Discipline	Big picture/ applications:	Day-to-day work:	Current projects for undergraduates:	Prerequisites:	Expected time- commitment:	Website:
AMO or Condensed Matter Henry Everitt	Ellipsometry is a technique that uses the polarization of light to probe the properties of matter. My lab has a one-of-a-kind ellipsometer that operates in the terahertz spectral region. We use this instrument to measure the reflection, absorption, and transmission of all kinds of materials in this spectral region.	This is mostly an experimental project, and day-to-day work involves aligning the instrument, mounting samples, measuring them, and analyzing the results. The analysis can involve the development of models that reveal the underlying physics responsible for the measured optical response.	The principal project is to move beyond reflection, absorption, and transmission measurements to full ellipsometric measurements that capture the full polarimetric response of materials. Materials of interest range from ordinary dielectric materials to tailored terahertz metamaterials to exotic materials fabricated by colleages at Rice and elsewhere. Because of the instrument, almost amy measurement on almost any material could be publishable.	No specific courses are required. Having freshman physics, including optics and electromagnetism is essential. Some programming experience (MatLab, Mathematica, Python, C++, etc.) is extremely beneficial, as is some knowledge of condensed matter physics. Students will be required to take the lab safety course. Freshman (and even high school students) have successfully carried out research on this instrument.	Due to the nature of these experiments, students will need to commit 3-4 hours in the lab each day they take measurements. Ideally students will commit to two days in the lab each week, but fluctuations in this number are normal and expected. Although no commitment is required, it is hoped that students will be interested in working in the group for a year or more, potentially culminating in an independent study project for credit.	

AMO	The rotational motion of gas	This is an	One project would perform	Having freshman	Due to the nature	
	phase molecules is	experimental project.	spectroscopy on gases not	physics, including	of these	
Henry Everitt	guantized, just like its	and dav-to-dav work	in the library, including	optics and	experiments.	
, , ,	electronic and vibrational	involves operating the	vibrationally excited and	electromagnetism.	students will	
	motions are. Because	spectrometer.	isotopic variants. Another	and basic atomic	need to commit	
	rotational energy levels	introducing gases into	project would revive a	quantum	3-4 hours in the	
	depend sensitively on	the absorption	second rotational	mechanics is	lab each day they	
	molecular shape, isotopic	chamber, measuring	spectrometer specially	essential. Some	take	
	composition, and excitation	spectra, and	constructed for measuring	programming	measurements.	
	state, rotational	identifying species.	the unknown products of	experience	Ideally students	
	spectroscopy is a powerful		chemical reactions. A third	(MatLab,	will commit to two	
	tool for unambiguously		project would explore	Mathematica,	days in the lab	
	identifying the composition		measuring forbidden	Python, C++, etc.)	each week, but	
	of a gas. My lab has rather		transitions made possible	is extremely	fluctuations in	
	unique rotational		by nanostructures filling in	beneficial. If a	this number are	
	spectrometers with an		the absorption cell.	project involves	normal and	
	extensive library of			lasers, the student	expected.	
	molecular spectra.			will be required to	Although no	
				take lab and laser	commitment is	
				safety courses.	required, it is	
					hoped that	
					students will be	
					Interested in	
					working in the	
					group for a year	
					or more,	
					culminating in an	
					independent	
					study project for	
					credit.	
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АМО	Most microscopes are	This is an	One project would be to	It is essential that	Due to the nature	
	composed of lenses, but	experimental project,	perfect the image	the student will	of these	
Henry Everitt	these lenses only operate	and day-to-day work	acquisition techniques,	have completed	experiments,	
	over a limited spectral	involves aligning and	both in hardware and in	freshman physics,	students will	
	range, badly distort laser	operating the	software, to achieve	including optics	need to commit	
	pulses, and often require	microscope, placing	highest-resolution,	and	3-4 hours in the	
	immersing the sample in oil	samples in the	diffraction limited images,	electromagnetism,	lab each day they	
	to achieve high resolution.	microscope for	for various illumination	and have	take	
	My lab has a one-of-a-kind	measurement,	sources. A second project	programming	measurements.	
	all reflective microscope	analyzing the	would perform	experience (esp.	Ideally students	
	that overcomes each of	imagery, and	spectroscopy on single	MatLab and/or	will commit to two	
	these challenges.	potentially measuring	particles with high spectral	LabView) is	days in the lab	
	Ultimately, this microscope	the scattering or	sensitivity and resolution. A	essential. The	each week, but	
	can measure "hyperspectral	emission spectra of	third project would combine	student will be	fluctuations in	
	images", where the third	samples.	these capabilities to	required to take	this number are	
	dimension is the reflection,		generate hyperspectral	lab and laser	normal and	
	emission, or scattering		images. A fourth project	safety courses.	expected.	
	(Raman) spectrum from the		would perform Raman		Although no	
	sample.		spectroscopy on samples.		commitment is	
					required, it is	
					hoped that	
					students will be	
					interested in	
					working in the	
					group for a year	
					or more.	
					potentially	
					culminating in an	
					independent	
					study project for	
					credit.	
					0. 0 Mit.	

Condensed	Photoluminescence	This is an	The principal project would	Having freshman	Due to the nature	
Matter or AMO	spectroscopy measured the	experimental project.	be to measure absorption	physics, including	of these	
	light emitted by samples	and day-to-day work	or emission spectra from a	optics and	experiments,	
Henry Everitt	when excited by lasers or	involves aligning and	variety of semiconductors,	electromagnetism,	students will	
	tunable light sources. We	operating the	nanostructures, and 2D	is essential. Some	need to commit	
	use "PL" for analyzing the	spectrometer, placing	materials provided by	programming	3-4 hours in the	
	optical and optoelectronic	samples in the	collaborators as a function	experience	lab each day they	
	properties of a wide variety	spectrometer for	of excitation wavelength	(MatLab,	take	
	of materials, including	measurement, and	and possibly temperature.	Mathematica,	measurements.	
	semiconductors,	analyzing the spectra.	Another project would be to	Python, C++, etc.)	Ideally students	
	nanostructures, and 2D		measure the Raman	is extremely	will commit to two	
	materials. My lab has a		scattering spectra from	beneficial, as is	days in the lab	
	variety of light sources		these same samples to	some knowledge	each week, but	
	exciting samples,		ascertain their lattice	of condensed	fluctuations in	
	spectrometers and		structure and strain.	matter physics.	this number are	
	detectors for measuring			The student will	normal and	
	their spectra, and cryostats			be required to	expected.	
	for measuring how these			take lab and laser	Although no	
	spectra change with			safety courses.	commitment is	
	temperature.				required, it is	
					hoped that	
					students will be	
					interested in	
					working in the	
					group for a year	
					or more,	
					potentially	
					cuiminating in an	
					independent	
					study project for	
		J			credit.	