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Muon Instrumentation

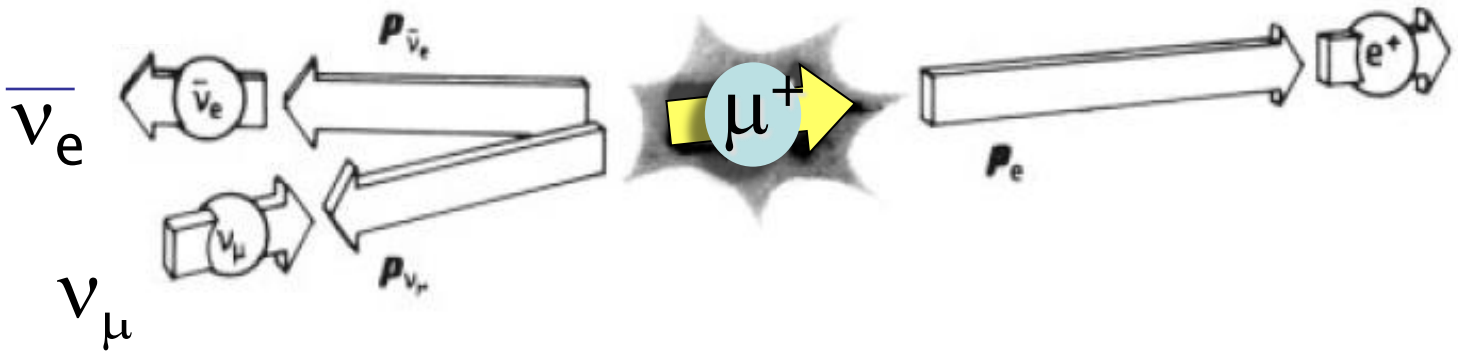
Adrian Hillier

ISIS Muon Group

What is a muon?

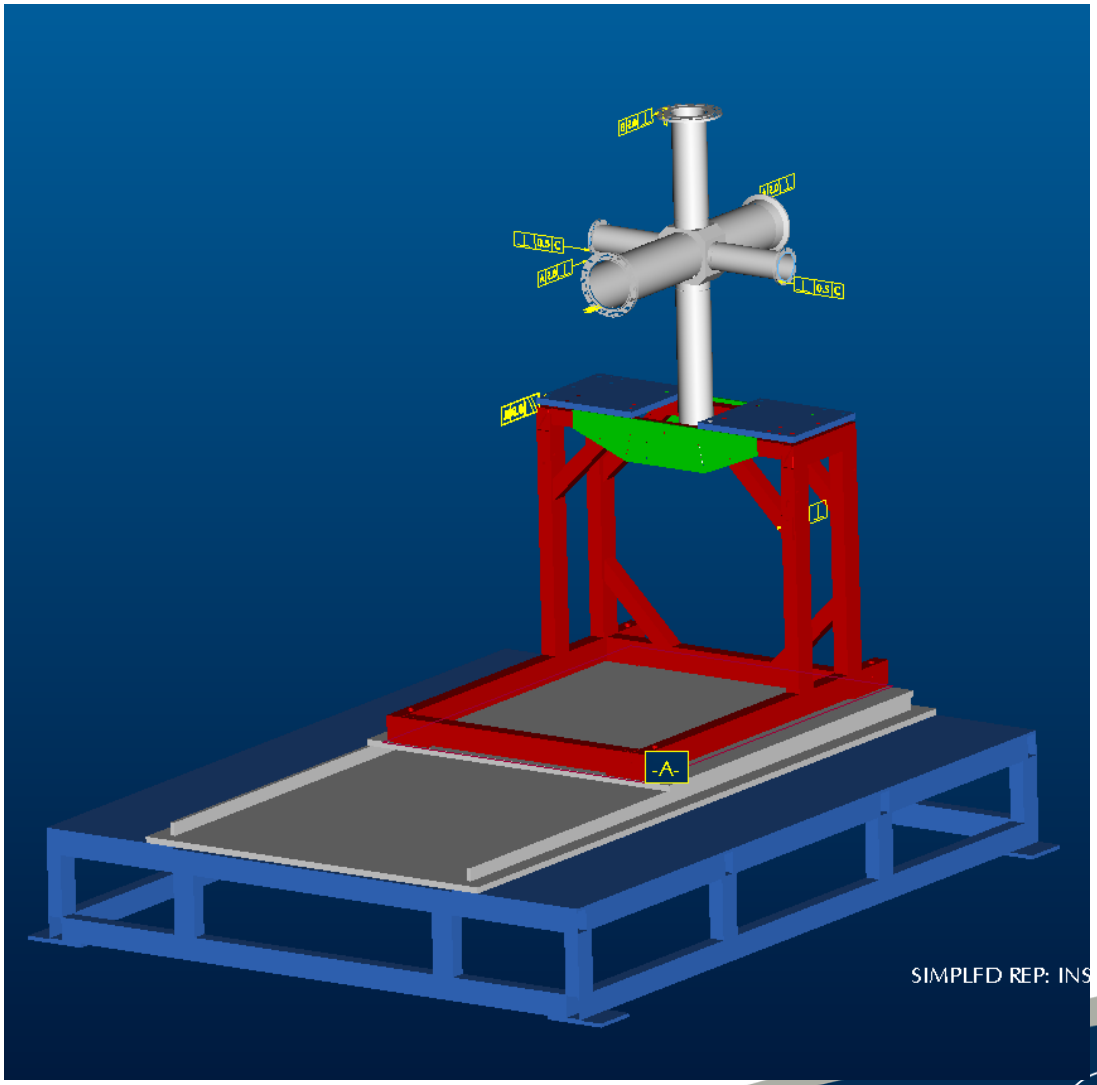
Muons are fundamental, charged particles which are:

