**LSU First Day Overview**

**First Day Emphasis**

1. Basic light scattering theory
2. Use of multi-angle light scattering to determine the molar mass, the radius of gyration (rms radius), and the second virial coefficient
3. Instrument hardware & flow cell cleaning and care
4. Connecting to your instruments
5. Instrument calibration and normalization
6. The Zimm plot
7. The Debye Plot

***1. What is the purpose of calibration?***

The DAWN and the miniDAWN need to be calibrated so that the voltage output from the photodiode detectors may be used to compute the excess Rayleigh scattering ratio. Only the 90 degree detector is used for calibration. Calibration is accomplished by measuring the scattering of pure toluene.

***2. Why is toluene used for calibration?***

Toluene has a relatively high Rayleigh ratio (the scattering of light by toluene is relatively high compared to other common solvents) and high purity toluene is readily available.

***3. What do I use for calibration if I am going to use an aqueous solvent or mobile phase?***

Toluene

***4. What is the purpose of normalization?***

To determine relative sensitivities for all detectors with respect to the 90 degree detector; that is, to determine the normalization coefficients.

***5. How is normalization performed?***

The scattering from a polymer small enough to be an isotropic scatterer (scatters equally in all directions) is used for normalization. The polymer must be prepared in the solvent or mobile phase to be used in the light scattering experiment. Since the scattering will be identical at all angles, the software computes “normalization coefficients” for each detector which can be used to convert the voltage reading of that detector to scattering relative to the calibrated 90 degree detector. The normalization coefficient for the 90 degree detector is always 1.000. Normalization coefficients for all other detectors should be some value close (but not equal) to 1.

***6. When using a flow cell, why does normalization have to be performed in the same solvent to be used in the light scattering experiment?***

Due to refraction of the scattered light as it passes from the solvent in the flow cell to the flow cell glass, the actual scattering angle is different from the fixed angle of the photodiode in the detector read head. Since this refraction (bending) is a function of the difference between the refractive index of the solvent and the flow cell glass, the measured scattering angle depends upon the refractive index of the solvent. Different scattering angles are, therefore, measured for different solvents. The actual scattering angle measured depends upon the refractive index of the solvent.

**7. When measuring the scattering from a polymer sample, what elements contribute to the** **total signal output?**

The voltage produced by the photodiode even if the laser is off (dark currents), the voltage from the scattering of the pure solvent (solvent scattering), and the voltage from the scattering of the polymer (the excess polymer scattering).

***8. In a Zimm plot, what information about the sample is obtained from the scattering measured as a function of the scattering angle?***

The average root-mean-square (rms) radius (also known as radius of gyration). More precisely, the z average rms radius for random coils.

**Sample Quiz Questions - Day 1**

1. List and define the terms in the optical constant K\*.
2. What information is contained in the particle scattering function P(θ)?
3. In the Zimm Plot using the Zimm plotting formalism, what is plotted on the x and the y axis?
4. What are the three properties of a polymer which can be obtained from a static (microbatch) light scattering experiment?
5. Which solvent is used for calibration?
6. How many detectors are calibrated during calibration?
7. What must be true of the polymer sample used for normalization?
8. Why must the polymer used for normalization be in the same solvent to be used in the light scattering experiment?
9. Name the three sources of voltages from the scattering of a polymer in solution.
10. Is the molar mass determined in a static microbatch light scattering experiment the weight average, the number average, or the z average molar mass?
11. Is the average radius determined in a static microbatch light scattering experiment the weight average, the number average, or the z average radius?
12. Is the second virial coefficient for a “good” solvent positive or negative?
13. What does it mean for a polymer in solution to be an isotropic scatterer?
14. What are the two main principles of light scattering that were discussed in the introductory lecture?
15. In ASTRA, what is the normal frequency that data is transmitted to the computer?
16. Why is it important to let ASTRA know which solvent you are using?