Multiferroic Meeting

National Physical Laboratory

17th June 2009

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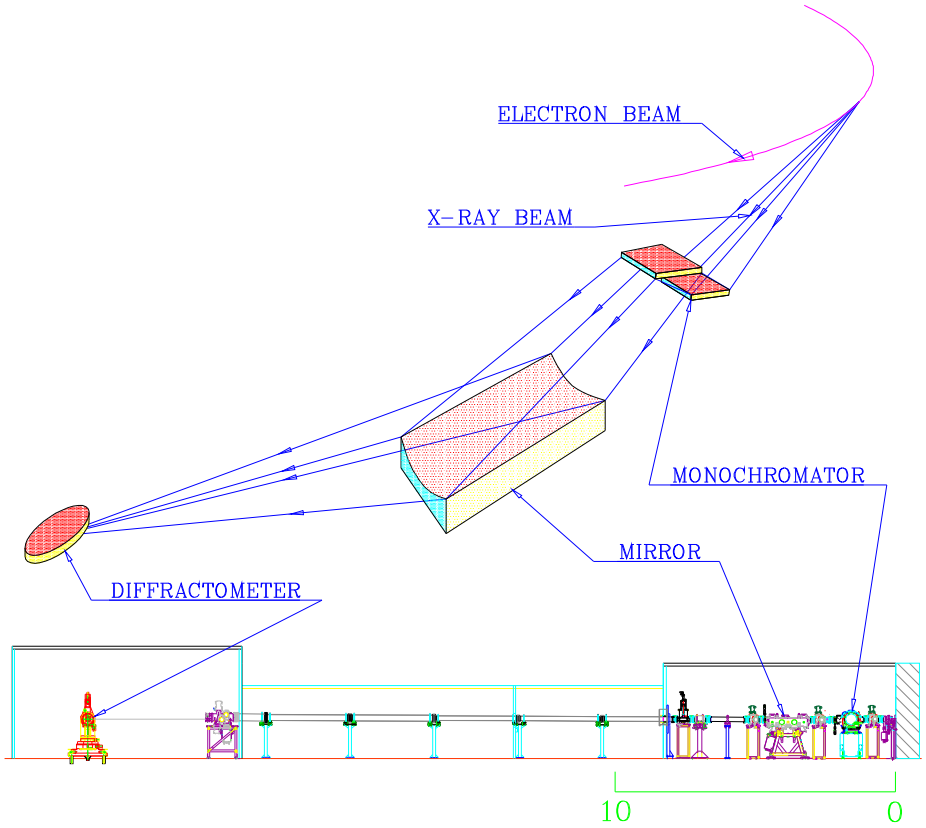
Basic Beamline Specifications



- BM Source – Critical Energy 9.8 KeV
- Constant offset Si<111> Water Cooled Mono
- Torriodal Mirror
- Energy Range 2.4 – 15 KeV (2.2 KeV post 2010)
- Beam Focus 0.8mm vertically 0.4mm Horizontally

Basic Beamline Specifications

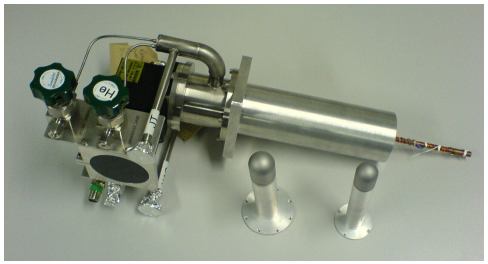
Huber Diffractometer

XMaS Huber Diffractometer

- 6 Primary Circles
- Rapid switching from vertical to horizontal scattering geometries possible
- 30 μm Sphere of Confusion (60 μm on Detector Circles)
- 2D detectors, point detectors and various analyzers mountable on 2θ arm
- Non Magnetic Construction
- Large Variety of Sample Environments
- Manipulate Incident Beam Polarisation and Analyze Polarisation of Scattered Beam

In – Situ Electrical Measurements

Already 2 Cryostats with Electrical Feedthroughs



- 2 K Base Temperature with ^{4}He
- Few mK temperature stability
- Hi-Voltage feedthroughs for in-situ E-field application (±2 kV) and electrical measurements
- Compatible with 4 T magnet

- 6 K Base temperature
- Hi voltage feedthroughs for application of E-field (±10 kV)
- Compatible with 1 T magnet
- Thermalised hi pressure gas line.

