

Contribution ID: 70

Type: **Parallel Session Presentation**

Optically polarized alkali metal cell for muonic helium measurements

Tuesday, 19 October 2021 18:50 (30 minutes)

Muonic helium is a helium atom with one of the two electrons substituted by a negative muon. This three-body atomic system gives rise to opportunities to precisely study the hyperfine structure interval as well as the negative muon magnetic moment and mass. Muonic helium atoms are formed by stopping a negative muon beam in dense helium gas, but in this formation process, the polarization of muons is lost by a factor of ten or more, remaining only several percent of the muons spin-polarized. They can, however, be repolarized by spin-exchange collisions with polarized alkali metal atoms [1], the same as spin-exchange optical pumping often used to polarize noble gas nuclei [2].

We are studying glass cells containing pressurized helium gas and alkali metals for muonic helium measurements at J-PARC Muon Facility MUSE [3]. The glass cell, helium gas pressure, and polarized alkali metal density are essential to maximize the number of polarized muonic helium atoms. So called hybrid alkali metal optical pumping, which was first developed to achieve a high ^3He nuclear polarization [4], can be applied for effective repolarization of muonic helium atoms. In the hybrid optical pumping, Rb is optically pumped conventionally, and the Rb polarization is rapidly passed to K atoms by spin-exchange collisions inside a cell with Rb and K enclosed together. Thanks to the smaller spin-destruction cross section in K-K collisions compared to those between Rb atoms, a higher alkali metal number density with a very high polarization can be obtained by the hybrid method.

We will discuss hybrid alkali metal optical pumping cells for muonic helium measurements.

[1] A. S. Barton et al., Phys. Rev. Lett. 70, 758 (1993).

[2] T. G. Walker and W. Happer, Rev. Mod. Phys. 69, 629 (1997); T.R. Gentile, P.J. Nacher, B. Saam, and T.G. Walker, Rev. Mod. Phys. 89, 045004 (2017).

[3] P. Strasser, K. Shimomura, and H. A. Torii, JPS Conf. Proc. 21, 011045 (2018).

[4] E. Babcock et al., Phys. Rev. Lett. 91, 123003 (2003).

Primary author: Dr INO, Takashi (KEK)

Co-authors: FUKUMURA, Seiso (School of Science, Nagoya University); STRASSER, Patrick (IMSS, KEK); FUJITA, Masaki (IMR, Tohoku University); IKEDA, Yoichi (IMR, Tohoku University); KANDA, Sohtaro (IMSS, KEK); KITAGUCHI, Masaaki (KMI, Nagoya University); NISHIMURA, shoichiro (IMSS, KEK); OKU, Takayuki (JAEA); OKUDAIRA, Takuya (School of Science, Nagoya University); SHIMIZU, Hirohiko (School of Science, Nagoya University); SHIMOMURA, koichiro (IMSS, KEK)

Presenter: Dr INO, Takashi (KEK)

Session Classification: Polarized Sources and Targets

Track Classification: Parallel Sessions: Acceleration, Storage and Polarimetry of polarized Beams