Modelling x-ray and neutron scattering from clay particles

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People involved in the work

Coordinator

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Modelling

Kari Pirkkalainen, Univ. Helsinki

Experiments

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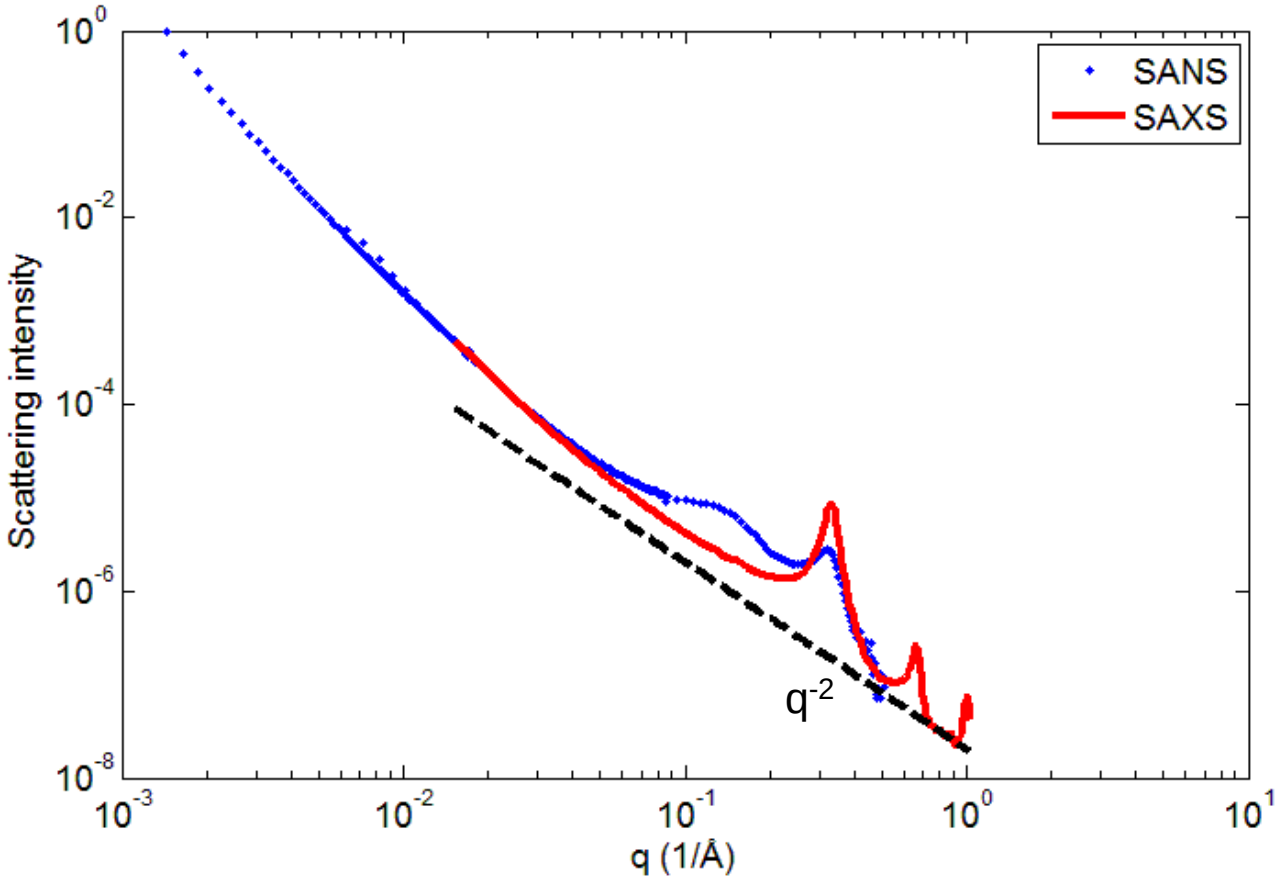
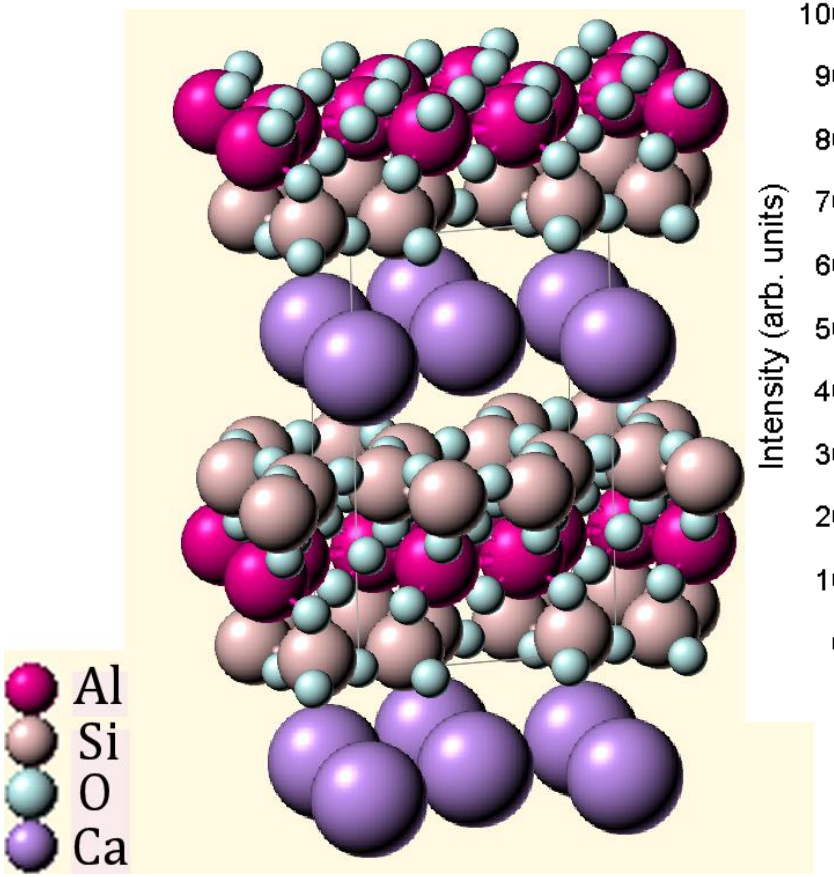
Michal Matusewicz, VTT