unstable: $\mu^+ \rightarrow e^+ + \bar{\nu}_e + \nu_\mu$



Positrons emitted preferentially in muon spin direction

Your basic muon spectrometer



Support Frame

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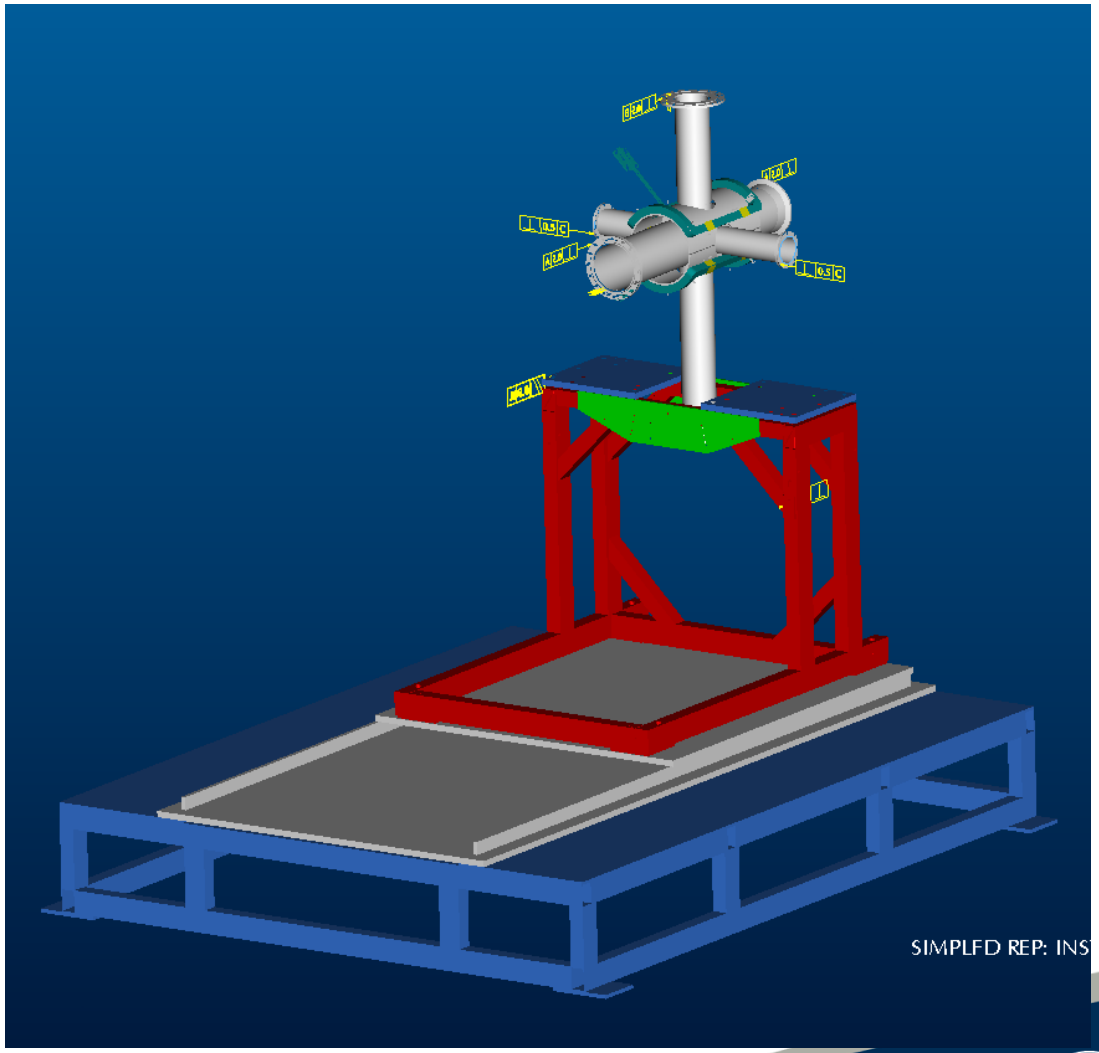
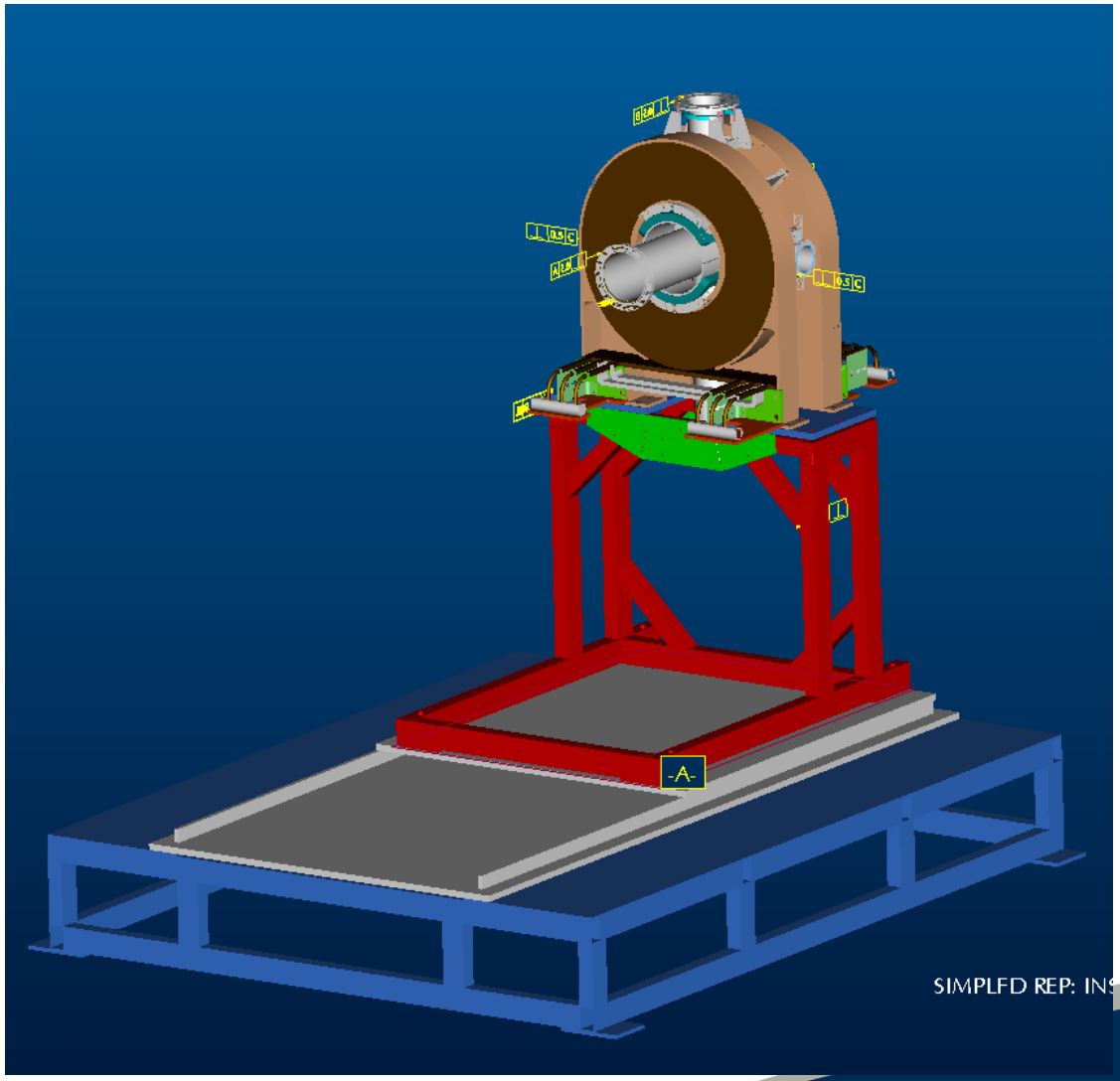
Your basic muon spectrometer



