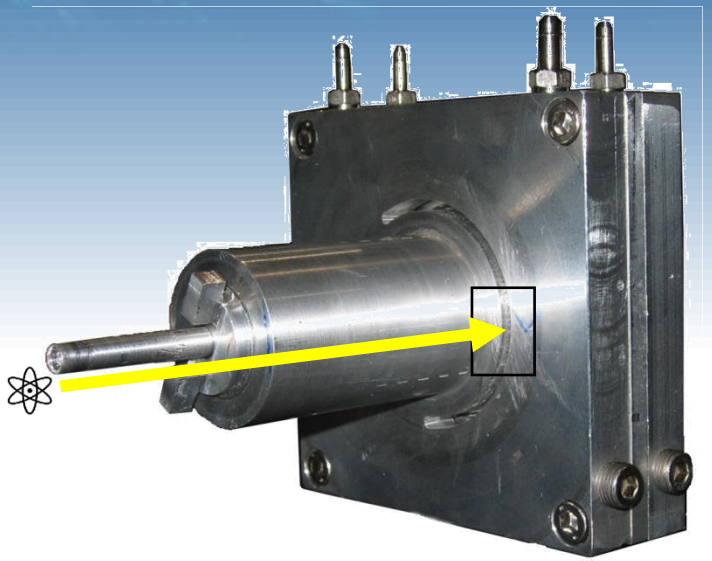
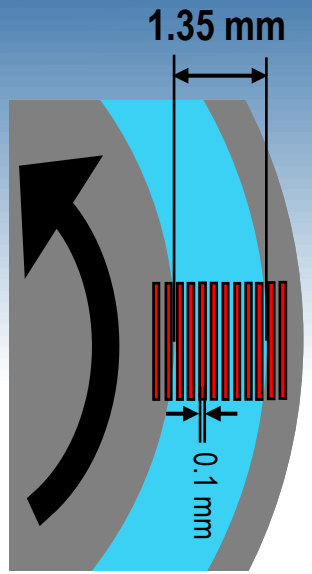
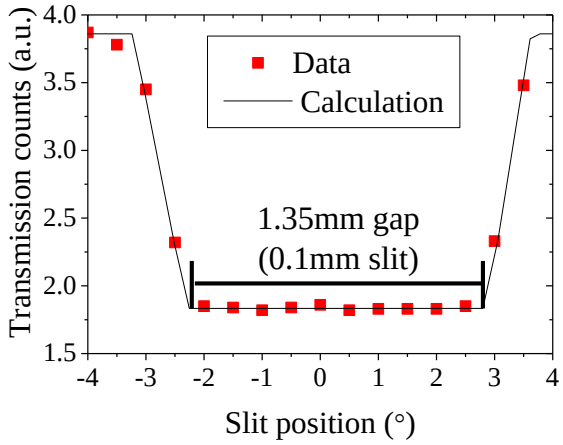
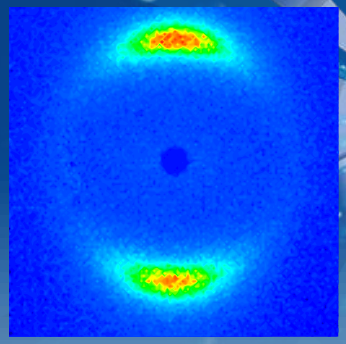
Latest equipment for rheo-studies

