



**EUROPEAN
SPALLATION
SOURCE**



Instrument presentation - MAGiC

DMSC STAP, April 2026

IURII KIBALIN (CIS)

MAGiC

Magnetism Single-Crystal Diffractometer



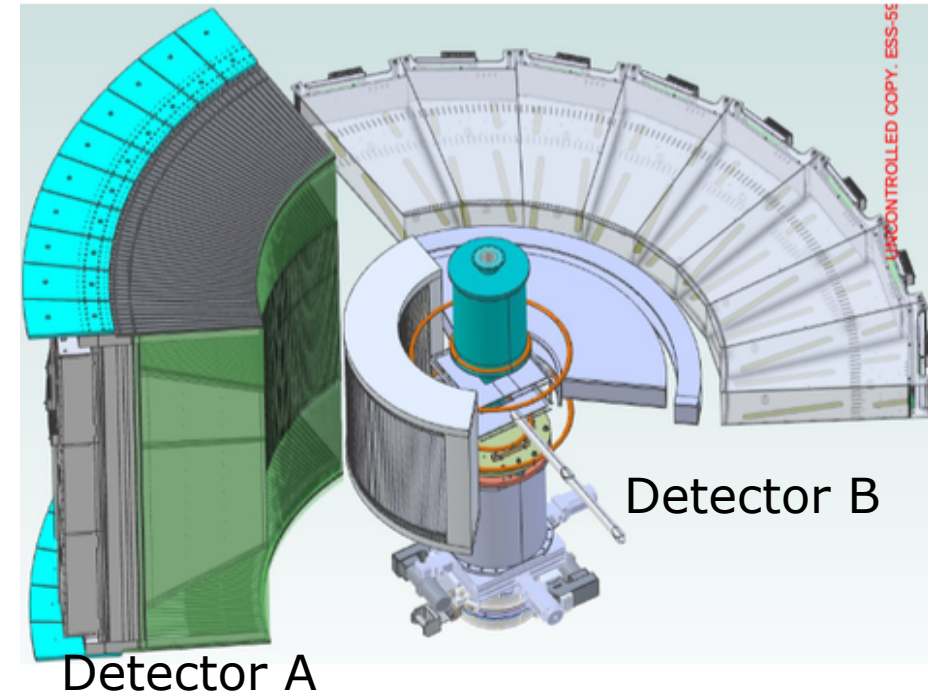
Single Crystal measurements:

- Laue-TOF Diffraction
- Half-Polarized Laue-TOF Diffraction
- XYZ Polarization Analysis Laue-TOF Diffraction
- Diffuse magnetic scattering
- Spherical polarimetry (**upgrade**)

Powder measurements:

- Powder Laue-TOF Diffraction
- Half-Polarized Powder Laue-TOF Diffraction
- Diffuse magnetic scattering

