

A Muon JRA in NMI3-II

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JRA presentation
NMI3-II Kick-off meeting
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Tasks in the Muon JRA

1. (Management and dissemination)
2. Software development for Muon Data Analysis
3. Concept studies for Future Muon Sources
4. Detector Technologies for Pulsed Muon Sources

Building on work during FP6, FP7 (NMI3-I) ...

JRA Tasks

Software Development for Muon Data Analysis

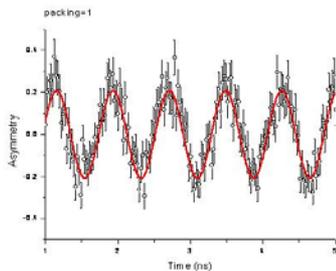
- Routines for efficient analysis of high field experiments
- Routines to link simulation with analysis codes
- Enhanced metadata for data storage

Analysis of High Field Experiments

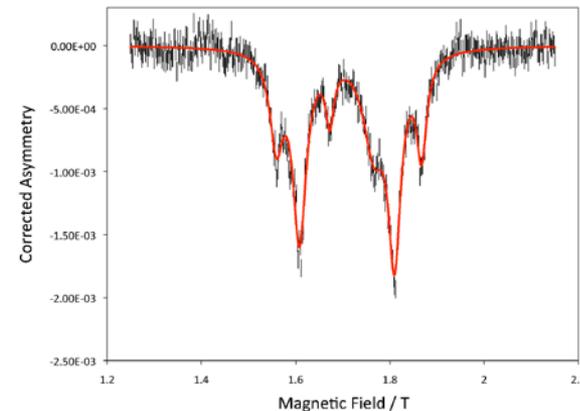
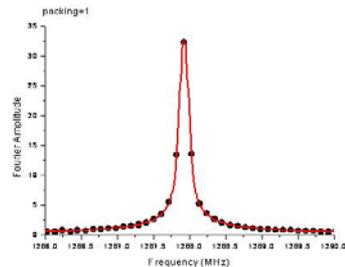
Both PSI and ISIS have recently developed novel high field spectrometers. New routines are required for efficient analysis.

Fast timing leads to large datasets and complex processing

Spectra can be complex with multiple overlapping peaks



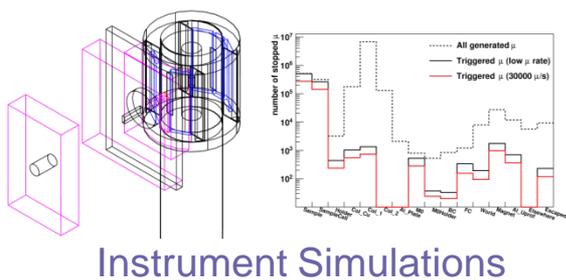
Efficient algorithms are required for data fitting and transforms



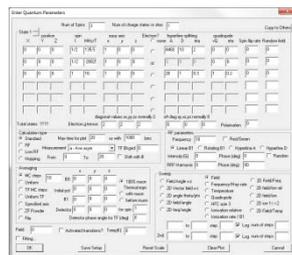
Efficient algorithms are required to extract and fit the lines

Linking Simulation and Analysis Codes

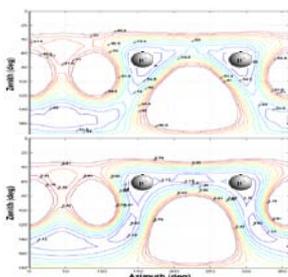
Many Simulation Codes are now in use:



Instrument Simulations

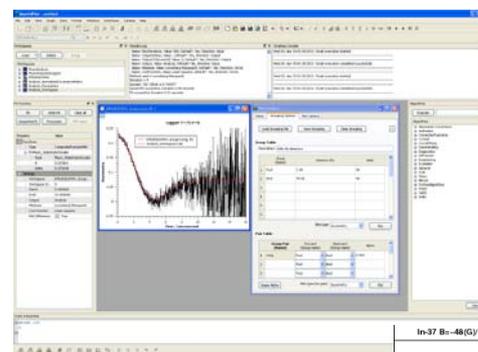


Quantum Spin Simulations

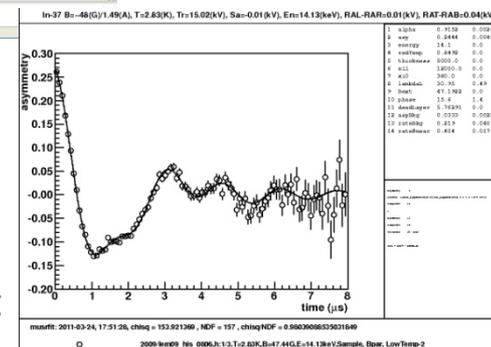


Field Simulations and DFT

Analysis codes are typical separate:



Mantid Data Analysis



musfit

Link Experiment Simulation and Analysis Codes for New Insight

Concept Studies for Future Muon Sources

- Concept study for advanced muon beams
- Concept study for high intensity muon sources

