Contribution ID: **83** Type: **Oral**

muCool: A novel low-energy muon beam for future precision experiments

Thursday 9 September 2021 12:55 (25 minutes)

High precision experiments using muons (μ^+) and muonium atoms ($\mu^+ e^-$) provide unique opportunities to test the fundamentals of the Standard Model in a second-generation, fully-leptonic environment, putting a broad spectrum of BSM scenarios within the reach of next generation experiments. Such experiments include the search for the muon electric dipole moment, measurements of the muon $g-2$, laser spectroscopy of muonium and gravitational equivalence principle tests using muonium. Such experiments would benefit greatly from an intense, high quality and low energy muon beam.

At the Paul Scherrer Institute, a novel phase space compression scheme (muCool) has been developed, which would produce such a beam, reducing the phase space of a standard muon beam by ten orders of magnitude at 10^{-3} efficiency, for a 10^7 boost in brightness. The muon beam is stopped in cryogenic helium gas, and using complex electric and magnetic fields in combination with a gas density gradient the muons are steered to a mm-size spot, where they have an eV energy spread. From here, they are extracted through a small orifice into a vacuum and into a magnetic field free region. The process takes less than 10 μs, critical to achieving a good efficiency considering the short 2.2 μs muon lifetime.

Several key steps in the phase space compression scheme within gas has been demonstrated with high efficiency during several measurements at the PSI muon facility. In this talk, the working principle of the device, the results of recent measurements and prospects for the future will be presented.

This work is supported by SNF grant 200020_172639.

Working group

WG4

Presenter: AYRES, Nicholas John (ETH Zurich)

Session Classification: WG 3 + WG 4 (WG3 zoom)