Undergraduate Research Advisors Contact Information (2016-2017)

First	Last	Research Area	Office	Phone	Email
Helen	Caines	Nuclear Physics - Relativistic Heavy Ions	Wright Lab-W 306	(203) 432-5831	helen.caines@yale.edu
Damon	Clark	Molecular, Cellular and Developmental Biology	KBT 224	(203) 432-0750	damon.clark@yale.edu
David	DeMille	AMO (Atomic, Molecular, and Optical Physics)	SPL 46	(203) 432-3833	david.demille@yale.edu
Karsten	Heeger	Experimental neutrino physics and dark matter	JWG 508	(203) 432-3082	karsten.heeger@yale.edu
Jonathon	Howard	Biophysics	Bass 334A	(203) 432-7245	jonathon.howard@yale.edu
Simon	Mochrie	Experimental Condensed Matter Physics / Biophysics	SPL 68C	(203) 436-4809	simon.mochrie@yale.edu
David	Moore	Experimental particle physics	Wright Lab 220	(203) 432-7986	david.c.moore@yale.edu
John	Murray	Psychiatry	34 Park Street	(203) 737-2382	john.murray@yale.edu
Nir	Navon	AMO (Atomic, Molecular, and Optical Physics)	Sloane Physics Lab TBA	ТВА	nir.navon@yale.edu
Laura	Newburgh	Nuclear/Particle/Astrophysics	Wright Lab TBA	ТВА	newburgh@di.utoronto.ca
Paul	Tipton	Experimental Particle Physics	SPL 34	(203) 432-3651	paul.tipton@yale.edu
Claudia	Urry	Astrophysics	HLH46 109	(203) 432-5997	meg.urry@yale.edu
For advising	also see: http://	/spsyale.sites.yale.edu/advising			

Relativistic Heavy Ion Research at Yale Caines-Harris Group (Contact: helen.caines@yale.edu)



Research conducted at:

STAR at RHIC– BNL, New York and ALICE at the LHC- CERN, Switzerland



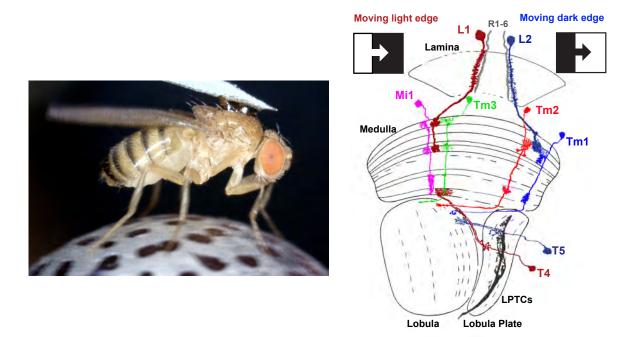
The Relativistic Heavy-Ion Group is an experimental research group based in the Wright Laboratory focused on activities at the <u>STAR</u> experiment at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) on Long Island, New York, and at the <u>ALICE</u> experiment with heavy ions beams at the Large Hadron Collider (<u>LHC</u>) located at the Center for European Nuclear Research (<u>CERN</u>) near Geneva, Switzerland. Both experiments are designed to investigate the hot and dense Quark-Gluon Plasma that is created when heavy ions (such as gold and lead nuclei) collide at ultra-relativistic speeds. The medium formed in these collisions is incredibly hot (several trillion degrees (Kelvin) absolute temperature) and dense. So hot in fact that the colliding nuclei, and the protons and neutrons inside, "melt", temporarily producing a soup of liberated quarks and gluons – the most elementary building blocks of all nuclear matter. This Quark-Gluon behaves like an explosively expanding near-perfect liquid.

Our group helps collect and analyze the data recorded by the STAR and ALICE detectors to further understand the properties of this intriguing new state of matter. Currently we are focused on understanding how fast moving quarks and gluons propagate through the Quark-Gluon Plasma. This research is important to understand the early evolution of our universe, since a Quark-Gluon Plasma is believed to have existed a few micro-seconds after the Big Bang.

We are also actively pursuing several research hardware projects designing and testing new detector technologies. In particular group members are part of ALICE's tracking detector upgrade. In laboratories here at Yale we are assembling and testing new inner read-out chambers for the ALICE's Time Projection Chamber.