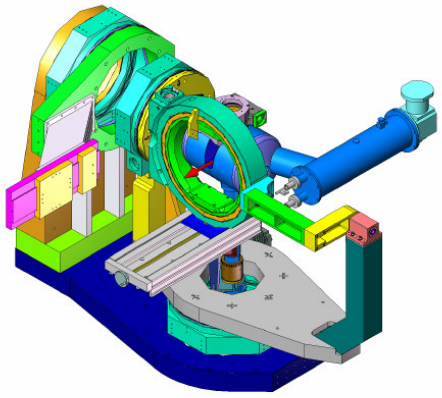
Possible Measurements

- Resistivity
- Capacitance
- P-E loops (polarisation vs applied electric field for ferroelectric analysis)

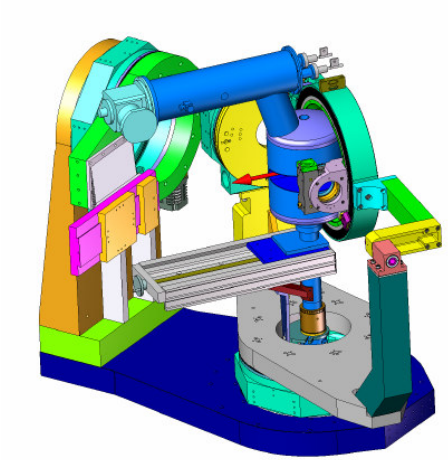
We have sample environments to 1500 K

4 Tesla Superconducting Magnet

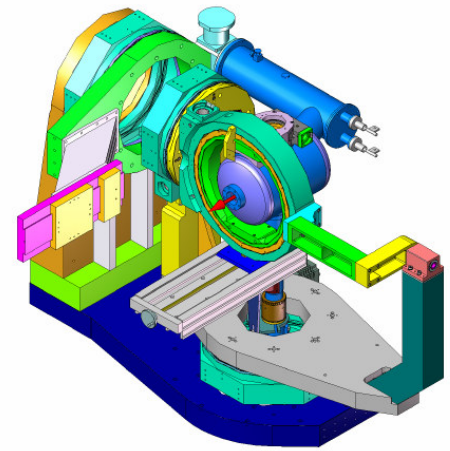
- Cryogen free design – 3 field and scattering geometries
- Decoupled cryogen free 1.7 K variable temperature insert
- Unique 180^0 open access and axial warm bores
- Must use non-ferromagnetic electrodes – such as Nickel
- Stable mechanical mounting needed for ferromagnetic samples



