

# University of Hawai'i Institute for Astronomy

Subaru User's Meeting  
January 2024

Mo'okini Heiau





# *IfA Research*

Photo: Bo Reipurth



# Hawai'i Astronomers Discover Death-Defying Planet

New *Nature* paper (lead author Marc Hon, IfA postdoc) describes an exoplanet in close orbit around a core-helium-burning star; i.e., the star should have expanded well beyond the planet's orbit during its red giant stage, and thus the planet should have already been engulfed

## Other IfA-connected authors

Current faculty: Dan Huber, Ben Shappee

Current postdocs: Dan Hey, Joel Ong

Current students: Jingwen Zhang, Casey Brinkman

Alumni: Zach Claytor (PhD 2022), Ashley Chontos (PhD 2022)

Former postdocs: Jamie Tayar, Lauren Weiss

Former faculty: Andrew Howard



UH News, 2023-06-28: <https://www.hawaii.edu/news/2023/06/28/death-defying-planet/>

Link to paper: <https://doi.org/10.1038/s41586-023-06029-0>



# Ho'oleilana

## Ho'oleilana: An Individual Baryon Acoustic Oscillation?

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<sup>2</sup>*School of Mathematics and Physics, The University of Queensland, Brisbane, QLD 4072, Australia.*

<sup>3</sup>*Institut de Recherche sur les Lois Fondamentales de l'Univers, CEA Université Paris-Saclay, 91191 Gif-sur-Yvette, France*

### ABSTRACT

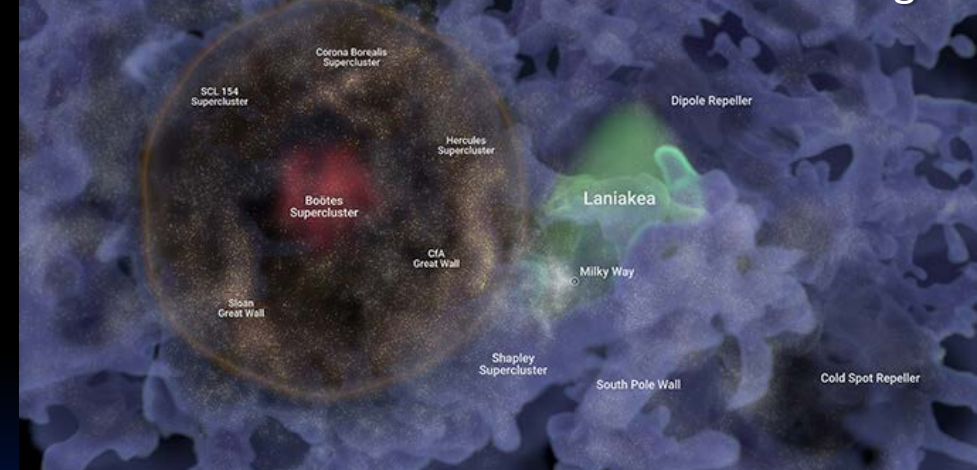
Theory of the physics of the early universe leads to a prediction of baryon acoustic oscillations that has received confirmation from the pair-wise separations of galaxies in samples of hundreds of thousands of objects. Evidence is presented here for the discovery of a remarkably strong *individual* contribution to the baryon acoustic oscillation (BAO) signal at  $z = 0.008$ , an entity that is given the name Ho'oleilana. The radius of the 3D structure is  $155 h_{75}^{-1}$  Mpc. At its core is the Boötes supercluster. The Sloan Great Wall, CMA Great Wall, and Hercules complex all lie within the BAO shell. The interpretation of Ho'oleilana as a BAO structure with our preferred analysis implies a value of the Hubble constant  $H_0 = 76.9^{+8.2}_{-4.8}$  km s<sup>-1</sup> Mpc<sup>-1</sup>.

