### **RESEARCH/JOB OPPORTUNITIES AT UA Spring/Summer 2019**

#### ASTRONOMY

## 

#### 1) **Space Situational Awareness (SSA)**: Dr. Eric Pearce (epearce@email.arizona.edu) Steward N514 (paid position) US Citizenship required

Students have multiple opportunities to support our Steward Observatory Space Situational Awareness (SSA) team. This team strives to develop and adapt astronomical techniques and instruments to the challenging task of detecting and characterizing man-made objects in Earth orbit. Students will help operate and process photometric data from a 3-channel very high speed photometer on the 61" Kuiper telescope. Specific tasks include the planning, collection, calibration, processing, and interpretation of multi-color photometric data of both astronomical objects and man-made satellites. All code will be in Python and camera operation is in the Windows 10 environment. With the team's other instrument, a portable small wide field of view telescope, we need observing assistants to help with the deployment and operation of the telescope. This telescope will be monitoring night sky brightness and light pollution at our four observatory sites surrounding Tucson, and performing astrometric/photometric surveys of the sky to measure man-made satellites.

During 2019 the team will be adapting our photometric processing pipeline to calibrate five-color photometric observations of satellites with the UKIRT WFCAM telescope. Tasks include adapting the photometric pipeline software to tie the satellite photometry to calibration fields that are "off target", and collected prior to, or periodically during the collect. Calibration field selection and observation planning will also be required to make these observations.

# 2) **Virtual and Augmented Reality:** Dr. Chi-Kwan Chan (<u>chanc@email.arizona.edu</u>) Steward N332 (unpaid positions)

The AstroXR team would like to invite students to help developing several virtual and augmented reality (VR/AR) apps for astronomy. The apps will explain different aspects of astronomy projects such as the OSIRIS-REx Mission <<u>https://www.asteroidmission.org/</u>> and the Event Horizon Telescope <<u>https://eventhorizontelescope.org/</u>>. By the end of the project, students will learn the 3D model creation suite Blender <<u>https://www.blender.org/</u>>, the game engine Unity <<u>https://unity3d.com/</u>>, best-practices in software and data versioning using git <<u>https://git-scm.com/</u>>, and the necessary math for 3D computer graphics.

Basic programming skills are recommended (e.g. Phys 105A or CSC equivalents)

#### STARS: LIVES & DEATH

1) **Supernovae & Massive Stars**: Dr. Nathan Smith (nsmith@email.arizona.edu) Steward 336 (initially unpaid, but possibility of paid position later)

Observational research on supernova explosions, massive star eruptions, massive star evolution, and star forming regions. Students can be involved with observing using Arizona's optical/infrared telescope facilities, as well as reducing and analyzing optical and infrared data taken with these telescopes and the Hubble Space Telescope. Our goal is to try to understand the violent death throes of massive stars by constraining the physical properties of their explosions, progenitor stars, and the local environments in their host galaxies using the change in time indicated by their imaging photometry and spectroscopy. A wide range of different research projects are available; contact Prof. Smith if interested.

#### PLANETS

1) **Exoplanets & Astrobiology** Attending Dr. Daniel Apai's Group Meetings (Contact Dr. Jon Rees (<u>jmrees@email.arizona.edu</u>).

Dr. Apai welcomes undergraduate students to attend his group meetings, which cover topics related to exoplanets and astrobiology.

BLACK HOLES & GRAVITATION

1) Black Holes and Quasars: Attending Dr. Xiaohui Fan's Group Meetings (fan@as.arizona.edu) Steward 340

Dr. Fan welcomes undergraduate students to attend his group meetings (weekly, Tuesdays at 3:30 PM). Come learn about the most massive black holes at high redshift and their evolution over time. Please email Dr. Fan to find out more about this opportunity.

2) **Gravitation and Relativistic Astrophysics:** Attending Dr. Vasileios Paschalidis' Group Meetings (<u>vpaschal@email.arizona.edu</u>) Steward 338

Dr. Paschalidis welcomes undergraduate students to attend his group meetings (weekly, Wednesdays 2-4 PM in or outside Parker Library at Steward Observatory).

## GALAXIES

1) Characterizing Natural Telescopes in Space: Dr. Brenda Frye (<u>bfrye@as.arizona.edu</u>) Steward 336 (unpaid positions)

This semester our group will learn how to estimate the redshifts of galaxies based off the their broadband colors. We will also learn how to reduce and analyze near-IR spectroscopy of galaxies situated behind dense galaxy cluster fields. Projects in these areas are leading to a better understanding of dark matter and galaxies at early stages of their evolution.

2) Assessing the Perfomance of the JWST/NIRCam Image Simulator PhoSim-NIRCam: Dr. Eiichi Egami (<u>eegami@as.arizona.edu</u>) Steward 274 (unpaid positions)

JWST (James Webb Space Telescope) is the next large space telescope that will be launched by NASA and ESA (European Space Agency) in 2021. As a preparation, our group has been developing an image simulator for JWST's NIRCam (Near-Infrared Camera), which was built under the leadership of Univ. of Arizona (PI: Marcia Rieke). The student will work on assessing the peformance of this image simulator (called PhoSim-NIRCam), and will help ensure that the images it produces are reliable and realistic. The work will also include simulating some real sky areas (e.g., a patch of the Large Magellanic Cloud) that will be observed as part of the NIRCam in-orbit commissioning. More details of PhoSim-NIRCam can be found at <a href="https://fenrir.as.arizona.edu/phosim">https://fenrir.as.arizona.edu/phosim</a>.