Paar Physica MCR 501

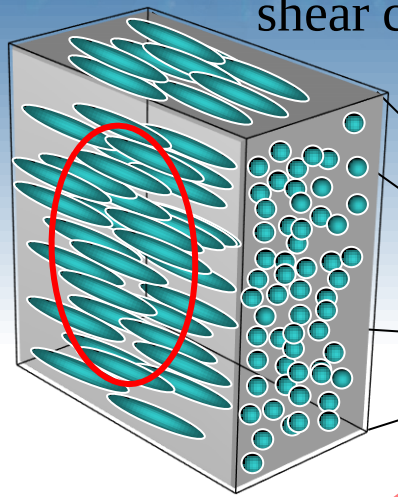


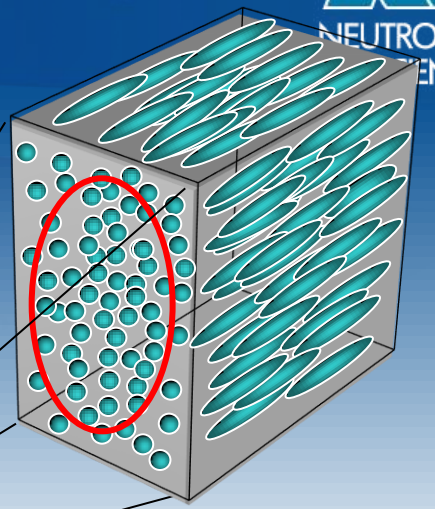




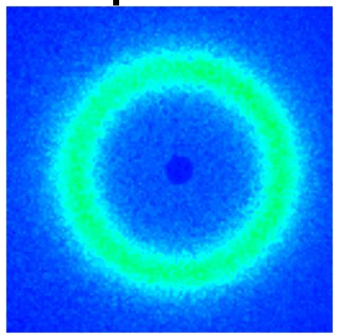


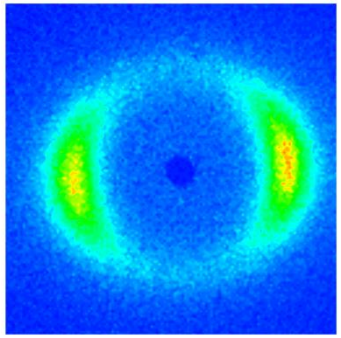
Couette
shear cell



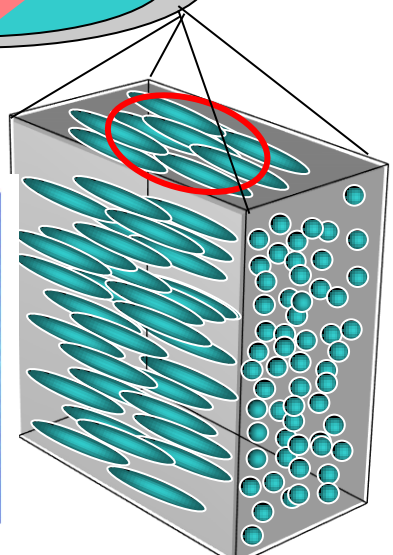


2-3 plane





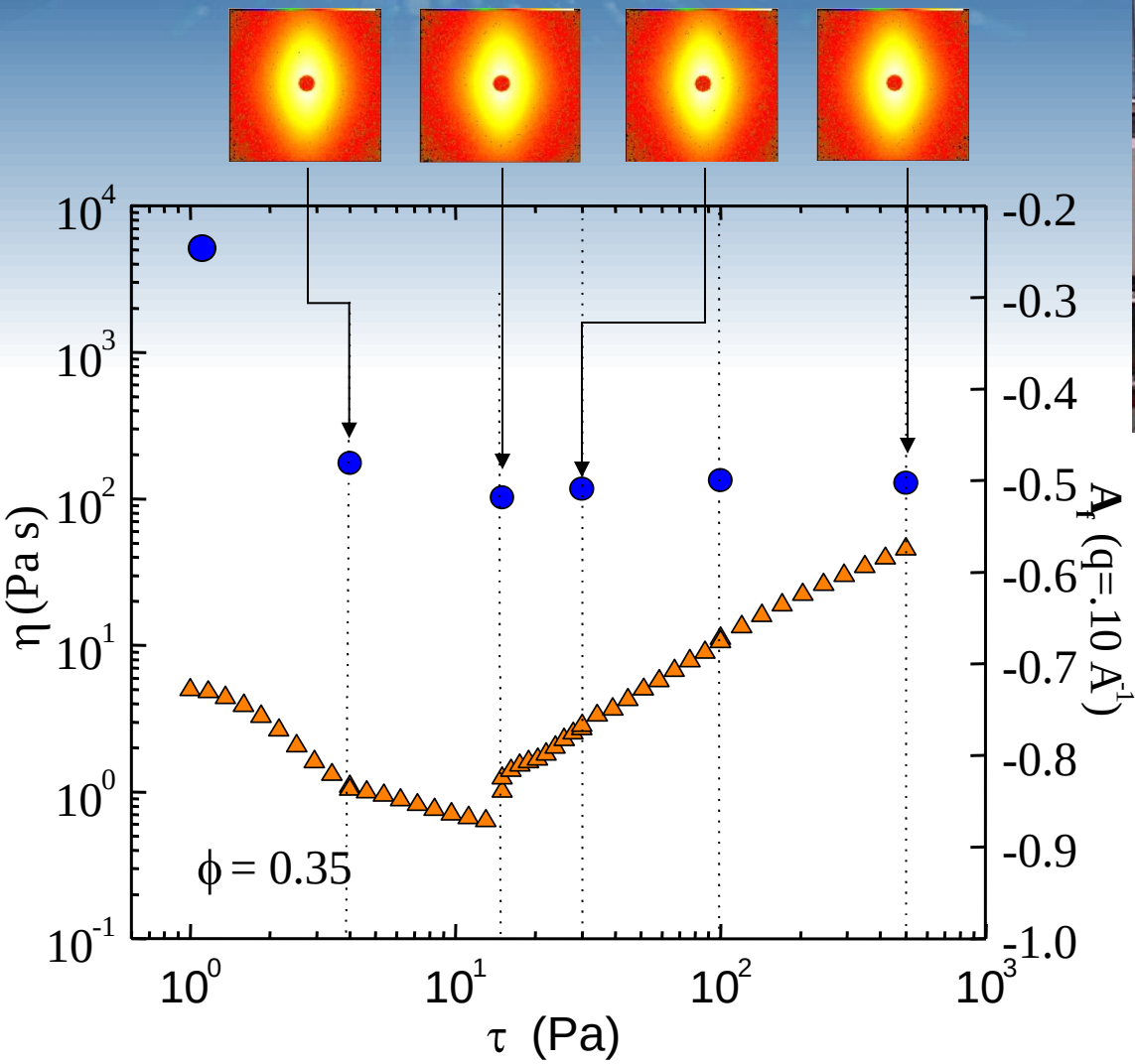
1-3 plane

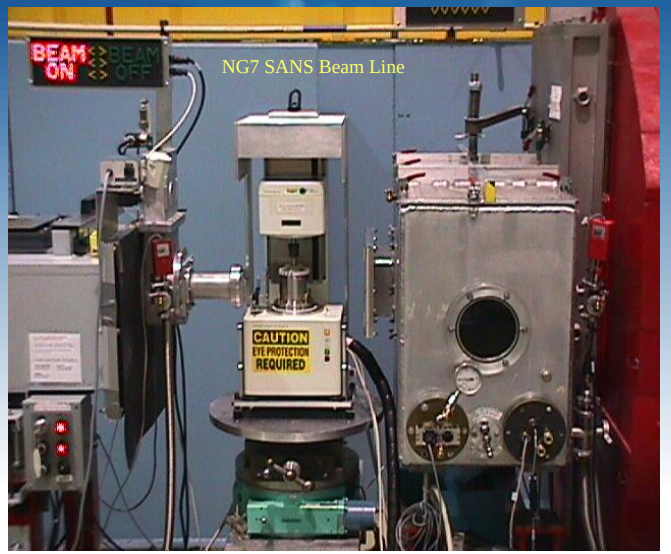


1-2 plane

Rheo-SANS development: PCC(7:1)/PEG Suspensions

N Wagner U. Delaware





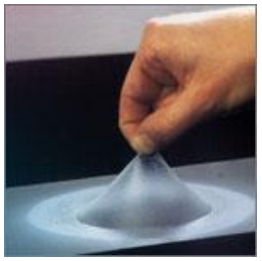
- Needles of Calcium carbonate in PEG align under shear leading to shear thinning/thickening behavior
- Rheology shows a discontinuity suggesting misalignement of rods at high stress
- **Rheo-SANS proves** that is not the case, and is probably due instead to cluster formation.

