SANS METHOD FOR INVESTIGATION SURFACTANTS WATER SYSTEMS

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Outline

- Introduction to surfactants
- Introduction to SANS method
- Filip’s part of experiment
- Emilia’s part of experiment
- References

Where do we use surfactants?

Classification of surfactants

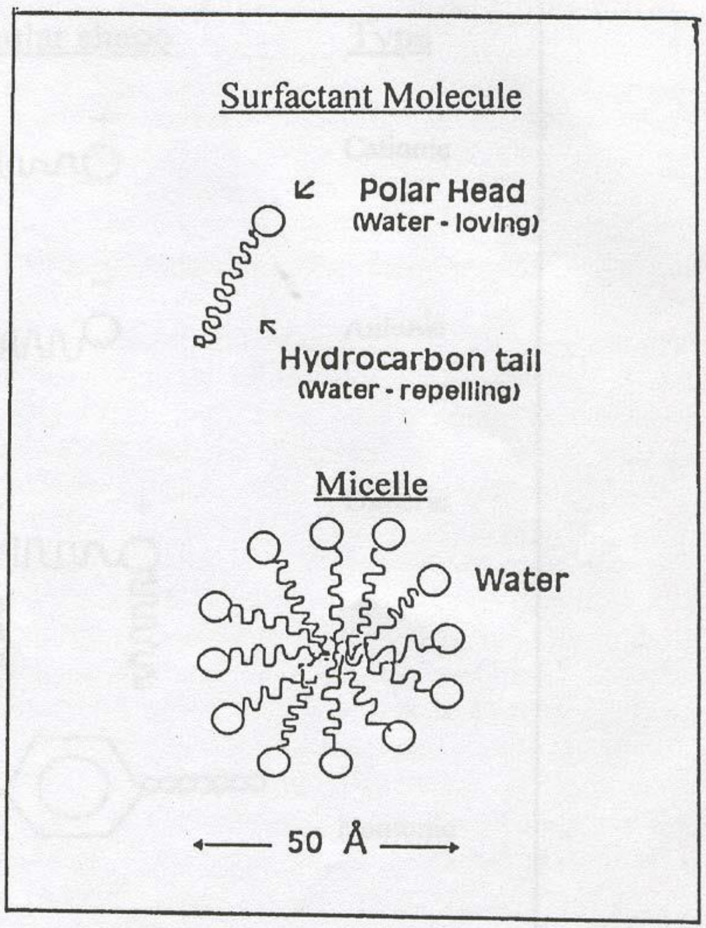
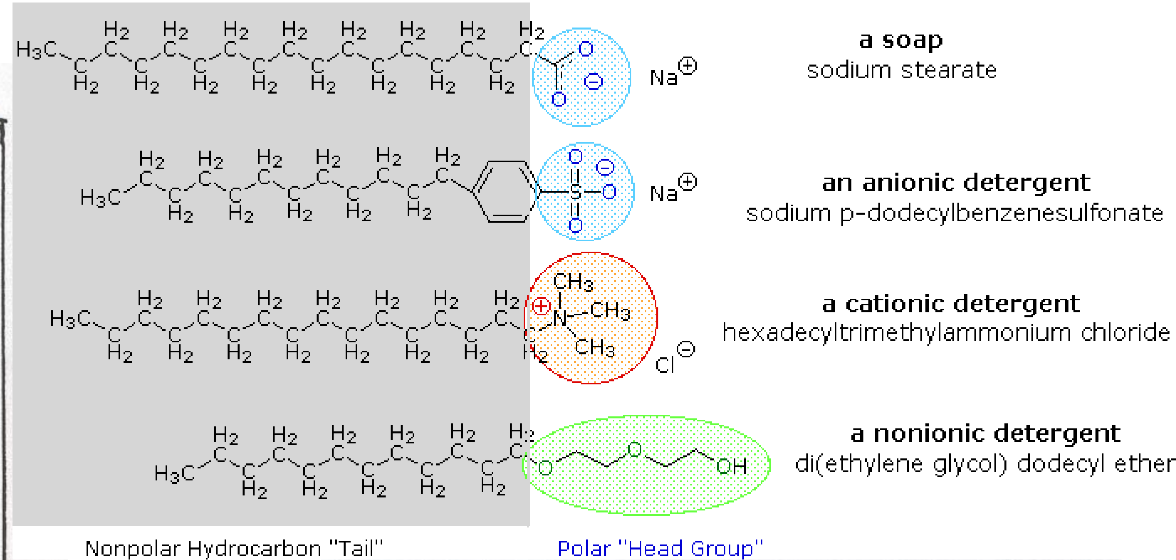


Figure 1. A schematic structure of a micelle and a surfactant molecule.



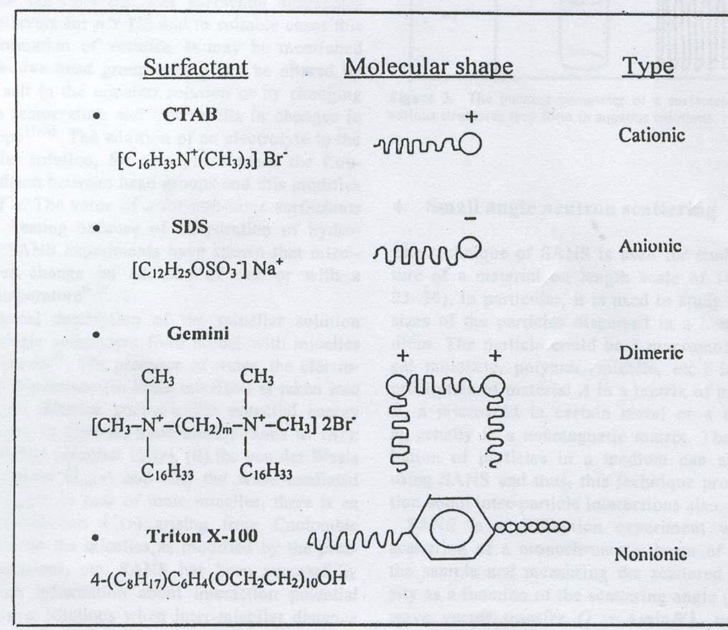


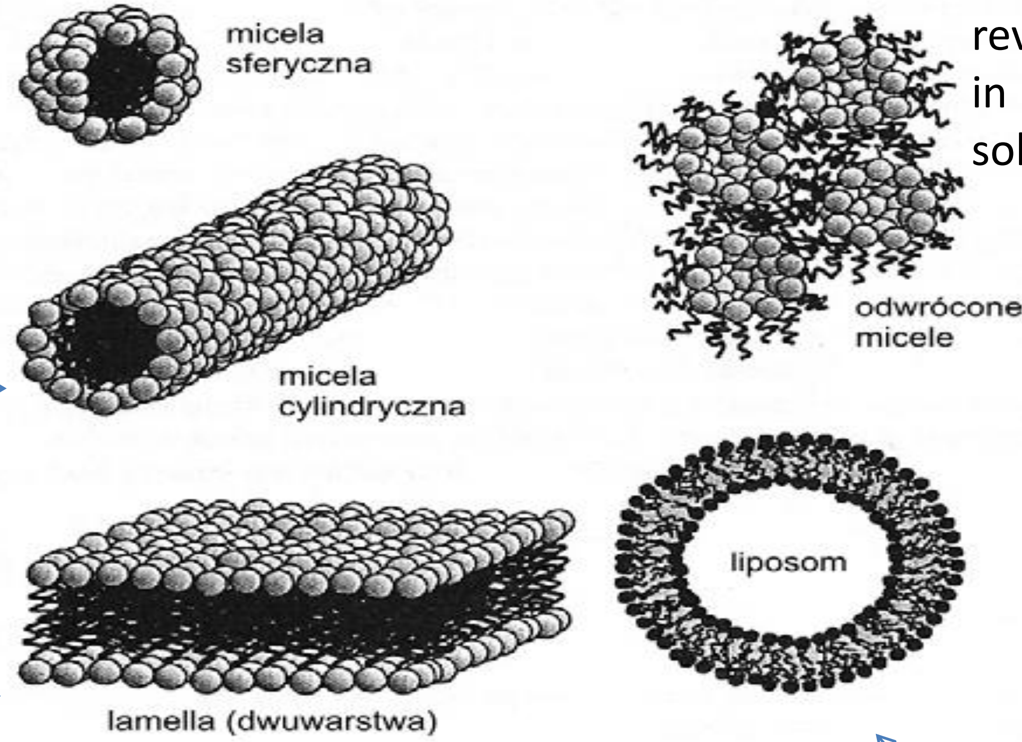
Figure 2. Some of the commonly used surfactants.