The group currently consists of 2 Faculty members, 2 Research Scientists, 3 Post-Doctoral Researchers and 9 Graduate students. Each summer we seek enthusiastic undergraduates to join the Relativistic Heavy Ion research team. You will work closely with a group member performing independent studies in this innovative and exciting field of Nuclear Physics. If you are interested in learning more, please contact Prof. Helen Caines.

Clark Lab Damon A. Clark Departments of Molecular, Cellular, and Developmental Biology and of Physics http://clarklab.yale.edu damon.clark@yale.edu

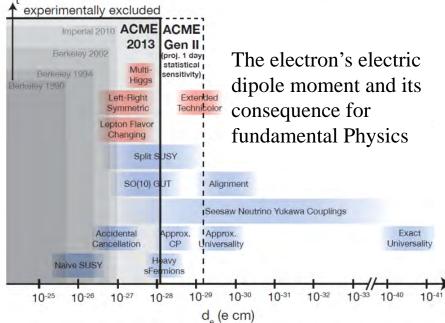


We are interested in understanding how neurons compute. To do this, we investigate the neural processing steps in the visual system of the fruit fly *Drosophila*, where luminance signals from photoreceptors are transformed into signals of visual motion. We want to learn what algorithm mathematically describes these processing steps, and also to learn how the neurons in these circuits implement that algorithm. To investigate this circuit, we capitalize on the genetic tools in *Drosophila* and measure the response properties of single neurons and neural connections. We also silence those single neurons and learn how that silencing affects the circuit's computation and the fly's behavioral responses. With these measurements and manipulations, we develop and test quantitative models for how a small visual circuit extracts motion information from the visual world. The computations involved – filtering, nonlinear interactions, and subtraction – are common to many circuits and computations, so the principles we extract will apply broadly across neural systems.

DeMille group @ Yale



Experimental atomic, molecular and optical (AMO) Physics

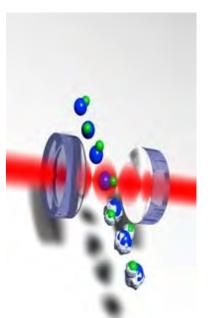




The diatomic molecule: our workhorse



Undergraduate research projects in lasers, optics and electronics



Molecular cooling and spectroscopy



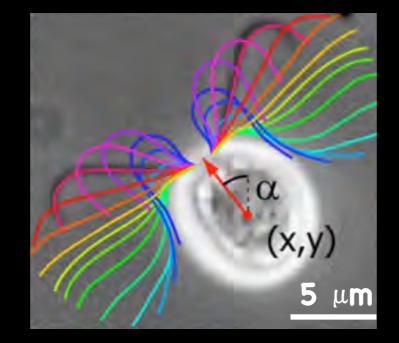
Contact: david.demille@yale.edu

howardlab.yale.edu Mechanics of Cell Shape and Motion

Microtubule dynamics



Varga et al. 2009 Gardner et al. 2011 Zanic et al. 2013 Podolski et al. 2014 Bowne-Anderson et al. 2015 Flagellar motility



Riedel-Kruse et al. 2007 Friedrich et al. 2010 Geyer et al. 2013 Mukundan et al. 2014 Geyer et al. 2016 Sartori et al. 2016 Neuronal morphology

new project!

Mechanical feedback organizes the cytoskeleton Experimental AND theoretical approaches!

Simon Mochrie

Project 1: Tensegrity Mechanics.

(Theory project suitable for someone who knows Newton's Laws and may be interested in learning a little representation theory.)

A tensegrity (tensional integrity) structure, or simply a tensegrity, consists of a number of compression elements that are connected together by tension elements. According to the strictest definition, a tensegrity's compression elements can not contact each other, but the

tensegrity nevertheless is self-supporting, and is more-or-less rigid under the action of external forces. Interestingly, tensegrities may be a model for a number of biological structures. Specifically, it has a been hypothesized that the cytoskeleton forms a microscopic tensegrity, in which actin filaments are cables under tension and microtubules are struts under compression. The figure shows a 120 strut tensegrity built from drinking straws and rubber bands, that could be a model of cell mechanics. Remarkably, the theory for this structure has not been worked out yet. This project seeks to do just that.



Project 2: super-resolution optical fluctuation imaging.