Blood Clots

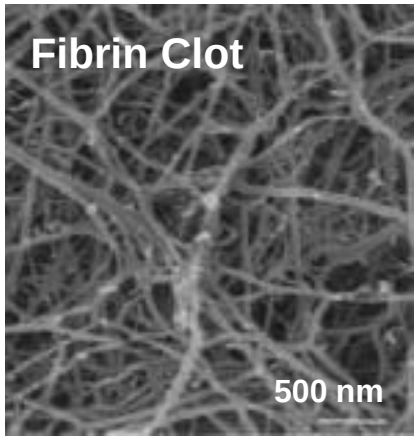
- Fibrin is the major protein component of blood clots
- First line of defense in haemostasis
- Structural disorders in fibrin are related to thrombosis, hemophilia and stroke
- Engineering Material
  (e.g. surgical seals, scaffolds)
- Unique mechanical properties
  (elasticity, strain hardening)
- Wide range of relevant length scales
  (1 nm – 20mm)

TISSEEL VH
[FIBRIN SEALANT]

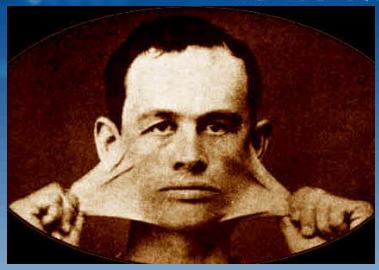
Baxter

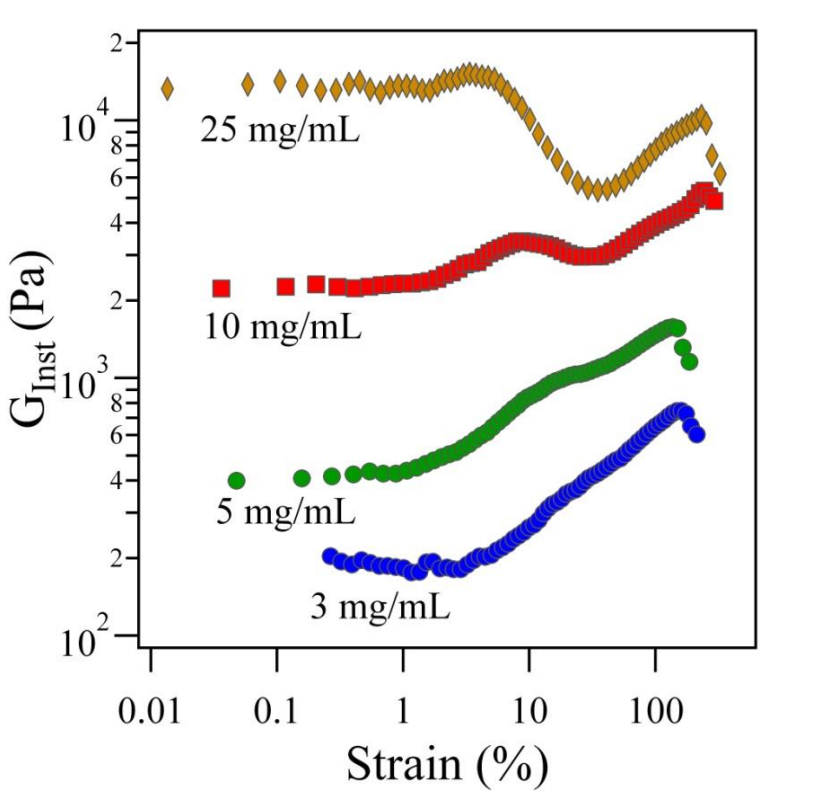