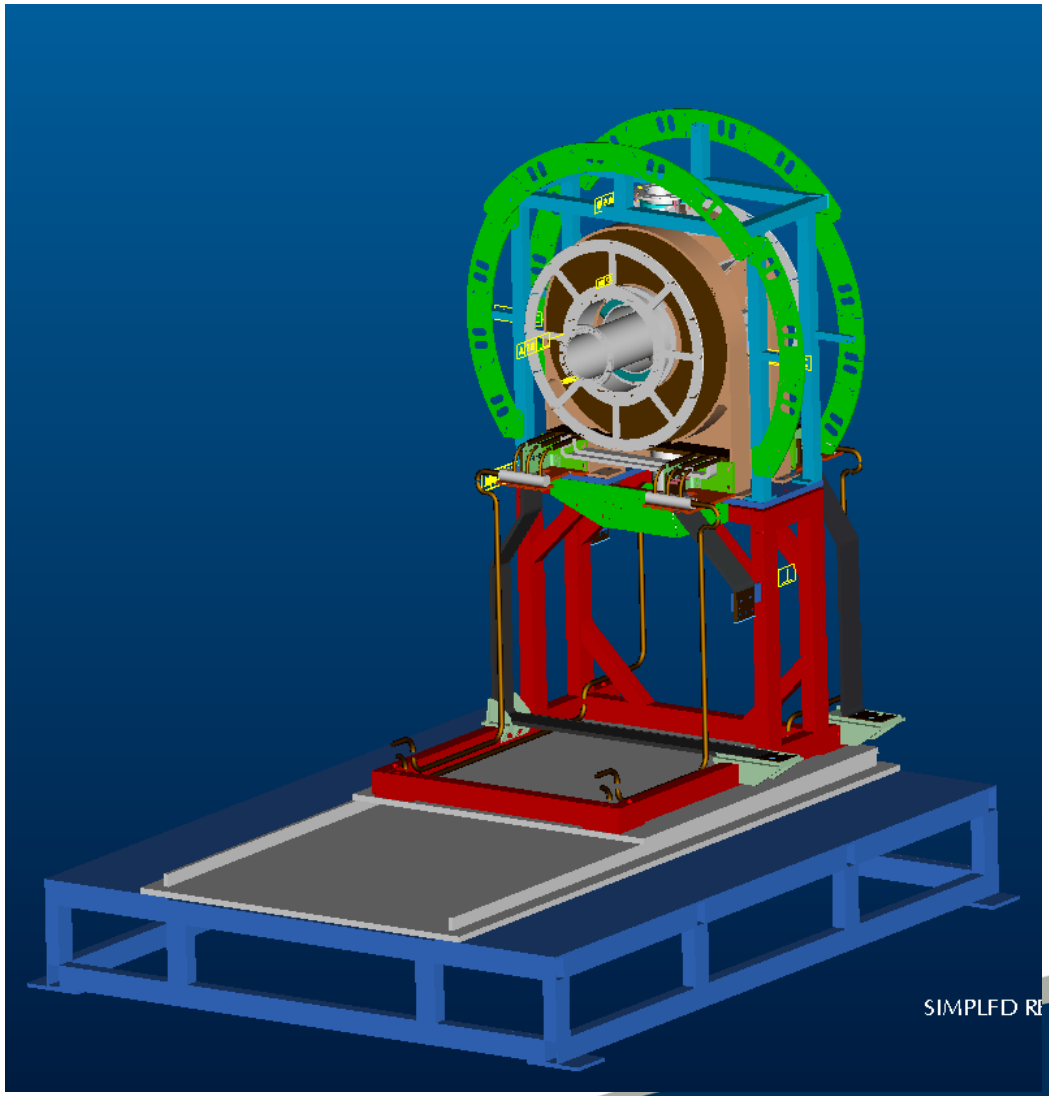
Transverse field coils

Your basic muon spectrometer



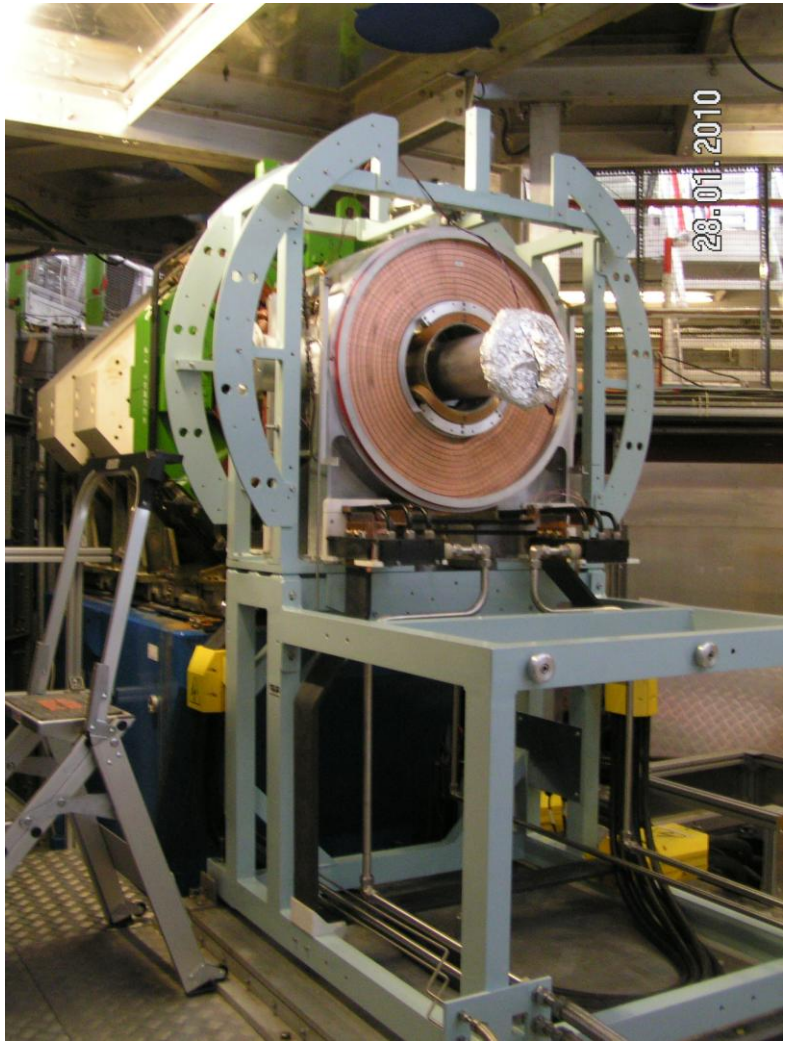
Main Magnet

Your basic muon spectrometer

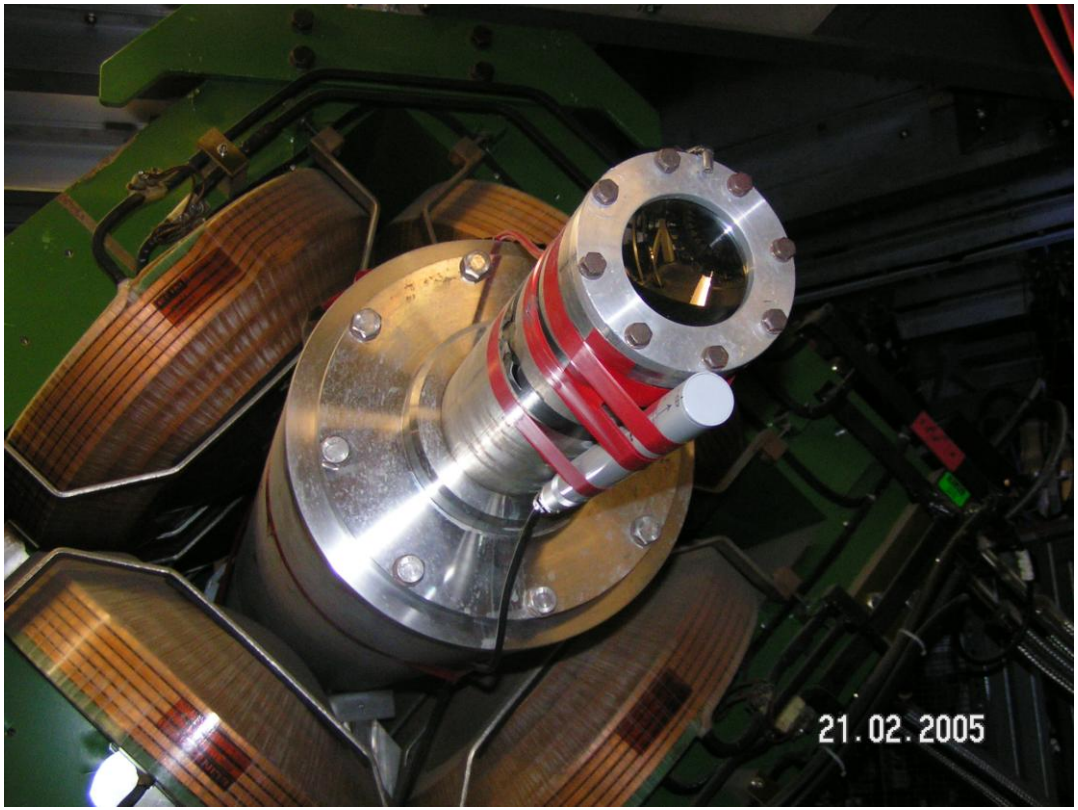


Zero field Coils

Your basic muon spectrometer

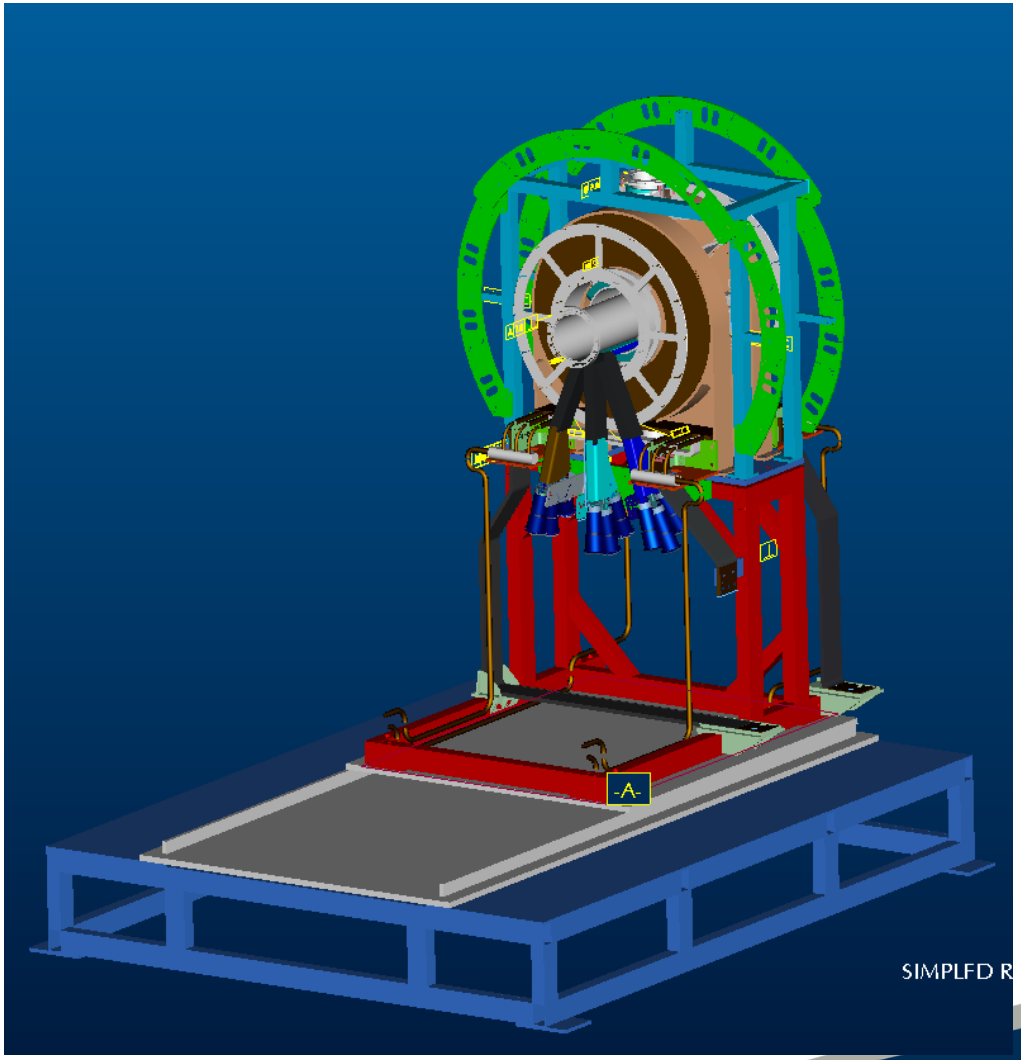


Your basic muon spectrometer



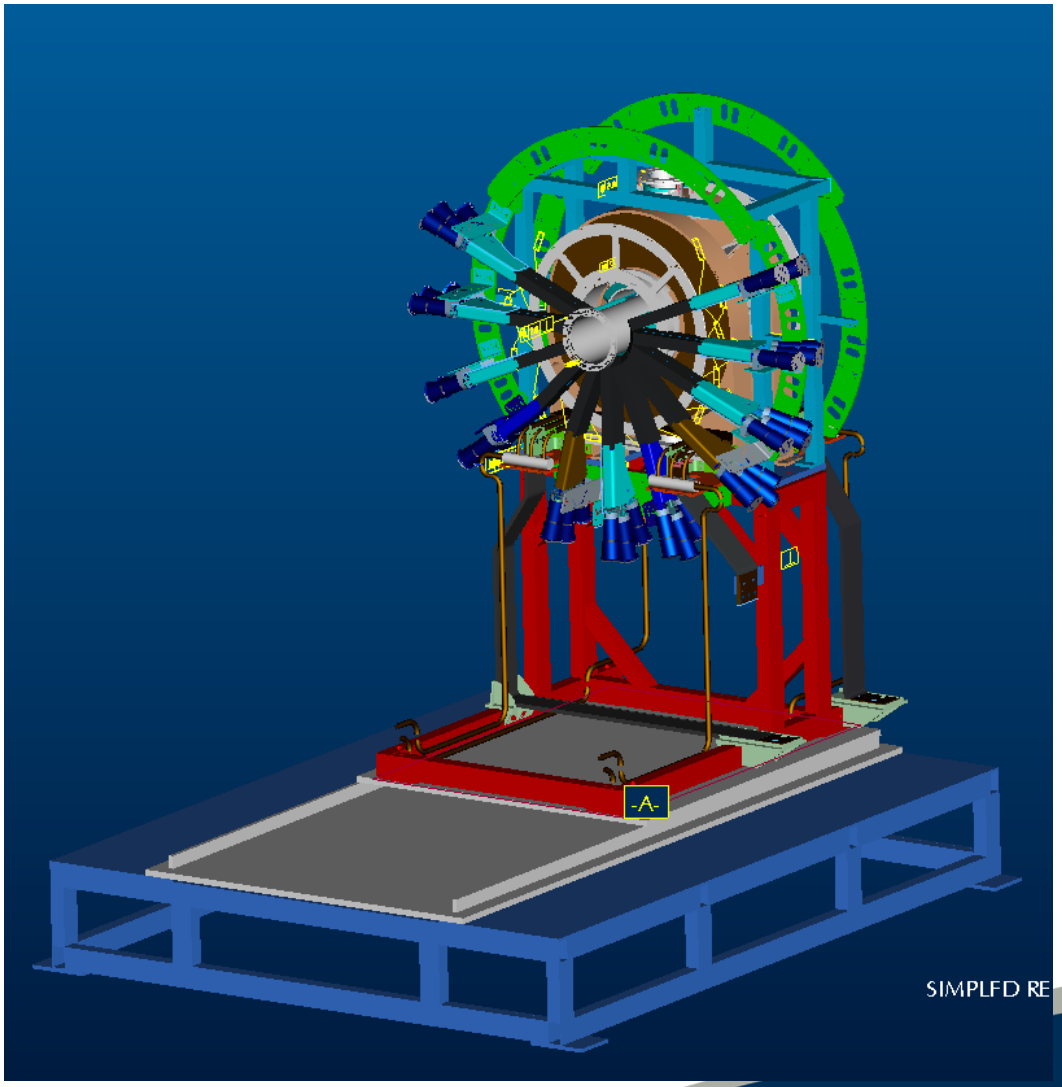
Hall probe controlling
Active zero field

Your basic muon spectrometer



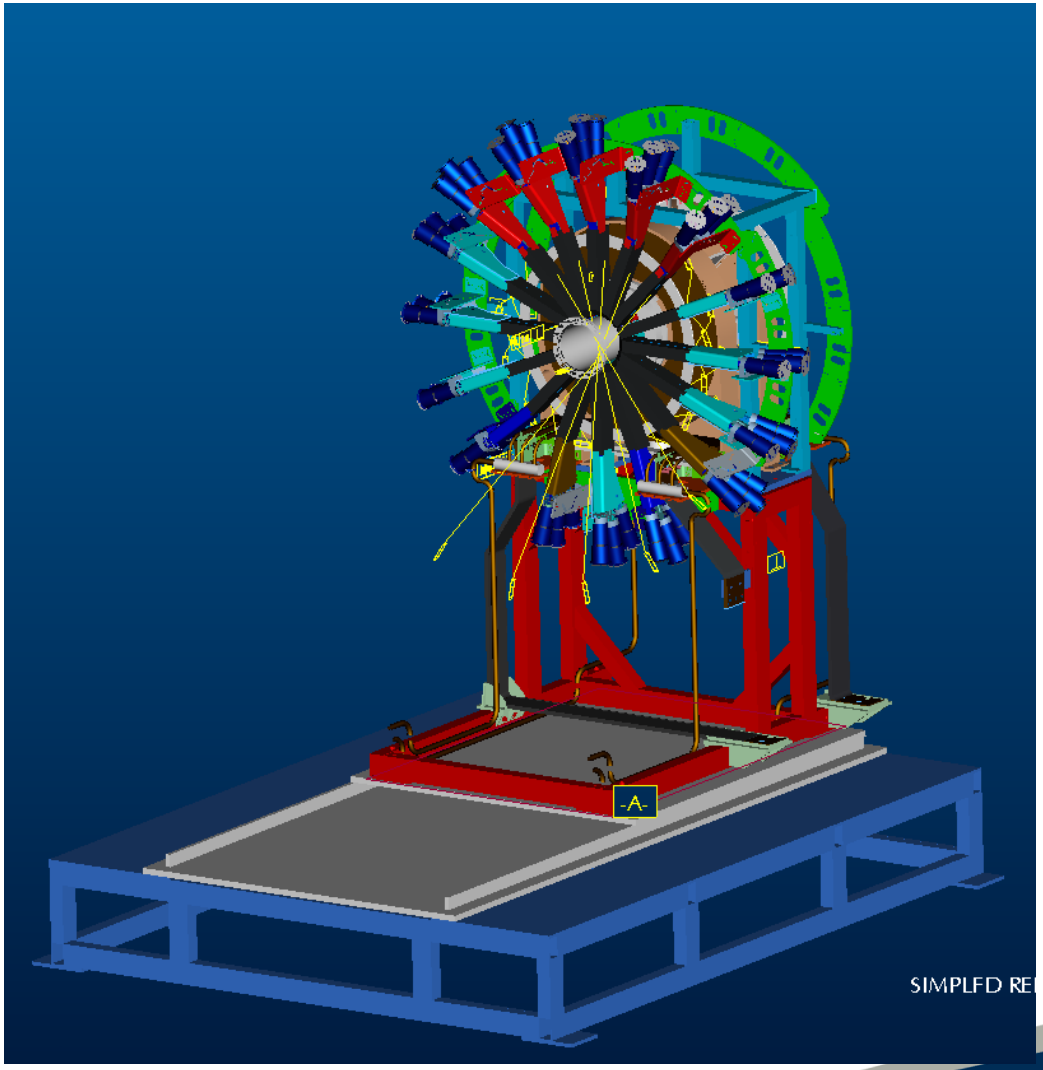
Adding detectors

Your basic muon spectrometer



More detectors

Your basic muon spectrometer



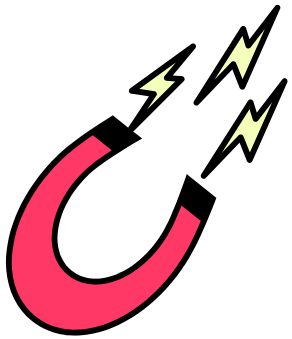
Even more


The International Conference on Muon Spin Rotation, Relaxation, and Resonance (μSR) is held every three years and that covers all aspects of the theory, practice, and applications of muon spin spectroscopy in molecular, condensed matter, and materials science. It also serves as a topical conference for the relevant fields of science where μSR is making significant contributions, including those of magnetism, superconductivity, strongly correlated electron systems, hydrogen in matter, and so on.
Invited Speakers:
J. Akimitsu (Aoyama Gakuin University, Japan)
H. Alloul (Universite Paris-Sud, France)
E. H. Brandt (Max Planck Institute, Germany)
P. P. Edwards (University of Oxford, UK)
A. D. Hualey (University of Edinburgh, UK)
Y. Kageyama (Kyoto University, Japan)
Miyake (KEK, Japan)
Nagamiya (J-PARC, Japan)
Sato (Tokyo Metropolitan University, Japan)
Tallon (Victoria University, New Zealand)
de Walle (UC, Santa Barbara, USA)
Yamada (Tohoku University, Japan)
Key Dates:
Registration Open: Feb. 15, 2008
Abstract Submission Deadline: April 11, 2008
Early Registration Deadline: April 11, 2008
Registration Deadline (on-line): July 14, 2008
Deadline for Submission of Proceedings July 14, 2008
Conference Web Site:
http://msr08.riken.jp
Contact:
msr08@riken.jp
μSR2008
FAN/S/021
POWER GOOD
DELL

