

Institute for Astronomy-UH Report



Karen Meech

Subaru Users Meeting

March 3, 2021





Management and Faculty Changes

- Bob McLaren has retired (served as interim Jan 2018-Jan 2021)
- Karen Meech (IfA Faculty) is serving as interim



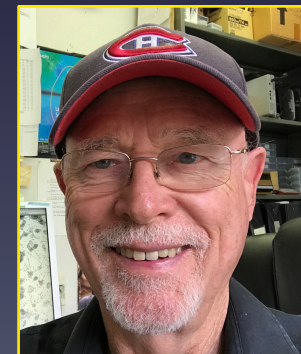
New Faculty

- Colby Haggerty – solar physics, plasmas



Retired

- Brent Tully



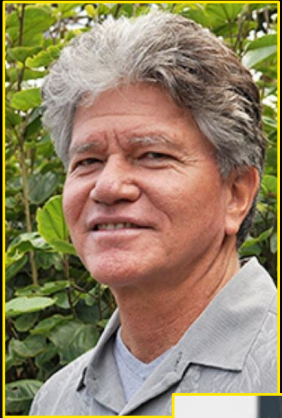


New Maunakea Lease



- Current UH lease for MK Science Reserve expires in 2033
- Work ongoing on updated Master Plan for 2020-2040 & updated Comprehensive Mgmt Plan
- EIS for new Master Lease is paused pending completion of planning projects
- State House committee recently advanced resolutions calling for formation of a working group to consider new approaches to Maunakea management
- UH will participate in the working group if/as requested, but anticipates major challenges in developing and implementing a new structure in time to ensure a future for astronomy
- UH will continue work on the current structure

Maunakea Stewardship Updates



- Final Administrative Rules for public and commercial activities took effect in Jan 2020
- UH Board of Regents approved reorganization of management entities on Maunakea, forming Center for Maunakea Stewardship under Greg Chun's leadership
- OMKM Director Stephanie Nagata retired in December after 20 years of distinguished service



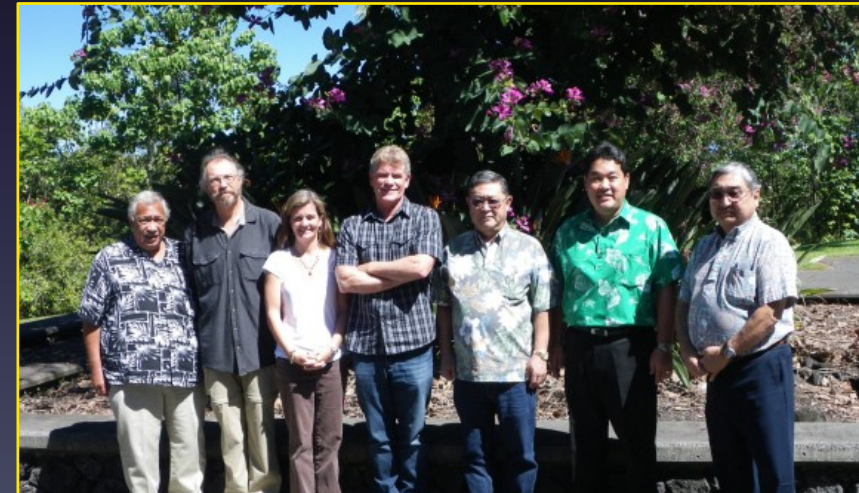
Maunakea Management Board

- **New Members**

- Billy Bergin (retired veterinarian, former UH Regent and Community leader)
- Diana Van De Car (retired attorney, long-time Volcano resident)
- Keahi Warfield (PUEO and RISE leader, Hawaiian Studies Ph.D. student)

- **Continuing Members**

- Roberta Chu, Chair (VP Bank of Hawaii)
- Greg Chun (Exec. Director, Center for Maunakea Stewardship)
- Doug Simons (CFHT Executive Director)
- Julie Leialoha (Natural Resources Management)



UKIRT Transition to full IfA Operation



- Relocated UKIRT remote observing operations and offices from EAO to IfA Hilo
- Refreshed UKIRT network and server hardware (64 bit)
- Replaced 1G Hawaiian Telcom leased line from MK summit to Hilo with 10G UH/IfA routed network link
- Virtualized data reduction, data transfer, web services
- Information security review and improvements based on NIST standard 800-53
- Created UHSDR₁ public data archive mirror at IfA Hilo

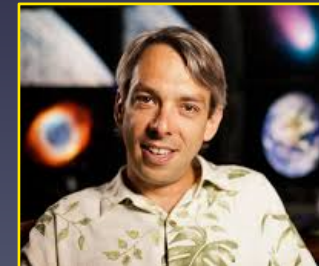
Other Subaru Efforts

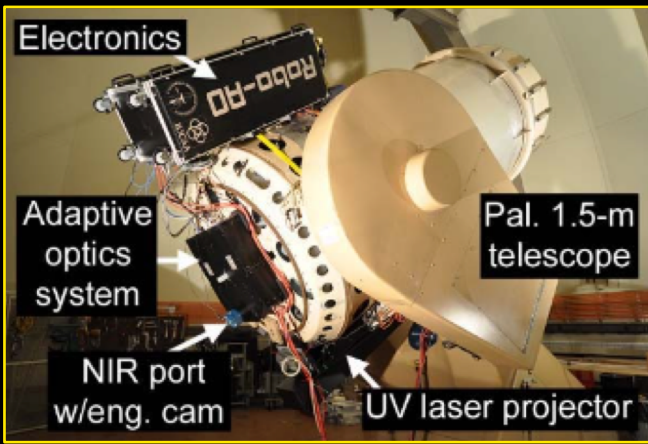


- Working with SCExAO team on near real-time data processing feedback loop
 - with science partners in Japan, USA, Australia, Europe
 - NSF funded UH/IfA 100G "data transfer nodes"



- Grad Miles Lucas working on SCExAO – quantify error budget for predictive control
- Subcontract to Postdoc Kyohoon Ahn – to work with Olivier Guyon on AO algorithmic developments for Subaru

