FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

MLZ
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MIEZETOP – A modular, transportable turnkey setup for quasi-elastic measurements

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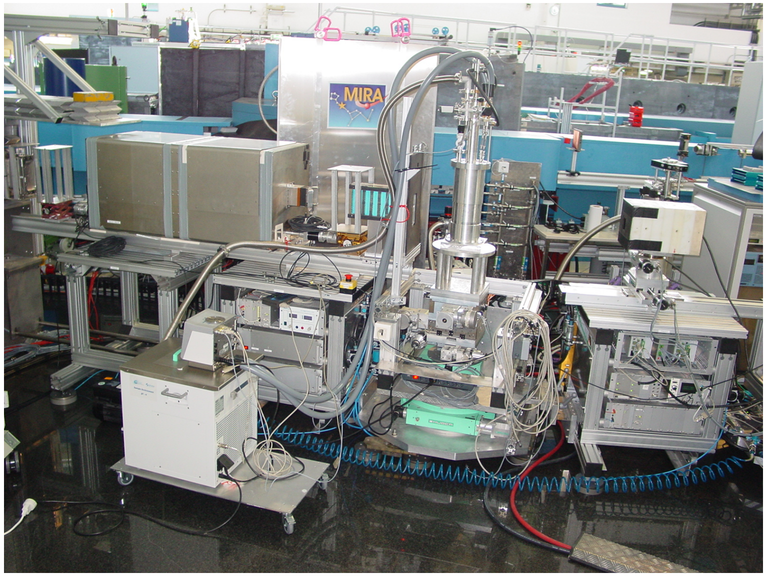
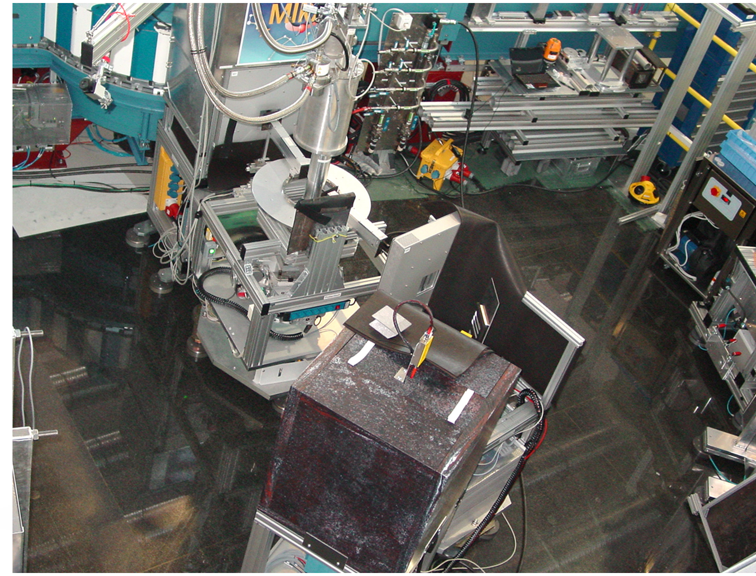
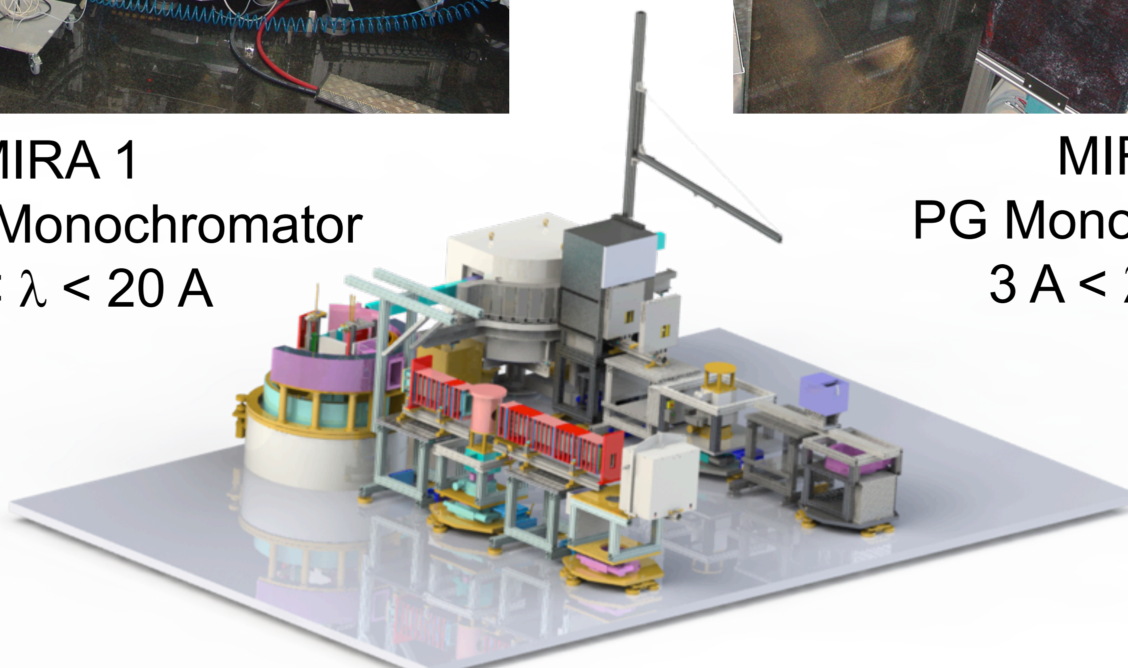
MIRA