The Muon instruments

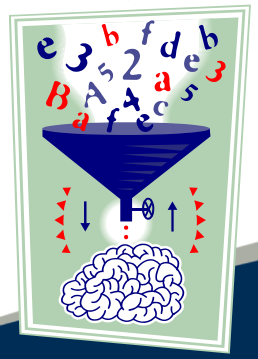
Main magnet (0-2.5kG)

Steering magnets



Active zero field

Sample environment



DAE -II

Calibration field (0-20G)

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INSTRUMENT GEOMETRIES

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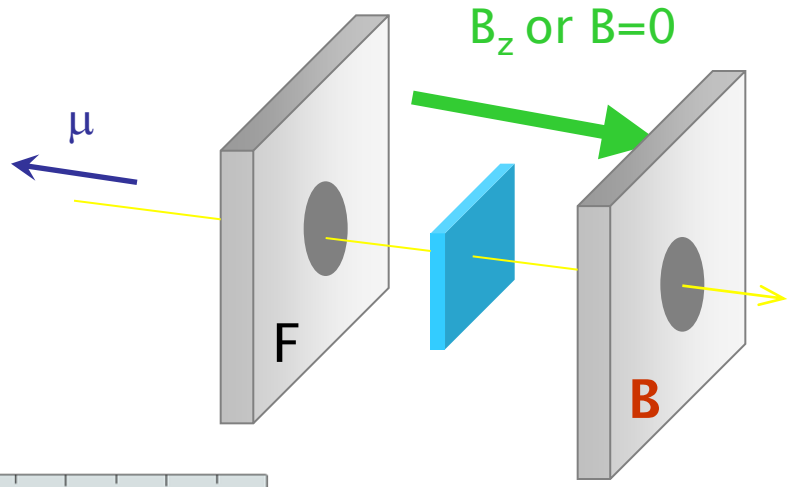
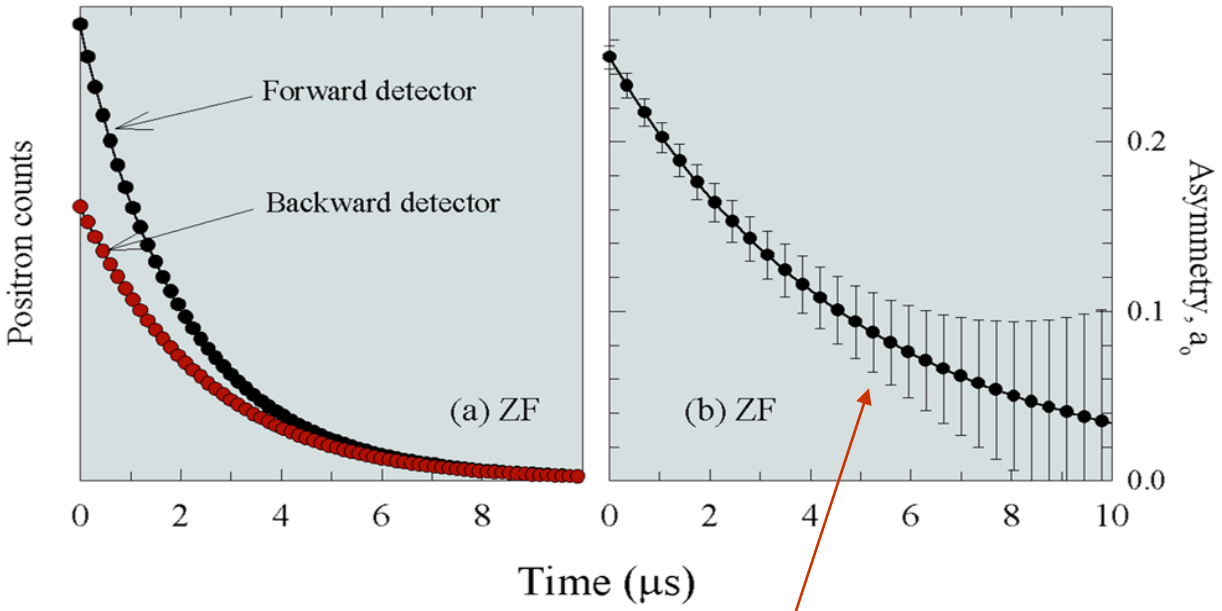
Relaxation

