

In-situ light scattering at neutron beam lines - experiences made and challenges ahead

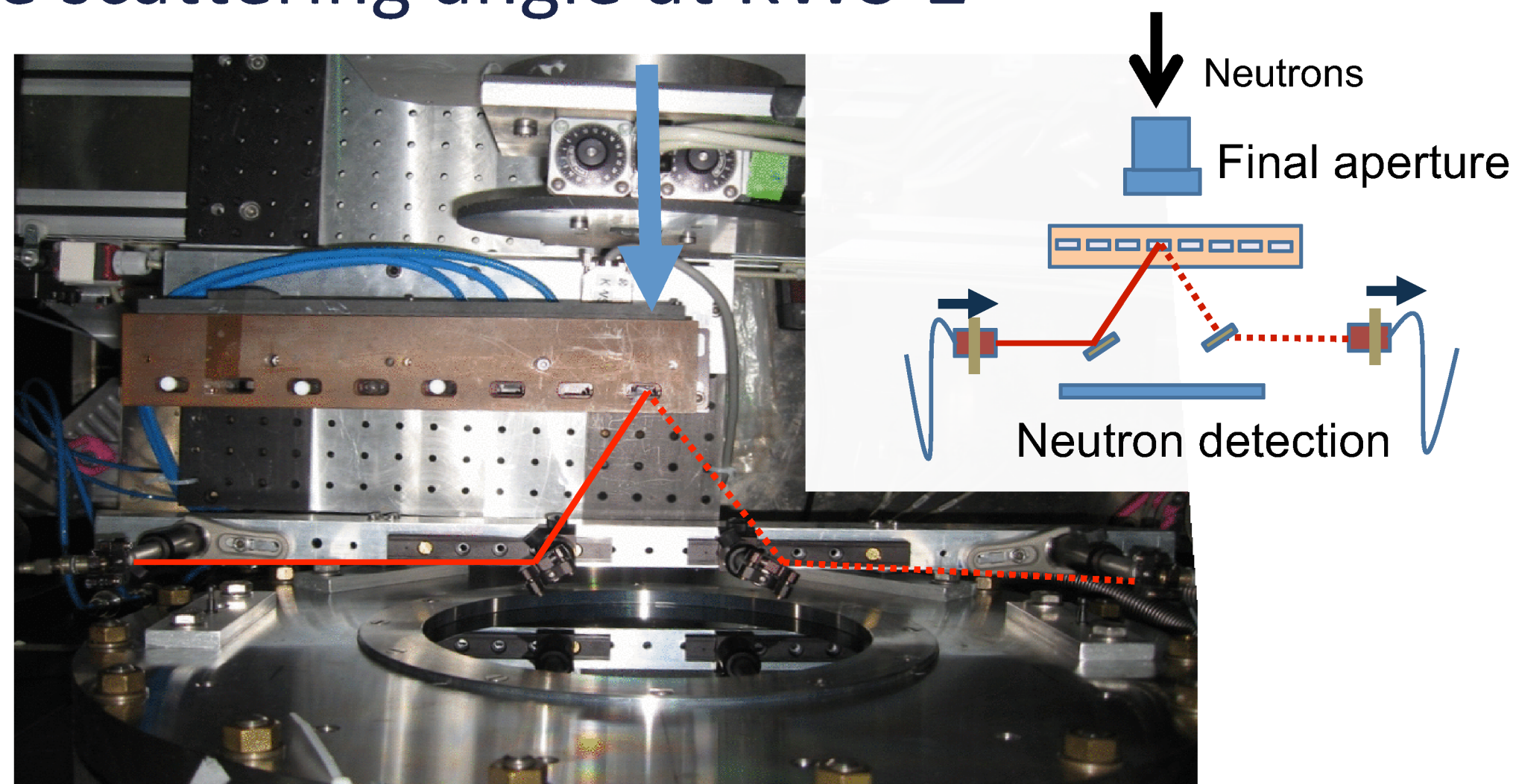
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¹ RWTH Aachen, Germany;

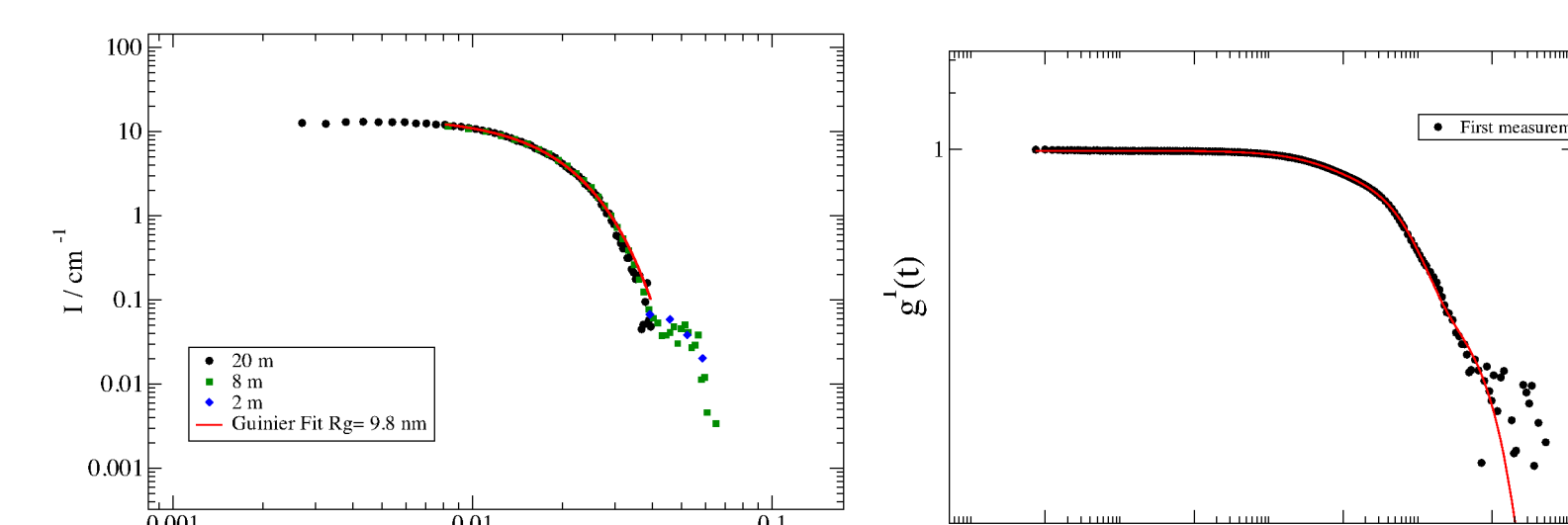
² Jülich Centre for Neutron Science, Garching, Germany.