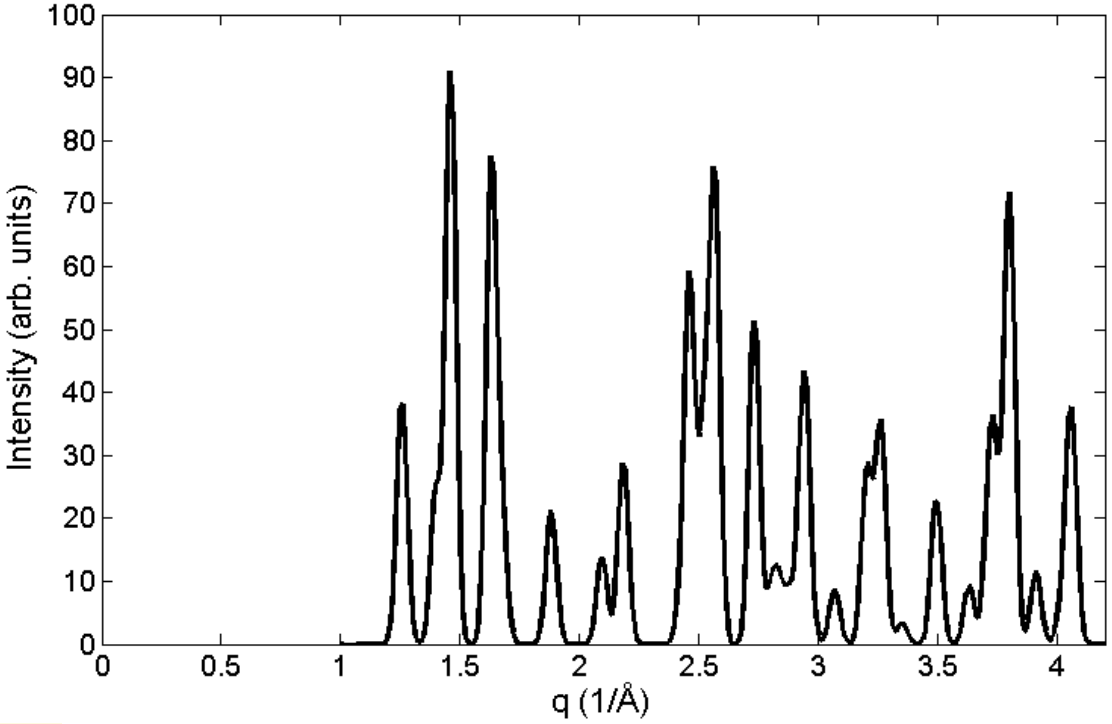
SAXS and SANS from MX-80



SAXS and SANS experiments by V. Liljeström

X-ray diffraction



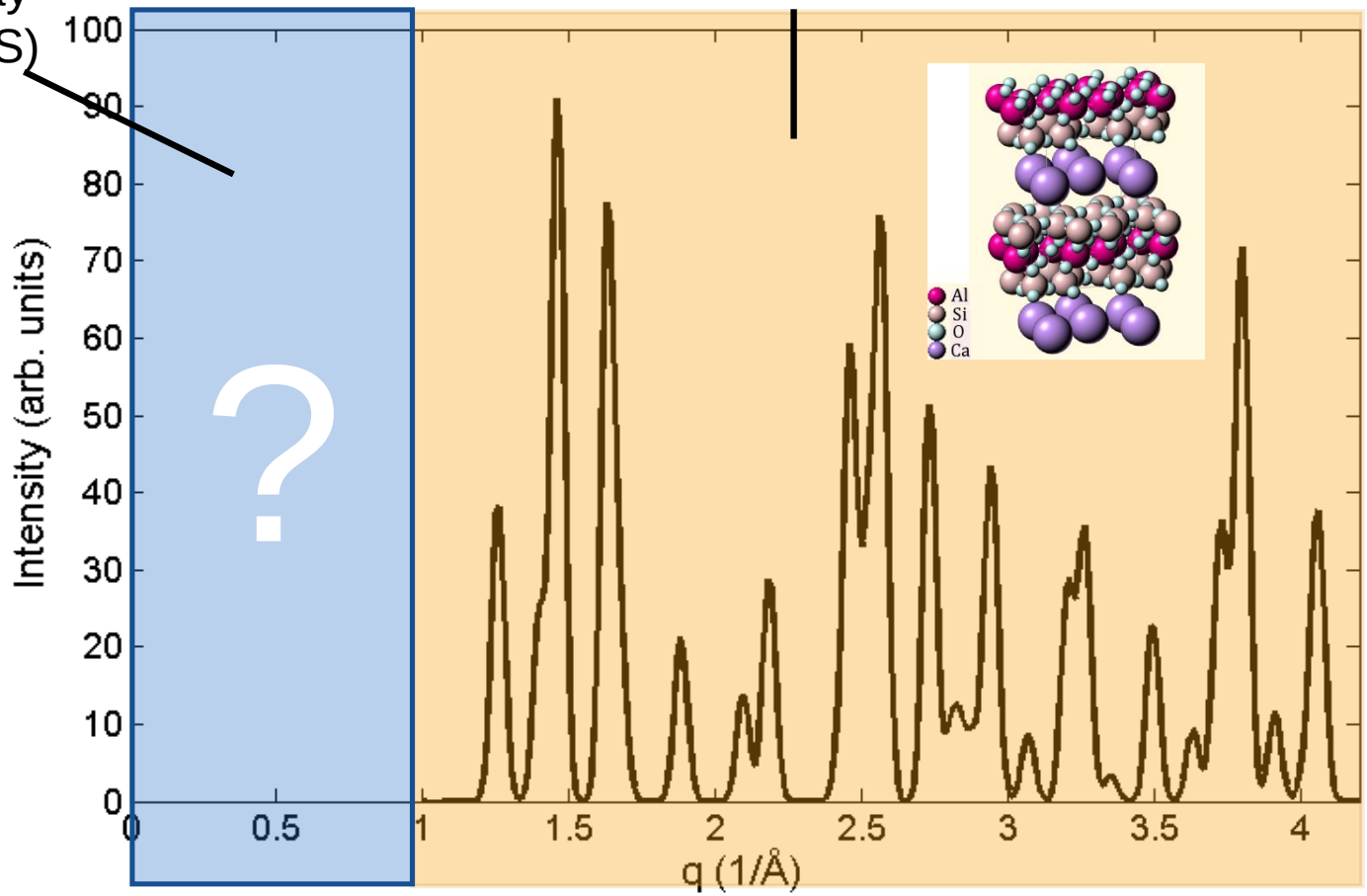


$$q = \frac{4\pi \sin(\theta)}{\lambda}$$