Types of micelles in water

spherical micelles

reverse micelles in non water solutions

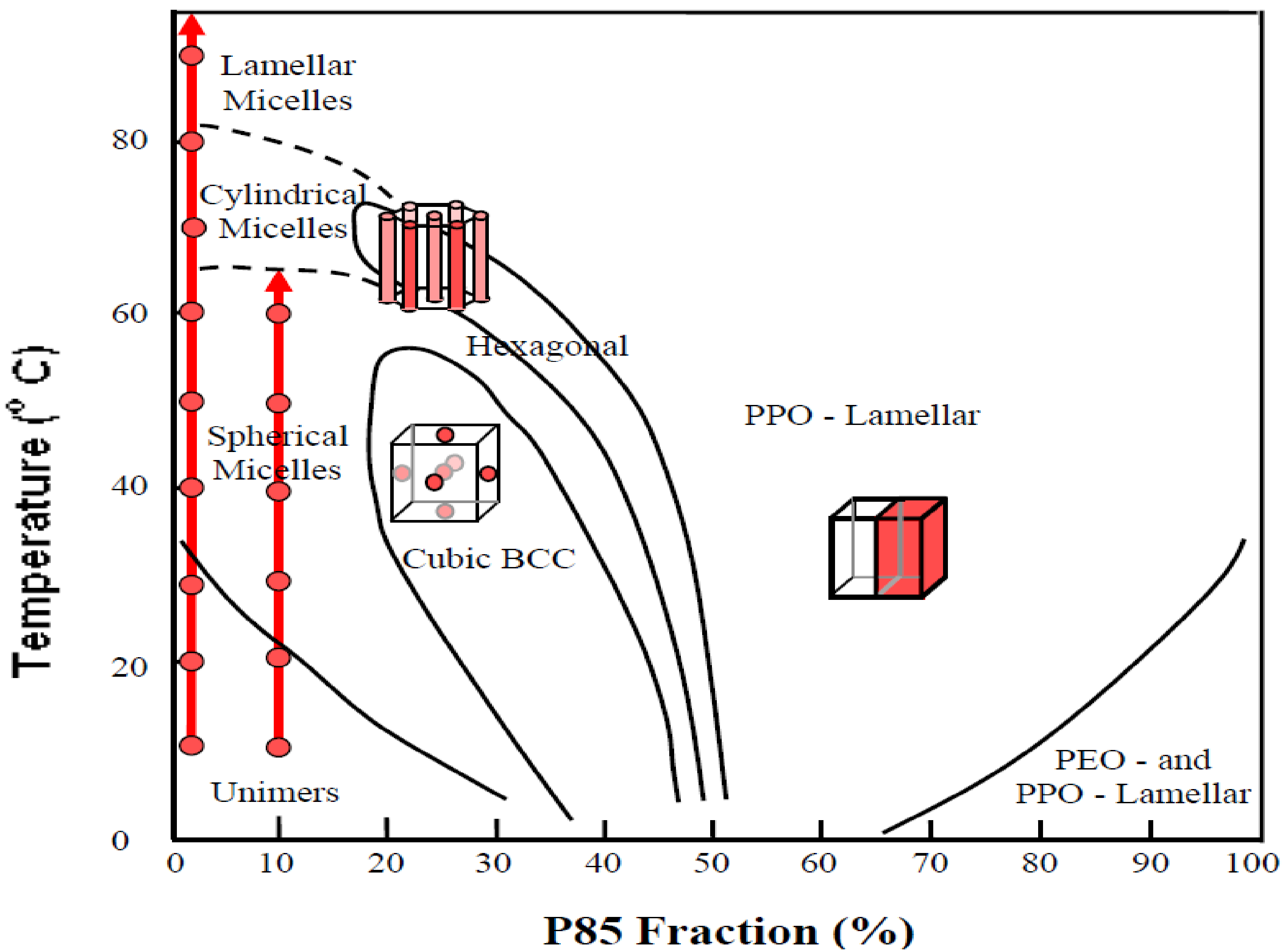
cylindrical micelles



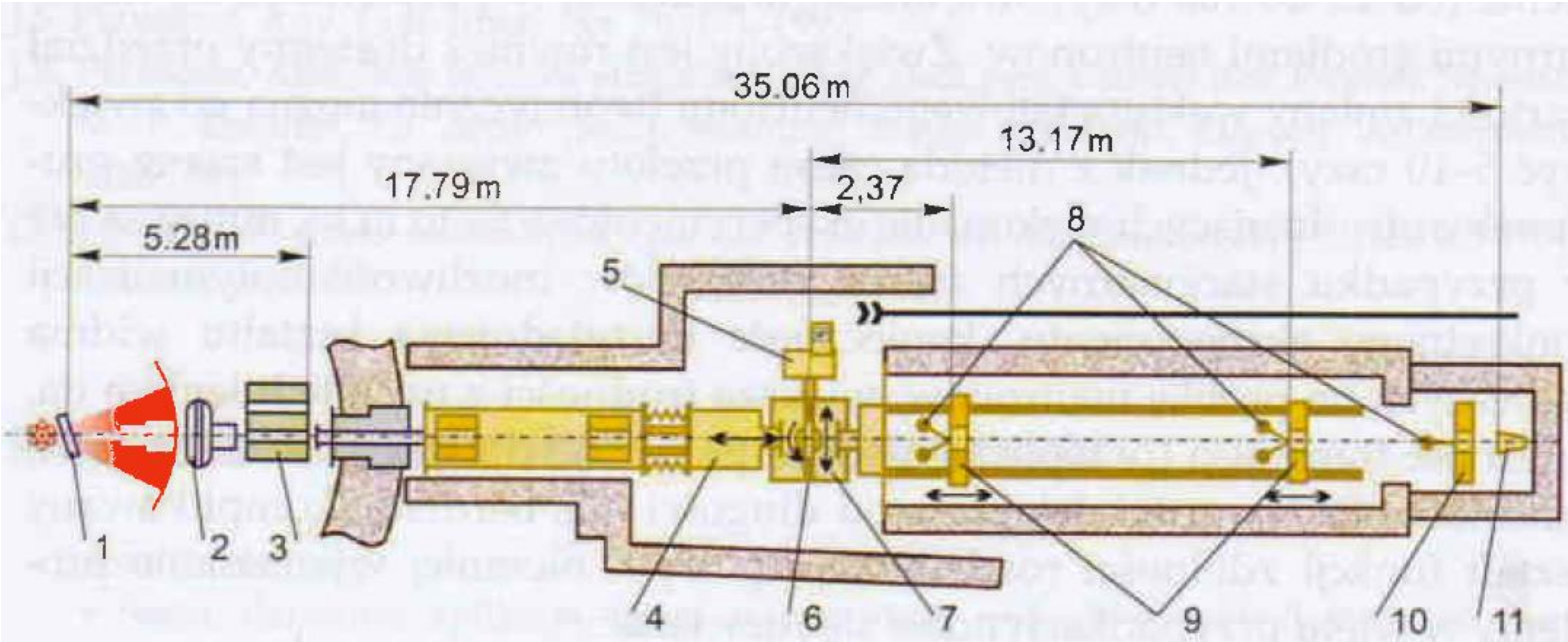
lamellar micelles

liposome

Example: P85 in d-water

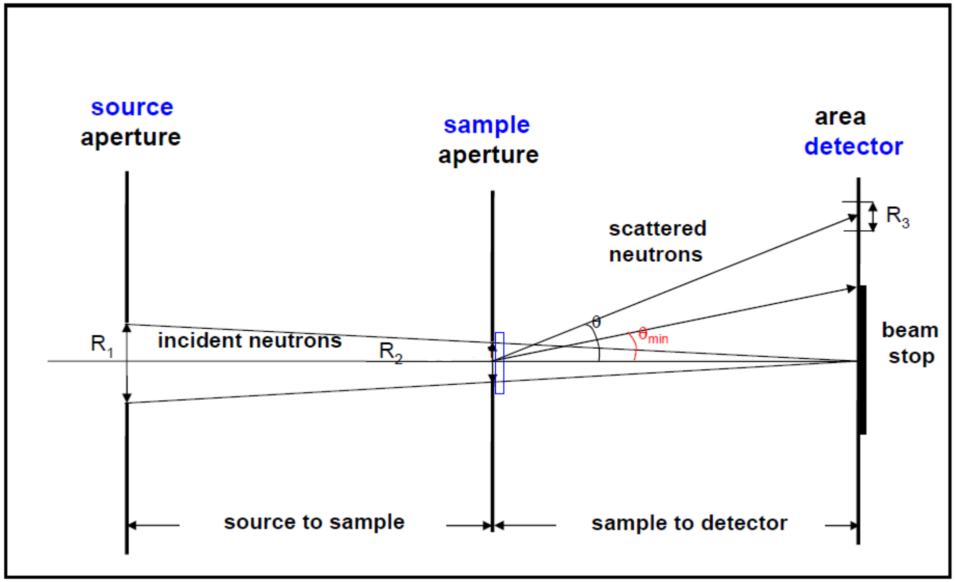


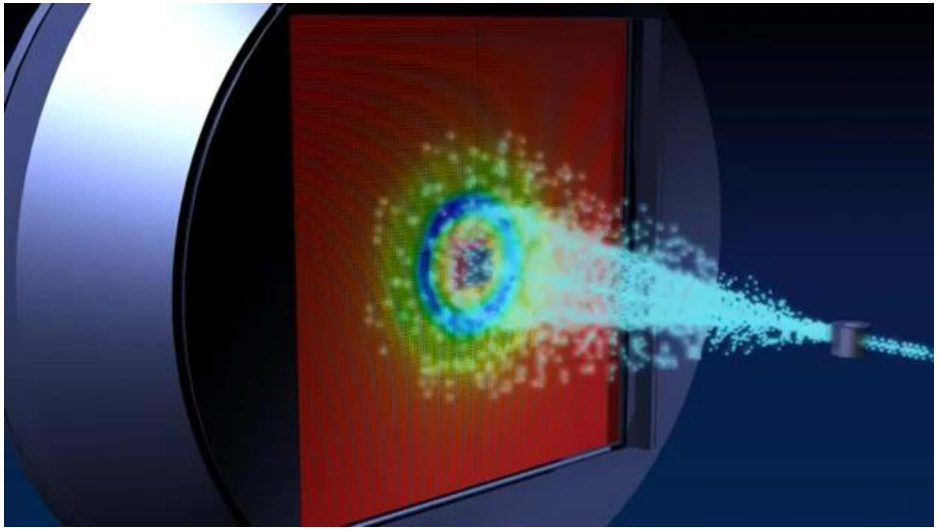
SANS instrument- YuMO

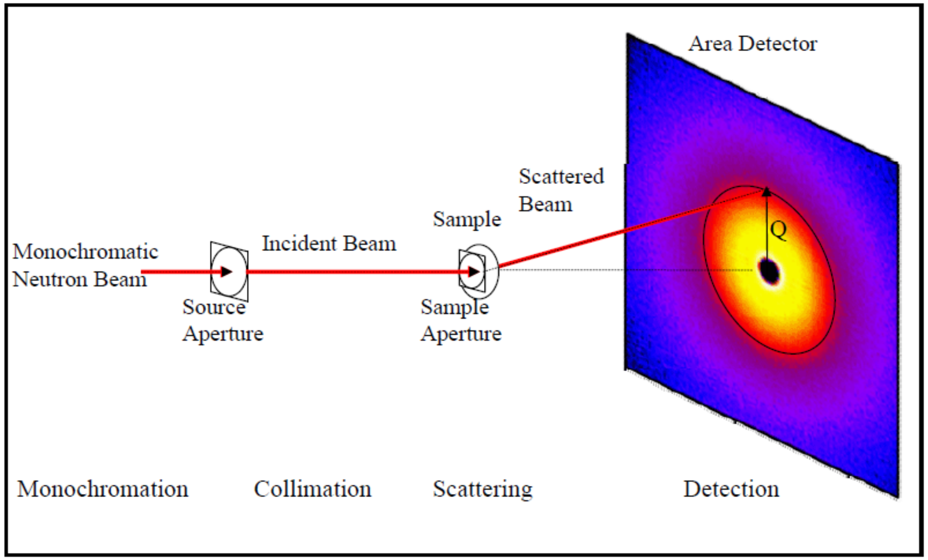


1 – Moderator
2 – Chopper
3 ,4– Colimators
5 – Thermostat
6,7 – Sample area
8 – Vanadium calibration sample
9,10,11 – Detection area;

SANS geometry







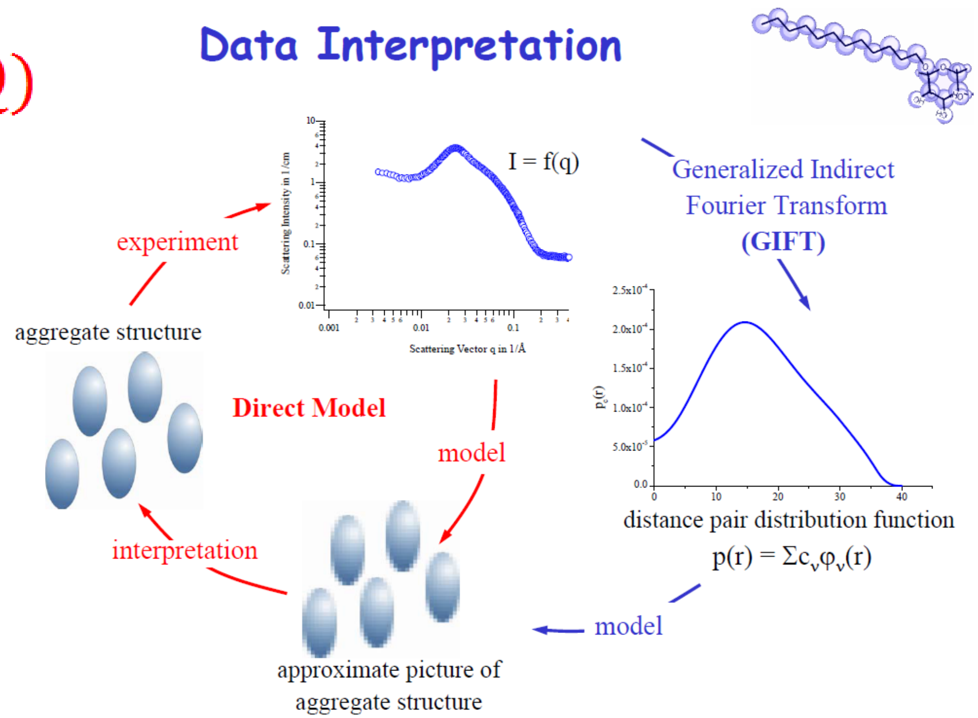
SANS profits

- Neutrons interact through short-range nuclear interactions. They have no charge and are very penetrating and do not destroy samples.