In-situ light scattering at Small-Angle Scattering Instruments

One scattering angle at KWS-2



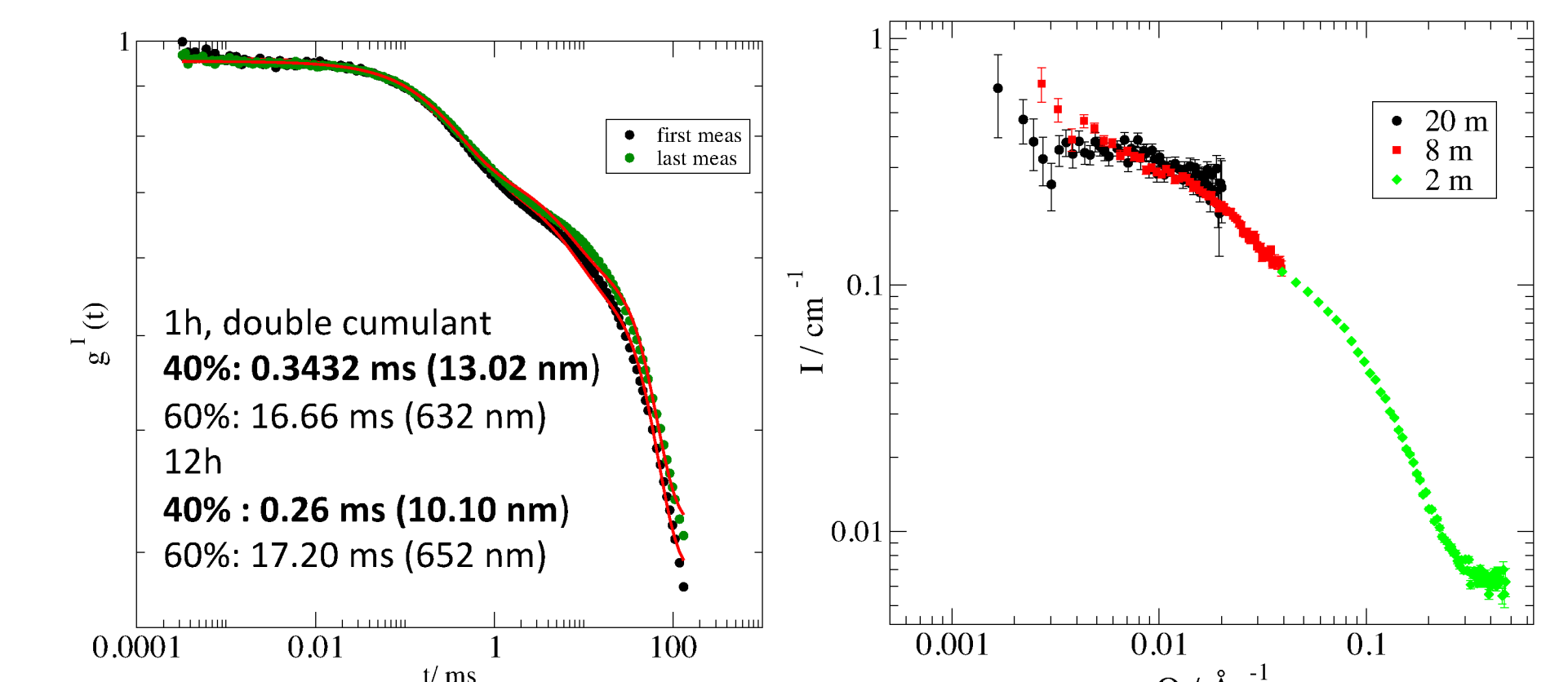
Calibration sample: 20 nm SiO₂ in H₂O



Particle size is confirmed in a Guinier fit of the SANS data.

