Spin Physics with Photons — Technical Highlights and Spin-Offs*

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Published 29 February 2016

The spin, as a fundamental property of a particle, has been a main object of investigation in particle and nuclear physics research in recent decades. For complete spin investigation, one requires a polarized target in addition to polarized beams and a recoil polarimeter. The advent of advanced beam and large acceptance detector technologies has driven the development of highly polarized, full angular acceptance targets. The Crystal Ball detector with its unique capability to cope with multi photon final states is used in Mainz at the A2 real photon facility in combination with a frozen spin polarized target. Technical highlights from the development of thin superconducting magnets to provide a longitudinal and transverse polarization are presented. A continuous polarization in the 'DNP'-mode is on the way. Another promising technology investigation is going in the direction of 'Active Polarized Targets' to use the target as an intrinsic part of the detector. This requires from the scintillating material and front-end electronics to operate at cryogenic temperatures.

Keywords: Photonuclear reactions; polarization phenomena in reactions; polarized and other targets.

PACS numbers: 25.20.-x, 24.70.+s, 29.25.Pj

1. Superconducting Coil Technology

An internal polarizing coil was tested in a standard liquid helium container at 4.2 Kelvin with maximum field of 2.3 Tesla.

The layout of a 10-layer notched solenoid coil (see Fig. 1) has been calculated in the framework of the PhD-thesis of J.M.Linturi in Mainz. The production of the pure Copper holder this superconducting coil was done at the mechanical workshop

*This work was supported by the 'Deutsche Forschungsgemeinschaft' (SFB 1044) and the European Community-Research Infrastructure Activity under the FP6 'Structuring the European Research Area' program (Hadron Physics, contract number RII3-CT-2004-506078).

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Fig. 1. The 10 layer notched solenoid.

Fig. 2. Field dependence on the current up to the Quench at 45A and 2.3 Tesla and on the axial position.

in Mainz. The German Company ‘Jelonnek Transformatoren und Wickelgut GmbH’ has done the winding and gluing process according to our guidelines. We have tested the coil using a special holding structure in a standard liquid helium Dewar at a temperature of 4.2 Kelvin. Two Hall probes from the company ‘Lake Shore Cryotronics’ were used to measure the longitudinal and transverse field component. The Hall probes could be moved inside the coil to measure a field map. A maximum field of 2.3 Tesla at a current of 45 Ampere could be reached (see Fig. 2). The measured field homogeneity in the relevant volume of the target material (cylinder of 2 cm diameter and 2 cm length) was $\Delta B/B = 1.2 \cdot 10^{-3}$. The calculated homogeneity is much better ($\Delta B/B = 1.2 \cdot 10^{-3}$), which can be explained by winding imperfections.

2. Active Polarized Target Developments

We have started a series of tests [1, 2] with photodetectors for operation at cryogenic temperatures of 4.2 Kelvin in order to do a readout of the scintillation-light of our

frozen spin target in the framework of the PhD-thesis of M.Biroth. The polarizable polystyrene target material is under investigation.

References

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