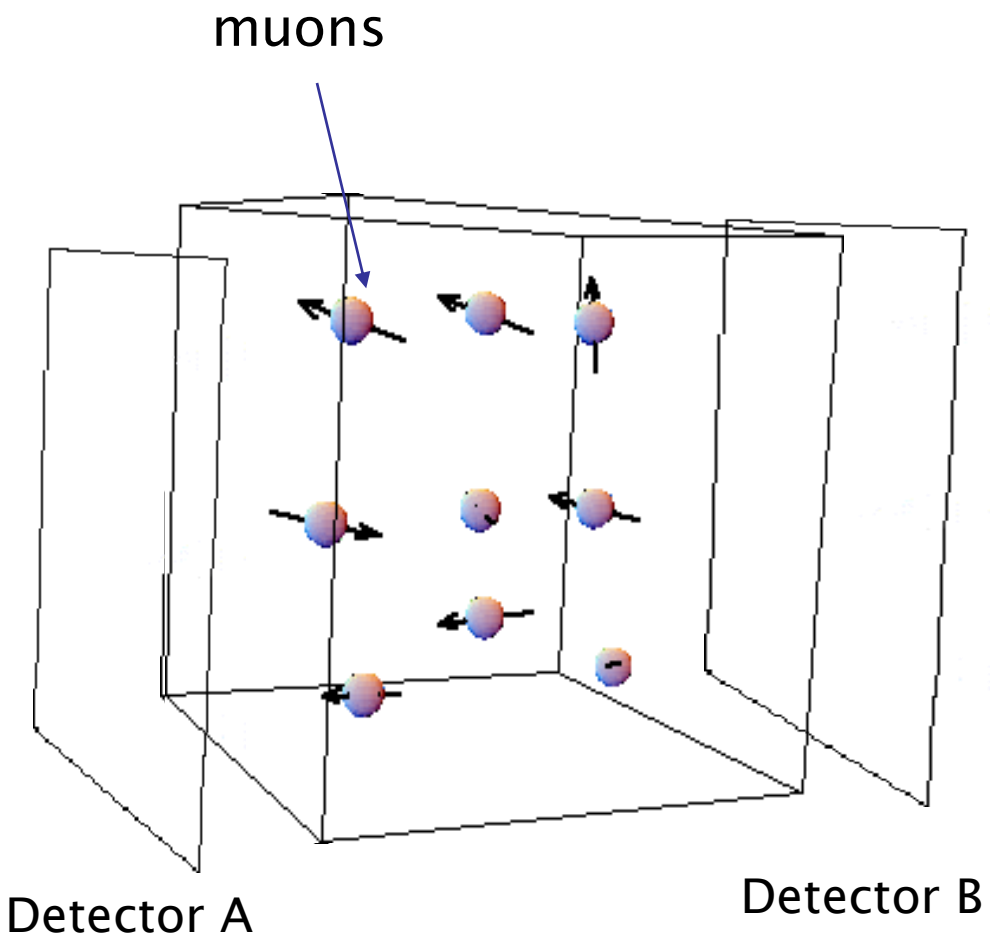




$$R_z(t) = \frac{F(t) - B(t)}{F(t) + B(t)} = a_o G_z(t)$$

The many faces of μSR

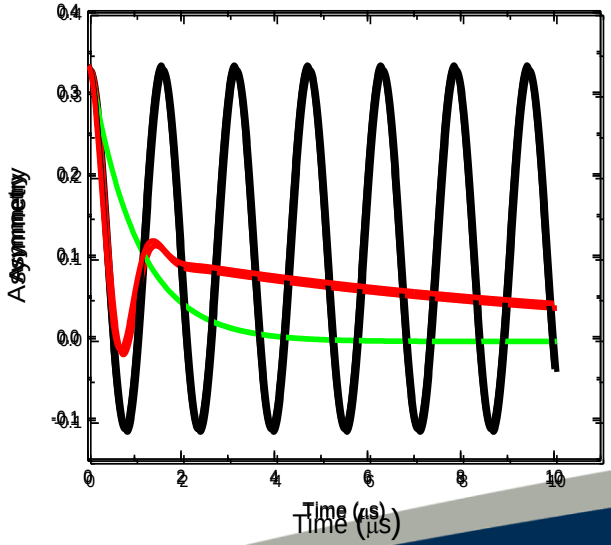
Longitudinal zero field - μSR



Precessing polarisation

Precessing and relaxing polarisation

Relaxing signal



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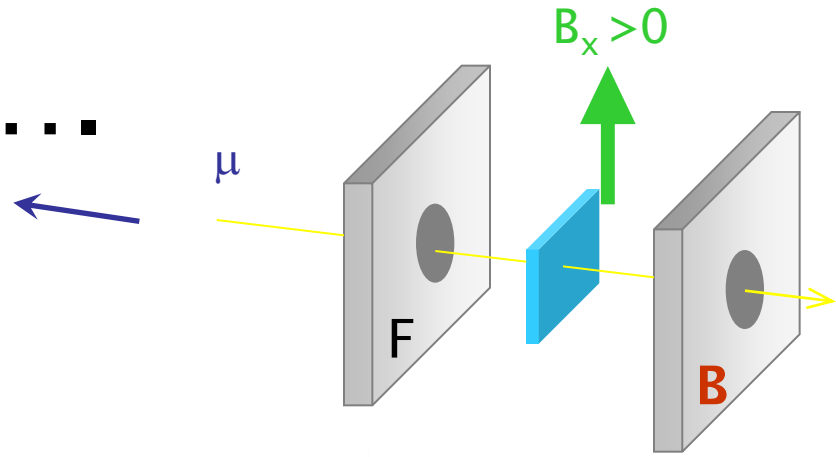
