

Effect of Temperature on the Micelle Structure of SDS in D₂O

2014 NCNR Summer School Presentation

Instrument: NGB 30m

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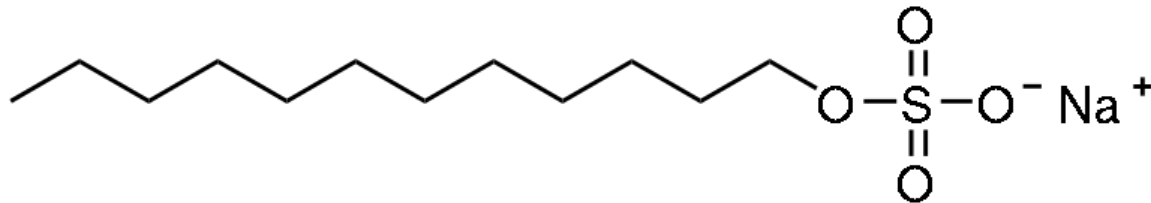
Isaac Weitzhandler

July 18, 2014



Sodium dodecyl sulfate (SDS)

- SDS: $\text{NaC}_{12}\text{H}_{25}\text{SO}_4$
- Surfactant
- Critical micelle concentration (CMC):
0.2% mass fraction
- Driving force: hydrophobic effect
- Self-assembles into micelles above CMC



Objectives

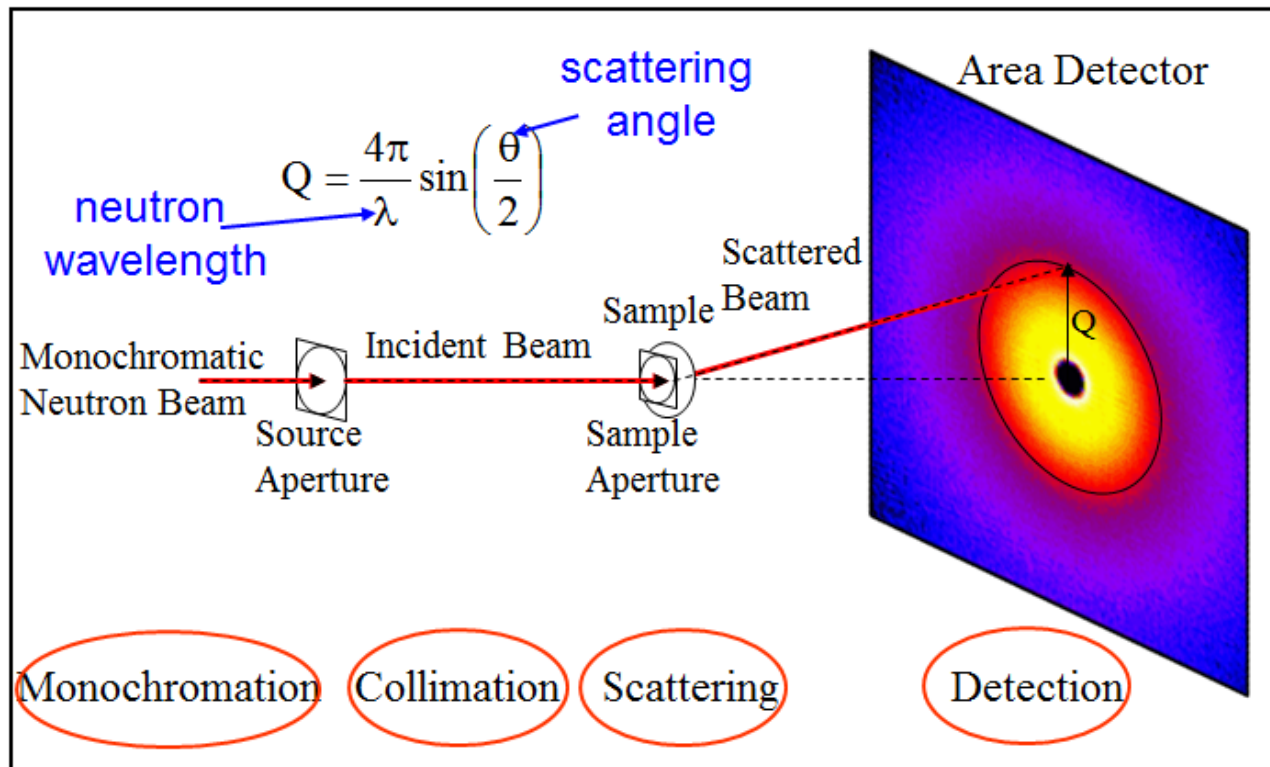
- Use SANS to determine effect of temperature on SDS micellization
 1. Micelle morphology
 2. Temperature effect on micelles size
 3. Temperature effect on micelles charge