### 1. INTRODUCTION

Pressure waves generated in the hot plasma of the early universe become imprinted in baryon fluctuations approximately 390,000 years after the hot Big Bang (Peebles & Yu 1970; Sunyaev & Zeldovich 1970). The remnants of these waves create a ruler that, observed across time in the evolving universe, provides constraints on the physics governing cosmic evolution (Weinberg et al. 2013; Aubourg et al. 2015). Eisenstein et al. (1998) investigated the possibility that early universe fluctuations caused by the baryon component of matter might explain structure on scales of  $\sim 13,000$  km s<sup>-1</sup> (Tully 1986; Tully et al. 1997; Israel et al. 1999) and hints of baryon induced features in the power spectrum of galaxy correlations were first announced by Percival et al. (2001). Subsequently, compelling evidence for what have come to be called baryon acoustic oscillations (BAOs) has been accumulating. The BAO signal can be discerned. It was demonstrated by Arnalte-Mur et al. (2012), though, that assuming BAO developed out of pre-recombination central dark matter concentrations identifiable today as rich clusters, the scales of associated BAO could be identified by wavelet analysis and the stacked density maps from  $\sim 800$  centers. These centers can be further utilized to identify the structures that contribute most substantially to the total BAO signal.

We were not looking for BAO. However visual examination of maps from the Cosmicflows-4 compilation of galaxy distances (Tully et al. 2023) revealed a structure that invited further inspection. By way of introduction, the two orthogonal views in supergalactic coordinates in Figure 1 show the distribution of galaxy groups north of the Milky Way equator in this data set.<sup>1</sup> The SGY axis roughly tracks redshifts. An evident overdensity is seen at  $SGY \approx 20,000$  km s<sup>-1</sup>, part of which is the

## Ho'oleilana - “sent murmurs of awakening”







# *Community Connections*



# October 7: AstroDay Kona





# O'ahu Outreach: October 20-21

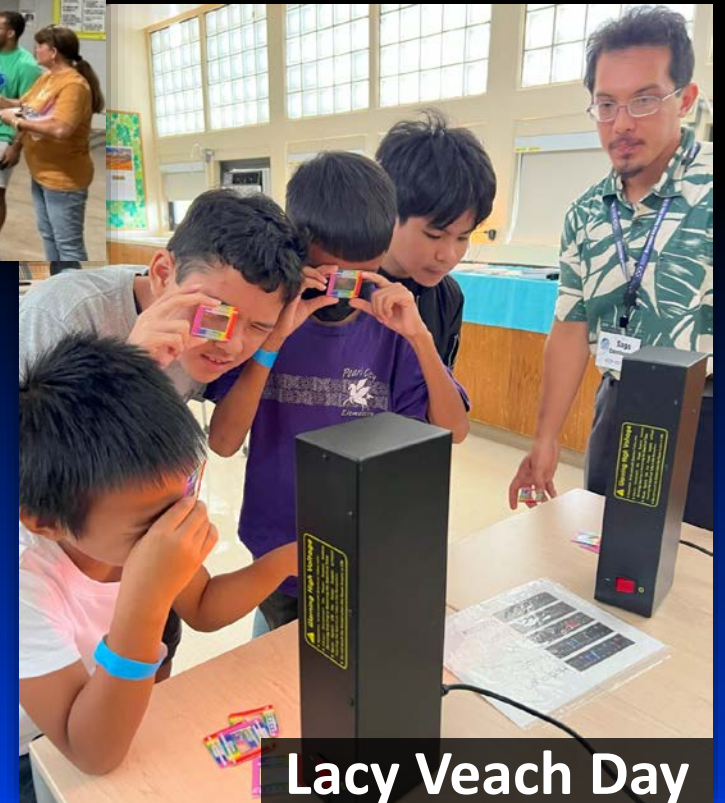
Discover UH Mānoa



Space Night @ Pearl Harbor ES



'Ohana stargazing @ SALT



Lacy Veach Day



# Maunakea Scholars at IRTF

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# Maunakea Scholars



**Waipahu HS – May 9**

**Maiyah Respicio: “Thor's Helmet Nebula: Wolf Rayet Star”**

**Malaea Perelini: “Discovery the Mystery Behind Iapetus' Light and Dark Hemispheres”**

**Casey Alhambra: “The Sun's Wild Side: Part 2”**



**Kalani HS – May 12**

**Vincent Grillo: “Using Redshift and Blueshift of Galaxies in Superclusters to Quantify Center of Mass”**

**Stephanie Lee: “Carina Constellation”**

**Last school year ~50 high school students across the state received observing time for their research projects**  
**Mahalo nui loa to our graduate students, who provide the bulk of the mentoring for this program**





