

# The Center for Adaptive Optics and its programs in Hawaii



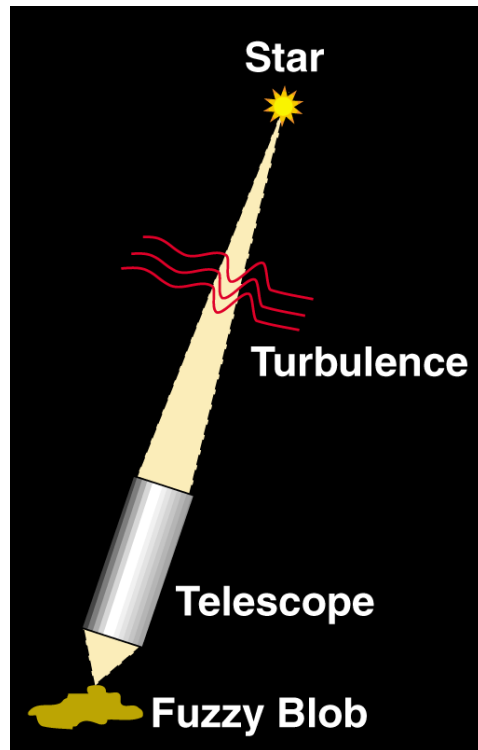
Claire Max, CfAO Director

MSTEE

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# Turbulence in the atmosphere limits the performance of astronomical Telescopes

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- Turbulence is the reason why stars twinkle
- More important for astronomy, turbulence spreads out the light from a star; makes it a blob rather than a point

**Even the largest ground-based astronomical telescopes have no better resolution than an 8" backyard telescope!**

# Adaptive Optics can correct for atmospheric blurring

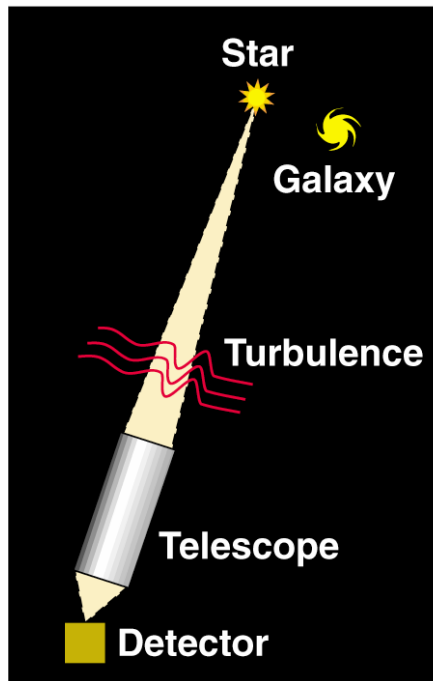


Measure details of blurring from “guide star” near the object you want to observe

Calculate (on a computer) the shape to apply to deformable mirror to correct blurring

Light from both guide star and astronomical object is reflected from deformable mirror; distortions are removed

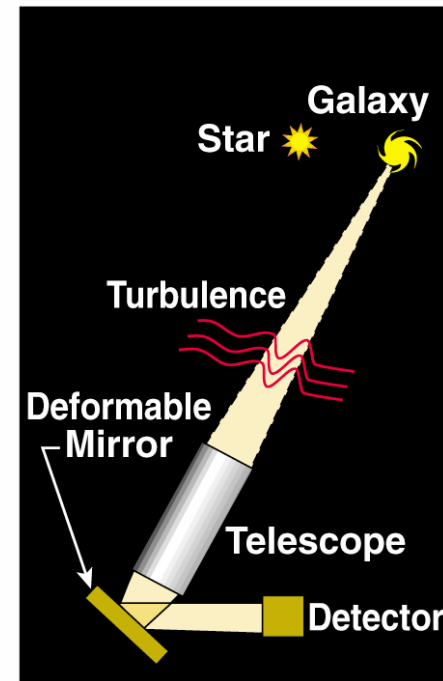
(a)



(b)



(c)