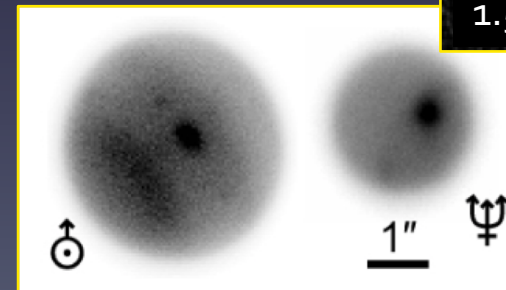
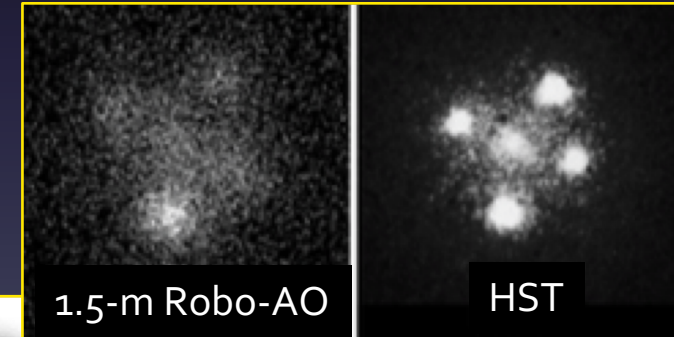
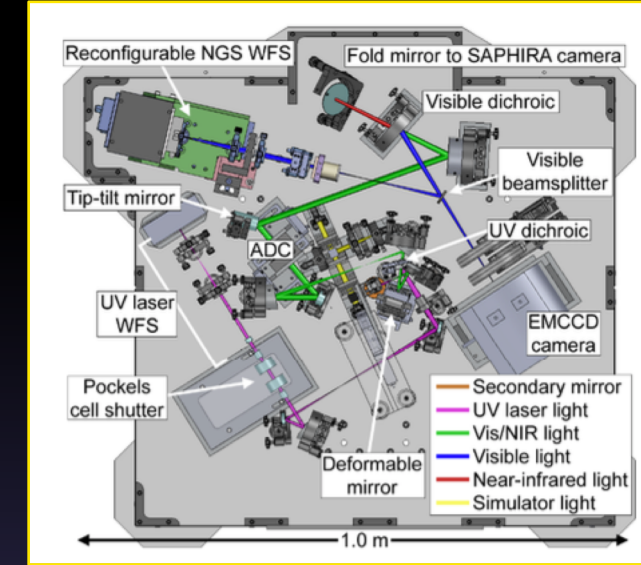
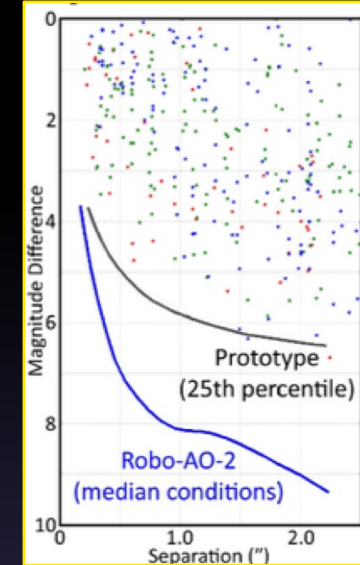




Roboticizing the UH 2.2m

Robo-AO 2 – NSF MRI award (C. Baranec)

- Goal: produce world-class science on medium-sized telescopes
- Prototyped at Palomar 1.5m
- Uniquely enabled science is listed below



Science – Extragalactic, stellar	Science – Exoplanets, planetary
IR Transient characterization	Wide Exoplanets and brown dwarfs
Discovering/monitoring QSOs	Transit exoplanet hosts (TESS)
Asteroseismology and multiplicity	Planetary monitoring
Stellar multiplicity in clusters	Small body characterization
Monitor jets / outflows / shocks	Astrometric microlensing

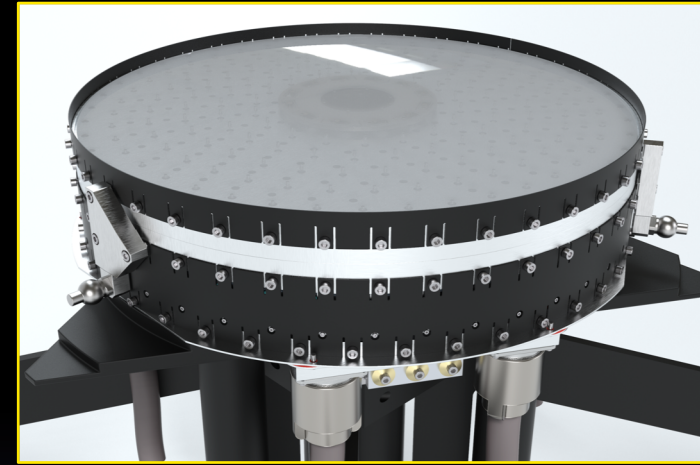
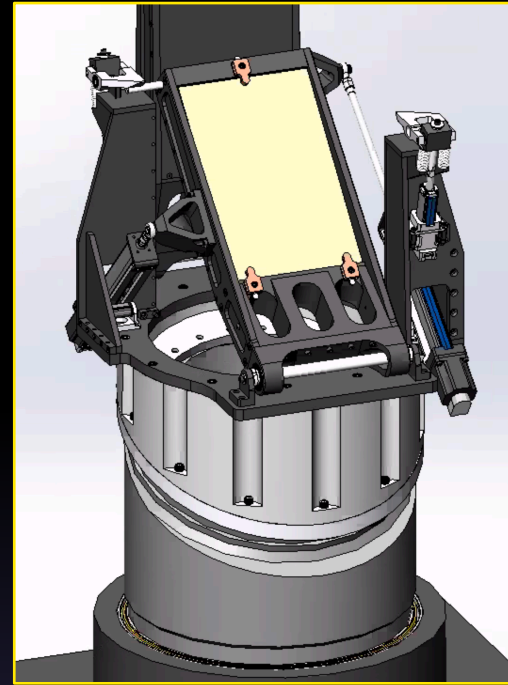
The UH 2.2m

- **Robotization Status**

- Mechanized M₃ unit to deploy in summer
- Adaptive secondary mirror (install this year)
 - To demonstrate new low-power, linear-response technologies
 - The prototype 19-actuator DM is working in lab
 - About to “cut metal” for the adaptive secondary mirror
 - Subaru may have particular interest w.r.t. “Ultimate” ground-layer AO system plans
- UH2.2m daycrew with the Robo-AO-2 laser projector
 - The AO system will be installed later this year

