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Muon capture at PSI

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The muon capture experiment MuCap uses a negative muon beam stopped in a time projection chamber as an active target filled with ultra-pure hydrogen gas. The elementary capture process mu- +p-> n+nu offers a rare (0.15%) but additional disappearance channel. The measured difference of the positive and negative muon's lifetime determines the rate of the capture process to a final precision of 1%. This can be used to derive an improved value of the proton's pseudoscalar form factor gP to 7% precision. A first result gP = 7.3 +- 1.1 has been published [1]. This is a first precise, unambiguous determination of gP and an important test of QCD symmetries. The analysis of the full data set with a 2-3 times better precision will be finalized soon.
Our new experiment, MuSun [2] will measure the doublet capture rate of the mu- +d -> n+n+nu providing a benchmark of the understanding of weak processes in the two nucleon-system. It was shown, that other weak reactions involving the two nucleon system (pp -> d e+ nu or neutrino-deuteron reactions) are related to the same low-energy constant, characterizing the two nucleon system at short distances. This constant is not well constrained and therefore the MuSun experiment comes closest to calibrating these basic astrophysical reactions under terrestrial conditions. The experiment will use a newly developed time projection chamber at 30 K which is currently designed. A commissioning test with the full cryogenic setup succeeded in spring 2010 and a first physics run is scheduled for October 2010.

[1] Phys. Rev. Lett. 99, 032002 (2007)
[2] http://www.npl.uiuc.edu/exp/musun/documents/prop07.pdf

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