



EUROPEAN  
SPALLATION  
SOURCE

# Work Package IC5

## Single Crystal Diffraction

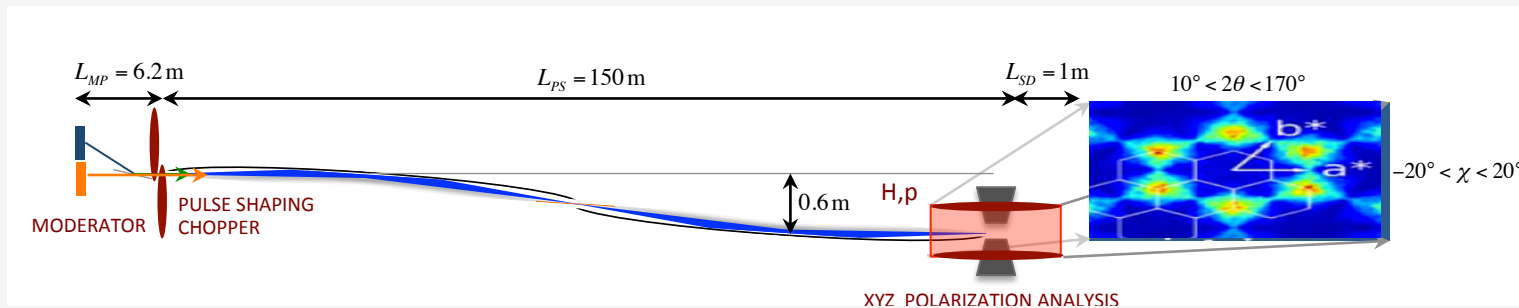
Werner Schweika

# The Magnetism TOF Laue Diffractometer

thermal + polarization and field  
*site susceptibilities*  
*spin densities*

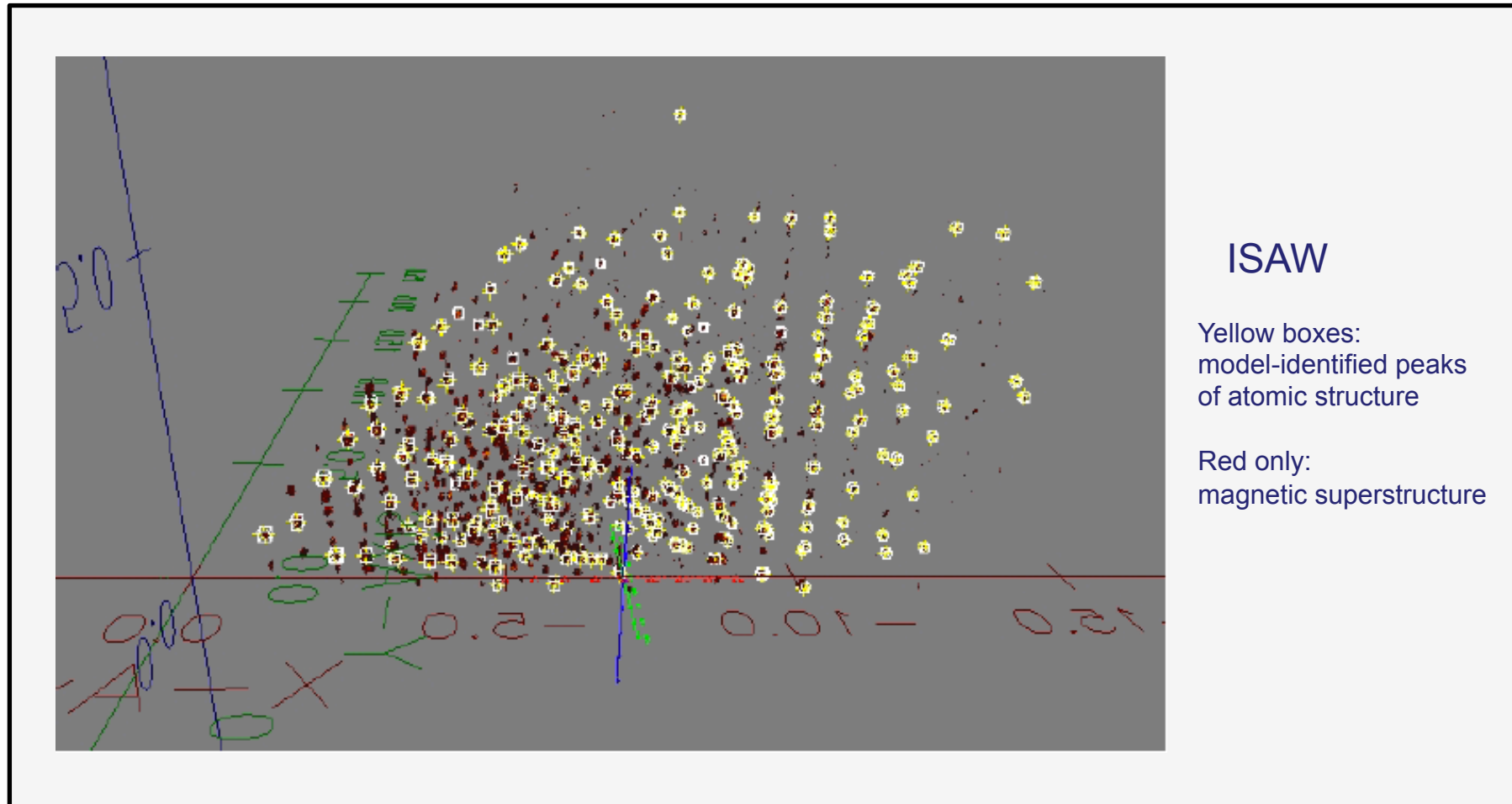
cold + polarization analysis  
*magnetic structure determination*  
*diffuse magnetic scattering*

*Science drivers: Physics, chemistry, material science, complex and frustrated magnetism, multiferroics, spin/charge/orbital ordering, quantum phase transitions, molecular magnets*