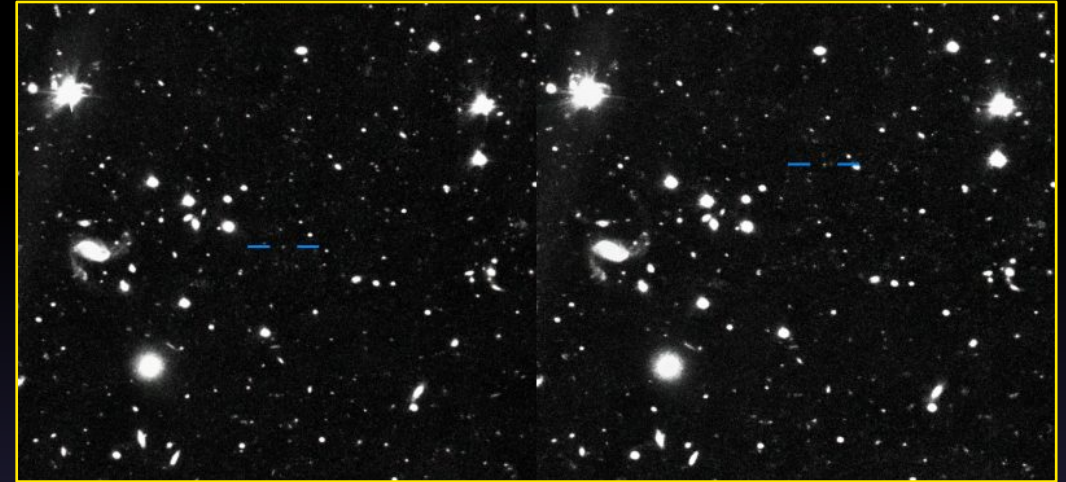
- **Other projects**

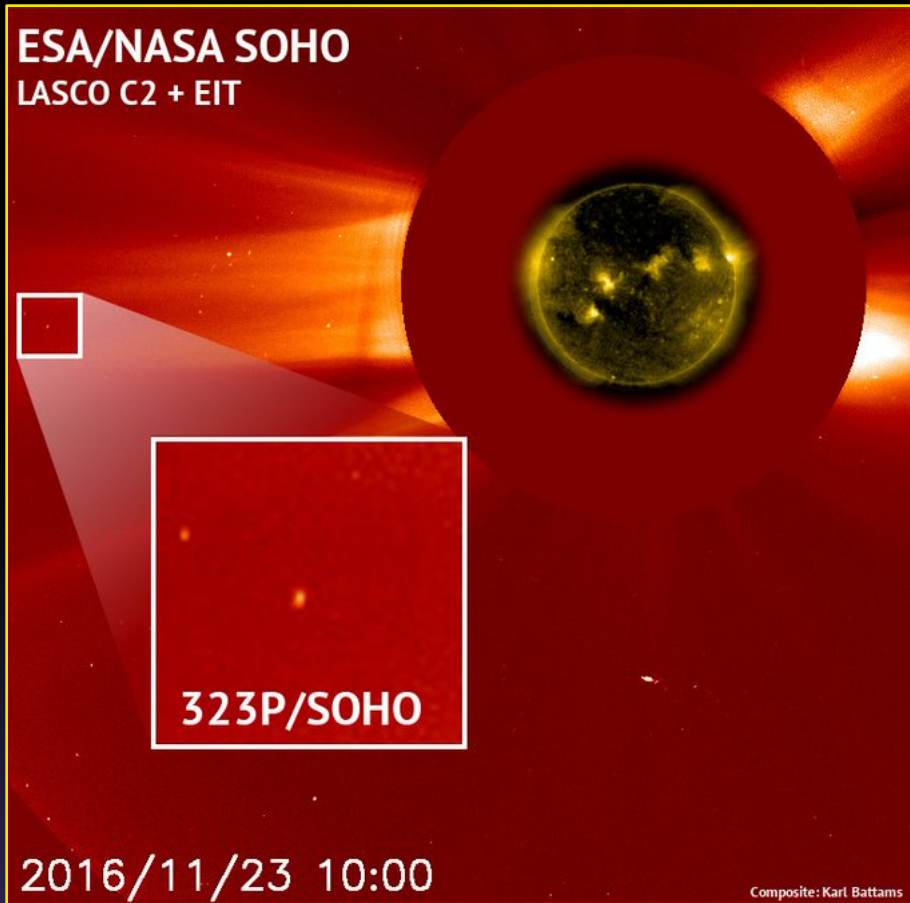
- Upgrade proposal for CHARIS integral field spectrograph to use new UH detector



Farfarout – The solar system's most distant planetoid

- Part of a program searching for planet 9
- Subaru discovered 2018 AG₃₇
- Now confirmed to be the farthest planetoid in the solar system
- Diameter ~ 400 km
- Team includes IfA Astronomer David Tholen.



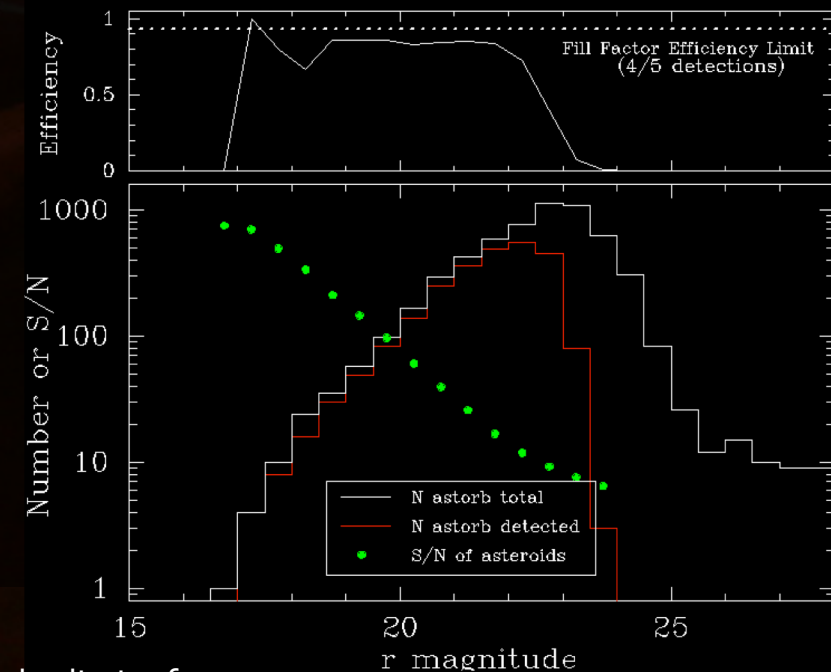


First images of a Sungrazer from the ground

- Study of activity of a near-sun object: 323P/SOHO
 - 2020 Dec. 21 – stellar in Subaru images
 - 2021 Feb 06 – disintegrating
 - David Tholen & postdoc Man-To Hui
- Near-sun small bodies ($q < 0.31$ au)
 - Dynamical end states (origins as SPCs or main belt asteroids)
 - #s are scarcer than predicted – do they fragment?