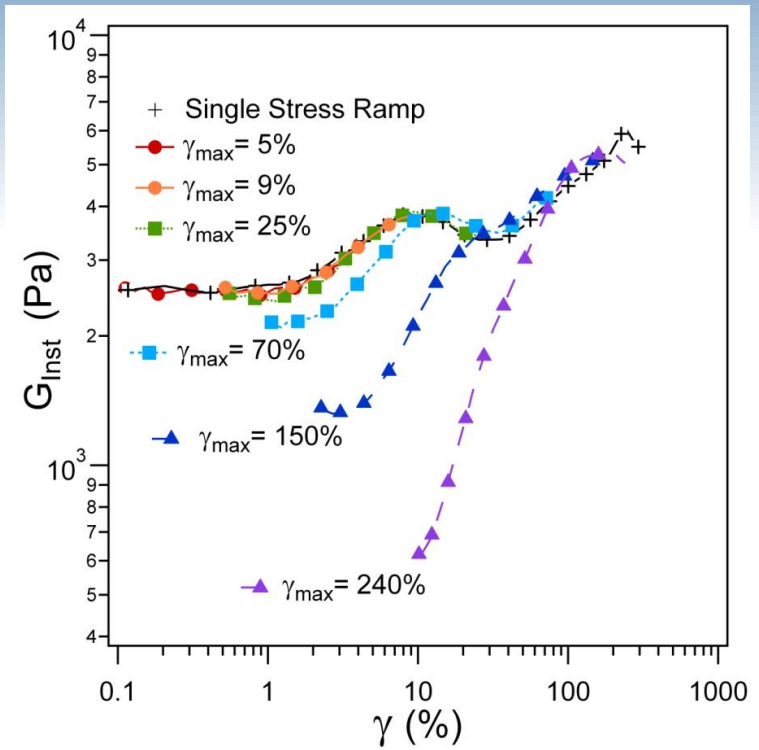
Reproduced from
Weisel et.al. 1999



Non-Linear Rheology

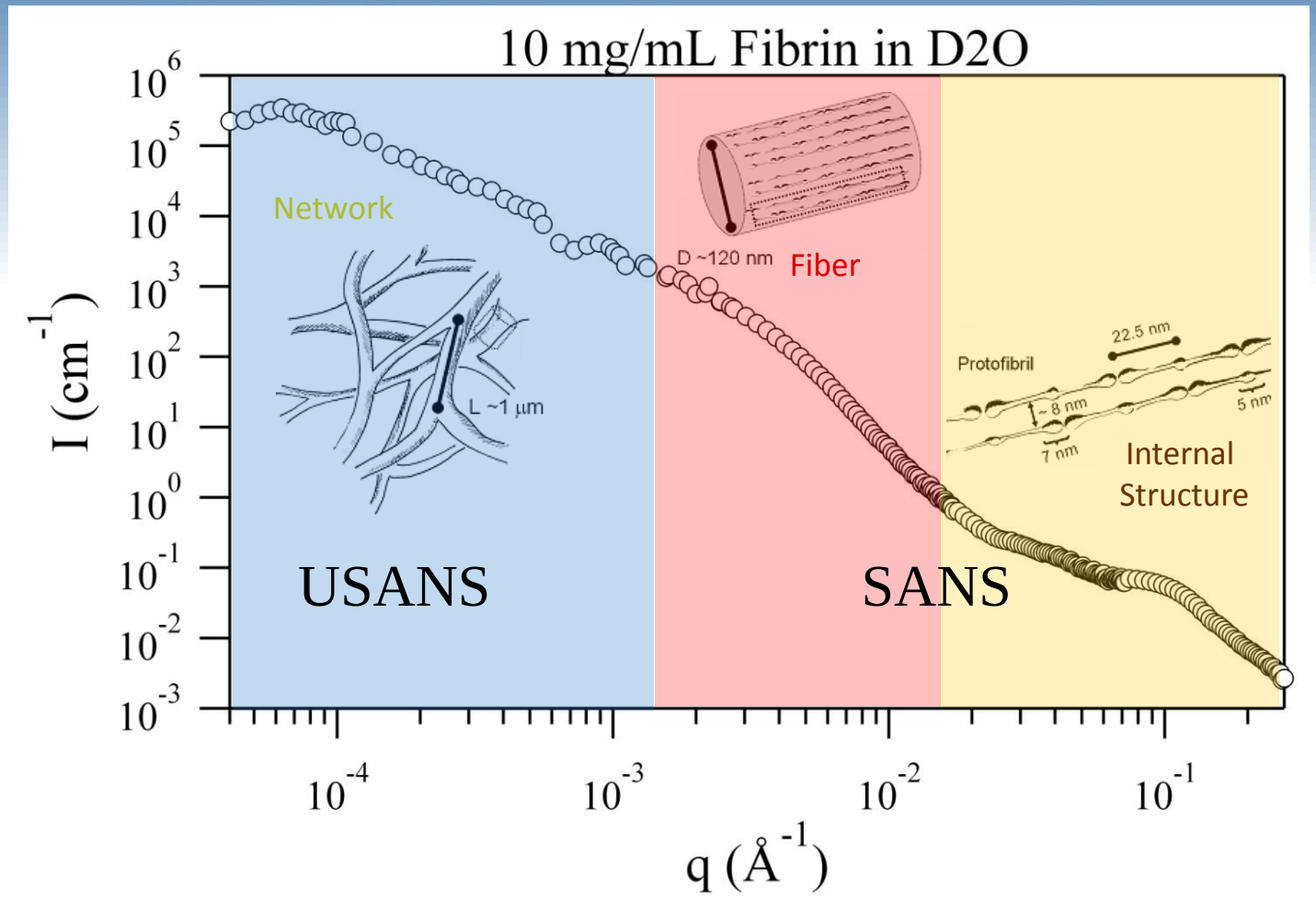






K. M. Weigandt, L. Porcar and D. C. Pozzo, *Soft Matter, 2009, 5, 4321-4330.*
K. M. Weigandt, L. Porcar and D. C. Pozzo, *Soft Matter, 2011, 7, 9992-10000.*

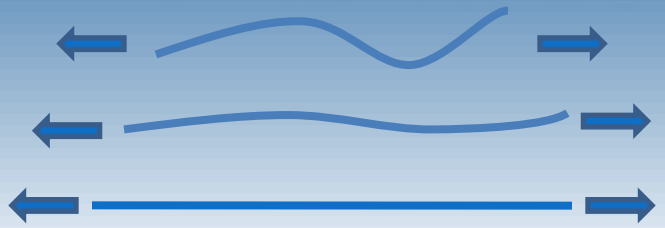
Fibrin gel structural features



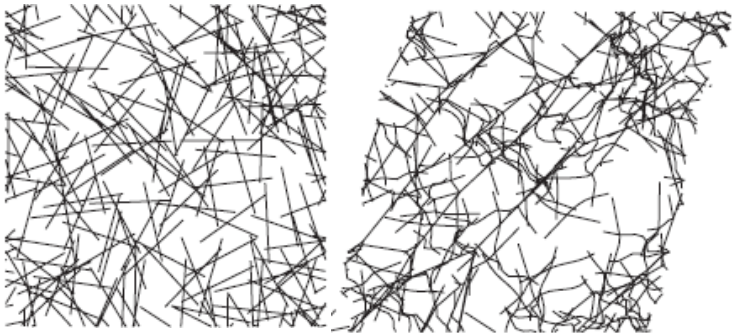
Origin of Strain Hardening

Theoretical Models

Conformational Entropy Reduction[1]