# Laue single crystal diffraction

## ARCS – SNS



# A polarized TOF Laue diffractometer with magnetic fields

*thermal*

~ D3, 5C1

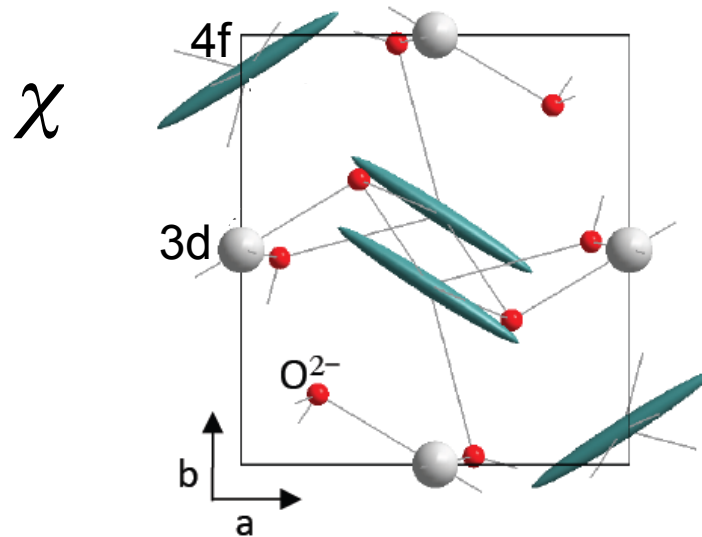
Polarization  $\parallel$  applied field & reversal