Experimental Setup

5% SDS in D₂O: 10 °C~90 °C, step 10 °C

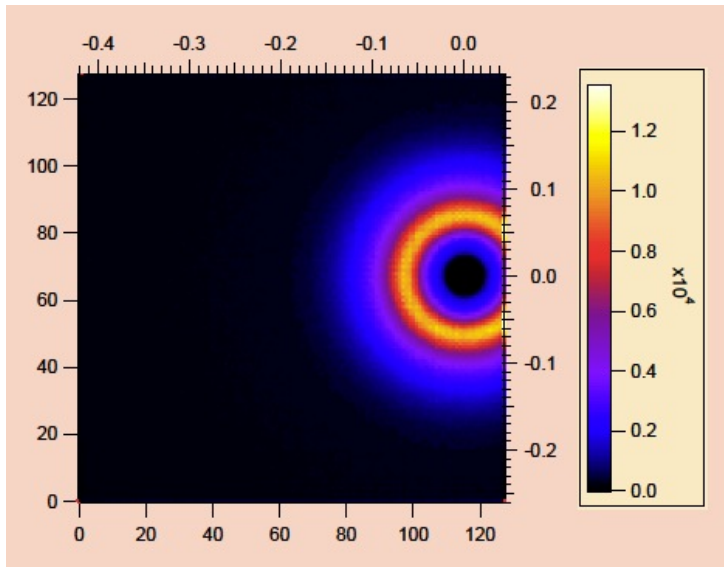
3 configurations: 1m, 4m, 13m

Q-range: 0.004 - 0.4 Å⁻¹

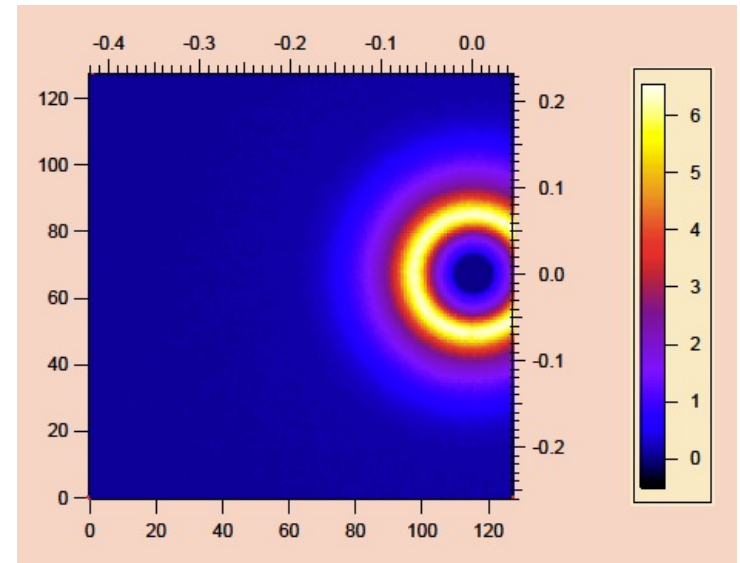
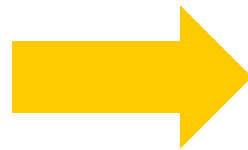


Data Reduction

$$\frac{\partial \Sigma}{\partial \Omega}(q) = A[I_{\text{sample}}(q) - I_{\text{background}} - \frac{T_{\text{sample}}}{T_{\text{empty}}}[I_{\text{empty}} - I_{\text{background}}]]$$