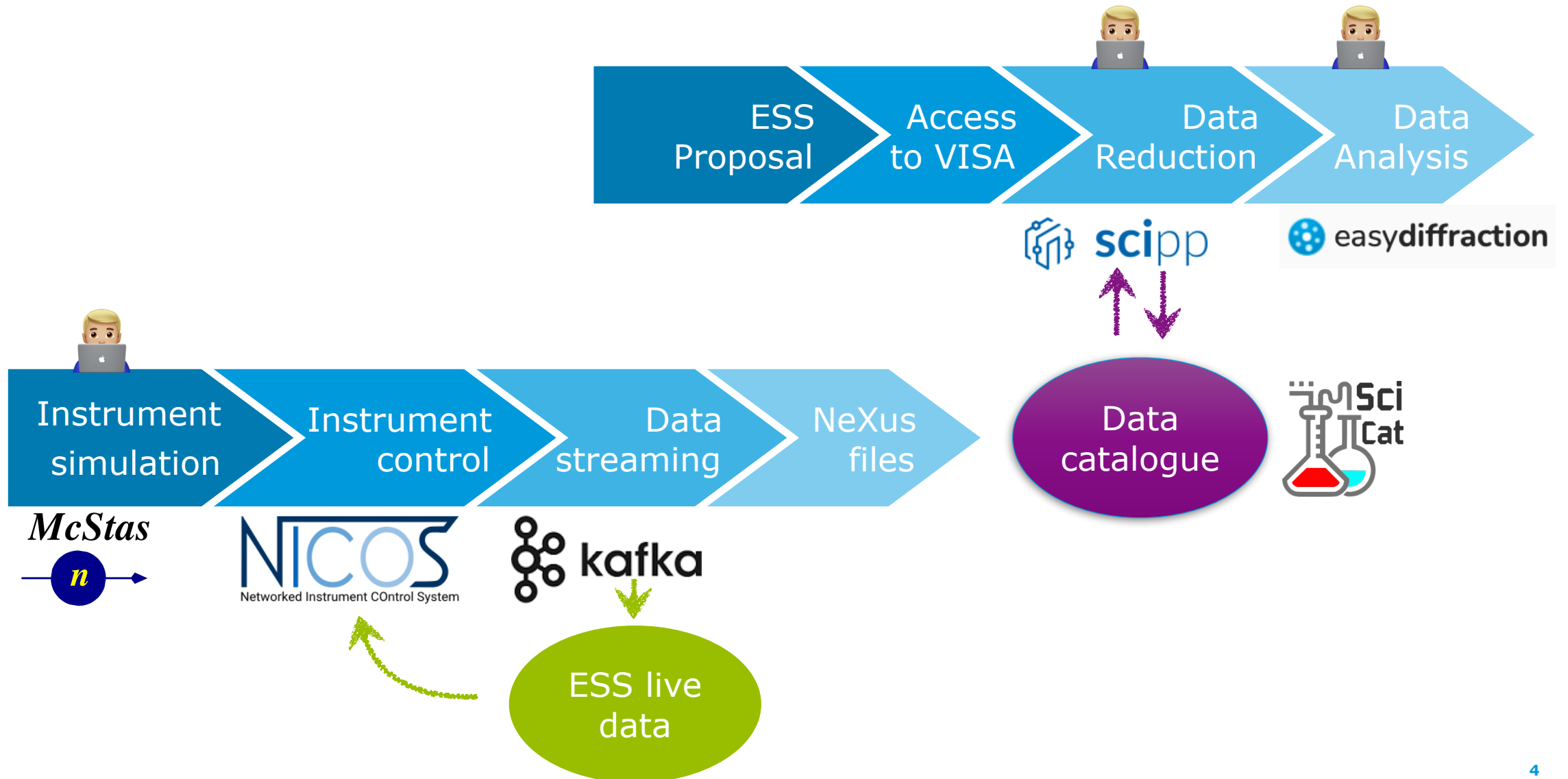
Detector A is used for all type of measurements
Detector B is dedicated to polarization-analysis experiments



Dates:

- Cold Commissioning: Q1 2027
- TG5/SAR: Q2 2027
- Hot Commissioning: Q3-Q4 2027

General data processing pipeline



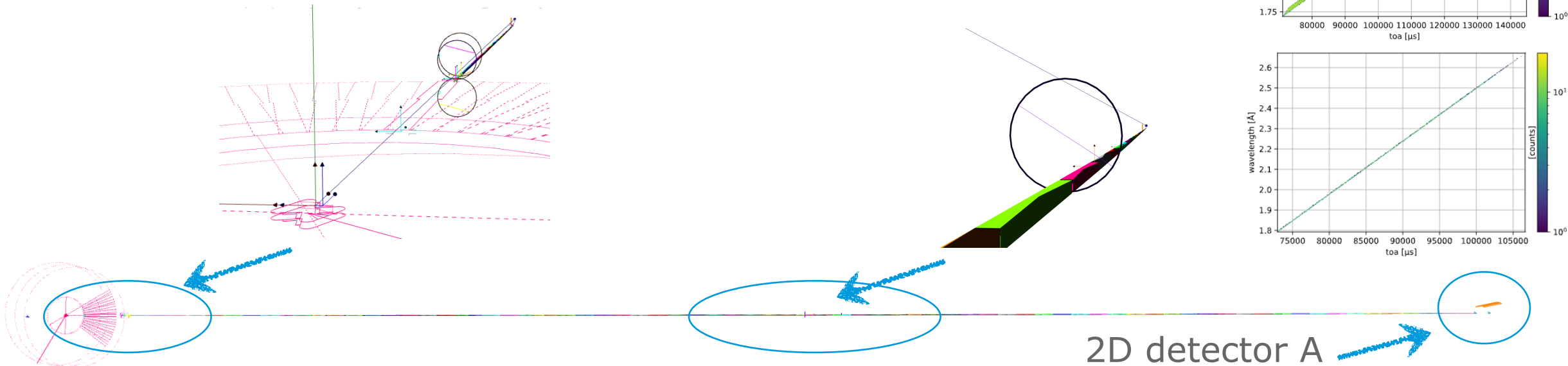
McStas model of MAGiC



- ✓ McStas model of MAGiC rewritten in McStas Script ([GitLab](#) page):
 - Chopper system; Monitors; Neutron guides; 2D detector A
- ✓ [Confluence](#) holds the current model status and necessary drawings.

- ✓ McStas simulation of neutron depolarisation within the MAGiC Guide Field ([resume](#))