Small Aphelion Survey for PHAs inside Earth's orbit

- **Goal (NASA funded program)**
 - Use HSC large AO to survey morning/evening sweet spots for otherwise undetectable NEOs
- **Strategy**
 - Observe 1 hr at sunrise / sunset
 - Download data in real time, WCS-fit, calibrate, extract detections
 - Remove static objects and lint moving detections, set aside known solar system objects
 - Find objects with high NEO digest scores, submit to MPC & JPL scout before next night
- **New Processing pipeline:**
 - Known object recovery efficiency approaches CCD fill factor limit
- **Results**
 - Runs plagued by bad weather
 - Recovered 1 new comet (C/2019 LB7)
 - Discovered new NEO – Amor-Class (2020 KK26)



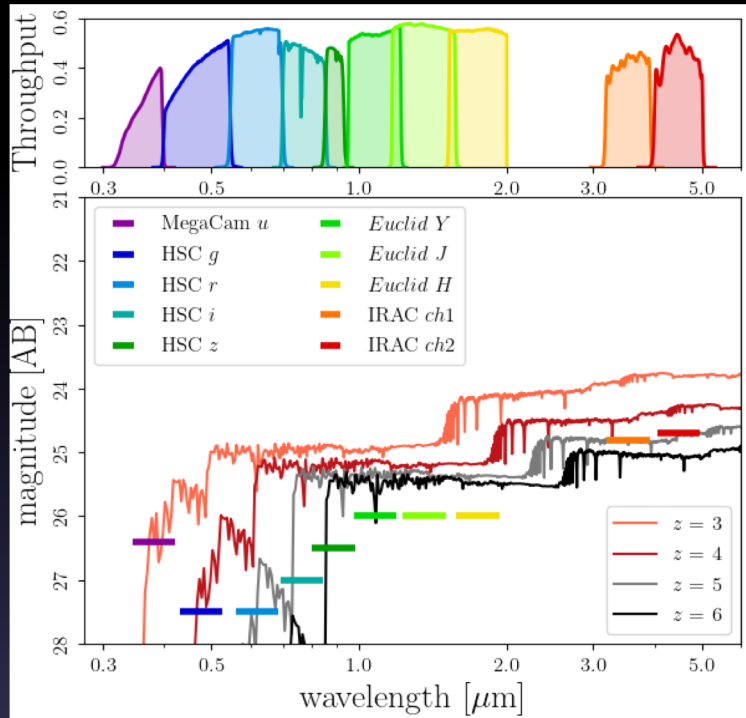
Extinguished night, limit of $r=22.5$

PHA Survey Processing pipeline - MINIMOP

- Reduces 1 night (60 images) of HSC data in 6 hrs on 10-cpu server
- Includes WCS, phot-calib, detection, moving object extraction, MPC submission
- Human verification of output for good NEO candidates

<table><tr><td>Tracklet id</td><td>1</td></tr><tr><td>Quality</td><td>22.49</td></tr><tr><td>dRA/dt, dDec/dt ["/hr]</td><td>71.228, 30.494</td></tr><tr><td>Magnitude</td><td>19.957</td></tr><tr><td>RA, Dec rms ["]</td><td>0.056 (0.055)</td></tr><tr><td>FWHM (median) ["]</td><td>1.543</td></tr><tr><td>FWHM_REL (median)</td><td>1.015</td></tr><tr><td>Mag CHISQR/DOF</td><td>0.689</td></tr><tr><td>Candidates[2]</td><td>(39084) 2000 VB34</td></tr><tr><td>MPC Digest</td><td>NEO (50.0), Int (50.8)</td></tr><tr><td>More ...</td><td></td></tr></table>	Tracklet id	1	Quality	22.49	dRA/dt, dDec/dt ["/hr]	71.228, 30.494	Magnitude	19.957	RA, Dec rms ["]	0.056 (0.055)	FWHM (median) ["]	1.543	FWHM_REL (median)	1.015	Mag CHISQR/DOF	0.689	Candidates[2]	(39084) 2000 VB34	MPC Digest	NEO (50.0), Int (50.8)	More ...		HSCA24404006fr_TAN (2571,1267)	HSCA24407006fr_TAN (2432,1327)	HSCA24407703fr_TAN (950,1316)	HSCA24410006fr_TAN (2292,1386)	HSCA24410703fr_TAN (808,1378)	HSCA24413006fr_TAN (2160,1444)
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	HSCA24404655fr_TAN (1924,861)	HSCA24407655fr_TAN (1827,912)	HSCA24407936fr_TAN (295,1230)	HSCA24410655fr_TAN (1732,964)	HSCA24410936fr_TAN (199,1280)	HSCA24413655fr_TAN (1639,1012)																						