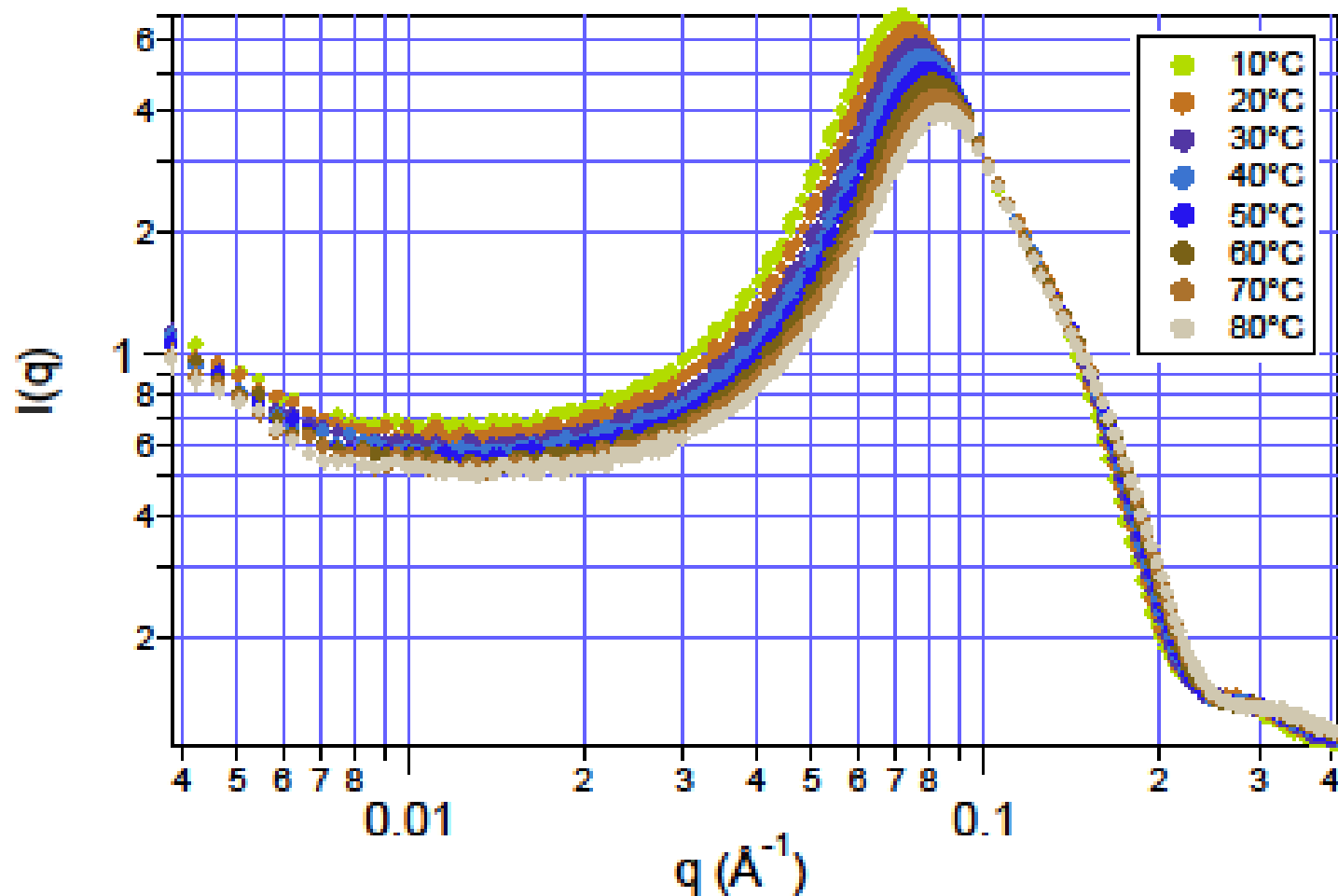


Raw data

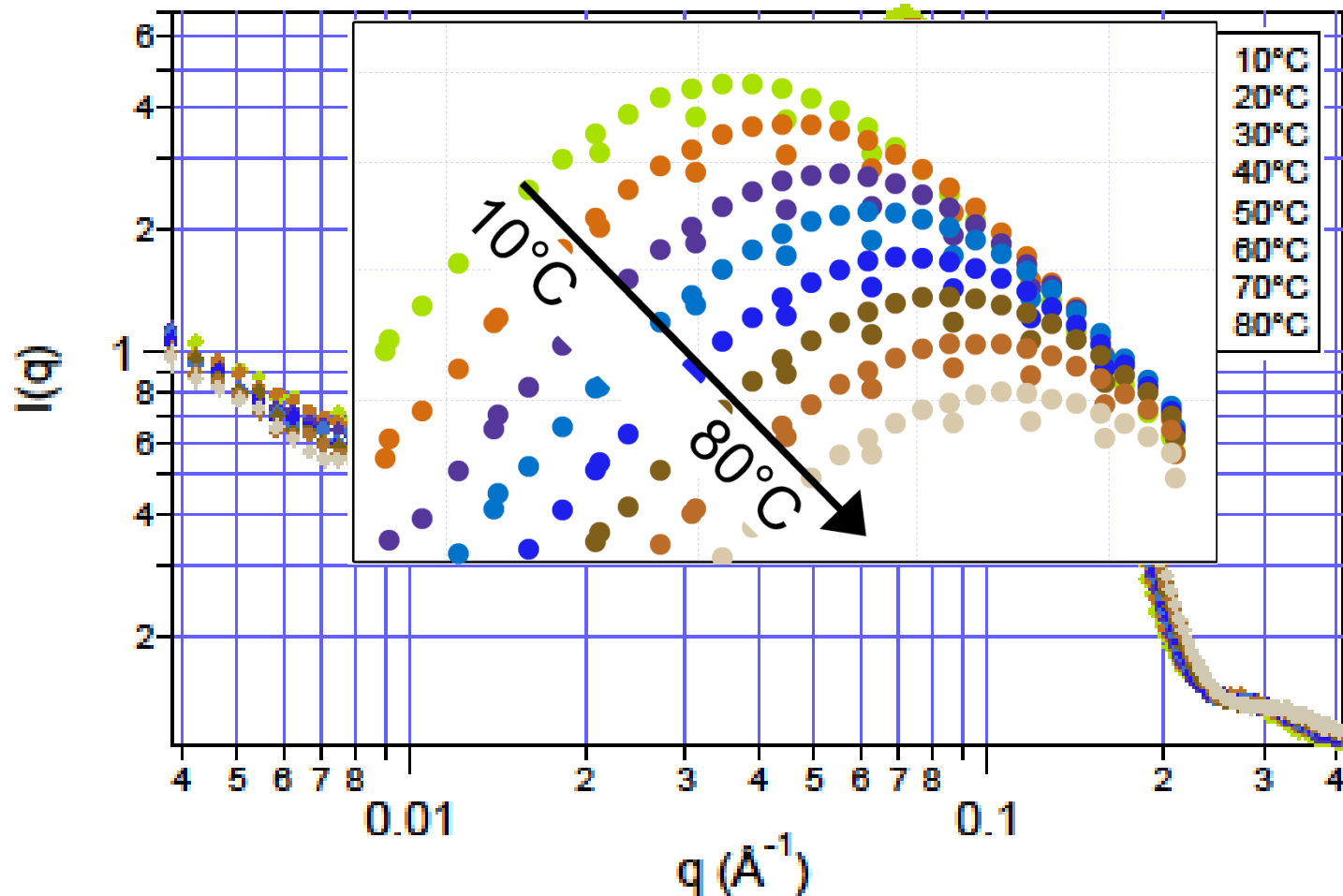


Reduced data

