

Speckle Suppression for High-Contrast Integral-Field Spectroscopy

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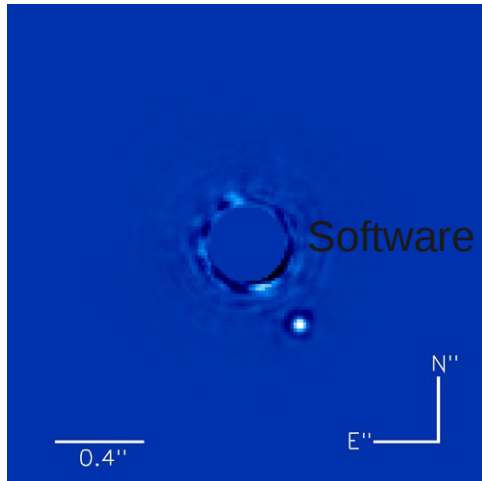


Image: β Pictoris, GPI

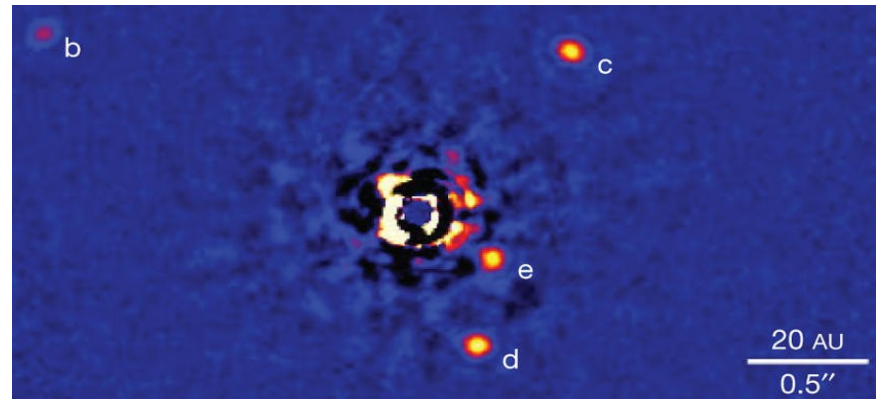


Image: HR 8799, Keck, Ben Zuckerman

- Challenge: Look for faint planets next to **bright** stars
- **Almost exactly equivalent challenge:**
 - 1) Put a 1000W stadium light 10 miles away.
 - 2) Still from 10 miles away, look for the glimmer of a glow-in-the-dark watch hand 1 inch from the flood light.
 - 3) Determine what the glow-in-the-dark paint is made of.