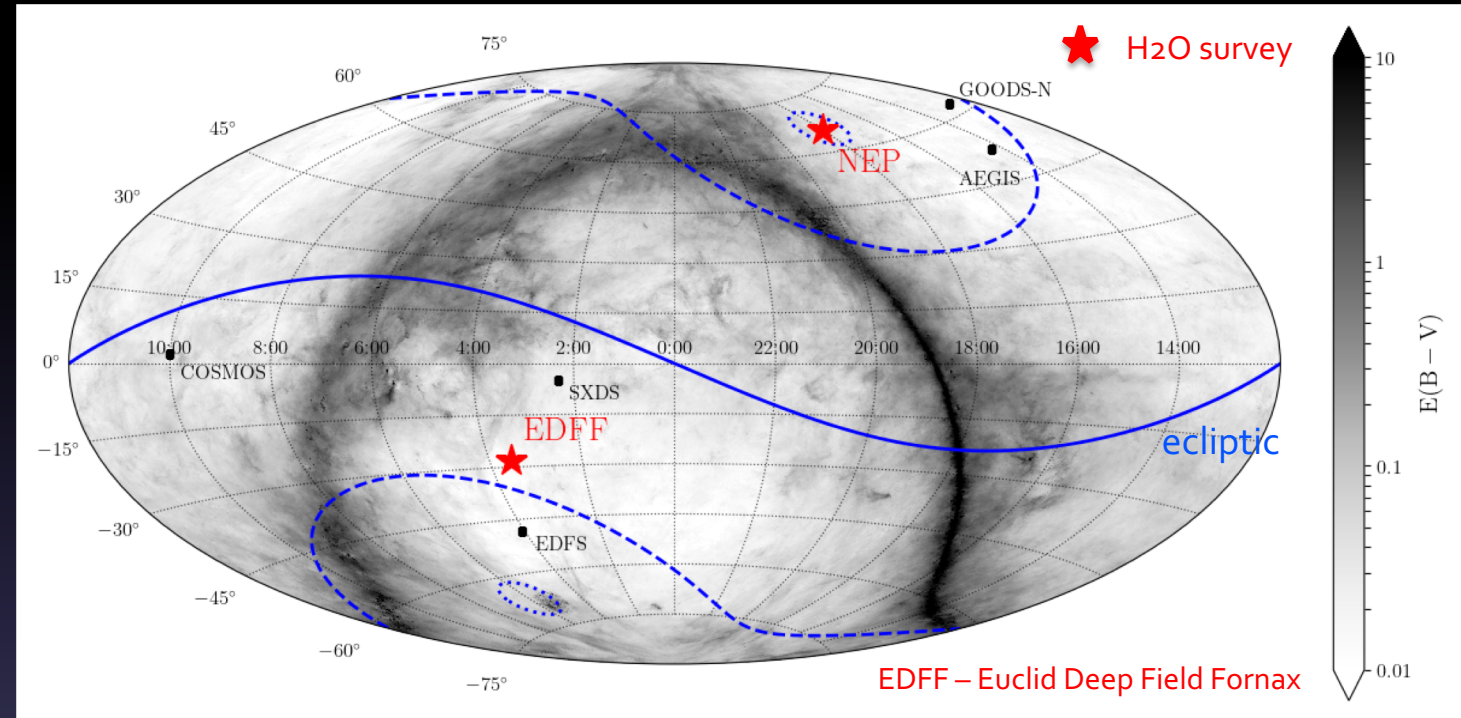
The Hawaii Two-o Survey (H₂O; PI D. Sanders)



Wavelength coverage and 5- σ depths

Overview paper (McPartland et al, 2021, submitted)

