TEXTURE AND STRESS ANALYSIS BY DIFFRACTION

Acknowledgement for presentation material to:
C. Randau, N. Al-Hamdany, G. Dovzhenko

Texture characterization by utilising monochromatic diffraction and a 2D-detector

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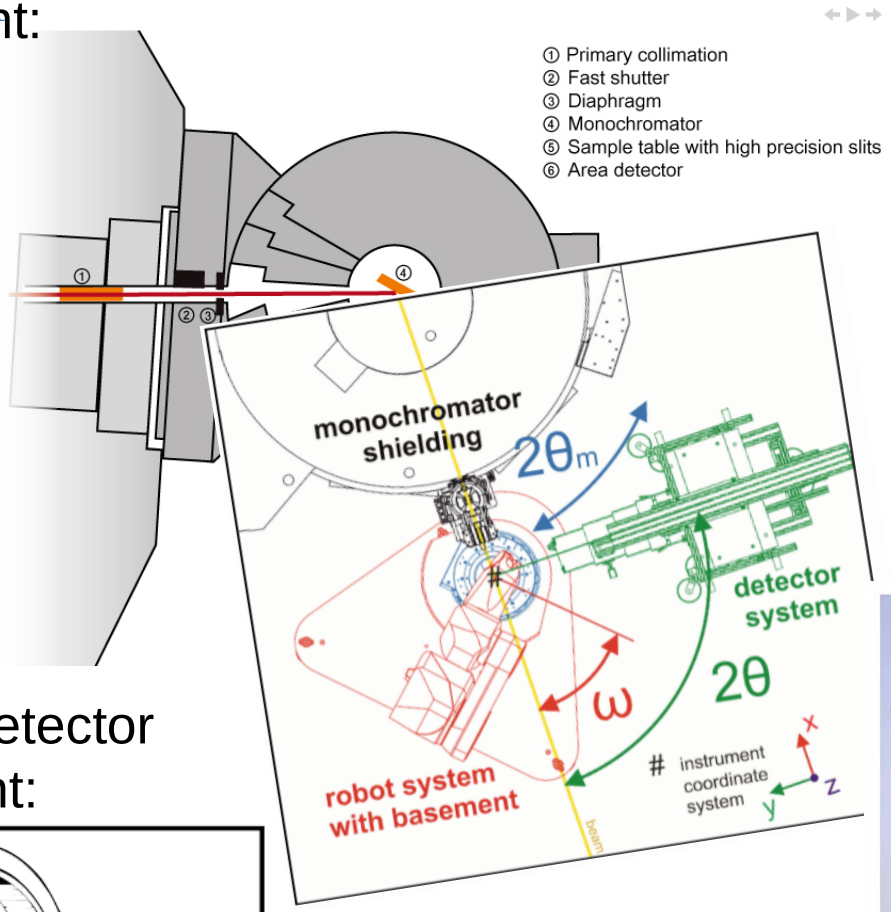
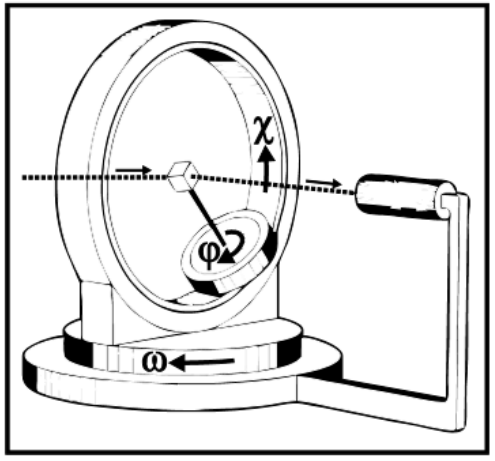
Centre for Materials and Coastal Research
GEMS
German Engineering Materials Science Centre

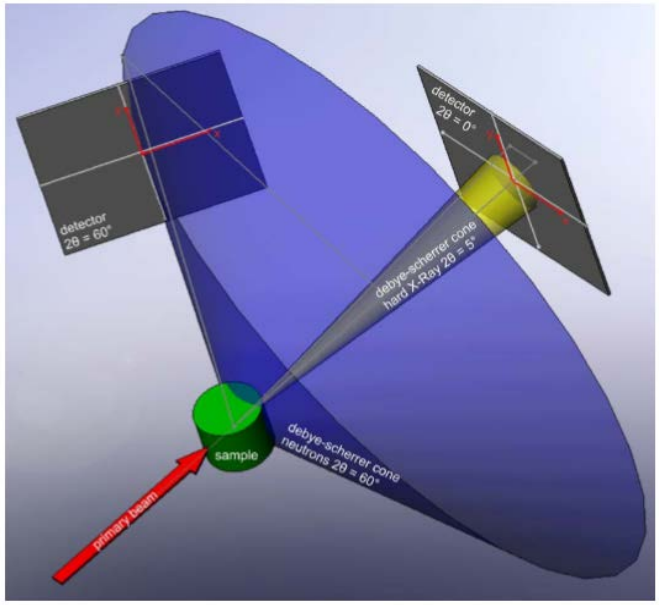
Instrument:



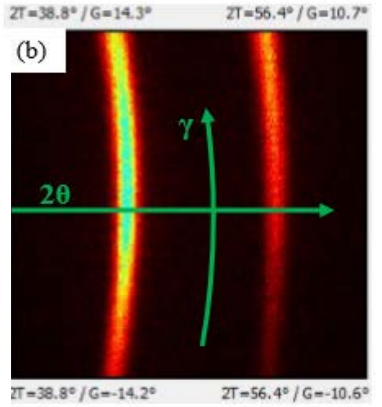
sample/detector movement:

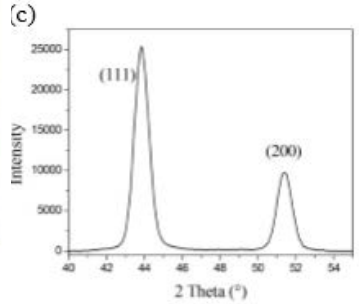


Debey-Scherrer-cone:



Scattering + DAQ:





Sample positioning in beam by robotic arm

<u>6-axes Robotic-arm:</u>

- definition of complex measurement path over samples
- reproducable alignment of sample orientation
- automatic sample change
- combination with systems for mapping the sample shape