👤 3D McStas simulation of detector A

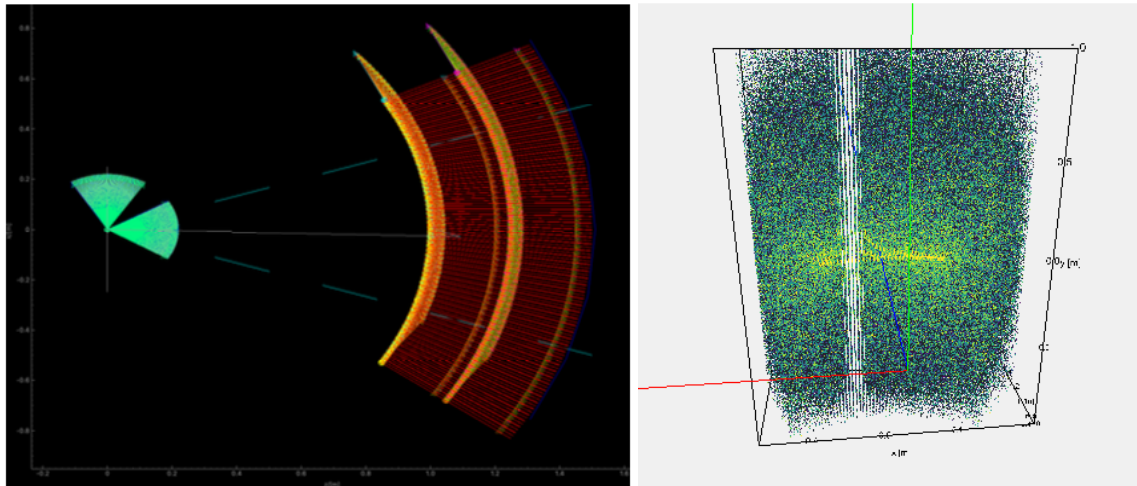


Simulation of 3D detector A using McStas

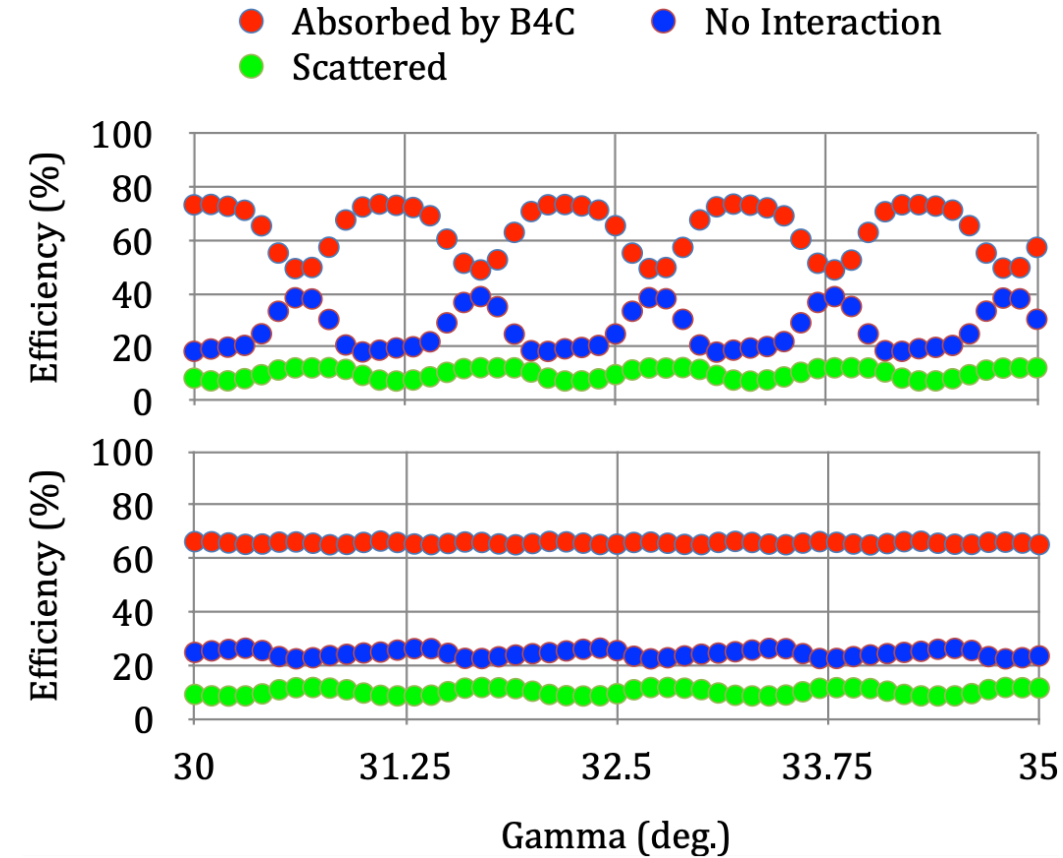


✓ Registration of events in 3D space

■ Event voxelization

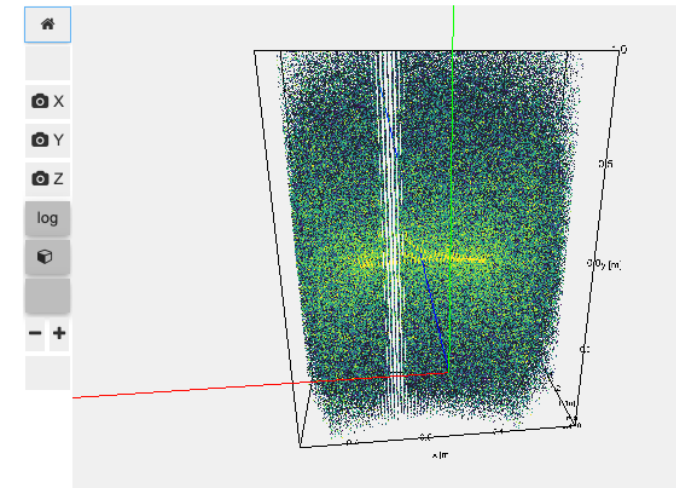
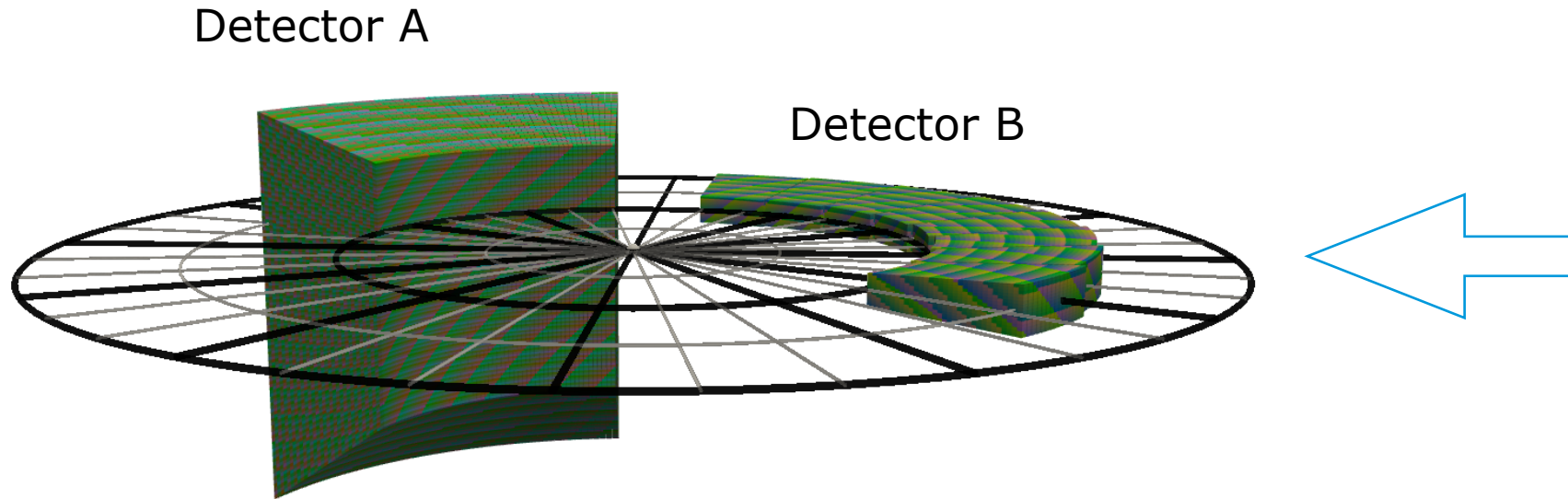


McStas model of detector A and registered events



