

# General SAXS & WAXS system at NTNU

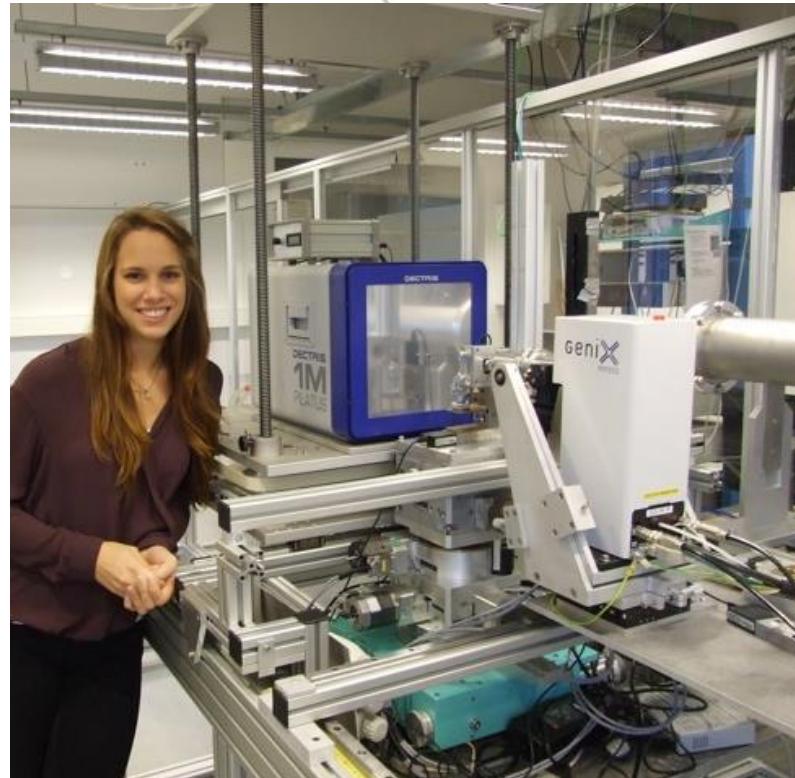
- *Studies of Functional Materials*

**RECX Opening**

**14 February 2014**

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