# Observations of the Committee

- The HERA crew and the collider experiments are to be congratulated on the recent rapid progress in understanding the problems unique to HERA II.
- An essential ingredient for this recent progress was more reliable and stable HERA operation over extended periods
- It has not yet been possible to confirm that the HERA accelerator is capable of reaching its design performance, due in part to the silicon tracker radiation dose constraints of the collider experiments
- Most of the radiation dose absorbed by these trackers arose from anomalous HERA events and injection inefficiencies, which will be reduced by continued and extended lumi operations
- Both collider experiments now experience severe background problems, which can be resolved into distinct categories:
  - Double-scattered synchrotron radiation, which appears now to be quite well understood, with solutions for further reduction in sight
  - Lepton beam-gas, which is also becoming quite well understood, but for which measures for only limited reduction have been identified
  - Proton beam-gas background, which is by far the most serious problem, but is the least well understood and requires much more work.
- ZEUS appears to be more sensitive to the backgrounds, probably due in part to operation of their main drift chamber at higher gas gain

# Further Observations of the Committee

- The increased lepton beam-gas background compared to HERA I appears to arise from the closer proximity of the beam separation to the IP, possibly in combination with a long unpumped section at the GA magnet, and in the case of ZEUS, smaller apertures at the IR
- The increased proton beam-gas background compared to HERA I is clearly associated with degraded dynamic vacuum which is still not well understood
- Factors possibly contributing to the poor dynamic vacuum include the semi-cryo surfaces in the IRs, and higher SR fluxes close to the relevant section of the proton vacuum system
- There is evidence that the vacuum problems involve heavy species such as methane, which are inefficiently pumped and possibly even generated by the present mix of pump technologies
- Not enough beam processing of the vacuum surfaces has yet been possible to determine the ultimate limitations of the present configuration
- Unless the vacuum is improved by large factors, extrapolation to full luminosity of backgrounds expected even after presently planned hardware changes still greatly exceed the levels compatible with operation of the main drift chambers of both H1 and ZEUS
- Only the next steps to better understand the dynamic vacuum problems have been identified, including operating the semi-cryo surfaces at higher temperature, and what will be done next depends on the results
- Much more work and better understanding is needed before HERA will be ready to proceed with a several-month shutdown to correct the remaining problems

# General Recommendations

- Progress towards better understanding of all the problems will be best served by giving highest priority to developing and refining routine and reliable HERA two-beam operations at ever higher beam currents, with emphasis on the lepton current for vacuum surface processing
- Further background studies should be designed to be done as much as possible within the context of developing lumi operation using e.g. isolated pilot bunches in both beams
- This two-beam operation could include collisions provided that it does not seriously impede the pursuit of the main goals of surface processing, machine development and parasitic background studies
- All possible effort should be devoted to better understanding the present vacuum limitations in the relevant region $0 < z < -20$m. This includes operating the "cryosurfaces" at higher temperatures, identifying the sources and composition of the dynamic gas load, and possibly optimizing the mix of pump technologies
- Simulations of the HERA I and HERA II proton beam gas backgrounds should be compared in an effort to better understand the HERA II problems
- Continuing efforts should be devoted to integrating the measured pressure profiles with the beam-gas simulations to determine how well the severity of these backgrounds is understood
- The additional goal of identifying before the spring shutdown any fundamental impediment to full operation with polarised beam appears to threaten the pursuit of solutions to urgent *known* problems, in particular the backgrounds. With luck it might be possible to show the opposite — that there is no such problem with polarisation. But to confirm and identify a fundamental problem would probably take weeks of dedicated studies. Hence it is recommended that beam polarisation be given a lower priority for now.