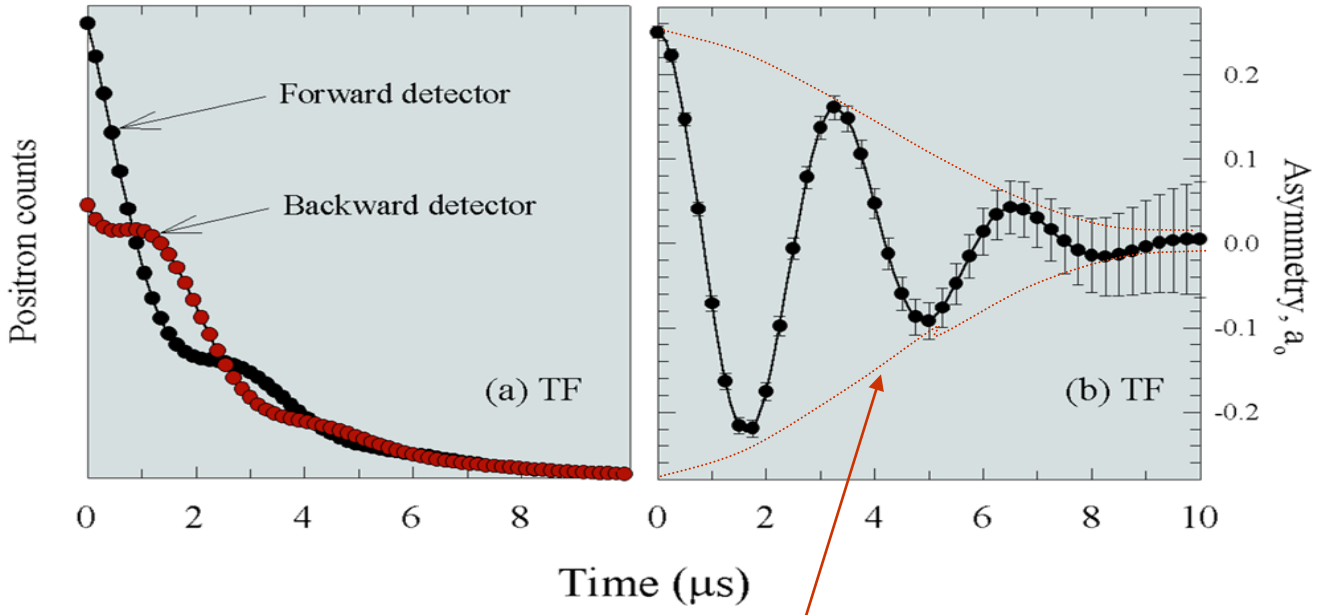
Rotation….





$$R_x(t) = \frac{F(t) - B(t)}{F(t) + B(t)} = a_o G_x(t) \cos(\omega_L t)$$

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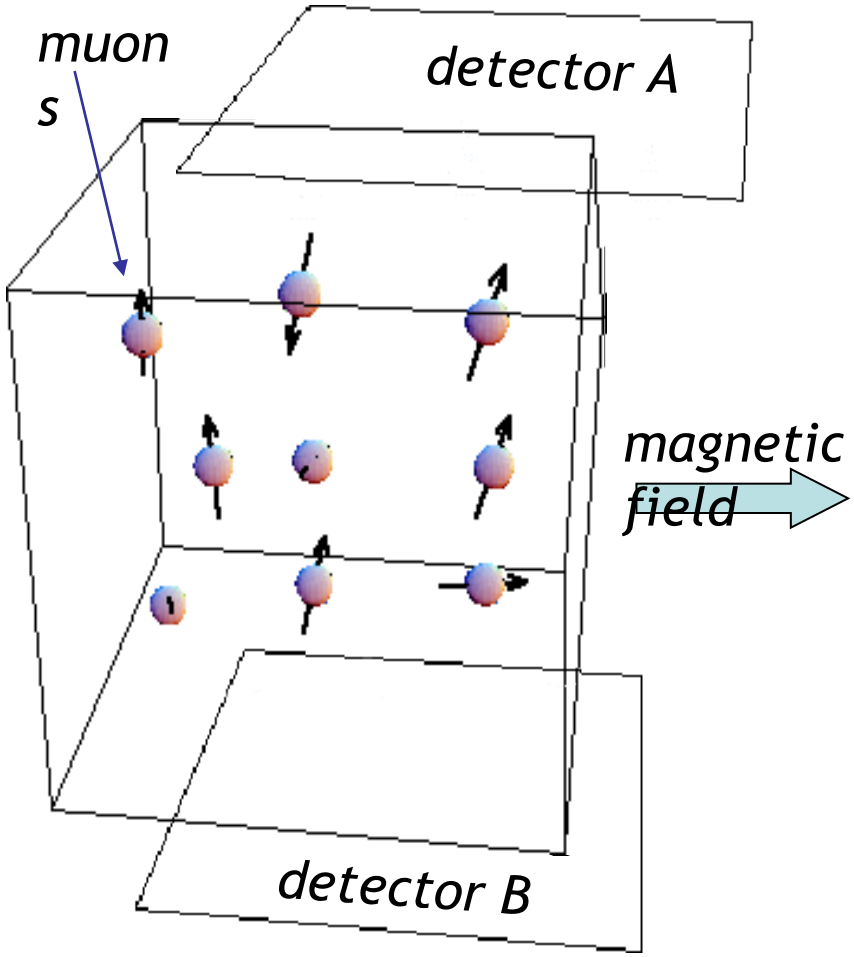
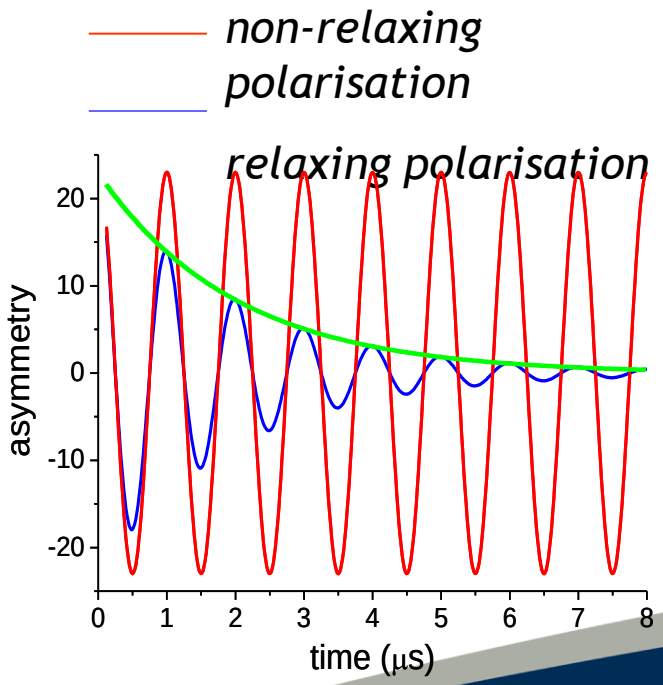
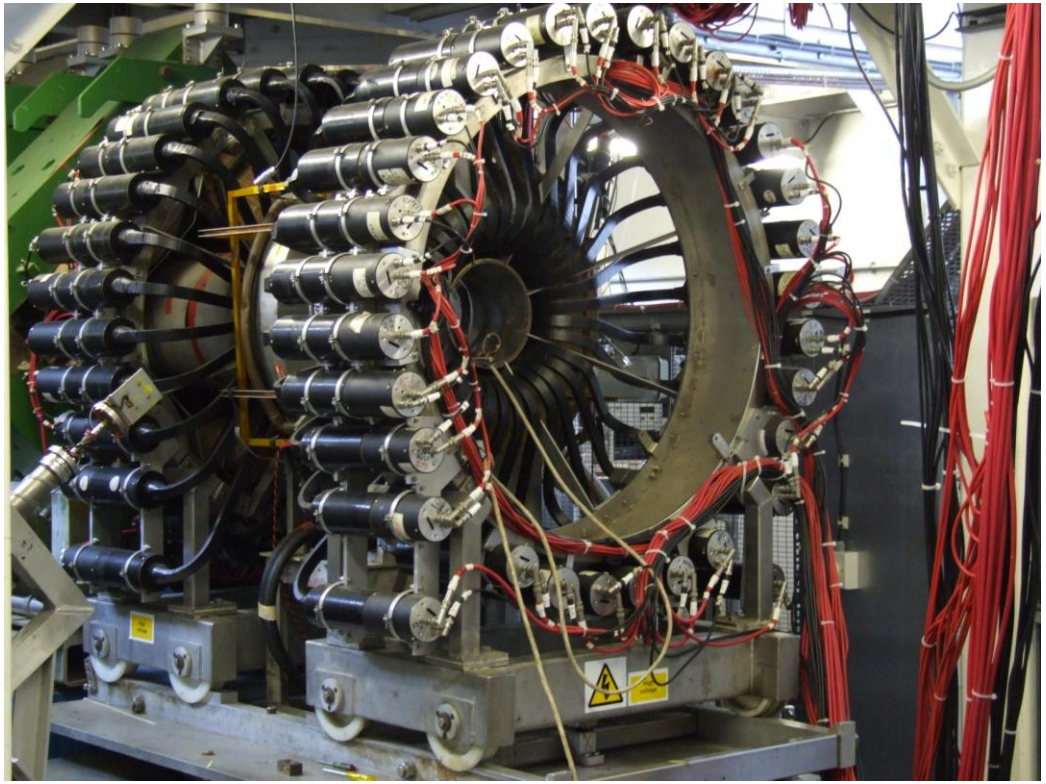
The many faces of μSR