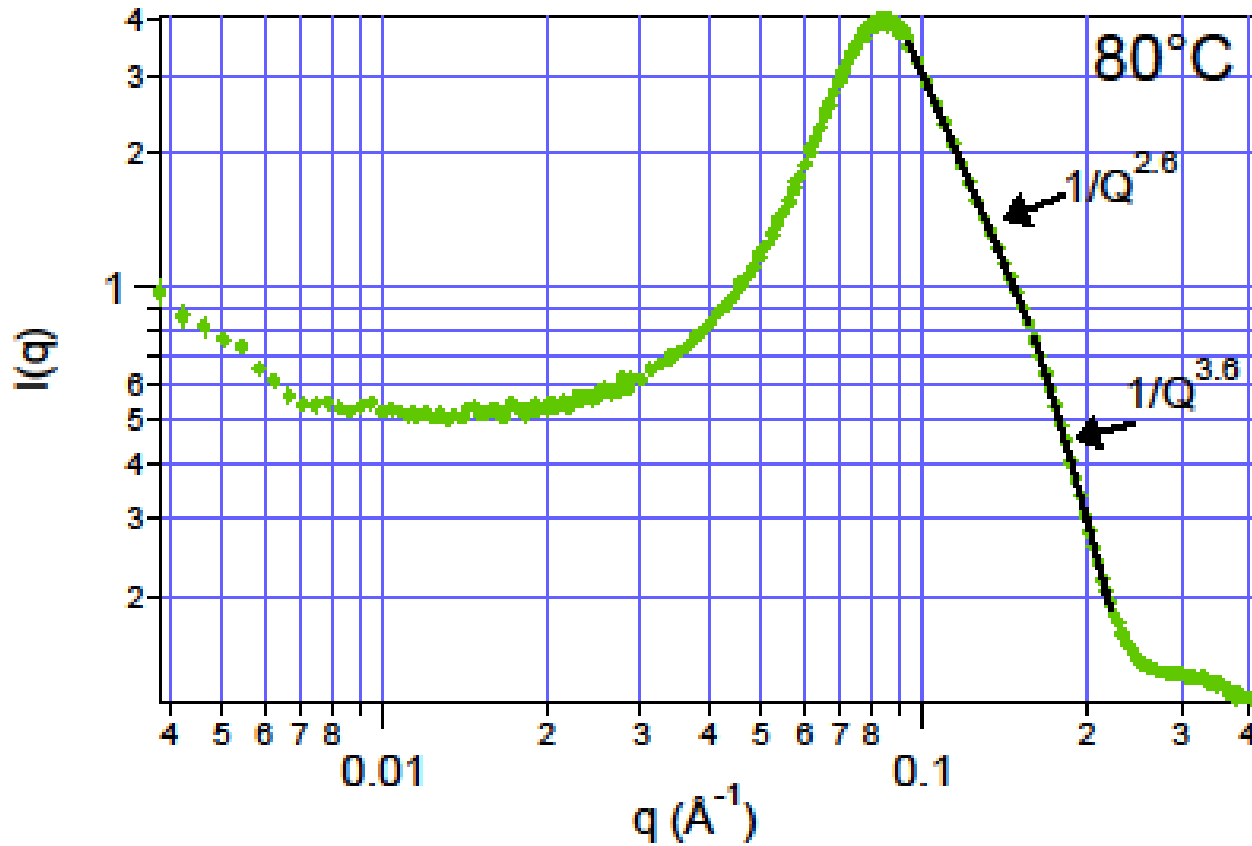
SANS from SDS Micelles



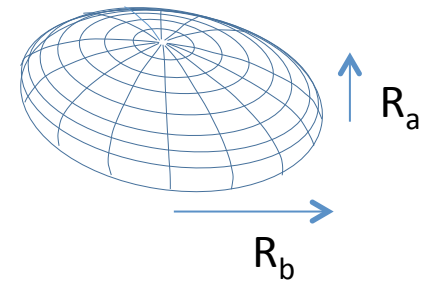