Sampling a pole figure by sample rotations with a 2D-detector

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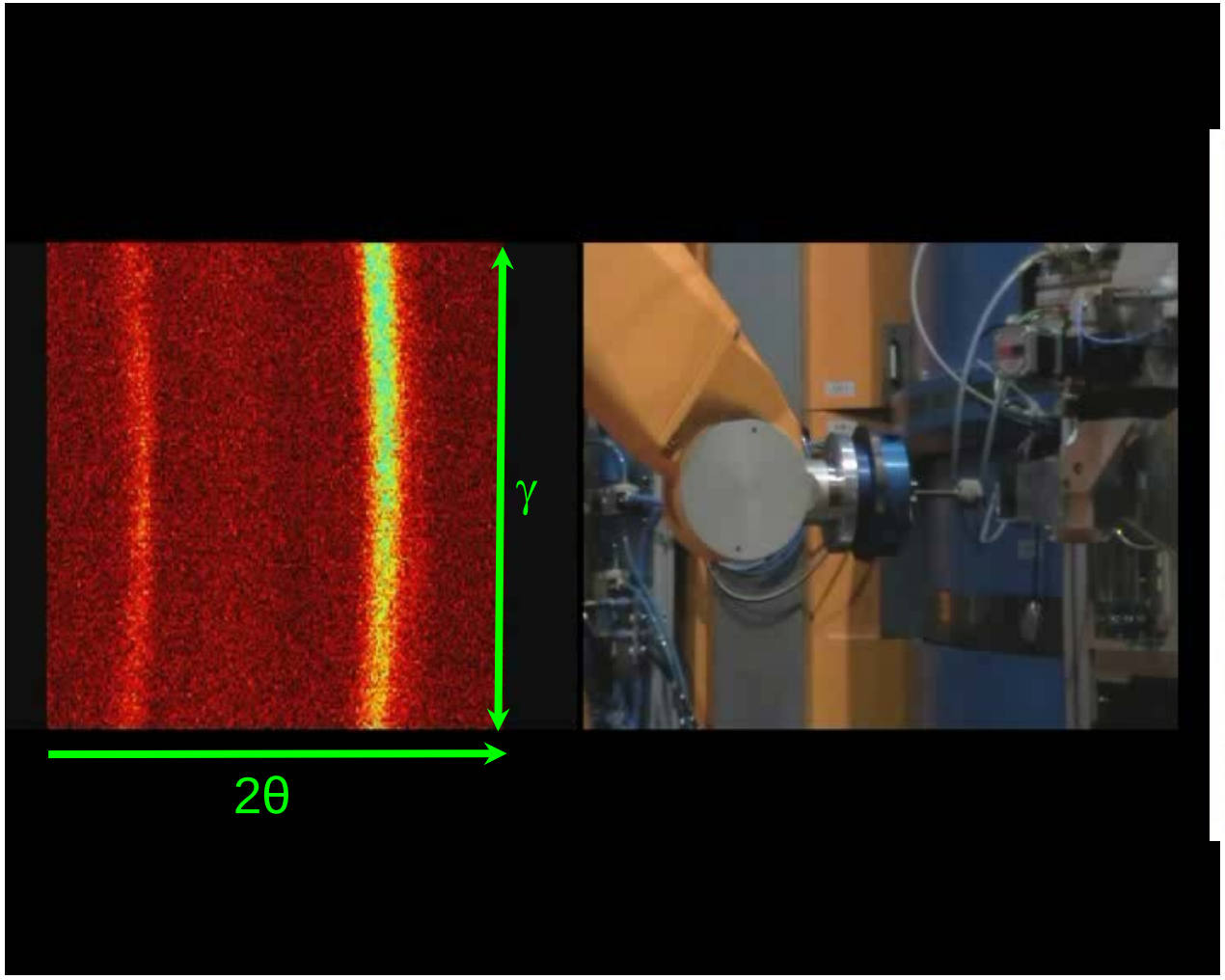
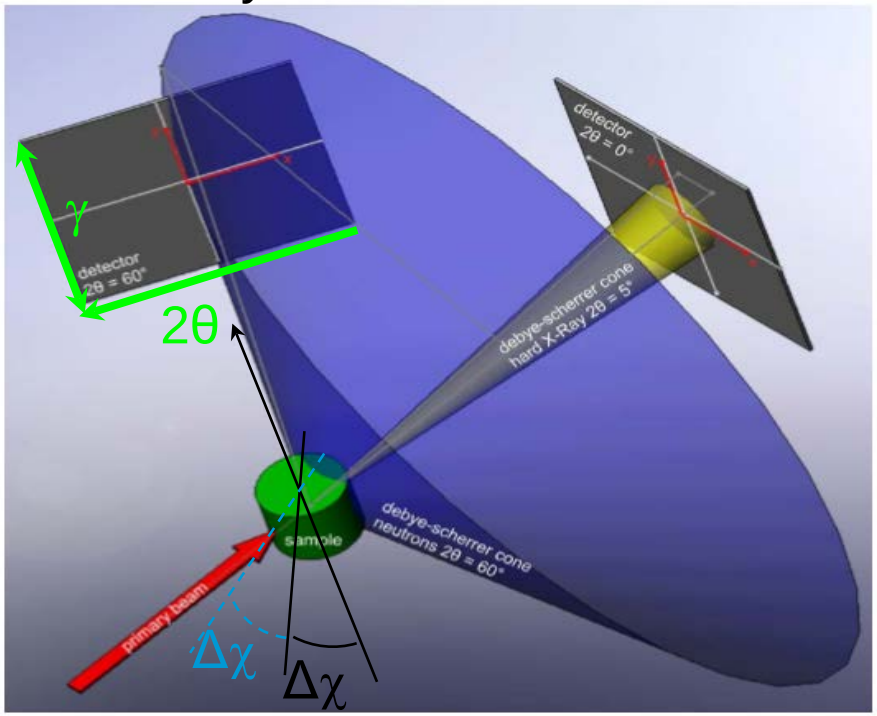
Sample scanning routine (χ and φ rotations @ 2θ=const.) :