Department of Physics, NTNU

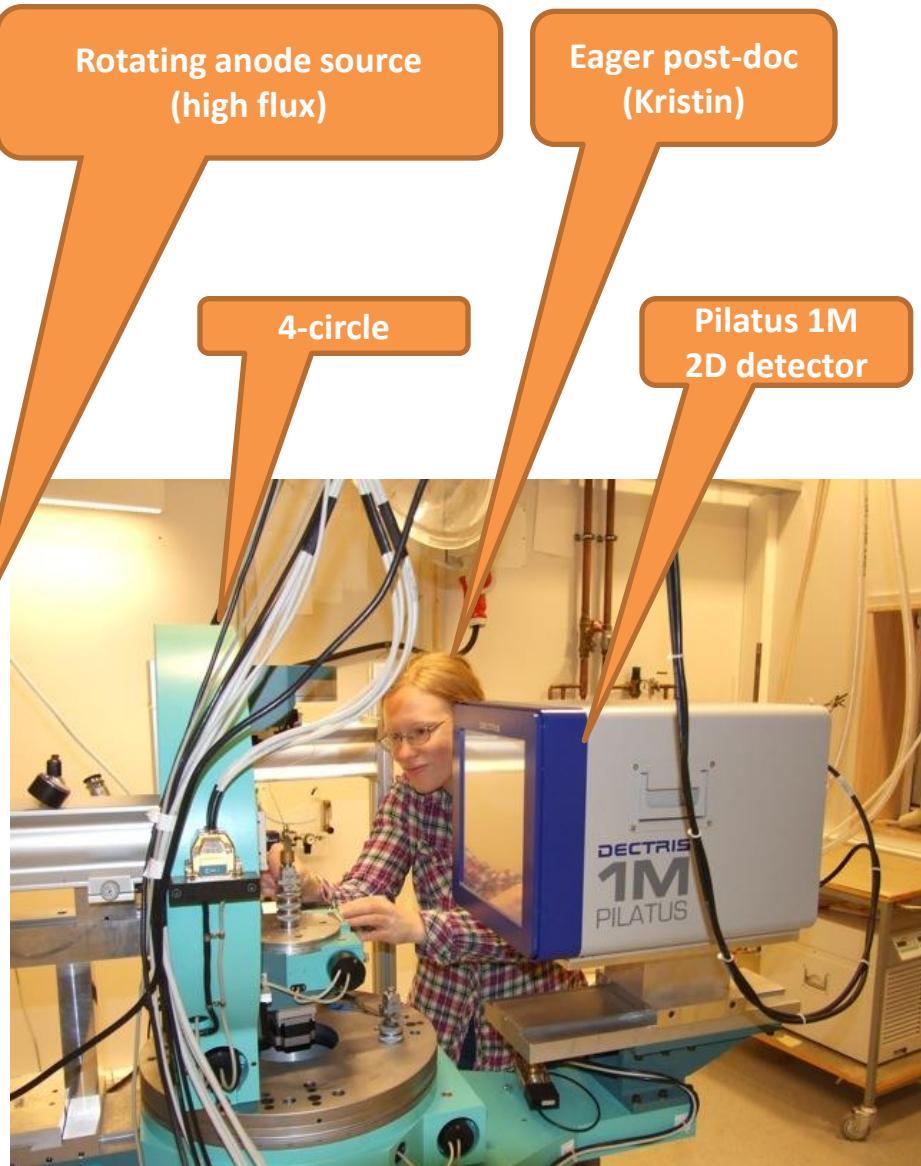


 **NTNU**

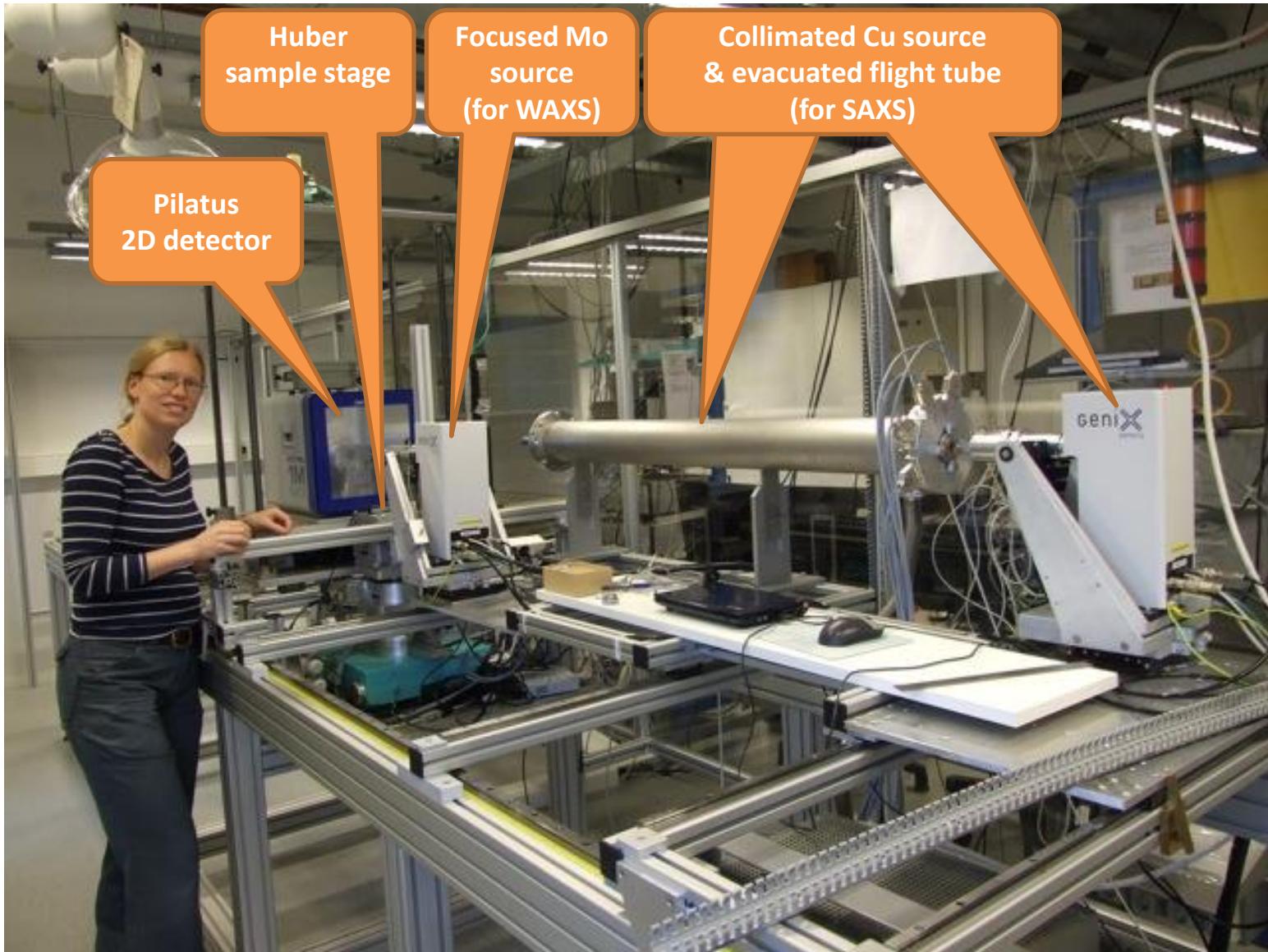
Norwegian University of  
Science and Technology