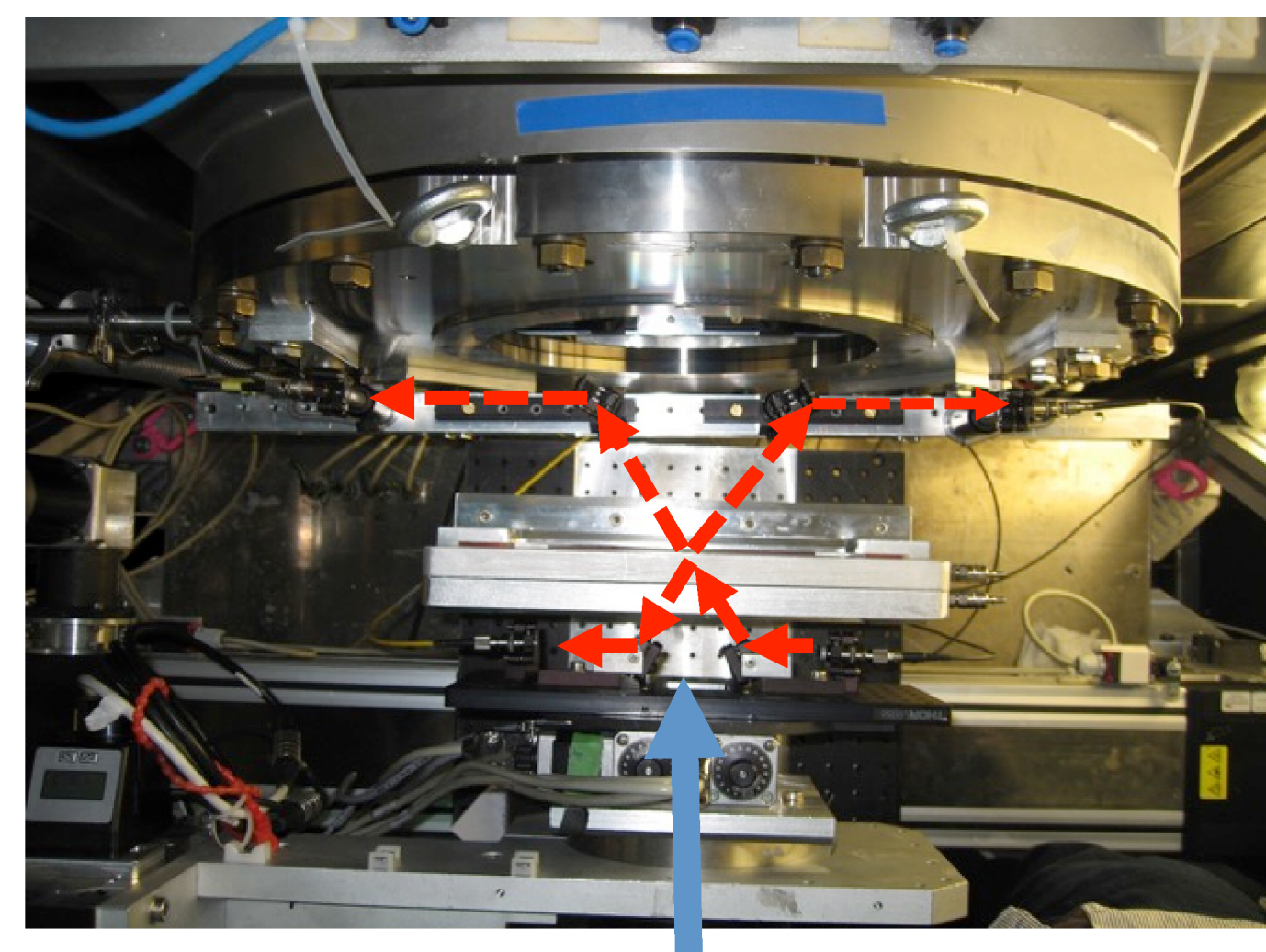
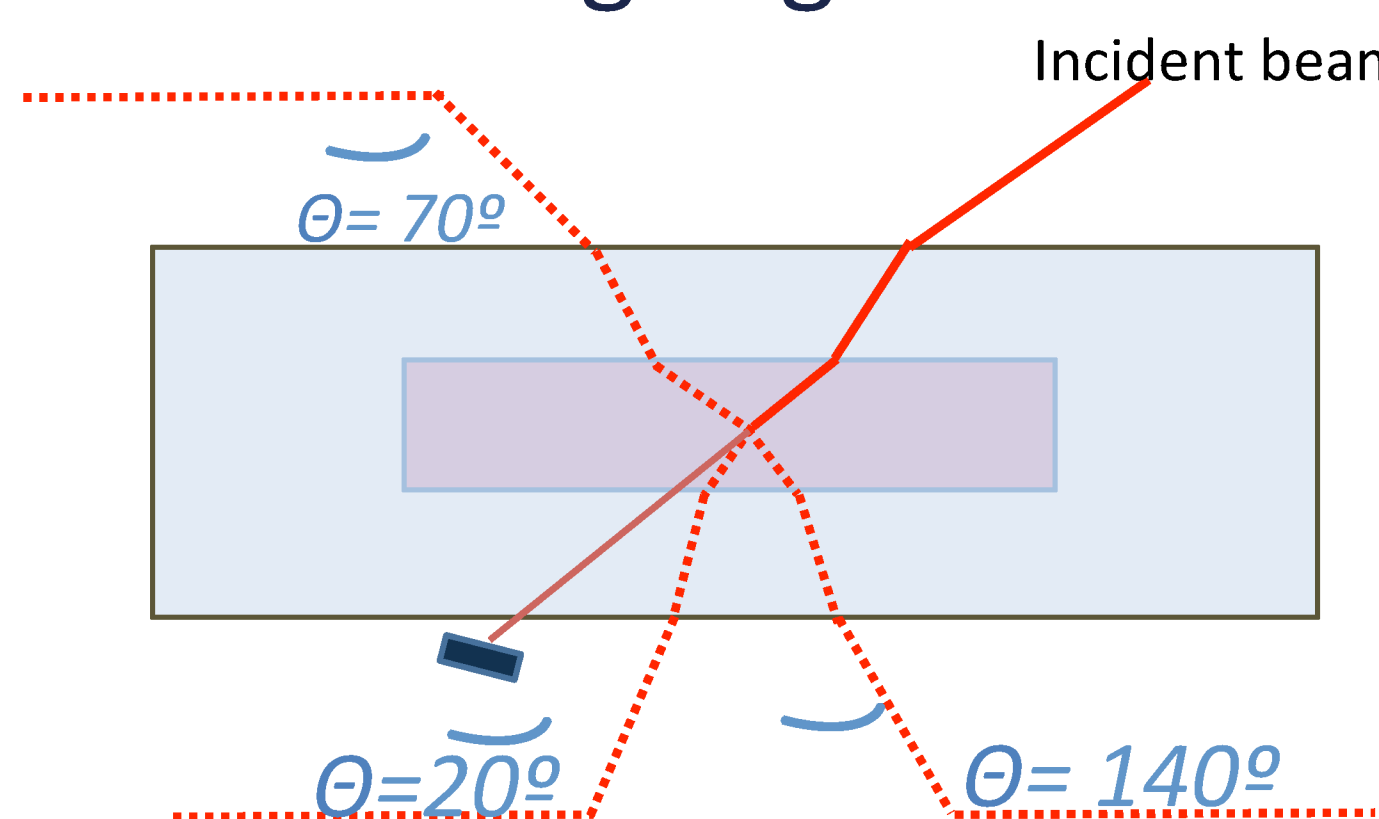
The light-scattering angle is determined from the auto-correlation function: $\theta=60^\circ$