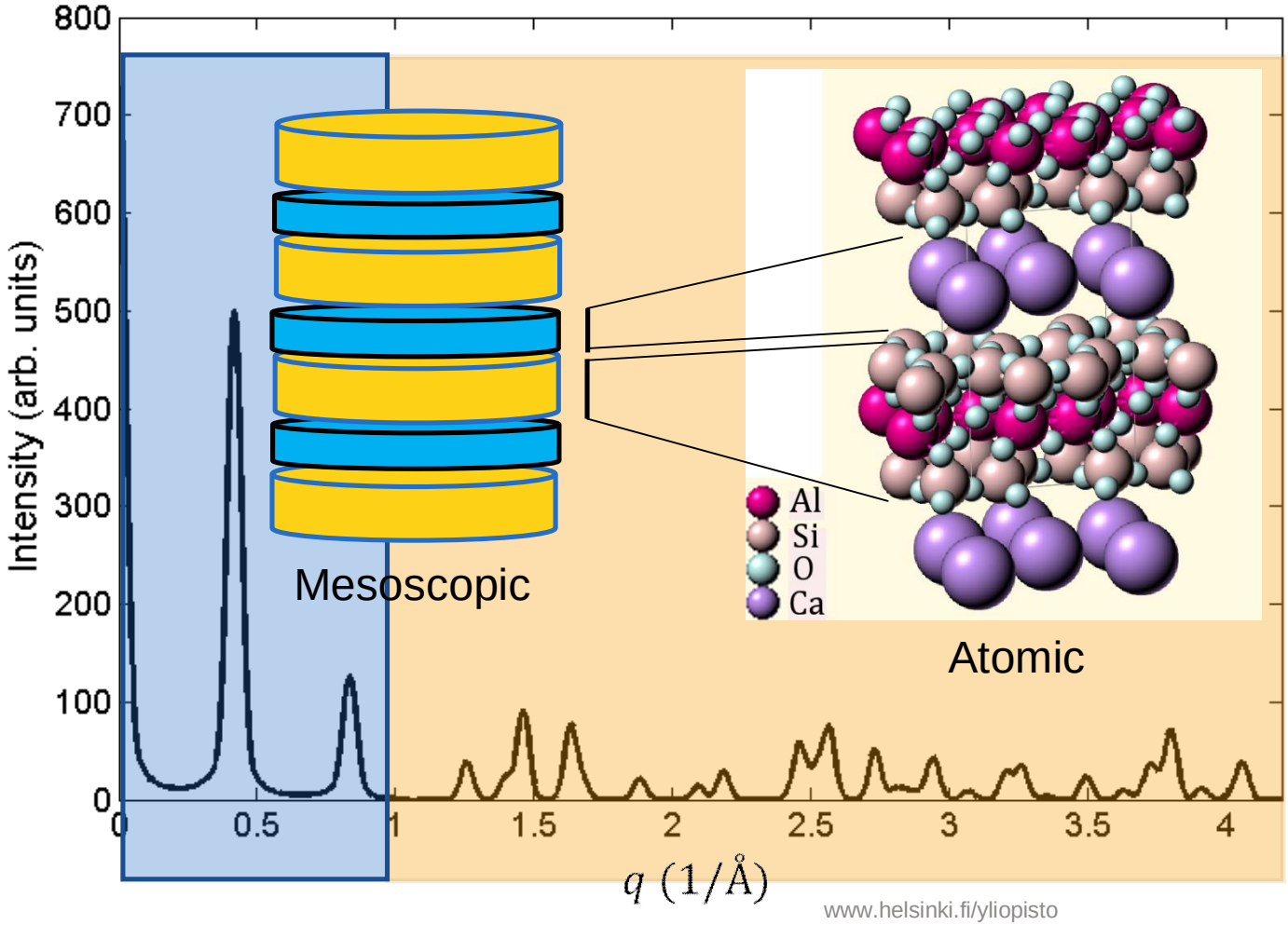
WAXS and SAXS

Small angle x-ray scattering (SAXS) region

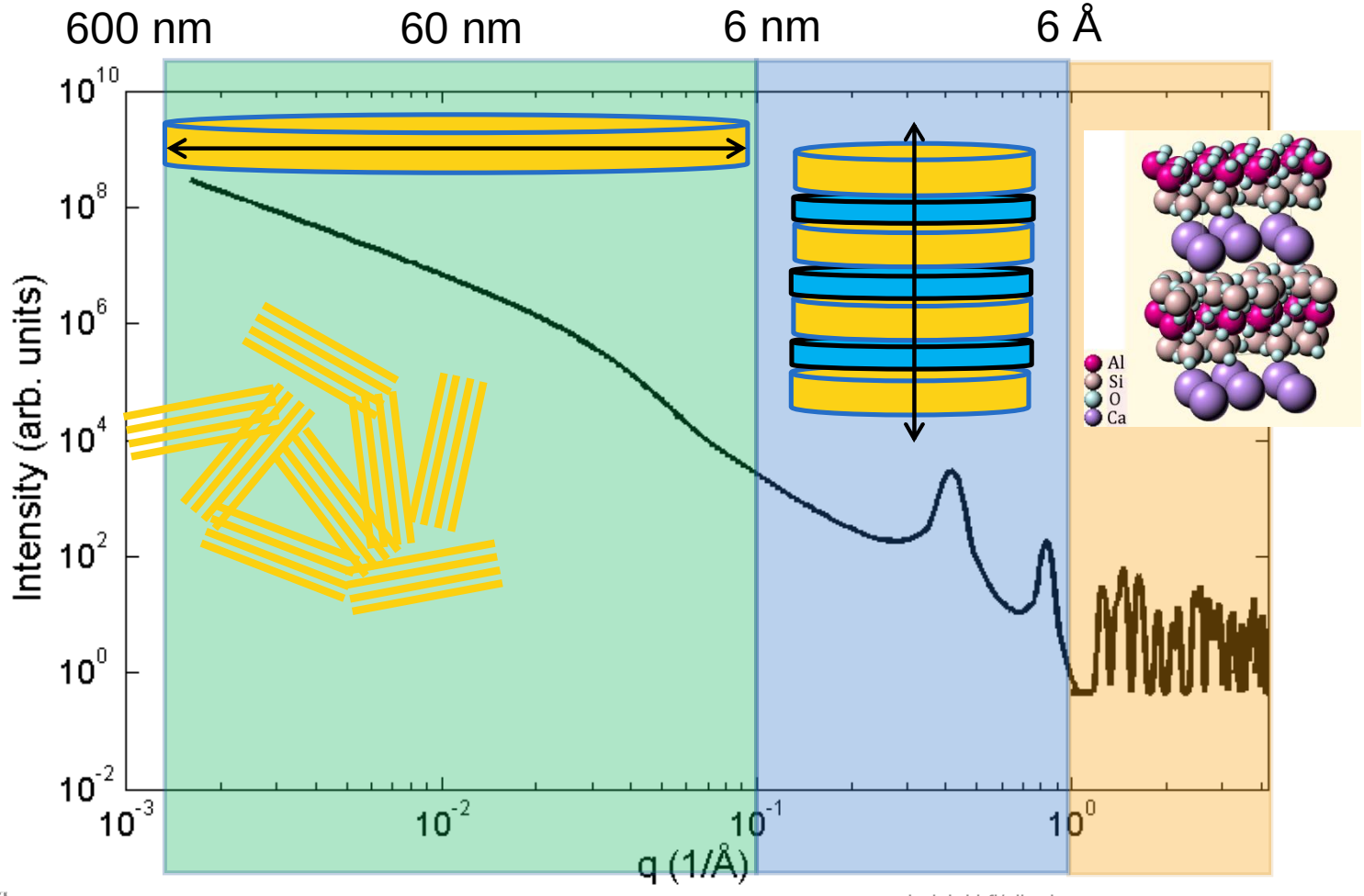
Wide angle x-ray scattering (WAXS) region



