A Muon JRA in FP7 – JRA5

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JRA presentation
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Tasks in the JRA5

- (Management and dissemination)
- Technologies for high-field instruments
- Developing technologies for μSR at high pressures
- Novel resonance techniques and simulation codes for complex experiments
- Muon beamline control and modelling

Building on work started during FP6 …

A broad collaboration

Partners:

- University of Parma, Italy
- University of Babes-Bolyai, Romania
- PSI Continuous Muon Facility, Switzerland
- ISIS Pulsed Muon Facility, UK (Coordinator)

Collaborators:

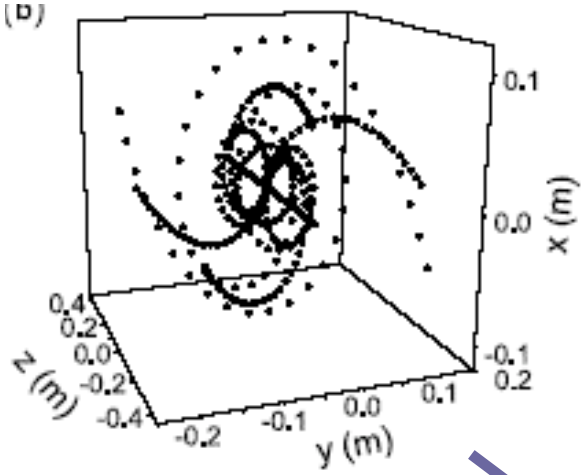
- Dubna, Russia
- University of East Anglia, UK
- RIKEN-RAL, Japan/UK
- University of British Columbia, Canada

JRA Tasks

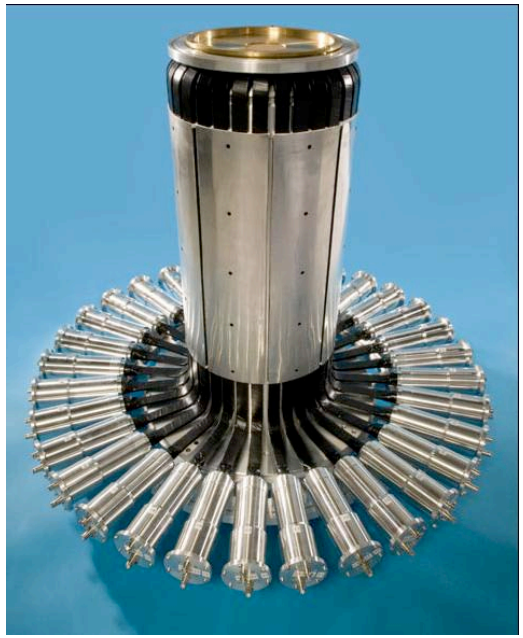
Technologies for High Field Instruments

- Fast-timing detectors for high transverse field applications
- Design and simulation of a high field instrument for PSI
- Performance assessment of high-field operation at ISIS

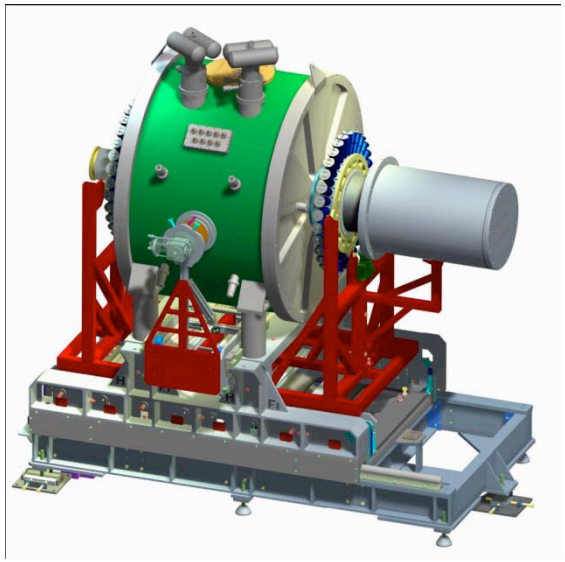
Instrument Development – High Magnetic Fields