A biological sample in time: Apo-myoglobin (MG)

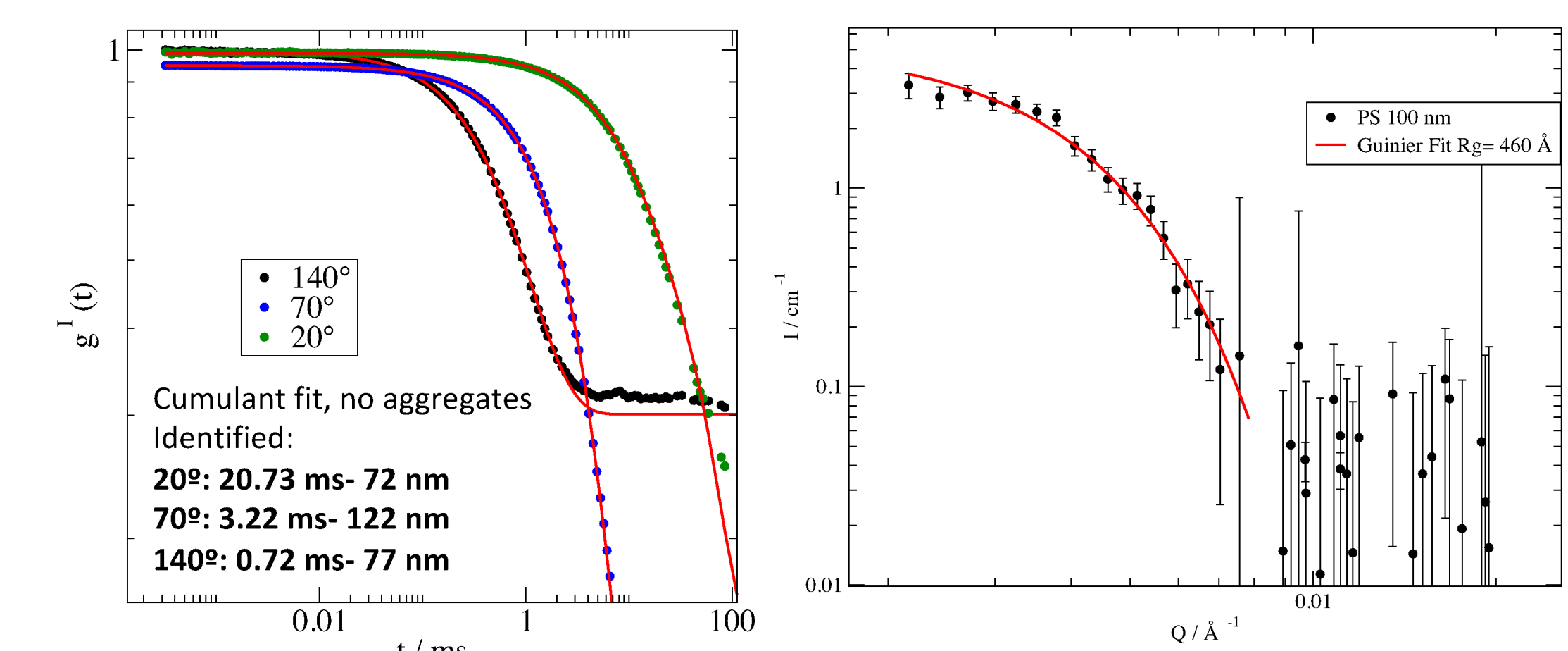


The SANS curve is a time-average and offers only a hint about the presence of the aggregates, while DLS even allows their size determination.

