Graduate Studies in Atomic, Molecular, and Optical Physics at

The College of William and Mary

Atomic, Molecular, and Optical Group:

Experimental Faculty:	4
Theoretical Faculty:	1
Graduate Students:	14
Female Students:	5

Rankings (US News and World Report):

W&M ranked 6th amongst public US universities

Physics Department Statistics:

Average annual number of Ph. D. recipients: 8
Average time to Ph. D.: 5 years

Departmental Website:

http://www.wm.edu/physics
http://www.wm.edu/as/physics/research/index.php

Graduate Admissions:

http://www.wm.edu/as/physics/grad/index.php
Application deadline: Feb 1st

Atomic Physics Website:

http://physics.wm.edu/~amophysics

Contact in AMO Physics:

Prof. Seth Aubin, saaubi@wm.edu, 757-221-3545

William Small Physical Laboratory

General Information:

The College of William and Mary (W&M), chartered in 1693, is the second oldest university in the US. It boasts four US presidents, supreme court justices and Jon Stewart as alumni. W&M is a liberal arts university with a strong research focus. Our 7,800 students (2,000 of them graduate students) enjoy a low student-to-faculty ratio, state-of-the-art facilities, and a beautiful campus.

Located in Williamsburg, Virginia, W&M is in the heart of colonial American history and is adjacent to Colonial Williamsburg, a historic recreation of 18th century colonial life. While much of the campus has been restored to its 18th-century appearance, the physics department is housed in a newly refurbished and expanded building that provides outstanding teaching and research space.

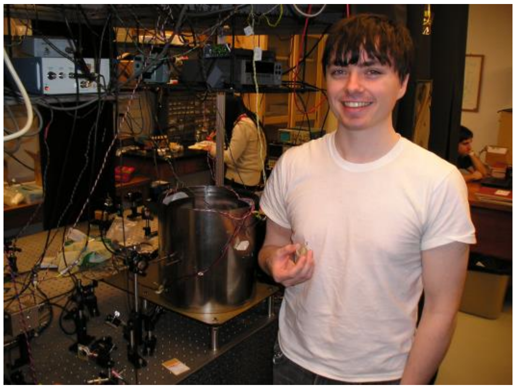
The William and Mary physics department benefits enormously from close ties with both Thomas Jefferson National Accelerator Facility (JLab) and NASA Langley Research Center in nearby Newport News (thirty minutes from the W&M campus). JLAB has a free-electron laser (FEL) facility for high power ultrafast laser research.

Research Areas

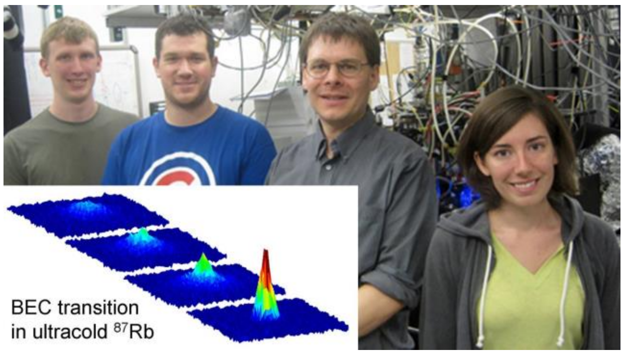
Atomic, Molecular and Optical Physics
Condensed Matter Physics
High Energy Physics
Nonlinear and Plasma Physics
Nuclear and Hadronic Physics

Atomic, Molecular, and Optical Physics:

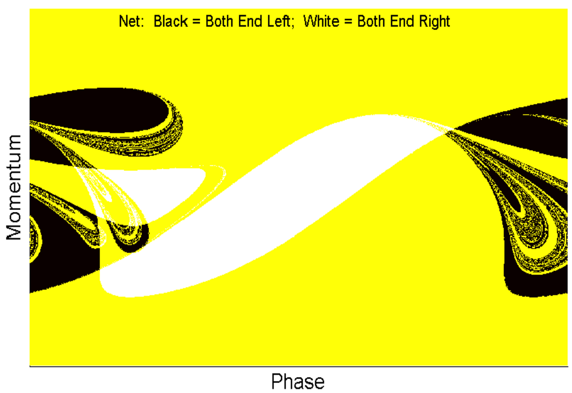
The physics department has a growing research program in atomic, molecular, and optical (AMO) physics that consists of four research labs and one theory group. Research infrastructure includes a number of titanium-sapphire, Nd:YAG, and precision diode laser systems, an ***ultracold quantum gases*** apparatus, and an ***ultrafast laser facility*** that supports joint AMO and condensed matter research. External collaborations include participation in the FrPNC atomic parity violation experiment at TRIUMF (Canada).



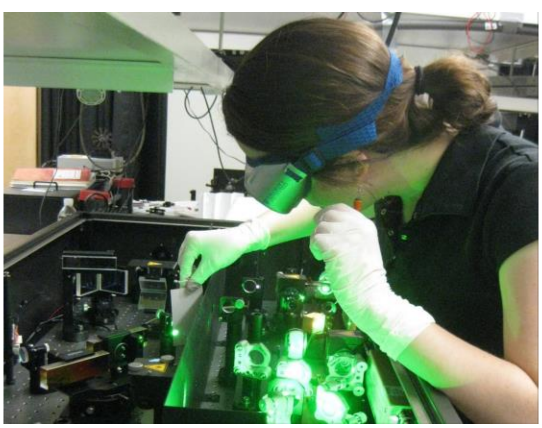
Precision magnetometry experiment



Ultracold quantum gases at W&M



Fractal structure in chaotic transport



Ultrafast Laser Facility at W&M

Quantum Optics

We study the quantum nature of light and its interactions with atoms. More specifically, we are conducting research into how to create, slow down, store and control quantum states of light without destroying them. In one approach, we reversibly store laser light pulses as long-lived spin states in an atomic gas for several milliseconds. In another scheme, we use crystalline whispering gallery disk resonators to enhance nonlinear and quantum phenomena at very low light intensity

Ultracold Quantum Gases

Laser cooling and trapping of atoms can be used to produce atomic gases at nano-Kelvin temperatures or lower. These gases are in the quantum ground state, such as Bose-Einstein condensates (BEC) and degenerate Fermi gases.

We use an atom chip to produce ultracold quantum gases for studying a variety of quantum phenomena: quantum pumping, atom interferometry, and 1D many-body physics.

Precision Measurements and Metrology

Quantum sensing: We are researching methods to improve precision magnetometers, atomic clocks, and interferometers with quantum-enhanced measurements, such as with squeezed states of light, and by controlling interactions.

FrPNC experiment: We are part of a collaboration at the TRIUMF accelerator (Canada) to measure parity violation and the nuclear anapole moment in laser cooled francium.

Theory: Chaotic Transport and Fractals

We want to understand and control quantum systems by understanding and controlling the equivalent classical systems. For example, can cold atoms be pumped from one reservoir to another *without applying an overall bias potential*? We predict quantum behavior, fractal structure, and classical chaos in this type of transport. Constructing quantum wave functions from classical trajectories provides an intuitive picture and insight that is otherwise unobtainable.

Ultrafast Dynamics in Thin Films

We investigate the dynamics of ultrafast processes in thin films and nanostructures by interrogating the material with precisely timed pairs of femtosecond pulses. We use this method to study a thermo- or photoinduced metal-insulator phase transition in strongly correlated materials, such as vanadium dioxide, as well as surface plasmon polaritons in thin films and nanostructures.

Biophysics: Mass Spectrometry of Proteins

We use Matrix Assisted Laser Desorption/Ionization (MALDI) for mass spectrometry studies of proteins. We have developed a novel data analysis methodology to extract the maximal information from MALDI spectra, and to simplify its analysis. Furthermore, we have developed new matrices, using Room Temperature Ionic Liquids (RTILs), that provide higher spatial resolution while maintaining mass resolution.