SANS from SDS Micelles



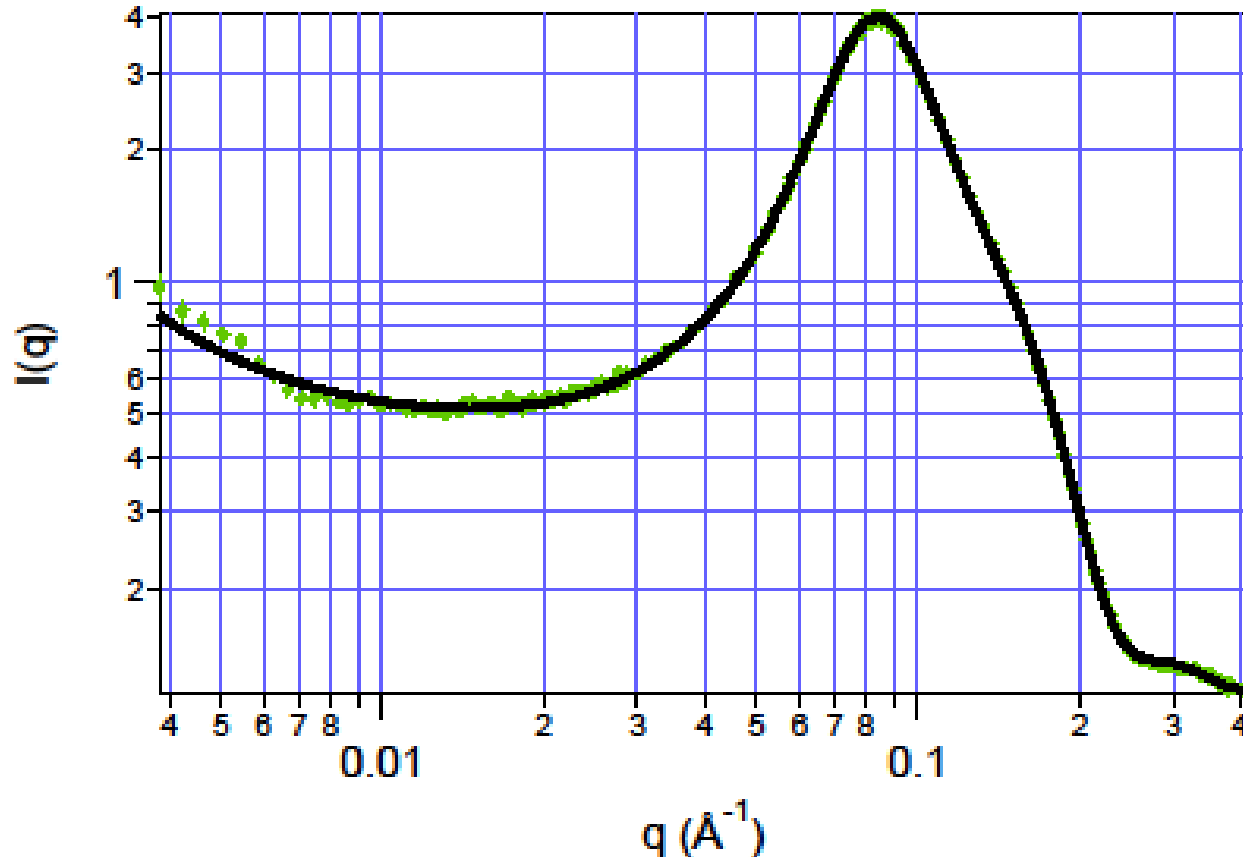
SANS from SDS Micelles



Ellipsoid

