Nuclear Muon Capture in Hydrogen and its Interplay with Muon Atomic Physics

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The MuCap collaboration has measured the singlet capture rate Λ_s for the semileptonic weak process $\mu + p \rightarrow n + v$ using a new experimental technique based on a hydrogen time projection chamber. This allows the unambiguous determination of the pseudoscalar form factor g_P of the charged electroweak current of the nucleon. Our first result $g_P(q^2 = -0.88m_\mu^2) = 7.3 \pm 1.1$ is consistent with accurate theoretical predictions and constitutes an important test of QCD symmetries. Additional data are being collected with the aim of a more than twofold reduction of the experimental uncertainties. As a follow up experiment the collaboration is planning a measurement of the muon capture rate on the deuteron to 1% precision. This would provide the most accurate experimental information on the axial current interacting with the two nucleon system and determine the low energy constant L_{1A} relevant for solar neutrino reactions and the SNO experiment.

Muon induced atomic and molecular processes represent challenges as well as opportunities for this science program, and their interplay with the main nuclear and weak-interaction physics aspects will be discussed.