Positron polarisation at HERA.

The week of 24 February — 3 March 2003 brought a major step forward for the exploitation of HERA: longitudinal positron spin polarisation has been generated simultaneously at all three positron(electron) interaction points at the routine energy of 27.5 GeV.

Wednesday 4 May 1994 had already marked a turning point in the art of the manipulation of spins in electron storage rings: longitudinal electron spin polarisation (with the spins oriented along the electrons' direction of motion) was established at the East interaction point in the electron ring of HERA (D.P. Barber et al., Phys.Letts., **B343**, 436 (1995)). That was the first time in the history of high energy electron storage ring physics that the naturally occurring vertical spin polarisation was, with the aid of "spin rotators", converted to longitudinal polarisation. This opened the potential for a new range of physics, in particular for the HERMES experiment which exploited the polarised electron and positron beams. In the following years a polarisation of 60 percent could be routinely attained until mid–2000 when the modifications for the HERA Luminosity Upgrade began.

However, the original proposal for HERA in the early 1980's foresaw longitudinal polarisation at all interaction points. But installation of spin rotators for H1 and ZEUS was delayed until the HERA Upgrade. And with the necessary (space saving) removal of the compensating solenoids for HERA–II, the more complicated magnetic fields around the H1 and ZEUS interaction points as well as the stronger quadrupole fields in the arcs, the conditions for polarisation are potentially much less favourable.

Nevertheless, starting on Monday 24 February with all three pairs of rotators switched on, with a special "spin matched" optic and with special orbit corrections ("harmonic bumps") but with the solenoid magnets of H1 and ZEUS switched off, longitudinal positron polarisation was generated at all three interaction points. Then on Sunday 2 March a polarisation of 51 percent was attained with the H1 and ZEUS solenoids switched on and during collision with the proton beam. This is to be compared with the theoretical maximum of about 83 percent that is allowed in this configuration.

Measurement and control of polarisation would not be possible without high quality reliable polarimeters. At HERA, the polarisation is measured with two polarimeters at places 3 km apart: vertical polarisation in the West straight section and longitudinal polarisation in the East straight section near HERMES. The HERA Upgrade also provided the opportunity to upgrade the polarimeters. Of course, as before, they observe the same value of the polarisation.

The provision of high energy longitudinally spin polarised electron and positron beams at the East interaction point had already made HERA a unique facility. The provision of polarised beams for all three experiments is even better and opens the way for a very exciting experimental programme.

It also increases confidence in the feasibility of the eRHIC project at Brookhaven National Laboratory, U.S.A., involving the provision of polarised electrons and positrons for collision with the high energy polarised protons in the RHIC collider.