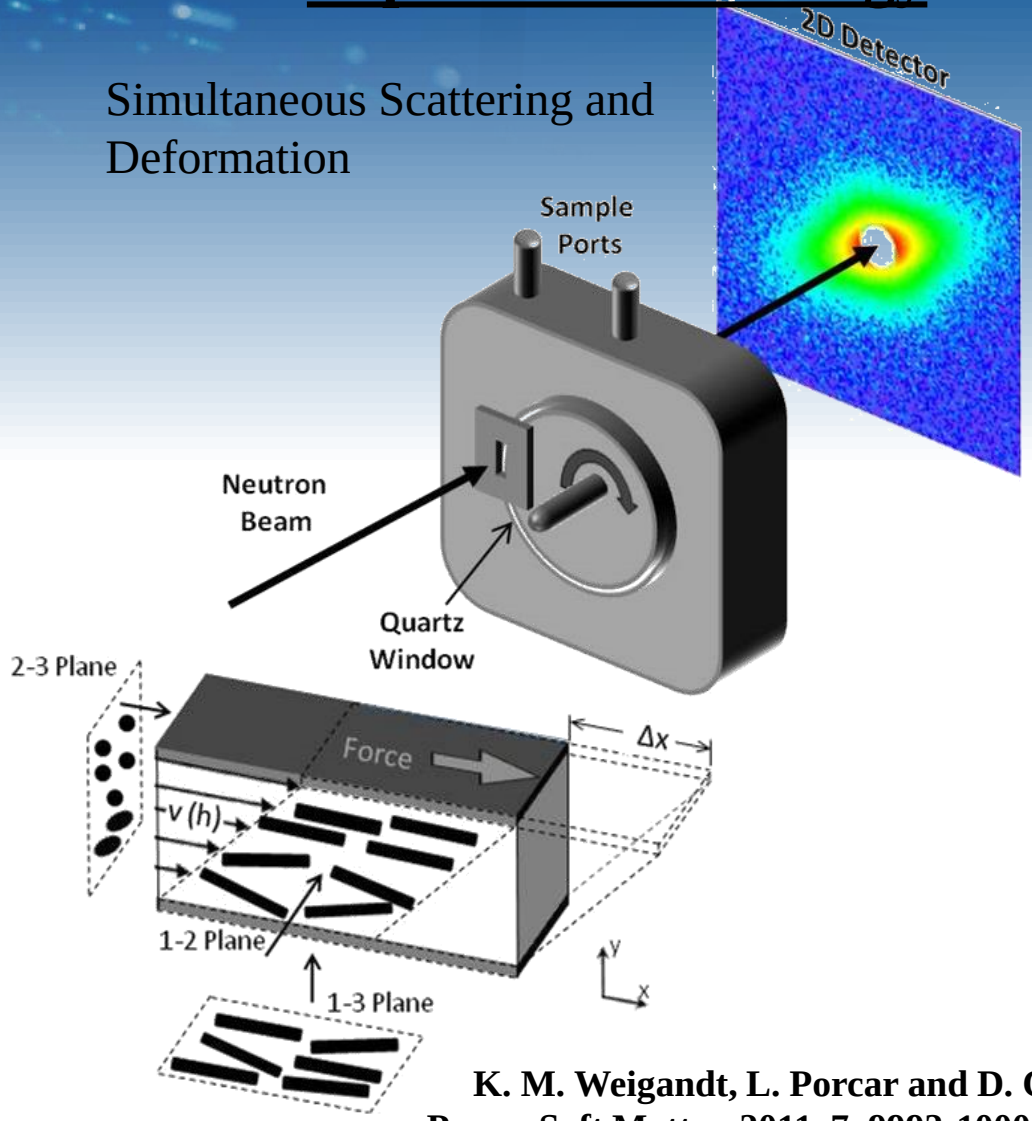


Bending and Stretching[2]



Experimental Strategy

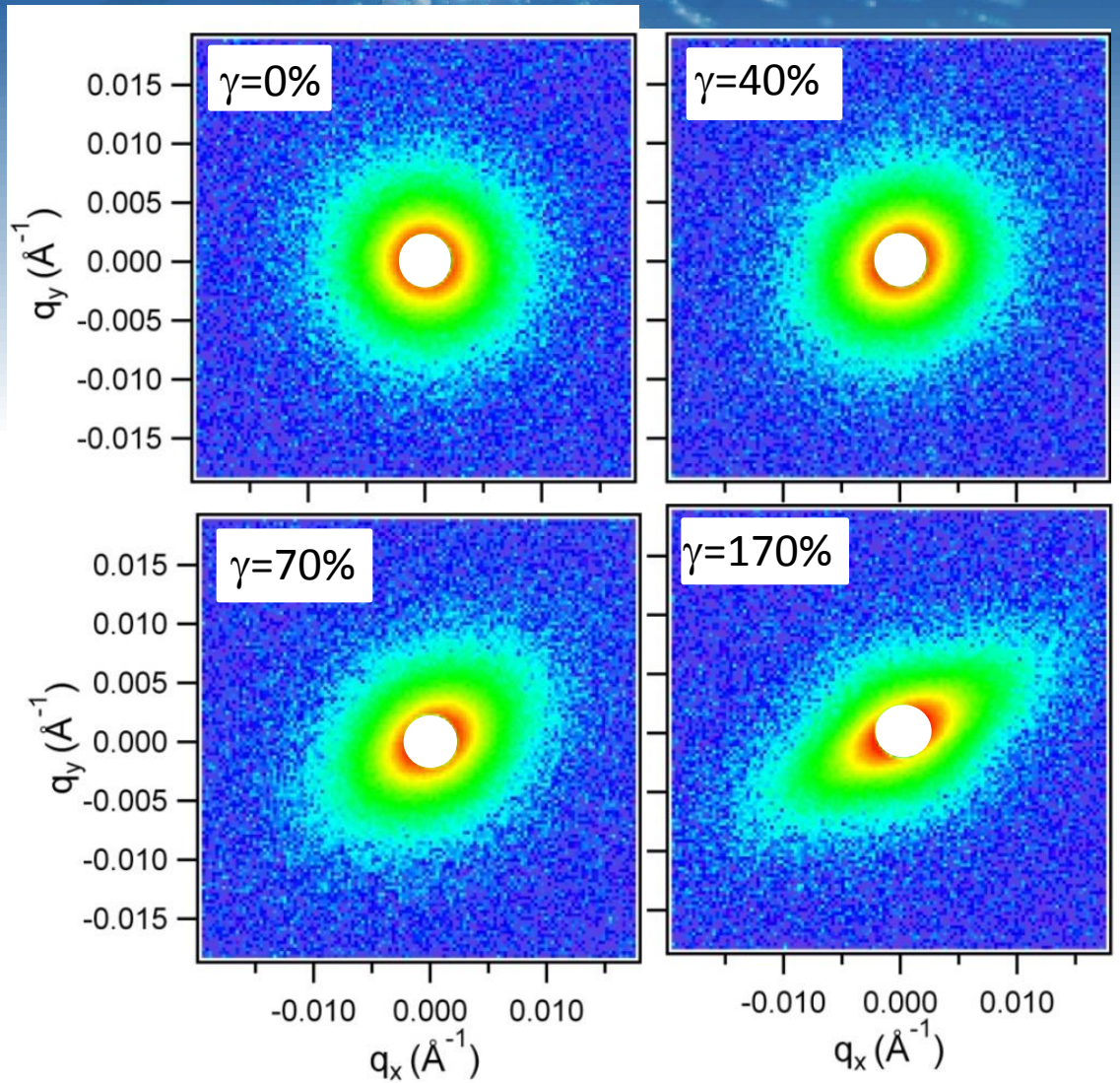
Simultaneous Scattering and Deformation



[1] C. Storm et. al., *Nature,* 435, 191-194 (2005)
[2] P. Onck et. al., *Phys. Rev. Lett.* 95, (2005)

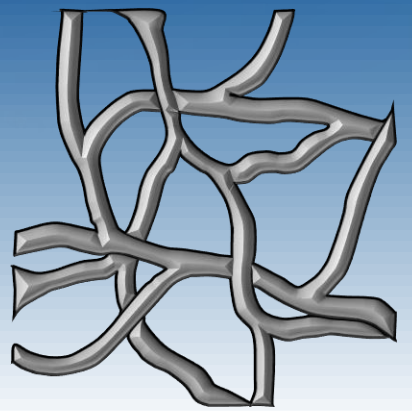
K. M. Weigandt, L. Porcar and D. C. Pozzo, Soft Matter, 2011, 7, 9992-10000.