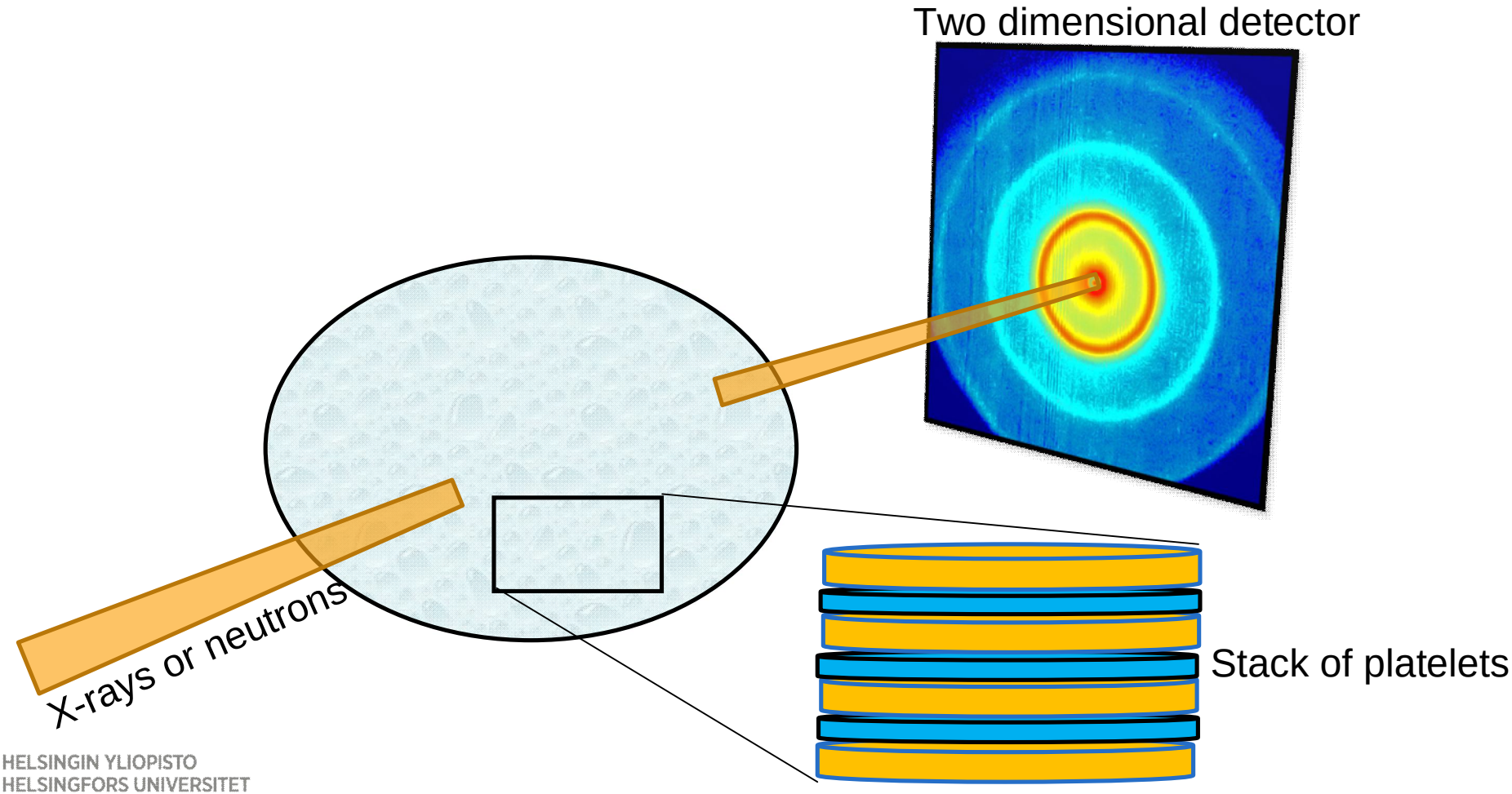
Atomic scale vs. mesoscopic scale



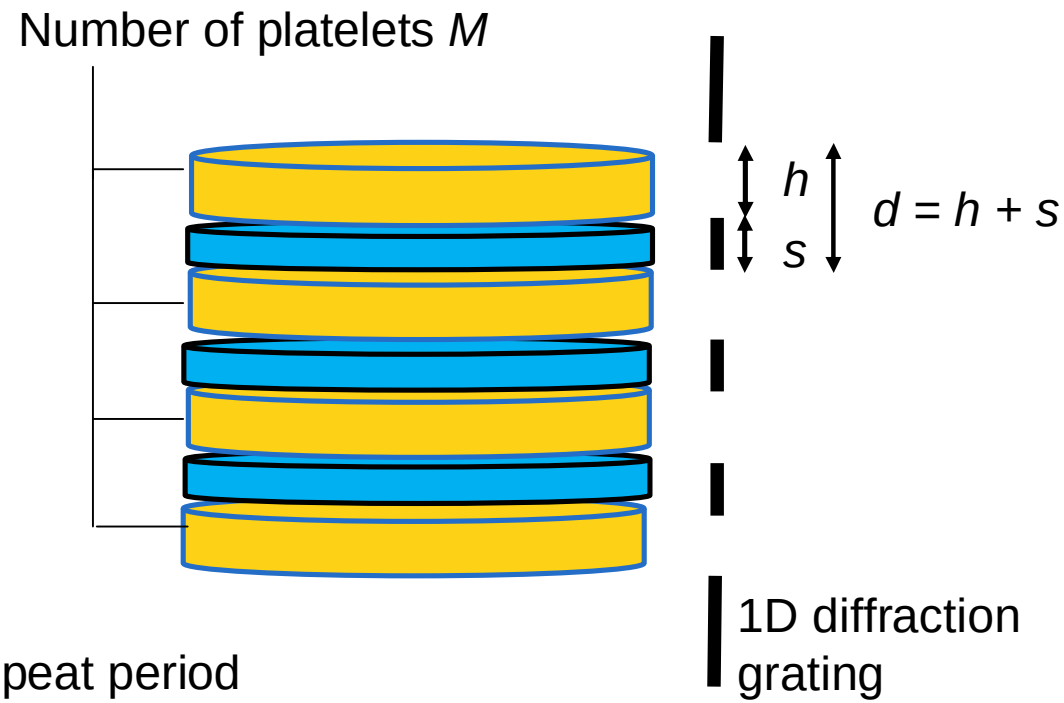
SAXS


600 nm
60 nm
6 nm
6 Å
Intensity (arb. units)
10^{10}
10^{8}
10^{6}
10^{4}
10^{2}
10^{0}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
10^{0}
q (1/Å)
Al
Si
O
Ca