MIRA 1
Multilayer Monochromator
6 A < λ < 20 A

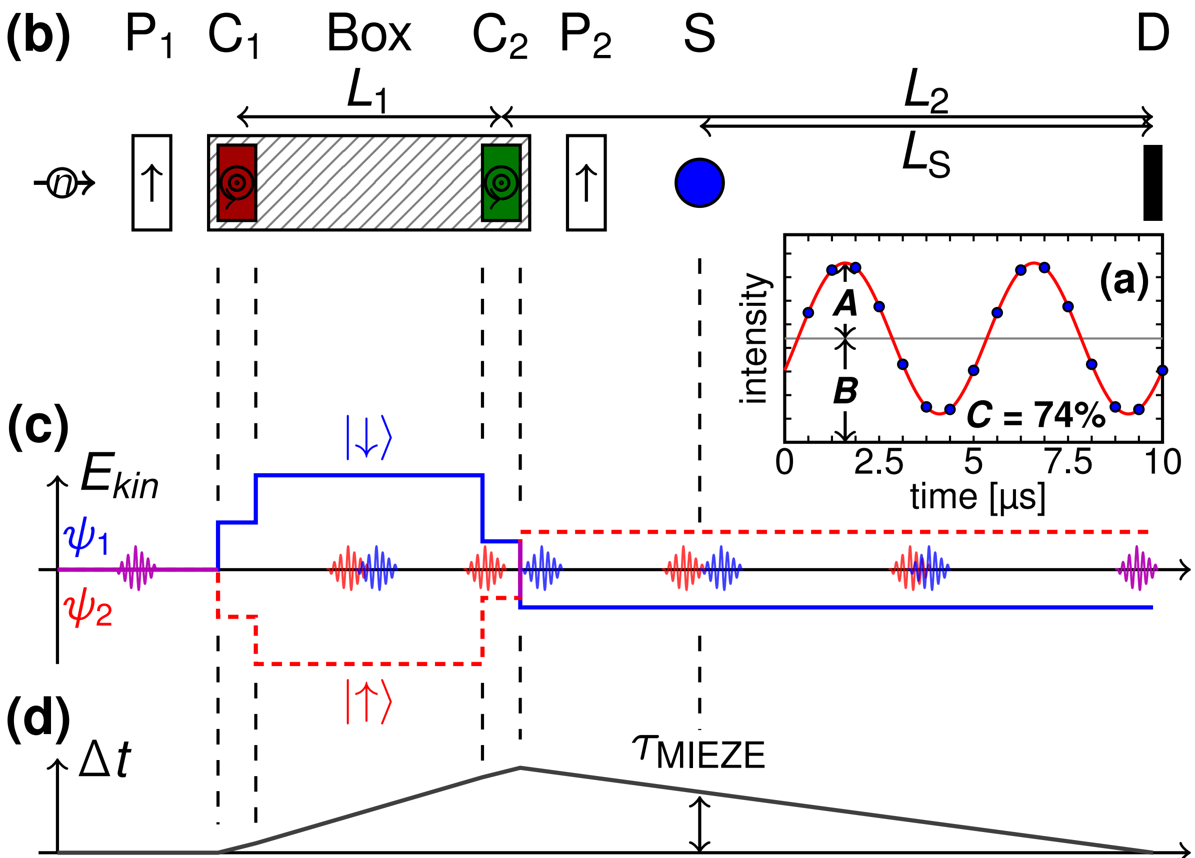


MIRA 2
PG Monochromator
3 A < λ < 5 A



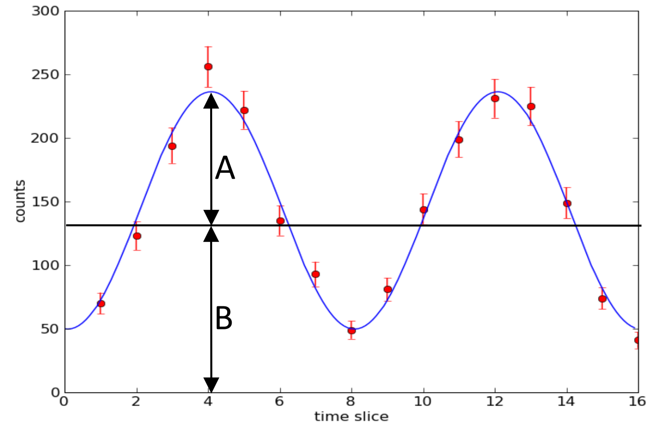
MIEZE - Basics

MIEZE (Modulation of IntEnsity with Zero Effort) uses the Neutron Resonance Spin Echo techniques, but the second NRSE arm is missing and the coils are operated at **different frequencies**.



Brandl et al., NIM A **654**, 394–398 (2011)

MIEZE measurement



- MIEZE **contrast** C = A / B

  is equivalent to polarization in spin-echo measurement

- MIEZE time $\tau_M = \frac{2h \cdot L_s \cdot \Delta\omega}{m \cdot v^3}$ is equivalent to τ_{NSE} in spin-echo

- To eliminate instrument resolution, *C* must be normalized to a purely elastic signal; e.g. graphite or scattering at very low q

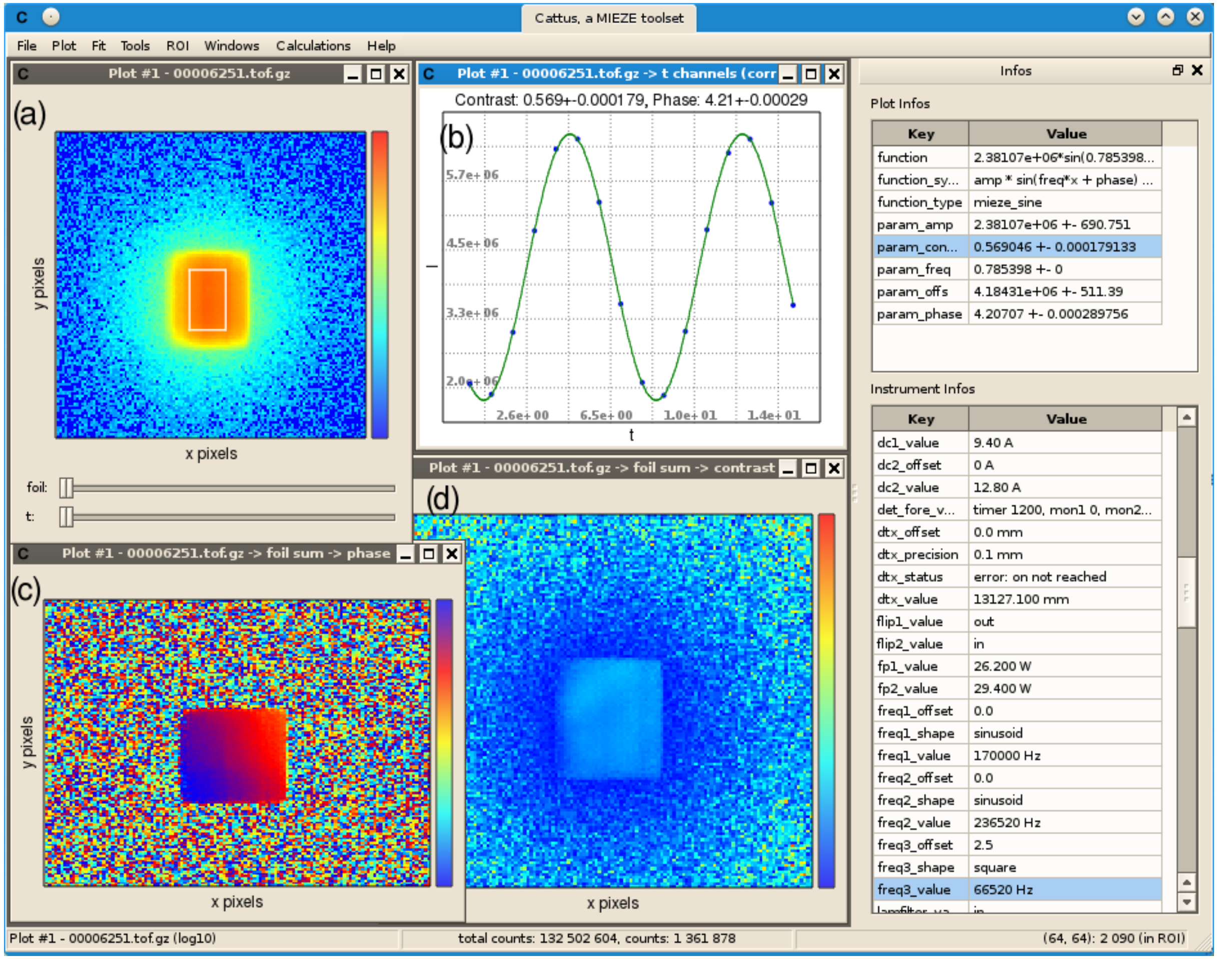
- Then C_{norm} is proportional to $S(q, \tau_M)$

CASCADE Detetcor

- Boron as solid neutron converter
- Symmetrical set-up
- 6 layers ≈1 µm
- Gas: 85/15% Argon/CO_2 normal pressure
- Internal readout-structure
- Voltage 2000-3000 V
- 200x200nm
- 128x128 pixel (2D)
- MIEZE possible

