# Simulation for a New Polarized Electron Injector (SPIN) for the S-DALINAC

TECHNISCHE UNIVERSITÄT DARMSTADT

Institut für Theorie Elektromagnetischer Felder

B. Steiner, T. Weiland

TEMF, Schloßgartenstraße 8, 64289 Darmstadt, Germany, steiner@temf.tu-darmstadt.de

## Abstract

The Superconducting DArmstädter LINear Accelerator (S-DALINAC) is a 130 MeV recirculating electron accelerator serving several nuclear and radiation physics experiments. For future tasks, the 250 keV thermal electron source should be completed by a 100 keV polarized electron source. Therefore a new low energy injection concept for the S-DALINAC has to be designed. The main components of the injector are a polarized electron source, an Alpha magnet, a Wien filter spin-rotator and a Mott polarimeter.

## Introduction

These days, polarized electron beam has been widely used for various spin physics experiments at many electron accelerators. GaAs polarized electron sources are mostly used because of its high polarization degree of about 80% in practice. The S-DALINAC is world wide the only accelerator in the low energy range. There is still a lot of basic research in modern nuclear physics to do

- violation of parity in nucleus,
- breakup reactions of light nucleus and
- determination of low energy constants.

Therefore a new injector has to be designed. The beam should be delivered by a 100 keV polarized electron source using a NEA-GaAs photocathode.

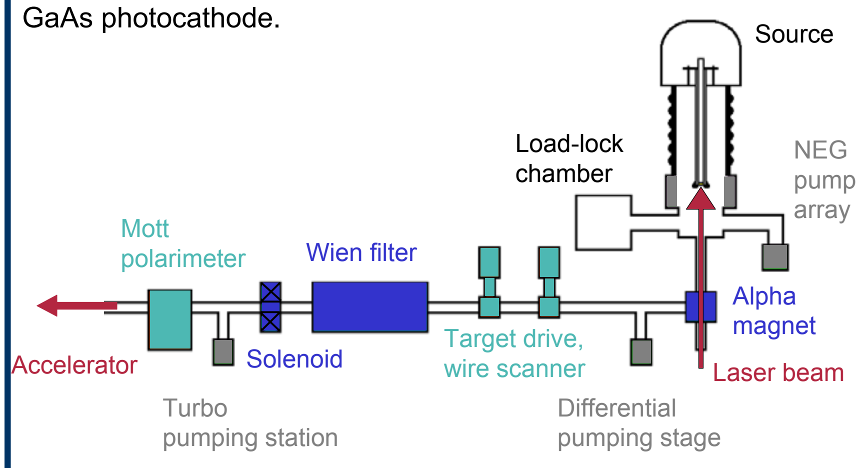


*Figure 1: Principle of the new Injector Design*

## Design

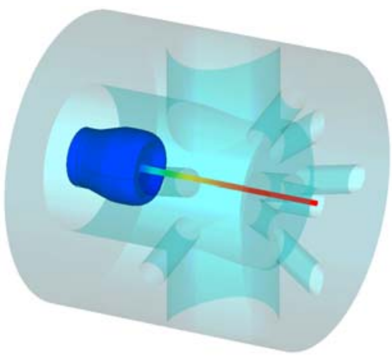

*Figure 2: Electron Source*

**Electron Source Characteristics**

- compact design
- easy handling
- long lifetime
- short maintaining time

**Alpha magnet Characteristics**

- easy system
- 90° deflection (real 270°)
- electron-optical characteristics controllable
- dispersion free