- Neutron wavelengths are comparable to atomic sizes and interdistance spacings
- SANS are used in situations where the important physical aspects (size, range of interaction etc.) occur at distances from 10 to 1000 Å

What do we measure?

$$I(Q) = \frac{d\Sigma(Q)}{d\Omega} = NS(Q)P(Q)$$

Where
N- number of particles
S(Q)- structure factor
P(Q)-form factor
assumption: S(Q)=1



Glatter, O. *J. Appl. Cryst.* 1977, 10, 415-421; 1980, 30, 431-442

I(Q) - angle-dependent scattering intensity, where q is the length of the scattering vector given by

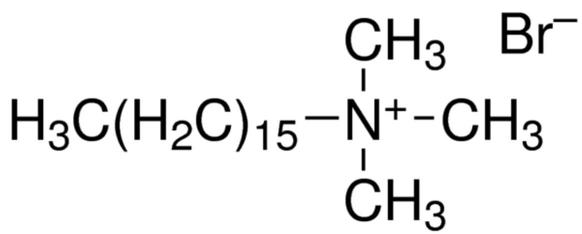
$$Q = \frac{4\pi}{\lambda}\sin\frac{\theta}{2}$$

C_{16}TABr & TX-100

Cationic classic surfactant

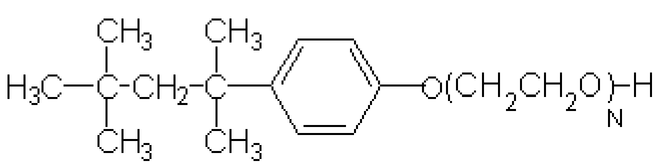
C_{16}TABr hexadecyltrimethylammoniumbromide