1-2 Plane Shear SANS Results

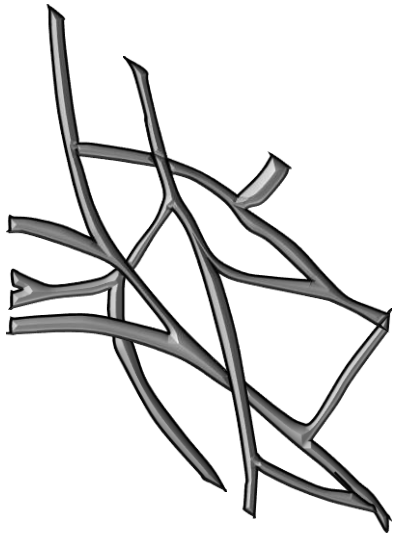


Strain Direction

Unstrained Fibrin

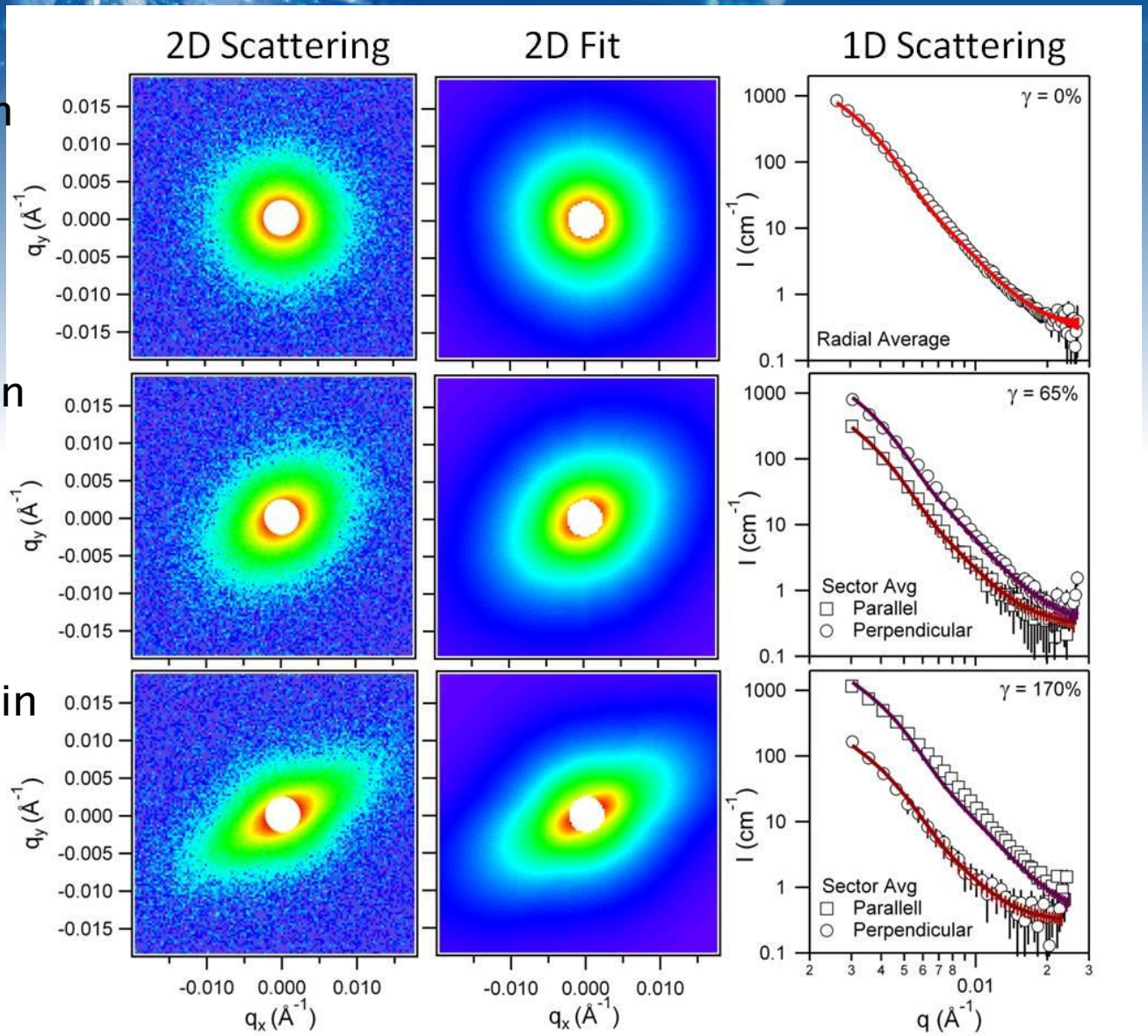


Strain-Aligned Fibrin



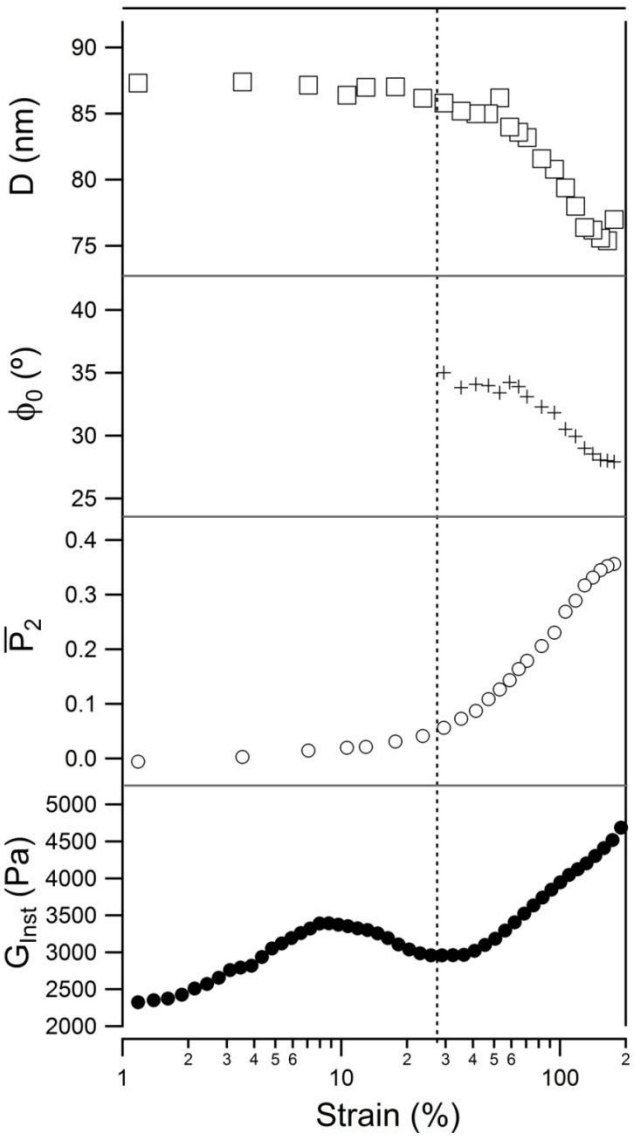
K. M. Weigandt, L. Porcar and D. C. Pozzo, *Soft Matter, 2011, 7, 9992-10000.*