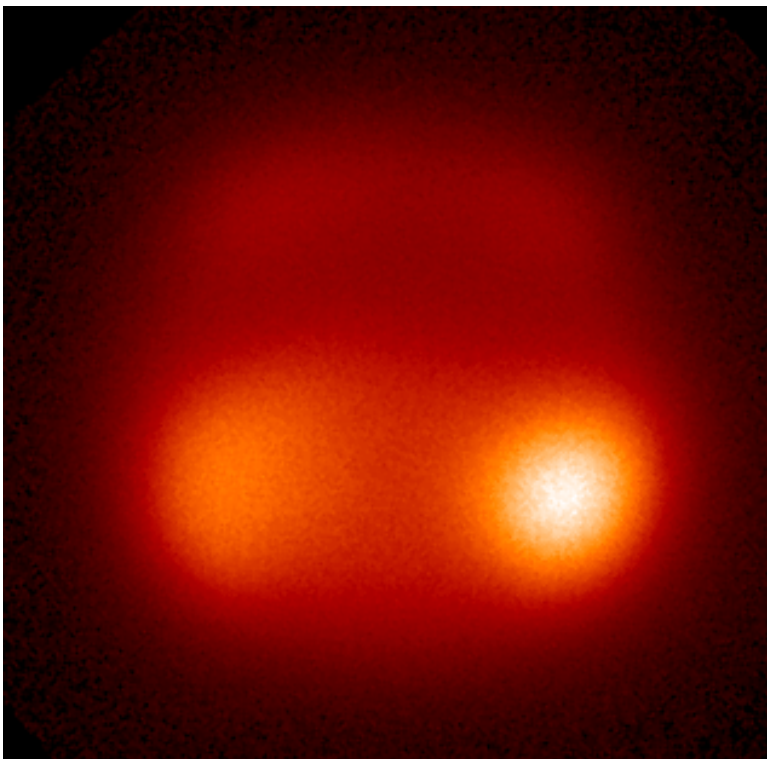


# The planet Neptune in infrared light

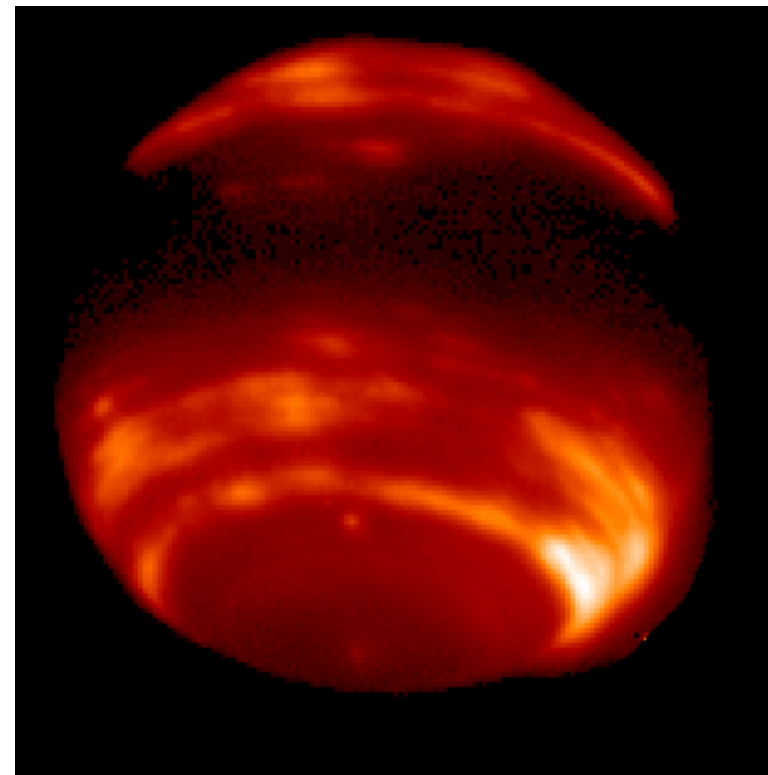
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Without adaptive optics