Small angle scattering experiment

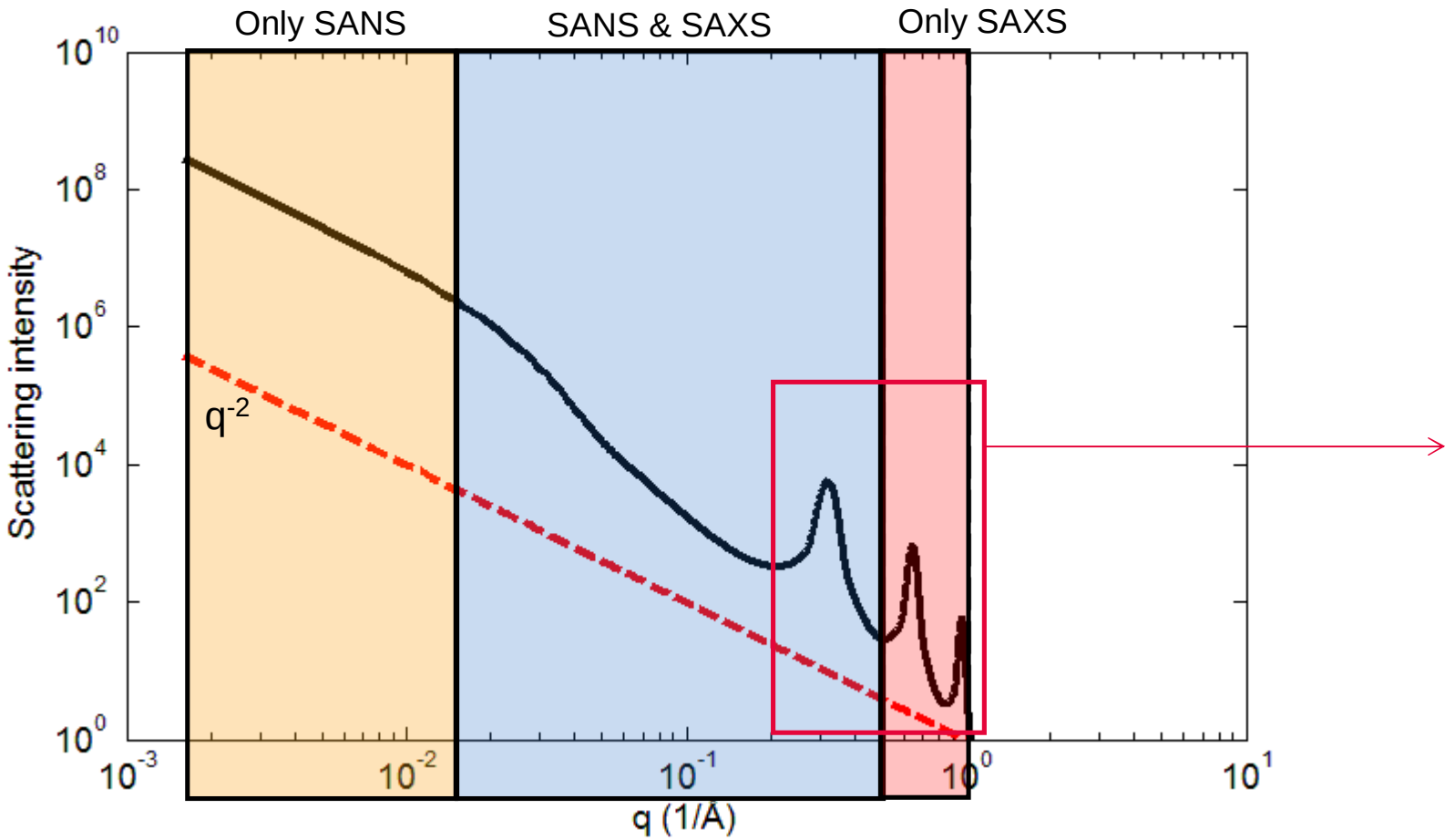


Simple model for a clay particle



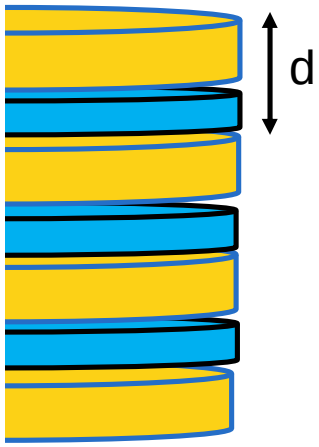
d = lamellar repeat period
h = ”hard phase” thickness
s = ”soft phase” thickness

