Design Studies for the ABS of ANKE in COSY Jülich by 3-dimensional Magnetic Field Calculations

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Abstract. Field distributions of the ANKE dipole magnets have been calculated numerically. Results for the stray field at the polarized atomic beam source and the gas-storage cell target in COSY-Jülich are presented. The necessary soft-iron shields around the rf-transition units of the atomic beam source are discussed. Furthermore, a dependence of the focussing properties of adjacent permanent sextupole magnets on their relative azimuthal orientation and on the deviation from co-axiality has been investigated.

The polarized atomic beam source (ABS) and the gas-storage cell target of the magnet spectrometer ANKE in the COSY-Jülich storage ring are under construction [1]. The center of the 40 cm long storage cell will be positioned 50 cm in front of the yoke of the central spectrometer dipole magnet. At the maximum magnetic field strength of 1.6 T in the 20 cm high gap appreciable magnetic stray fields are expected at the storage cell and the ABS.

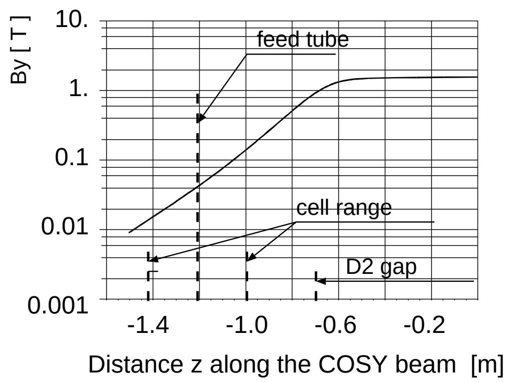

FIGURE 1. Calculated vertical stray field component B_y along the COSY beam at $B_{gap} = 1.6\ T$.

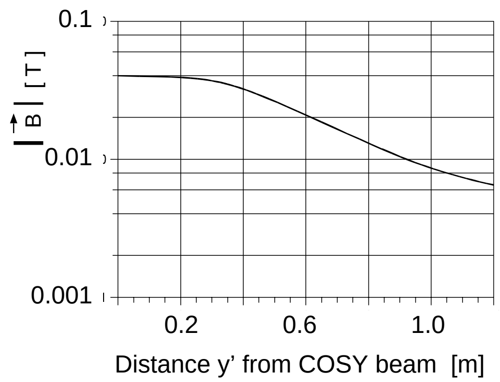

FIGURE 2. Distribution of the calculated total field strength along the ABS-beam axis.

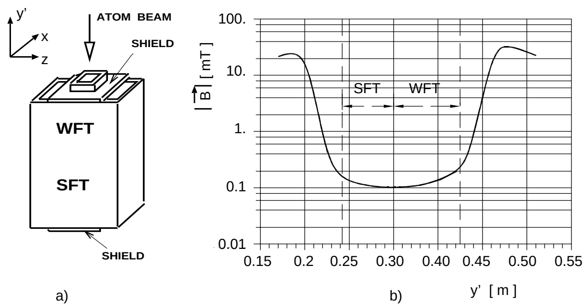

FIGURE 3. Holding-field magnet of the WF and SF transition units with the additional iron shield (a) and the calculated field along the ABS-beam axis (b)

Field distributions have been calculated with use of the computer code MAFIA [2]. Fig. 1 shows the vertical field component B_y along the COSY beam for $B_{gap} = 1.6\ T$, whereas Fig. 2 contains the strength of the total field along the ABS-beam (y') axis (for definition of the coordinate system see [1]). These data allow to the following conclusions: (i) at the storage cell the stray field B_y is strong enough to be used as holding field for deuterium. Near the symmetry plane of the magnets $(y = 0)$ $B_x, B_z << B_y$. (ii) The rf-transition units are operated at field strengths of $10^{-4}T$ to $10^{-3}T$ and have to be shielded. (iii) At the turbomolecular pumps, positioned at about $y = 120\ cm$, the stray field is below the field limit [3] of 0.013 T .
The necessary shieldings of the rf-transition units by two orders of magnitude have been designed with the MAFIA code, starting from the design of the transition units for the HERMES ABS [4]. The yokes of their magnets themselves act as shielding against an external magnetic field, but the value of the rest field in the transition region is too high. To reduce this rest field, it is necessary to add 5 mm thick iron plates with short tubes (Fig. 3a). The rest field calculated with such a shield is shown in Fig. 3b.
Furthermore, the dependence of the total focussing properties of two adjacent magnets upon their relative azimutal and axial position has been studied. In the ANKE ABS the two last sextupole magnets have apertures of 30 mm diameter and the distance between them is 15 mm. The calculations show that relative azimutal rotation from parallel to antiparallel magnetization inside corresponding segments of the two magnets reduces the flux into the storage cell by 3% only. For axial misalignment by ¡ 0.5 mm the reduction is ¡ 1%.

REFERENCES

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