With Keck Observatory  
adaptive optics

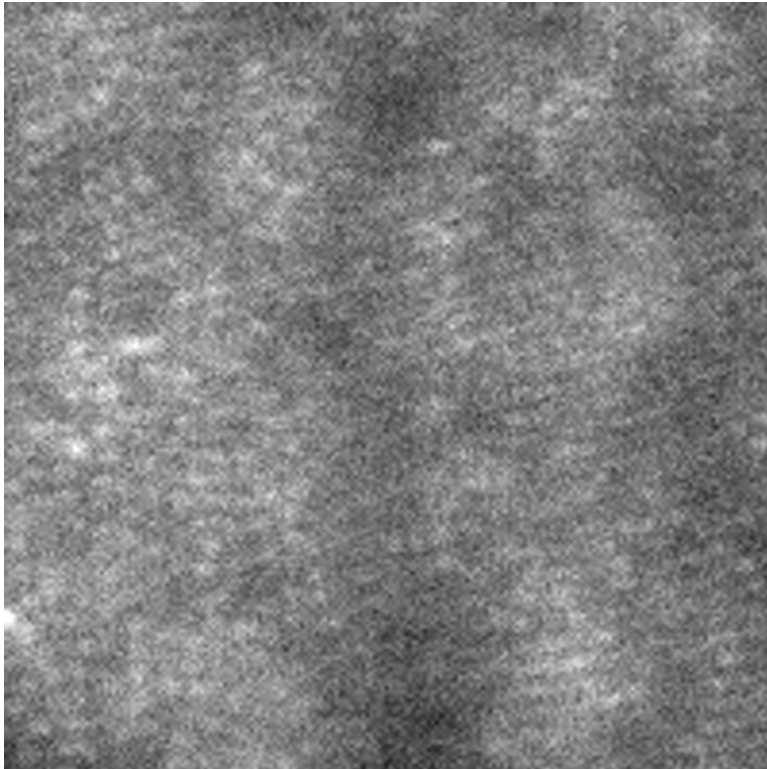


2.3 arc sec

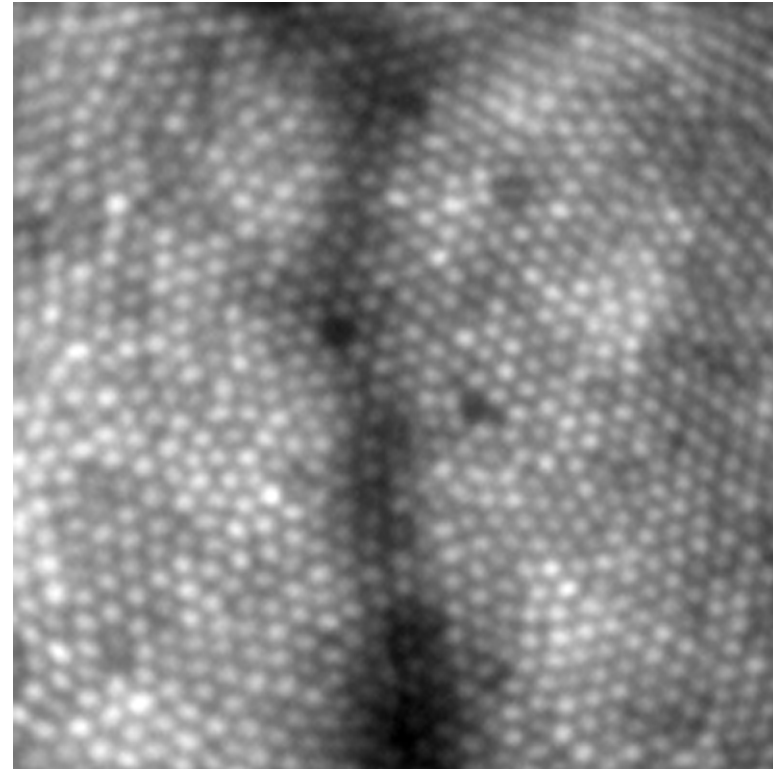
Two images in infrared light

# Adaptive Optics yields major improvement for retinal imaging in living human eyes

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**Without AO**



**With AO: see individual cones (color detectors)**

Credit: Austin Roorda, Univ. of California at Berkeley

# CfAO is a National Science Foundation “Science and Technology Center”

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- Long-term, multi-disciplinary science and technology research
- More effective ways to educate students
- Ensure timely transition of research and education advances into service to society
  
- Headquarters at University of California at Santa Cruz
- Partnership of 13 universities, industry, observatories

# CfAO Mission and Themes

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## Mission:

To advance and disseminate the technology of adaptive optics in service to science, health care, industry, and education.

## Themes:

- 1) Education
- 2) Adaptive Optics for next-generation Extremely Large Telescopes
- 3) "Extreme Adaptive Optics" - image planets around nearby stars
- 4) Adaptive Optics for vision science (image living human retina)

# CfAO works closely with partners at Hawaii observatories and industry

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- Keck Observatory
- Gemini Observatory
- Scientists at Air Force AEOS
- Solar astronomers involved in ATST on Maui
- Subaru Telescope and UH-IfA on Big Island
- High-tech industry