Simulations (FP6) have enabled us to design better detectors for high magnetic fields



and new instruments that will be evaluated during FP7 (HiFi, ISIS)



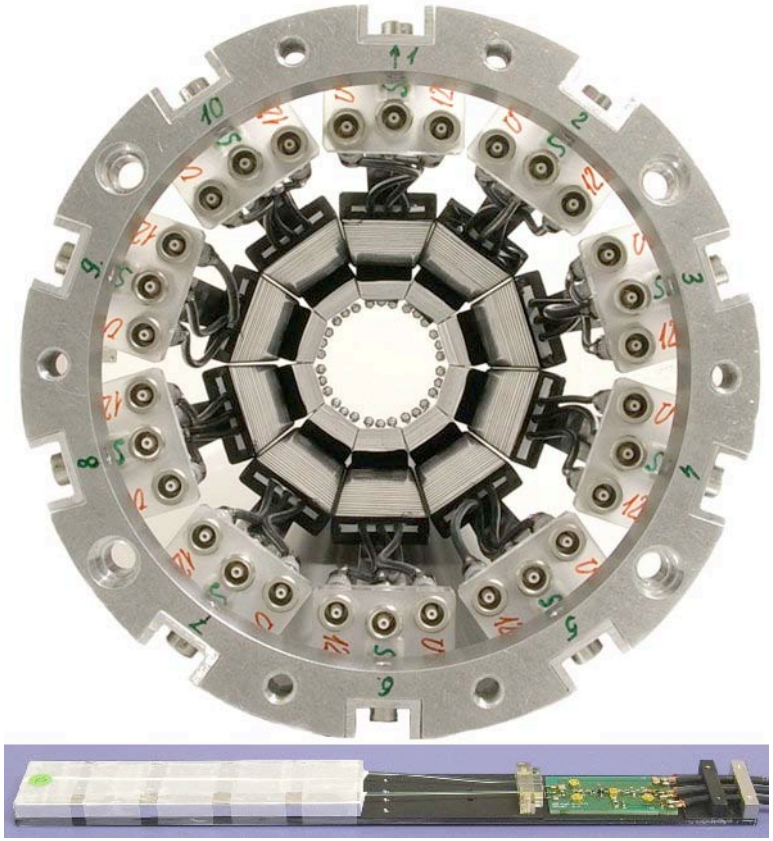
PSI will develop a High Field Spectrometer during FP7

Fast Timing Detectors

Experiments in High Fields at PSI will require detectors that can provide:

- Fast timing
- Work in a High Magnetic Field

Arrays will be designed using APD technology developed during FP6



APD detector array under development for the ALC beamline at PSI

Developing technologies for μSR at high pressures

- Development of a solid-sample pressure cell
- Development of gas-phase sample cell with RF coils

Pressure measurements

Develop Solid Sample cells to:

•increase pressure above 2.5GPa,
•improve signal background

by

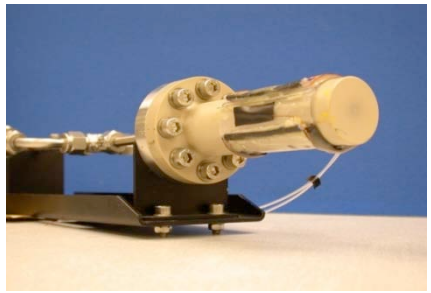
•Exploring new Cell Materials,
•Studying new Cell Geometries
•Beamline optimisation

Develop Gas cells to:

•increase pressure to 200bar,
•provide RF measurements

by

•Exploring new Cell Materials,
•Integral RF coils
•Using thick windows and a high momentum muon beam