$\mathbf{P} \uparrow \mathbf{H}$

$\mathbf{P} \downarrow \mathbf{H}$

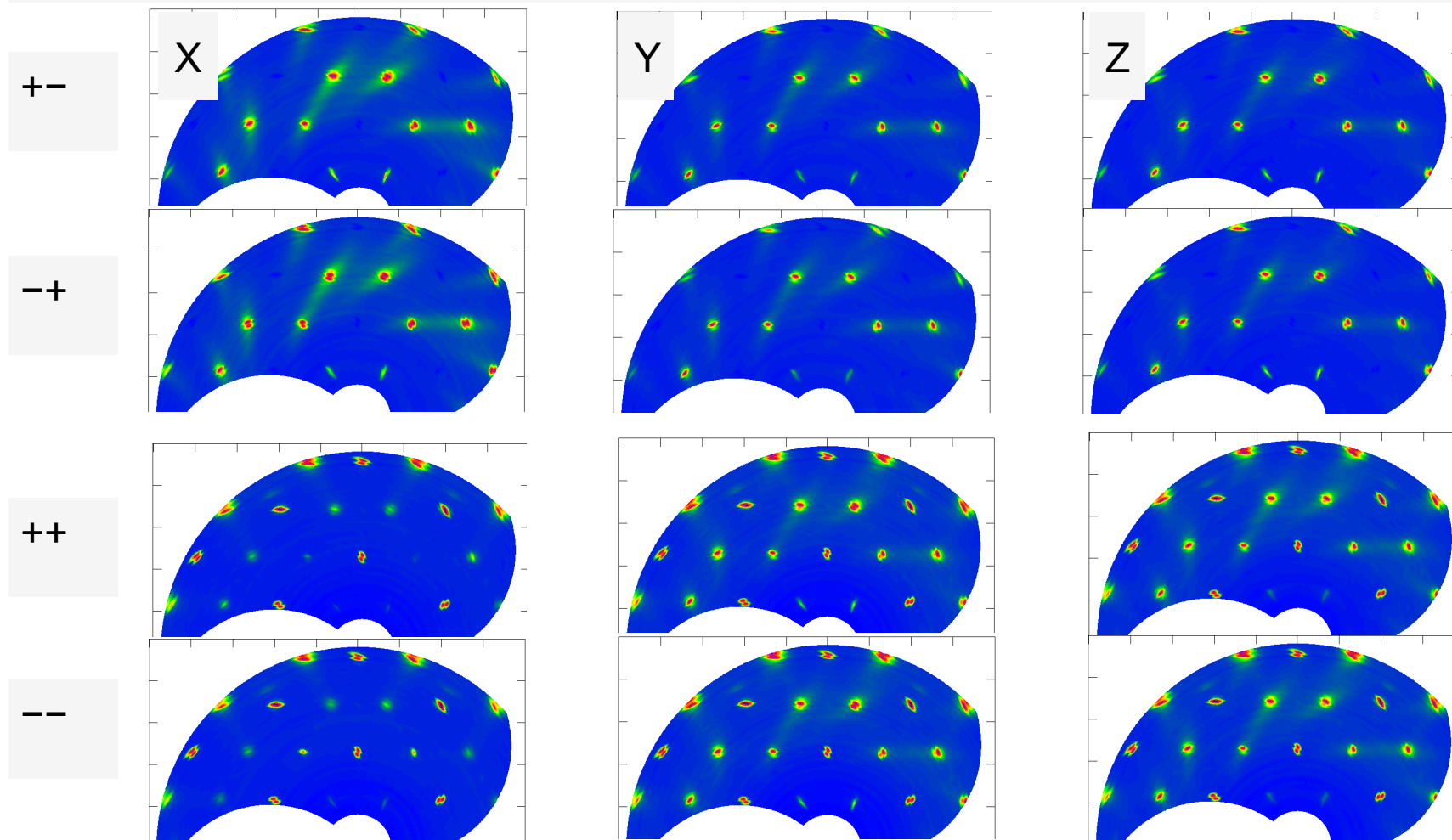
induced moments,

site susceptibility from interference term  $\pm M_Q^\perp N_{-Q}$



# Full Polarization analysis

*spinflip* + *polarization reversal*  
*non-spinflip*



# Full Polarization analysis

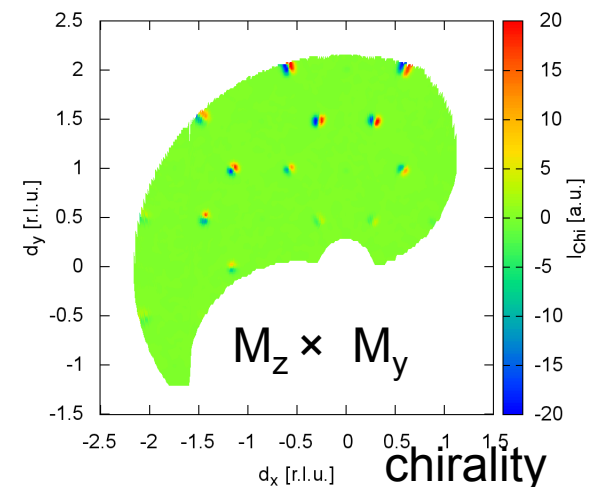
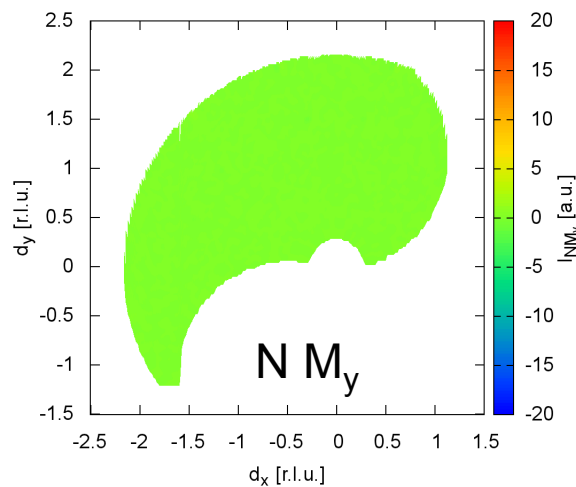
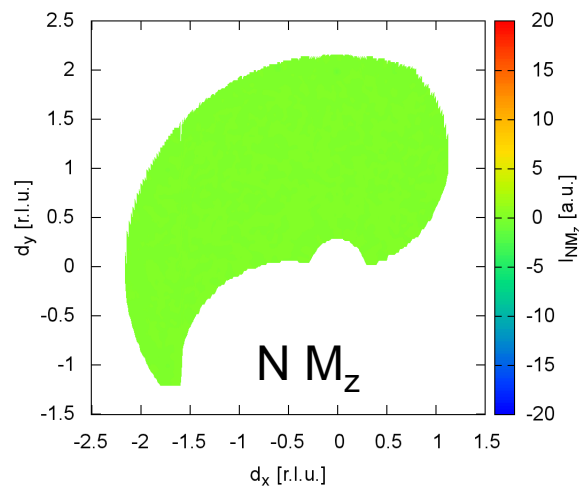
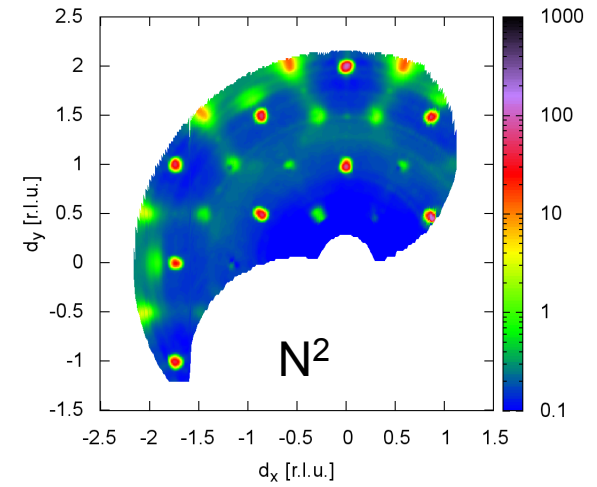
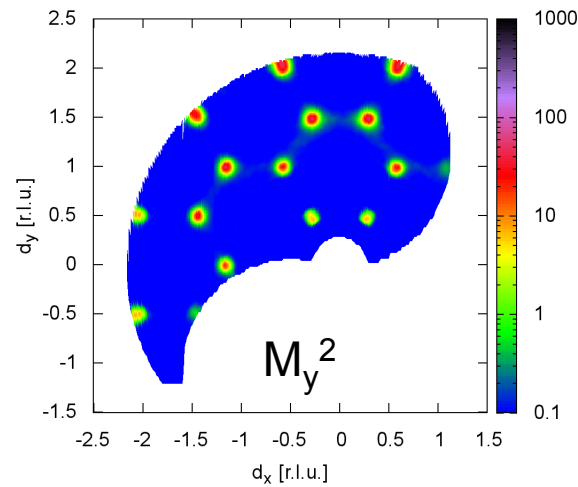
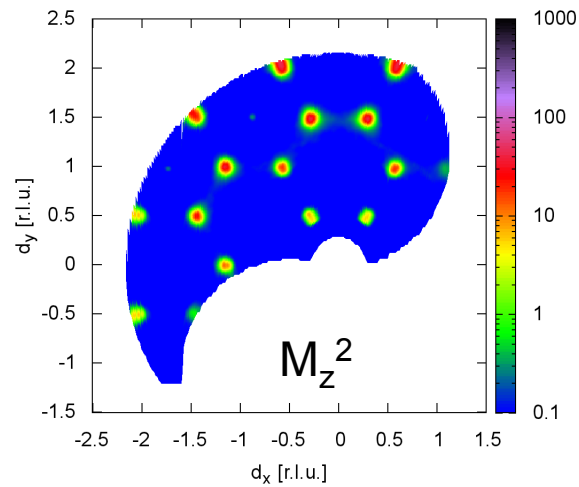
*spinflip*  
*non-spinflip*