2D-Form Factor Fitting



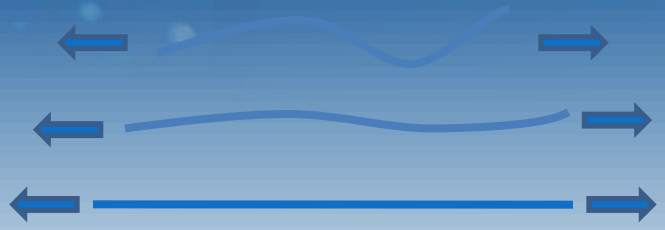
[1] SansView: http://danse.chem.utk.edu/sansview.html

Origin of Strain Hardening in Fibrin

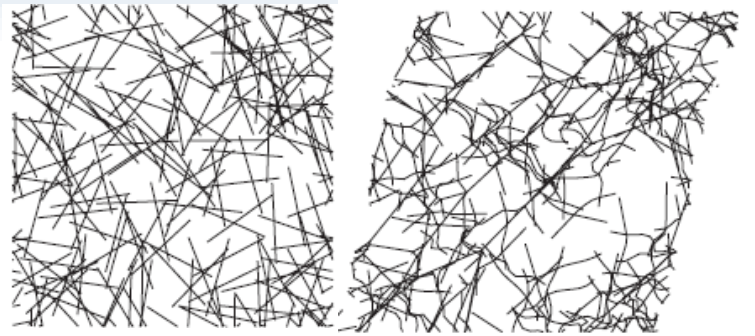


M. Weigandt, L. Porcar and D. C. Pozzo, *Soft Matter, 2011, 7, 9992-10000.*

Theory 1: Conformational Entropy Reduction[1]



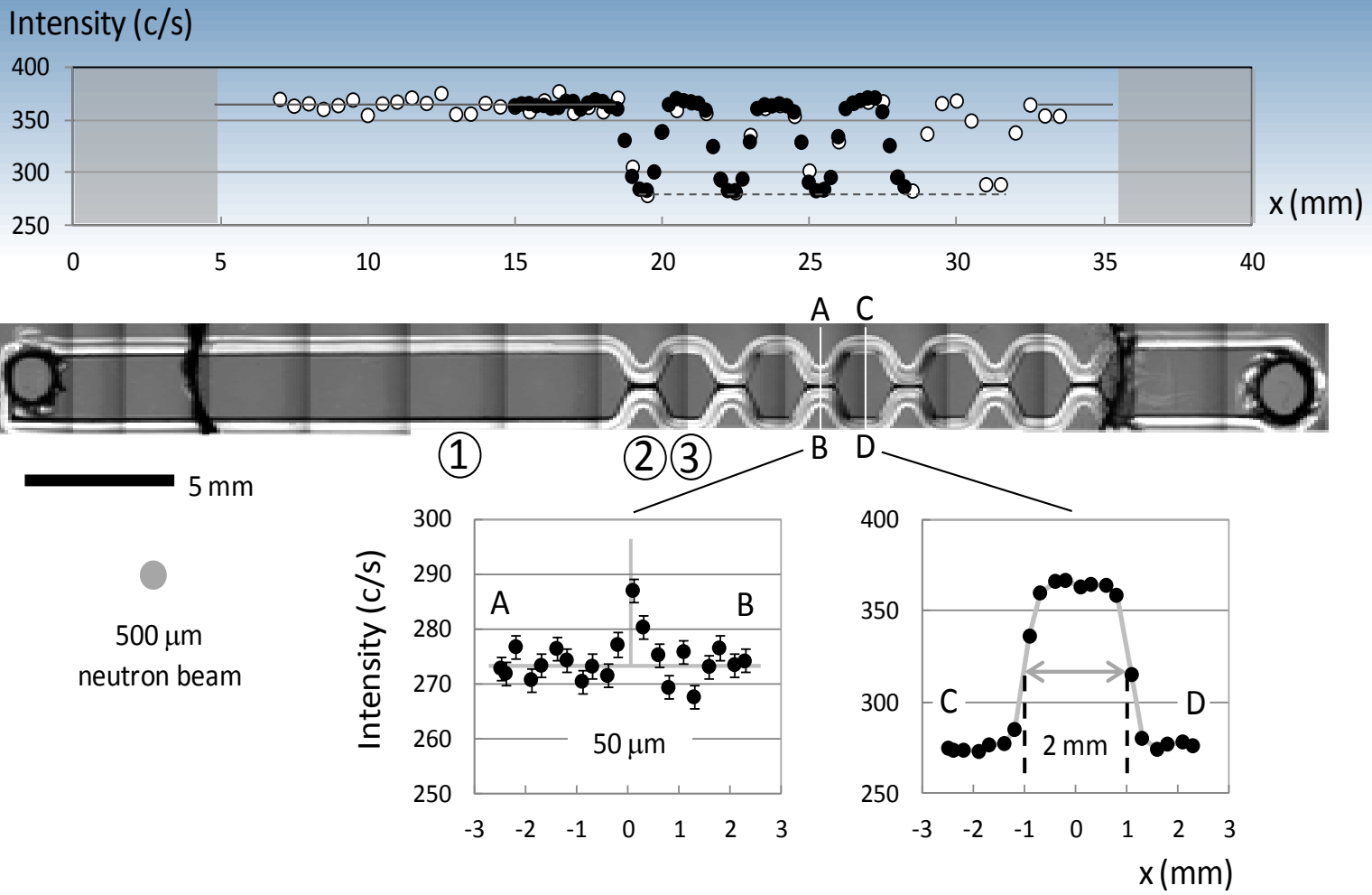
Theory 2: Bending and Stretching[2]

