERA-B is possible but would require a redesign of the kicker magnets for beam energies greater than 1 TeV. A fall back solution, placing the beamdump in the east area, is also available.

A new electron beam lattice will also require modification of the RF cavity positioning. Additionally the electron beam horizontal and vertical position will be shifted w.r.t. the proton beam due to the detectors asymmetry.

The hall infrastructure at HERA-B requires attention. No parking position is available for the complete detector or detector elements during the construction phase. Radiation shielding discussions are converging and the detector will carry the shielding required - no independent shielding wall will be present. Access to the HERA tunnel will be restricted due to magnet warm up requirements.

The detector position is, at p[resent, in conflict with HERA's reference magnets and the polarization laser. Both of which may be required to move.

Open discussion

D. Saxon pointed out that HERMES would not be in favour of the fallback beamdump solution. He also stated that ZEUS was worried about changes to the HERA collimator positions. Willeke replied that no final decision had been made w.r.t. the beamdump and that the concern expressed by ZEUS was understood and more tests and calculations would be made.

L.Foá requested that a concrete statement be made about the reference magnets. Willeke answered that HERA would prefer not to move them and that the situation was being investigated.

R.Felst was also concerned about the foreseen collimator changes. Backgrounds limit the trigger and datataking abilities of the existing HERA experiments. No compromise should be accepted in the collimation and scrapper systems. B.Wiik accepted this stating that the main issues had been identified and that more work was required. No single critical item prohibiting the building of the experiment had be identified.

R.Sosnowski asked whether the working groups existing included representatives from the experiments. B. Wiik confirmed that the solutions will clearly involve a compromise w.r.t. the experiments requirements.

Item 5. Referees report on the HERA-B proposal.

The chairman thanked the HERA-B open session speakers for their detailed presentations and proposed that the referee's for HERA-B, J.Jaros and R.-D.Heuer, should report to the PRC.

Referees's report

J.Jaros stated that his original thoughts were that this experiment was technologically impossible. Now, one year later, the experiment has been shown to be possible although still challenging. The proposal is a wonderfully complete document.

The reach of the experiment has been reduced by the σ_{BB} measurement of E789. The expected sin2β accuracy for 1 years datataking is now 0.2. This remains a good experiment.
The proposal addresses additional physics goals which are very significant and complimentary to B-factory physics.

The approval of SLAC and KEK B-factories define a window of opportunity for HERA-B. SLAC and presumably KEK are in direct competition with HERA-B. They expect a reasonable fraction of the design luminosity in 99 allowing sin2β to be measured to 0.2 in the first year, assuming 10% of the design luminosity. The SLAC machine will commission its high energy ring (PEP) in 97 with collisions expected in summer 98. The detectors will be ready in the period fall 98 to spring 99 ready for initial luminosity. The FNAL-Tevatron main injector schedule is slightly less certain but CDF can also be expected to compete with HERA-B.
HERA-B is clearly significant and competitive since HERA luminosity is available today and the target has been tested successfully. The window of opportunity, is however relatively short and the experiment must take data as soon as possible. It should also be stated that B mixing experiments in proton and in e+e- will be complimentary.

The experimental difficulties although present are soluble. Si, TRD and tracking calorimeters can be made with sufficient radiation hardness. The MSGC's must still be proven and the proposed backup solution must be followed through. The RICH design has addressed radiation damage and occupancy and the solution looks robust.
A worry still remains w.r.t. GEANT's simulated prediction of the occupancy. Soft process effects may not be correctly handled by the cutoffs imposed during the simulation. Results from CDF suggest that 50% of the occupancy is understood from the simulation. A calculation scaling the observed occupancy at an FNAL experiment to HERA-B suggest that the occupancy assumed is correct.
The trigger can now be simulated fully and the assumptions made previously can now be justified. It is however not clear that the cost of the electron trigger is as justifiable as the muon trigger.

No "show stoppers" have been found and therefore it is recommended that the experiment be approved provided the experiment can take data in 99. Additional efforts should be made to simplify the design using simpler solutions if available.

R.-D Heuer stated that his conclusions were similar to those of J.Jaros.

The CP physics reach of the experiment has been lowered somewhat by the cross-section result from E789. Some safety margins are available: other CP violating channels, charged B tagging and a possible increase in the proton beam energy.

The time scale has now become critical. FNAL was always assumed to be a competitor, now SLAC and KEK will provide hard competition.

The detector design is now understood. The target feasibility has been proven. Si detector designs are available with sufficient radiation hardness and replaceability. The tracking simulations look good although some work is still required to include non gaussian behavior. The MSGC's still require work in understanding ageing effects. The RICH counter work has been very impressive and a prototype is currently being tested. The occupancy and ageing problems seem to have been answered.

The understanding of the trigger has been greatly improved by the availability of a detailed simulation of level 1. The electron trigger still looks difficult and costly.

The data acquisition front-end electronics looks manageable although some uneasiness still exists due to the high rates and timing requirements. Trigger stability will also require additional understanding.

The recommendations are the same as those of J.Jaros with the conclusion that less emphasis should be placed on the electron trigger.

Open discussion

D.Saxon stated that many backup solutions were foreseen and asked how long these would be followed up. J.Spengler answered that there would be a review at the end of 94 and that consequences of experience gained with prototypes would be used to define the following years schedule.

D.Saxon pointed out that the tracking costs are dominated by readout electronics costs. How accurate were these estimates ? W. Hofmann replied that the Si costing were well understood. The tracking was however not quite so advanced and it should be assumed that the ADC costs would be safe and that the TDC estimates less safe.