Transverse field μSR





MuSR



0.25 T main field, longitudinal

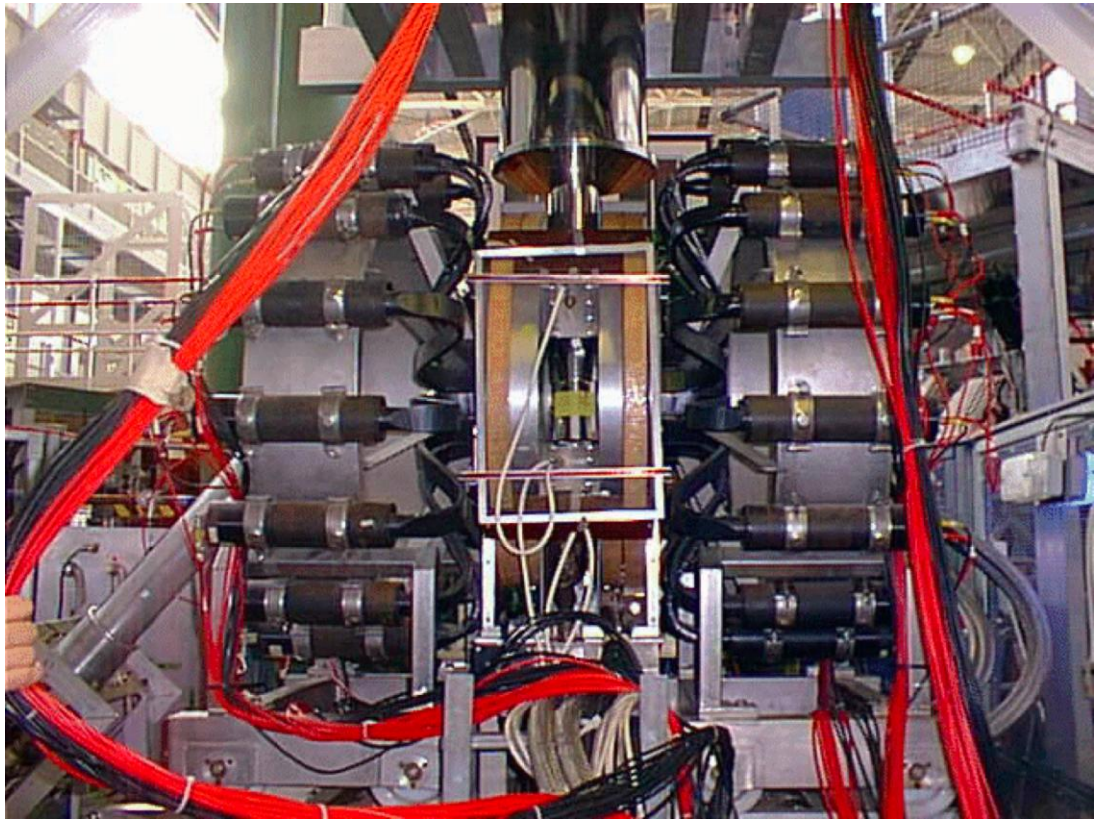
+ 20 G transverse fields

+ Stray field compensation

64 Detectors

Data Rates –
single pulse 45 MeV/hr

MuSR



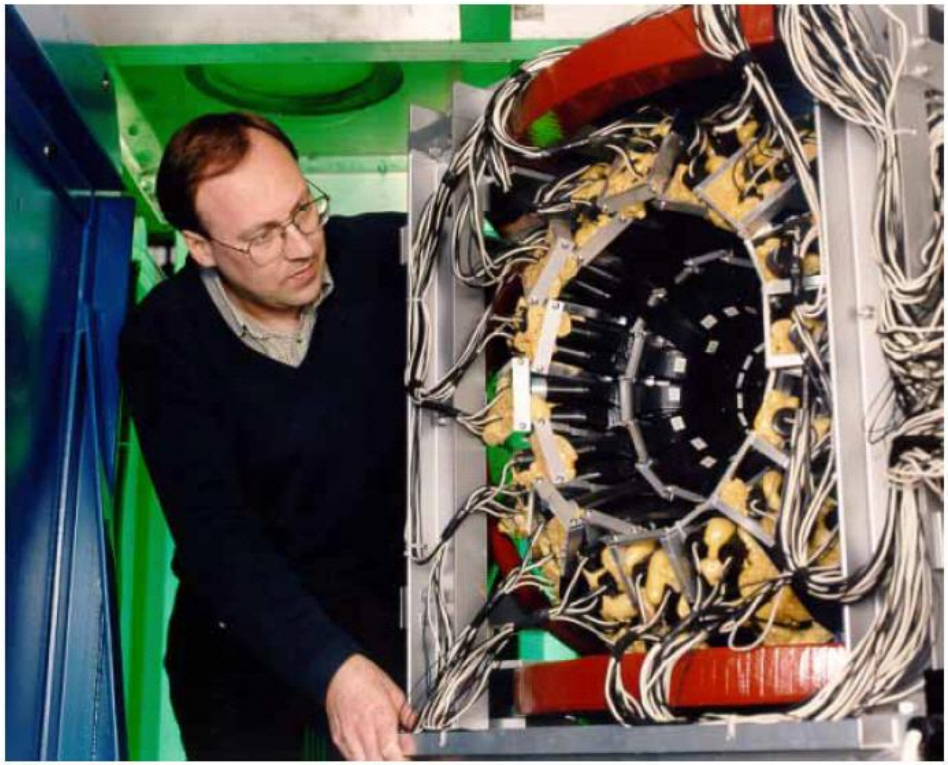
0.07 T main field, transverse

+ Stray field compensation

64 Detectors

Data Rates –
single pulse 45 MeV/hr

ARGUS



0.4 T main field, longitudinal

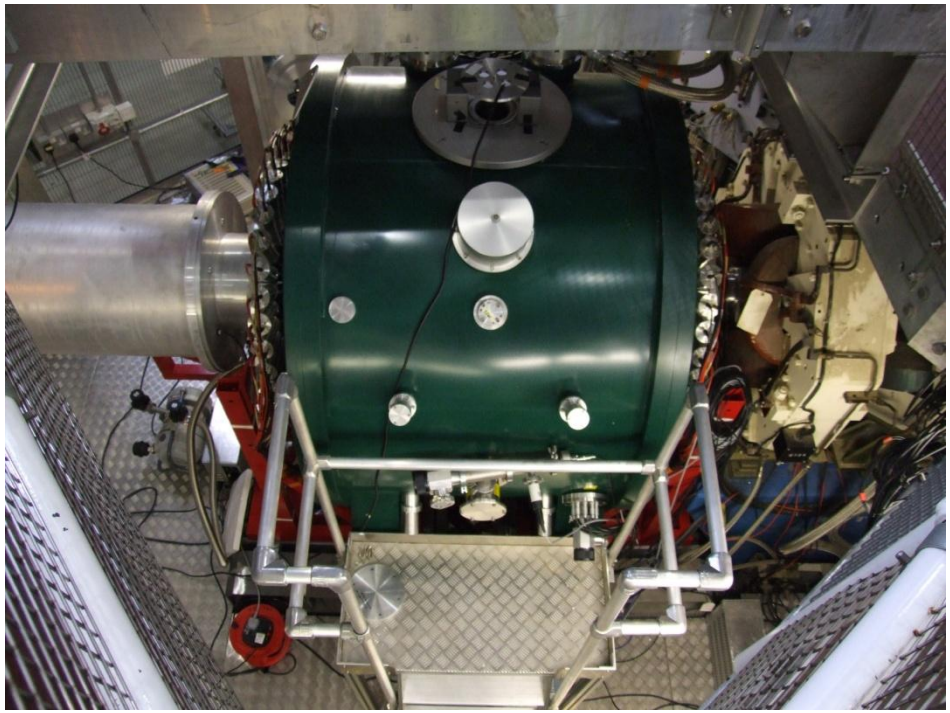
+ 150 G transverse fields

+ Stray field compensation

192 Detectors

Data Rates –
single or double pulse 55 MeV

HiFi



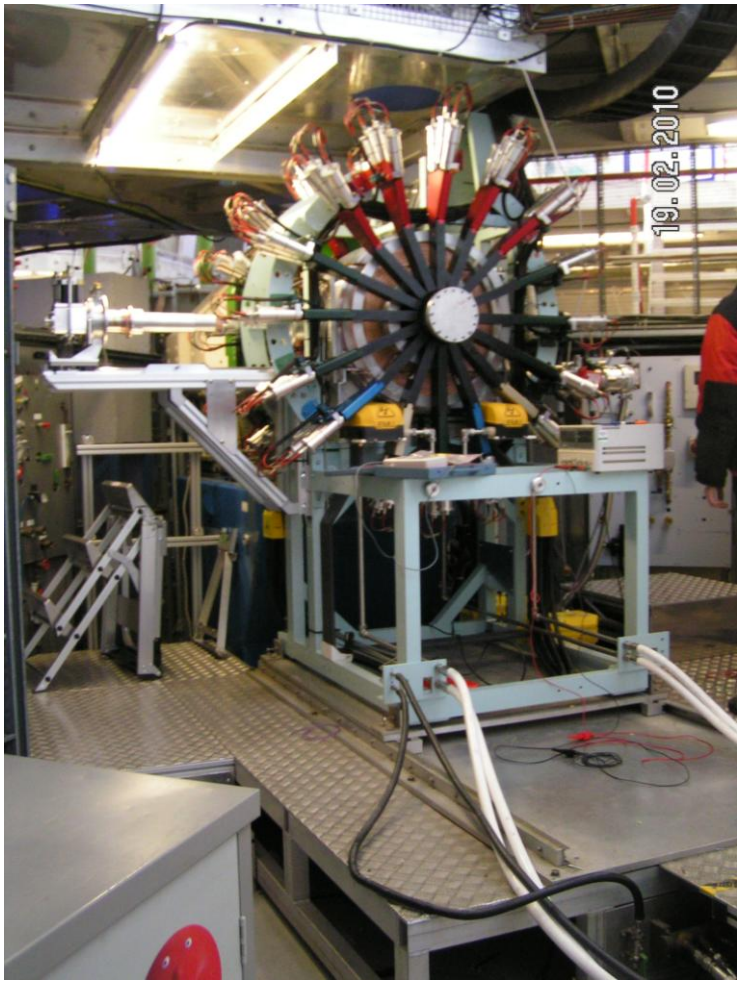
5 T main field, longitudinal

+ 400 G auxiliary field (for field switching, e.g. ALC)

+ 2 x 100 G transverse fields

+ Stray field compensation

EMu



0.5 T main field, longitudinal

+ 150 G transverse fields

+ Stray field compensation

96 Detectors

Data Rates –
single pulse 55MeV

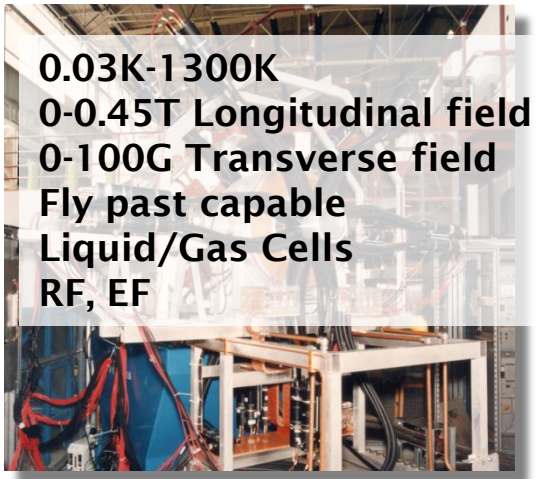
Fly-past

Instrument Summary

0.3K-480K
0-0.4T Longitudinal field
0-150G Transverse field
0-6.4kBar Pressure Cell
Fly past capable
RF, EF, Laser

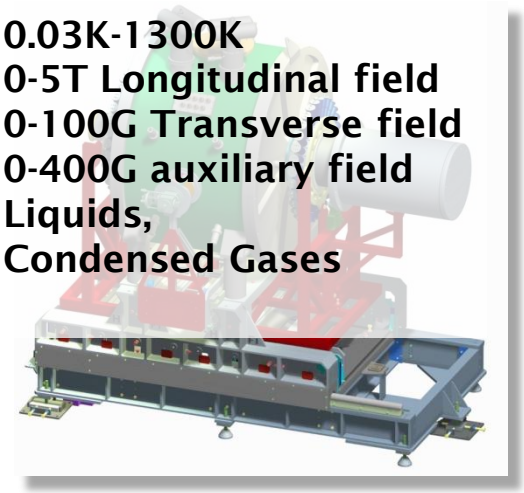
ARGUS

EMU



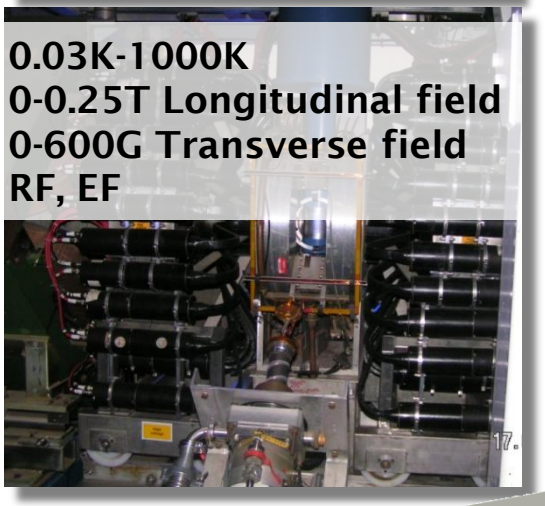
0.03K-1300K
0-0.45T Longitudinal field
0-100G Transverse field
Fly past capable
Liquid/Gas Cells
RF, EF

0.03K-1300K
0-5T Longitudinal field
0-100G Transverse field
0-400G auxiliary field
Liquids,
Condensed Gases



HiFi

MuSR



0.03K-1000K
0-0.25T Longitudinal field
0-600G Transverse field
RF, EF

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Thanks

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