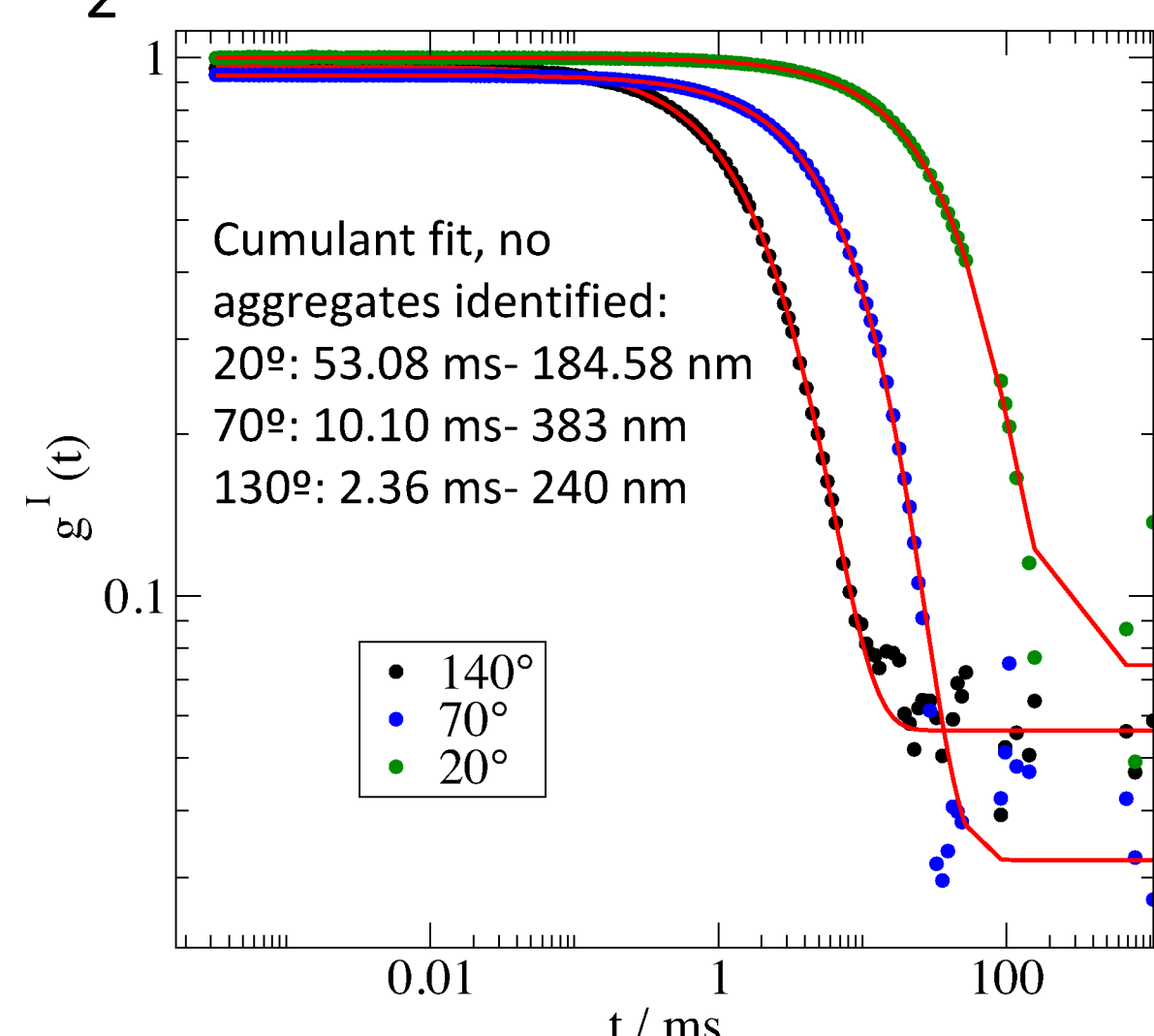
Three scattering angles at KWS-2



Calibration sample: 100 nm Polystyrene particles in D₂O

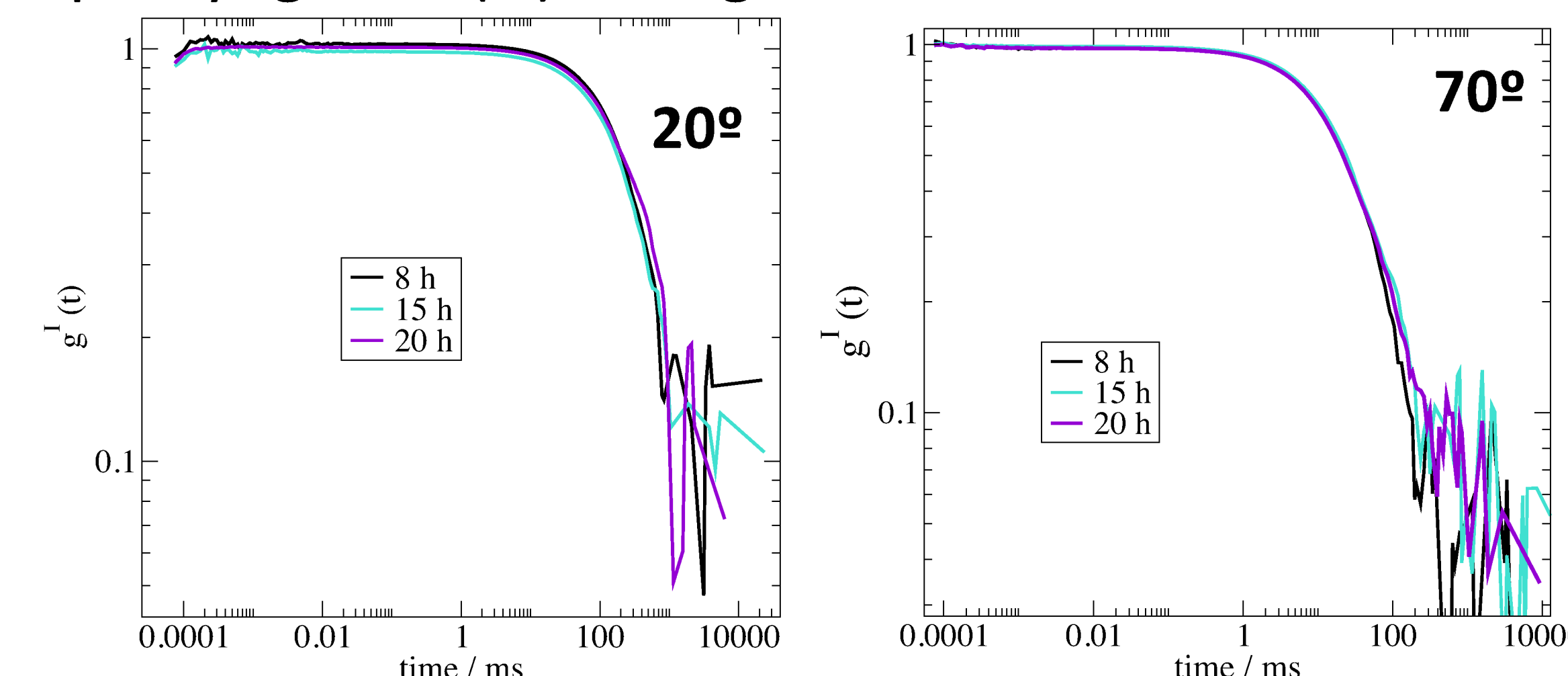


300 nm Polystyrene particles in D₂O



DLS accesses a size-range that is not accessible for standard SANS instruments.

Apomyoglobin (N) 38 mg/mL: Time evolution at different scattering angles