## Wide-angle scattering

### 4-circle setup



# *GAXS, general-angle X-ray scattering!*



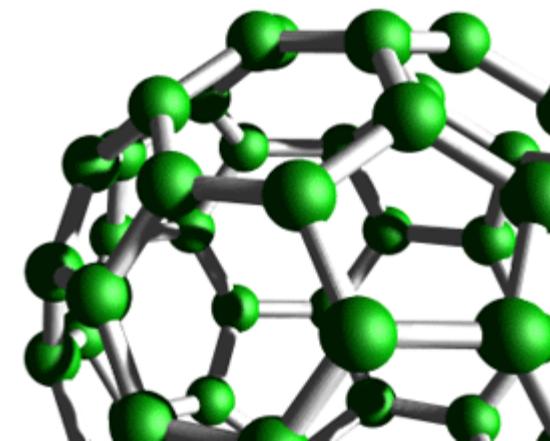
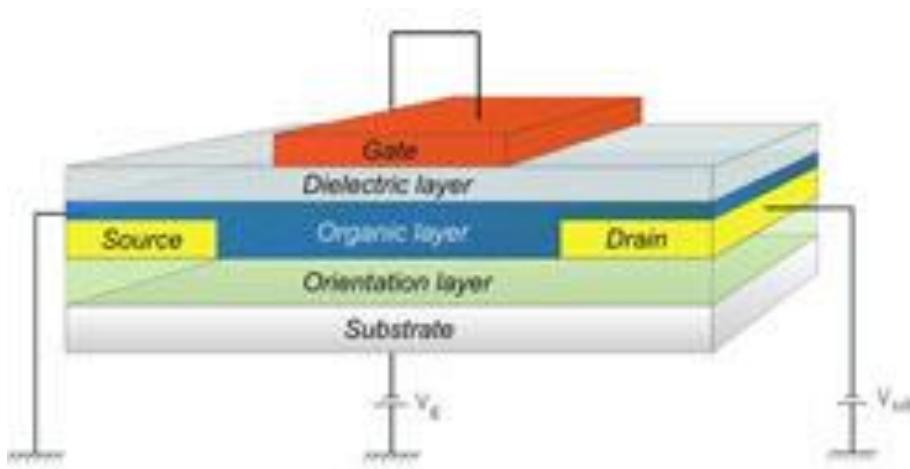
## Why Grazing Incidence X-ray Scattering (GIXS)?

