Measuring the lifetime of the muon to 1 ppm with MuLan at PSI

DAVID HERTZOG, University of Illinois at Urbana-Champaign, MULAN COLLABORATION — The MuLan collaboration\(^1\) will measure the positive muon lifetime to 1 ppm. This precision will determine the Fermi coupling constant \(G_F\), which sets the strength of the weak interaction, to 0.5 ppm. In addition to its fundamental connection to the structure of the standard model, the \(\mu^+\) lifetime is needed as a normalization for muon capture experiments. A \(\pm 12.5\) kV electric kicker is used to impose a pulsed structure on the continuous muon beam at the Paul Scherrer Institute, with a bunch of \(~50\) muons arriving within a \(5\) \(\mu\)s beam-on time followed by a \(22\) \(\mu\)s beam-off measuring period. Muons are stopped in a depolarizing target, either amorphous sulfur or Arnokrone-3, to reduce the effects of spin rotation; an external magnetic field is applied to dephase the muons over the accumulation time. A scintillator hodoscope with 170 tile pairs arranged in a truncated icosahedral (“soccer ball”) geometry provides a high level of segmentation to minimize pulse pileup. Similarly, new waveform digitizers will resolve pulses at separations of \(4\) ns. A dataset is in hand that should provide an initial result with \(7\) to \(10\) ppm precision, a factor of \(\sim 2\) better than the current world average, and major production running is scheduled in 2005 and 2006. MuLan is supported by the National Science Foundation and the Department of Energy \(^1\) U.C. Berkeley - Boston U. - U. Illinois - Istanbul Tech. U. - James Madison U. - U. Kentucky - KVI - PSI

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