8h (triple exponential)
82%: 32.81 ms (114 nm)
18%: 359 ms (too large)
Last term: background

20h
78%: 31.37 ms (110 nm)
22%: 352 ms (too large)

8h (double cumulant):
82%: 0.089 ms (3.4 nm)
18%: 16.75 ms (635 nm)

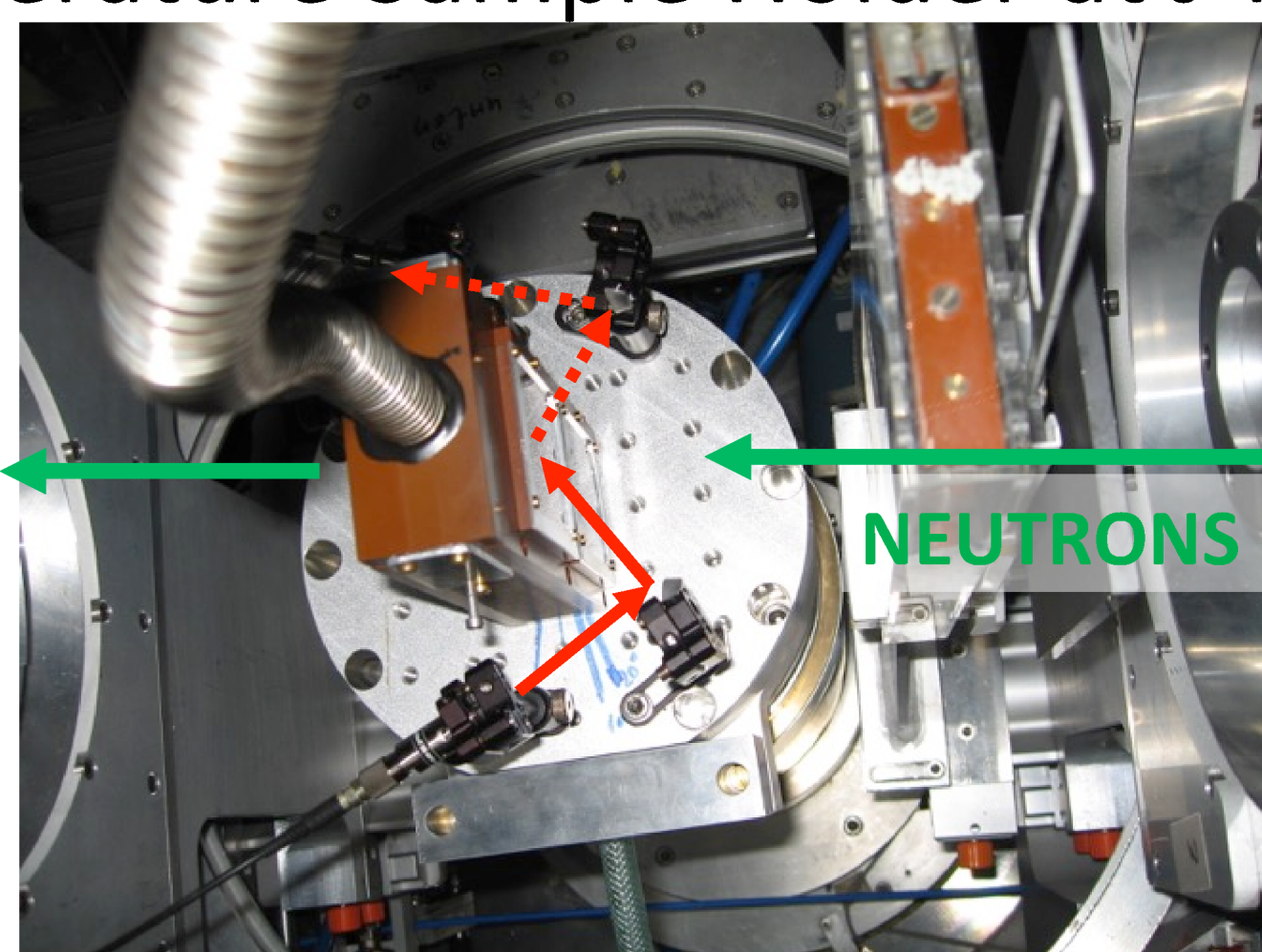
20h
78%: 0.76 ms (9.4 nm)
22%: 12.7 ms (619 nm)

Remarks:

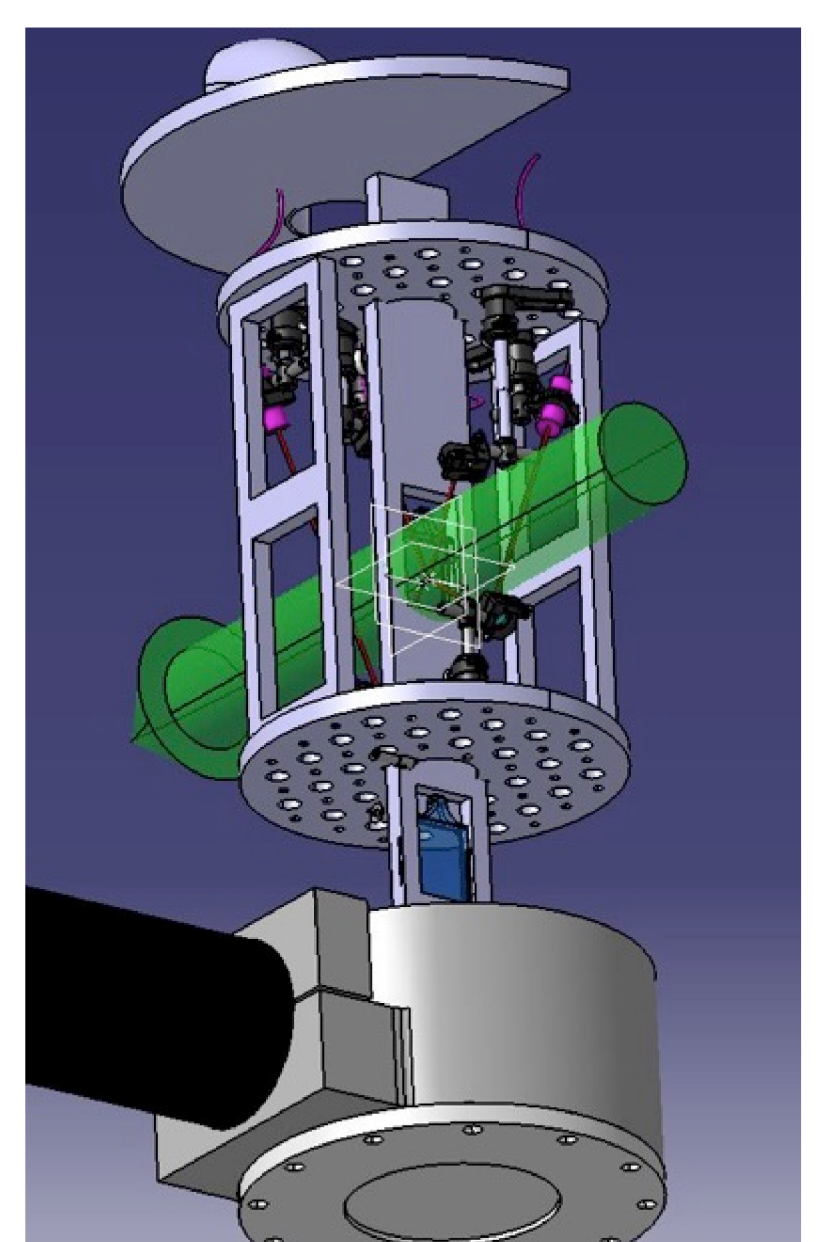
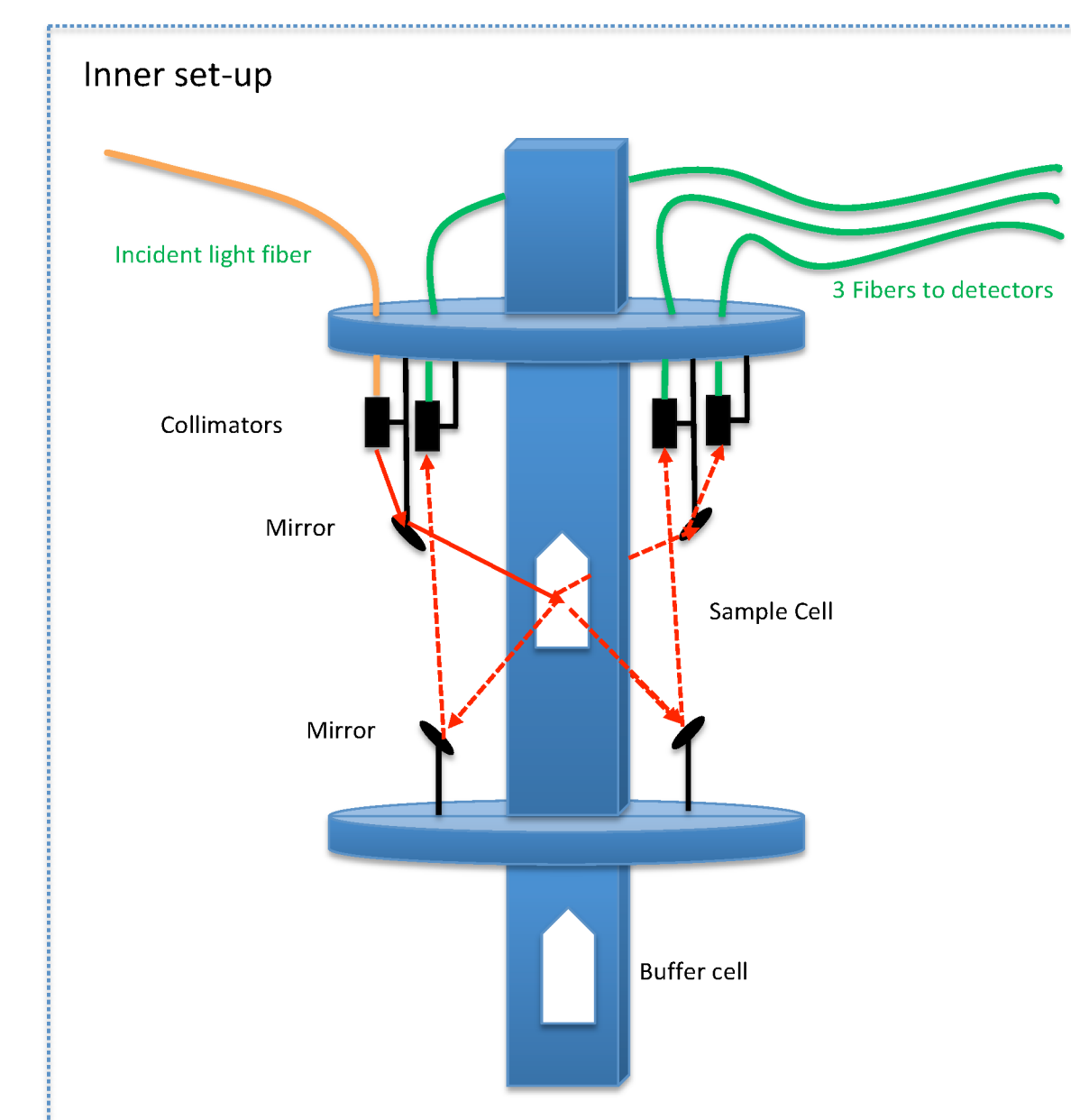
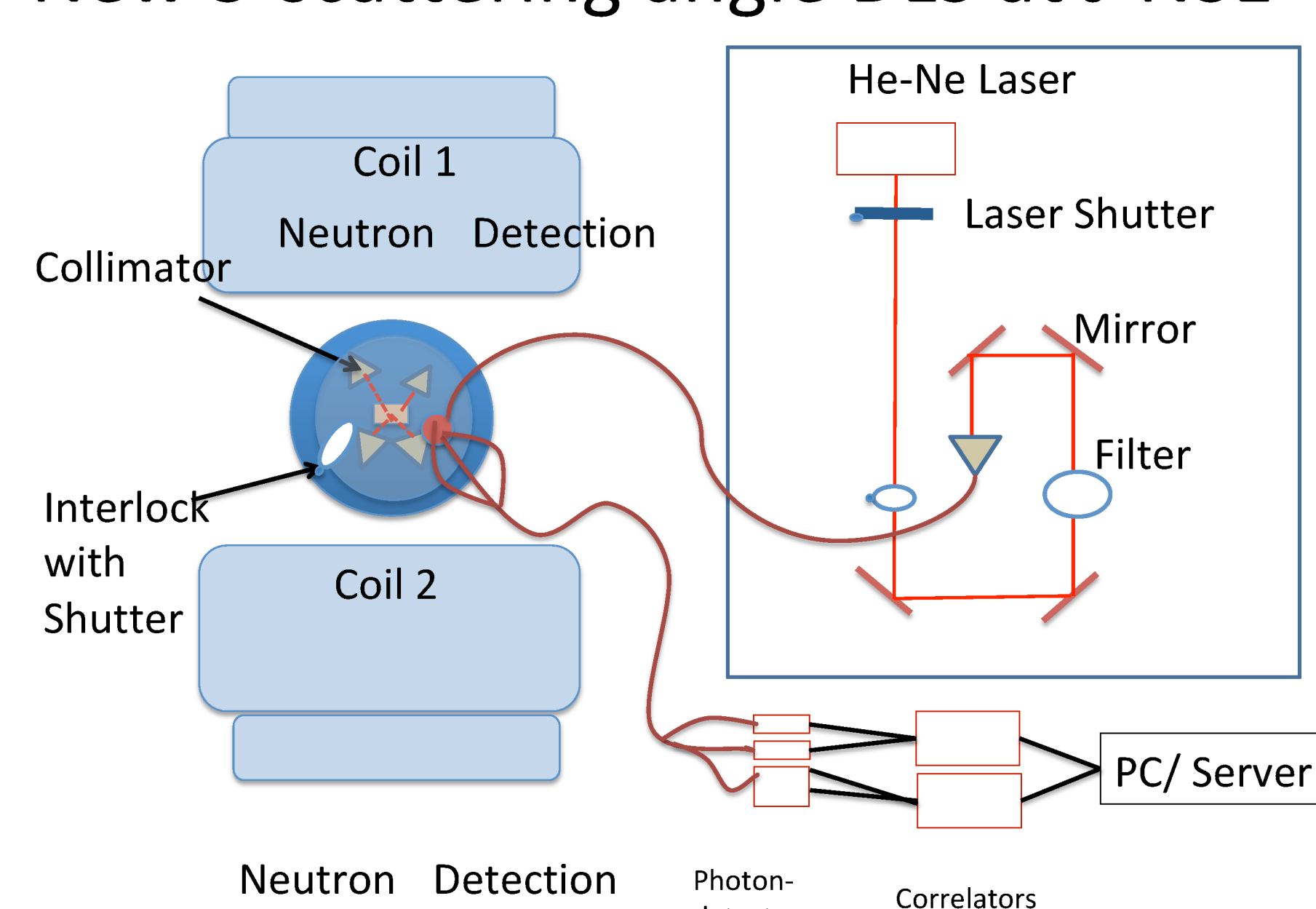
- Cross-validation within the results delivered by the three scattering angles is possible
- Three-angle set-up is difficult to align
- Probably not suitable for routine user service.

In-situ light scattering at Spin Echo Instrument J-NSE

High-Temperature Sample Holder at J-NSE



New 3-scattering angle DLS at J-NSE



Summary: Lessons learned

- Each instrument requires its own set-up.
- Strong link to instrument control software required (sample and file name of neutron data is used for DLS data).
- Online data treatment of light scattering data can enable a quick response to sample degradation.