XRD: Non-destructive, quantitative structural analysis:  
Unit cell, texture, correlation lengths, dynamics, phase transitions, ...

GIXS: Surface sensitive, thin films, interfaces, grain boundaries, ...  
*Sensitivity where most reactions and interactions take place!*

- + easy sample preparation
- + no vacuum requirements
- + relatively easy interpretation

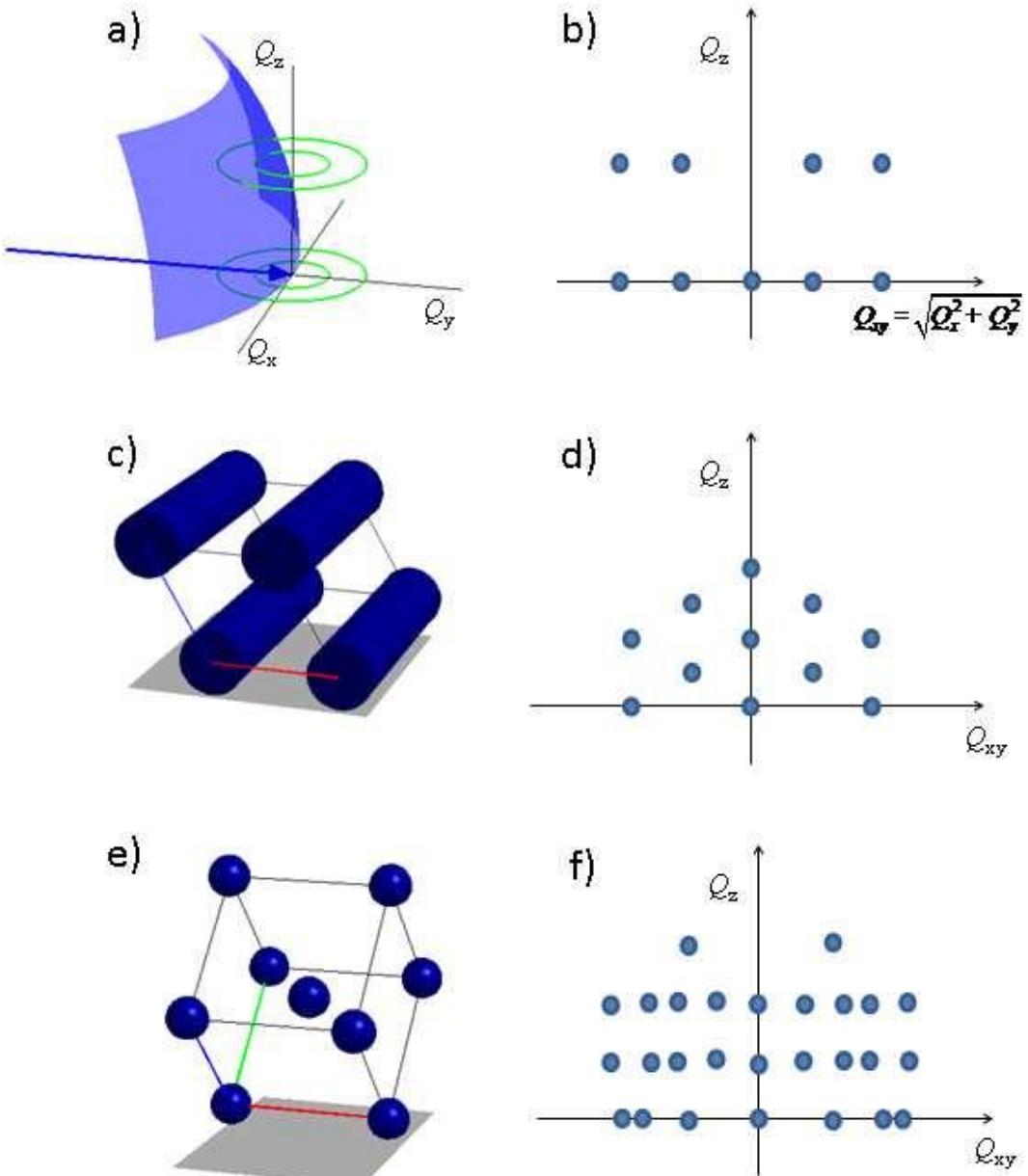
→ *an indispensable tool in nanotechnology!*  
*Here: organic electronics.*