[Estimated efficiency of Detector A](#) at inclination 5° and 6.065° as function of γ

Event voxelization

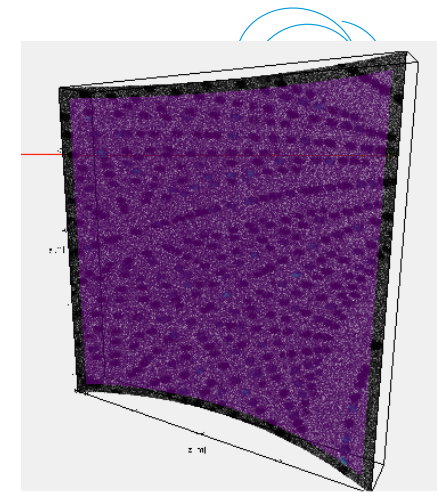


3D spatial distribution of events registered by detector A

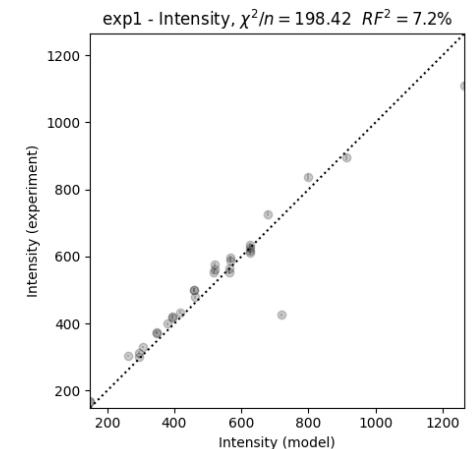
- ✓ Voxel map is received from CDT
- ✓ JSON template is prepared (in agreement with ICD of MAGiC)
- 🕒 The template is under review of ECDC (ticket [ECDC-5623](#))