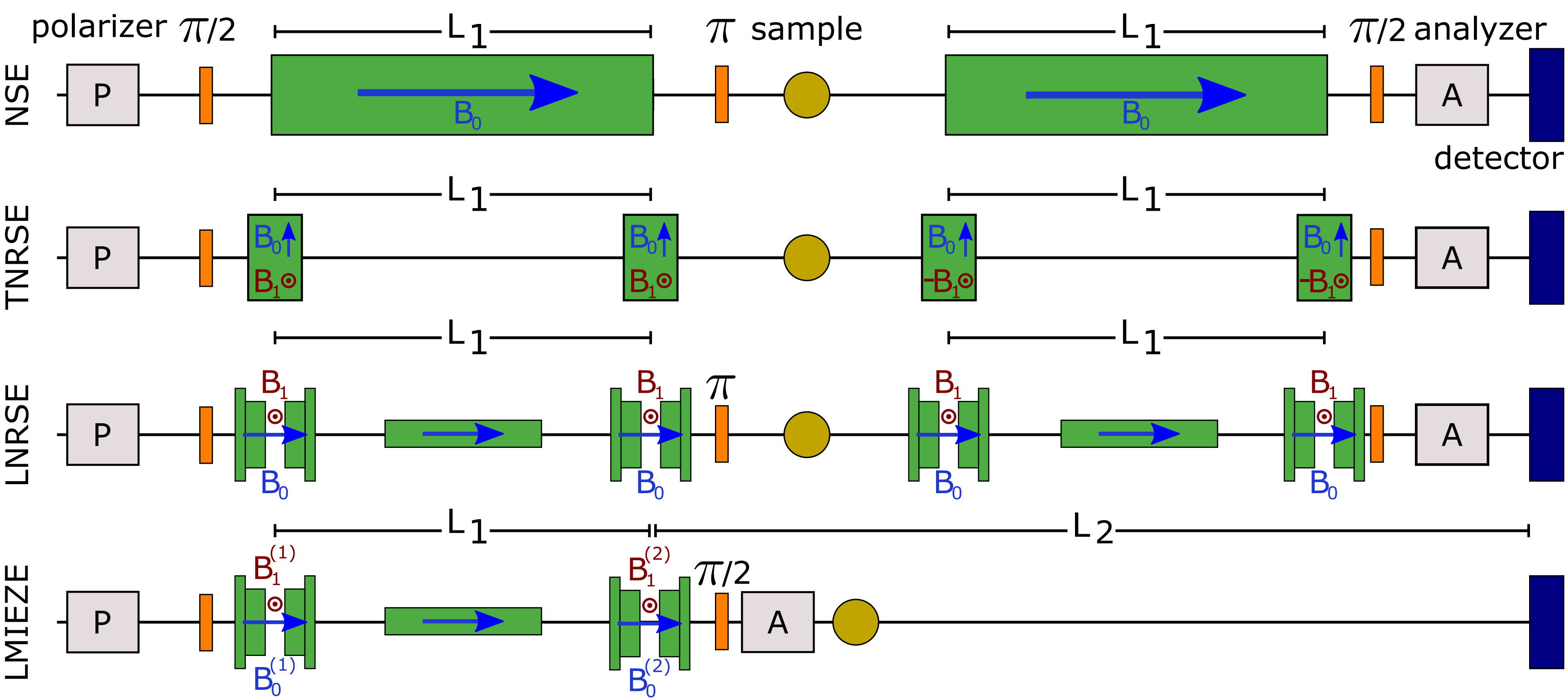
→ Combines principle of solid neutron converter with multi-wire-chamber

Software for analysis



Weber et al., Journal of Physics: Conference Series **528** (2014) 012034

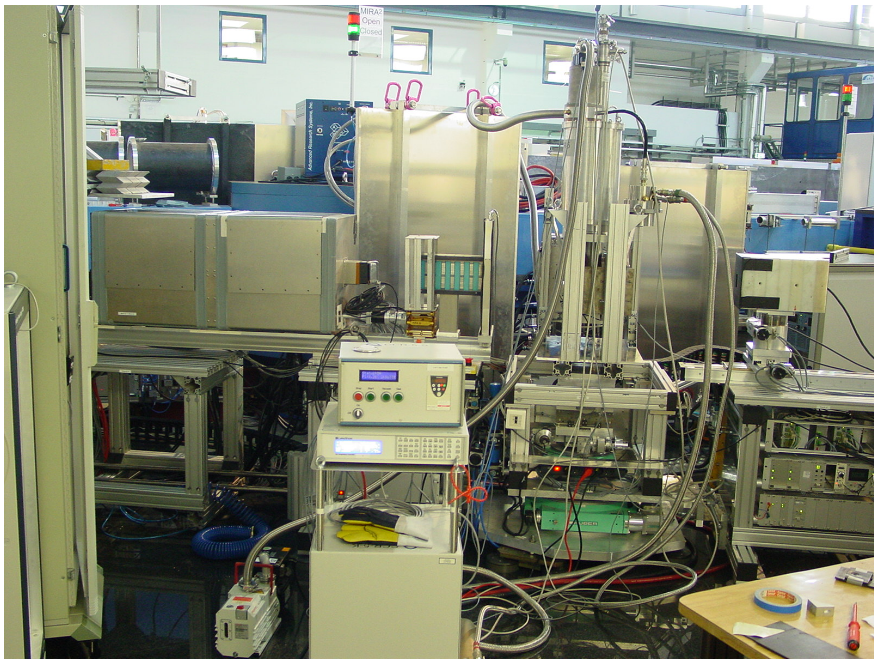
Different NSE variants

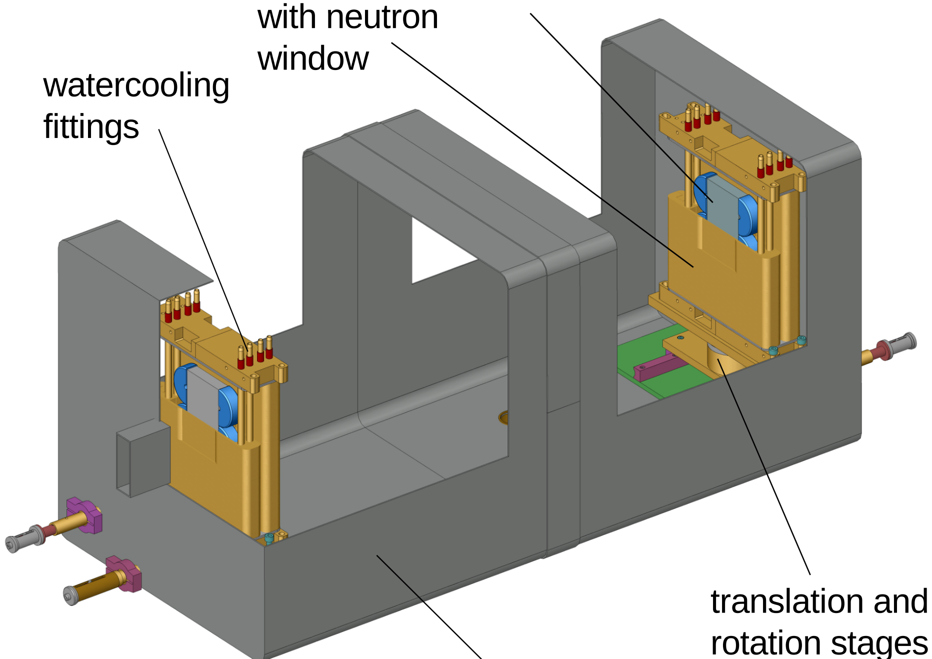


Krautloher, Keller et al., Rev. Sci. Instrum. **87**, 125110 (2016)