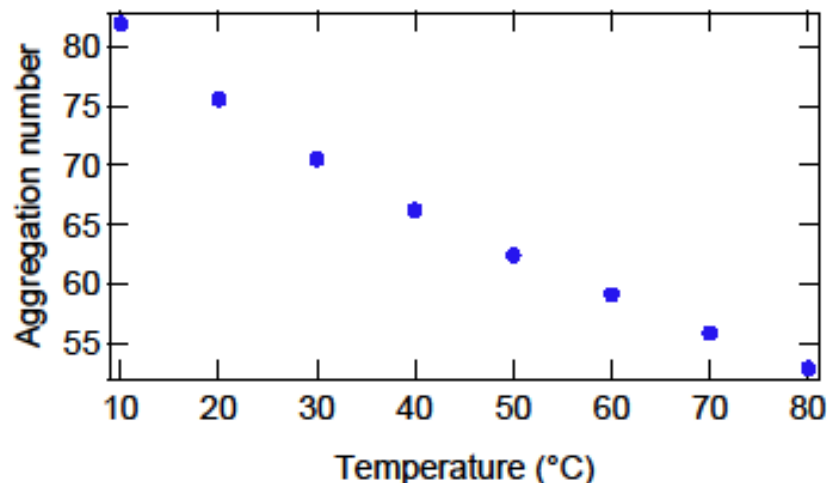
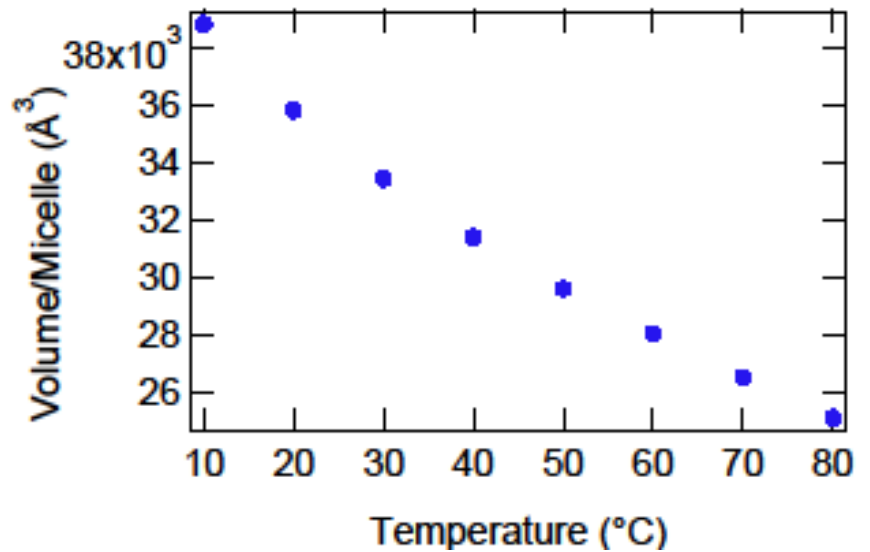
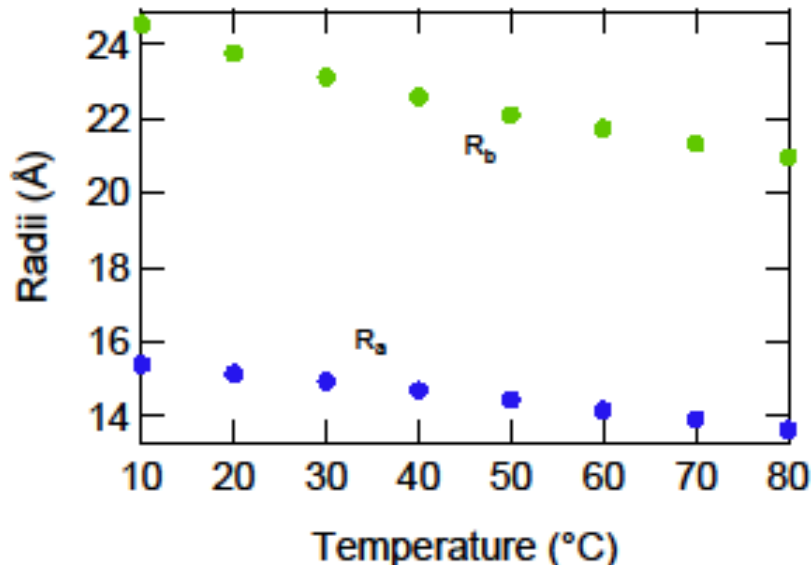


