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Simultaneous injection of positrons and electrons – progress towards a pair-plasma at NEPOMUC

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A pair-plasma, a system where both the positively and negatively charged particles have the same mass, is predicted to possess unique physical properties. The APEX collaboration attempts to magnetically confine the first low-temperature electron-positron pair plasma in the magnetic field of a levitated superconducting coil. In a prototype experiment, positrons provided by the NEPOMUC facility are magnetically guided towards our confining field created by a supported permanent magnet. Perpendicular electric and magnetic fields at the injection port provide a drift to inject the positrons across magnetic field lines. Extensive investigations of the large parameter space spanned by electric and magnetic field configurations deepened the understanding of the injection process and resulted in injection efficiencies of 100% [1] and confinement times exceeding one second [2]. To create the first mixture of positrons and electrons in our device, a compact electron source placed upstream forms a second beam propagating parallel to the positron beam. A successful co-injection and detection of both particles was demonstrated, while using conditions optimized for positron injection. This represents an important step towards the goal of a confined pair-plasma. An overview of this project as well as future prospects will be presented in this contribution.

[1] E. V. Stenson, et.al., Phys. Rev. Lett. 121, 235005 (2018).

[2] J. Horn-Stanja, et al., Phys. Rev. Lett. 121, 235003 (2018).

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