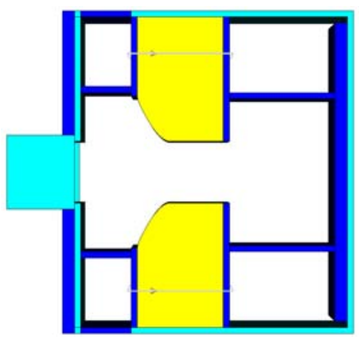

*Figure 3: Alpha Magnet*

## Simulation Results

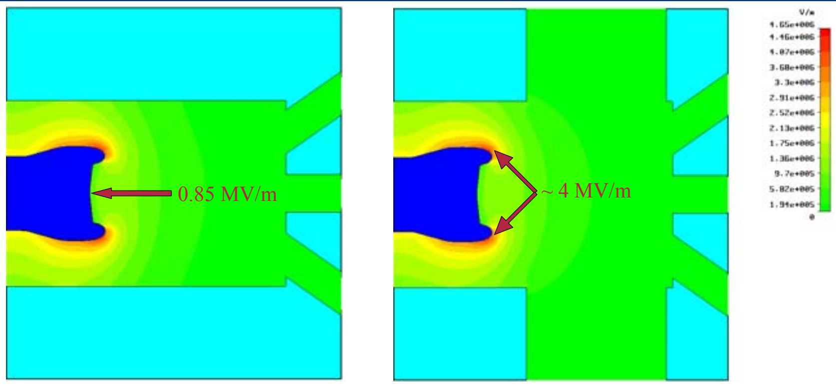


*Figure 4: Section Planes of the Absolute E-field of the Source*

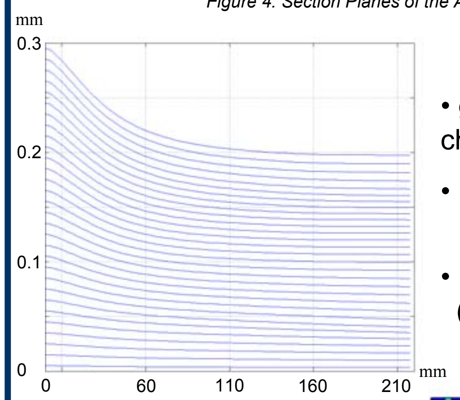


*Figure 5: Trajectories in the Source*

- good electron optic characteristics
- low E-field at photocathode (<1 MV/m)
- nearly dispersion free beam ($<=10^{-4}$ mrad)

- operating range $B_{hom}$= 300-500 Gauß
- nearly dispersion free beam
- steepness of fringing field important
- "independent" of small energy input range
- high magnetic flux density backflow

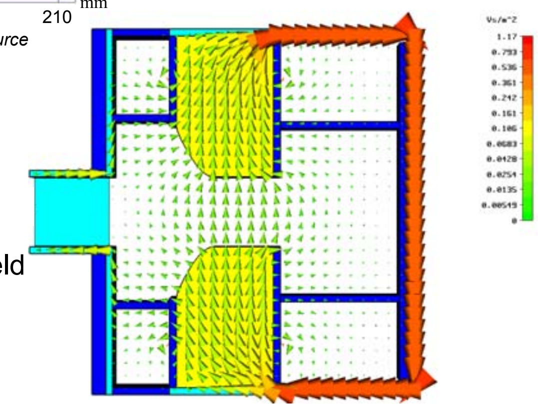

*Figure 6: Magnetic Flux Density in the Alpha Magnet*

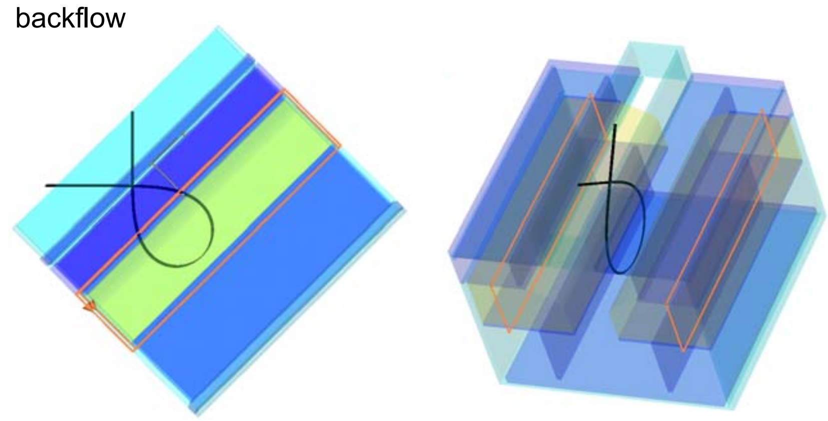

*Figure 7: Trajectories in the Alpha Magnet*

## Summary / Outlook

**Summary**

| Successfully Design | Expectation |
|---|---|
| Cathode<br>compact design<br>beam characteristics realized<br>Alpha magnet of MAMI<br>design transferable | long life time of the photocathode<br>easy handling<br>short maintaining time |

**Outlook**

simulation from gun through Alpha magnet
beam transport calculation to 2-cell structure
longitudinal beam dynamics calculation