Abstract

The first step in the three-step laser assisted H beam stripping for charge exchange injection is to remove one electron in a strong magnetic field. In order to preserve the beam emittance for the subsequent laser induced stripping of the second electron the magnetic field has to have large gradient of about 40 T/m along the beam trajectory. The required magnetic field strength for stripping 1 GeV H beam is 1.2 T. In order to allow for undisturbed passage of high power beam during the nominal SNS operation the stripping magnet made of permanent material resides in vacuum chamber and can move in and out of the beam line. This paper describes requirements, design and the magnetic field calculation results for a stripping magnet for the Laser Stripping Experiment at SNS.

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Stripping magnet requirements

- Field strength >1.2 T
  - To provide efficient 1 GeV H ion neutralization
- Field gradient along beam path >4 T/cm (@1.2T point)
  - To ensure small angular spread
- Field strength at beam to laser interaction point <.002 T
  - To ensure efficient laser to H atom interaction
- Minimum total beam deflection from entrance to exit
  - To facilitate stripped beam transport
- Compatibility with SNS high power operation
  - Clear aperture of 150mm

Distribution of the stripping probability along the beam path (bell shaped curves) inside a magnet with linearly ramping fringe field (magnetic field profile is shown on the same graph)

Angular spread on the magnetic field gradient (linearly increasing magnetic fields with different maximum field strength and ramp length were used in the calculations)

Plot of the magnetic field strength (blue) and gradient (red) distribution along the beam path.

The magnet assembly design

The SNS laser stripping experiment layout

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Layout of the magnets arrangement for the SNS stripping experiment. Dimensions are in mm.

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The SNS laser stripping experiment layout