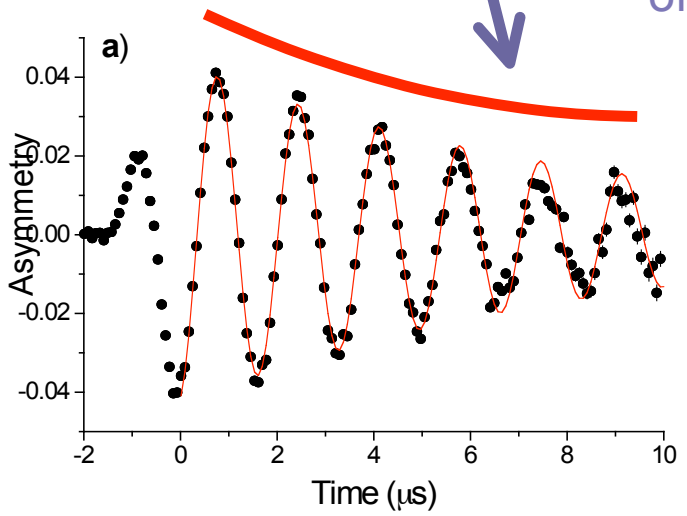
14 bar gas cell developed with EPSRC funding

Novel Resonance Techniques and Simulation codes for Complex Experiments

- RFμSR experiments using NMR style pulsed techniques
- Development of an in-situ NMR spectrometer
- Simulation codes to support μSR experiment analysis

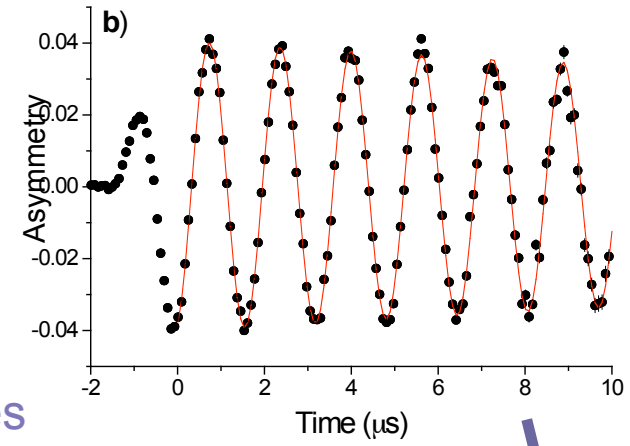
Pulsed RF Techniques

Decay envelope tells us about the environment the muon is probing



RF irradiation of nuclei

modifies environment



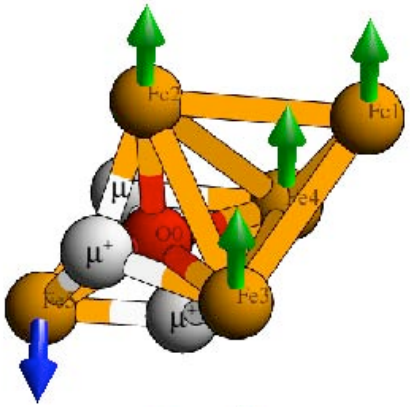
New information about muon coupling and dynamics – a model for proton behaviour

NMR style RF experiments can provide new information – these will be investigated during FP7