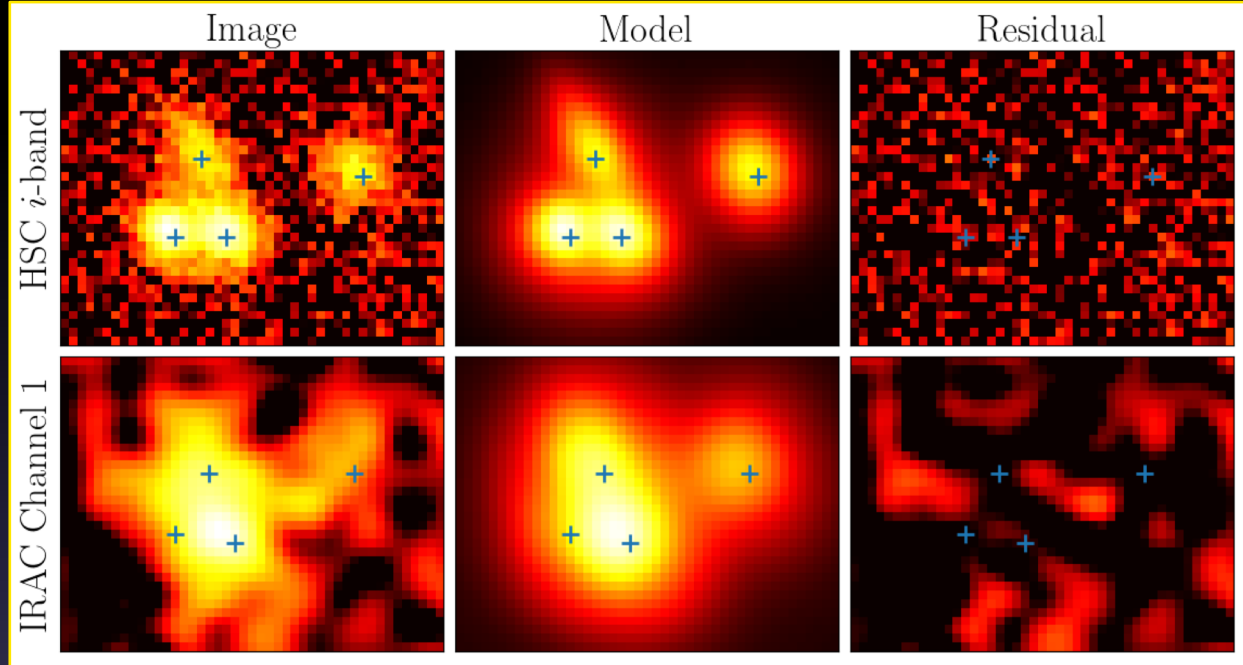
<https://project.ifa.hawaii.edu/h2o>



Deep ($i_{AB} < 27$) CFHT+HSC+Spitzer survey Goals

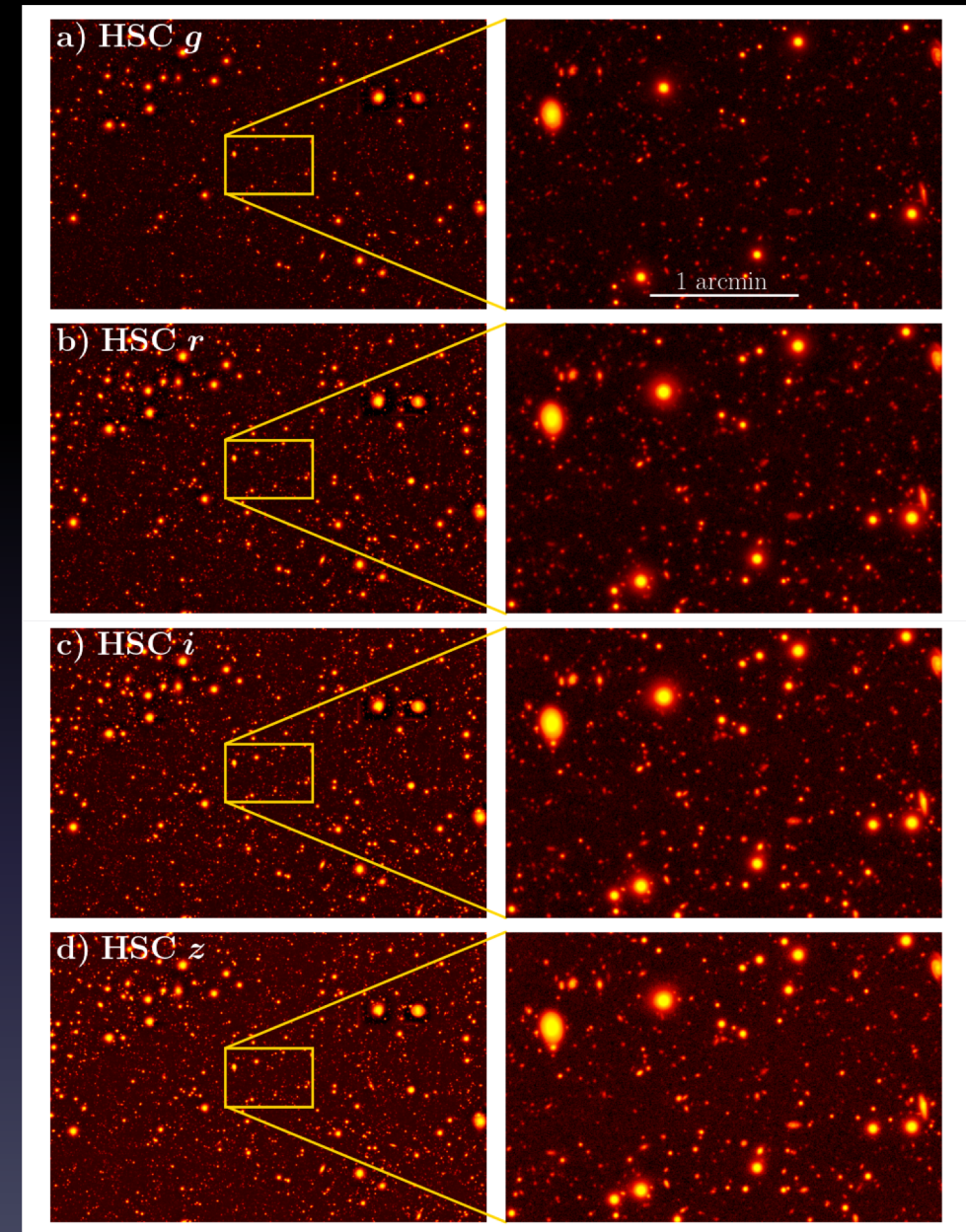
- Measure galaxy stellar and stellar-to-halo mass functions at $3 < z < 6$
- Investigate quenching vs environment at high- z
- Constrain cosmological parameters

H₂O Data and Analysis



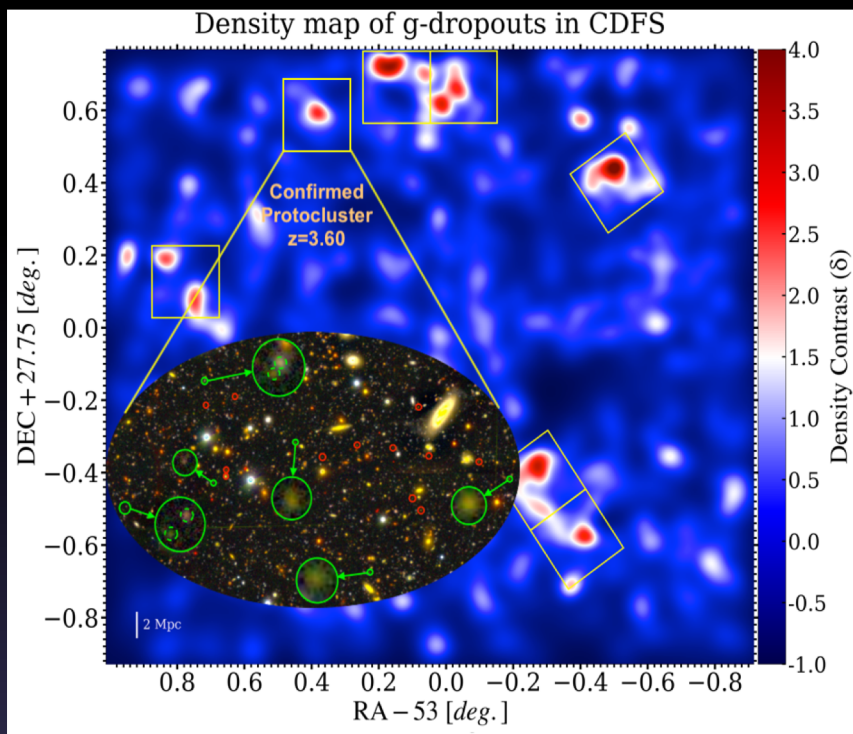
“The Farmer” model-based photometry method

- Create and optimize a model for every source
- Self-consistently measure flux from the optical to the infrared