Horizontal Field – Vertical Scattering + 90° ± 5°

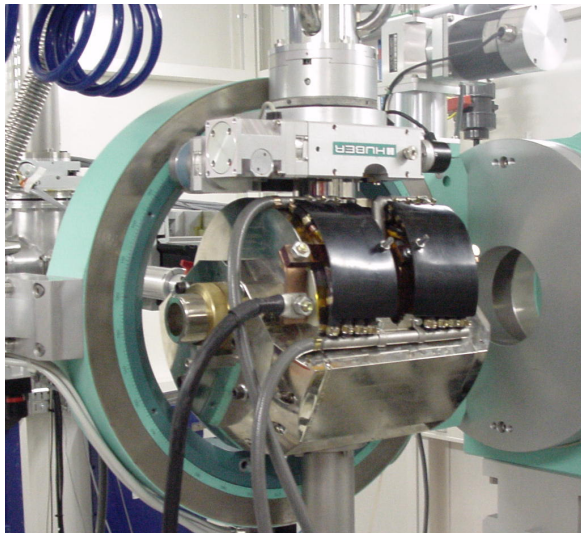


Vertical Field – Horizontal Scattering

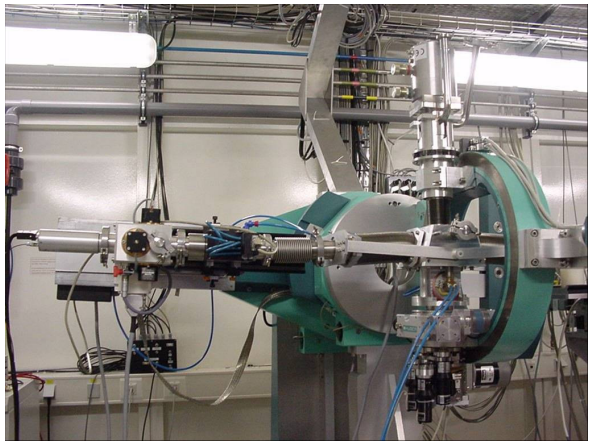


Horizontal Field – Vertical Scattering + 90° ± 5°

Electromagnet Systems

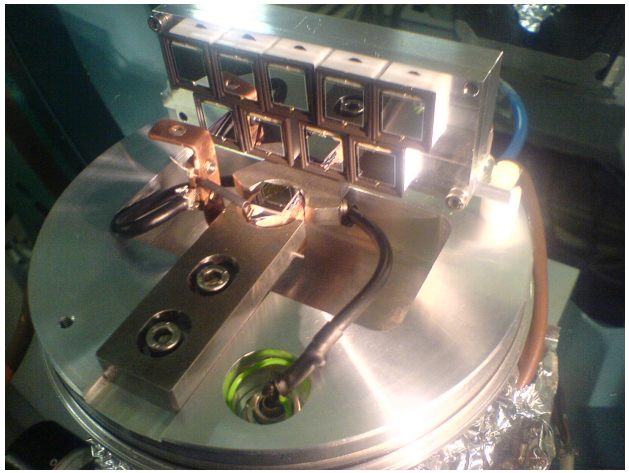


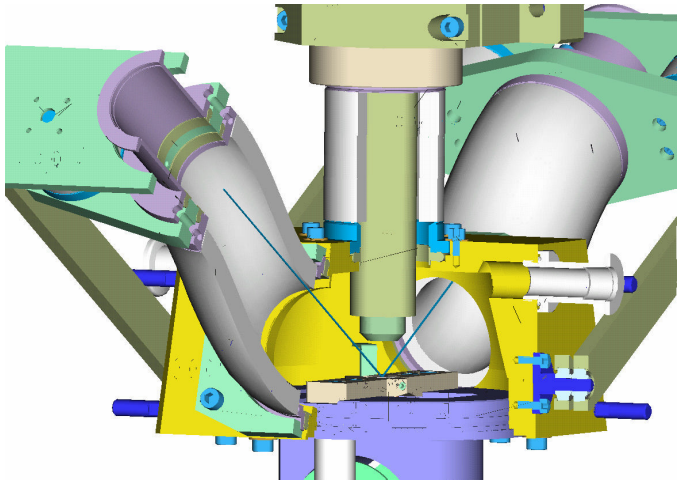
- +/- 1.5 Tesla, Flipping 1 Hz
- In-Vacuum 0.1 Tesla
- Various Permanent Magnets