Advanced Muon Beams

Concept study for a **Muon Microbeam**:

- Beam size at sample: $50 \times 50 \mu\text{m}^2$
- Possible at most intense surface muon beams at PSI
(Reduction of beam size by sequential collimation and imaging)
- Rough estimates give few thousand muons per second

Potential for **new μSR experiments**:

- ~ micron size samples
(ex. single crystals of novel materials, FeSC, bulk samples: $\sim 2 \times 2 \text{ mm}^2$)
- Study of inhomogeneities in larger samples (scanning beam)
- Measurement of multiple samples, higher pressures (anvil cell)

High Intensity Muon Beams

Concept study for future **High Intensity Muon Sources**, examining:

- Production target technologies
- Beam optics
- Future facilities (e.g. ESS) and how best to exploit the beam

Potential for **new μ SR experiments**:

- Fast/high statistics measurements of spectra to reveal weak features
- Measurements to 'long' times, applications in conventional μ SR and for Radio Frequency spectroscopy
- New high intensity advanced muon beams (e.g. low energy muons)

Detector Technologies for Pulsed Muon Sources

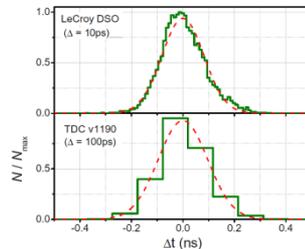
- Collaborative work between ISIS and PSI to develop G-APD technologies for Pulsed Muon beams
- Development of a prototype G-APD array at ISIS with a performance assessment

Geiger mode Avalanche Photodiodes

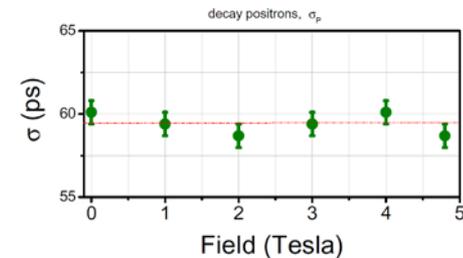
APD technologies developed at PSI during JRAs under FP6 and FP7
 Required to meet the challenging requirements of the new High Field Instrument



APD Detector array



Detector resolution better than 100 ps



Resolution independent of field

Very successful for measuring at PSI with a *continuous* beam structure

Can the same technology be applied at the ISIS *Pulsed* Source?



A prototype APD array for the ISIS Pulsed Source

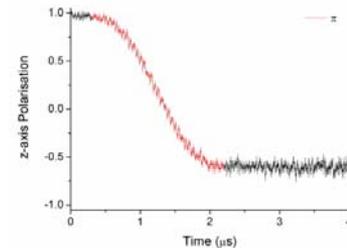
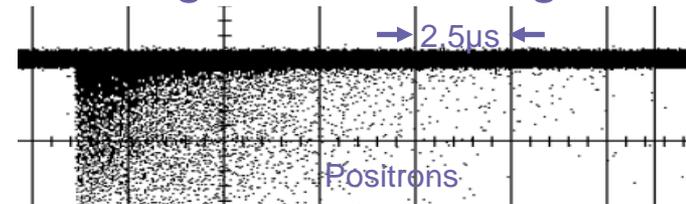
Applying APD technology to the ISIS Pulsed Beam brings new challenges.

Very high instantaneous rates demand:

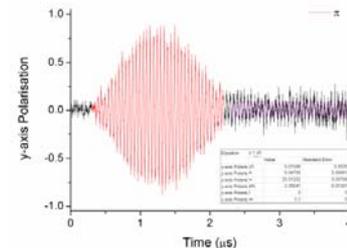
- Short detector deadtimes followed each 'hit'
- High detector segmentation

We plan to:

- Evaluate a test system to study the suitability of APD detectors for pulsed beams
- Develop a prototype APD detector for the HiFi instrument, optimised for pulsed Radio Frequency measurements where fast timing in high fields is required



Longitudinal and Pulsed RF signals compared



RF requires fast timing and a new geometry

Resources

- Post-Doctoral worker based at STFC
- Post-Doctoral worker based at PSI

plus funds for consumables and travel for regular meetings

An important part of our work will involve Developing the Muon User Community

Taking place as part of the **Outreach** Work package, with a **focus on high field μ SR**, an area of **recent development**

Will involve:

1. Establishing a website describing high field developments at ISIS and PSI
2. Producing publicity material describing applications of high field μ SR
3. Holding two science themed workshops

With appropriate funding for these activities



A broad collaboration

Partners:

- STFC
- PSI

Observers (muon JRA):

- Parma,
- Huddersfield,
- ESS
- RIKEN-RAL

Observers (Outreach):

- Coimbra,
- East Anglia,
- Orsay,
- Fribourg



Watch our page on the new website...

<http://nmi3.eu>

where we will post project news and results