(Computational and/or wetlab project suitable for someone who knows MatLab or wants to learn it and/or wants to use web-lab skills in a physics context)

The 2014 Nobel Prize in Chemistry, awarded to Bertzig, Hell and Moerner "for the development of super-resolved fluorescence microscopy", recognized the on-going revolution in our capability to image nanoscale structures within living systems, that super-resolution methods have initiated. Recently, super-resolution optical fluctuation imaging (SOFI) has been proposed and demonstrated. SOFI generates sub-diffraction-limit images by examining the temporal fluctuations in a sequence of images. Favorable features of SOFI include that: it enhances the resolution along all three dimensions; it eliminates uncorrelated background signal, thus improving contrast; and it can be implemented entirely in software. Thus, SOFI has the potential to give every microscope set-up super-resolution capability. This project seeks to develop and implement a new version of SOFI – TPR-SOFI -- that overcomes a number of its key limitations. TPR-SOFI will employ the reversible binding and unbinding of a fusion protein, consisting of a tetratricopeptide (TPR) protein, which serves as a binding module, fused to an array of (say) five tandem FPs. The TPR reversibly binds a specific five-amino acid tag, that itself will be fused to the protein of interest. Thus, when the TPR-multi FP construct binds to or unbinds from the

amino-acid-tagged protein, there will be an approximately five-fold larger change in intensity than for a single FP, switched optically. The figure shows a proof-of-principle microscopy image of bacteria (E. coli) expressing a protein called Ftsz that binds a fluorescently-tagged TPR, which are the bright spots. One subproject, which is computational, is to write software to turn a movie of such microscopy images into super-resolution images. Another sub-project, which is wetlab-based, is to participate in engineering TPR-multi-FP fusion proteins to massively improve the signal-tonoise in TPR-SOFI.





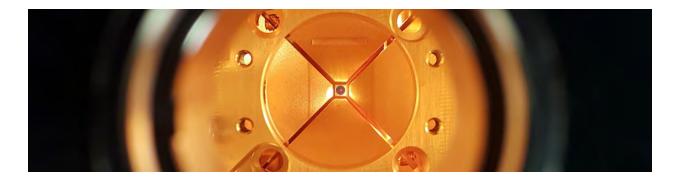
Experimental Neutrino and Particle Physics at Wright Lab *Prof. David Moore*

Our group is developing new technologies aimed at answering some of the major outstanding questions in nuclear and particle physics:

- What are the fundamental properties of neutrinos? Are neutrinos Majorana particles?
- · What is the nature of dark matter and dark energy?
- Are there new fundamental interactions or deviations from gravity that can be observed at microscopic distances?

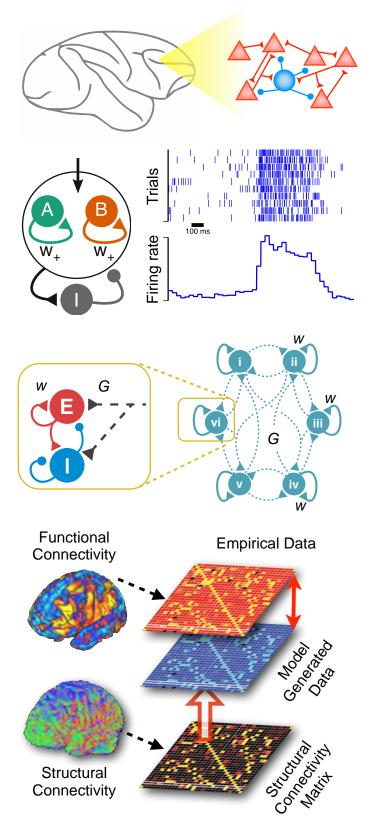
Answering these questions requires applying cutting-edge techniques from particle, nuclear, atomic, and optical physics in experiments aimed at understanding the basic building blocks of the universe. See <u>http://campuspress.yale.edu/moorelab/</u> for more details on these experiments.

Research projects are available for undergraduate students!



Computational Neuroscience

Modeling Brain Circuits to Uncover Principles of Dynamics and Function John Murray, Ph.D. (Yale Physics B.S.'06, Ph.D.'13) http://murraylab.yale.edu john.murray@yale.edu



Questions

- What are the **computational principles** governing how the brain works? (How can we "do physics" on neural systems?)
- How can we model brain dynamics across **multiple spatiotemporal scales** (synapses, neurons, circuits, networks)?
- How do neural circuits physically compute core **cognitive functions**, such as working memory and decision making?
- How do **large-scale network** dynamics emerge from structured long-range connections and local properties?
- How can we model brain **disorders** as perturbations to model parameters?

