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MHE

May 30, 1997

Minutes of the Meeting on HERA Luminosity Upgrade May 30 1997

Present: R.Felst, H1; W. Bartel, H1; K.Gadow, H1; U. Schneekloth, Zeus; E. Lohrmann, ZEUS; B. Loehr, ZEUS; D. Barber, MPY; B. Parker, MPY; K. Sinram, MEA; K. Woebke, MEA; C. Luettge, MPY; T. Sen, MPY; R. Kose, MR; I. Muschik, MR; F. Loeffler, MEA; K. Zapfe, MVP; S. Wolff, MKS; H. Brueck, MKS; H. Lierl, MKS; S. Wipf, MPY

Topics:

1) Single Particle Stability of the Electron Beam
2) Geometry of superconducting combined function magnets inside the detectors
3) Alignment system for magnets around the IR

Single Particle Stability of the Electron Beam (T. Sen)

T. Sen reported on unexpected difficulties with the dynamic aperture of the Rev.1 lattice. Compared to the previous solution, the dynamic aperture in terms of rms beam size amounts only little more than 10σ. This is considered too close to the minimum stable amplitude required especially in view of the fact that a perfect lattice without errors has been considered so far.

The lattice has been analyzed and it was found that the driving terms of 3rd integer resonances are not as well intrinsically compensated as in the previous lattice, and, due to different phase advances across the straight section, higher order sextupole driven effects including tune-shift with amplitude turn out to be much stronger.

A number of possibilities have been discussed to improve the lattice:

- Changing the phase advance across the straight section
- Adding sextupoles in the straight section to cancel low order resonance driving terms

The discussion led to the conclusion, these analysis should be pursued. In parallel, one should provide as soon as possible the new lattice based on superconducting quadrupoles which is expected to have much less chromaticity contributions from the straight sections.

Geometry of superconducting combined function magnets inside the detectors

The arrangement of superconducting quadrupoles in the detectors which has emerged from recent discussions and iterations has been presented. The set up consists of three magnets, two (e-beam) downstream magnets and one upstream magnet. The arrangement is the same for H1 and ZEUS. It allows a collision point in the center of the colliding beam detectors.

The upstream magnet has a length of 3.5m. The cryostat is centered on the detector axis at a distance of 4.4m from the IP which coincides with the welds of the H1 liquid Argon cryostat which is limiting the available space. The magnet is rotated around this point in the horizontal plane by four mrad so that the downstream end of this magnet which occurs at 1.9m is shifted by 10mm outwards in the horizontal plane. The beam, which is centered on the detector axis at the IP has a horizontal displacement of 10mm (inwards) with respect to the magnet axis. In order to provide the necessary deflection and focusing, the magnets needs to a quadrupole field of up to 12tesla/m and a dipole field of about 0.16 tesla.

The aperture of the magnet for the beam is 114 mm which is about 30mm more than needed. This is chosen in order to have the same aperture as needed on the downstream side for the sake to simplicity of the design and to provide a smooth aperture profile across the IR to avoid HOM losses.

The outer diameter of the cryostat is assumed to be 188mm to fit inside the H1 cryostat with a clearance of 2mm for alignment.

The first downstream quadrupole has a length of 2m. It is aligned parallel to the detector axis but shifted outwards by 17mm. The corresponding 17mm offset of the beam to the axis provides the necessary deflection. The gradient of this magnet is 13 tesla/m. No systematic dipole field is needed. A small dipole component of 0.1tesla is assumed for empirical corrections and to maintain flexibility. The extension of the beam orbit upstream of the detector which is a line with a horizontal slope of 8mrad marks the border of the high power synchrotron radiation fan generated inside the set-up. It has a clearance of 15mm from the aperture with a radius of 57mm Within 10 mm from the 8mrad-line, the intensity of the synchrotron radiation is expected to drop by 3 orders of magnitudes. The 20s beam envelope has a clearance of about 20mm from the inside aperture limit.

The second downstream magnet follows the first one with a 30cm drift space in between to provide space for coil heads and cryogenic piping. It needs a very large aperture of 140mm to provide room for the deflected beam and, on the opposite site, for the synchrotron radiation fan. The free space between the border of the synchrotron radiation fan and the outer aperture is about 15mm. The beam stay-clear on the inside is about the same. The gradient of this magnet reaches up to 11 tesla/m. No systematic dipole field is foreseen. The set-up is shown below. It will be the basis of the magnet design and the Rev.2 lattice design.

Alignment system for magnets around the IR (U. Schneekloth)

U.Schneekloth presented ideas on a laser based on-line alignment and survey system. It was assumed to install the lasers inside the tunnel and inject the lasers beam via little holes inside the poles of normal-conduction QI and QJ magnets upstream and downstream of the detectors. Possibilities of injecting the laser beam into the beam vacuum have been discussed. The conclusion is that this problem needs further discussions and iterations.

Next Steps

- Starting with Rev.2 lattice design
- Pursue analysis of e-beam stability
- Start design of the superconducting quadrupole based on IR geometry
- Analyze synchrotron radiation of Rev.2 lattice and re-optimize position downstream backscatter Syn.Rad. masks and radius of detector beam pipe
- Recalculated HOMLs in the IR

Next Meeting: Friday, June5 1997 9:00h Bld 30b 4th floor, R459