Polarized electron source operation at average currents of several mA

R.Barday and K.Aulenbacher

Institut für Kernphysik der Universität Mainz, 55118 Mainz, Germany

Future Projects such as EIC or antiproton polarization will require a highly polarized electron beam with several tens mA average current and with a sufficient charge lifetime. Existing sources achieve charge lifetimes of several hundred C but operate at average currents of hundreds of microamperes only. Therefore it is necessary to test the constancy of charge lifetime with beam current.

Experiments with high current were carried out using a 100 kV load-lock electron gun. The polarized electrons were produced from bulk GaAs photocathodes by laser illumination at a wavelength $\lambda = 808$ nm.

We made three observations which can tend to a reduction of charge lifetime. The first one is thermal heating because a temperature of 350 K leads to rapid degradation of the Cesium-Oxide activation layer of the photocathode. The second is ion trapping in the transfer line which leads to an increased flow of ions towards the cathode. It is possible to improve the lifetime of the photocathode by suppressing the ion flow with a repeller at a positive potential, behind the anode of the source. The third phenomenon is beam loss. A beam loss of 4 μA located 1 meter from the source limits the lifetime to 3 hours.

The effect outgassing from beam dump was studied. In order to decrease the outgassing rate of the beam dump in the presence of the polarized beam a new electron beam collector has been developed.