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Muon Capture as a Probe of the Weak Axial Current

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Muon capture provides a powerful tool to study the properties and structure of the nucleon and few nucleon systems predicted by chiral effective theories founded on Quantum Chromodynamics. Our program focuses on capture from the simplest of all muonic atoms, muonic hydrogen (MuCap experiment) as well as muonic deuterium (MuSun experiment), by using a novel active target method based on the development of high pressure time projection chambers filled with hydrogen/deuterium gas. In this contribution we discuss two applications.

Nucleon axial radius and muonic hydrogen. In a recent review [1] the model independent re-evaluation [2] of the axial radius squared $r_A^2(z\ \mathrm{exp.}) = 0.46(22)$ fm^2 from νd scattering and the muon capture rate in hydrogen measured in MuCap was used to update the value of the induced pseudoscalar form factor g_P and, alternatively, to determine an independent $r_A^2(\mathrm{MuCap}) = 0.46(24)$ fm^2 from muon capture.

MuSun and astrophysics neutrino reaction. The precision measurement of the capture rate for $\mu d \to nn\nu$ in MuSun will determine a critical low-energy constant in effective field theories, required for the calculation of fundamental astrophysics reactions like solar *pp* fusion and νd scattering at SNO. Data taking of the experiment was successfully concluded and the analysis is in an advanced state.

[1] Richard J Hill et al, Rep. Prog. Phys. in press (2018), http://iopscience.iop.org/article/10.1088/1361-6633/aac190

[2] A.S. Meyer et al, Phys.Rev. D 93, 113015 (2016)

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