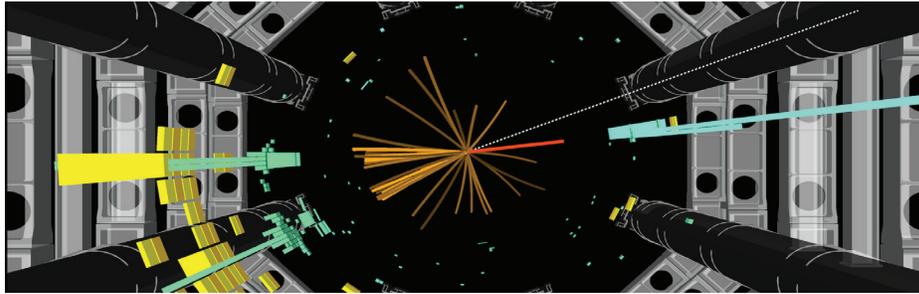


Yale *Department of Physics*

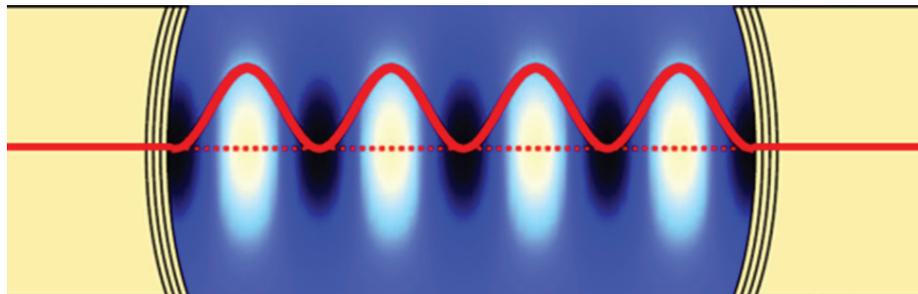
Friday, November 8, 2019

4:00pm-5:00pm

Sloane Physics Lab, 3rd Floor Lounge



We seek to facilitate undergraduates with a physics interest to obtain research positions, and to facilitate faculty in their search for capable undergraduate researchers. Faculty with primary and secondary appointments are invited.



Please RSVP by Tuesday, November 5th if you plan to attend.



Hosts: Simon Mochrie (DUS) & Karsten Heeger (Department Chair)

Light refreshments will be served

Sponsored by the Department of Physics, Yale Society of Physics Students, and Yale Women in Physics

Undergraduate Research Fair 2019

Table of Contents

Sean Barrett	2
Helen Caines	3
Damon Clark.....	4
Sarah Demers.....	4
George Fleming.....	5
Steve Konezny.....	6
Shelly Leshner	7
Reina Maruyama.....	8
David Moore	9
Nir Navon	9
Laura Newburgh.....	10
Corey O’Hern.....	10
Alison Sweeney	11
Research Opportunities	12
Within Yale	12
Outside Opportunities	12
Appendix	13
Research Areas in Physics	13
Associated Centers and Departments	13
Yale Physics in on-campus centers, programs and institutes:	13
Affiliated departments and schools	14



Sean Barrett



Contact: Sean Barrett (sean.barrett@yale.edu)

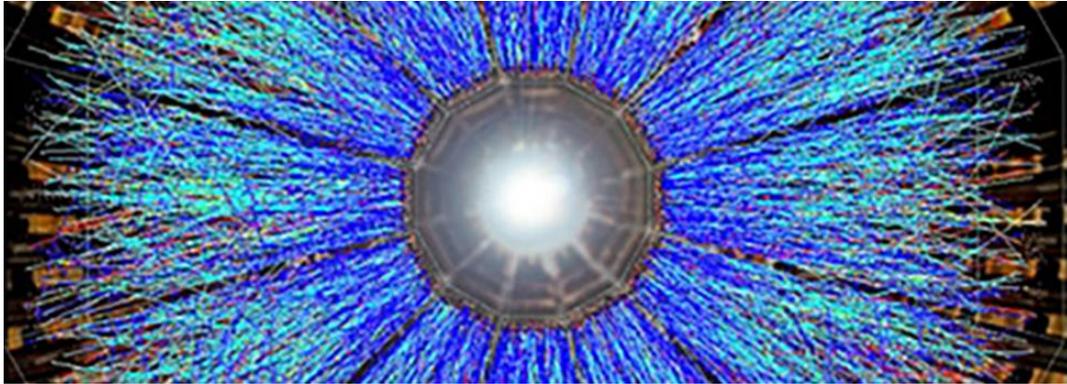
URL: <https://opnmr.physics.yale.edu/>

Research Area: Condensed Matter Experiment, Quantum Info, Biophysics

Research Description: Basic Areas of Interest: Condensed Matter Experiment, Quantum Control, Biophysics, Novel Forms of Image Processing, Developing Novel Equipment