$CH_3(CH_2)_{15}N(Br)(CH_3)_3$



Nonionic classic surfactant

TX-100 ([p-1,1,3,3-tetramethylbutylphentyl]poly(oxyethylne))



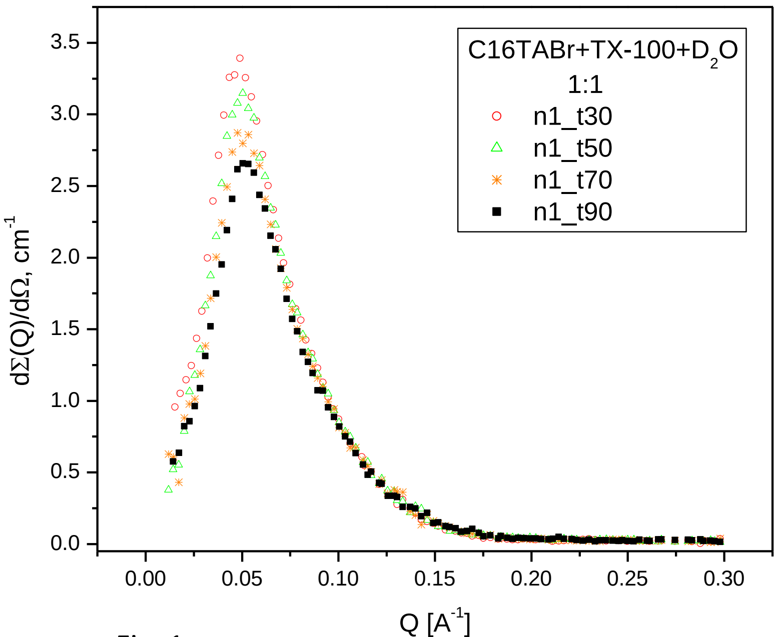


Fig. 1

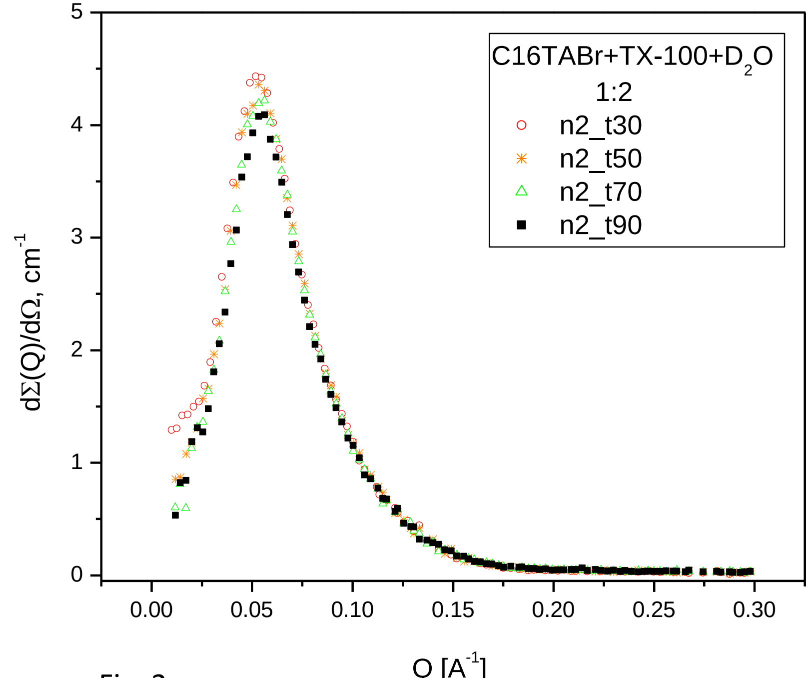


Fig. 2

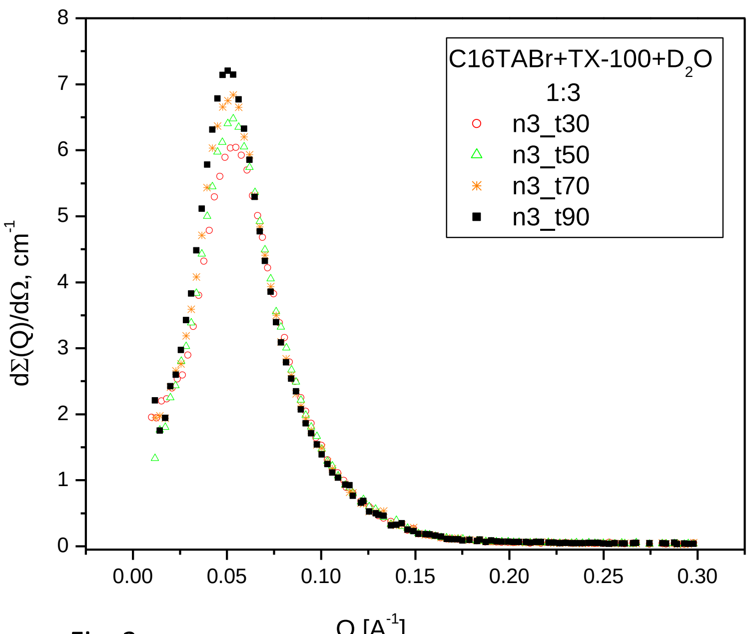


Fig. 3

Differential neutron scattering cross sections for 1/1 (Fig.1), ½ (Fig.2), 1/3 (Fig.3) solutions in D_2O.