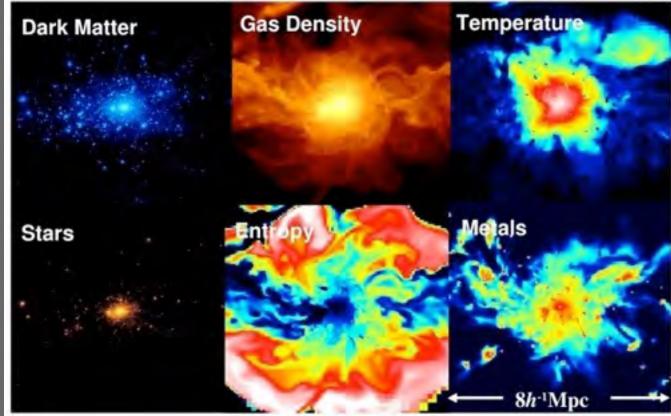
Techniques

- **Computational modeling** over multiple scales of analysis, from local spiking microcircuits to large-scale networks
- Dynamical systems theory (e.g., attractors, oscillations)
- High-performance cluster computing for model simulation and analysis
- Analysis of experimental data: — single-neuron spike-train recording
 - whole-brain neuroimaging

Skills involved: Scientific programming (Python preferred)

Computational Astrophysics @ Yale



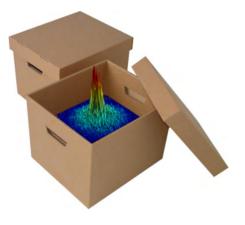


Daisuke Nagai

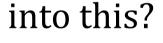
Associate Professor in Physics & Astronomy

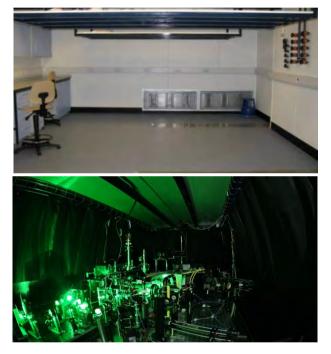
Research Interests – Computational Cosmology & Astrophysics: Galaxy Clusters, Galaxy Formation & Evolution, Dark Energy, Dark Matter, Cosmological Simulations, High-Performance Computing

Ultracold Quantum Gases @ Yale Nir Navon



Interested to turn this





Quantum gases are among the coldest substances in the universe, cooled in the lab down to a few nano-degrees above absolute zero.

Today, we can manipulate and observe these ultracold gases with exquisite control, with lasers (and other tools). This has allowed, over the last few years, to use quantum gases as fascinating systems to study diverse exotic quantum phenomena, such as superfluidity or topological phases of matter (see this year's Nobel prize award).

The start of the ultracold quantum gas lab at Yale in January is a rare opportunity to learn many experimental techniques related to the laser cooling and trapping of atoms at ultralow temperatures.

Contact me if you are interested! nn270@cam.ac.uk



Newburgh group

- 21cm radio CHIME and HIRAX
 - beam measurements with holography and drones
 - development of HIRAX analog chain
 - development of cryogenic noise measurement
 - fun analysis projects because we just built the instrument and have a lot to learn
- Cosmic Microwave Background — ACT and Simons Observatory
 - auxiliary data sets: hardware, software, and testing

CHIME — radio interferometer to measure Dark Energy



HIRAX prototype measure Dark Energy



Atacama Cosmology Telescope - microwave telescope to measure early Universe physics



The Tipton ATLAS High Energy Physics Group

Tipton's group is pursuing:

ATLAS at CERN:

-Deeper understanding of Higgs boson production and decay modes using the ATLAS detector at the LHC

-Using machine learning to search ATLAS data for events with two Higgs bosons, a signature common in many models containing new particles or new forces. ATLAS Upgrade:

 -We sometimes have positions for mechanical engineering students to help with R&D on new particle detectors. We are currently prototyping very low mass
Carbon structures (carbon foam, honeycomb, and facings) for use as structural support of particle detector sensor elements.