# *IfA Strategic Planning*



# New Faculty at IfA

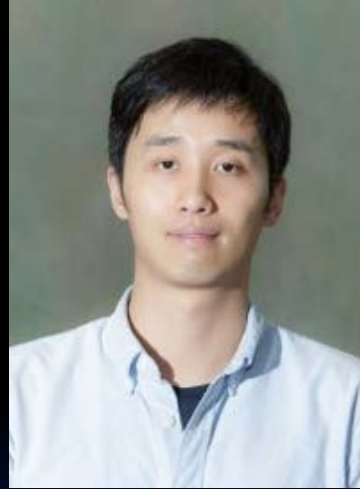
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**David Jones**

**IfA-Hilo** (January 2024)  
Einstein Fellow & Moore Fellow @  
UCSC  
PhD: Johns Hopkins

*Research focus: time domain science,  
cosmology, “Young Supernova  
Experiment” at Pan-STARRS*



**Fei Dai**

**IfA-Mānoa** (February 2024)  
NASA Sagan Fellow @ Caltech  
PhD: MIT

*Research focus: formation,  
evolution, and habitability of  
planetary systems*



**Jeffrey Reep**

**IfA-Maui** (December 2023)  
Astrophysicist @ US Naval Research Lab  
PhD: Rice University

*Research focus:  
magnetohydrodynamics of solar flares*



# Additional Faculty Hiring at IfA



University of Hawai'i at Hilo



CENTER FOR  
MAUNAKEA  
STEWARDSHIP

Maunakea  
Astronomy Jobs

[Home and Jobs Listing](#) [About the Employers](#) [About Maunakea](#) [Job Resources](#)

## Assistant Astronomer

Full time Regular Employment at [University of Hawai'i Institute for Astronomy](#)

Category:  
[Science](#)

Location:  
[Hilo](#)

Open date:  
Monday, September 18, 2023

Closing date:  
Friday, November 17, 2023

[Information/Apply](#)

### Summary

The Institute for Astronomy at the University of Hawai'i at Mānoa invites applications for tenure-track, Assistant Astronomer faculty positions. The IfA faculty are sited at three facilities on the islands of O'ahu (on the Mānoa campus), Hawai'i, and Maui, with the majority of astronomers based on O'ahu in Honolulu (Mānoa). All faculty regardless of location participate equally in the teaching program, research, and academic life at the IfA. The IfA has strong research groups in most areas of astrophysics, supported in part by access to all observational facilities on Maunakea and Haleakalā, with significant expertise in extragalactic, time domain, stellar, exoplanetary, planetary, and solar astronomy, as well as astronomical instrumentation.

Candidates in all areas of astronomy are encouraged to apply. In 2023-2024 the IfA seeks to fill five positions starting Fall 2024, four in Honolulu (on the Mānoa campus) and one in Hilo, as part of an ongoing faculty hiring plan through the 2020's.

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# Expanding IfA Directorate

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- ✱ Proceeding with recruiting *Associate Director for Research & Education*
  - ✱ This “Executive/Management” (E/M) level position was approved by UH Administration and expect to release a job ad for this important position in 4-6 weeks
- ✱ This will leave us with 3 E/Ms in the IfA Directorate
  - ✱ **Associate Director (Dave Lonborg)** – principally focused on administration leadership, strategic planning, campus matters, land management issues, MKSS, etc.
  - ✱ **Associate Director for Education and Research** – principally inward looking (optimizing our education program?, research strategic planning?, faculty workload?, Physics & Astronomy re-org?, Space Sciences Program?, Native Hawaiian Place of Learning?, etc.)
  - ✱ **Director** – Uniquely outward facing including County, State, Federal officials and agencies, MKSOA, community, MKOs (complex inter-observatory discussions), focused on securing new land authorization on Maunakea this decade in collaboration with other entities