Current and/or Imminent Research Projects:

1. Experimental probes of Time Crystal Physics
2. Using a novel form of MRI to create higher resolution images of a broader range of samples in less time.
3. Developing new forms of control for interacting quantum spin systems.
4. Developing new approaches to get better spectra/images in less time.



Helen Caines



Contact: Helen Caines (helen.caines@yale.edu)

URL: <https://rhig.physics.yale.edu/>

Research Area: Nuclear Experiment

Research Description: Relativistic heavy ion physics is of international and interdisciplinary interest to nuclear physics, particle physics, astrophysics, condensed matter physics and cosmology. The primary goal of this field of research is to recreate in the laboratory a new state of matter, the quark-gluon plasma (QGP), which is predicted by the Standard Model of particle physics (Quantum Chromodynamics) to have existed ten millionths of a second after the Big Bang (origin of the Universe) and may exist in the cores of very dense stars.

The research activities of the Relativistic Heavy Ion Group at Yale are centered at Yale, but involve experimental research on the STAR experiment at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) on Long Island, New York, and on the ALICE experiment with heavy ions at the Large Hadron Collider (LHC) located at the Center for European Nuclear Research (CERN) in Geneva, Switzerland. Both experiments seek to form and investigate hot, dense QCD matter (the QGP) at several trillion degrees absolute temperature (Kelvin).



Damon Clark

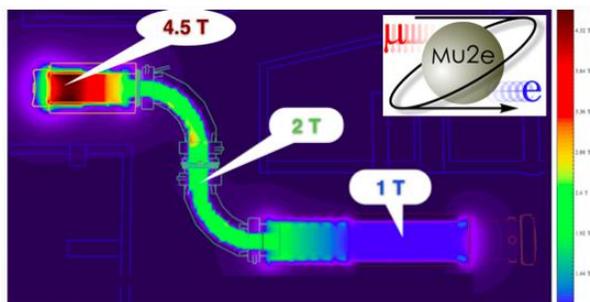


Contact: Damon Clark (damon.clark@yale.edu)

URL: <https://clarklab.yale.edu/>

Research Area: Neuroscience and computational neuroscience

Research Description: We want to understand how a small neural circuit performs basic computations to guide behavior. We perform experiments to test models of neural function, and use models to understand how processing in the brain relates to natural inputs and to natural behavior.



Sarah Demers



Contact: Sarah Demers (sarah.demers@yale.edu)

URL: <https://demerslab.yale.edu/>

Research Area: High Energy Particle Physics

Research Description: We study the Higgs boson using data from the ATLAS Experiment and CERN's Large Hadron Collider and use the Mu2e experiment at Fermilab to search for rare decays of the muon, which would be a sign of

physics beyond the standard model. (I am looking for undergraduate researchers on Mu2e right now.)



George Fleming

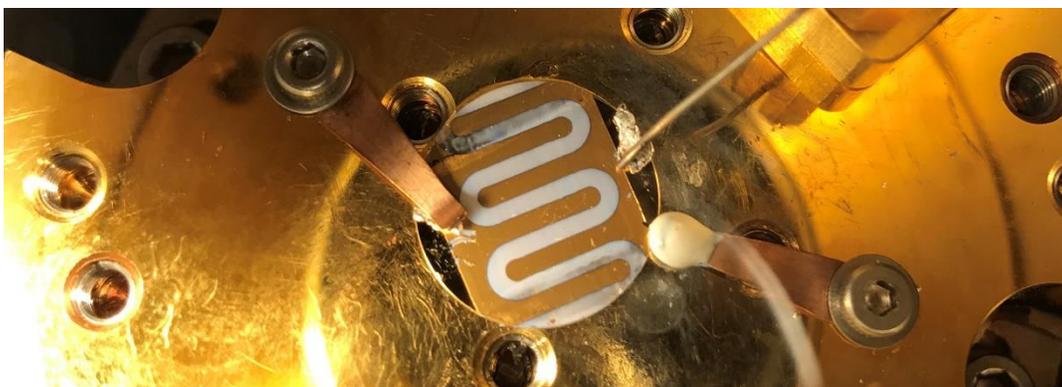


Contact: George Fleming (George.fleming@yale.edu)