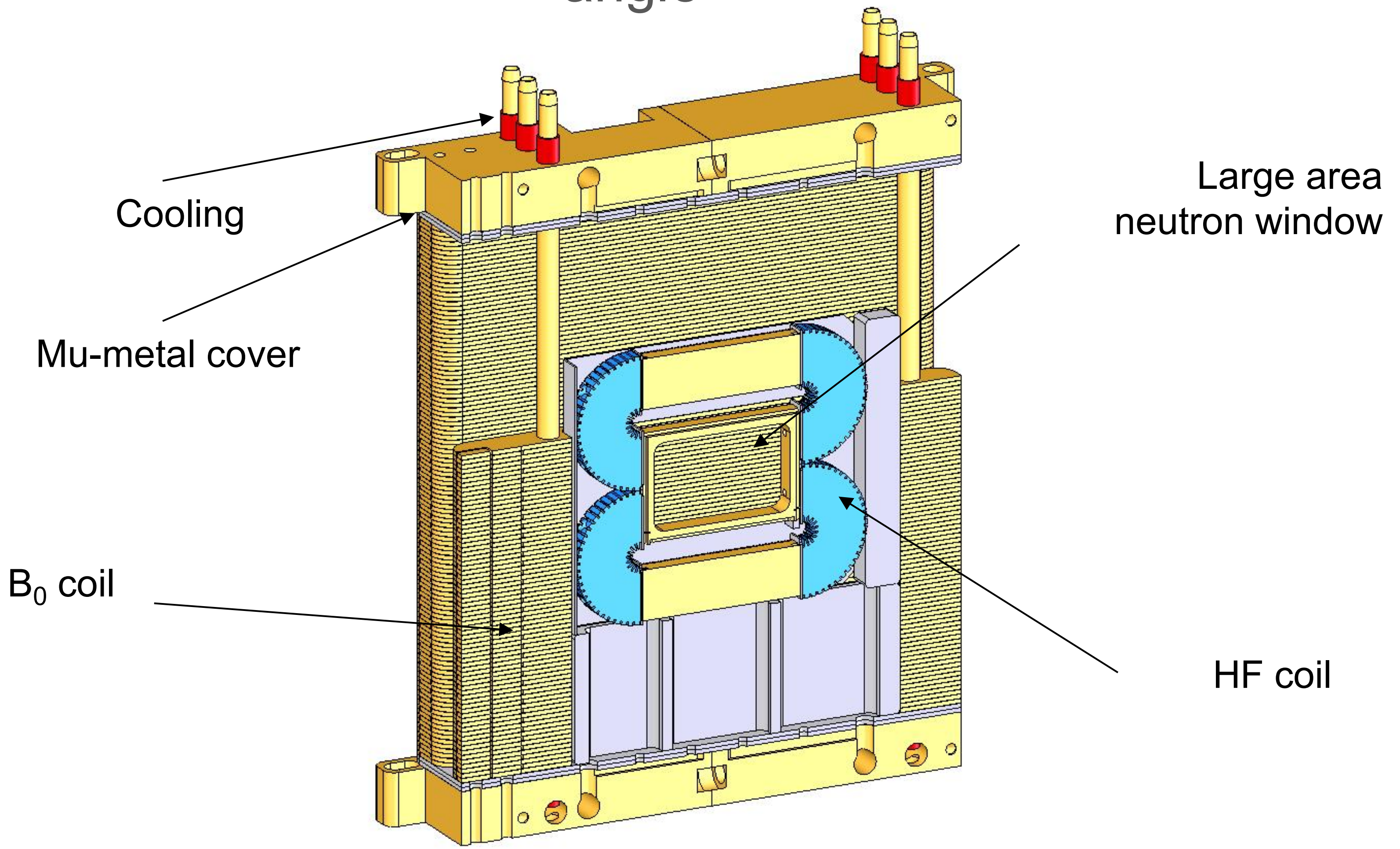
Georgii et al., NIM **A** **837**, 123 - 135 (2016)

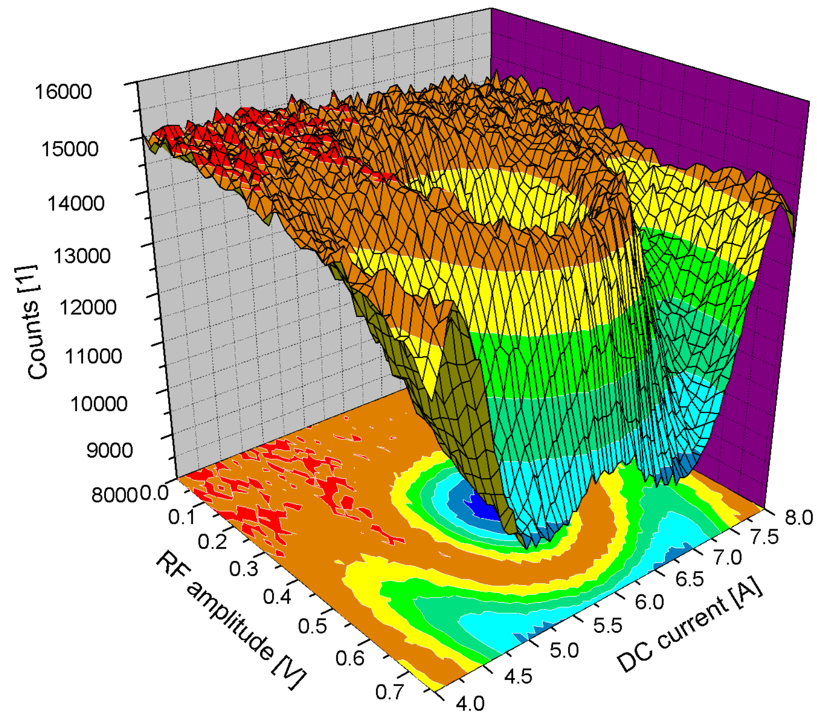
TMIEZE BOX on MIRA





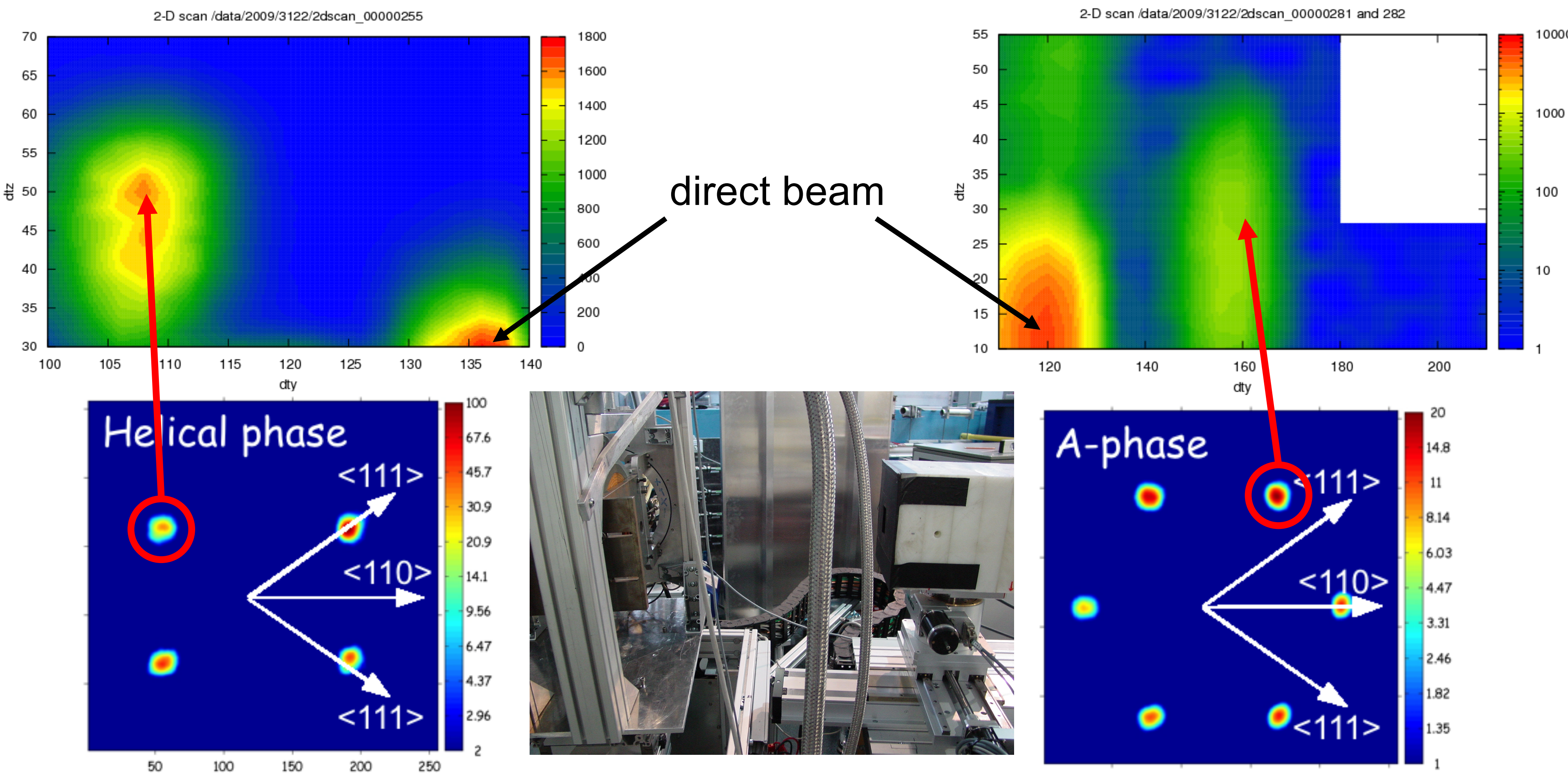
Spin-Echo coils for long wavelength and large tilting angle



