ANALYTICAL SEMINAR

Camryn Gietl

Graduate Student
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"Nanoscale Raman Advances Enabled by Tip-Enhanced Raman Spectroscopy (TERS)"

Understanding nanoscale materials requires chemical information that conventional optical measurements cannot fully provide. Raman spectroscopy offers chemical specificity, but diffraction limited focusing produces lateral resolution on the order of hundreds of nanometers, causing signals from distinct nanoscale regions to be averaged together. Tip Enhanced Raman Spectroscopy overcomes this limitation by confining Raman signal enhancement to a nanoscale metallic probe, enabling spatial resolution on the scale of individual nanostructures under ambient conditions. Using this approach, hyperspectral measurements of single polystyrene nanoplastic particles reveal internal heterogeneity and local structural variation through small but measurable shifts in Raman peak position. Complementary measurements using modulated illumination and intermittent contact operation further confirm that the observed contrast arises from true chemical signal rather than measurement artifacts by demonstrating consistent nanoscale localization of multiple Raman bands. Together, these studies show how nanoscale Raman measurements support application driven advances in materials and environmental analysis by resolving chemically meaningful heterogeneity and structure within individual nanoscale particles.

Tuesday, January 27, 2026 | 3:30 PM | WTHR 172

ANALYTICAL SEMINAR

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"Measurement approaching fundamental limits: instrumentation and systematics in the electron EDM search"

Experimental searches for the electron electric dipole moment (eEDM) in molecular systems have affirmed an upper bound of 4.1 x 10^{-30} e cm, requiring detection of energy shifts on the order of 10 μHz. Achieving this degree of sensitivity demands rigorous identification and control of systematic sources of uncertainty across the measurement chain. A non-zero measurement, which to date has not been detected, would have immediate implications for constraining proposed extensions to the standard model. The measurement protocol used to establish the most recent bounds combines Ramsey interferometry on trapped ions with spatially resolved single-ion detection via fluorescent imaging, allowing for simultaneous measurement of distinct opposite-parity states. Investigations into the eEDM exemplify measurement science pushed to the extreme edge of vanishingly small energy differences, where instrumental design and uncertainty analysis become inseparable.