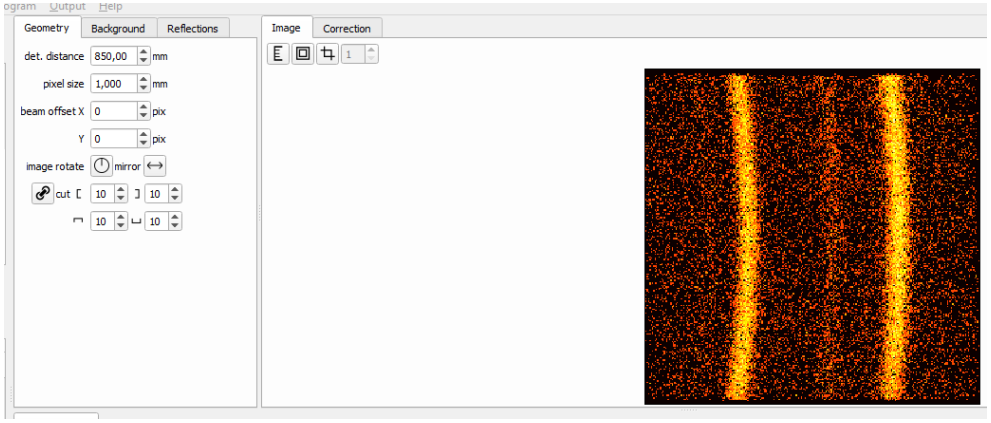


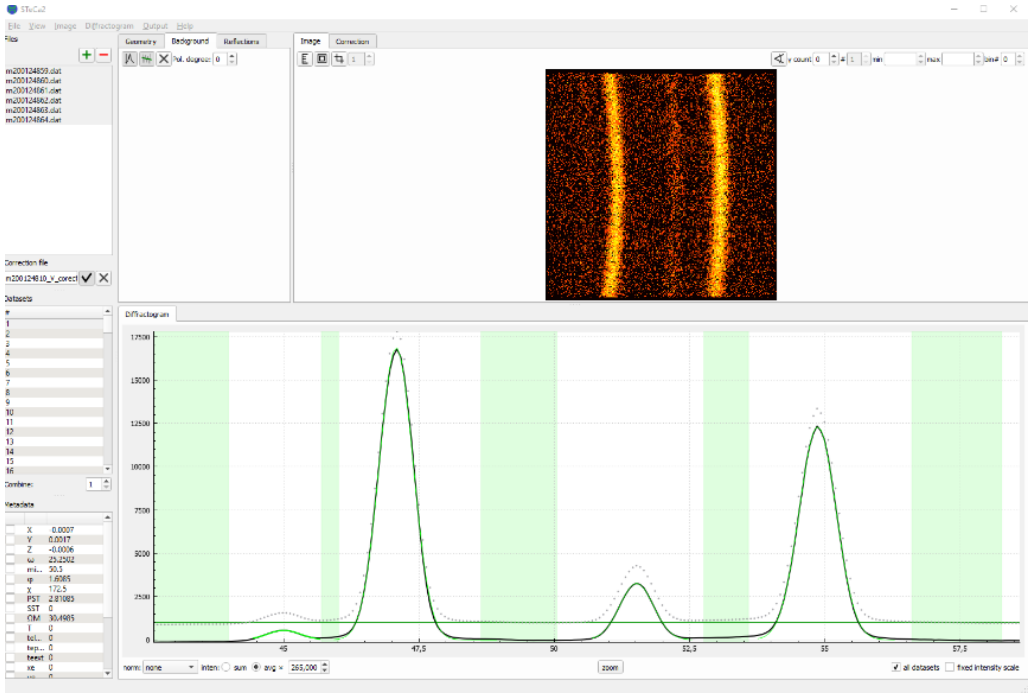
Δχ-sample-stepping to scan the Debey-Scherrer-cone:



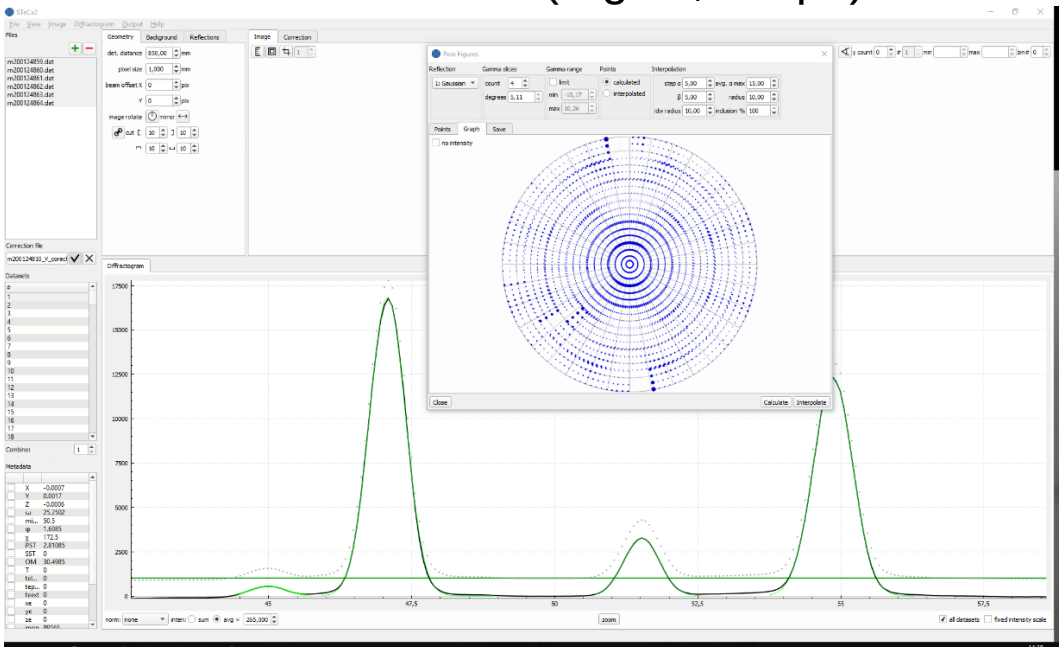
Data: Images from diffraction as function of sample (χ and φ)

SteCa2-Software: Arranging diffraction reflection on the sample sphere





- loading of 2D-images for all χ-positions of sa.
- definition of scatt. geo. (pixel -> 2θ and γ)
- definition of background region
- definition of reflections (region, shape)



<u>For pole figure/texture information</u>:

- extraction, correction and normalization of intensity for all measured reflections and ploting on a sphere for ($2\theta_{polefigure}$ = c, φ,χ)
- interpolation/redistribution of intensity on the chosen pole figure (α,β)-grid