Data Reduction using SCIPP

- ✓ Request list is on the [Confluence](#) page
- ✓ Data reduction workflow for unpolarized neutrons using SCIPP is uploaded on [GitHub](#)
 - Load McStas simulated data in event space (2D detector)
 - Calibrate data (normalization per incident spectrum using the monitor before sample)
 - Perform peak searching directly in event space
 - Determine the UB matrix, starting from a good initial guess and assuming a single domain.
 - Apply time-of-flight correction due to the long-pulse source
 - Integrate peaks in event space using a simple (background-free) method
 - Refine integrated intensities using CrysPy
- ✓ This workflow has been discussed with Denis Vasiukov (MAGiC), Florence Porcher (DREAM) and Dan Mannix (HEIMDAL) who provided critical feedback.



Laue pattern from 2D detector



Refinement of found I_{hkl} by CrysPy

Data analysis by Easy Diffraction

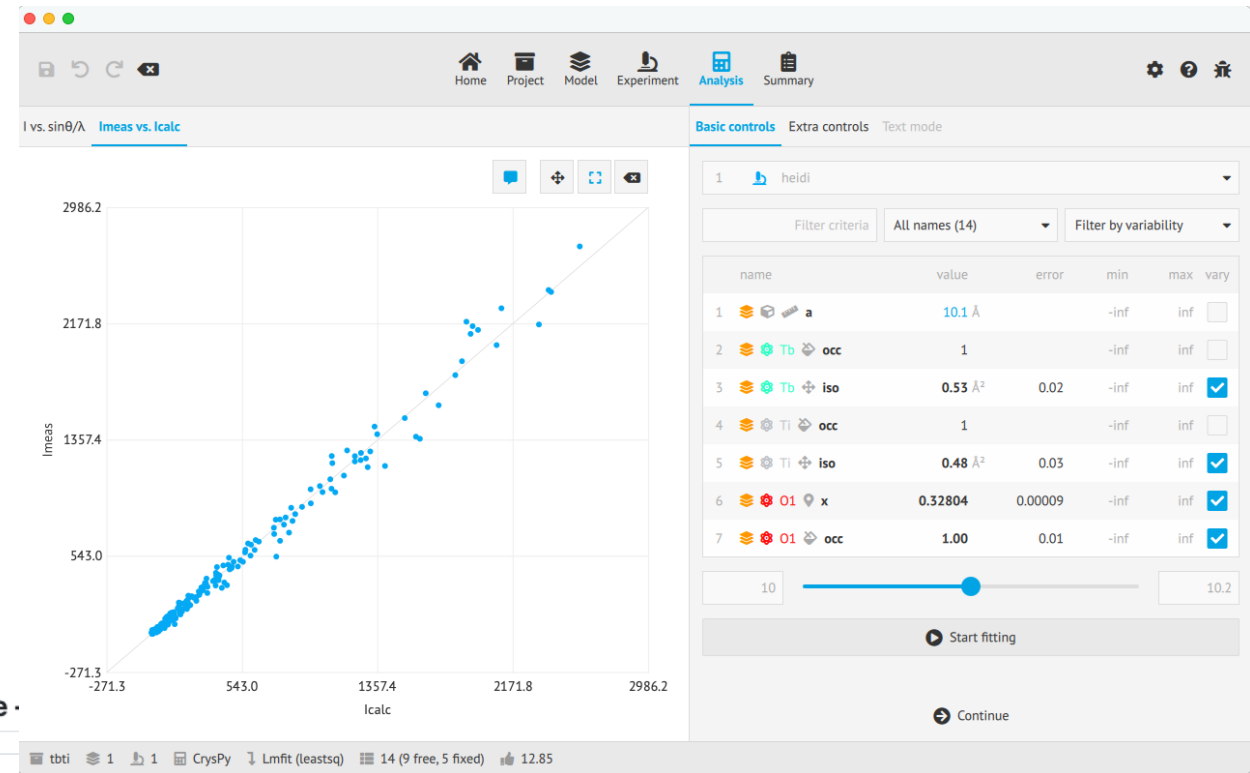


In its current state, EasyDiffraction supports refinement of nuclear structures using single-crystal measurements:

- Crystal structure refinement of Taurine using time-of-flight single crystal neutron diffraction data from SENJU at J-PARC ([Jupyter notebook](#))
- GUI interface allows to work with single crystals

Road Map:

- magnetic structure



1.2 Magnetic Structure

Feature	LTD	CLI	APP
Irreducible representations	17	17	17
Magnetic Space Groups	17	17	17
