Agenda and Minutes of the 1st Meeting of the JRA, 30th March 2009

Agenda:

The JRA in Framework Programme 7

1. Overview of the new JRA (Stephen Cottrell)
2. Fast timing detectors for operation in high magnetic fields (Alexey Stoykov)
3. Designing a high Longitudinal Field instrument for ISIS (Philip King)
4. Development of a solid sample pressure cell (Daniel Andreica)
5. Development of a gas-phase sample cell with RF coils (Stephen Cottrell)
6. RF μSR experiments using NMR style pulsed sequences (Nigel Clayden)
7. Simulation codes as an aid to experiment analysis (Giuseppe Allodi)
8. Beamline diagnostics and modelling, and experiment simulation (James Lord)
9. Discussion

Beamline and instrument simulation: results from FP6

1. Towards a general instrument simulation programme (Toni Shiroka)
2. Modelling a high field instrument for ISIS (Zaher Salman)
3. Simulations for the ALC upgrade and the high-field instrument at PSI (Kamil Sedlak)
4. Improving muon production characteristics (Bob Cywinski)
5. Discussion

Attending:

1. Giuseppe Allodi (Parma),
2. Alex Amato (PSI),
3. Daniel Andreica (Babes-Bolyai),
4. Pavel Bakule (RIKEN-RAL),
5. Nigel Clayden (East Anglia),
6. Steve Cottrell (STFC),
7. Bob Cywinski (Huddersfield),
8. Adrian Hillier (STFC),
9. Philip King (STFC),
10. Hubertus Leutkens (PSI),
11. James Lord (STFC),
12. Alexander Maisuradze (PSI),
13. Elvezio Morenzoni (PSI),
14. Thomas Prokscha (PSI),
15. Zaher Salman (PSI),
16. Robert Scheuermann (PSI),
17. Kamil Sedlak (PSI),
18. Toni Shiroka (PSI),
19. Alexey Stoykov (PSI),
20. Andreas Suter (PSI)

Talks:

The JRA in Framework Programme 7

Stephen Cottrell (STFC): **Overview of the new JRA**
An overview of the JRA was presented, including a list of partners and collaborators. The various tasks associated with this JRA were outlined and the timeline for the work highlighted.

Alexey Stoykov (PSI): **Fast timing detectors for operation in high magnetic fields**
A summary of the past research into Avalanche Photodiodes (APDs) was presented. This showed that APDs were insensitive to field, compact, low voltage, and were marginally faster than PMT's. However, they had a small active area and therefore large arrays would be needed.

Philip King (STFC): **Designing a high Longitudinal Field instrument for ISIS**
An overview of the upgrades happening at ISIS was presented, including the EMU upgrade, RIKEN-RAL laser, pressure cell, the forthcoming very high flux instrument as well as the new high field instrument (HiFi). An overview of the science case and technical design was given and it was reported that proposals are being accepted this round for Oct '09.

Discussion:

a. Will you be able to check the alignment of the magnetic field to the geometry offline?
   Yes, an NMR probe and jig have been built.
b. What is the field outside the magnetic and will this affect the other instruments?
   The design was 2G at 3m and 5G within the experimental area, which is the same as EMU.
c. Will they be an alpha shift?
   Asymmetry should be flat and simulations have been done.

Daniel Andreica (Babes-Bolyai): **Development of a solid sample pressure cells**
At PSI there are currently 25kbar pressure cells, but these require large samples to ensure an adequate signal to noise ratio. Increasing the pressure will require smaller volumes, and therefore new materials should ideally make a smaller contribution to the measured signal. The issues that will be addressed are the cell design, better focussing of the muon beams and new materials.

Discussion:

a. What kind of new materials are going to be investigated?
   Ceramics, 'Russian' alloy (bad for muons) and the 'Japan-Russian' alloy (good for muon, but bad for pressure).
b. The focus of the beamline through the pressure cell can be as good as 50% within 2mm which is better than before (7mm).
c. The postdoc will be appointed soon.
d. Could you increase the size of the cell (diameter and length)?
   This can cause problems in the cell, such as bending. We are under discussion about two layer cells.
e. Could you use different cells for different pressures?
   Yes, and we do this already. We optimise the cells to give 30-40% signal at max pressure.

Stephen Cottrell (STFC): **Development of a gas-phase sample cell with RF coils**
An overview of the gas phase pressure cells was given. These currently have a maximum pressure of 50bar, but future experiments require pressures of at least 200bar. The relative merits of PEEK and Ti cells were presented along with the programme of work.

Discussion:

a. RF coil design will be critical. Will it be limited to a low B_1?
   Yes, both muonium and diamagnetic muons will be measured.

Nigel Clayden (East Anglia): **RF μSR experiments using NMR style pulsed sequences**

A review of the current technical setup at ISIS was given and it was stated that the time for setup was an issue. Using NMR this might be achieved rapidly, with the potential for off-line calibration. For applying pulse techniques, the fundamental limitation will be the muon lifetime, and therefore the number of pulses that can be included in the sequence will be limited when compared to typical NMR experiments. There may be novel experiments using simultaneous NMR and μSR, but these are likely to require millikelvin temperatures.