+

*polarization reversal*

=>

*complete separation*  
*by diagonal terms*



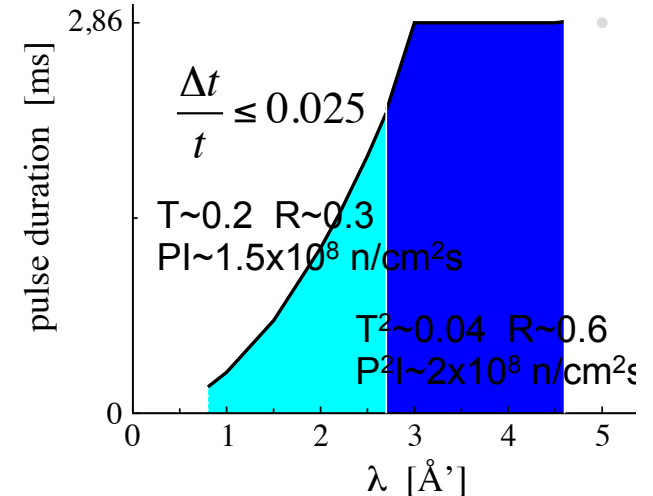
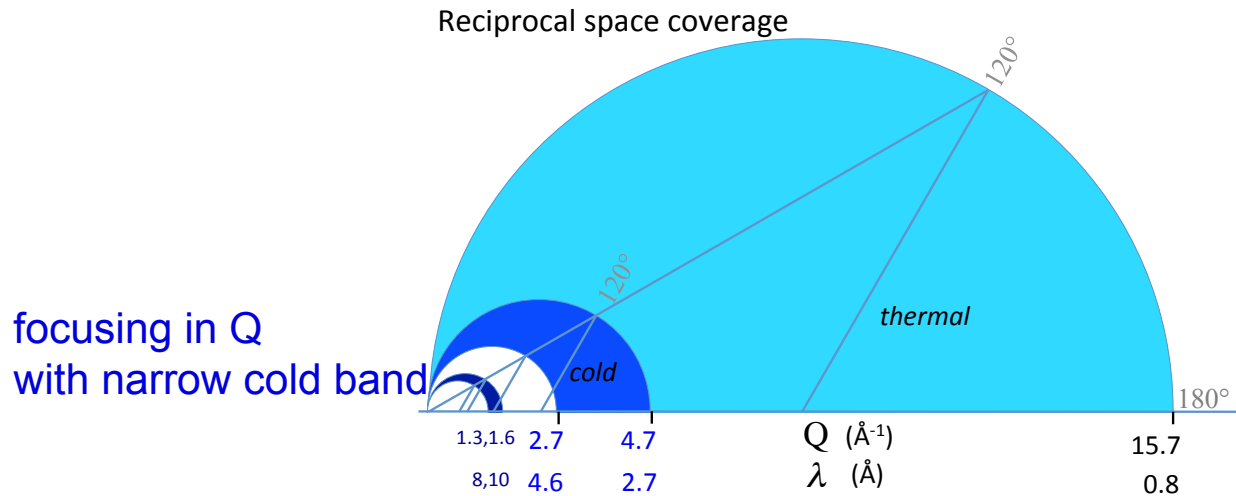
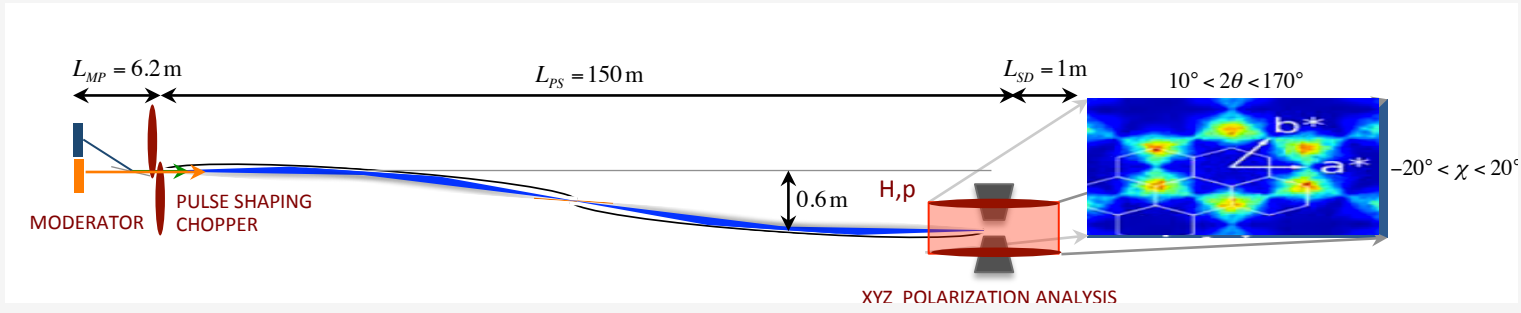
chirality

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# The Magnetism TOF Laue Diffractometer