# UH Space Sciences Initiative

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- ✳ UH is exploring resource sharing, options for inter-department collaboration, and aligning strategic priorities among related departments to enable a Space Sciences Initiative (SSI)
- ✳ Initiative relies on forming a dedicated engineering team to develop technical proposals, write grant applications, perform design engineering, teach classes, support internships, enable workforce development, etc.
- ✳ *Initial focus is on ground based instrumentation for Hawai'i astronomy and aerospace*



# UH Space Sciences Initiative

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- ✧ State legislature allocated funding to hire 10 PhD engineering faculty (via College of Engineering) and an architectural study to expand IfA-Hilo facilities
  - ✧ Representative engineering skills anticipated in this SSI team include additive manufacturing, materials science, aerospace, adaptive optics, optics, cryo-mech, advanced electronics, controls, etc.
  - ✧ Recruitment underway now with new faculty arriving at Mānoa and IfA-Hilo this summer
- ✧ *SSI will provide the first engineering classes offered at UH Hilo (of interest in the local community for many years...)*
- ✧ Maunakea Observatory collaboration will be important as SSI will be designed as a shared resource for tech-dev, workforce programs, and more broadly as a means to increase local engineering/tech expertise in Hawai'i astronomy



# Recent KITV Report on UH Space Science Initiative

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# Strategy for Developing UH Space Sciences Initiative

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- ✧ **Leverage existing UH assets** across several UH sites to build momentum behind program, leaving UH as a core/hub for Hawai'i astronomy and aerospace engineering and instrumentation development
- ✧ **Increase** engineering and tech-dev **opportunities** for students, faculty, staff through collaborative efforts
  - ✧ Institute for Astronomy, College of Engineering, UH Hilo, HSFL, SOEST, etc.
- ✧ **Expand** local high-tech **workforce** using facilities on Maunakea and Haleakalā as a platform
  - ✧ New instrumentation, facilities, upgrades, technology development, etc.
- ✧ **Augment/upgrade** existing **facilities** using new facility funding, combined with on-going instrument development strategy, to self-fund program long-term
- ✧ **Advance overall program in phases...**



