BEAM LINE STUDIES FOR THE MEG EXPERIMENT ($\mu \rightarrow e\gamma$)

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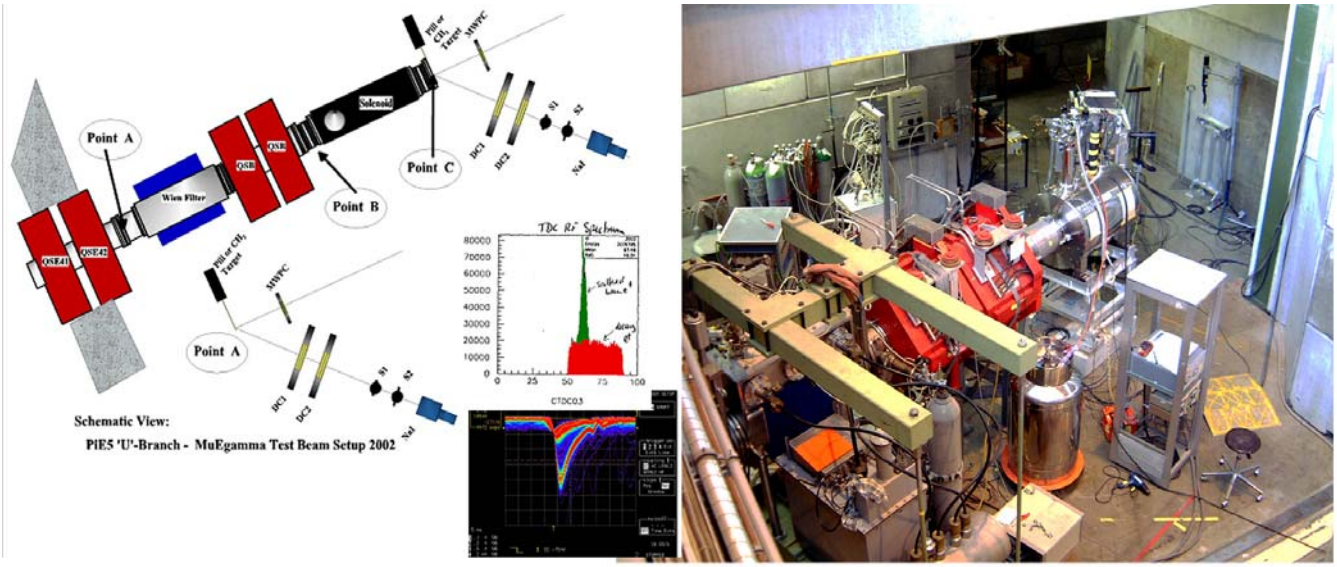

Figure 1: *Schematic diagram and photograph of the test setup used in the πE5 "U"-branch. Measurements were made at three locations: Point A, post QSE41/42 doublet, point B after the separator and the final location, point C, post solenoid. A 4 μm thick differential pressure window, made of Mylar, was placed just after QSE42 in order to suppress rest-gas activation for the measurements. Also shown are the detector systems used, a small "pill" scintillation counter, mounted on an X-Y scanner. A scintillation counter telescope S1,S2, together with a large NaI(Tl)-counter. A set of fast multi-wire proportional chambers (MWPC1/2), used for tracking, and a profile MWPC. The particle discrimination power is demonstrated in the inserts, which show an oscilloscope trace from the 2mm pill counter (μ^+-line and e^+-line), as well as a time difference spectrum, relative to the accelerator radio-frequency signal (correlated peak - due to beam e^+, flat spectrum - due to μ^+ and Michel e^+). The NaI(Tl)-counter, at point C in the photograph, is mirrored w.r.t. the position in the diagram.*

In order to reach the design goals of the detectors planned for the MEG-experiment [1], a well understood beam transport system is required. This should deliver a high intensity surface muon beam, capable of stopping in a small, well defined, thin target, placed centrally in a gradient-field solenoid, and allowing only a minimum of contaminant particles to enter the detectors.

Beam studies were started at the end of 2001 in one of the two branches ("U" and "Z") of the πE5 beam line at PSI, the most intense surface muon beam available. The conclusion reached after initial measurements in the "U"-branch [2] was that a stopped surface muon beam of sufficient intensity and free from beam correlated positrons could not be achieved in the "U"-branch, using a so-called "2-in-1" method. This simultaneously degrades the momentum of the desired surface muons and spatially separate them from contaminant beam positrons via an induced differential energy-loss in a degrader and subsequent spectrometer.

The goal of the years two beam periods in July/August ("U"-branch) and November/December ("Z"-branch) was to find a viable alternative method, as well as make a comparative study of both branches, such that an optimal choice can be made as to which branch is most suitable for the experiment. Figure 1 shows the setup used for the "U"-branch measurements, however, the principle was applicable to both periods.

Provisional results show that a suitably intense surface muon beam of 28 MeV/c with a very good μ/e-separation of between 7-11 sigma, as well as a small target spot-size of approximately 5-6 mm (sigma), in both dimensions, can be achieved by a two-stage method to transport, separate and stop the muons, using a WIEN-filter and a solenoid/degrader system. A detailed analysis of the data is currently underway.

REFERENCES

[1] PSI Proposal R-99-05.01, "Search for $\mu \rightarrow e\gamma$ down to 10^{-14} branching ratio", May 1999, and
"The MEG experiment: search for the $\mu \rightarrow e\gamma$ decay at PSI", September 2002,
http://meg.web.psi.ch/docs/prop_infn/nproposal.ps.gz.

[2] A. Baldini *et al.*, PSI Progress Report on "The $\mu \rightarrow e\gamma$ Experiment", July 2002,
http://meg.web.psi.ch/docs/progress/jun2002/report.pdf
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