Other Projects:

Crayfis:

ile calorimeters

-Using arrays of cell phones as cosmic ray shower detectors. See https://crayfis.io/

If you are interested please contact Prof. Paul Tipton by email: Paul.Tipton@yale.edu Meg Urry's Group

Supermassive black holes & galaxy evolution





Other Undergraduate research opportunities

Yale University

Yale Society of Physics Students (SPS)

Home » Advising

Advising



Thomas Appelquist (Eugene Higgins Professor of Physics) Particle Theory: My wife Marion and I like to spend time in the Colorado mountains, and in London and Los Angeles where our children live.

Click here to contact professor.



Keith Baker (Professor of Physics)

Research interests are in experimental particle physics, especially at the interface with cosmology and astrophysics. Current activities include research at the energy frontier in the ATLAS collaboration at the Large Hadron Collider (LHC), and at the precision frontier using lasers and microwave sources, both on campus and at the Jefferson Lab's Free Electron Laser.

I used to enjoy piano, basketball, and parties ... lots of parties.

Click here to contact professor.



Charles Baltay (Eugene Higgins Professor of Physics and Astronomy)

I am an experimentalist concentrating on fundamental issues, be that in particle physics, astrophysics, or cosmology. Lately I have been working on learning about the nature of Dark Energy, the mysterious component that makes up three quarters of our universe, yet we know essentially nothing about it. We do this both from telescopes in the Andes in Chile,

and from a space mission we are proposing.

Skiing and sailing is what I do to get away from it all...

Click here to contact professor.



Helen Caines (Associate Professor of Physics)

I work at RHIC (the Relativistic Heavy Ion Collider) on Long Island and "across the pond" at the LHC (Large Hadron Collider) in Geneva, studying what happens when Au and Pb ions are collided at 99.99% the speed of light.

RESEARCH EXPERIENCES FOR UNDERGRADUATES Yale University | Summer 2016



INTERDISCIPLINARY RESEARCH

- Atomic scale design, control and characterization of complex oxide interfaces
- studying the novel chemical, electronic, and magnetic properties of nanomaterials
- Multi-scale surface engineering with bulk metallic glasses
- Theoretical modeling of nanomaterials, surfaces, and interfaces at the atomic level
- Synthesis of materials at the atomic scale

Applications due by Feb. 1, 2017

http://crisp.southernct.edu/index.php/Research_Experiences_

Crisp Center for Research on Interface Structures and Phenomena

The CRISP REU program provides students with the opportunity to conduct team-based interdisciplinary research. During the course of this eight-week research program, REU students will be conducting research under the advisement of university faculty and researchers.

NON-RESIDENTIAL REU PROGRAM: June 5 – July 31, 2017

STIPEND:

Each REU participant will receive a stipend of \$4000 (which includes \$1000 for travel/parking). These students attend all of the program events, but are responsible for transportation to and from campus.

ELIGIBILITY:

NATIONAL SCIENCE FOUNDATION

This program is open to highly motivated undergraduate students who have completed their junior year, although consideration is given to exceptionally well qualified underclassmen. US citizenship or permanent residency is required. Minorities, women and persons with disabilities are strongly encouraged to apply.

APPLICATION PROCESS:

Starting Nov. 1 candidates must apply directly to the Yale SURF program through the Leadership Alliance at <u>www.theleadershipalliance.org</u> Students must also complete a supplementary application for CRISP to indicate interest available at <u>http://crisp.southernct.edu/index.php/Research_Experiences_</u>.

CRISP is an NSF-funded Materials Research Science & Engineering Center

RESEARCH EXPERIENCES FOR UNDERGRADUATES Yale University | Summer 2017



INTERDISCIPLINARY RESEARCH

- Atomic scale design, control and characterization of complex oxide interfaces
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RESIDENTIAL REU PROGRAM: June 5– July 31, 2017

STIPEND:

Each REU participant will receive a stipend of \$4000 (which includes \$1000 for food). This is a residential program and university housing will be provided on the Yale campus.

ELIGIBILITY:

This program is open to highly motivated undergraduate students who have completed their junior year, although consideration is given to exceptionally well qualified underclassmen. US citizenship or permanent residency is required. Minorities, women and persons with disabilities are strongly encouraged to apply.