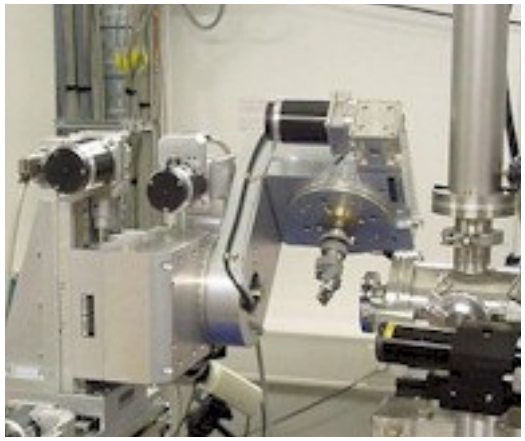
1.5 T Electromagnet

In-vacuum magnet



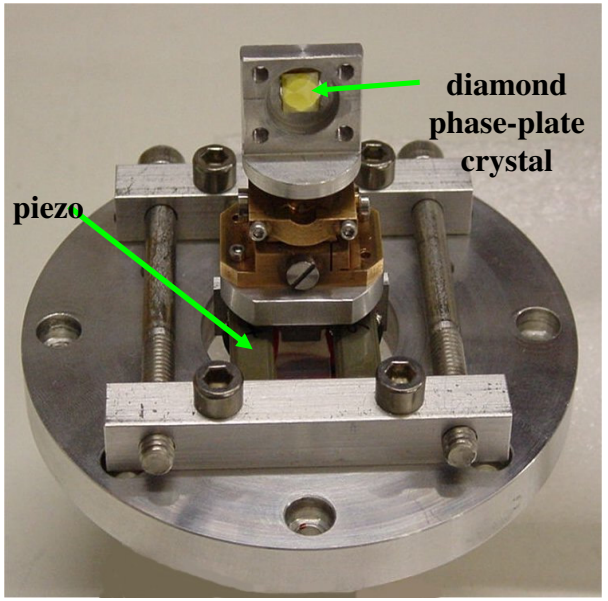


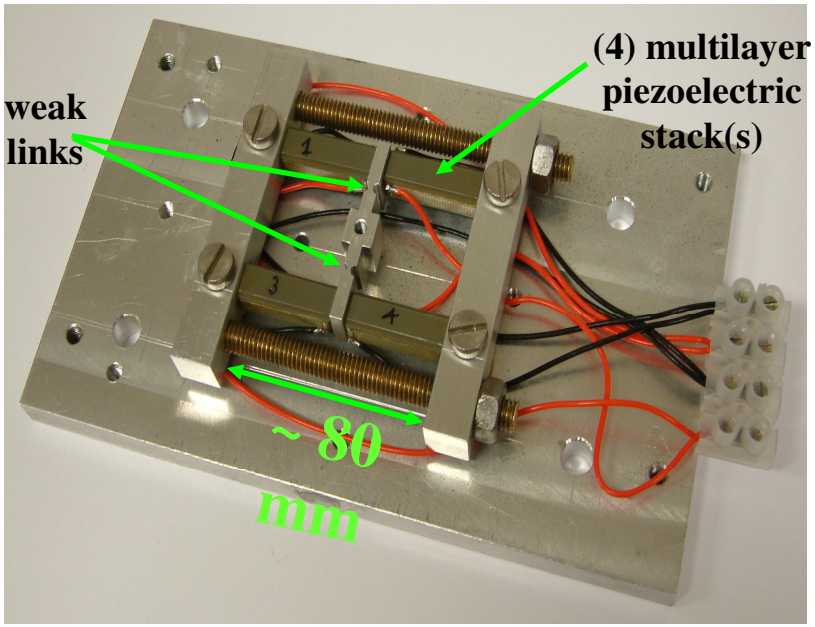
Phase-plate Flipper

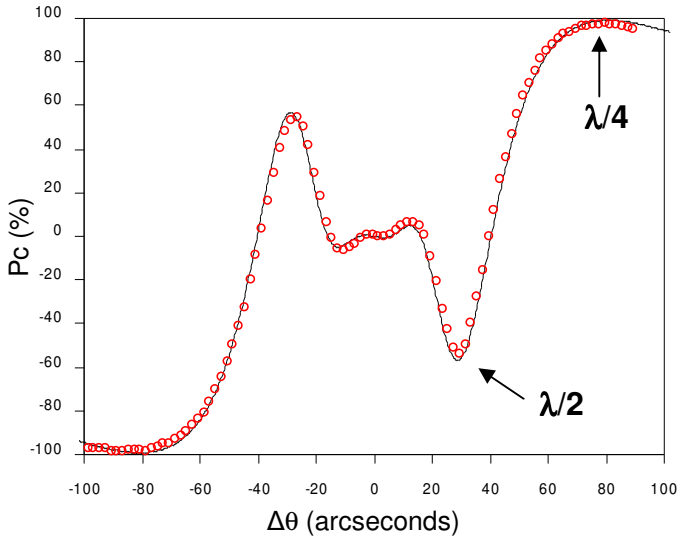


Phase-plates condition the incident x-ray beam.
They produce circularly / linearly polarised x-ray photons

- Mounted onto Huber 410 circle
- +/- 300 arc seconds rotation
- Flipping speeds up to ~100 Hz
- Potential to mount in-vacuum

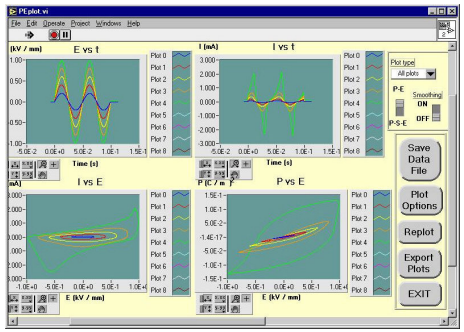


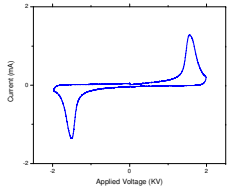




In Situ Applied Electric Fields

On-line PE loop data analysis using NPL code



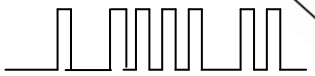


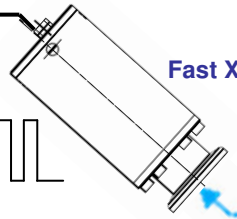
i – V Loop

Ramp	Current	Det	Mon

GPIB Output to Array and SPEC

Detector Pulses





Fast X-ray Detector (APD)