Monochromatic vs. Polychromatic

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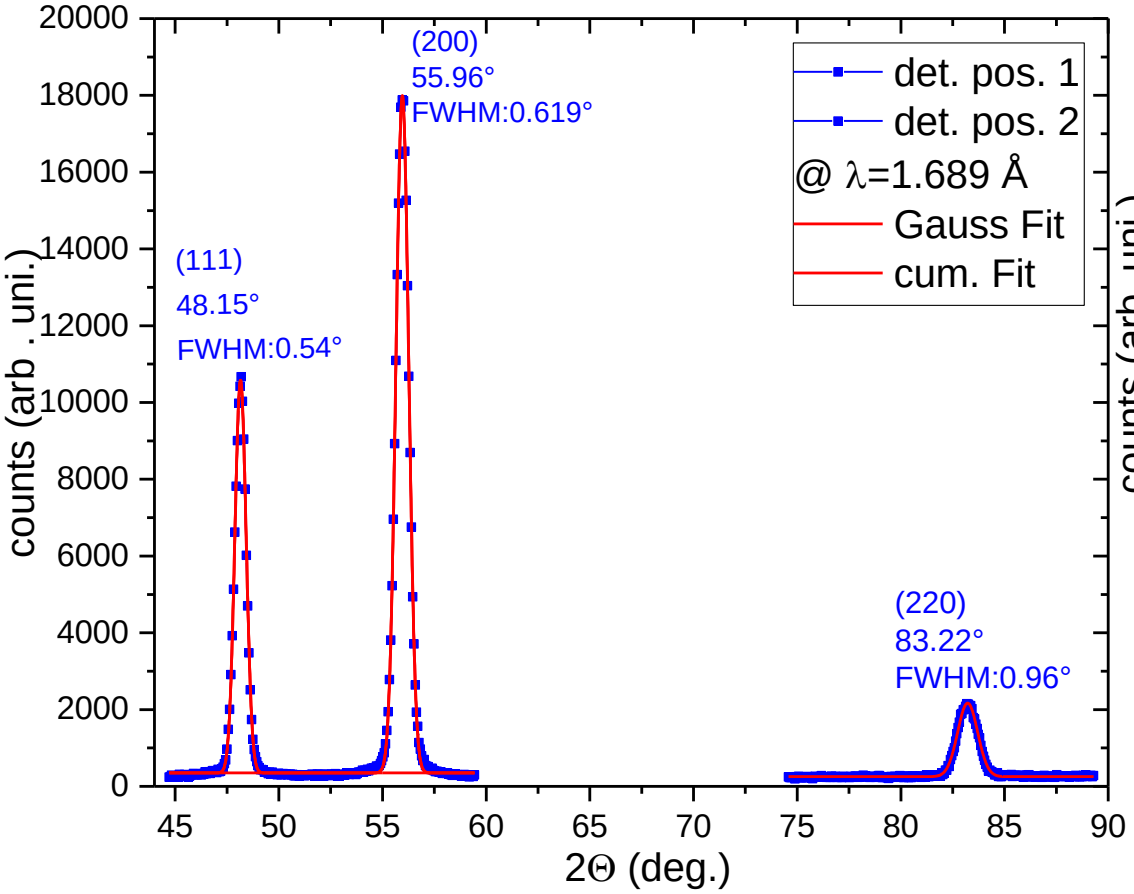
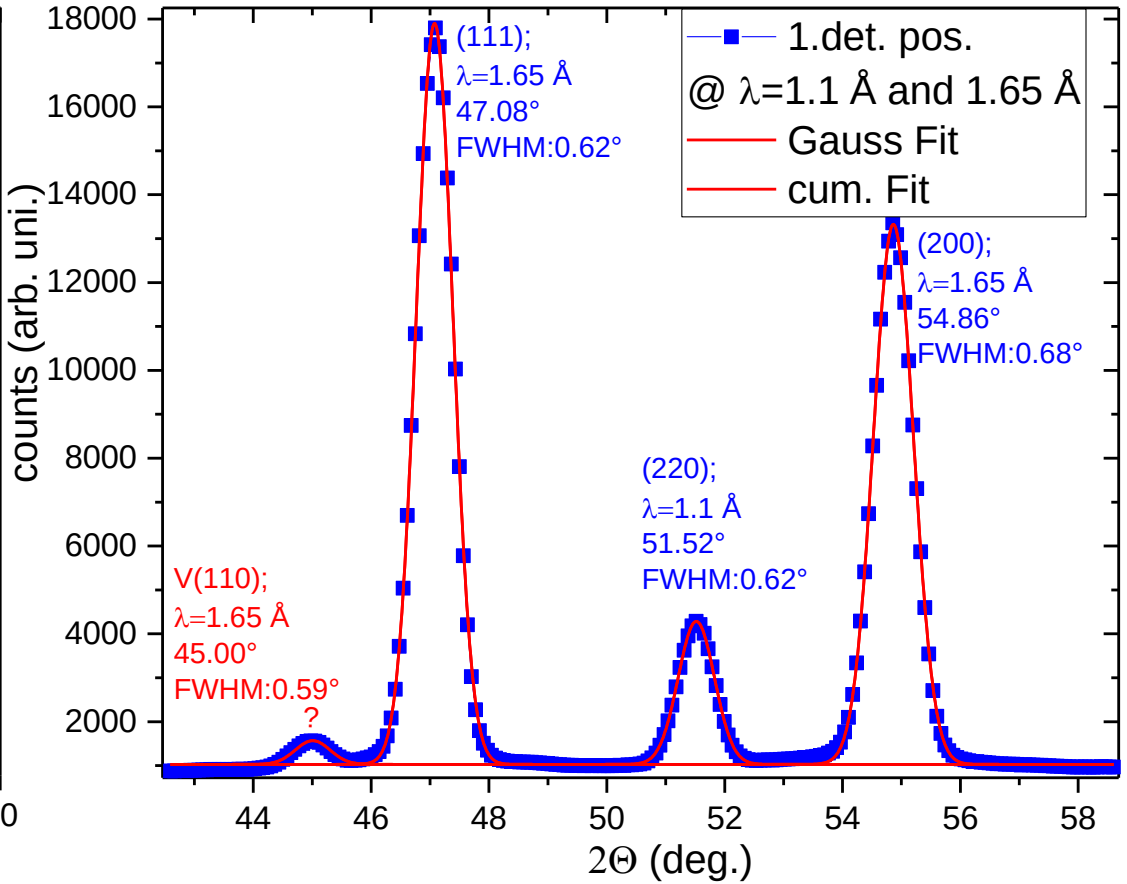
Monochromatic beam:

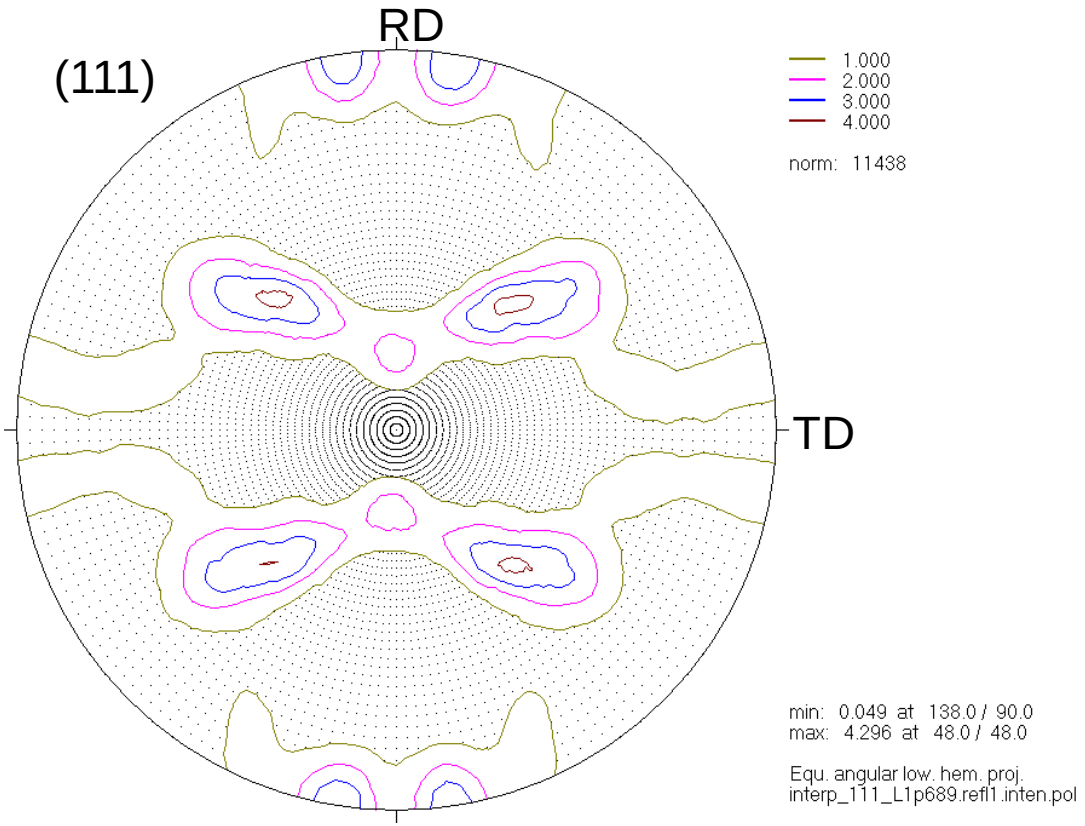


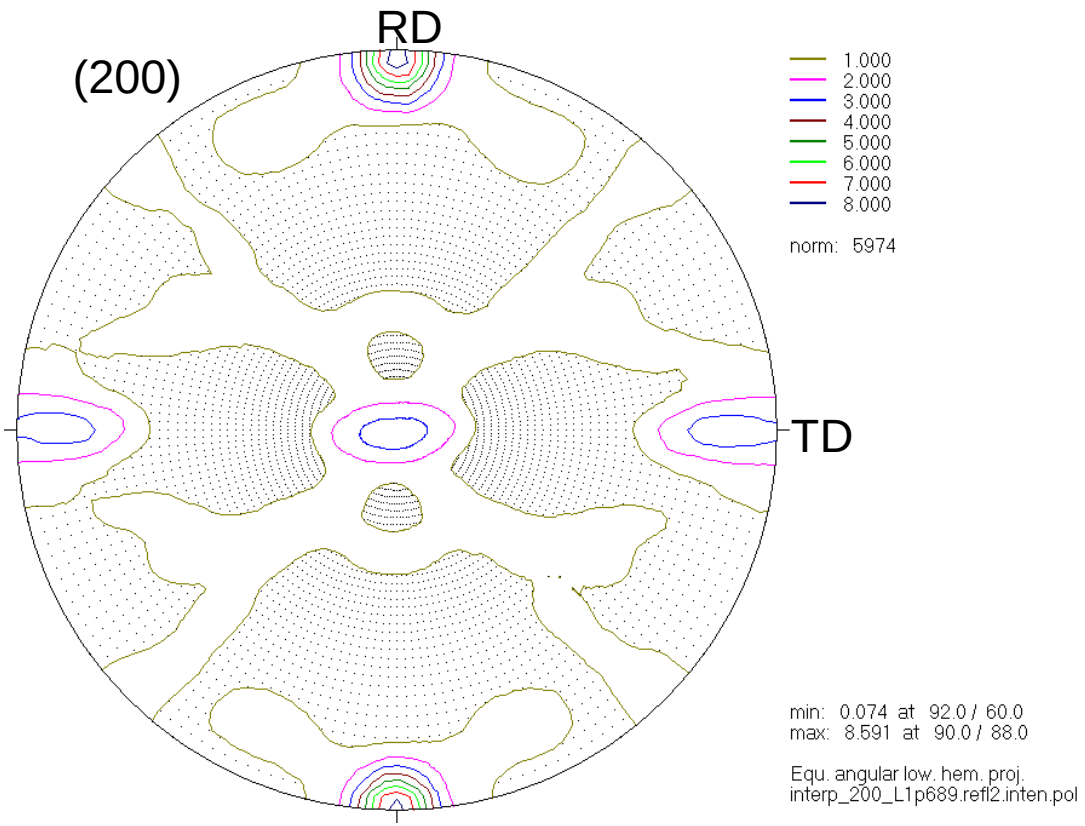
polychromatic beam:



=>ToF-diffraction => the correlation to (hkl) could be done at this step

Polefigures from diffractogramm (Pfplot-software):





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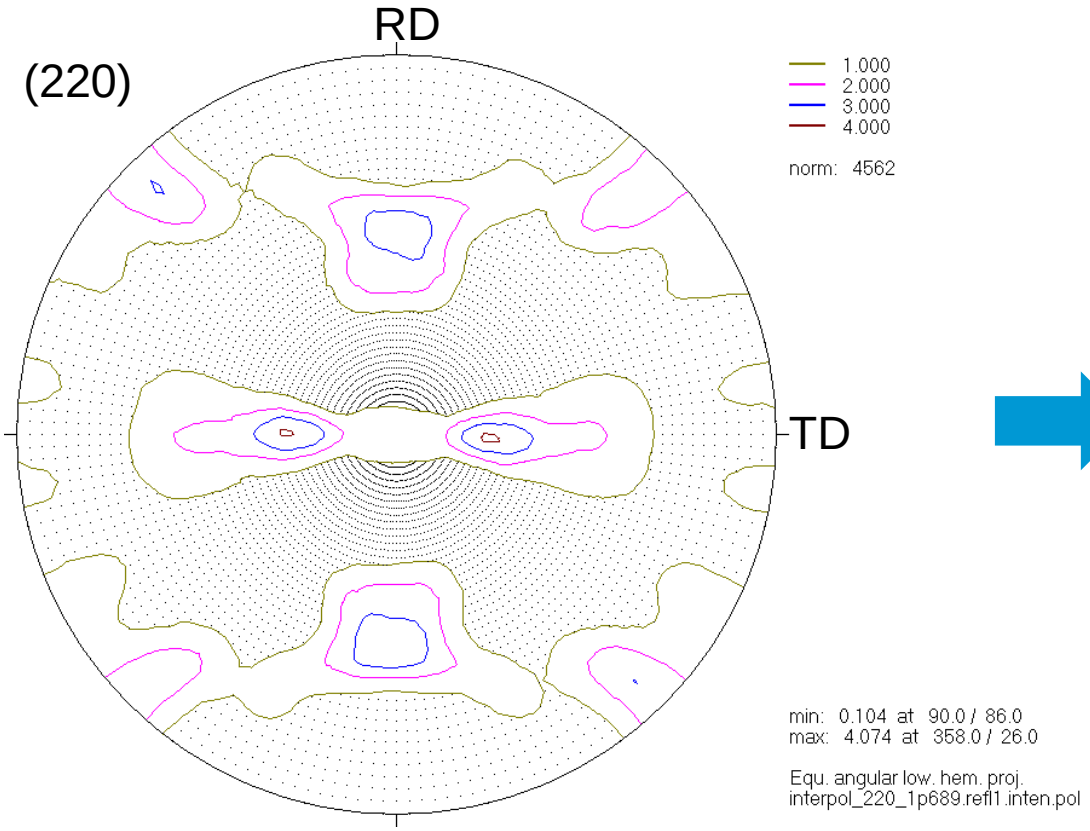

Additional software (GKSS/CLZ ODF-calc.):