APPLICATION PROCESS:

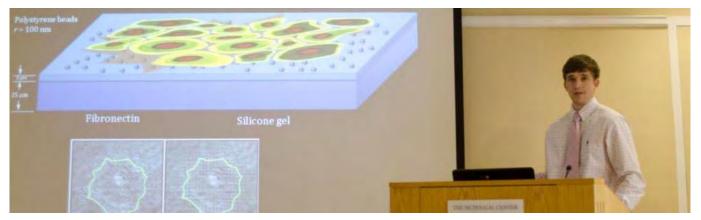
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CRISP is an NSF-funded Materials Research Science & Engineering Center

Raymond and Beverly Sackler Institute for Biological, Physical and Engineering Sciences

Home » Programs » Sackler / NSF REU

SACKLER/NSF REU SITE: Convergence of Research at the Interface of the Biological, Physical, and Engineering Sciences



Overview

This program enables undergraduates (primarily rising juniors and seniors) interested in pursuing a career in the sciences to conduct interdisciplinary research at Yale for a 10-week period during the summer. Our program focuses on research at the intersection of biology, physics, and engineering and serves as a glimpse of what graduate school at a large research institutions is like.

The REU features a series of workshops, which combine group exercises with short periods of lecturing and discussions, to complement the research experience participants obtain in individual laboratories. The workshops help students develop strong communication skills, briefly explore scientific ethics, and help participants learn about the graduate application process and the difference between a PhD and an MD/PhD. REU participants are provided with the opportunity to present their research to the Yale community, both as an oral and as a poster presentation. Finally, there are several opportunities for REU students to interact with graduate students and postdocs at Yale. We have some social activities in place for students to help them enjoy the weekends and integrate into Yale's campus and New Haven easily; however, this is not the focus of our program. Instead, we do provide participants with information on nearby recreational areas and points of interest.

This REU Site is closely linked with the Raymond and Beverly Sackler Institute and Yale's Integrated Graduate Program in Physical and Engineering Biology (PEB), and as such, hosts REU students in the laboratories of Sackler/PEB affiliated faculty (click here; to see the list of faculty labs).

Details of the research program

- The program for 2017 will run Sunday, May 28 Friday, Aug 4
- The program provides financial support of \$5,250 for the 10-week period. In addition, it will cover travel expenses up to \$400 and provide a food allowance and free room and board on Yale's campus.
- Students will be involved in a variety of enrichment activities. These include a series of workshops covering laboratory procedures, documenting laboratory results, delivering compelling presentations, and discussing scientific ethics and the process of applying to graduate school.
- Students will be able to showcase their research through a power point presentation halfway through, and a poster session towards the end, as part of an undergraduate research symposium, held in conjunction with Yale's SURF program and the CEMRI CRISP REU program at Yale.
- Research will be balanced with some social activities, such as a welcoming picnic and a cricket match.
- Selected students will be matched with Sackler/IGPPEB affiliated faculty advisors based on research interests, prior research experiences, and available openings.

NSF REU site link

How to Apply

You can apply through Yale's Graduate School Application website. Note: Because the application for the Sackler / NSF REU is set up through the online application system of Yale University's Graduate School of Arts and Sciences, some of the language throughout the application may suggest that you are applying to the Graduate School at Yale, this is not the case. Please ignore wording related to graduate study at Yale as you complete the application.

The complete application will include 1) the application form (including a personal statement), 2) a CV 3) two letters of recommendation and 4) a transcript.

Your personal statement should describe your career aspirations, your current research interests and what you hope to gain from participating in this summer program is required. Additionally, please describe any relevant research experience(s) and list 3-4 faculty members with whom you would be most interested in conducting your summer research and why.

The application deadline for 2017 is February 1.

Eligibility: you must be a permanent resident or a US citizen to apply, you must have health insurance, and you must be enrolled at an undergraduate institution the summer of your internship.

Click here to view the faculty affiliated with the program.

For questions about the fellowship e-mail dorottya.noble@yale.edu .

Partnerships

We have developed strong partnerships with Connecticut College and the University of Maryland, Baltimore County's Meyerhoff Scholars Program but applicants from non-partner institutions are also welcome.

Information for current program participants

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African Scholars | YYGS-Beljing | YYGS-Singapore Yale Young Global Scholars



The 2017 Yale Young Global Scholars application is available! Apply now >>

The deadline to apply is January 31, 2017 at 11:59 PM EST. We encourage all potential applicants to begin and complete their applications as soon as possible to ensure all materials are submitted by the deadline. Sign up for our e-newsletter to receive program updates!