Neutron guide concepts

polarizing thermal + cold neutrons

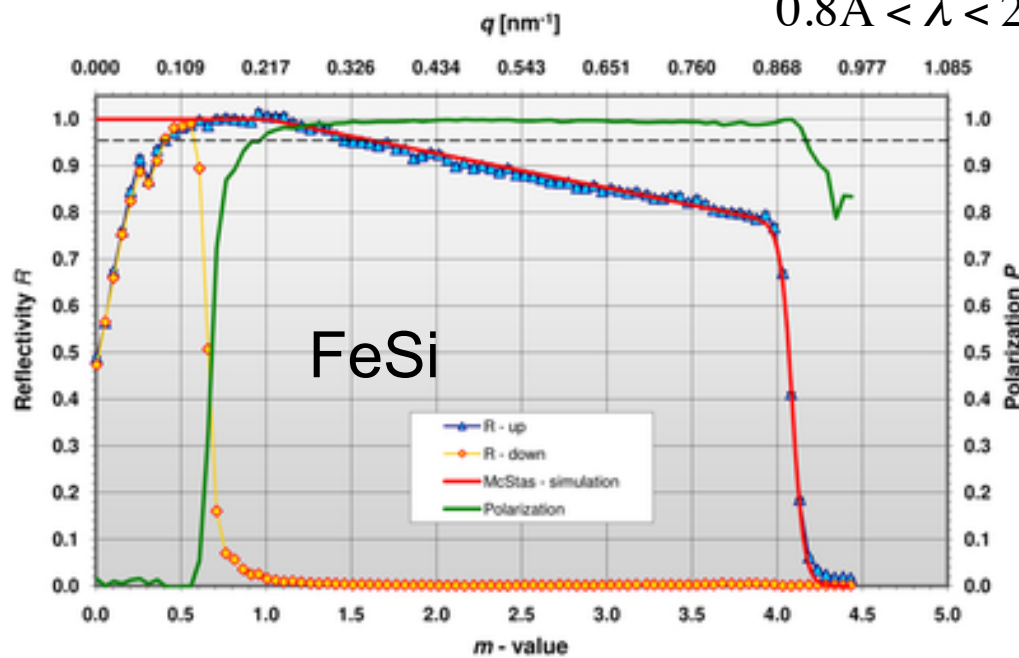
$$\Delta\theta = 20'$$

$$\Delta\theta = 40'$$

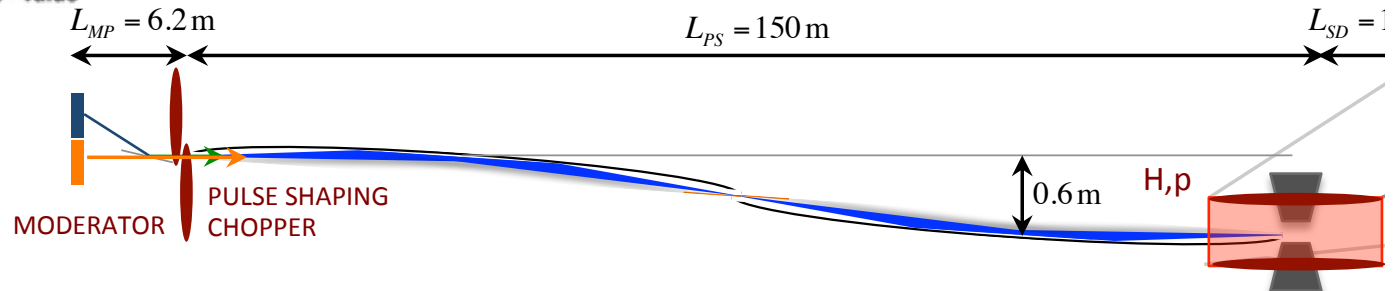
$$0.8\text{\AA} < \lambda < 2.7\text{\AA}$$

$$2.7\text{\AA} < \lambda < 10\text{\AA}$$

$$\Delta\lambda = 1.9\text{\AA}$$



<sup>3</sup>He-cell supermirror possible ?





## Selene parameters (following Jochen Stahn)

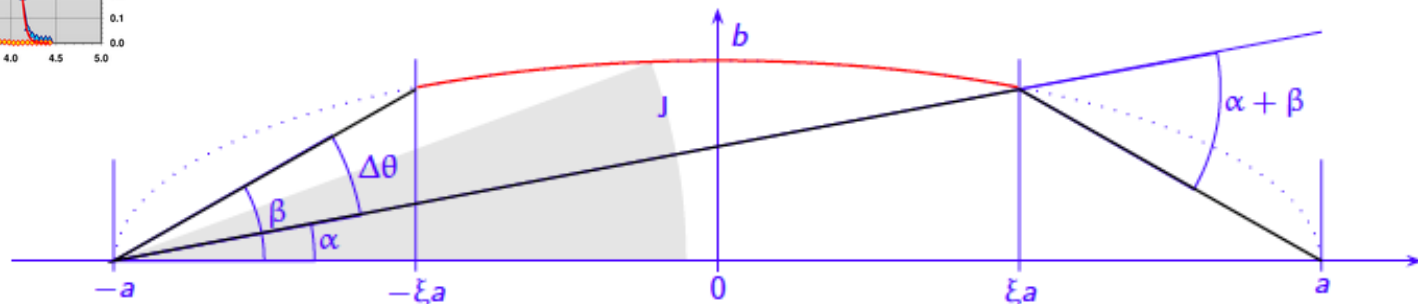
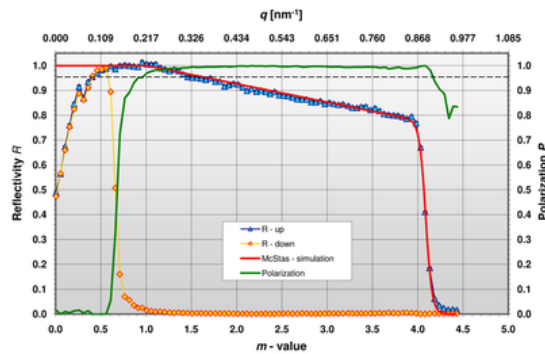
Thermal spectrum of interest:  $0.8\text{\AA} - 2.4\text{\AA}$  ( $2.7\text{\AA}$ )  
 divergence:  $\Delta\theta = 20' = 0.00582\text{ rad}$

$$\Rightarrow \frac{\Delta\theta}{\hat{\theta}} \approx 0.8 \quad b/a \approx 0.0022 \quad \hat{\theta} = 0.00364 = 0.21^\circ \quad \lambda_{\min} = 0.8\text{\AA}$$