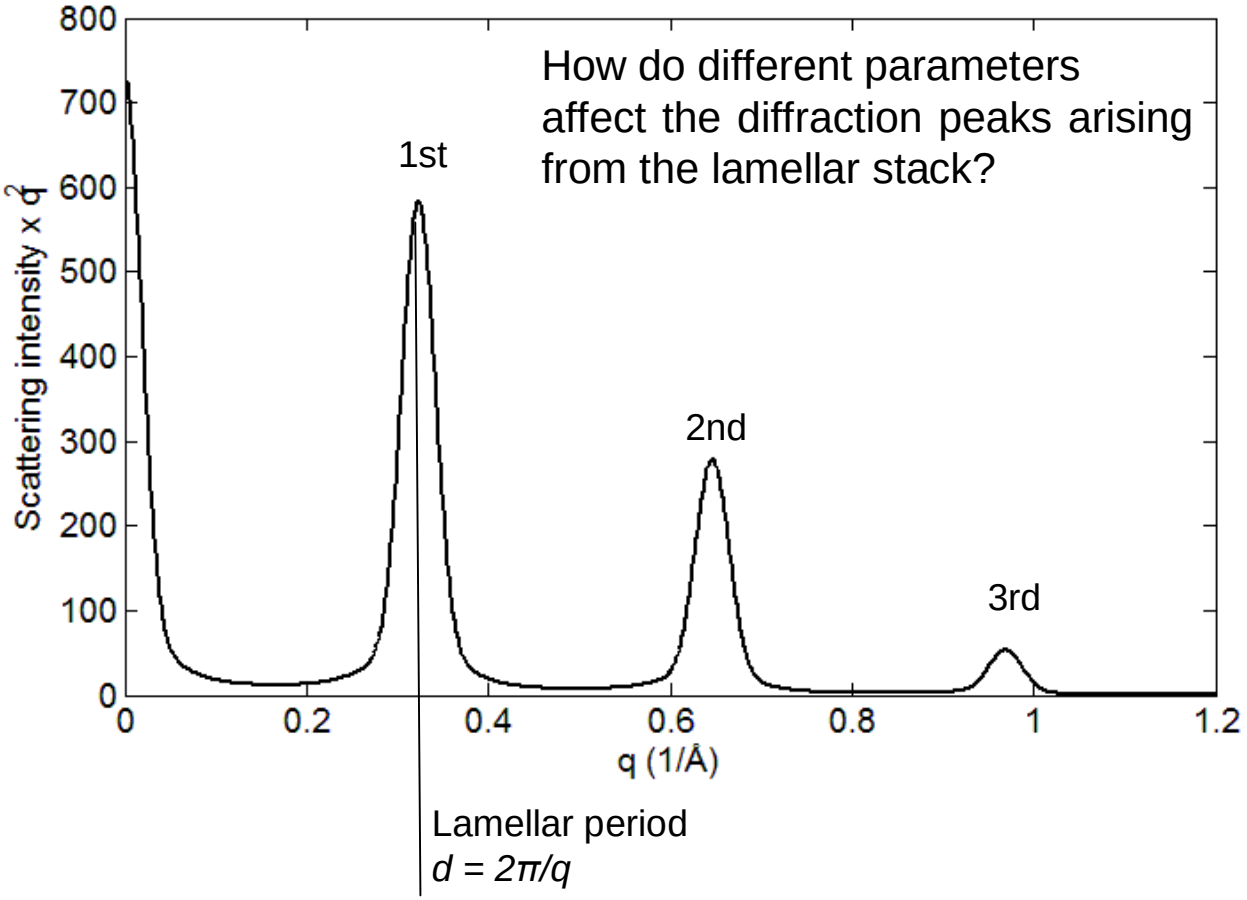
The q-range covered by our experiments



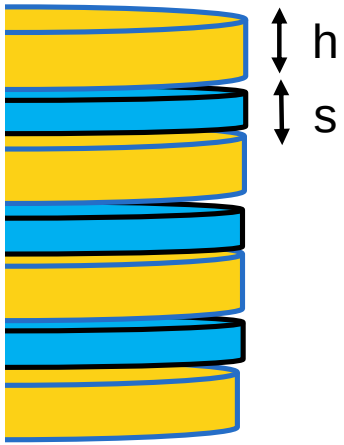
SANS =
Small
Angle
Neutron
Scattering

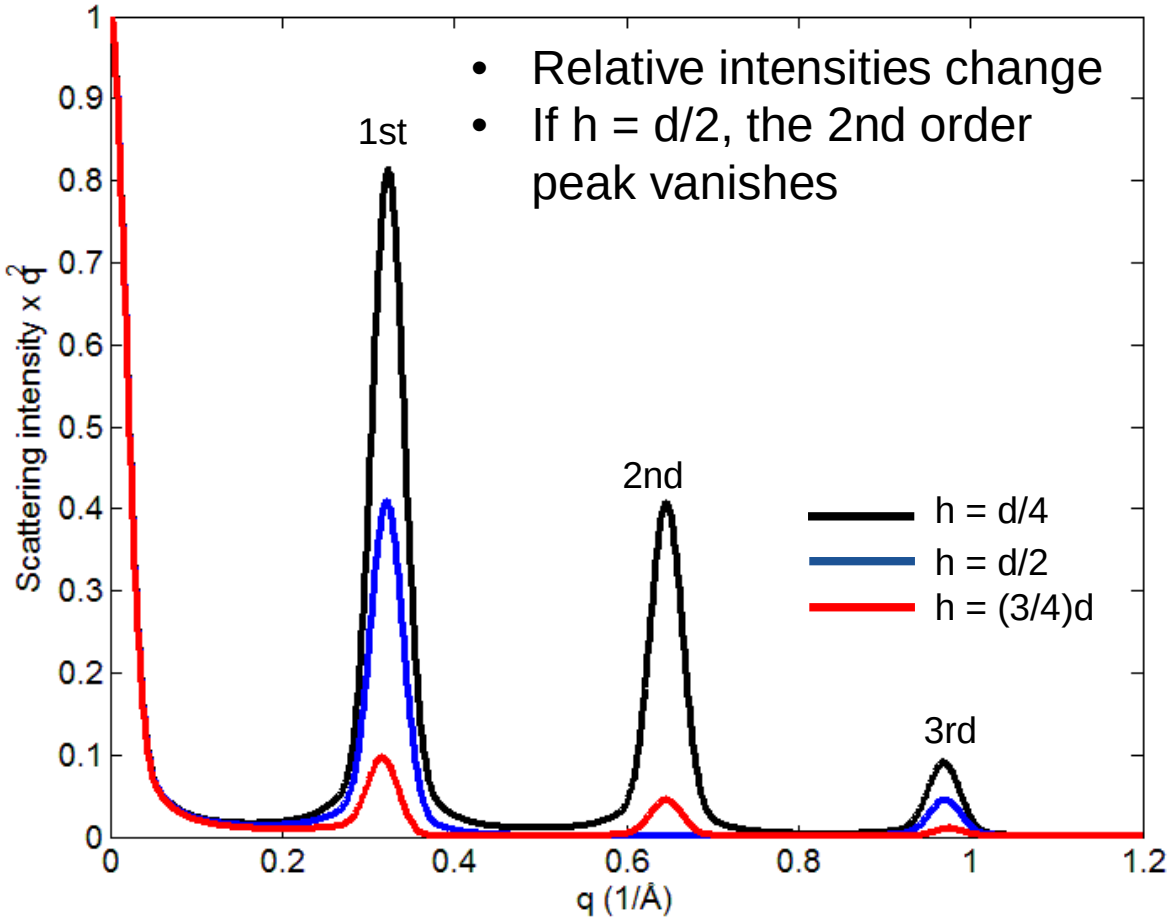
Properties of stacks: Intensity times q^2-plot



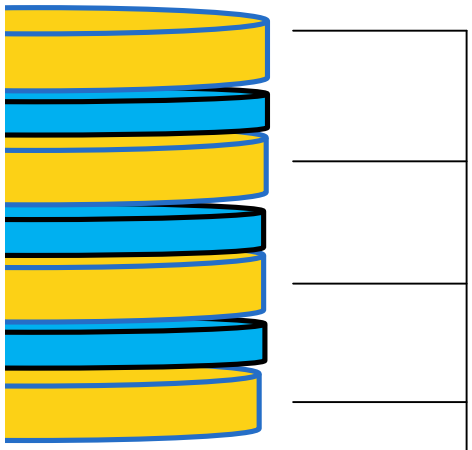


Thicknesses of the plates (h) and the ”soft” phase (s)