n1=1/1
n2=1/2
n3=1/3

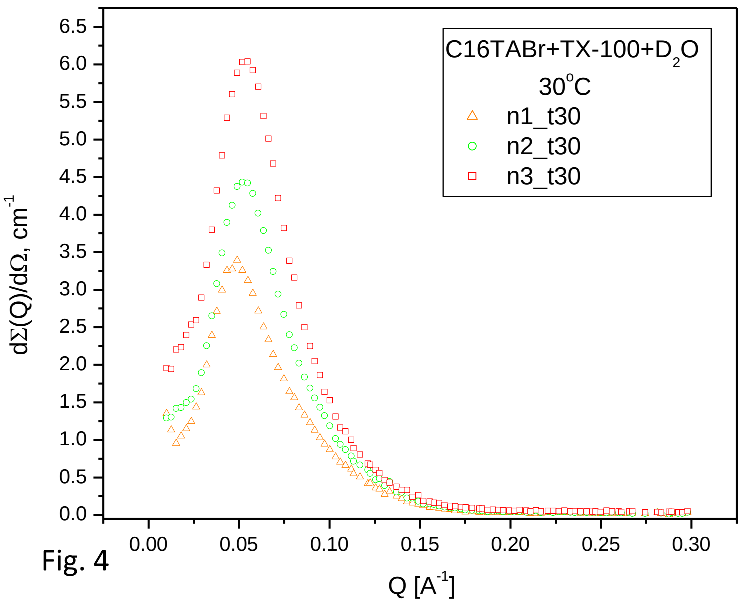


Fig. 4

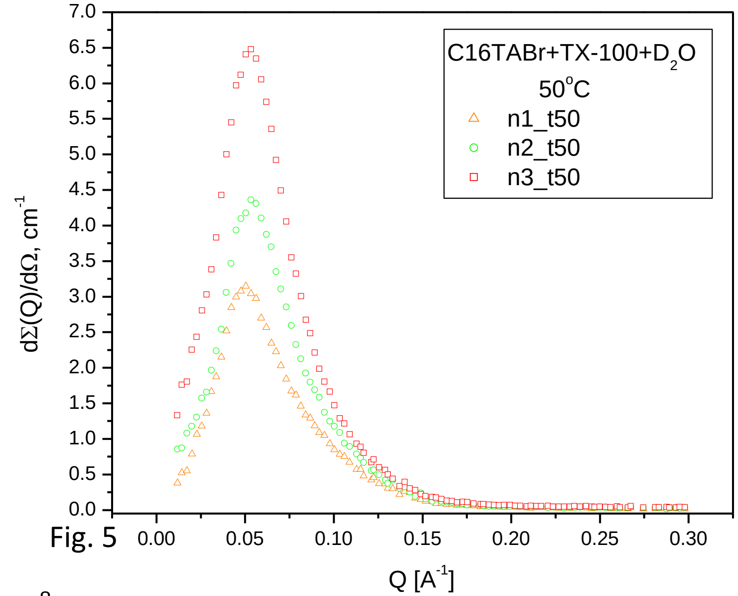


Fig. 5

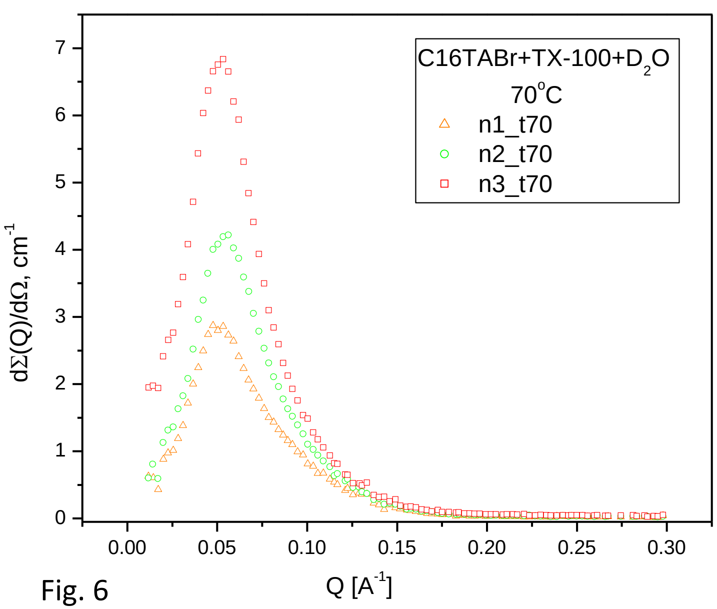


Fig. 6

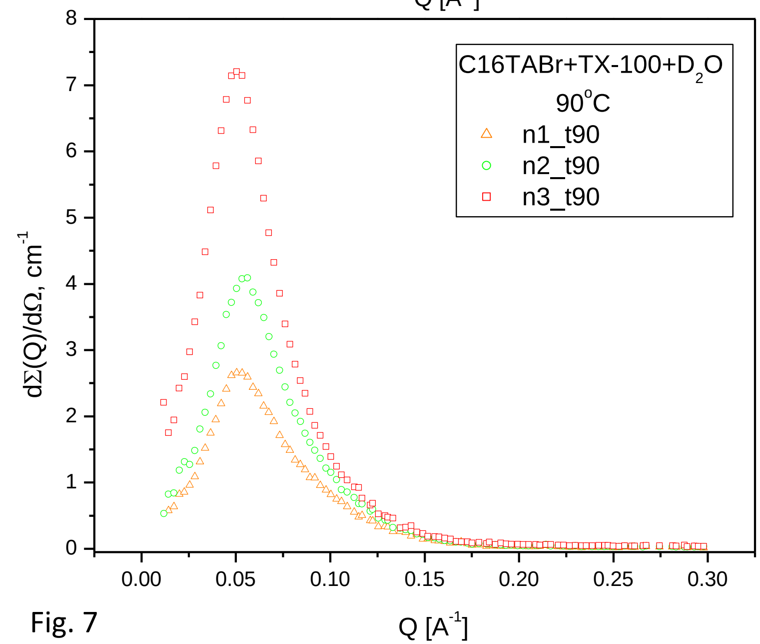


Fig. 7

Differential neutron scattering cross sections for 1/1, ½ , 1/3 solutions in D_2O at temperatures 30°C (Fig. 4), 50°C (Fig. 5), 70°C (Fig. 6), 90°C (Fig. 7).

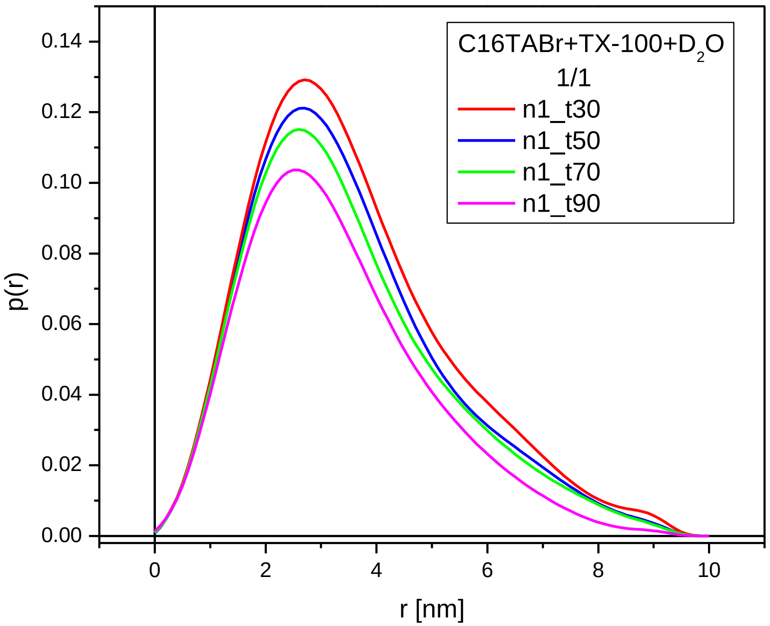


Fig. 8

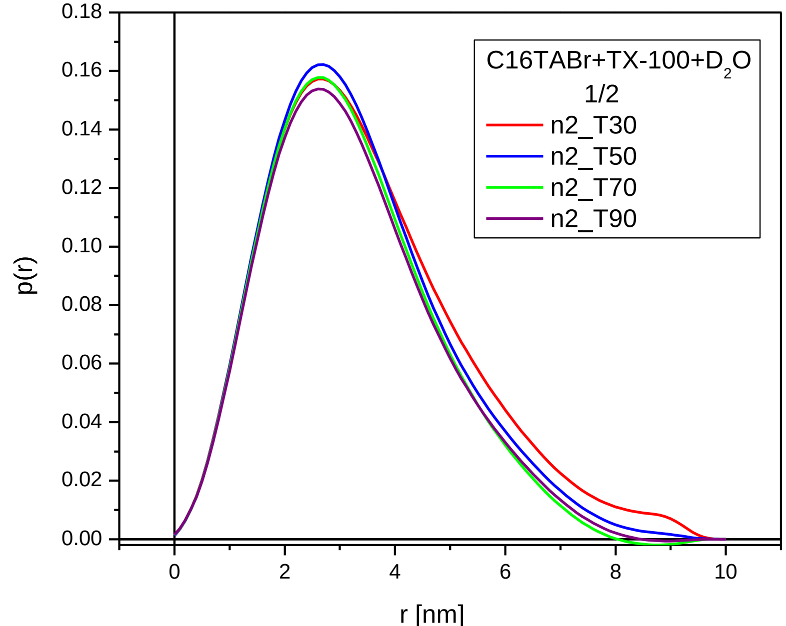


Fig. 9

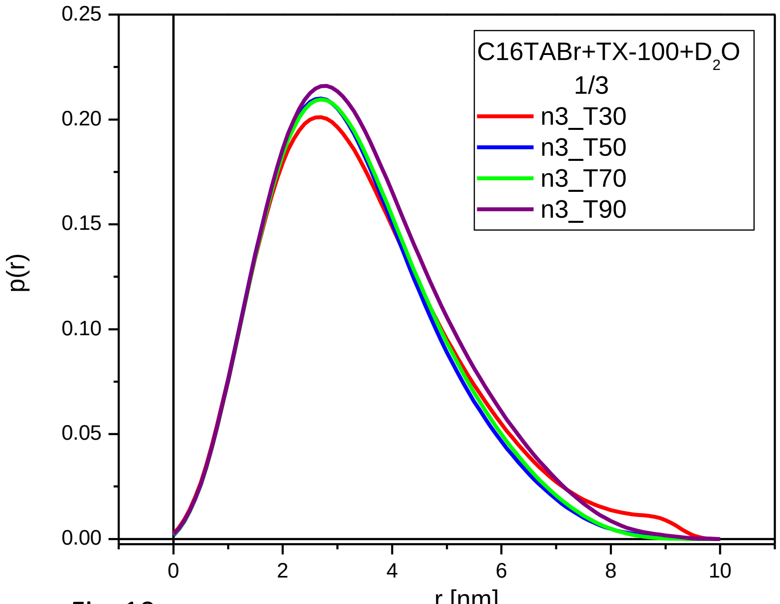


Fig. 10

Fig. 8-9 The distance distribution function for water solutions $C_{16}TABr$ and TX-100