Uniform Ellipsoid with S(Q)

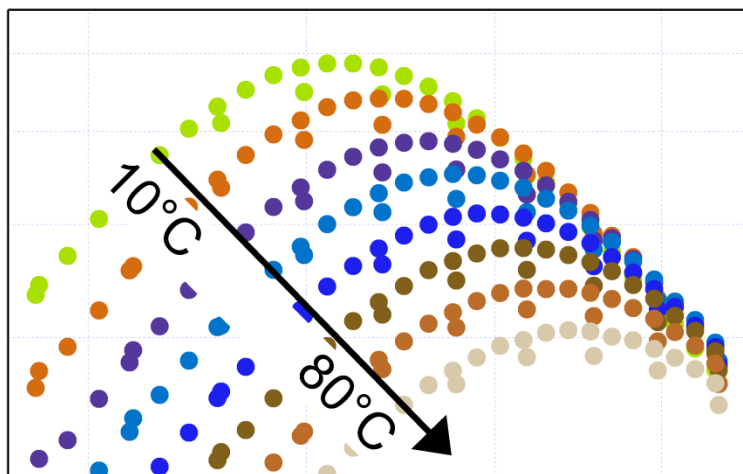
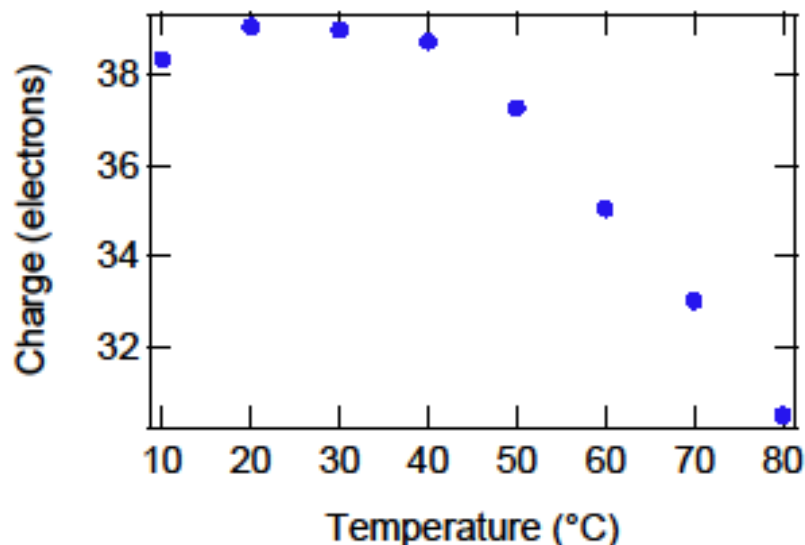