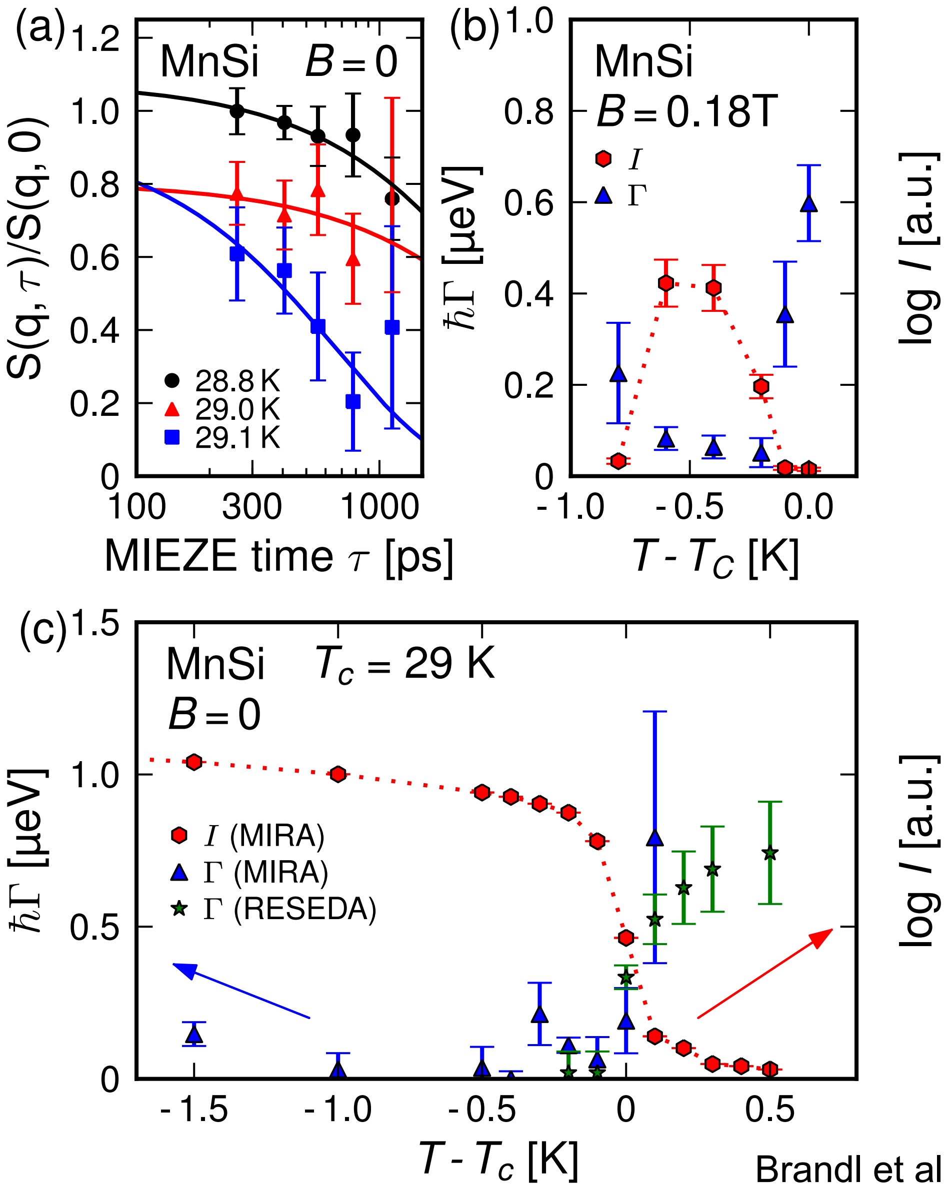


π Spin flip at a HF 109 kHz

TMIEZE in MnSi

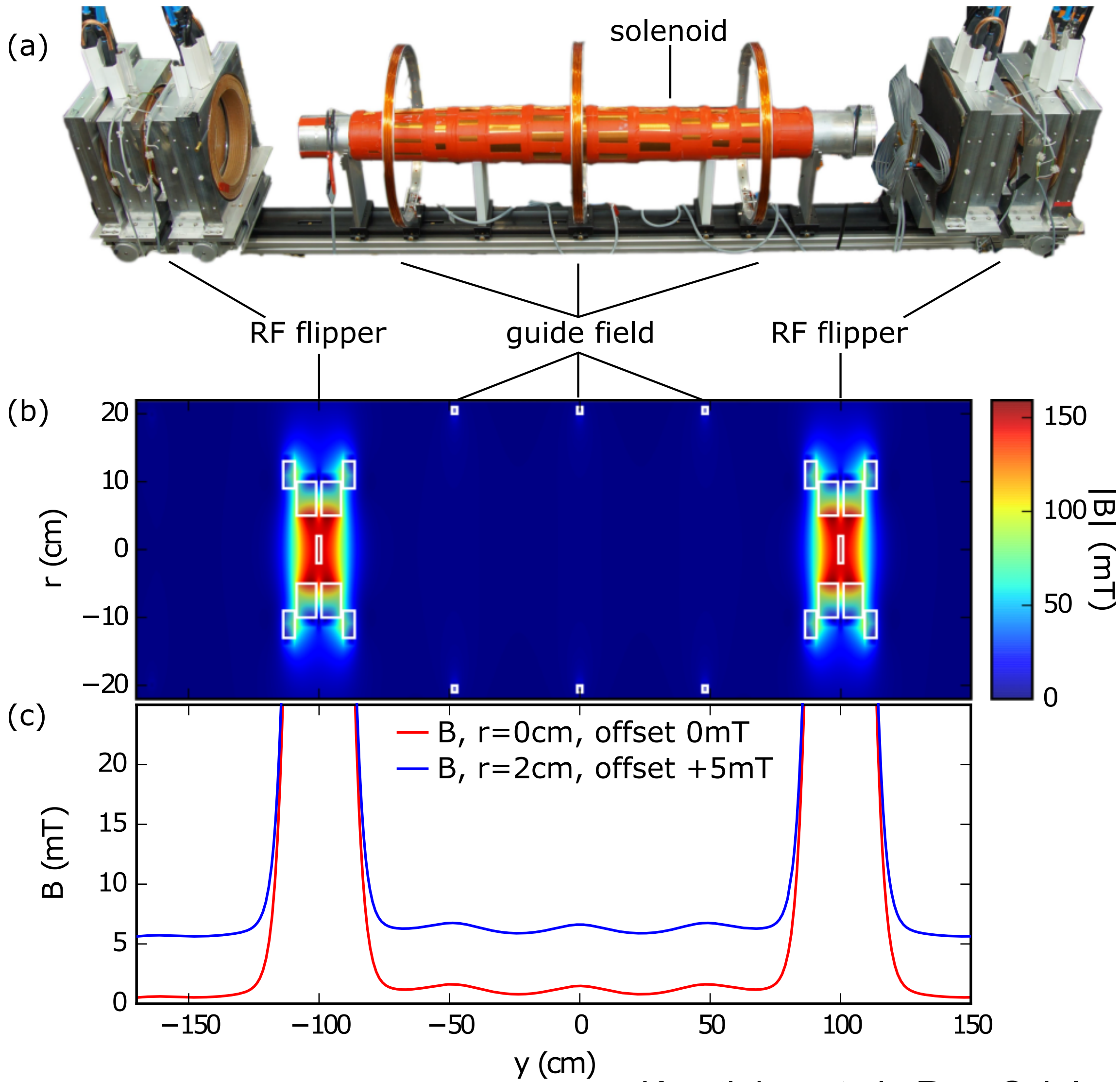


Results

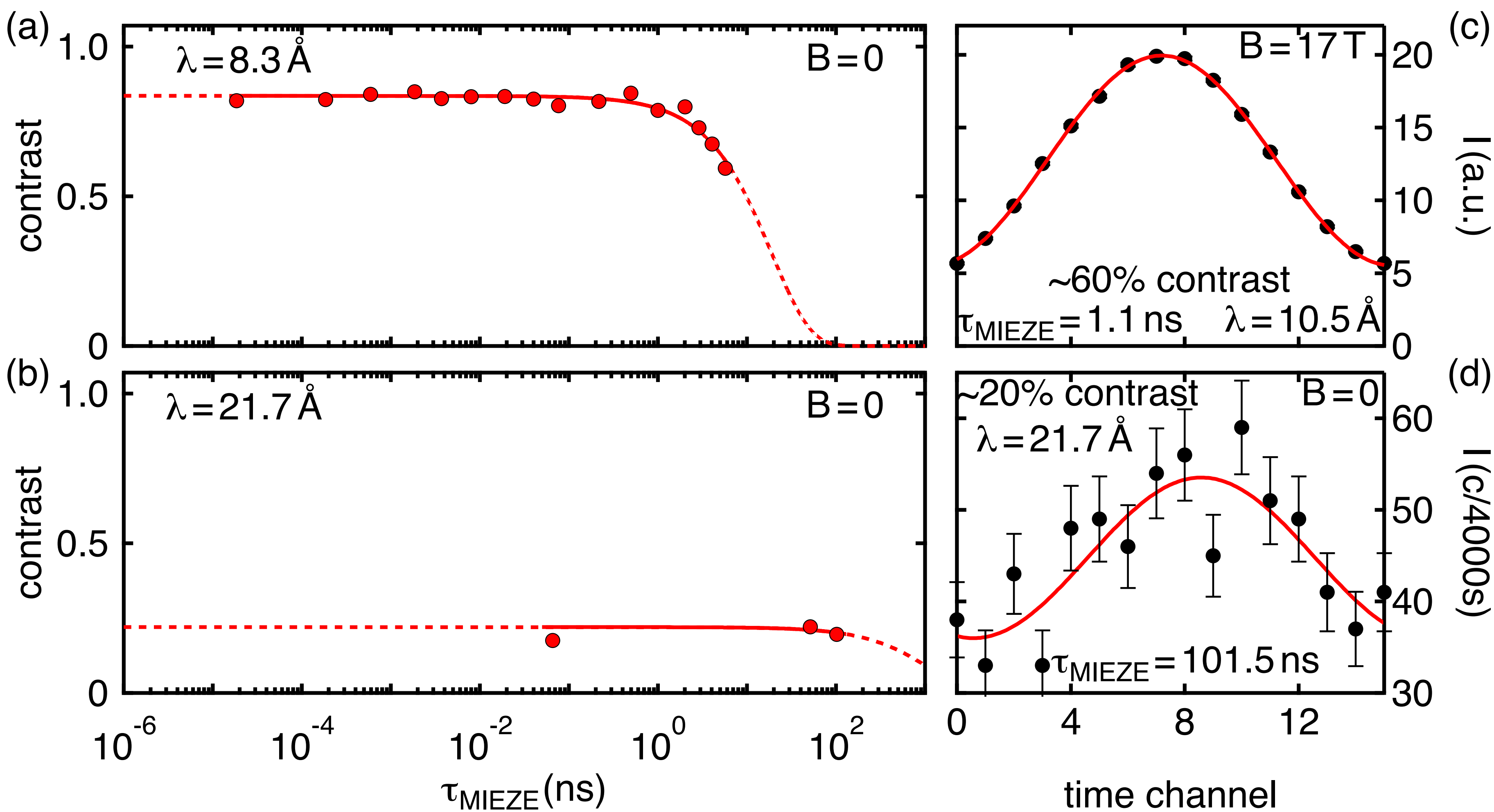