n1=1/1
n2=1/2
n3=1/3

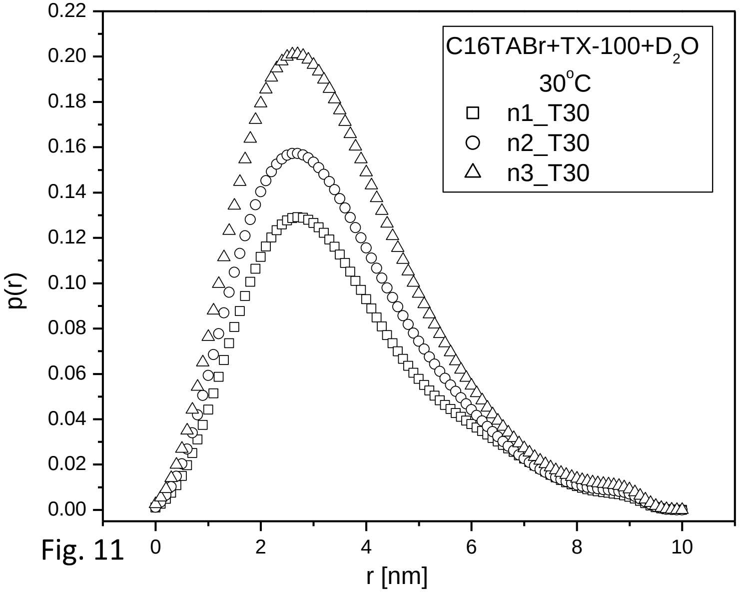


Fig. 11

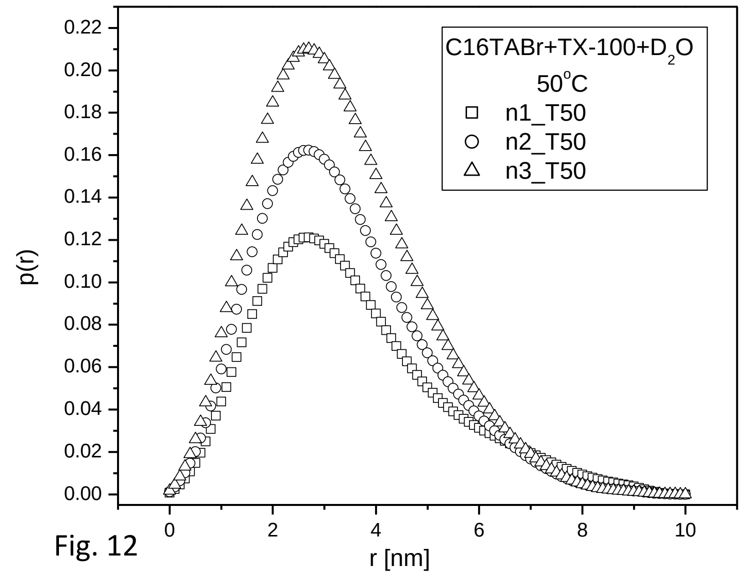


Fig. 12

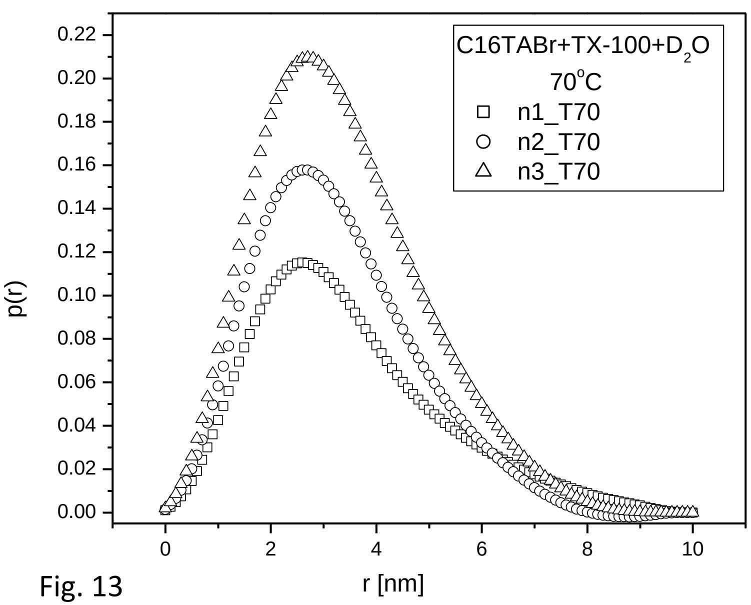


Fig. 13

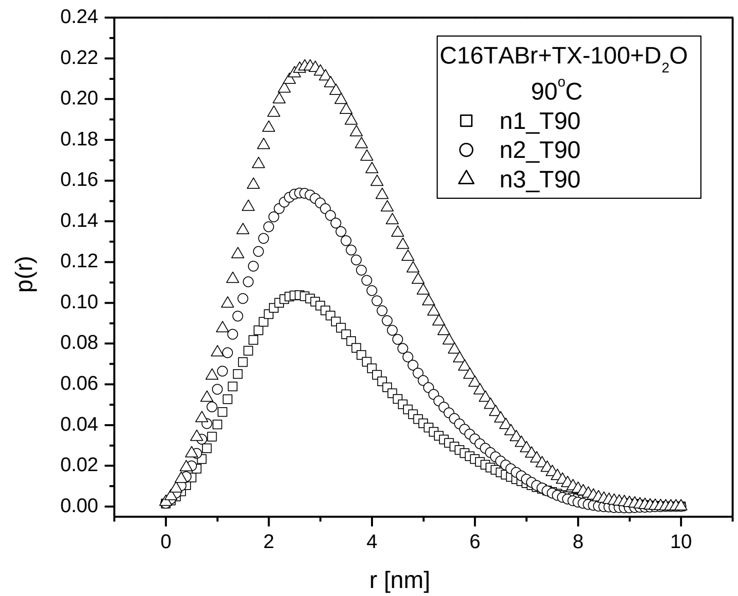


Fig. 14

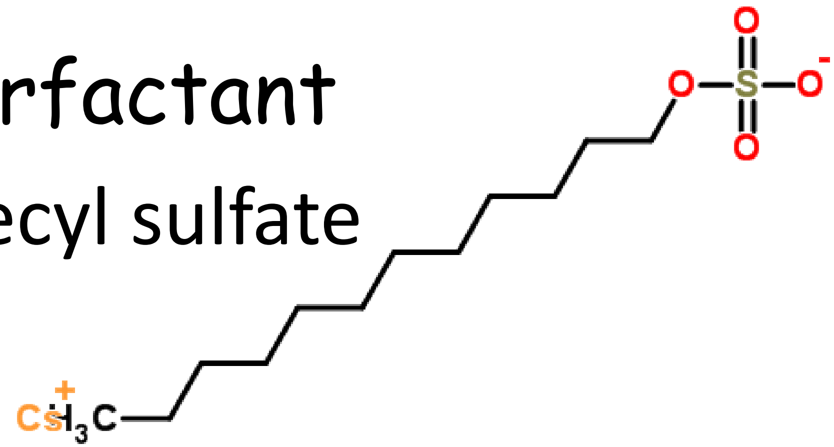
Fig. 11-14 The distance distribution function for water solutions $C_{16}TABr$ and TX-100