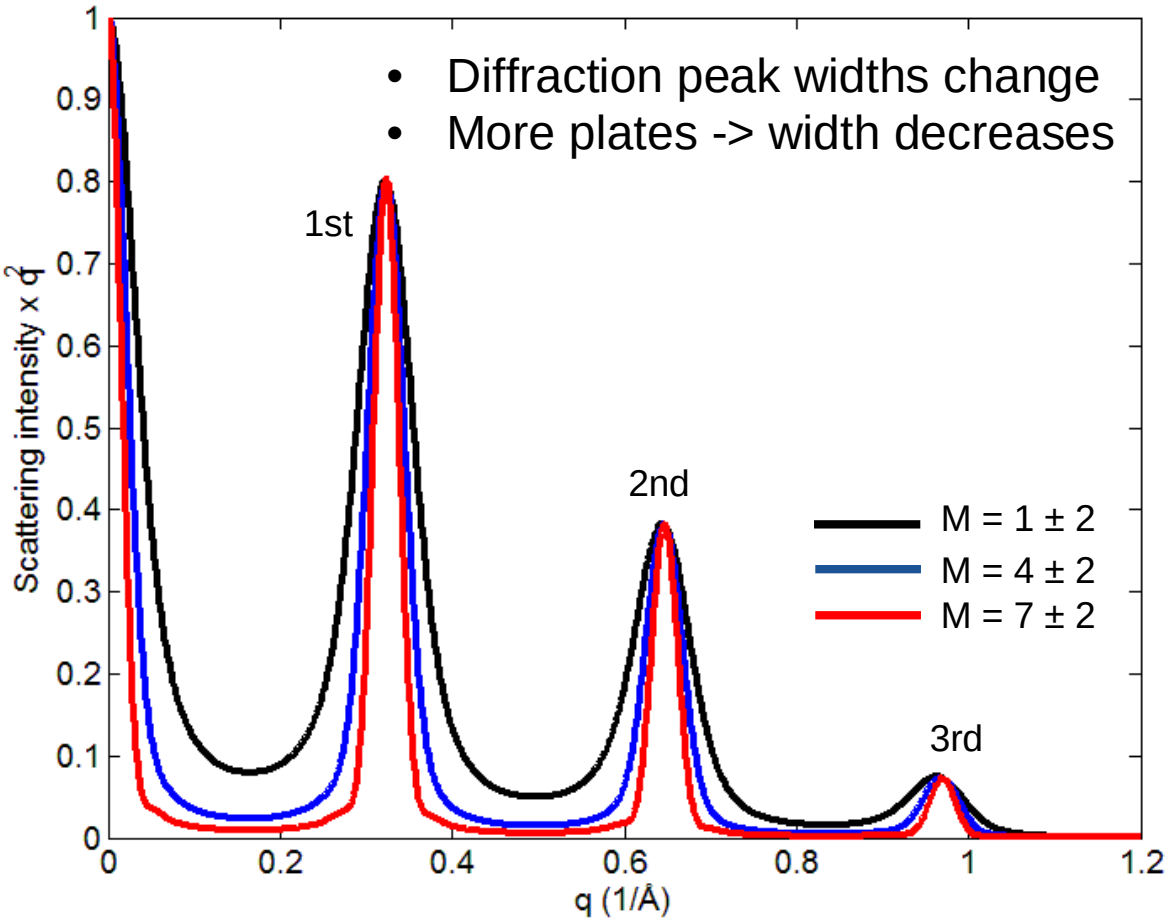




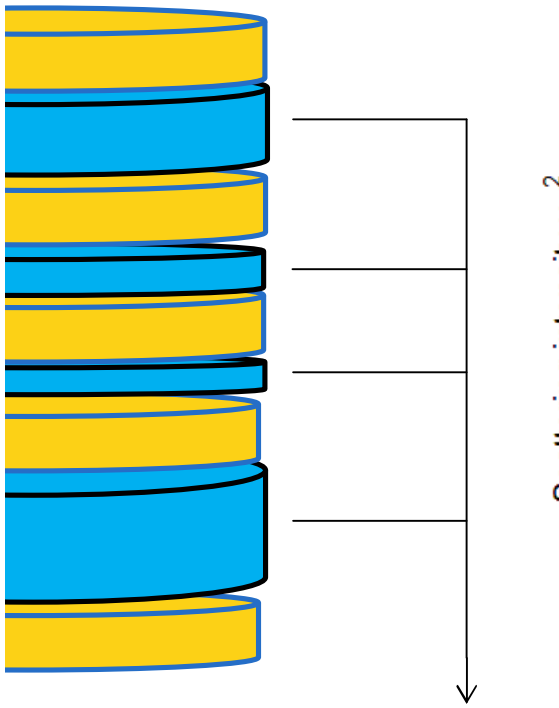
The number of plates in the stacks



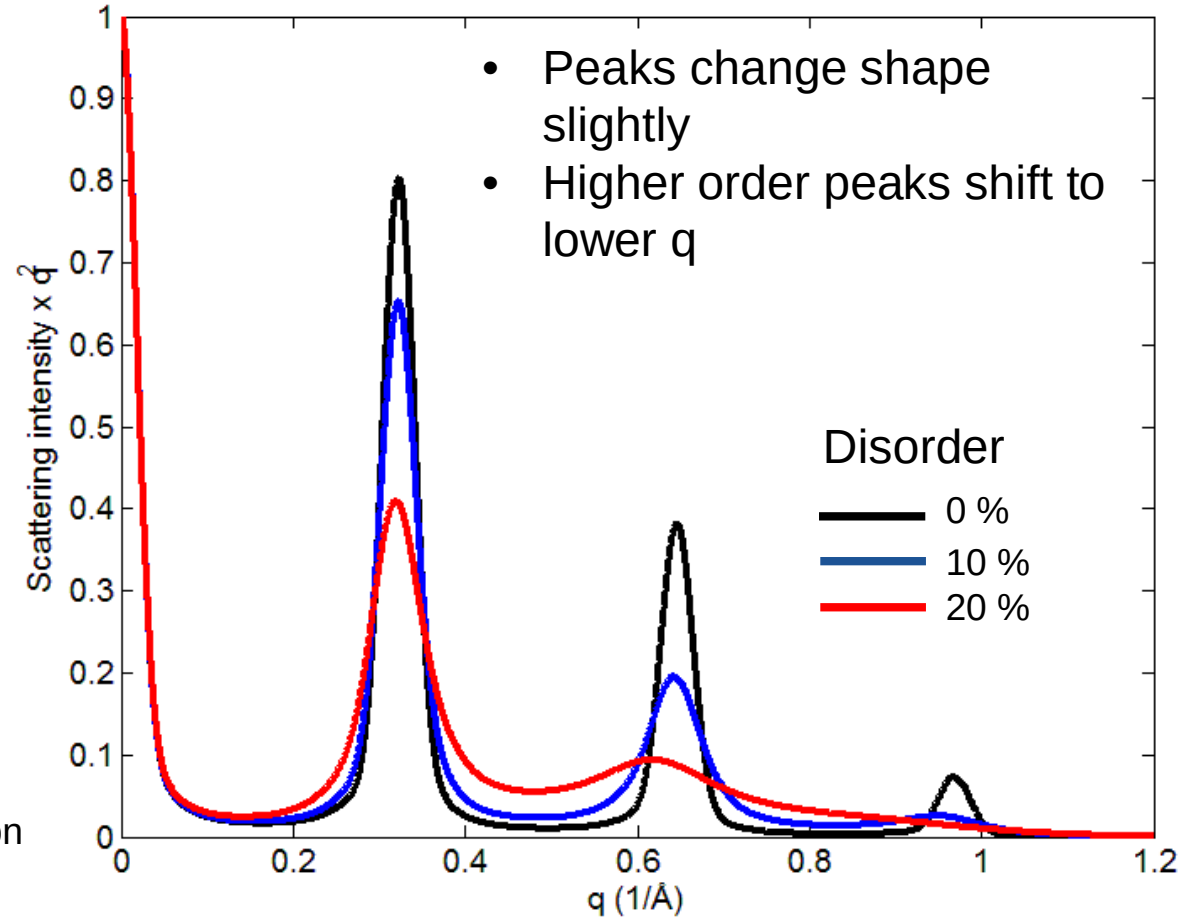
No. Of plates in the stack M = 4



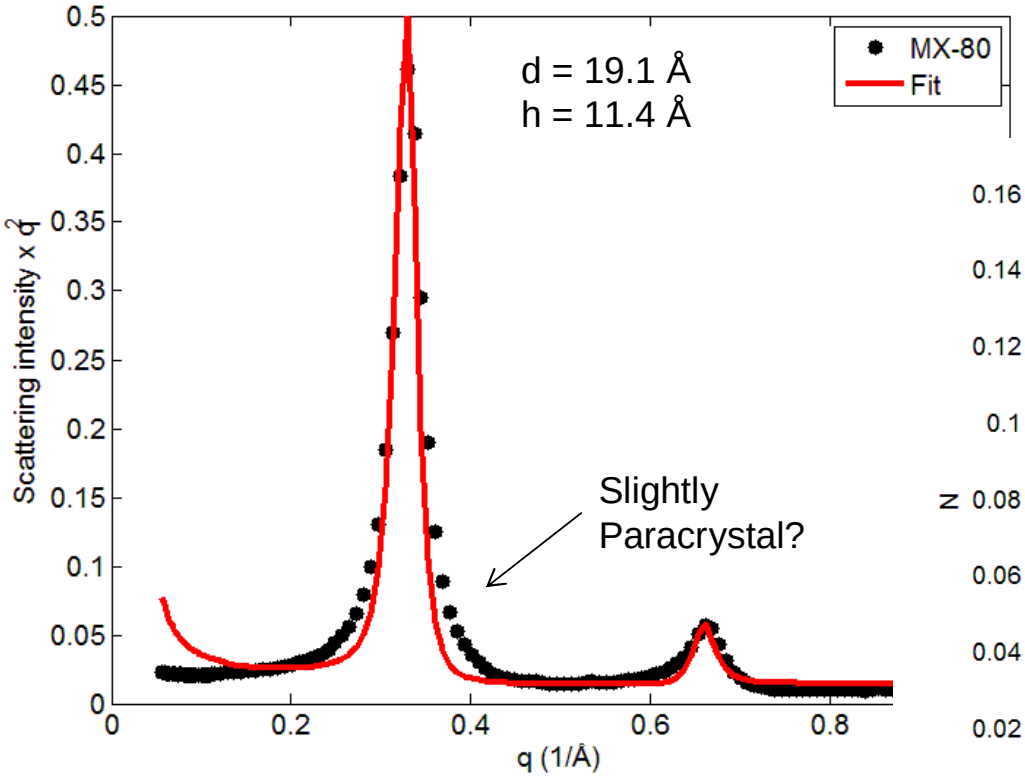
Variation in the ”soft” phase (paracrystal – like structure)