$$a = 37.5\text{m}, \quad b = 8.4\text{cm} \quad m \approx 2.6$$

$$\alpha = \hat{\theta} - \Delta\theta/2 = 0.0008 = 0.043^\circ$$

$$\beta = \hat{\theta} + \Delta\theta/2 = 0.0066 = 0.375^\circ$$



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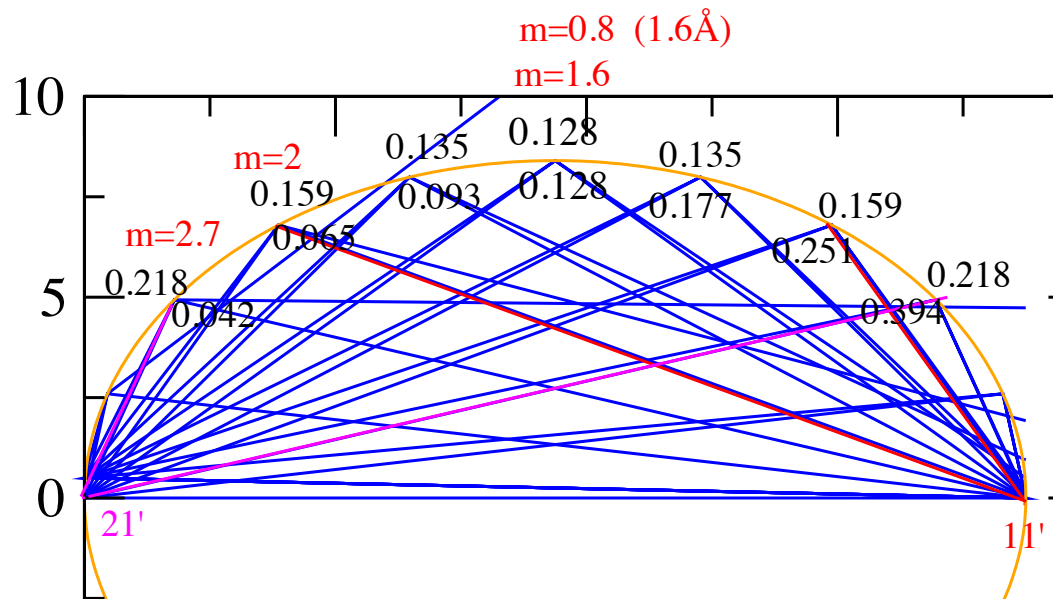
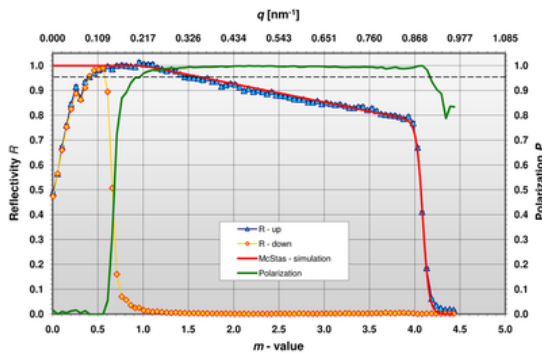
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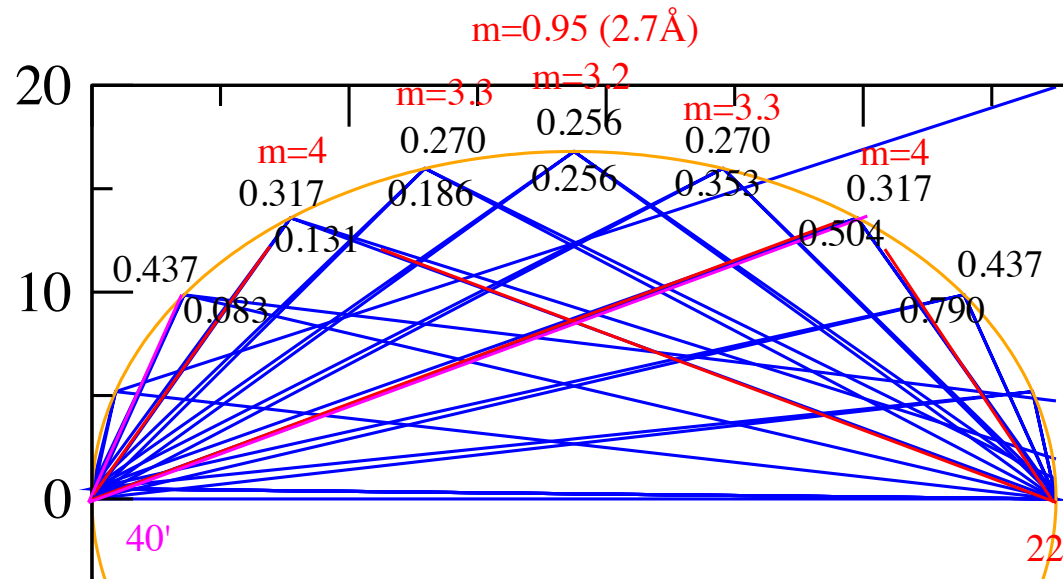
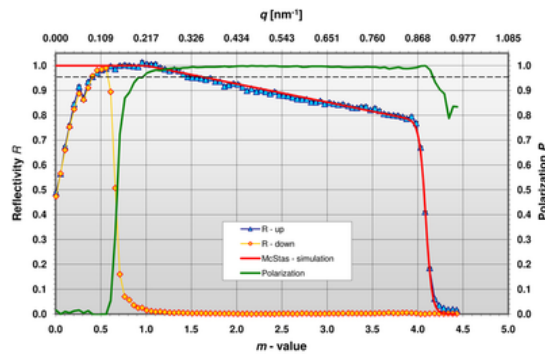
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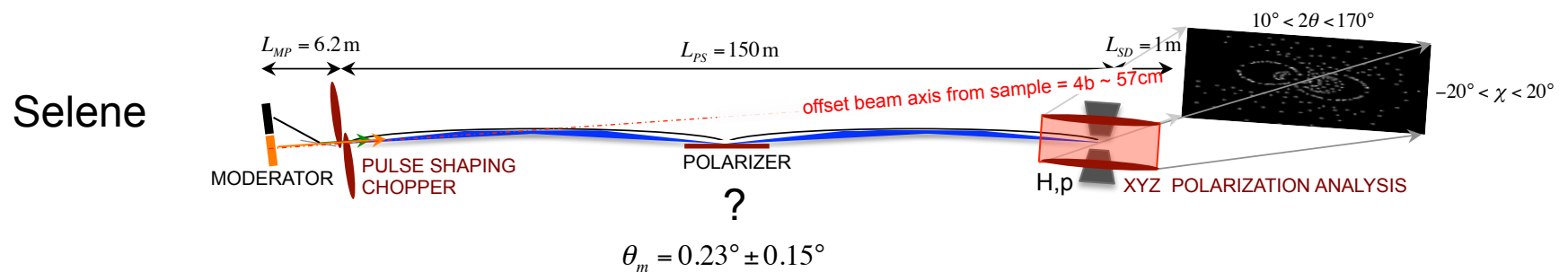
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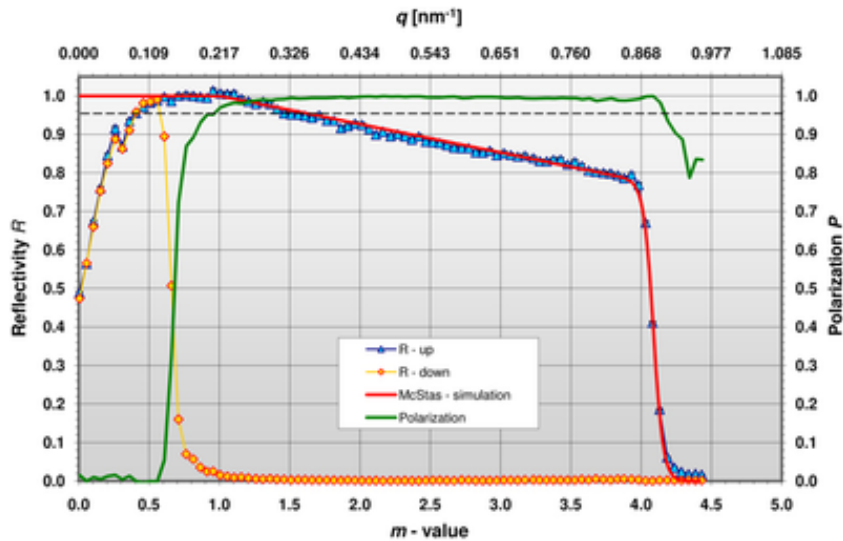
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Neutron guide concepts