Symmetry-adapted modes	17	17	17
Magnetic propagation vector (k_x, k_y, k_z)	17	17	17
Magnetic moments (m_x, m_y, m_z)	17	17	17
Local Susceptibility ($\chi_{11}, \chi_{22}, \chi_{33}, \chi_{12}, \chi_{13}, \chi_{23}$)	17	17	17

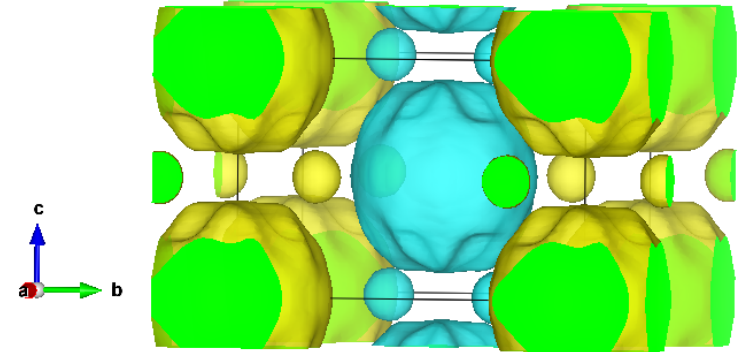
Data analysis by CrysPy



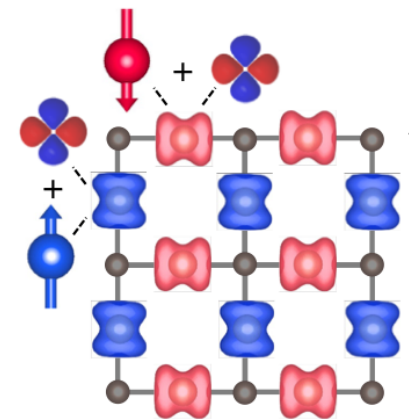
- ✓ Magnetization density reconstruction by Maximum Entropy Procedure for magnetically ordered compounds;
- ✓ Multipole model in description of magnetization density and magnetic form-factor;
- ✓ The option of twins was added to refine the integrated intensities and flip ratios for single crystal diffraction experiments.

These modifications are published in one of the development branches on the [GitHub page of CrysPy](#).

Half-polarized Laue TOF
SC diffraction



Mz component reconstructed
by MEM



Multipoles to describe
magnetization density

Instead of conclusion

List of tasks



Data reduction

- Data reduction workflow in SCIPP
 - Domain-based reflection classification
 - Peak integration with background correction
 - Unit-cell estimation from high-intensity reflections in Q space
 - Peak-shape characterisation
- Data reduction workflow in Mantid

McStas simulation

- 3D detector A
- 3D detector B with analyser
- Polarization option

Data analysis

- Incommensurate magnetic structures into CrysPy



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