Muon-S: JRA working group meeting

Villigen, September 9, 2005

The fourth semi-annual meeting of the Muon-S JRA was held at the Paul Scherrer Institut, Villigen, Switzerland on September 8th - 9th 2005:

Working Group Meeting WP1 (Detectors), WP2 (Simulations) and WP3 (Advanced Techniques)

Agenda:

1. Proposed agenda for open and closed session at the forthcoming NMI3 meeting,
2. WP 1 discussion on position-sensitive detection,
3. WP 2 discussion on instrument simulation and its experimental tests,
4. Discussion on analog detection,
5. Any other business.

Attending:

- S. Cottrell (ISIS)
- R. De Renzi (Parma)
- T. Lancaster (Oxford)
- E. Morenzoni (PSI)
- R. Scheuermann (PSI)
- T. Shiroka (Parma)

External observers invited to attend: A. Amato and A. Stoykov (PSI)

1. Proposed agenda for the NMI3 Meeting

It was agreed to suggest the following agenda for the open session to the coordinator:

- Introduction (Cesare Bucci)
- High field avalanche photo-diodes (Robert Scheuermann)
- Flypast methods at ISIS (to be defined)

- RF methods and AC susceptometer (Stephen Cottrell)
- Analog detection (Robert Scheuermann)
- Position sensitive detection (Toni Shiroka)
- Instrument simulation (Tom Lancaster)
- Discussion
- Summary and conclusions (Cesare Bucci)

2. WP 1 - Choices regarding position-sensitive detection (PSD)

A brief overview of the available options for PSD was summarized by TS, with interesting additional considerations by AS. The first issue was to list possible applications of PSD and single out those with a higher chance of application in the immediate future. Those considered were:

a- Positron and muon tracking for complete vertex reconstruction.

b- Moderate positron-only spatial resolution to discriminate vertex origin in e.g. two portions of a sample.

c- Moderate segmentation of detectors to allow for software reaggregation.

d- High segmentation of detectors to overcome dead time effects at ISIS.

At the first stage positron and muon tracking could be probably too challening. The most promising for a realistic near future deployment seems d. A few schematic geometries under consideration for the new high field instrument at ISIS were briefly discussed.

Particular attention must be devoted to the devices showing the shortest dead-time, since this is a parameter of importance for the ISIS application.

To overcome the problem of a large density of hits, especially at a pulsed source as RAL, a pixelated detector would be highly desirable. The main challenge is to provide a modular pixel density, high at the centre and moderate at the edges of detector. This would allow a good performance even at high fields, where the pile-up effect in the central region of cylindrical symmetry detector arrays becomes critical. The large area of the detector (to be achieved by the use of moderately large peripheral pixels) would allow a large flexibility by the use of software defined detector geometries.

A preliminary, very rough spatial resolution would be sufficient also for purpose b, e.g. for performing experiments involving chemical diffusion.

It was further recognized that as a first step towards PSD prototyping it is necessary to build up practice with experimental detector issues and to be able to test single small scale positron detectors.

Both the use of silicon (Si-pads and pixels) and scintillating fiber PSD detectors will be pursued, the first having the advantage of an extremely developed technology, while the latter the best time response.

Tests of scintillating fibers (high photon generation and transmission) and segmented photomultiplier tubes (highest quantum efficiency) will also allow to check the analogue detection schemes.

It is foreseen that the combination of moderate segmentation (10 fibers per cm) and analog detection, which can cope with a few tens of particle hits per pulse, may be the best compromise for a high field positron detector at ISIS.

Silicon strips and pads will be tested to find the best compromise between high S/N ratio (larger but slower) and fast (smaller but noisier) detectors. A test on the DEVA beam of an existing ISIS silicon strip detector is scheduled for early next year.

3. WP 2 - Simulations and measurements in high field

Simulations of muon and positron trajectory evolution in high magnetic fields allow specifying and optimising the parameters of the future high-field μSR spectrometer.

Up to now not only the magnetic field distribution inside the magnet, but also the stray field map up to a distance of ~ 0.5 m, can be taken into account. The sophistication of simulations is such as to allow realistic predictions and therefore the possibility of experimental checks.

TL and RS gave a brief report on the recently completed tests performed on ALC. They consisted in studying the evolution of the beam waist as a function of field by using a specially prepared mask featuring an offset hole. Observations agreee well with simulations performed by TL using the GEANT4 suite.

Open challenges towards the monitoring of positron trajectories where discussed. It was decided that new beam time on ALC will be requested for next round.

4. Analog detection

The Stuttgart analog detection scheme is foreseen to be tested at the begining of February 2006 for the case of RF experiments.

5. Other business

The next meeting will take place at RAL in February 2006, exact date still to be agreed.