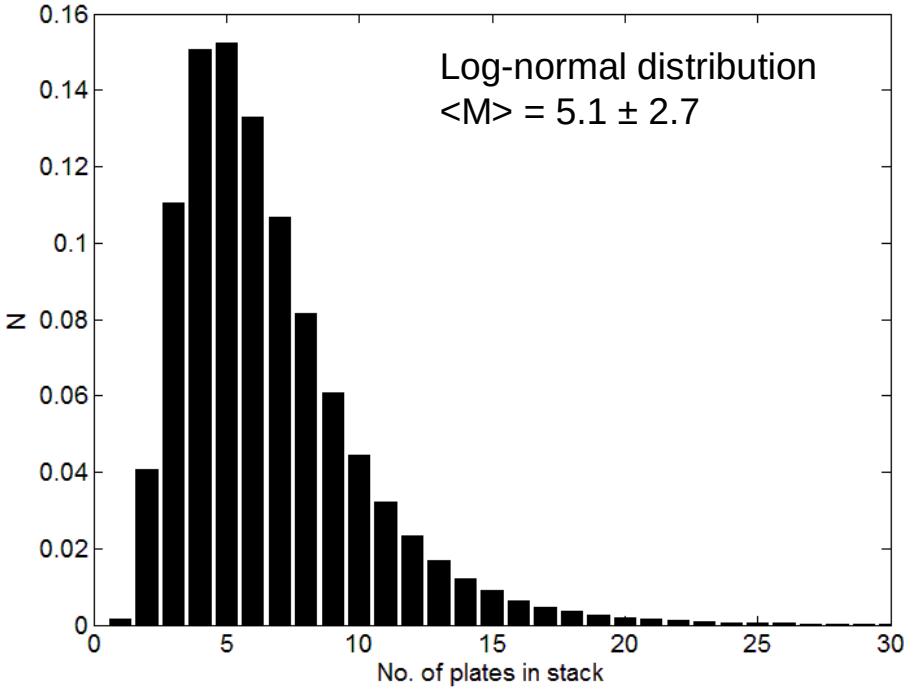
Variation



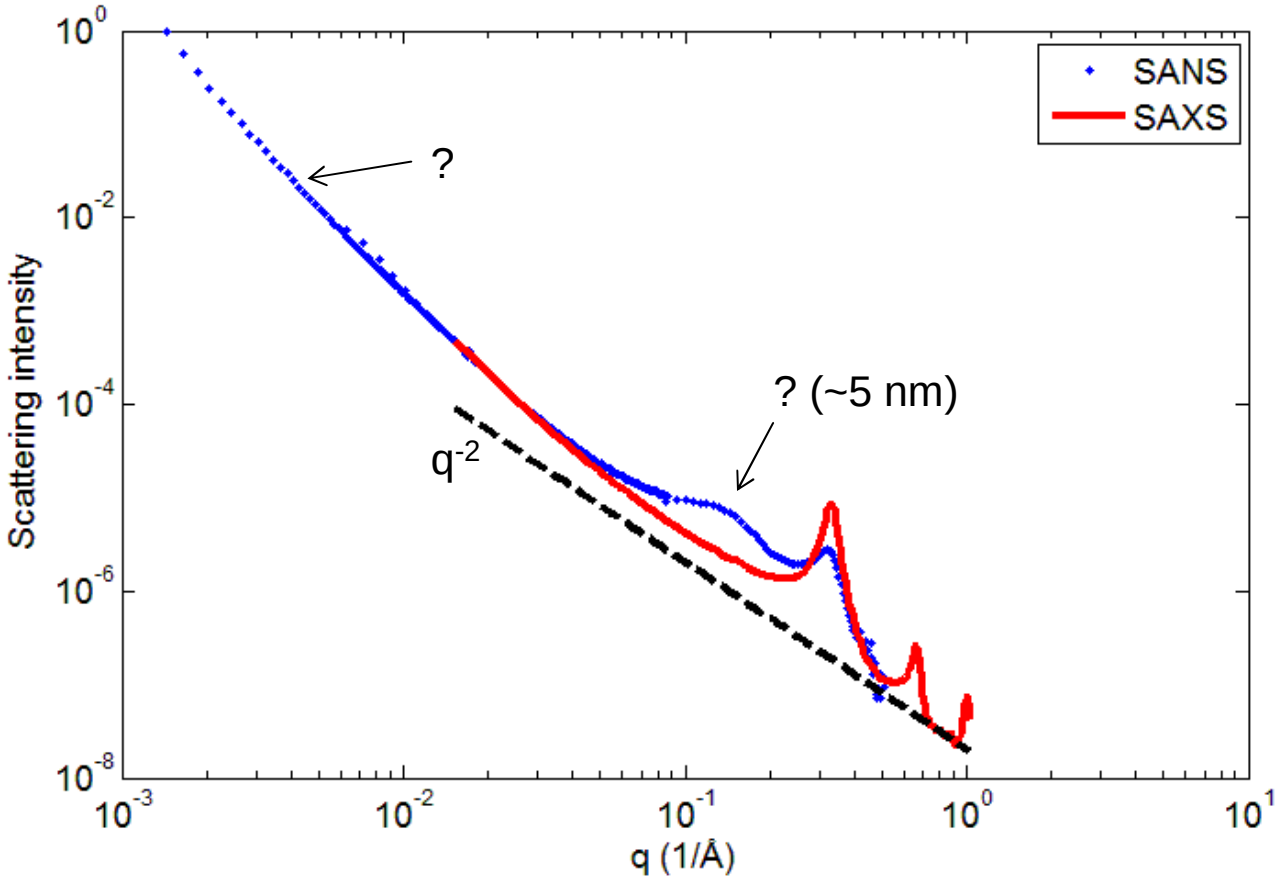
Results: fit to SAXS pattern of MX-80



SAXS experiment by V. Liljeström



Conclusions



SAXS and SANS experiments by V. Liljeström

Conclusions

- SAXS and SANS allows the determination of
  1. Lamellar repeat distance
  2. Hard and soft phase thicknesses
  3. Distribution of number of plates in a stacks
  4. Variation of thicknesses (disorder) in stacks
- Possibly also
  1. Other nanoscopic structures (i.e. pores)?
  2. Assembly of stacks into larger aggregates

End of talk

Thank you for listening

Questions?