polarizing cold + thermal neutrons



no, only for 0.8 Å

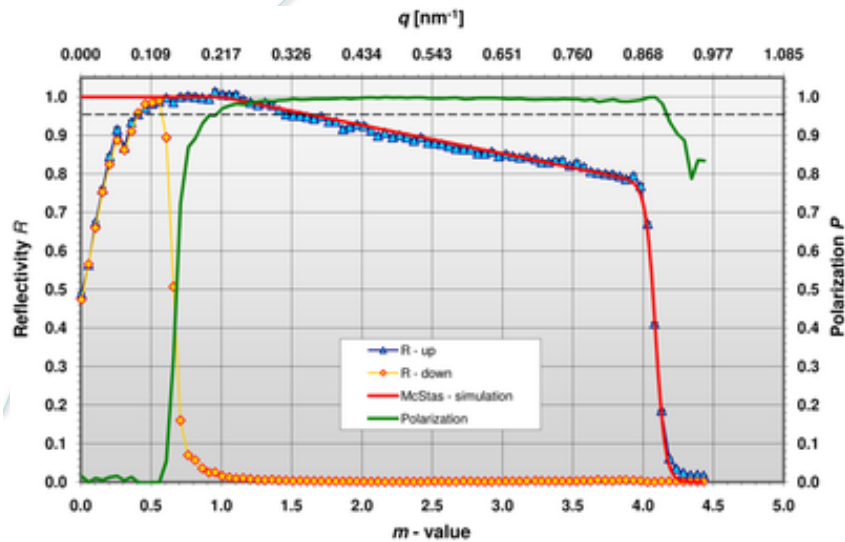
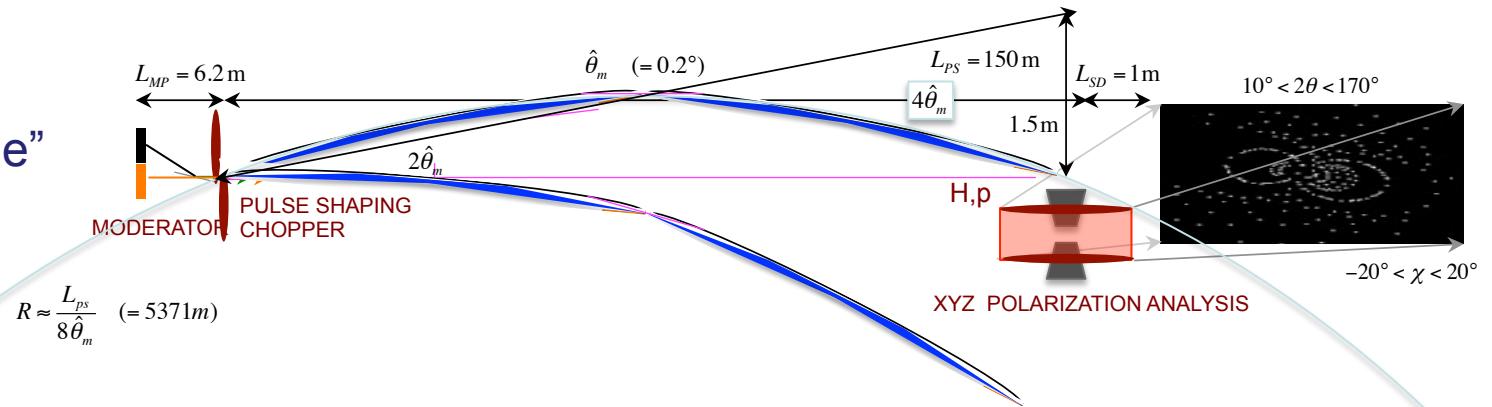


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Neutron guide concepts

polarizing cold + thermal neutrons

“kinked Selene”