URL: <http://lsd.physics.yale.edu>

Research Area: Theoretical Particle Physics

Research Description: Studying composite mechanisms of physics beyond the standard model arising from strongly-coupled quantum field theories, including composite Higgs bosons, composite dark matter, and early universe stochastic gravitational radiation arising from confining phase transitions which generate composites. Also, development of methods for calculations in strongly-coupled field theories in curved spacetimes, leading to important connections to conformal field theories.



Steve Konezny



Contact: Steve Konezny (steven.konezny@yale.edu)

URL: <https://konezny.sites.yale.edu/>

Research Area: Materials for solar energy conversion applications

Research Description: We use theoretical, experimental, and computational methods to study the mechanisms of charge transport and structure-electronic property relationships in materials that are the backbone of many renewable energy strategies such as solar cells, batteries, and fuel cells. These studies inform the design of materials and devices with optimal performance and energy conversion efficiency. By combining low-temperature high-sensitivity electrical measurements with computational modeling and theory, our work is focused on the characterization and mechanistic studies of electron transport in important materials for energy applications.

Open Projects: I have 4 research projects that are focused on fabrication, measurement, and/or theory, depending on student interest and experience:

Device Design and Characterization for Energy-Related Materials

This project involves studying charge transport in materials for solar energy conversion using various device architectures and methods. The student will learn thin-film fabrication and microscopy characterization methods, how to design and deposit electrodes, and useful techniques in the west campus clean room such as photolithography and optical profilometry.

Theory of Charge Transport in Nanostructured Materials

Studying charge transport is important from a fundamental physics perspective, but also can provide guidance for material design. This project involves studying the mechanisms of charge transport important to nanostructured materials used for solar energy conversion. The student will learn how to apply these models to temperature-dependent electrical data. Programming experience recommended.

Temperature-Dependent Charge Transport Measurements in Energy Materials

Our lab on west campus has a cryostat capable of accessing temperatures between ~ 7 and 315 K. By measuring the conductivity of materials in this range, one can decipher the mechanism of charge transport and learn valuable information about improving device performance. Because important materials for energy applications are often highly porous by design for achieving high surface area, conductivities are often very low. The cryostat is therefore equipped with highly sensitive electrical equipment capable of measuring currents on the order of femtoamps. This project is a study of charge transport as a function of temperature under various light and ambient gas conditions. Prior experience in LabView and Python would be helpful, though experience can be swapped for an interest to learn.

Impedance Spectroscopy for Studying Materials for Energy Applications

Studying the resistance and capacitance properties of a material upon application of an ac signal can potentially provide much more information than dc methods. These data can be fit with an equivalent circuit model, each component of which corresponding to a particular physical process in the device. This project is an application of this powerful method, which allows complicated systems such as thin-film devices or electrochemical cells to be studied systematically. Some programming experience will be useful.



Shelly Lesher



Contact: Shelly Lesher (shelly.lesher@yale.edu)

URL: <https://www.uwlax.edu/profile/slesher/>

Research Area: nuclear structure

Research Description: Using experimental methods to study rotations and vibrations in nuclei

Transfer Reactions on Rare-Earth Nuclei

Analyze a dataset from an accelerator experiment and learn about low-energy nuclear structure and transfer reactions. Datasets include $174,176\text{Yb}(p,t)$,

$^{162}\text{Dy}(p,t)$ and $^{180}\text{Hf}(p,t)$. You will need to know or learn how to program in root1, be self-motivated, and willing to learn. Knowledge of computer languages (C++, Python or R) is a plus. This analysis will be published in a peer-review journal.