Discussion:

a. Would the intended NMR measurements require millikelvin temperatures with high fields?
   Yes.

Giuseppe Allodi (Parma): **Simulation codes as an aid to experiment analysis**

A summary of the intended workplan was presented. The code should be able to calculate both the electrostatic and magnetic fields, and permit comparison with experimental data. This is a 1-year project.

Discussion:

a. Will you be using a rigid model for the crystal lattice?
   Yes, as this is normally done.
b. Is the magnetic information static or dynamic?
   Static.
c. How about a web interface so no code installation is required?
   This will require a server and has license issues, but is possible.
d. Will the CIF format be incorporated into the NeXus file?
   It could be.

James Lord (STFC): **Beamline diagnostics and modelling, experiment simulation**

A summary of the reasons why we need to have methods for beam diagnostics was presented together with possible diagnostic tools. The problems associated with conventional modelling of beamlines were also discussed - most modelling packages assume perfect alignment of quad, dipoles and perfect field profiles. The need for recording beamline settings was highlighted.

Discussion:

a. Will PSI adopt Nexus?
   Yes, most likely at the end of this year.
b. How is work progressing to develop the high field CCD camera at ISIS?
   The camera is working but needs testing at field.
c. What is the current status of the instrument simulation code?
   The code exists and has been packaged to make it easy to use; however, it needs better documentation.

General discussion about the JRA

a. When does the JRA start?
   1st March 2009.
b. Where is the money?
   Transfer of funds will be arranged.

c. What is the position regarding the appointment of Post Docs?
   ISIS hope to have someone in-post within 6 months, who will concentrate on ISIS tasks and management.
d. There will be a series of meetings, less formal and focussed on specific tasks.
e. How is the NMR project progressing?
   It is progressing well; we can measure protons and therefore use test samples to show offline that the coils work. It was noted that if coils are retuned to study muons (rather than protons) the Q of the coil, and therefore it's performance characteristics, may change.

Beamline and instrument simulation: results from FP6

Toni Shiroka (PSI): **Towards a general instrument simulation programme**
The current program is built on GEANT 4, and has been designed to enable complex geometric designs and electromagnetic fields to be simulated without requiring a knowledge of C++ programming. Some of the problems of GEANT 4 have been
addressed and resolved, such as no overlapping fields and the default beam being point like. In the latest version a simple interface has been constructed and this has led to improvements in the design of the current beamlines. However, data output and interpretation is still an issue.

Discussion:

a. Can you simulate high-energy muon spot size?
   Yes.
b. How easily is it to avoid coincident counts?
   This has been implemented.
c. How easy is it to setup the programme?
   The first part of the code is 'easy' to setup. However, this simply gives you a ROOT file containing counts in detectors. The second stage is more difficult, as this is really carrying out an analysis that, in some measure, is outside of the remit for this program. Maybe a general template is needed.
d. Is muonium simulated and its interaction with gases?
   It may require a small change in the code and recompiling

Zaher Salman (PSI): **Modelling a high field instrument for ISIS**
The simulations were useful in the design of HiFi, such as testing field maps and the design/optimisation of the detectors. However, simulations have big limitations and give mainly qualitative results not quantitative.

Discussion:

a. Why did you consider a conical detector shape?
   This would maximise the solid angle at the expense of increasing the double counts.
b. What are the window materials?
   25μm Al and 125μm Mylar.

Kamil Sedlak (PSI): **Simulations for the ALC upgrade and the high field instrument at PSI**
The simulations now give a more realistic detector response, include a good estimate of the background, but still are qualitative as the simulations are not perfect. In 10T, losing the low energy positrons gives an increase in the asymmetry. This can be achieved by increasing the diameter. However, the standard figure of merit decreases.

Discussion

a. The deviations from the exponential decay when incorporating the background doesn't seem to be correct?
   It is!
b. GEANT 4 is difficult to use to simulate beamlines?
   Turtle gives the same answer and could be used if ray tracing is not required.
c. Can you simulate sample displacement?
   Yes, easy and has been done for ALC.
d. ALC sample thickness is very important?
   Yes.
e. Are the simulations calibrated for alpha?
   This is different for forward and backwards.

Bob Cywinski (Huddersfield): **Improving muon production characteristics**
A possible stand-alone muon source was presented (FFAG). It could operate from CW to a pulsed source with a power of 0.5mA 1GeV. There also exists the possibility of multiple targets. However, to further the design, simulations need to be benchmarked. Therefore, using GEANT 4, the ISIS target has been simulated, including changing the target material. Choosing the correct physics model is critical. However, the simulations show that increasing the target thickness (at the expense of only a 1-2% reduction in proton transmission) could give a doubling of the muon rate.

Discussion:

a. Why use Ni-Be?
   Easier to handle Be
b. Could you improve the statistics by the selective sampling of significant events?
   We need more information first.
c. JPARC has a C target surrounded by Cu, however, this gives large thermal gradients, which might lead to possible target breaking.
d. Do you have access to the energy distribution of the pions?
   Yes, in principle, however, if we have a pion with energy at the surface of the target then it is ignored.