# Grazing Incidence Small-Angle X-ray Scattering (GISAXS)

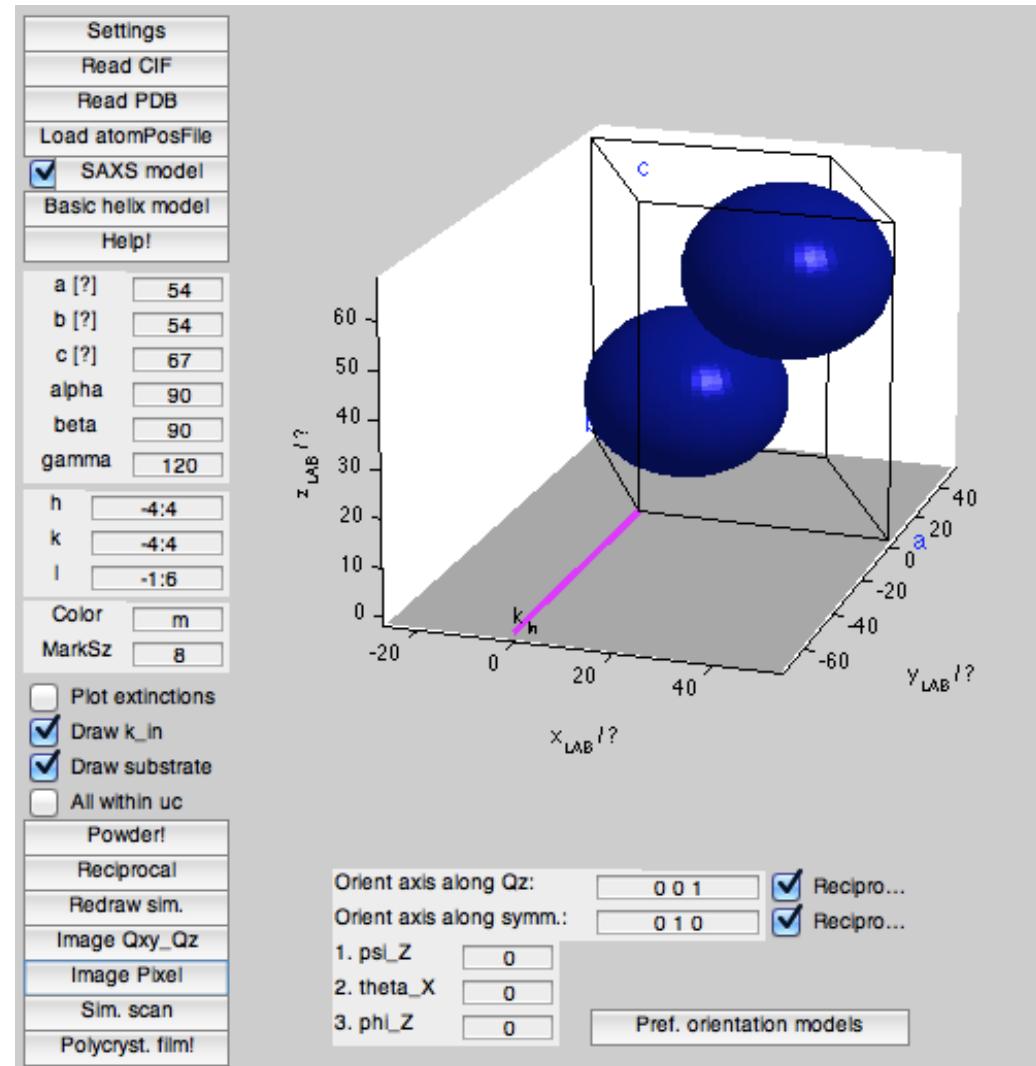
