A 50KV INVERTED POLARIZED GUN

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A pulsed source of polarized electrons, optimized for a reliable operation for future experiments at the stretcher ring ELSA, was developed and set up. It is realized as inverted gun. The set up of the source, its load-lock system, the transfer line and laser system are described in the following report.

INTRODUCTION

Starting in the next months experiments with circularly polarized photons (produced by Bremsstrahlung of longitudinally polarized electrons) will be carried out [1]. In order to preserve the polarization level to the experimental target, several depolarizing resonances have to be crossed and corrected for during the acceleration of the electron beam. To study these phenomena in detail, an existing 120kV polarized electron source was improved and set into operation [2]. Detailed studies of depolarizing resonances up to 2 GeV could be performed using this source [3]. It turned out that the reliability and life time of this source will hamper the planned experiments. For this reason, a second source of polarized electrons was developed and set up. It will operate with a newly installed pulsed injector linac which requires an injection energy of 50keV, a pulse length of 1µsec and a repetition rate of 50Hz. The required maximum peak current at the source has to be 100mA.

THE 50KV GUN

A cross section of the gun is shown in Fig. 1. This setup allows for heat cleaning and activation of the crystal inside the gun chamber. For this, the cathode unit can be retracted and an activation unit may be driven in. In addition, it allows to adjust the perveance of the gun to the desired value by changing the cathode position. Numerical simulations using the EGUN code showed that the space charge limited

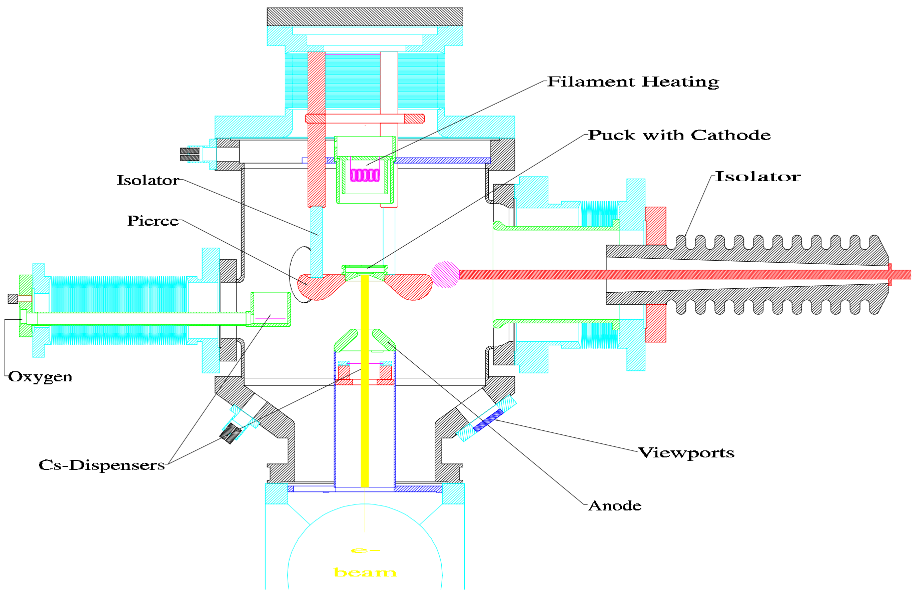

Figure 1: Setup of the 50kV gun

maximum current could be varied from 60mA to 330mA without changing the high voltage. The maximum field strength at the surfaces of the electrodes is below 3.3kV/mm. Consequently a continuous emission (dark current) of less than 1nA has been achieved at 60kV in first high-voltage tests.

The gun is equipped with a NEG-pump and a ion getter pump. The total pressure is below $1x10^{-11}$ mbar, with partial pressures of the major poisoning gases (carbon dioxide and water vapor, [4,5]) of $1x10^{-13}$mbar.

