3D Neutron Diffraction

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3D Neutron Diffraction (3DND) is a new technique to study shape and orientation of the individual grains composing polycrystalline samples. 3DND enables non-destructive 3D grain mapping of mm- to cm-sized samples that is not possible using other techniques.

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We are developing the algorithms for the 3D reconstruction based on datasets collected at BL18 (J-PARC), ENGIN-X (ISIS), ICON (PSI), and virtual experiments done using McStas [2].

**Data analysis**

Data acquired simultaneously by NF and FF detectors

**NF**

- CM of diff spots [3]
- \( \sigma_i \rightarrow (\sigma_j)_i, U_j \) [4]
- Sync diff, ext spots via ToF (X)
- \( U_j + 3D \) grain shape = 3D map

**FF**

- Binarise, locate [5] extinction spots
- FF covers 2.3 st \( (\Gamma_{\text{max,1}}) < (\Gamma_{\text{min,1}}) \)

**Time-of-flight 3DND**

In June 2014 at BL18 we analysed an Armco Iron sample (99.8% purity), prepared to contain mm-sized grains. The sample was scanned over 180deg in 3deg steps, acquisition time per projection: ~ 1h.

Setup used at BL18. Data were acquired simultaneously by near- (indicated by red arrow) and far-field detectors.

**Near-field detector**

- MCP detector, 28x28\( \text{mm}^2 \)
- 1200 fr/s, pixel size 55\( \mu \text{m} \)
- Use: shape of the grains

**Far-field detectors**

- 36 det, each 256x256\( \text{mm}^2 \)
- Pixel size 4 mm, Q: 0.6-30.7
- Use: orientation of the grains