An official Yale University program, participants in the Yale Young Global Scholars Program for Outstanding High School Students can expect an amazing summer experience studying in beautiful campus lecture halls and classrooms, living in Yale's historic residential colleges, eating in awardwinning dining halls, meeting a talented community of fellow students, engaging with world-renowned professors, and interacting with extraordinary visiting practitioners.

Interested in what students had to say about their YYGS experience? Read the student blogs >>

2016 YYGS alumnus Abdul Moiz put together a collection of short vignettes from participants of the International Affairs & Security session as a sort of guidebook to prospective applicants. Download Abdul's "Application Tips and What to Expect at YYGS Guidebook" >>



"Application Tips and What to Expect at YYGS Guidebook" by Abdul Moiz IAS '16

YYGS-Singapore Scholarship Winner: Rodger Chinhangue, Imagine Scholars

Alumni Reflections: "My Experience at YYGS-Singapore"



Yale Young Global Scholars: Explore Your Passion for STEM

More videos >>

CONNECTED

This mailing list is for students and educators interested in receiving program announcements >>

If you are interested in employment opportunities with YYGS, complete this form to receive information about open positions and information sessions (Current and recent Yale students only) >>

More news...

Copyright © 2016 Yale University · All rights reserved · Privacy policy Contact Yale Young Global Scholars for more program information.

2017 Summer Employment Opportunities Information Session

Thursday Nov. 10th @4 PM -- WLH 208

For Who:

Yale <u>undergraduate</u> or <u>graduate</u> student who are looking for a great paid full-time job on campus next summer

Refreshments will be provided!

Free housing & meals Competitive compensation Two, four or six week positions available

More Information: http://globalscholars.yale.edu/join-us-1





Sign In





Grants

YSEA Undergraduate Grants

YSEA Undergraduate Grants are intended to fund a finite project or project phase that has specific objectives and can be completed within a predetermined time-frame. Grant recipients are selected based on technical merit, learning potential and available funds. The application process for individual and group grants has four required elements:

- 1. 1-2 page abstract of the grant proposal
- 2. Itemized budget
- 3. Letter of support from a faculty advisor
- 4. Contact information for the department administrator to whom grant funds are to be sent.

The abstract should include detail on the specific deliverables associated with the project scope, methods to be used in developing and validating project deliverables and other goals for the scope of work to be funded. Each grant is intended to fund a single project with a clear indication of expenses for which the YSEA Grant funds will be used. The abstract should also provide an overview of project participants including students, advisors and any outside resources.

The budget contains an itemized bill of materials for required equipment, supplies and other expenses needed to complete the project or experiment prior to the start of the next academic year. Details on the source(s) of any additional funding needed to complete the project or experiment will allow the Grants Committee to confirm viability of project scope and deliverables. Note that YSEA grant funding is not provided for teaching, travel or general purpose equipment like computers or software.

Grant recipients are asked to submit a report at the conclusion of the project. We generally ask that these submittals be suitable for publication in the <u>Yale Scientific Magazine</u> or the <u>YSEA web site</u>. Note that eligibility for future grant funding is contingent on receipt of a summary at the conclusion of the project for each grant received.

To apply for a YSEA grant (individual or group) please contact the YSEA undergraduate grants committee at Grants@YSEA.org.

2015-2016 Grant Recipients

Individual Research Grants

Student	Description	Web site	Report
Benjamin Lerude	Application Sensing for Music: An Investigation into the Artificial Intelligence Behind Music Streaming		
Kevin Nguyen	Mechanisms of EXO1 and MRN in DNA Resection and Homologous Recombination		

Group Grants

Group	Description	Web site	Report
Bulldogs racing team	Design, construct & race a hybrid formula car	http://bulldogsracing.com/	
YUAA CubeSat Team	Develop a miniaturized satellite capable of one way laser communication	http://yaleaerospace.com /team/	
High-Performance UAV team	Design, construct, and fly an unmanned aerial vehicle (UAV) that is optimized for efficient flight	<u>http://yaleaerospace.com</u> /team/	

View Past Recipients

- <u>2014-2015</u>
- 2013-2014

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