H₂O Subaru HSC images illustrating data depth

H2O Results



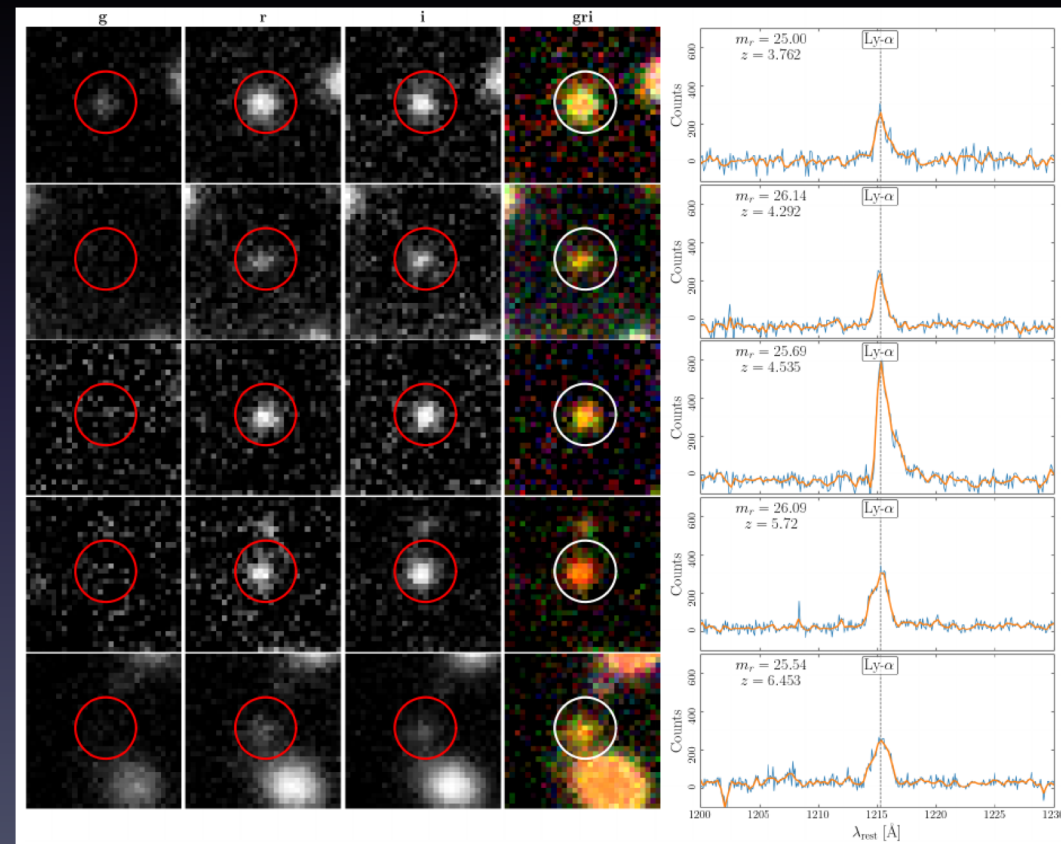
Green circles – narrow redshift range $dz < 0.05$ within radius of 1 Mpc

H2O confirmed Protocluster candidate at $z=3.6$

- Deep coverage allows id of rare high- z protoclusters
- Candidate at $z=3.6$ confirmed with Keck II/DEIMOS
- Pilot study confirms technique for identifying high z protoclusters
- H2O should find 50-100 protoclusters at $3 < z < 6$

H2O confirmed High-Redshift Dropout Galaxies

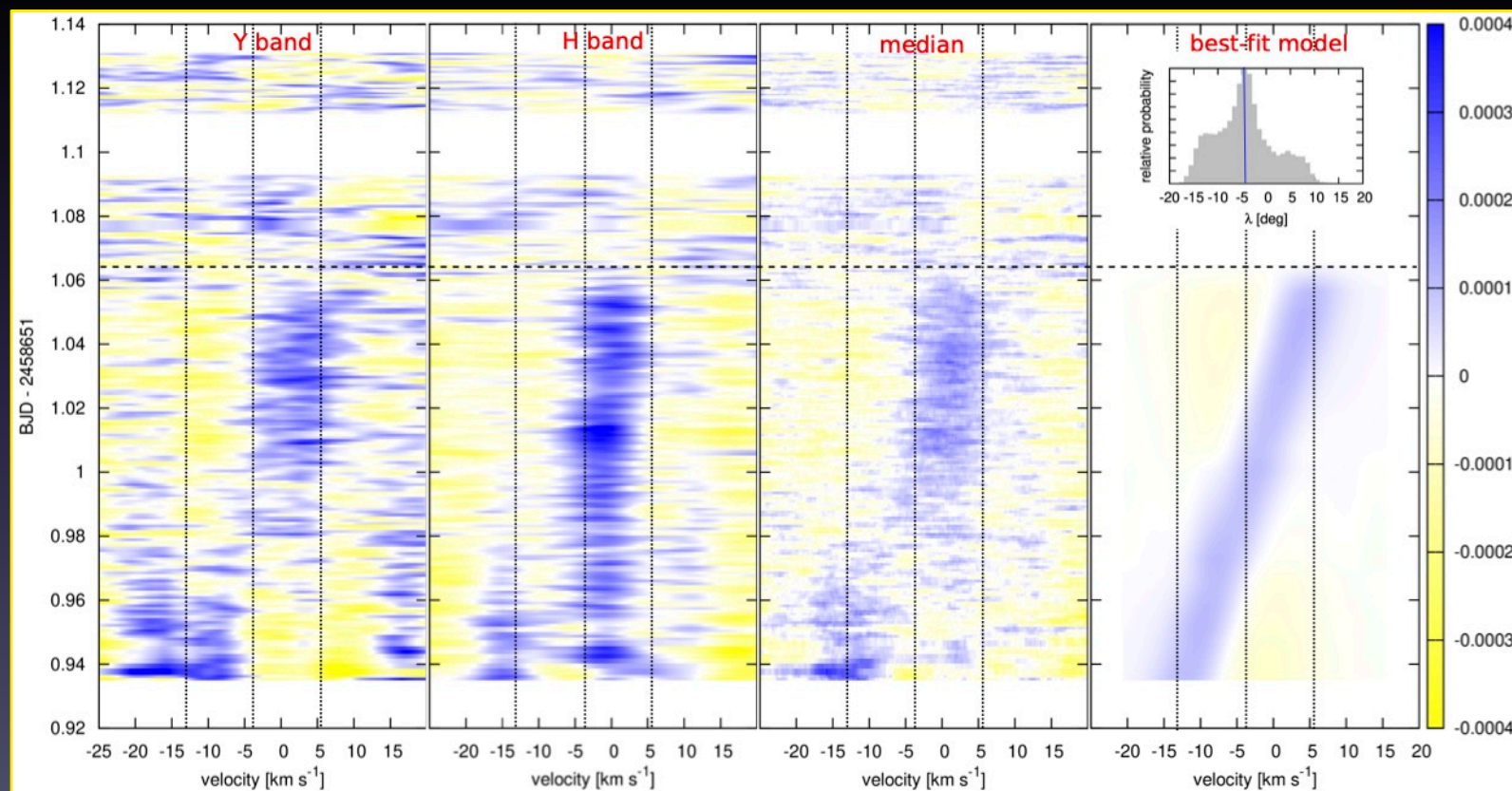
- Developed strategy for identifying high- z (> 3) galaxies using dropout method
- HSC images of g & r-band dropouts with Keck DEIMOS spectra
- H2O will detect $\sim 500,000$ galaxies at $z > 3$