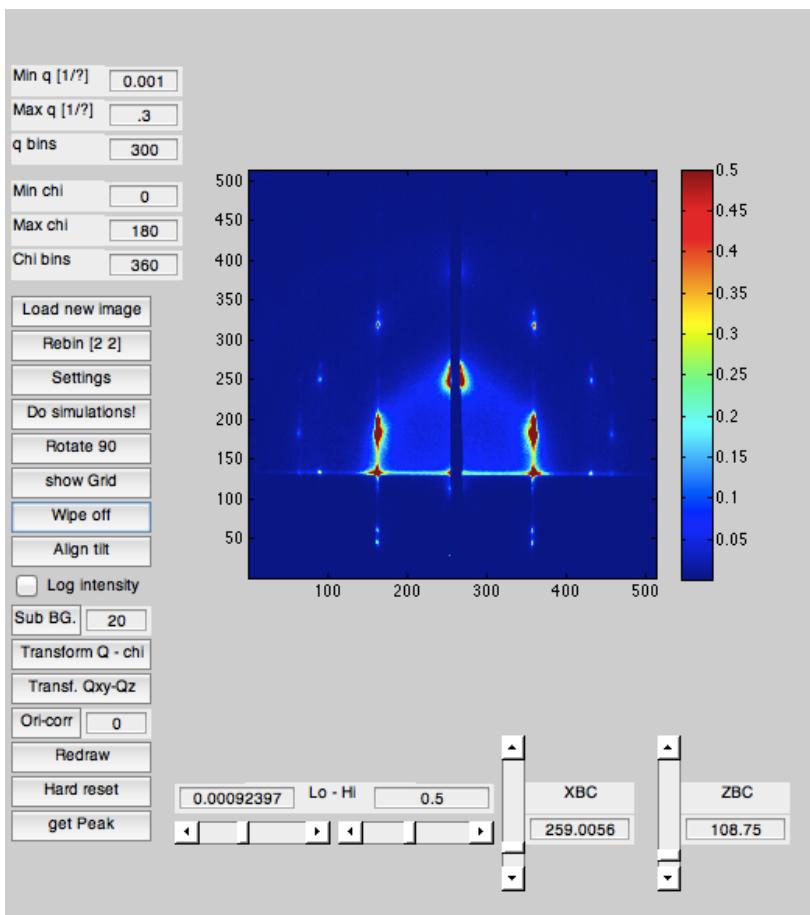
Examples shown here:

- Ordered, mesoporous, micelle-templated, inorganic films.
- Unit cell dimensions  
 $\sim 50\text{-}150 \text{ \AA}$



# Simulating GISAXS

"3D hexagonal" (Space group  $P6_3/mmc$ ).  
Silica.



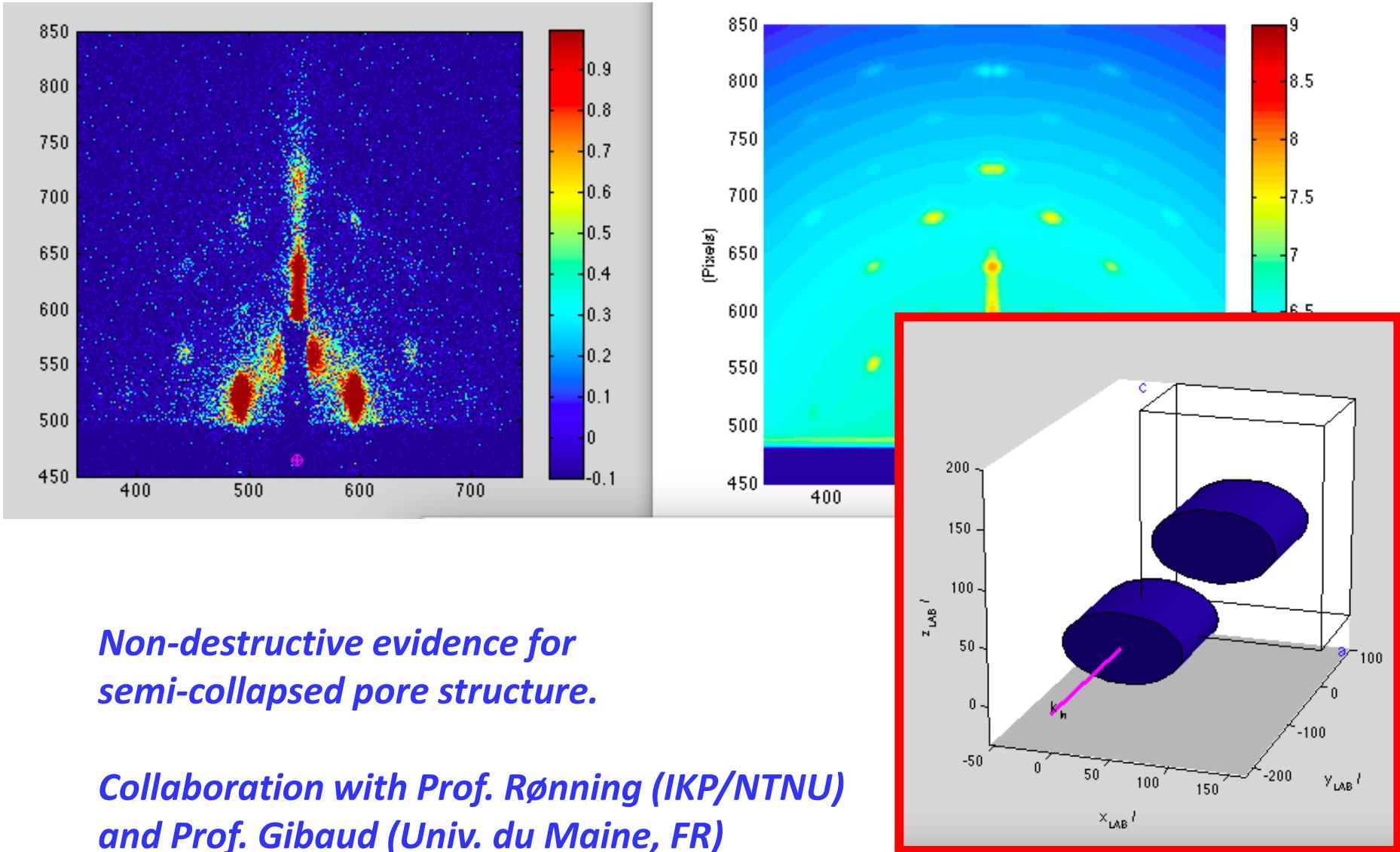
SimDiffraction

J Appl Cryst 2008

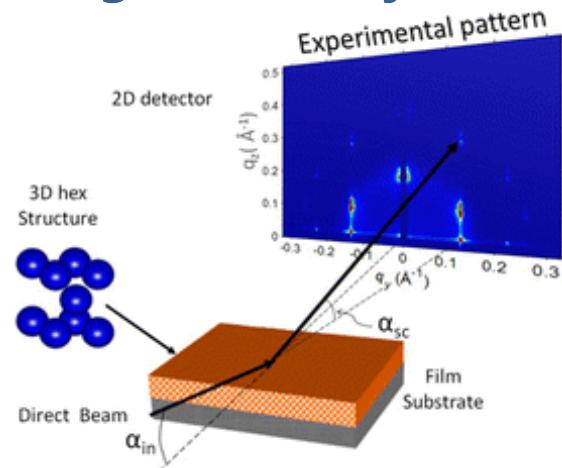
ACS Applied Surf. and Interfaces, 2014

## Simulating GISAXS! Ordered mesoporous alumina

Here: starting with an "2D hex" ( $p6mm$ ) structure, finding ...