Simulation codes for analysis

Visualization of structure **plus**

magnetic moment

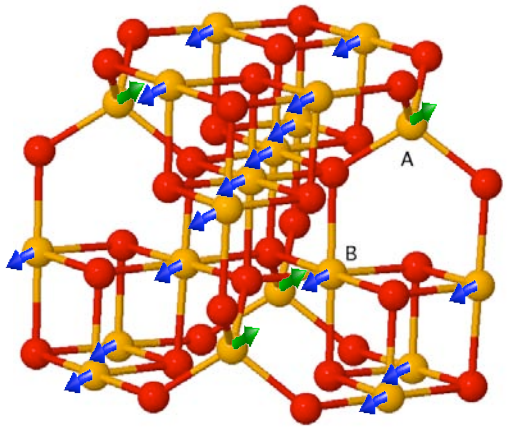


Search for muon sites by mapping

electrostatic potentials

and

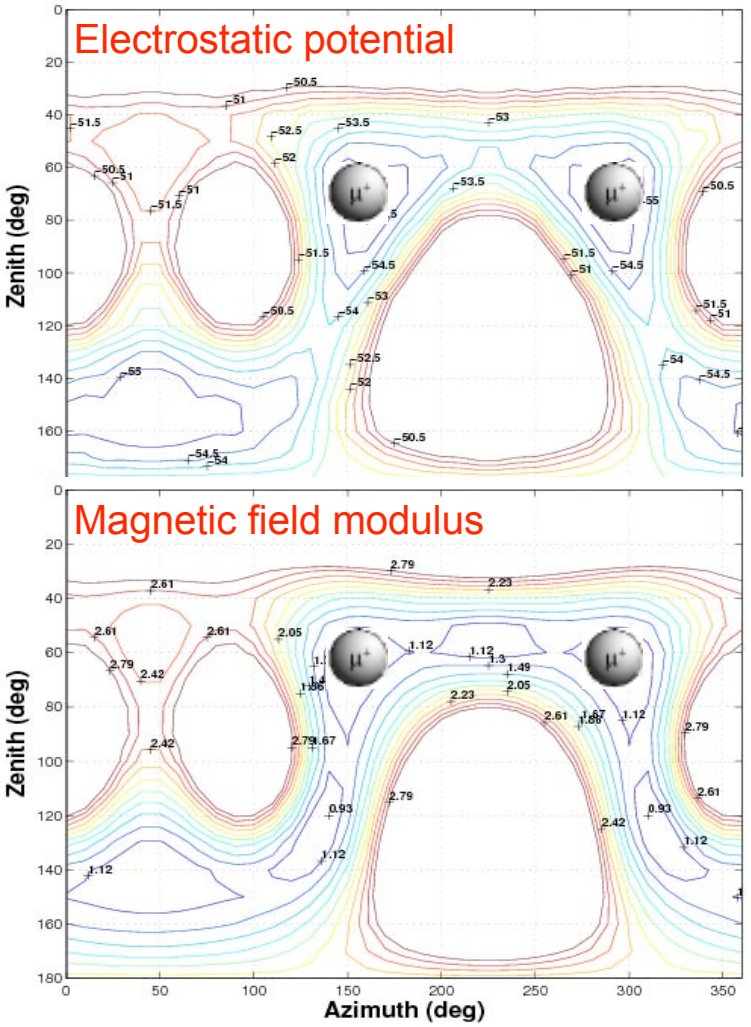
magnetic dipolar fields



Simulate μSR signals

and

compare to experiment



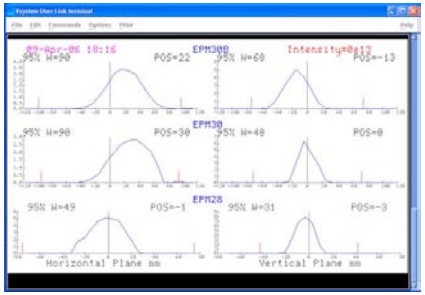
Muon Beamline Control and Modelling

- Development of techniques for beamline diagnostics
- Instrument simulation code to allow full instrument modelling
- Extension of Nexus file format to capture full parameters

Beamline Diagnostics

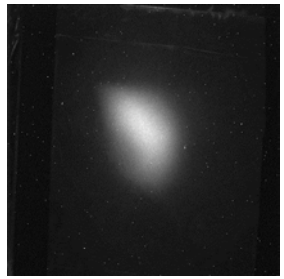
- Muon beamlines are complex and tuning can take many hours
- Diagnostic information is limited to:

Production target profiles



Beamline

Final beam spot imaging



but only at zero B-field

In FP7 we will:

- Investigate methods for providing beamline diagnostics
- Extend final beam spot imaging to work in High Magnetic Fields
- Develop data formats to store beamline parameters for instrument simulation

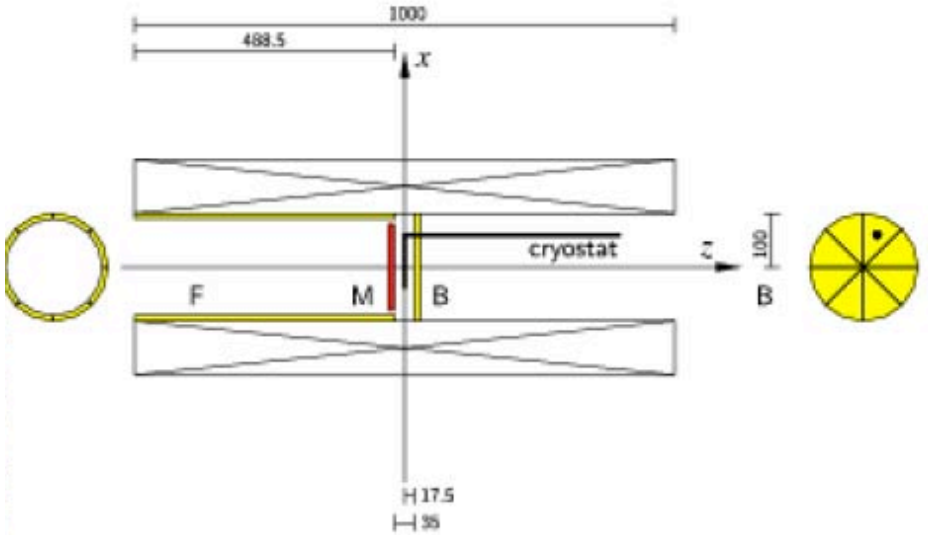
Instrument Modelling

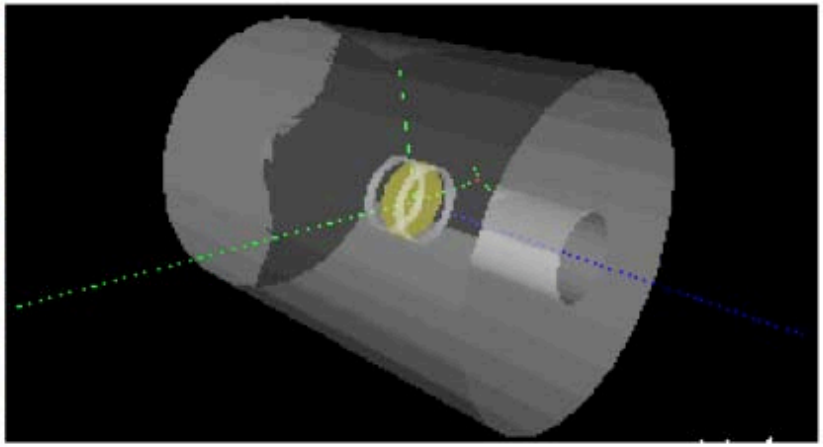
Simulation of the PSI ALC Spectrometer using GEANT

Modelling studies positron motion and detection:

- In high field solenoid,
- Through cryostat walls,
- To a physical detector

Work in FP7 will generalise these simulations as a tool for instrument design and data analysis





Resources

- Three year Post-Doctoral worker based at STFC (Novel Resonance Techniques)
- Three year Post-Doctoral worker based at PSI (Technologies for High Field Instruments)
- Two year Post Doctoral worker based at Babes-Bolyai (μSR at High Pressures)
- One year Post Doctoral worker based at Parma (Simulation Codes)

plus funds for consumables and travel for regular meetings

Conclusion

Watch this space…

http://muon.neutron-eu.net/m_nmi3

where we will post project news and results