$$\frac{\partial \Sigma}{\partial \Omega}(q) = \left(\int \phi(\Delta\rho)^2 V_{\text{particle}} \left(\frac{3j_1(q\mu R_e)}{qR_e} \right)^2 S(q) d\mu \right) + \frac{A}{q^n} + Bkgd$$

Micelle size decreases with temperature



Charge decreases with temperature



Conclusions

- Micelle structure: ellipsoidal
- Ellipsoid size decreases with increasing temperature
- Micelle charge decreases with increasing temperature

Acknowledgements

- **NCNR Summer School**

- **NGB 30m**

- Boualem Hammouda

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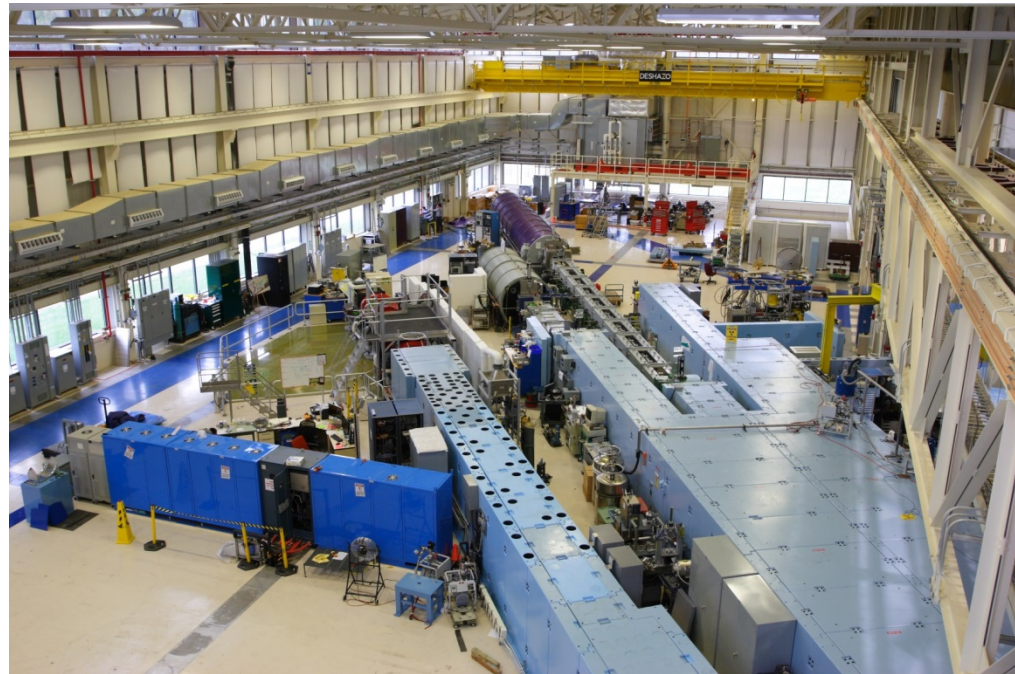
- **NGB 10m**

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Thank you



Questions?