LOAD-LOCK

To enhance the reliability of the source, a load-lock system was developed and will be installed in September 1998. It consists of a preparation chamber and a magnetic manipulator (see Fig. 2). A filament heater is used for heat cleaning of the crystal. A channel cesiator and a heated silver rod allow an activation of the crystal with cesium and atomic oxygen. High pumping speed will be achieved by means of

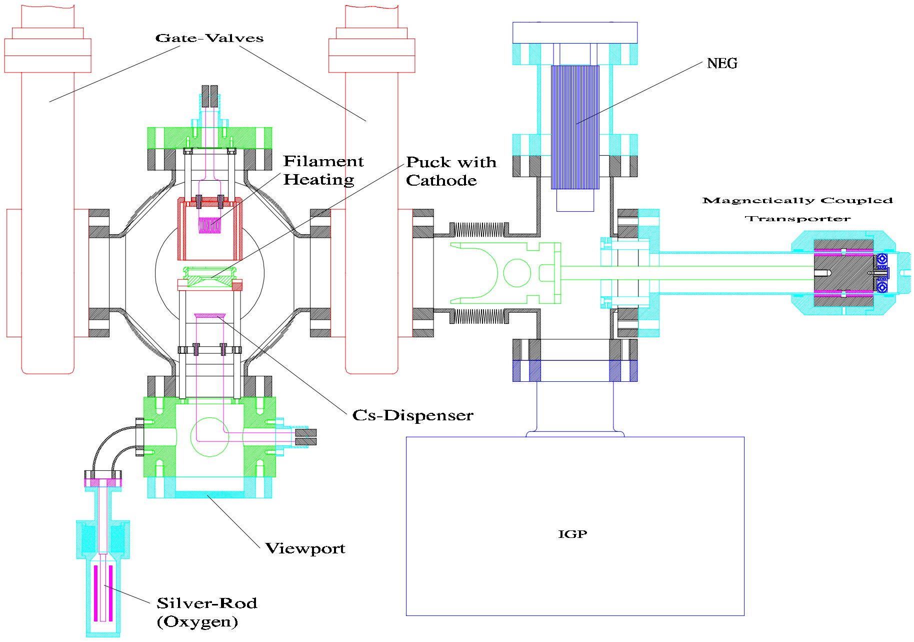

Figure 2: Setup of the load-lock

a turbo molecular pump, an ion getter pump and a NEG-pump.

TRANSFER LINE

In order to decouple the ultrahigh vacuum of the gun from the higher pressures downstream in the injector ($P=10^{-8}$ mbar), the transfer line is equipped with four ion getter pumps, one NEG-pump and one turbo molecular pump. Two 90° magnetic bends provide additional isolation. The polarization of the beam is changed from longitudinal to transverse by means of an electrostatic toroidal bending condenser. Several monitor stations (wire scanners, cromox screens, faraday cup) will allow a precise measurement of the beam position, profile and intensity. Numerical simulations of the space charge dominated beam transport were carried out to optimize the position of the focusing solenoids and quadrupoles. From this simulations we expect a high transfer efficiency up to currents as high as 200mA.

LASER SYSTEM

Assuming quantum efficiencies of about 0.5% the laser peak-power has to be 40W in minimum which corresponds to pulse energies of 40µJ. Taking into account the phenomena of charge saturation a pulse energy of about 1mJ (pulse length 1µsec) is needed. For the operation of the 120kV source, a flashlamp-pumped free running Ti:sapphire laser was used. The laser pulses were chopped to 1µsec by a pockels cell and polarizer and fed via a 85m long optical fiber to the source. This system will be used for the 50kV source as well. To suppress the spiking of the pulsed laser, the method of injection seeding by a cw seed-laser will be investigated in near future. For this purpose, a cw-Ti:sapphire laser was set up. This laser is pumped by an argon vapor laser and will allow a modelocked operation if injection locking by a RF-modulated low power diode-laser is applied.

CONCLUSION

To fulfill the demands of future experiments a 50kV source of polarized electrons was developed and set up. It will be equipped with a load-lock to enhance the reliability of the source. The transfer line to the

injector provides for high vacuum isolation and was optimized for high transfer efficiencies. The pulse shapes of an existing flashlamp pumped Ti:sapphire laser will be improved by injection seeding.
The source is planned to go into operation at the end of this year.

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