$C_{14}E_7$ & CsDS

Anionic classic surfactant

CsDS -Caesium dodecyl sulfate

$C_{12}H_{25}CsO_4S$



Nonionic classic surfactant

$C_{14}E_7$ -Heptaethylene glycol monotetradecyl ether

$CH_3(CH_2)_{13}(OCH_2CH_2)_7OH$

$$H - (OCH_2CH_2)_7OCH_2(CH_2)_{12}CH_3$$

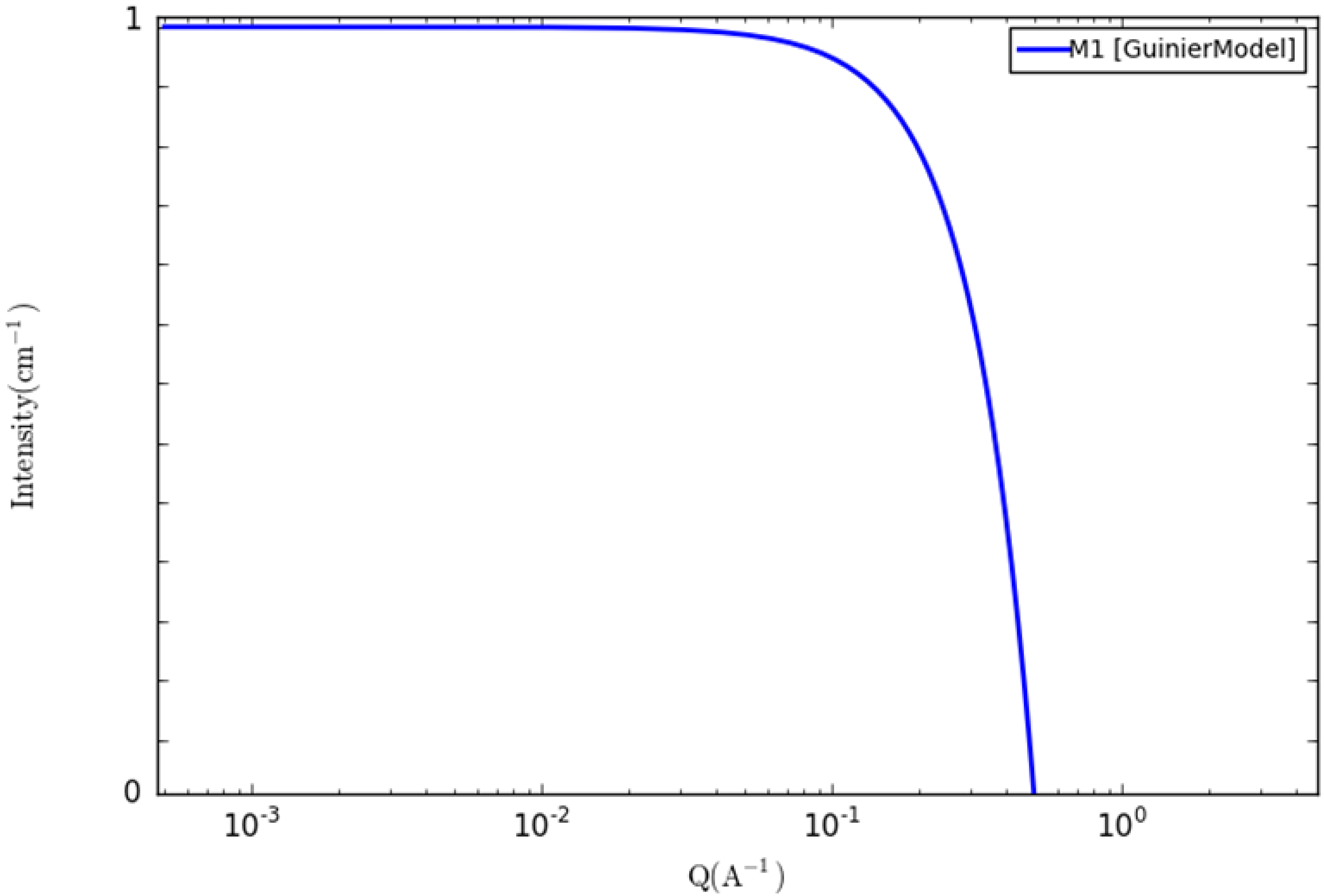
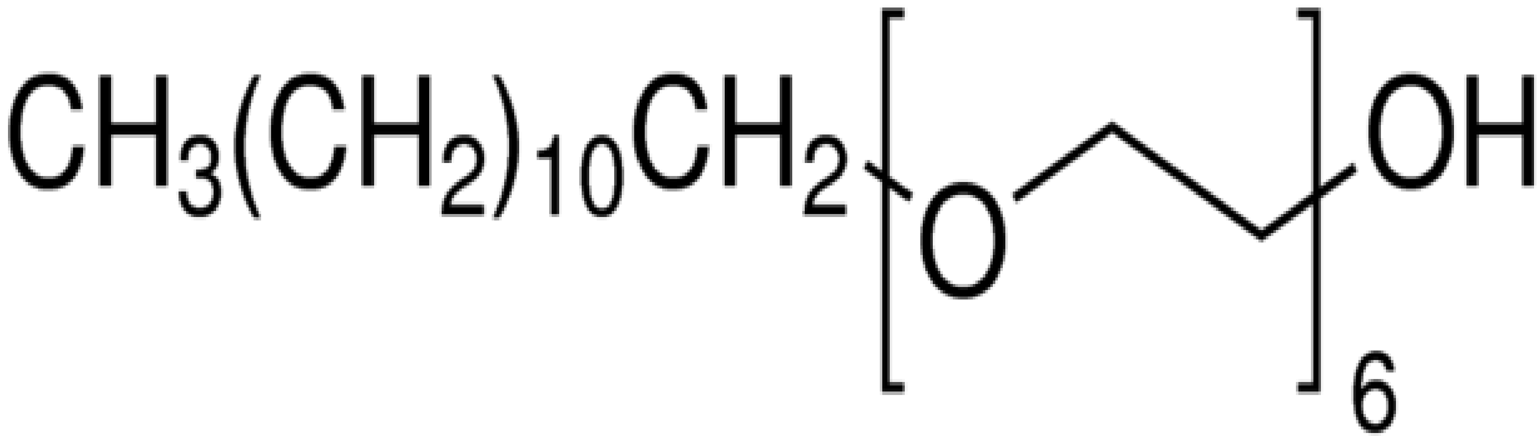


Fig. 15 Differential neutron scattering cross section of dilute binary mixtures: $C_{14}E_7$ and CsDS in D_2O.

Hexaethylene glycol dodecyl ether ($C_{12}E_6$)

