Polarized Electrons in ELSA

(preliminary results)

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Abstract. Polarized electrons have been accelerated in the electron stretcher accelerator ELSA for the first time. Up to 2.1 GeV the polarization of the electron beam supplied by the 120 keV polarized electron source has been measured with a Møller polarimeter. Preliminary results of polarization measurements at high energies and the performance of the source are presented.

EXPERIMENTAL SETUP

The polarized electron source [1] operates in 50 Hz pulsed mode with a pulse length of 1 μsec using a flashlamp pumped Ti:Sapphire laser. At $\lambda = 750$ nm pulses up to 100 mA have been extracted from a GaAs superlattice crystal, delivered by the Nagoya group [2]. A polarization of the electron beam at the source of about 66 % is measured by Mott scattering at 120 keV. The lifetime of the source (1/e-intensity) depends on the beam intensity and is up to 50 h at about 50 mA.

The polarized electrons from the source are injected into the 20 MeV linac, then accelerated in the booster synchrotron up to 1.2 GeV and transferred to ELSA. During further acceleration in ELSA to energies between 1.27 and 2.1 GeV the beam crosses several depolarizing resonances. The influence of these resonances on the beam polarization has been studied with a Møller polarimeter.

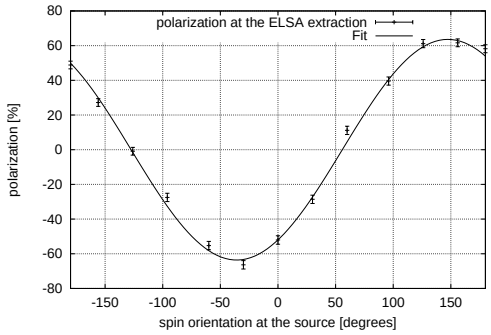
It uses a 40 μm Vacoflux foil with an inclination of 21° to the beam. The spin polarization of the foil is (8.27±0.26)% at saturation (100 Gauss). For the

asymmetry measurements a 2-arms-coincidence mode with 4 detectors is used. Averaged over the acceptance of $\Theta^* = (90 \pm 15)^\circ$ an asymmetry coefficient $a_{zz} = -0.76 \pm 0.02$ has been calculated (using Monte Carlo simulations). A Faraday cup and detectors sensitive to Bremsstrahlung events are used as intensity monitors.

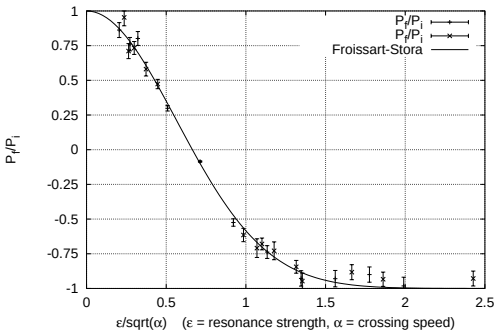
RESULTS

Up to 1.27 GeV, the beam polarization can be transferred from the source to the experimental area with small depolarization (Fig. 1a).

The loss of polarization due to crossing of the 3^{rd} imperfection resonance at 1.32 GeV could be avoided by a harmonic correction with a vertical closed orbit bump (Fig. 1b).



(a) Dependence of the final polarization on the spin orientation at the source.



(b) Polarization after crossing of the third imperfection resonance (extraction energy 1.37 GeV).

FIGURE 1. Polarization of the extracted beam.

With a ramping speed optimized for the resonances at 1.32 and 1.5 GeV (but without any correctors) a polarization of about 45 % could be conserved up to 1.9 GeV. Strong depolarization occurred at 2.0 GeV. Therefore above 2.0 GeV fast tunejump quadrupoles are essential to conserve polarization. The construction of two quadrupoles (with ferrite yoke) has been started [3].

REFERENCES

1. S. Nakamura, PhD thesis, in preparation
2. T. Nakanishi et al., proceedings of this workshop
3. C. Steier, D. Husmann, Correction of Depolarizing Resonances in ELSA, proceedings of the 1997 PAC, Vancouver