D.Saxon pointed out that a MSGC honeycomb pixel detector will introduce dead material and asked what the relative importance of momentum resolution and pattern recognition is ? W.Hofmann replied that for pattern recognition pixel readout is favoured due to the high occupancy and that the design is not driven by momentum resolution.

N.Wermes expressed his worries about operating a RICH detector in a high occupancy environment and in particular about the kaon reconstruction efficiency. J. Spengler replied that these issues had been addressed in the proposal.

L.Foá observed that tracking detectors are concentrated after the magnets with little proceeding them. A.S.Schwarz stated that using an a tracking algorithm in the Si requiring ≥ 6 points/track and an independent search in the main tracking detectors followed by a track linkage algorithm gave good results with low spurious linkage, as described in the proposal.

B.Wiik asked whether the electron beam pipe still fitted within the magnet pole pieces. W.Hofmann replied that this was originally required and should still be possible.

B.Wiik stated that reducing the requirement for upstream electron identification could result in the detector being available earlier. Additionally material proceeding the RICH is primarily from the electron identification detectors. It might therefore be beneficial, to the occupancy, if the electron identification was simplified.

J.May asked what would be done if 25% of the budgeted cost was not available. W.Hofmann stated that a global reorganization would be required. Possibly the use of the ARGUS magnet would be reconsidered. The TRD might also be sacrificed.

B.Wiik asked what reaction rate the experiment could survive if no limits were set by HERA. A.S.Schwarz suggested that a 50% increase w.r.t. the proposal could be accepted. The higher rates would result in increased radiation damage and occupancy.

A.D.Martin pointed out that the addition physics aspects offered a unique opportunity to study the gluon. Two different proton beam energy runs would be required.

L.Foá asked whether fluctuations in bunch behavior are dangerous ? J.Spengler said that the worst case seen during target tests resulted in a 30% loss of rate. F.Willeke added that such fluctuations could be minimized by HERA.

N.Wermes stated that the additional physics potential of HERA-B was interesting and recommended that the physics of the D-meson system should be studied.

P.Söding stated that simplification, more manpower and cost savings were required. He then asked what HERA-B expected from the PRC ? W.Hofmann said that money and manpower questions were still open partially as a result of HERA-B not being an approved experiment. The PRC should approve HERA-B with the requirement of satisfying funding, manpower and time schedule requirements. HERA-B plan to have an end of summer workshop where groups will be given an opportunity to join the experiment. This would allow a presentation of unresolved issues to the PRC in the fall.

P.Söding stated that it would be an advantage to have a fully defined detector and approval by the end of this year. A.S.Schwarz agreed with this pointing out that an improvement in the manpower situation would only be possible if groups could apply for manpower and funding for an approved experiment.

B.Wiik asked for the amount of funding required for the 94 schedule. W.Hofmann could give no accurate answer. D.Wegener pointed out that funding requests were now being processed for 96 and that it would be difficult to pledge money before this date. B.Wiik replied that machine money could also not be committed due to uncertainties in the design. A decision about the feasibility of using the OMEGA magnet would be useful in view of the long delivery times for new superconducting magnets.

Closed discussion

W.Hofmann, D.Wegener and non PRC members were required to leave the session.

The chairman requested that the CP and additional physics questions should be raised first.

D.Saxon stated that the CP experiment is very significant and must be carried out quickly.

R.Sosnowski pointed out that both referees recommended the experiment w.r.t. the physics goals.

J.WESS asked what would the PRC members say if HERA-B was not approved in view of SLAC and KEK ? A.D.Martin replied that the additional physics is unique to

HERA-B. W.Buchmüller stated that rare B decays are interesting and asked whether HERA-B could be competitive. Additionally B_c is interesting although CDF might be more competitive. L.Foá pointed out that CP violation experiments in kaon decays have been going on for 30 years maybe the B measurements will end the kaon measurements. N.Wermes stated that the LHC will, eventually, carry out a similar experiment to HERA-B.

The chairman concluded that the PRC was satisfied with the physics potential of HERA-B. There exists an additional physics program which is also very interesting. The development of trigger and readout electronics could also be considered an essential stepping stone towards the LHC.

The chairman requested that the technical feasibility of the experiment should be discussed.

J.May stated that if HERA-B could not be realised technologically then the LHC must reconsider its research and development strategy.

B.Wiik pointed out that doubts existed about the electron trigger and detector system. The question of whether the experiment could sacrifice the electron identification had also not been answered.

N.Wermes stated that redundancy is important and therefore it is difficult to see sacrificing the electron identification as a method of reducing funding required. Possibly the electron systems could be staged if this was required.

D.Saxon asked whether a physics run with muons would be possible in 98 given that trigger and electronics tests were scheduled for an earlier date. R.-D.Heuer pointed out that phasing was already present in the proposal and recommended that it be formalized.

B.Wiik asked whether using the ARGUS or OMEGA magnets would cause problems for the detectors. R.-D.Heuer replied that the occupancy at lower field values would require additional study.

The chairman summarized that the PRC found the experiment to be challenging but technically realizable. Emphasis should be given to the muon systems and the electron system should be staged. The magnet decision was also required as well as an increase in manpower. The HERA-B experiment should therefore present the PRC with an update at the October meeting allowing for a final decision at the January 95 PRC.

The letter of recommendation, prepared by the referees, is appended to the minutes.

Item 6. Future PRC schedule and summary of recommendations made.

The October PRC, 17-18th, will discuss the following items. The HERMES collaboration will provide a detailed review of the tests they have carried out. The HERA-B - HERA interfacing will be discussed. Reports of the 94 data taking period will be given by H1 and ZEUS.

(C.Youngman - 6th September 1994)