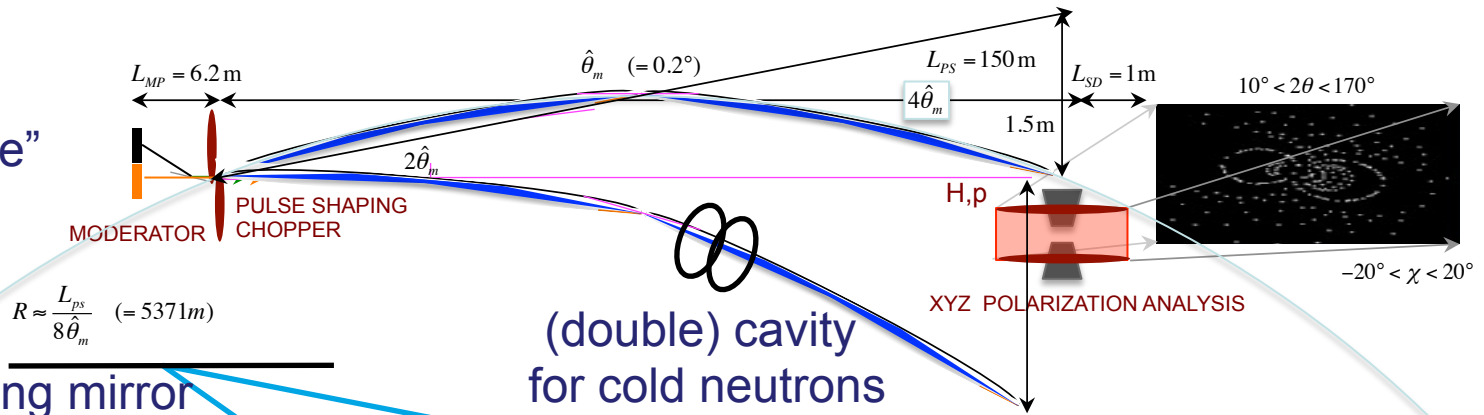


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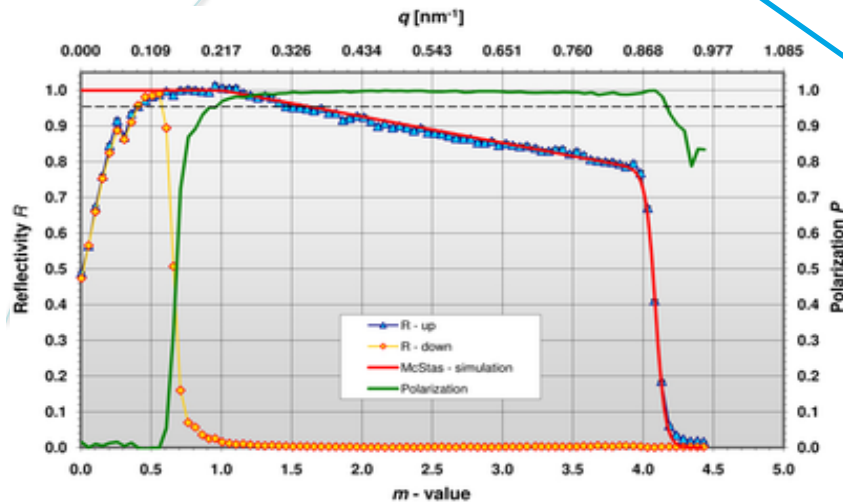


polarizing mirror for thermal neutrons

(double) cavity for cold neutrons

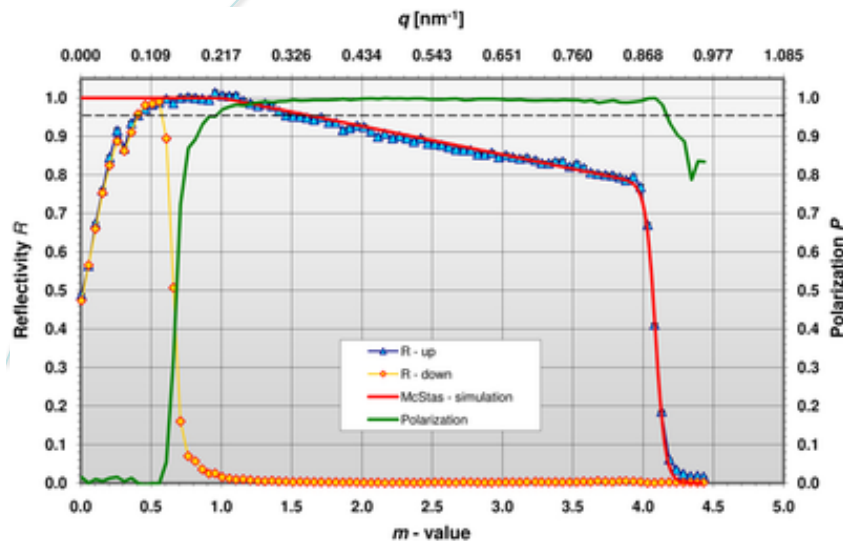
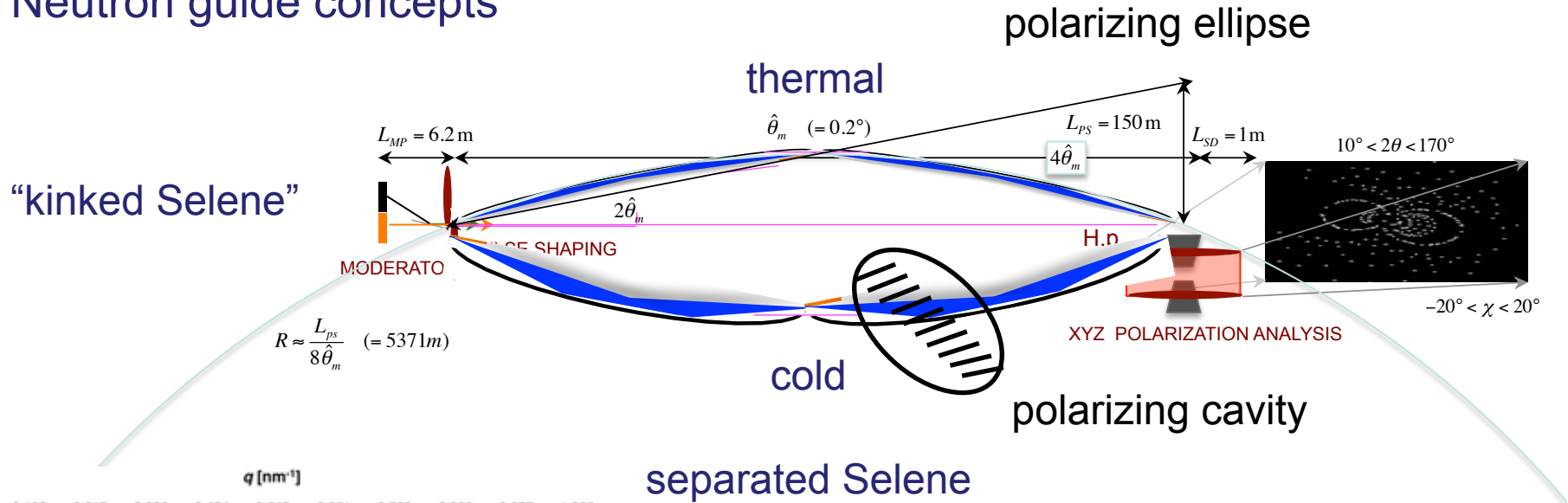
adjusted to divergence spread rotate with wavelength band

limited to narrow divergence of thermal neutrons



# The Magnetism TOF Laue Diffractometer

## Neutron guide concepts



crossed?!

# Chopper system