# UH Institute for Astronomy - Hilo

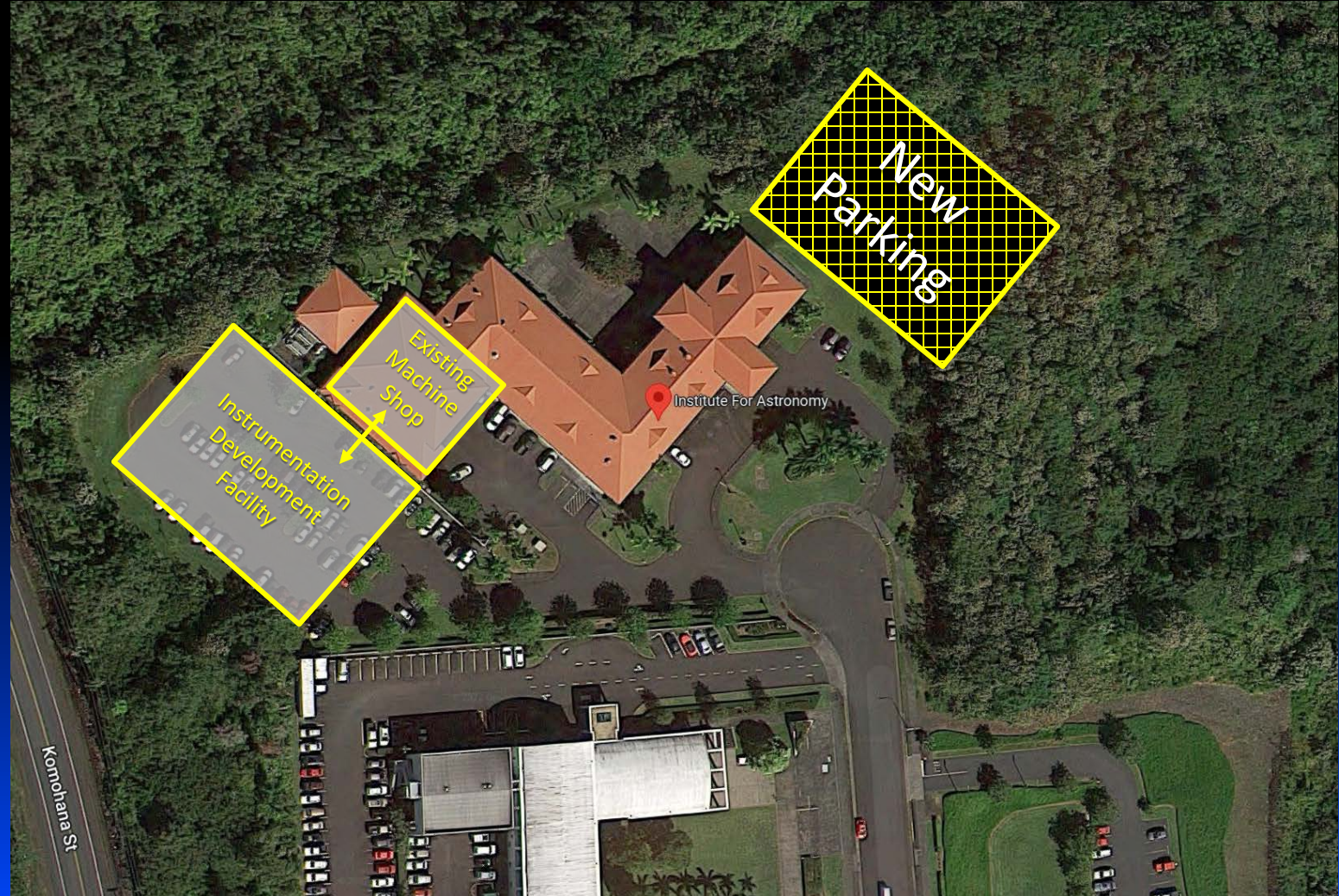
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# Expanding IfA-Hilo for New Instrument Technology Development

- \* *Allocated \$2M from State legislature to develop bid package for building addition*
- \* Preliminary architectural designs
- \* Specifications and Requirements
  - \* Floor space, layout, etc.
  - \* Parking
  - \* Labs, clean rooms, high-bay integration room, etc.
- \* Cost, schedule, permits, etc.
- \* Community engagement
  - \* UHH, College of Engineering, Chambers, etc.
- \* *Seeking Federal money for construction*



# Overall Program Development

- ✱ There are many “parts in motion” with the Space Science Initiative and in some cases tracks are being laid just before the train arrives...
  - ✱ CoE recruitment, program administration, building addition, new UH Hilo engineering classes, workforce development, overall program design within UH
    - ✧ Mindful of numerous links to astronomy and aerospace facilities, principally on Hawai‘i Island and Maui
    - ✧ On-going State and Federal fund raising will be required (e.g., building construction, more positions, etc.)
- ✱ Several rounds of recruitment probably needed to fill-out all engineering positions
- ✱ Program will be established using existing lab, office, machine shop capabilities while we proceed with IfA-Hilo building addition (completed 2030?)
- ✱ Pre-engineering classes at UH Hilo starting fall 2024 - can push out if necessary





# Advancing IfA's Mission

- ✧ These activities reflect growth in several strategic directions at IfA
  - ✧ Hiring 8 new IfA faculty, 10 faculty engineers, Associate Director for Research & Education over ~1.5 year period
  - ✧ Launching major expansion of IfA-Hilo facility to increase capacity for tech-dev, instrumentation, internships
  - ✧ First engineering program at UH Hilo
- ✧ *Despite uncertainties about Maunakea astronomy, IfA remains steadfast in building our capacity, supporting our community, and partnering via innovative programs (‘Imiloa, Ka Haka ‘Ula, Nāwahī, UHH engineering, Maunakea Observatories, etc.)*



# Mahalo