Basic programming skills are recommended (e.g. Phys 105A or CSC equivalents)

3) Galaxy Structure Attending Dr. Dennis Zaritsky's Group Meetings (dfz@email.arizona.edu) Steward 328

Dr. Zaritsky welcomes undergraduate students to attend his group meetings (held every other Wednesday from 2-3 PM in N305). Learn about the structure of a new class of low surface brightness galaxies and topics in galaxy evolution. Please email Dr. Zaritsky to find out more about this opportunity.

#### PHYSICS

## ATOMIC, MOLECULAR and OPTICAL / HIGH ENERGY / NUCLEAR PHYSICS

1) Dr. Bira van Kolck (vankolck@email.arizona.edu) PAS 386B (unpaid positions)

Research interests are on effective field theories applied to particle, nuclear, atomic, and molecular physics. Emphasis is on the development of systematic low-energy expansions in the presence of bound states and resonances

BIOPHYSICS

1) Dr. Charles Wolgemuth (wolg@email.arizona.edu) PAS 451

My group does research in biophysics. We focus on understanding how cells produce forces to move, grow and divide. We use every technique that we can throw at a problem, from experiments to computational modeling and data analysis. Being strongly interdisciplinary, my group is accustomed to taking in new students and teaching them how to do research at the cutting edge between physics and biology. If you've ever wondered about the role that physics plays in your own body, our research might interest you.

CONDENSED MATTER

1) Dr. Brian LeRoy (<u>leroy@physics.arizona.edu</u>) PAS 547 (initially unpaid with possibility of paid positions in summer)

I work in experimental condensed matter physics. My research focuses on studying the electronic and optical properties of 2D materials which are a single or few atoms thick. In order to study these materials they need to be isolated from bulk crystals. This involves exfoliating crystals and then using several characterization techniques to identify the materials of interest, all of which can be done by undergraduate students.

2) **Dr. Weigang Wang** (<u>wgwang@physics.arizona.edu</u>) PAS 441 (unpaid and paid positions available)

I work on experimental condensed matter physics. In particular, we study the quantum mechanical tunneling of electrons in nanostructures. I have 3 undergrads working in my lab this semester. I have an immediate opening for a URM student. He/she will learn how to test the resistance change of a nanopillars under magnetic field. The URM student will be paid by \$4000-\$5000 for the research in summer 2018. For more information on our research. please visit: http://www.physics.arizona.edu/~wgwang

## CONDENSED MATTER & ATOMIC, MOLECULAR AND OPTICAL PHYSICS

1) **Dr. Sumit Mazumdar** (<u>mazumdar@email.arizona.edu</u>) PAS 374 (unpaid and paid positions available)

Multiple topics in Atomic, Molecular and Optical Physics and Condensed Matter Physics.

2) **Dr. Mohammad Hassan** (<u>mohammedhassan@email.arizona.edu</u>) PAS 363 (unpaid positions available)

<u>Research projects available in Ultrafast Laser Science.</u> My research focuses on achieving the attosecond temporal resolution in electron microscopy by generating attosecond electron pulses and establishing "**Attomicroscopy**" field. Which will be utilized for recording movies of electronic and atomic motion in Action.

### COSMOLOGY

1) Dr. Eduardo Rozo (<u>erozo@physics.arizona.edu</u>) PAS 420G (initially unpaid with possibility of paid positions later)

Dr. Rozo is an experimental cosmologist, utilizing large scale structure probes to better understand the physics behind the accelerated expansion of the Universe: that is, since gravity pulls, how is it possible for the expansion of the Universe to be accelerating? Dr. Rozo's research directly addresses this problem by utilizing the abundance galaxy clusters in large volume surveys. If you are interested in cosmology — be it theory or experimental — please do not hesitate to stop by his office for a chat.

### PARTICLE PHYSICS

1) **Dr. Ken Johns** (johns@physics.arizona.edu) PAS 454 (initially unpaid with possibility of paid positions later)

I work in experimental particle physics on the ATLAS experiment at the CERN LHC. I do data analysis searching for exotic new particles and also build electronics for detectors. Currently I have three undergraduates working in the lab, mostly on electronics projects. A good time to check in is March, which is typically when we form our summer hiring plan. Additionally, in the fall 2018 we will need a significant number of undergraduates (6-8) to help with testing production electronics for Micromegas detectors.

2) **Dr. John Rutherford** (<u>rutherfo@physics.arizona.edu</u>) PAS 442 (unpaid and paid positions available)

Projects available to study experimental elementary particles. Using the highest energy accelerators to probe the smallest sizes. Developing cutting-edge instrumentation and detectors to improve our ability to see even finer detail.

## 3) Attending Group meetings hosted by Dr. Erich Varnes, Dr. Ken Johns and Dr. Elliott Cheu (contact: <u>varnes@physics.arizona.edu</u>., johns<u>@physics.arizona.edu</u>) PAS 432

Undergraduates are welcome to attend group meetings on experimental particle physics. Weekly meetings are hosted by the three listed professors and their postdocs and students – the team is happy to have interested undergraduates sit in. 9 AM Fridays in PAS 432.