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

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High precision experiments using muons (μ+) and muonium atoms (μ+e−) offer promising opportunities to test theoretical predictions of the Standard Model in a second-generation, fully-leptonic environment. Such experiments including the measurement of the muon g-2, muonium spectroscopy and muonium gravity would benefit from intense high-quality and low-energy muon beams.

At the Paul Scherrer Institute, a novel device (muCool) [1] is being developed to reduce the phase space of a standard μ+ beam by a factor of 109 with 10−4 efficiency, for a 105 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 entire process takes less than 10 μs, which is crucial given the short 2.2 μs muon lifetime.

The presented poster will outline the working principle, the present status and future prospects of the muCool experiment with a special focus on the extraction stage from the orifice into vacuum.

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[1] Belosevic, I., Antognini, A., Bao, Y. et al. muCool: a next step towards efficient muon beam compression. Eur. Phys. J. C 79, 430 (2019). https://doi.org/10.1140/epjc/s10052-019-6932-z

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