Reina Maruyama

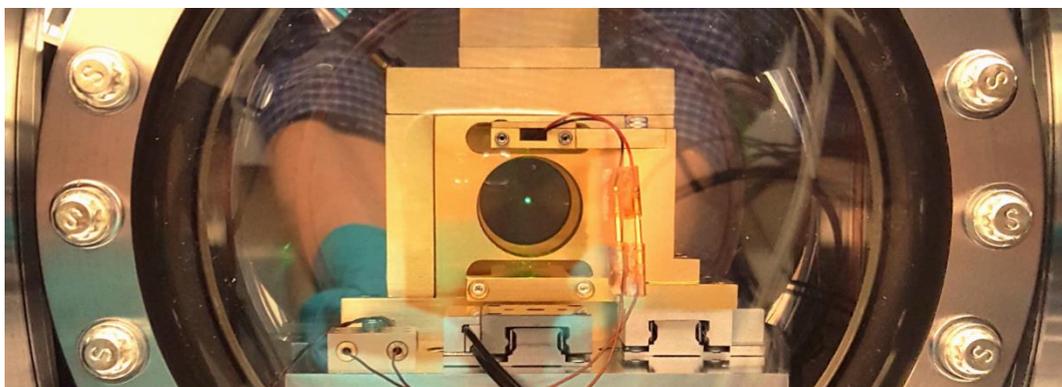


Contact: Reina Maruyama (reina.maruyama@yale.edu)

URL: <https://maruyama-lab.yale.edu>

Research Area: Experiments in Neutrinos and Dark Matter

Research Description: We are looking for/studying the identity of dark matter and neutrinos. Keywords: WIMPs, Axions, Quantum Computing-inspired detectors, neutrinoless double beta decay, lepton number violation, lasers, particle physics, nuclear physics, atomic physics, inclusivity and diversity of ideas and people



David Moore

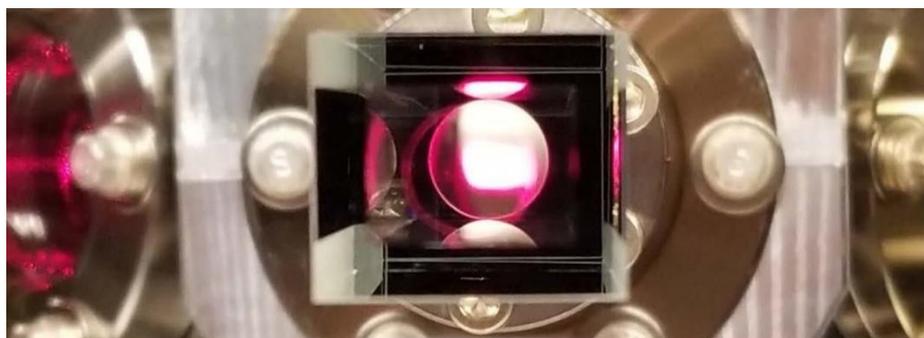


Contact: David Moore (david.c.moore@yale.edu)

URL: <http://campuspress.yale.edu/moorelab/>

Research Area: Nuclear, Particle, AMO

Research Description: Neutrino physics, precision tests of the Standard Model



Nir Navon



Contact: Nir Navon (nir.navon@yale.edu)

URL: <https://uqm.yale.edu/>

Research Area: Ultracold matter, quantum many-body physics, quantum simulation

Research Description: Using ultracold atoms to study collective quantum phenomena and strongly correlated phases of matter

Open Projects: See attached flyer



Laura Newburgh

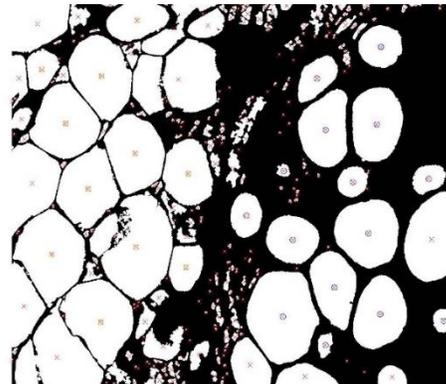
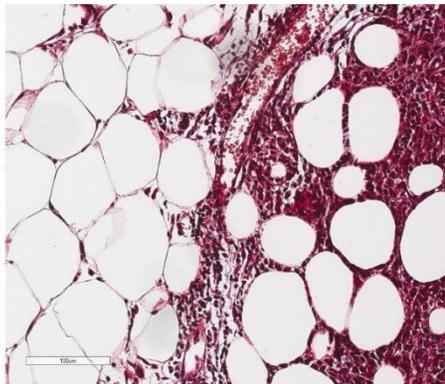


Contact: Laura Newburgh (laura.newburgh@yale.edu)

URL: <http://campuspress.yale.edu/newburgh/>

Research Area: Experimental Cosmology

Research Description: I work on radio and millimeter telescopes to study Dark Energy, inflation, and particles



Corey O'Hern



Contact: Corey O'Hern (corey.ohern@yale.edu)

URL: <https://jamming.research.yale.edu>

Research Area: Theoretical and Computational Studies of Soft and Biological Materials

Research Description: The O'Hern group tackles a broad range of fundamental questions in soft matter and biological physics using a combination of theoretical and computational techniques. In soft matter, the group seeks a predictive understanding of glass and jamming transitions, in which materials such as granular

media, dense colloidal systems, and foams, develop solid-like properties in the absence of crystallization over a narrow range of control parameters. In the area of biological physics, the O'Hern group is interested in the dynamics of protein folding, unfolding, and aggregation, the organization and dynamics of DNA, and the structural and mechanical properties of cells and tissues.



