F.Willeke, -MHE Hamburg, 6.6.1997

Minutes of the Meeting on HERA Luminosity Upgrade

June 6.1997

Present: K. Gadow, FH1; D.P. Barber, MPY; S. G. Wipf, MPY; R. Bacher, MHE; R. Felst, F22; Y. Holler, MEA; U. schneeklth, MEA; E. Lohrmann, ZEUS; B. Parker, MHE; B. Holzer, MHE; R. Kose, MR; K. Zapfe -Dueren, MVP; W. Bartel, H1; H. Lierl, MKS; G. Woebke, MEA; G. Lopez, MKI; A. PETROV, MEA; W. Hain, ZEUS; T. Sen, MPY; D. Sellmann, MKS, H. Brueck, MKS; S. Wolff, MKS; F. Willeke, MHE

Topics:

- **Coil Design of Superconducting Quadrupole**
- **Synchrotron Radiation from the low beta quadrupoles**
- **Magnetic Shielding of Photo-multipliers close to S.S. Quadrupole**

1.) Erratum

In the previous minutes from May 30'97, there was a typing mistake: The outer diameter of the superconducting quadrupole **QO is 176mm instead of 188mm**.

2.) Geometry of S.C. Quadrupoles

The aperture of the upstream s.c. quadrupole QO has been reduced to 90mm. The maximum dipole field of QG,H needs to be 0.15 tesla to preserve the possibility of shifting the further outwards by another 10 mm to make full use of the available aperture for the beam and for the synchrotron radiation.

After the meeting, K. Gadow informed F.W. that the tilt of 4mrad of the upstream QO will not be possible in the case of H1 since there is a second, aperture limiting weld at ~2.8 m from the IP. The magnet needs to be aligned on the calorimeter axis. The problem can be solved in the following ways:

The detector will be tilted by 4 mrad. The beams collide at a horizontal distance of 18 mm from the detector axis. Alternatively, the detector is not tilted. The beams collide in the center of the detector. A dipole component in the center of the magnet of 1.5 kgauss is needed to provide the necessary deflection of 8 mrad. The maximum field experienced by the beam is as high as 3 kgauss. The solution has to be optimized in between these limits.

3.) Superconducting coil design

H.Brueck presented field calculations for the superconducting quadrupoles.
The required field strength can achieved easily with a large margin in the current density of the superconducting cable. The field quality of QG and QH is sufficient with values of the multipole components in the order of DB/B=1E-4 at a radius of 25 mm around the beam orbit. The reference radius of 25mm corresponds to at least 15 sigma of the beam. The dipole field of the QO has a decapole component which feeds down to a large octupole term from due the offset of the beam from the axis. The octupole component amounts to 2E-3. This is not completely negligible. It would be desirable to introduce further wedges in the coil to reduce the decapole by a factor of 2-4.

4.) Synchrotron radiation Generated in the Low Beta Quadrupoles (U. Schneekloth)

The synchrotron radiation fan which is generated in the upstream low beta quadrupoles has an angular divergence of 0.5mrad (rms value). This creates a synchrotron radiation tail. The outer parts of this tail is absorbed inside the superconducting magnets. The power level is in the order of 5 watts and the photon background in the experiments due to this effect amounts to 7e14 photons per second. The masks which protect the detector from back-scattered photons from the downstream power absorbers have to be retraced a somewhat (from 45mm to 55mm) so that they are not hit by primary synchrotron radiation. Additional masks 1.6m from the IP in upstream direction are foreseen to cut away the radiation which might arise from slightly mis-steered beams.

It was proposed to use dielectric material for the masks with a thin metallic (Ti) coating to avoid electrostatic charging. Appropriate materials need a high Z, and dielectric properties not to different from vacuum to avoid the excitation of wakefields, trapping of electromagnetic fields and corresponding power dissipation.

An inquiry on possible materials will be made (W. Bartels) wakefield calculations will be performed with dielectric masks in the new IR geometry..

5.) Comments on SC Quadrupole Geometry

U.Schneekloth pointed out that the upstream s.c. quadrupole coil head and surrounding cryostat will shadow somewhat the forward calorimeter.

6.) Shielding of the Field of the S.C. Quadruopole

Photomultiplier of the ZEUS detector need to be shielded from the magnetic field of the superconducting quadrupoles. B. Parker presented 2-dimensional field calculations testing a 5 mm thick shielding cylinder around the magnet. In case of the QO with its dipole field, shielding is very difficult and residual fields of 1.2 kGauss are still present. The impact of the ends of these shielding cylinders which extend longitudinally only over a small section of the magnet on field quality needs to be investigated. Shielding in case of QG and QH is somewhat more easy. However residual fields are still in the order of 700 gauss. The conclusion is that 5 mm thickness is not sufficient for shielding and that the shielding must be included into the magnet design to keep field distortions under control.
Shielding material must probably anisotropically distributed.

7.) Remark on QI Aperture

Due to increased horizontal defocusing by the superconducting quadrupoles, the pole radius of the QI quadrupole magnet (horizontally focusing low beta quadrupole for the leptons) must be increased from 35 mm to 37 mm.

8.) Next Steps

- S. C. coil design refined
- Re-iteration of s.c. quadrupole geometry in H1
- Investigation for possible dielectric materials for s.r. masks
- Wake field calculations for the new IR
- Continue work on Rev.2 lattice.
- Analyze stability of Rev.2 electron lattice

9.) Next Meeting:

Friday, June 13, 9:00h, Bld 30b, 4th floor, R459