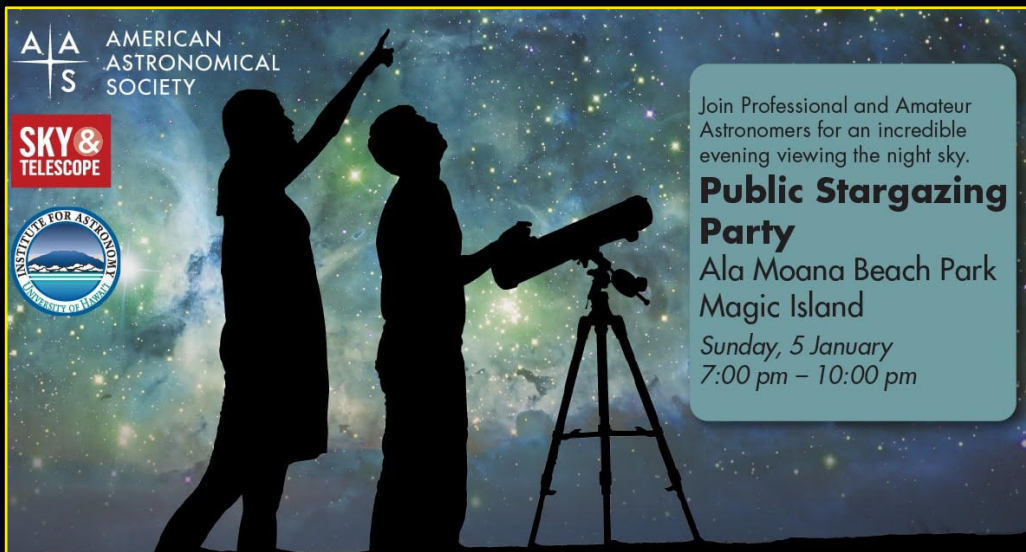


Atmospheric Escape from 22 Myr old Planet AU Mic b

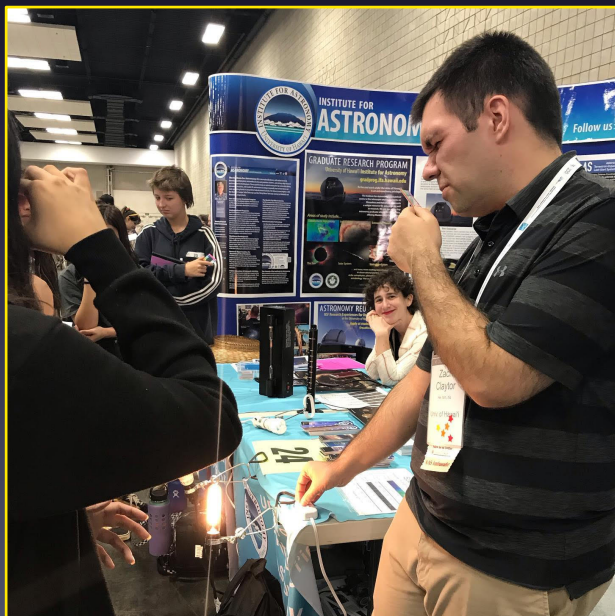
Spectra during transit of PMS star during Neptune-sized planet transit

- 8.5 dy period
- Data suggest spin orbit alignment of the system.
- Constrain escape rate of gas from the atm
- IRD Spectrograph





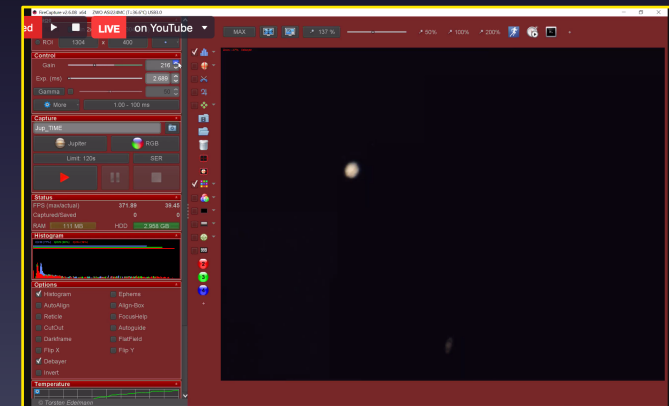
AAS 235 Mtg booth Jan 2020, Waialua Intermediate School students on Education day



IfA Outreach in 2020

In spite of the pandemic, we have had a strong year.

Like other observatories, IfA participated in pandemic food distribution on Hawaii island



Jupiter-Saturn conjunction
— live on YouTube

Astroday 2021 - hybrid



MAUNAKEA OBSERVATORIES

ASTRODAY

PRINCE KUHIO PLAZA

FRIDAY
April 30
↓
SUNDAY
May 2

Learn about science in Hawai'i through our **contactless activities!**

PICK UP KITS & OTHER INFO
go to participating shops and restaurants
*while supplies last

VIEW DEMOS & PRESENTATIONS
scan our QR codes throughout the mall

Come at your own convenience
—during regular mall hours—

The poster features a blue background with a white and red 'ASTRODAY' title. Below the title, it lists the dates 'FRIDAY April 30' and 'SUNDAY May 2' with a downward arrow between them. It includes information about contactless activities, picking up kits, and viewing demos. At the bottom, it encourages people to come at their own convenience during regular mall hours. The bottom of the poster has a graphic of a blue sky with white clouds and several colorful planets (orange, green, yellow, blue) connected by thin lines.

IfA Outreach in 2020



Like other observatories, IfA participated in pandemic food distribution on Hawaii island