Announcing the Final Examination of Amy LeBleu-DeBartola for the degree of Master of Science in Physics

Date: April14th, 2022
Time: 3:00 p.m.
Room: Virtual
(https://us04web.zoom.us/j/77977454935?pwd=a3nDQPhF0afWF9UOvkIOAHTNGeeGQM.1
Passcode: aM4wmW)
Dissertation title: Raman Excitation Laser Effects on Peak Parameters and Peak Metamorphic Temperatures of Primitive Carbonaceous Chondrites

Abstract:
MicroRaman (μRaman) spectroscopy is often regarded as a non-destructive technique, utilized to analyze limited materials, both terrestrial and extraterrestrial. Carbonaceous chondritic meteorites are of particular interest but they are dark (low albedo) materials, and thus absorb the majority of incident visible light. Raman excitation lasers can induce considerable localized heating, even when low laser powers are used. It has been previously suggested to utilize low power lasers of ≤0.4 mW to minimize damaging carbonaceous samples in several fields, including Meteoritics, Geology, Chemistry, and Paleontology. Peak Metamorphic Temperatures (PMT) experienced by the meteorite can be estimated from Raman fitting parameters related to the Graphitic (G) and Disordered (D) carbon bands for carbonaceous material; such Raman thermometers are assumed to be highly reproducible and non-destructive, making them advantageous for the analysis of small, precious samples. We performed Raman analyses of Murchison (CM2), Allende (CV3), Tagish Lake (C2), and Jbilet Winselwan (CM2) meteorites with an excitation wavelength of 514.5 nm and varying irradiances. We show that the derived band positions and widths utilized to characterize PMT from Raman spectra are highly sensitive to the power of the excitation laser used with permanent changes observed even for the lowest laser power used in this study (0.15 mW coupled to a 20x magnification objective). In addition, we evidence different types of damage, whereby low irradiances can cause enough heating that some small, volatile organics are removed, and high irradiances cause the destruction of weak bonds in the Kerogen-like organic matrix. These effects imply that typical Raman instrument's lowest power settings damage the sample, at minimum by heating the sample and changing the thermometry, but also likely by changing the total amount of organics present, which may cause significant variations in the derived PMTs reported across different laboratories or over repeated irradiation of the same sample.

Outline of Studies:
Major: Physics

Educational Career:
B. S. & B.S. from Louisiana State University

Committee in Charge:
Dr. Daniel Britt (Chair)
Dr. Christopher Bennett (Co-Chair)
Dr. Adrienne Dove
Dr. Yan Fernandez
Dr. Amanda Stockton

Approved for distribution by Dr. Christopher Bennett, Committee Chair, on April 11, 2022.

The public is welcome to attend remotely.