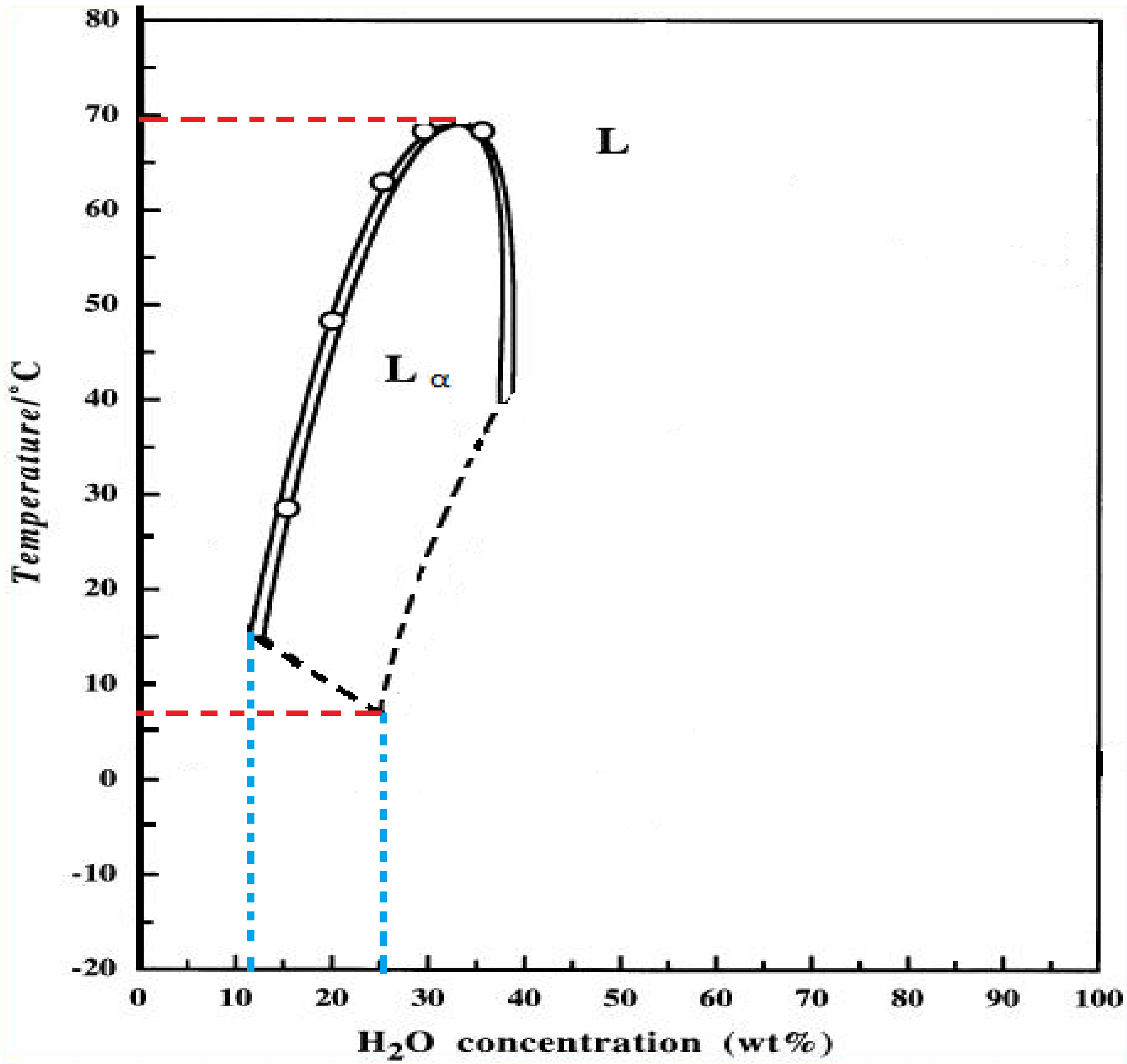
Linear Formula

$CH_3(CH_2)_{11}(OCH_2CH_2)_6OH$

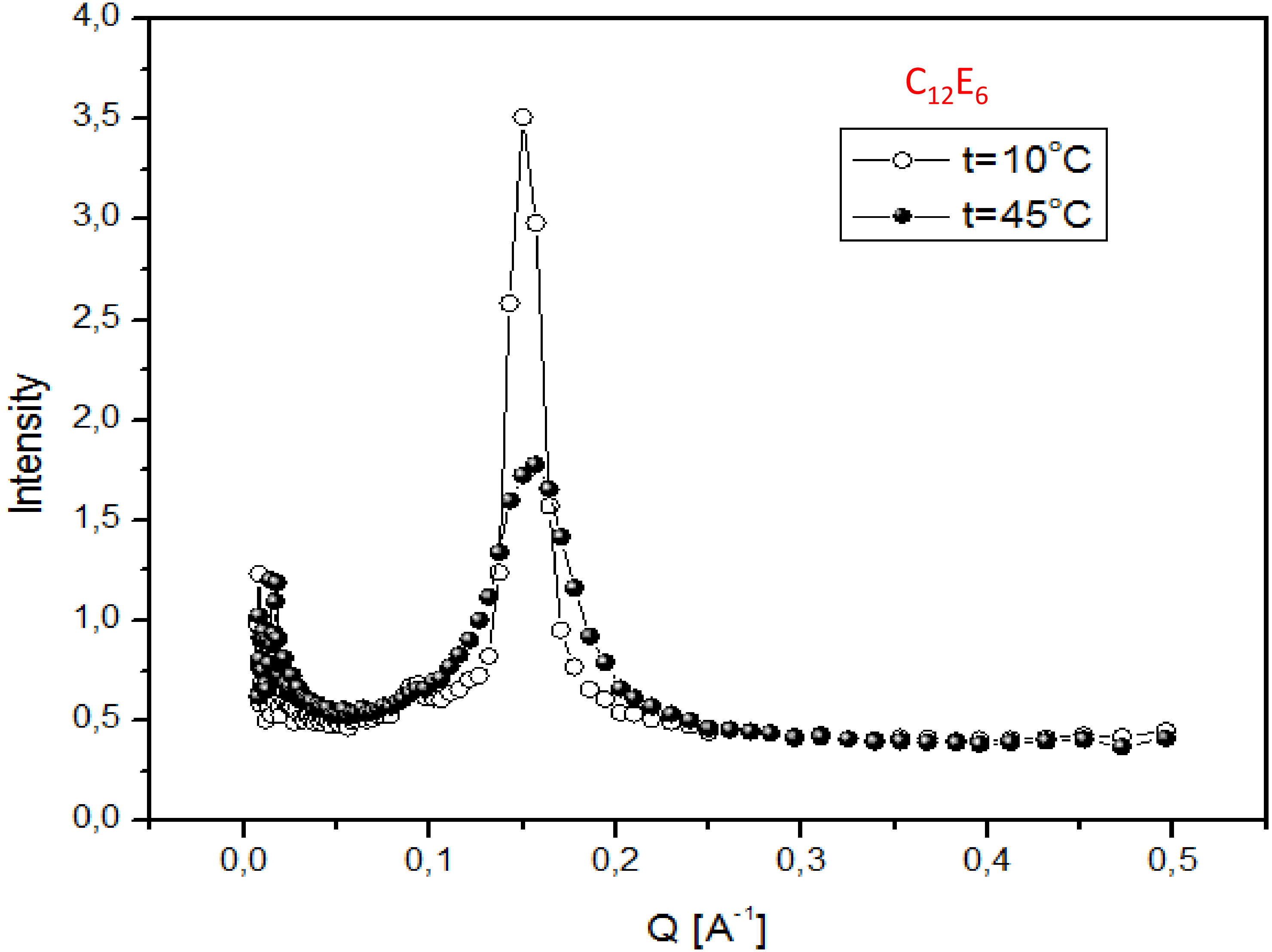


nonionic surfactant

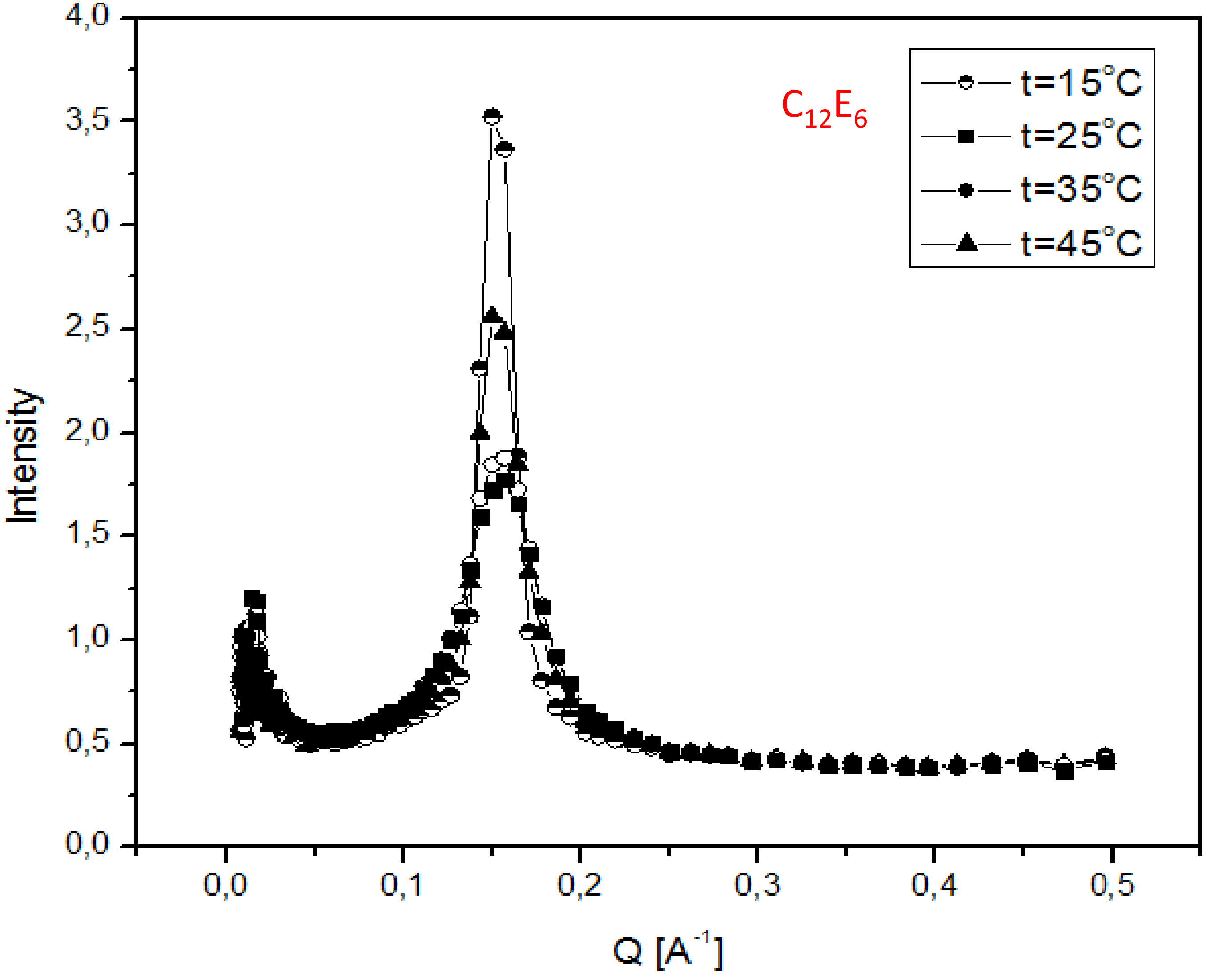
Diagram of $C_{12}E_6$ lamellar phase



Intensities at different temperatures



Intensities at different temperatures



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Special thanks for dr Aldona Rajewska

Thank you for your attention!