X-Rays

Electroded sample

Synchronised Digital 400Khz Data Storage Card

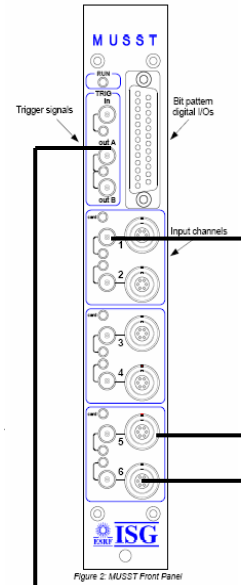


Figure 2: MUSST Front Panel

I to v Amplifier

High Voltage Ramp

High Voltage Amplifier

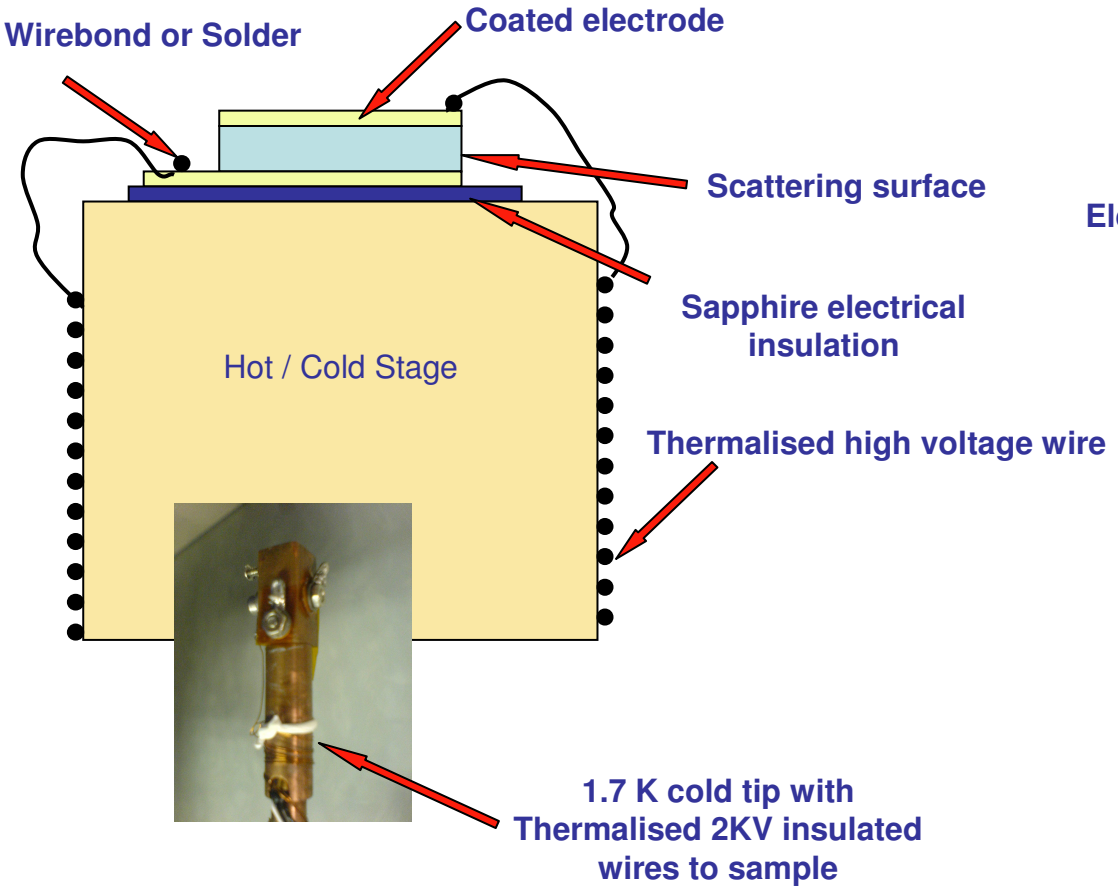
Function Generator

D.C. Program Ramp

Synchronisation Pulse

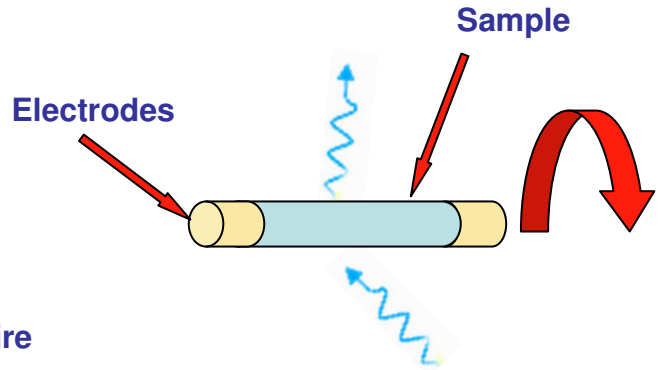
Sample Mounting Considerations (X-rays)

Single Crystals



Powders

More complex – need to spin sample!



- Use bearings/brushes to transmit potential to sample
- Use capillaries or solids ?
- Possible movements of powders in magnetic field