- complete/uncomplete pole figure
- inverse pole figure(s)
- ODF

-nice would be ONE „software for all steps“ ;-D

Stress characterization by utilising monochromatic diffraction and a 2D-detector

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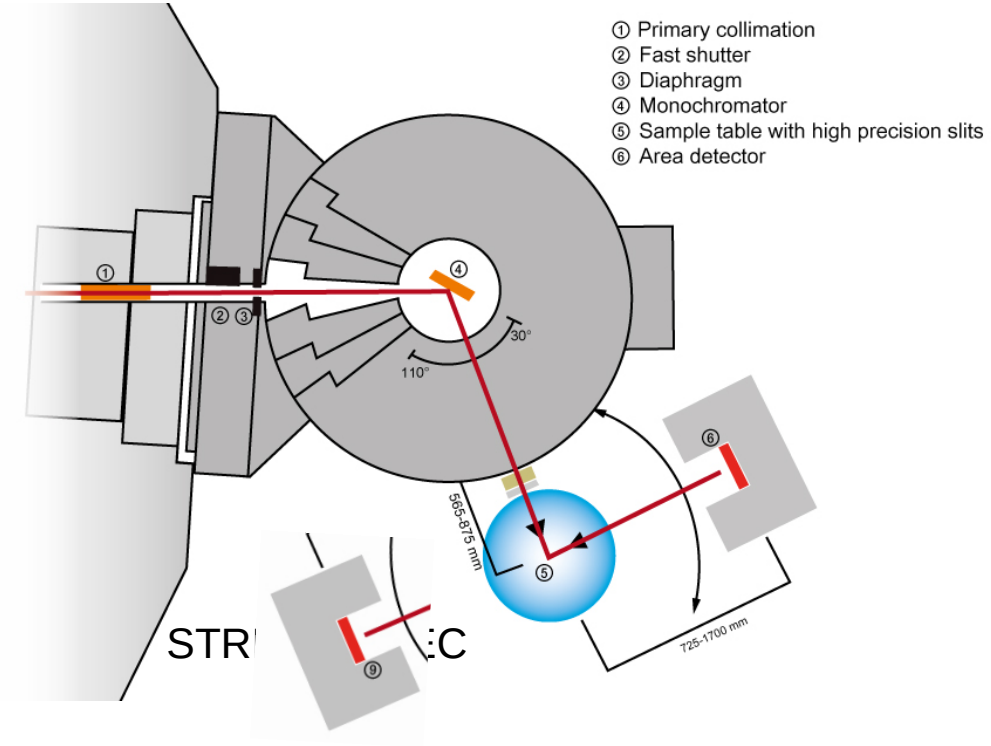
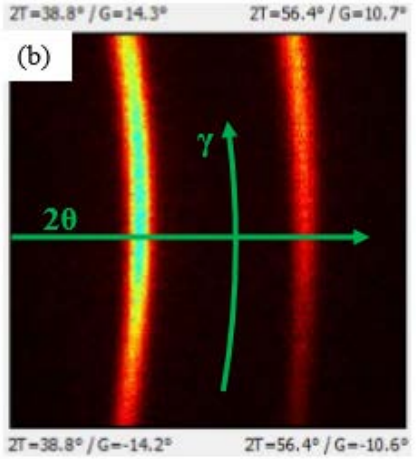
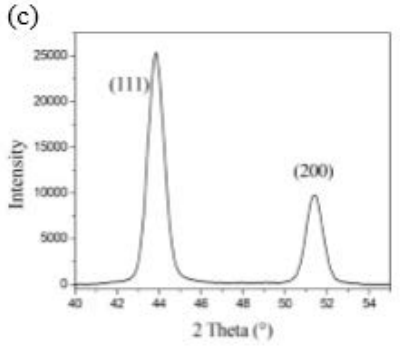
Instrument:



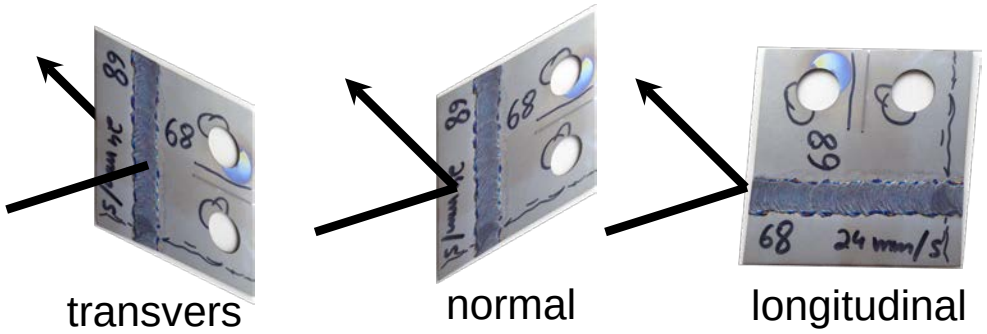
Scattering + DAQ:



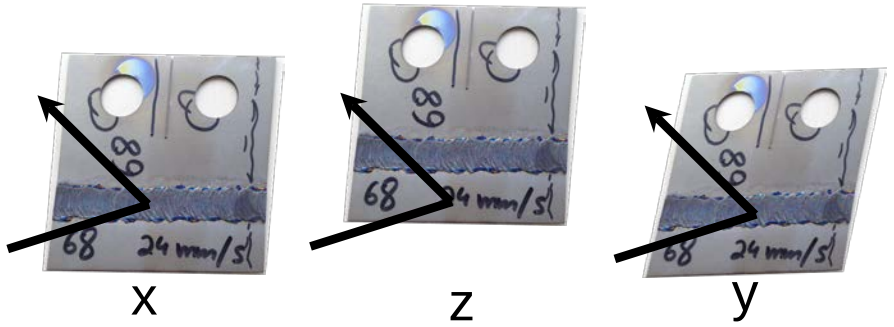


Sample movement:

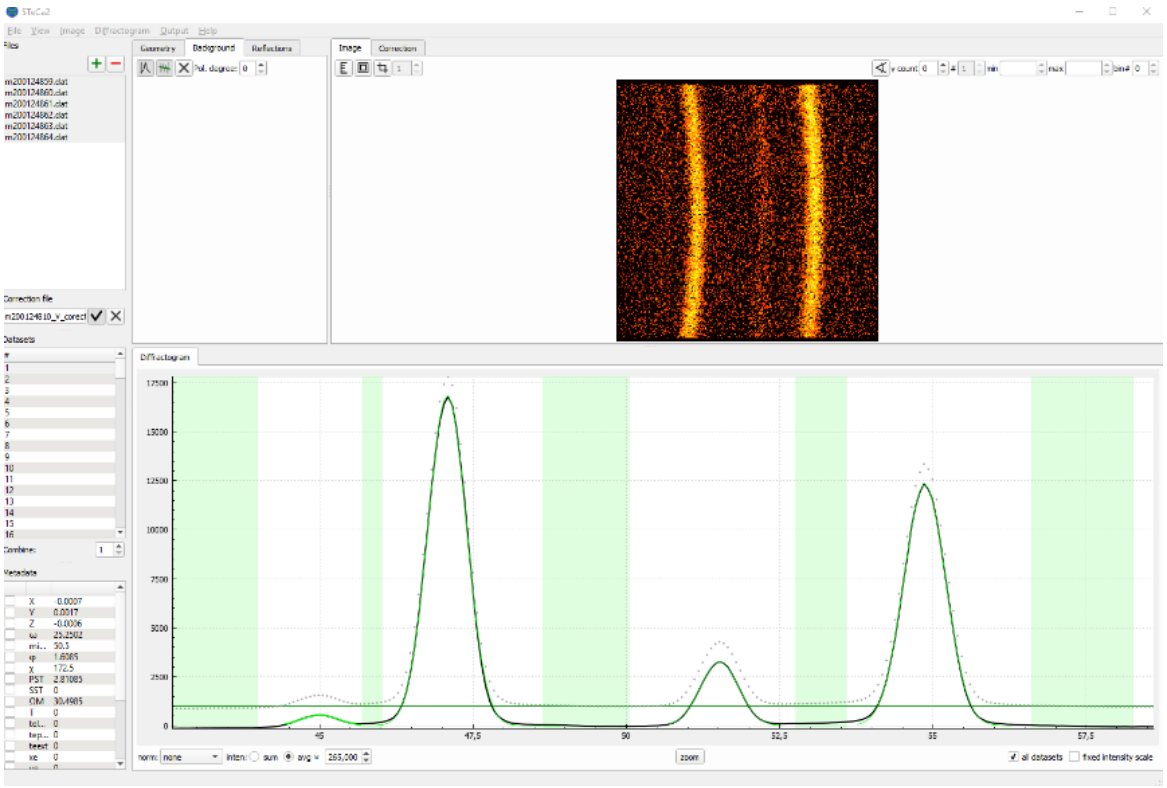
- rotation

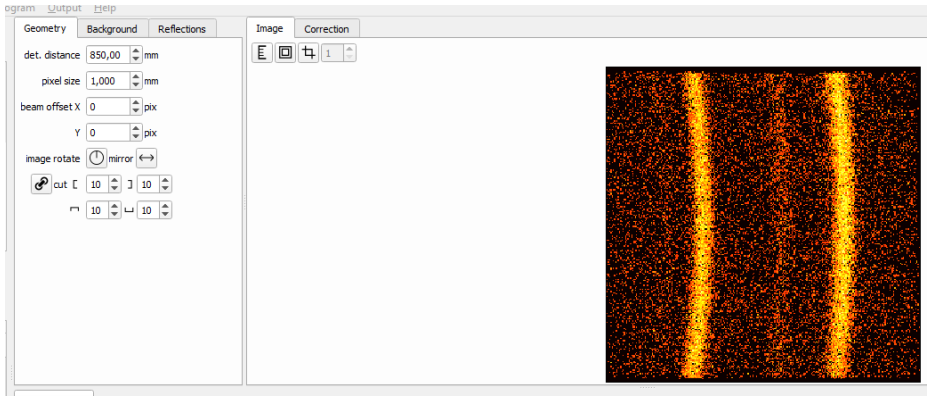


- translation



SteCa-Software: Arranging diffraction reflection on the sample





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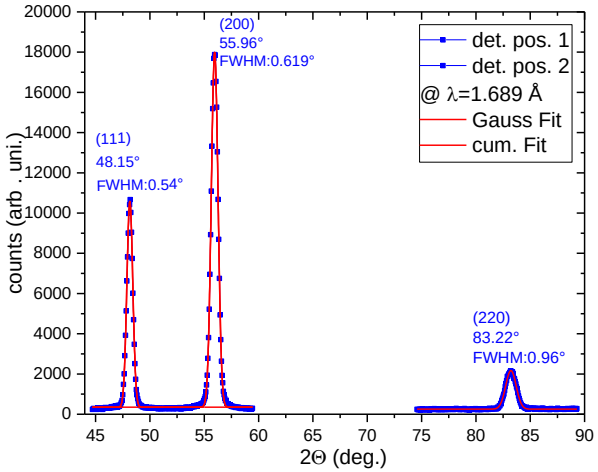
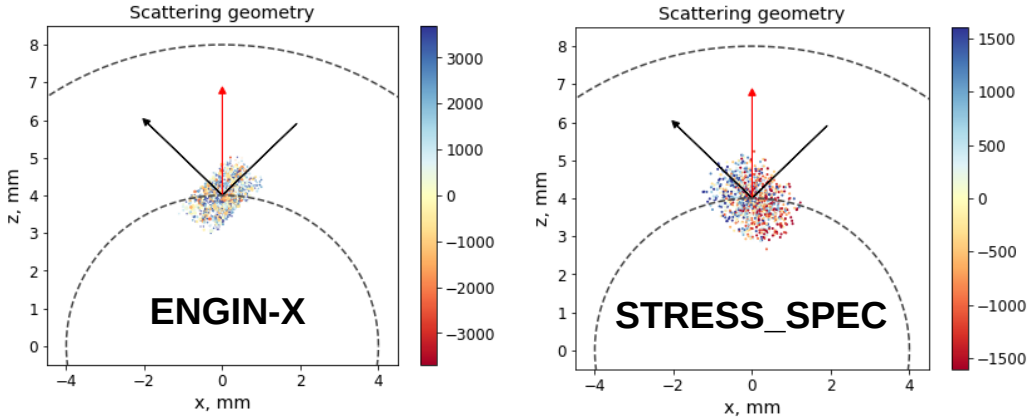
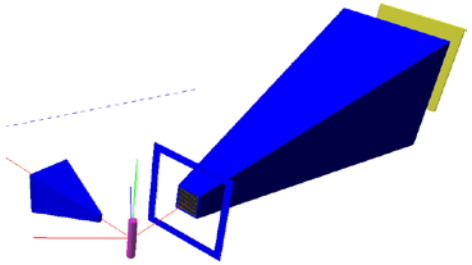


- **For BEER integration of tof needed**
- **Information of second detector**

Treatment of spatial resolution effects in neutron residual strain scanning

MC simulation of sampling distribution: pseudo-strains in $\mu\varepsilon$ associated with the sampling points:

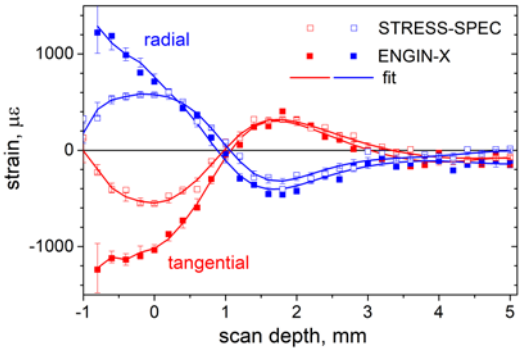




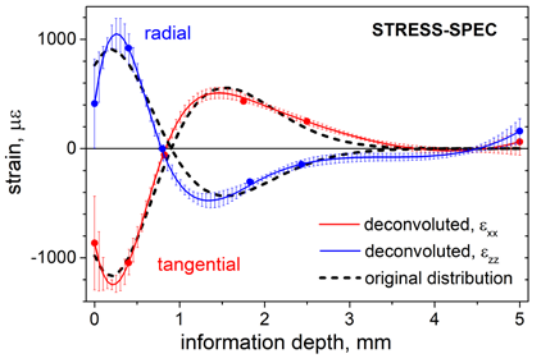
Ray-tracing model of STRESS-SPEC

Test on synthetic data (simulation of an experiment at STRESS-SPEC and ENGINX):

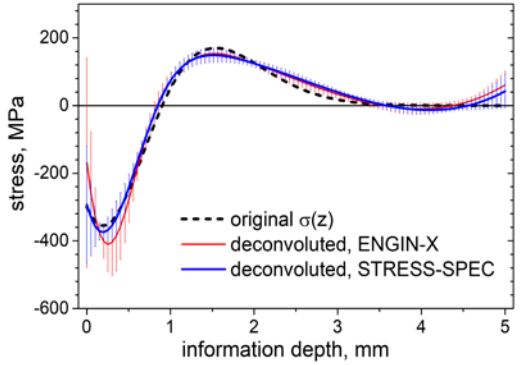
fitted strain distribution



restored strain, $\varepsilon(z)$



restored stress, $\sigma(z)$

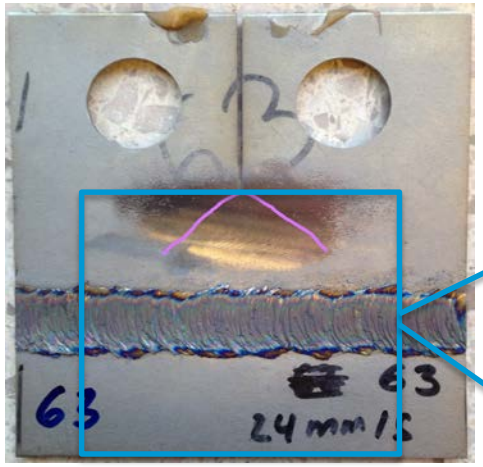


Sampling events are used to restore intrinsic stress, free of resolution and pseudo-strain effects.

