First Results from the New Muon Lifetime Experiments at PSI

Peter Kammel[1]
representing the MuCap [1] and the MuLan [2] Collaborations

[1] University of Illinois at Urbana-Champaign, Urbana, USA

Contact e-mail: pkammel@uiuc.edu

We survey a new generation of precision muon lifetime experiments at the Paul Scherrer Institute, and present their first results and plans for the future.

The goal of the MuCap experiment is a measurement of the rate Λ_S for the muon capture on the proton to 1%, from which the induced pseudoscalar form factor g_P of the nucleon can be derived. MuCap reports a first result for $g_P = 7.0 \pm 1.1$, in agreement with the precise chiral prediction (see Fig.1). Further data will reduce the present error by more than a factor of 2. A measurement of the related $\mu + d$ capture process with similar precision would provide unique information on the axial current in the two nucleon system, relevant for the $\nu + d$ reactions observed by the SNO experiment and the solar fusion process.

The MuLan experiment aims to measure the positive muon lifetime τ_μ with 20–fold improved precision compared to present knowledge in order to determine the Fermi coupling constant G_F to better than 1 ppm. A first analysis of a limited data set already cuts the uncertainty in the world average of τ_μ in half and demonstrates the viability of the new experimental technique. Two orders of magnitude higher statistics are being collected and part of these new data are currently being analyzed.

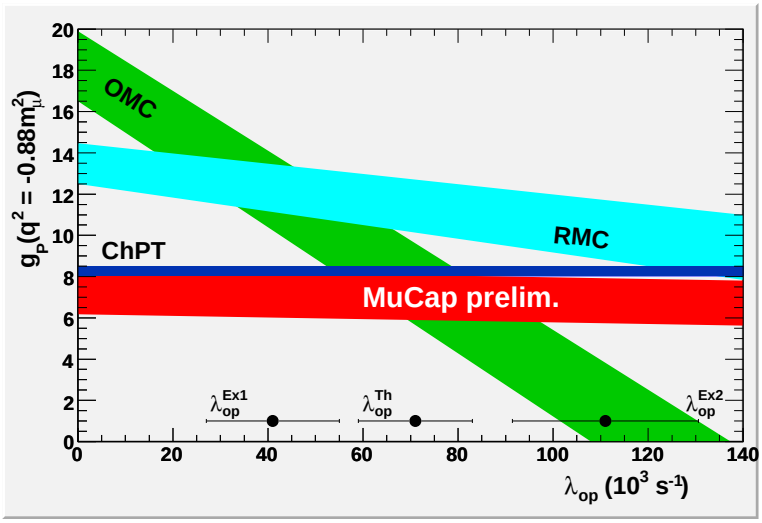

Figure 1: Impact of the MuCap result: Previous experiments and theory are inconsistent. The experiments cannot be reliably interpreted to extract g_P, as they depend on the poorly known ortho-para transition rate λ_{op} in muonic molecular hydrogen. MuCap avoids this model dependence and reports the first unambiguous result for the pseudoscalar form factor g_P.

1. http://www.npl.uiuc.edu/exp/mucapture/
2. http://www.npl.uiuc.edu/exp/mulan/