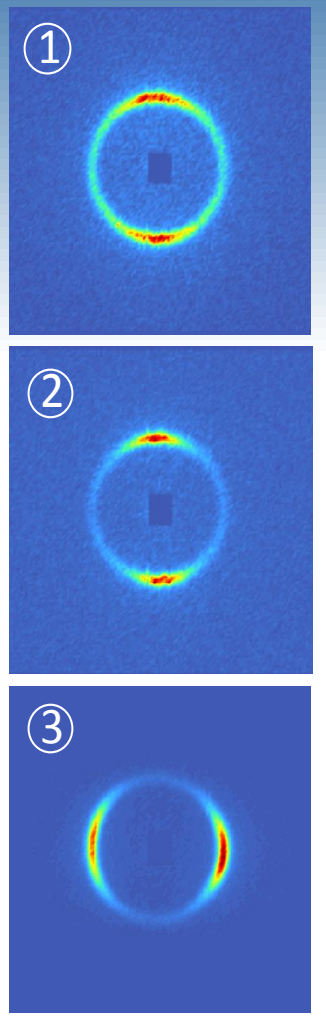


Recently Reported: Protein Unfolding

[1] C. Storm et. al., *Nature,* 435, 191-194 (2005)
[2] P. Onck et. al., *Phys. Rev. Lett.* 95, (2005);
[3] A. Brown et. al., *Science*, 325, (2009)

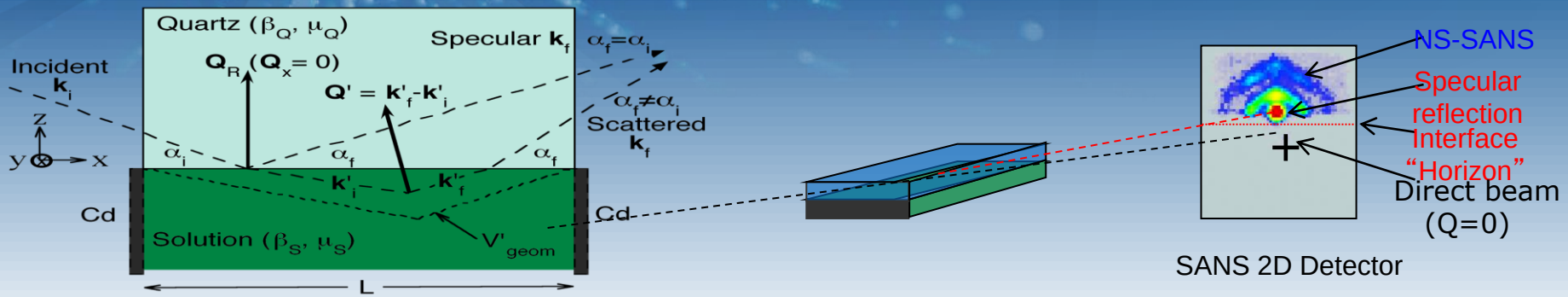
New directions: toward microfluidic…



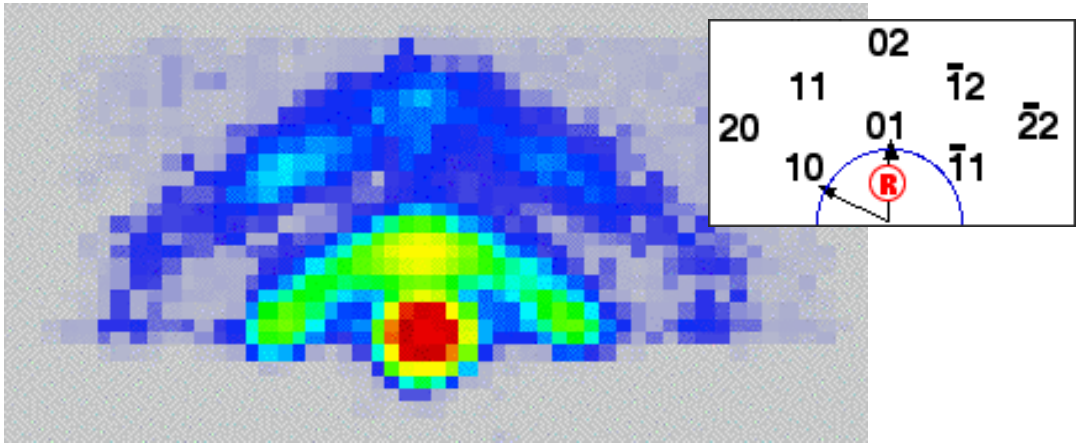


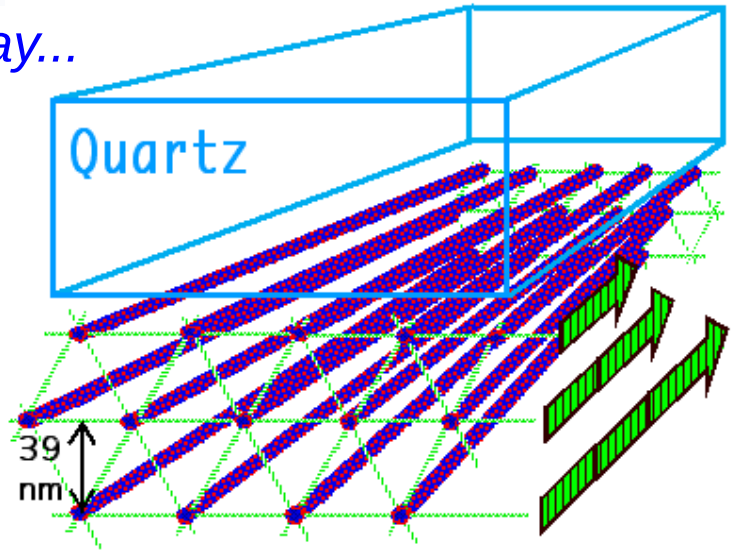
CTAC/pentanol/water

Reflectivity, SANS & Crystallography



In Poiseuille shear past a surface the micelles don't just line up, they form a strongly oriented crystalline hexagonal array...





Grazing incidence "Near Surface" SANS data (<~100micron) from surface

W.A. Hamilton, P.D. Butler, S.M. Baker, G.S. Smith, J.B. Hayter, L.J. Magid and R. Pynn, *Physical Review Letters* 72, 2219 (1994)
W.A. Hamilton, P. D. Butler, John B. Hayter, L. J. Magid and P. J. Kreke, *Physica B* 221, 309 (1996)

Conclusions:

- SANS can provide unique structural information / deuteration
- Ideal for multicomponent systems
- Studies of transient states
- From surface to bulk (GISANS and SANS)
- Microfluidic and many more sample environments…

Quality neutrons priceless !!!