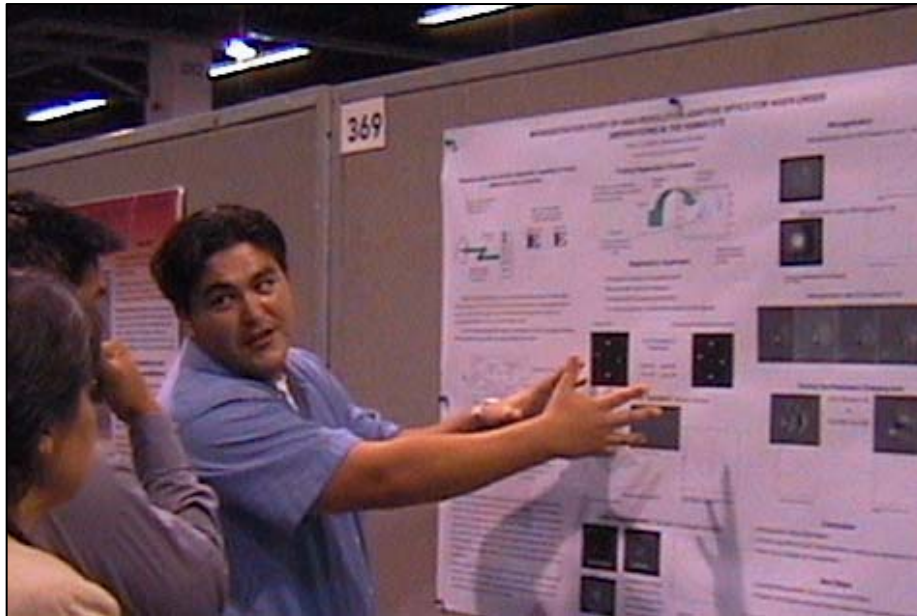
# CfAO Education Programs: Goals for Hawaii Partnerships

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## Broaden participation in high-tech careers in Hawaii

- Advance Hawaii students into tech workforce
- Develop pathways to facilitate student entry into CfAO related fields (engineering, science, computers, observatory work)
- Increase community interest and support



# Three CfAO Internship Programs

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**Maui Akamai  
Program:  
Industry/Gov  
Started 2003**

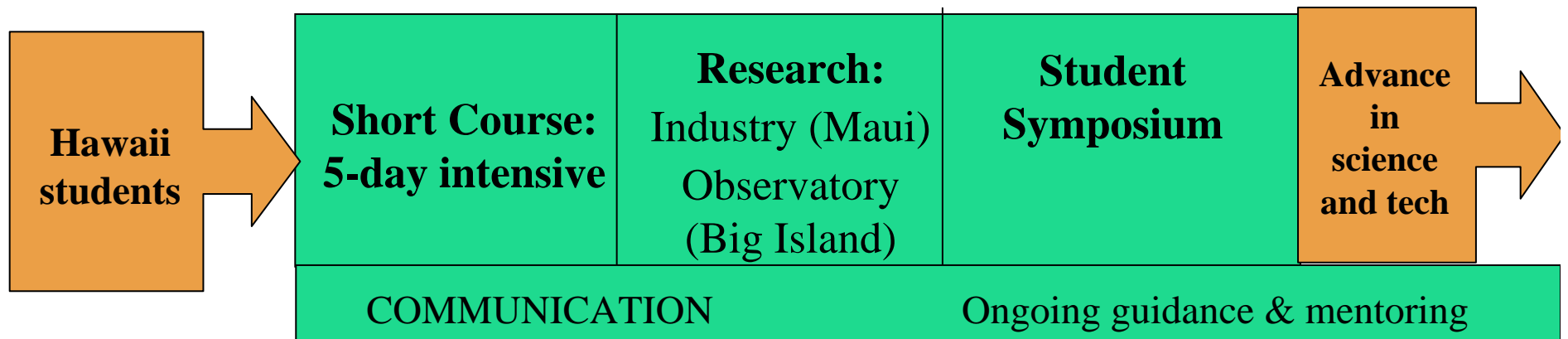


**Mainland Program:  
Academia and  
National Labs  
Started 2002**



**Big Island  
Akamai Program:  
Observatories  
Started 2005**

# CfAO Akamai Internship Programs: Maui & Big Island



## Maui Internship Hosts:

Boeing, Trex, Akimeka, IFA, MHPCC,  
Oceanit, Keck, Textron, Northrop Grumman

## Big Island Internship Hosts:

Keck, Gemini, Subaru, UH-IFA, Smithsonian

10-12 students/summer on each island

## What does the future hold?

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- NSF funding for our Science and Technology Center ends Nov 2009
- We are asking ourselves what activities are most important to our partners for us to continue
- Many of the key players are here in this room
- We are very interested in hearing about your ideas and priorities!