SCRP Proposal Guidelines 2024

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INTRODUCTION

My primary research focus is on the behavior of partially-miscible liquid-liquid mixtures, which my students and I study using lasers and other instrumentation. Some pairs of liquid mixtures combine in all proportions, like ethanol and water; other pairs, like oil and water, mix only a little bit, and usually separate into two distinct layers, or phases. In my laboratory, my students and I study the in-between behavior: pairs of liquids that mix in all proportions above a certain temperature, but separate into two layers for certain compositions below this temperature. We use laser light scattering to make a map of the one-phase / two-phase behavior. The map is called a phase diagram, and the boundary dividing the one-phase / two-phase behavior is known as the coexistence curve. The maximum temperature reached by the coexistence curve is called the critical point, and strange and beautiful physical behavior occurs in its immediate vicinity. Our three-fold objectives are to (i) correlate the observed macroscopic behavior with microscopic solvation dynamics, (ii) study the unique behavior that occurs near the critical point, and (iii) examine how the addition of a third component to the system alters the phase diagram.

Thank you for your interest in applying to SCRP! Please complete the online application through the SCRP web site:

https://willamette.edu/arts-sciences/additional-academic-opportunities/scrp/eligibility/index.html

As part of the application, you are to submit a PDF response to the assignment described on the next page. All written work should be double-spaced, with 1” margins and 12-pt font.

Online SCRP Proposals are due on Sunday, March 10th, 2024.

Work in our laboratory this summer will likely include a laser technique known as vibrational Raman spectroscopy. As part of your SCRP application process, I would like you to gain a basic understanding of this spectroscopic method. Please write a three-to-four page report on Raman spectroscopy that includes the following:

i. A brief, theoretical discussion of how Raman spectroscopy works, and what information about a molecule is gained from a Raman spectrum. Explain the difference between Rayleigh scattering and Raman scattering.

ii. Describe a typical experimental setup for Raman spectroscopy. Include a figure of your own creation – do not simply include a photocopy of a setup from some other source.

iii. Compare and contrast vibrational Raman spectroscopy and infrared spectroscopy.

iv. Include a Raman spectrum of a fairly simple molecule (between three and six atoms) and identify as many peaks as possible.

v. Read the *Review of Scientific Instruments* article "Subwavenumber Charge-Coupled Device Spectrometer Calibration Using Molecular Iodine Laser-Induced Fluorescence" and then do your best to explain how we calibrate the Raman spectra we collect with our instrumentation. Contact me for access to this article.

Include appropriate reference citations. Our library has a limited collection of books on Raman spectroscopy. Please be courteous – if you check them out, photocopy what you need and return them promptly.

Feel free to discuss your proposal with me! I will be happy to help you interpret the references you procure.