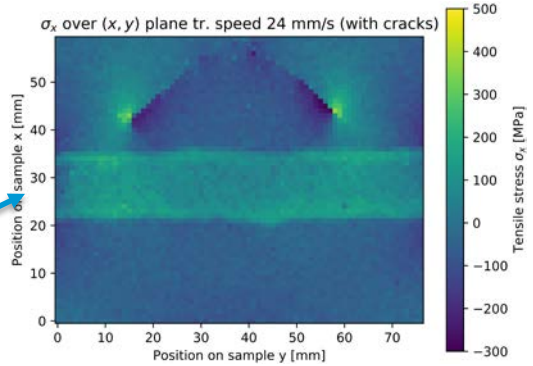
Collaboration: NPI Řež, MLZ Garching, KIT-IAMK Karlsruhe
J. Šaroun, J. Rebelo Kornmeier, J. Gibmeier, M. Hofmann

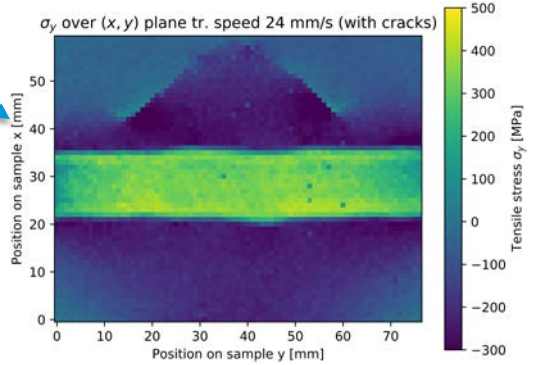
Python code under development: STRESSFIT

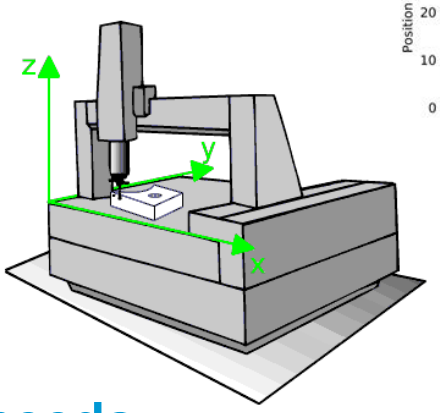
What we envison



Scanned area







Fast strain scanning:

- Stress maps
- Large sample series

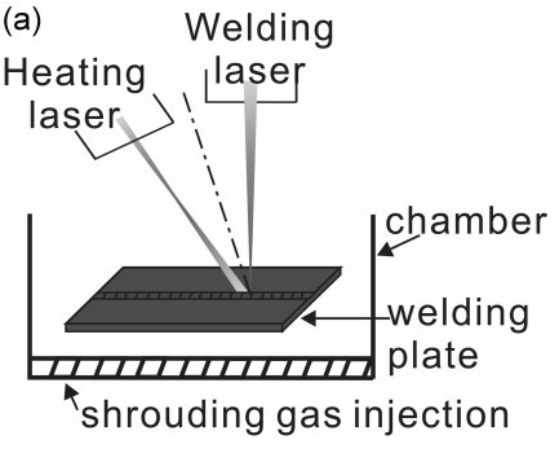
Software needs:

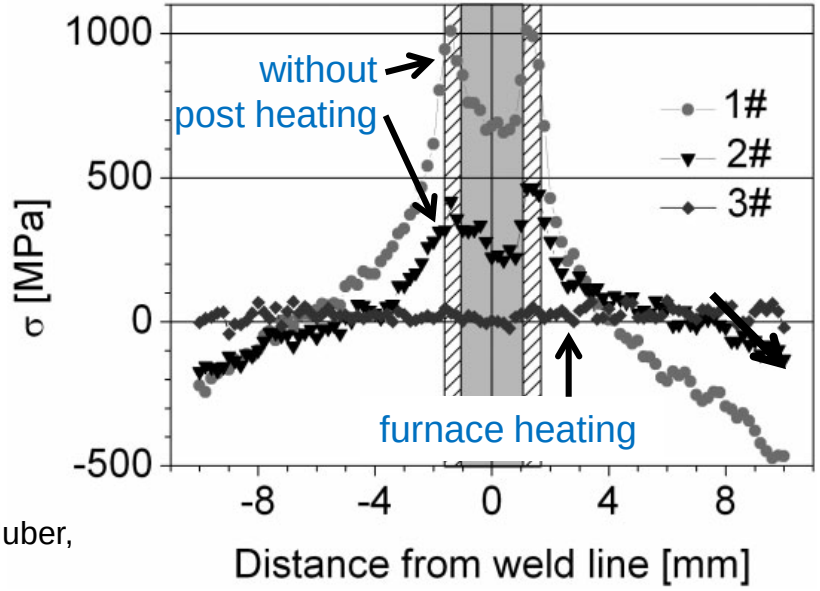
- automatic sample exchange and measurements integrated into control, reduction, analysis software (identification of sample, coordinates, …)

What we envison

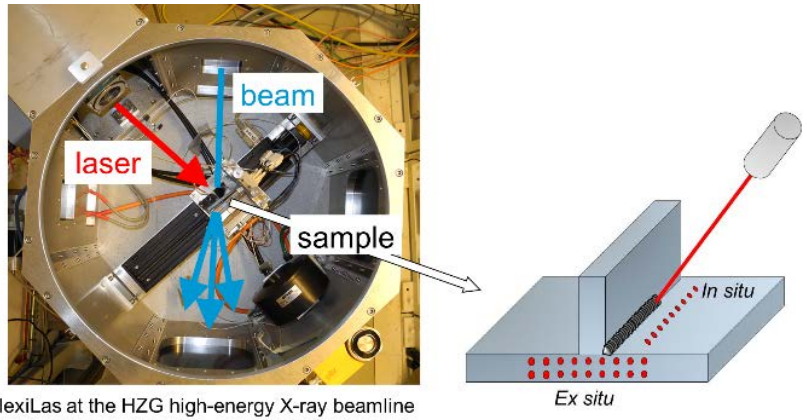
In situ and in operando measurements

Effect of in situ post-weld heat treatment during laser beam welding:





J. Liu, V. Ventzk, P. Staron, N. Schell, N. Kashaev, N. Huber, Adv. Eng. Mater. **14** (2012) 923–927



FlexiLas at the HZG high-energy X-ray beamline HARWI II@DESY

Software needs:

- Integration of SEE into control, reduction, analysis software
- Fast data read out, reduction, analysis