Brandl et al., NIM A **654**, 394–398 (2011)

LMIEZE on RESEDA



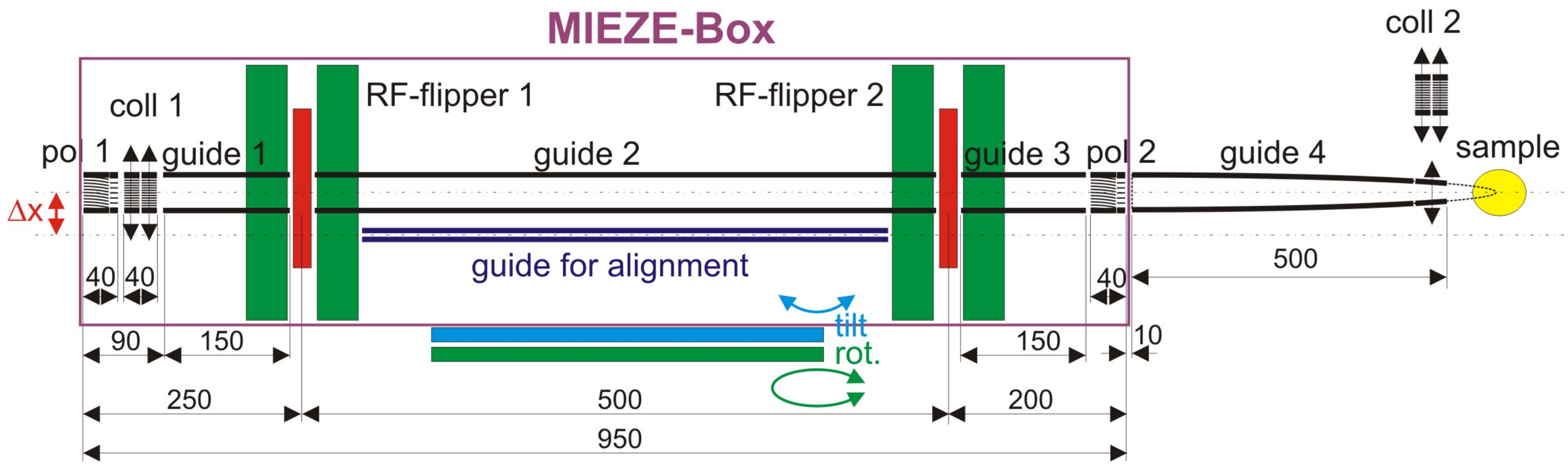
Krautloher et al., Rev. Sci. Instrum. **87**, 125110 (2016)