Alison Sweeney



Contact: Alison Sweeney (alison.sweeney@yale.edu)

URL: <https://physics.yale.edu/people/alison-sweeney>

Research Area: biological physics

Research Description: biological self-assembly

Research Opportunities

Within Yale

- [Yale Science & Quantitative Reasoning Opportunities Page](#)
- [Yale College Dean's Research Fellowship & Rosenfeld Science Scholars Program](#)
- [Yale College First-Year Summer Research Fellowship in the Sciences & Engineering](#)
- [Yale Science & Quantitative Reasoning: STARS](#)
- [Yale Science & Quantitative Reasoning: Tetelman Fellowship](#)

Outside Opportunities

- [CMS Summer Research Experience in Germany at the University of Hamburg](#)
- [Perimeter Institute for Theoretical Physics Undergraduate Theoretical Physics Summer Program.](#)

Appendix

Research Areas in Physics

Name	Rank	Astro	AMO	Biophysics	Condensed Matter Experiment	Condensed Matter Theory	Gravitation	Nuclear Experiment	Nuclear Theory	Particle Experiment	Particle Theory	Quantum
Alhassid, Yoram	Professor											
Appelquist, Tom	Professor											
Baker, Keith	Professor											
Baltay, Charlie	Professor											
Barrett, Sean	Professor											
Caines, Helen	Professor											
DeMille, Dave	Professor											
Fleming, Bonnie	Professor											
Girvin, Steve	Professor											
Gladney, Larry	Professor											
Glazman, Leonid	Professor											
Harris, Jack	Professor											
Harris, John	Professor											
Heeger, Karsten	Professor											
Lamoreaux, Steve	Professor											
Mochrie, Simon	Professor											
Moncrief, Vincent	Professor											
Read, Nick	Professor											
Shankar, R.	Professor											
Skiba, Wittek	Professor											
Tipton, Paul	Professor											
Urry, Meg	Professor											
Daisuke, Nagai	Associate Professor											
Demers, Sarah	Associate Professor											
Goldberger, Walter	Associate Professor											
Maruyama, Reina	Associate Professor											
Padmanabhan, Nikhil	Associate Professor											
Poland, David	Associate Professor											
Sweeney, Alison	Associate Professor											
Cheng, Meng	Assistant Professor											
Da Silva Neto, Eduardo	Assistant Professor											
Machta, Benjamin	Assistant Professor											
Moore, David	Assistant Professor											
Navon, Nir	Assistant Professor											
Newburgh, Laura	Assistant Professor											

Associated Centers and Departments

The Yale Physics Department fosters cross-disciplinary research collaborations worldwide and across Yale University:

Yale Physics in on-campus centers, programs and institutes:

- [Center for Research on Interface Structures and Phenomena \(CRISP\)](#)
- [Integrated Program in Physical and Engineering Biology \(PEB\)](#)
- [Program in Solar and Terrestrial Physics](#)
- [Yale Center for Astronomy & Astrophysics \(YCAA\)](#)
- [Yale Center for Quantum Information Physics \(CQuIP\)](#)
- [Yale Center for Microelectronic Materials and Structures](#)
- [Yale Institute for Nanoscience and Quantum Engineering \(YINQE\)](#)
- [Yale Quantum Institute](#)

- [Yale Wright Laboratory](#)

Affiliated departments and schools

- [Astronomy](#)
- [Applied Physics](#)
- [Chemistry](#)
- [Computer Science](#)
- [Geology & Geophysics](#)
- [Mathematics](#)
- [Mechanical Engineering](#)
- [Molecular Biophysics & Biochemistry](#)
- [Molecular, Cellular, and Developmental Biology](#)
- [Neuroscience](#)
- [School of Engineering](#)

For further information on research in the physics department please see <https://physics.yale.edu/research>