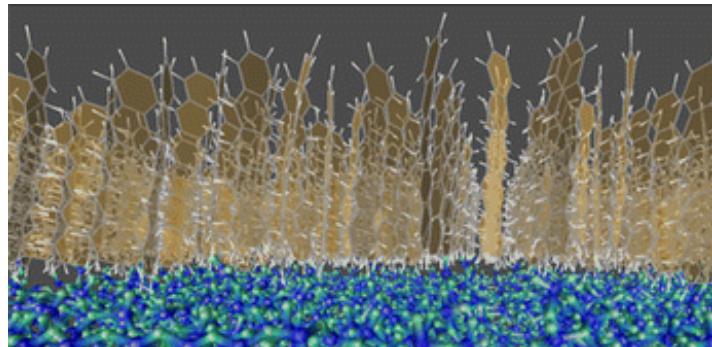


# Scattering Studies of Functional Materials – overview. (Last three years)



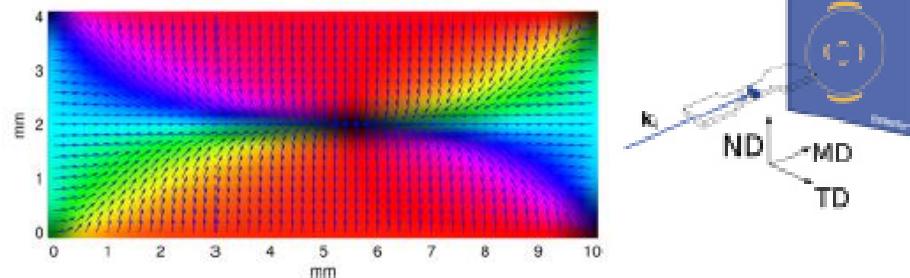
## Catalysis

Sanchez, **ACS Appl. Surf & Interf.** 2014\*  
Høydalsvik, **J Phys Chem C** 2014  
Kehres, submitted 2014  
Voss, submitted 2014



## Organic Electronics

Risko, **ACS Nano** 2014\*  
Bubnova, **Nature Mater** 2014  
Liman, **J Phys Chem B** 2013  
Cho, **JACS** 2012  
Park, **J Mater Chem** 2011

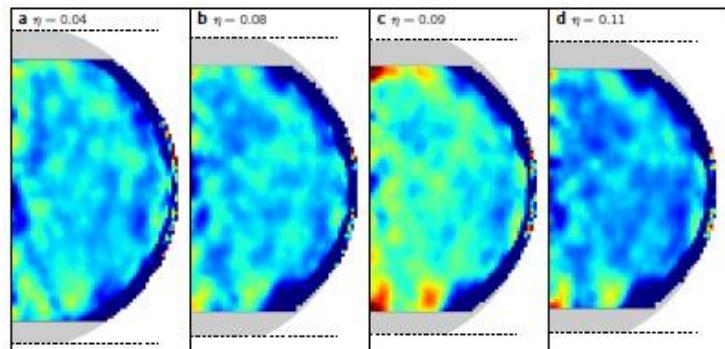


## Soft Matter

Granlund, **Polymer** 2013\*  
Müller, **Polymer** 2013  
Shu, **JACS** 2013  
Simonsen, **Langmuir** 2011

## Hard Matter

Aas, **Thin Solid Films** 2014  
Tollefsen, **Met. Mat. Trans.** 2013



## Coherent Diffraction

Fløystad, submitted 2014\*  
Böttiger, submitted 2014  
Esmaeili, **Macromolecules** 2013  
Falch, **IEEE** 2013  
Fløystad, submitted 2013

## Conclusions

- Active group, attracts many students, good publication record
- Unique WAXS instrument
  - based on a rotating anode (to be replaced, financed by RECX)
  - collimating multilayer mirror
  - SPEC software
  - Pilatus detector
  - 
  - XRD / WAXS
  - GIWAXS
  - Reflectivity-measurements
- Unique GAXS instrument
  - Two microfocus sources: Mo , Cu
  - Xenocs collimator
  - Pilatus detector
  - 
  - WAXS, SAXS
  - GISAXS
- Usage: 1) Home laboratory experiments.  
2) Teaching.  
3) Preparation for synchrotron experiments.



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Alumni (from last two years):

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Dr. Håvard Granlund (2013)

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