Kindervater et al., EPJ Web Conf. **83**, 03008 (2015)

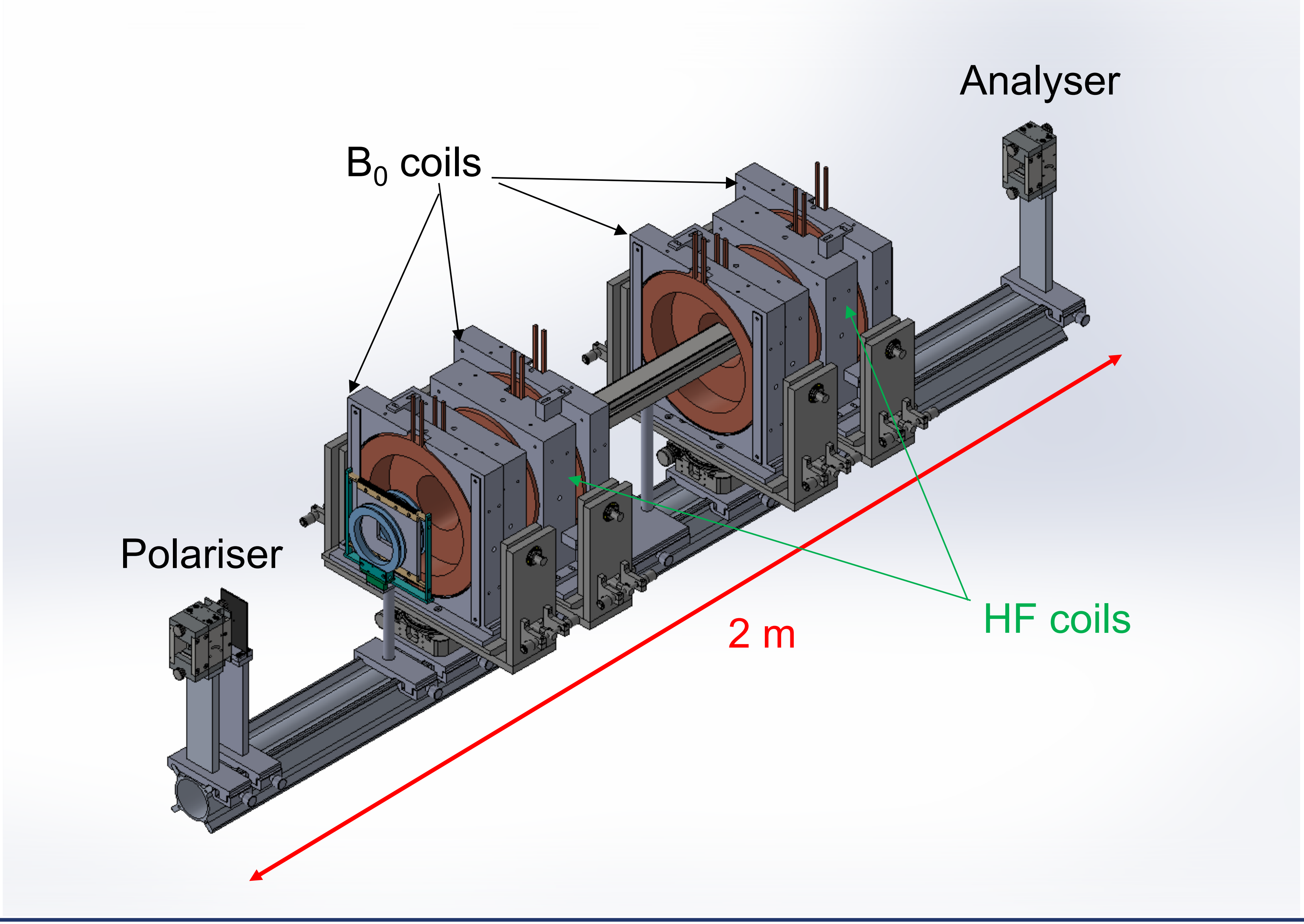
MIEZETOP

A longitudinal Neutron Spin Echo (LNRSE) add-on with a total length of 1 m for measurements in magnetic fields and ferromagnetic materials using MIEZE.



- A total field integral of 1/10 of IN15, yielding spin echo times of 10 ns @ 10Å at MIRA.
- Flux gain due to focusing guides for small samples.
- Transportable and easy-to-use for measurements at the 26 T magnet in Berlin.
- Compact LNSE design, therefore insensitive to magnetic stray fields.

Current design



Scientific goals

Superconductors

- unconventional superconductivity in copper oxide-, rare earth- and iron-based materials and its relationship to magnetism
- flux pinning and flux lattice melting

Magnetic Materials Research

- second order phase transitions and critical phenomena on large length and time scales
- spin glass transitions
- Berry phase contributions in chiral spin glasses

Heterostructures:

- field driven magnetisation for studies of spin excitations of topological forms of magnetic order in bulk compounds
- multi-ferroic compounds as well as systems with coupled order parameters (say ferromagnetic and superconducting)

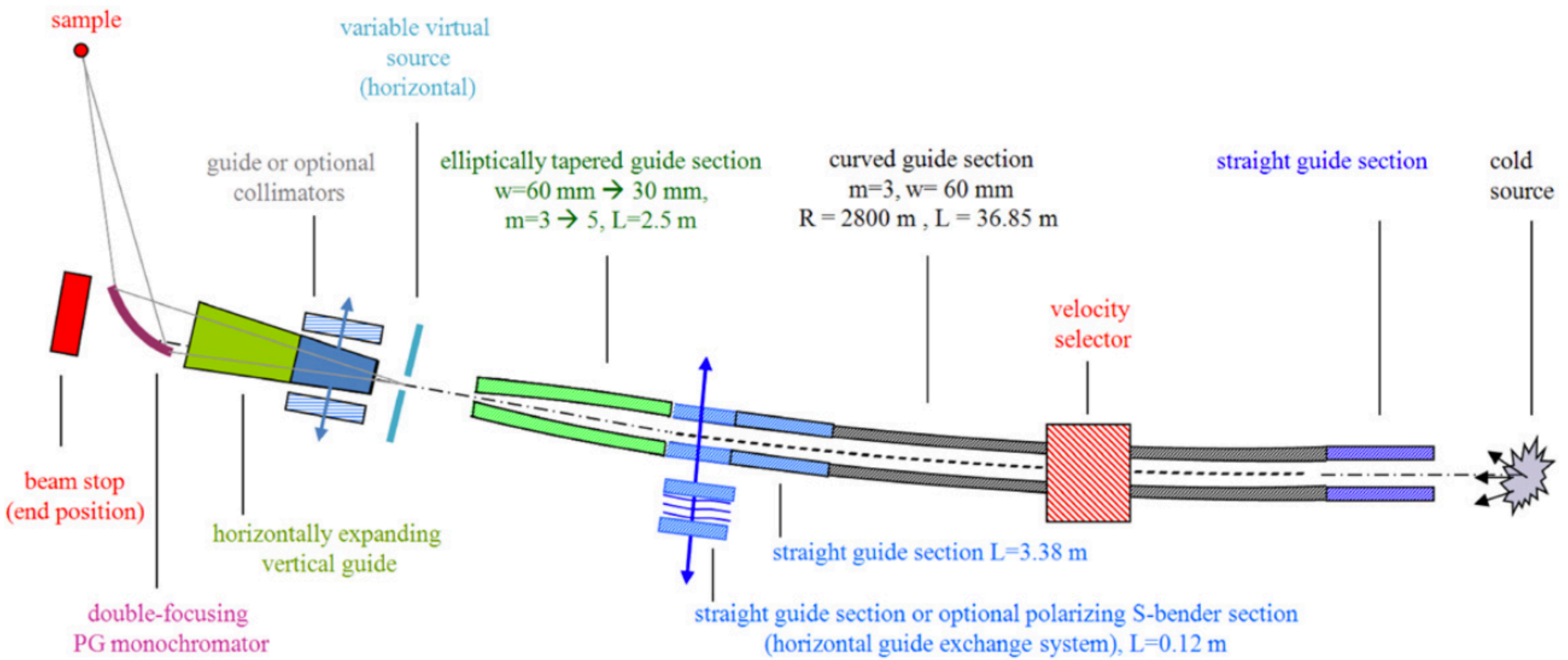
Quantum Matter:

- fluctuations are not only spectator, but are at the heart of fundamentally new forms of order and functionalities.
- Geometrically frustrated materials such as spin ice with the the emergence of magnetic monopoles
- spin liquid phases, i.e., properties in which quantum entanglement boosts the effects of quantum fluctuations to prevent conventional long-range order.
- zero temperature phase transition driven by quantum fluctuations (also referred to as quantum phase transitions), are characterised by excitation spectra with emergent quantum statistics and symmetries
- the critical slowing-down in field driven magnetic Ising transition
- field driven Bose-Einstein condensation of magnons

High-resolution spectroscopic studies under high magnetic field

TAS FLEXX upgrade, 2011

- cold triple axis spectrometer
- Larmor diffraction option (NRSE)
- high m=6 focusing optics before monochromator
- state of the art, 5y old

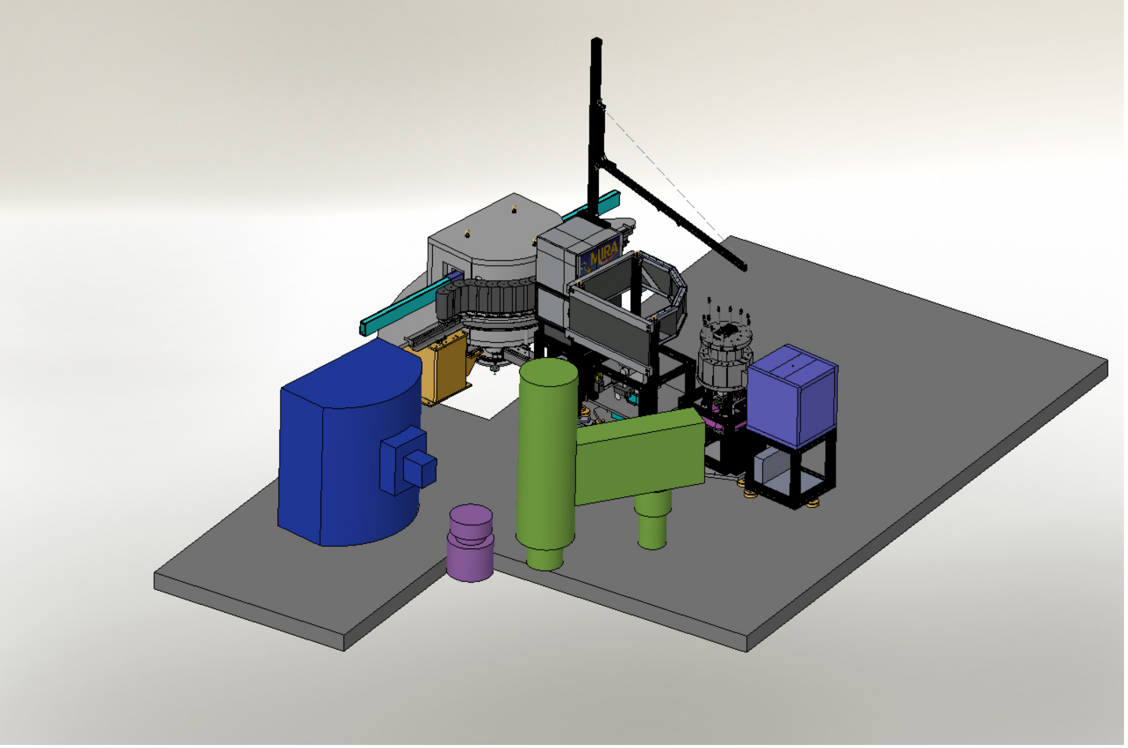


Skoulatos, Habicht, NIMA A **647**, 100 (2011)

FLEXX: A dedicated Larmor diffractometer

Location: old MIRA1 position (near current MIRA2) as shown in figure below

McStas simulations show intensity increase by x10 compared to MIRA1



Primary spectrometer requirements:

- need to extend wavelength to less cold to make the new instrument a competitive option
- requirement to keep the flux of following instruments unaltered
- Need to extend the “Tanzboden”

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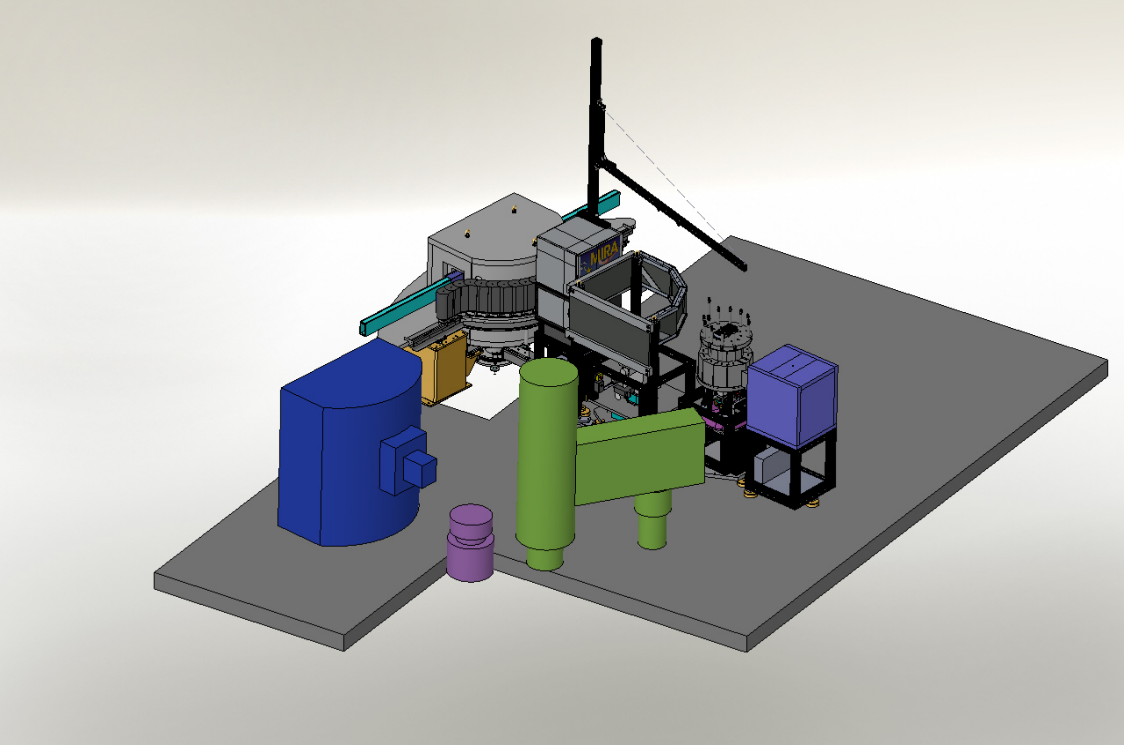

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Thanks to

- Nikolas Arned
- Georg Brandl
- Tobias Weber

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- Roland Gähler
- Thomas Keller