CHARIS: an **integral-field spectrograph (IFS)**

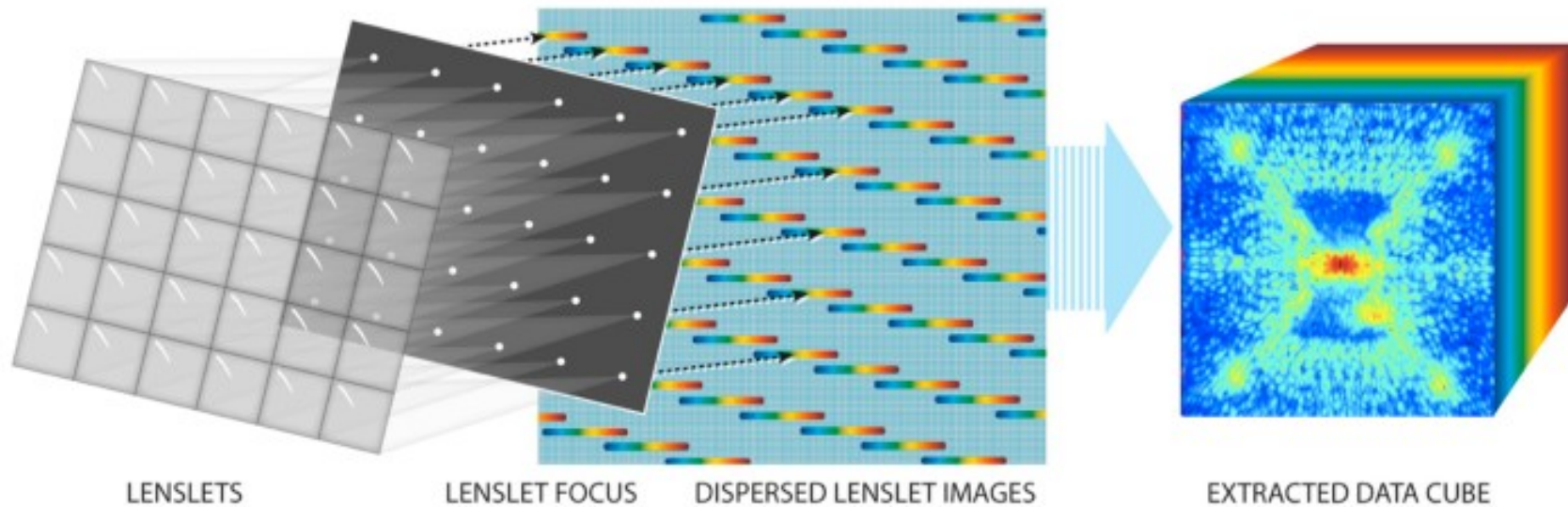
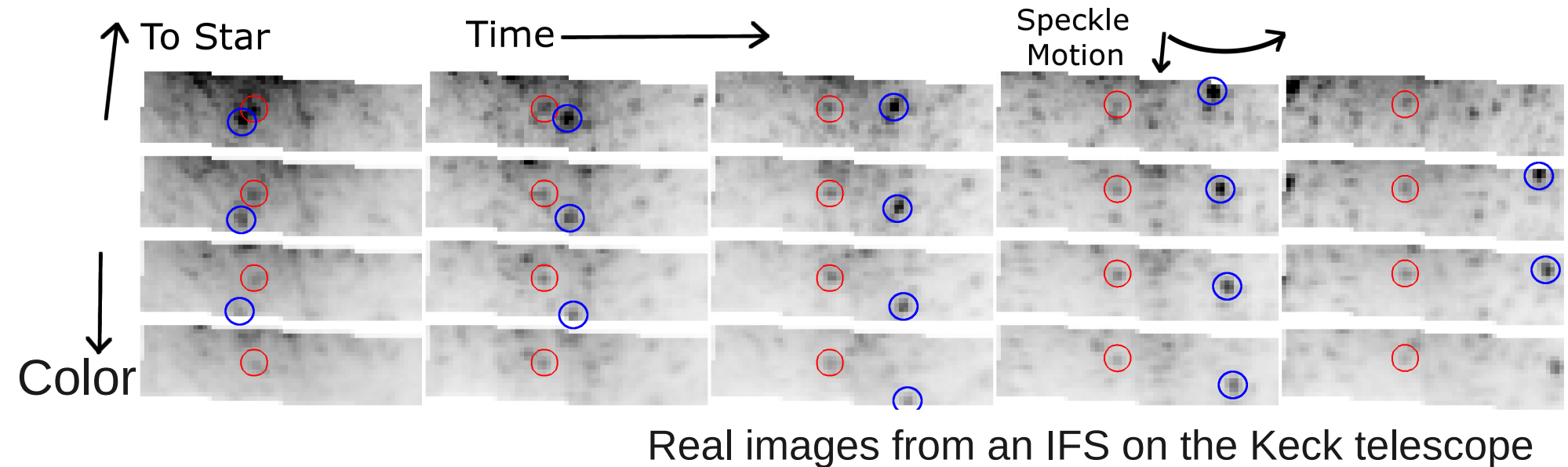


Image credit: Michael McElwain (NASA Goddard)

IFSs like CHARIS are up to the task

- Adaptive Optics: two flexible mirrors, with thousands of pistons, adjust 1000 times per second to ***undo the stars' twinkling***
- 20,000 lenslets form a “compound eye;” a prism then takes a spectrum of each position on the sky

Planet or speckle?



- An IFS takes an image in each color. **A simpler camera would see only one horizontal row of the image above.**
- **Speckles** (like the one circled in blue) appear to move in both time and color, the **planet** (circled in red) doesn't.

An IFS should use both dimensions of the image to tell planets apart from speckles.

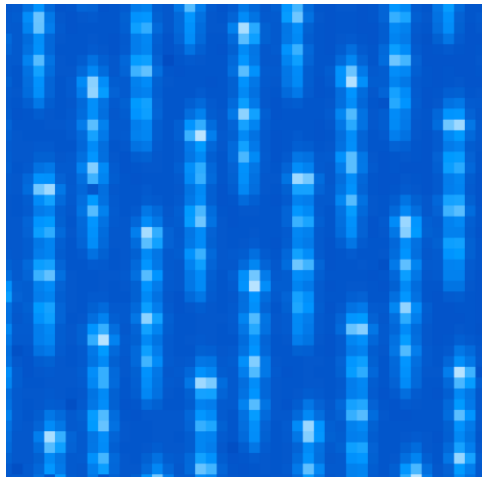
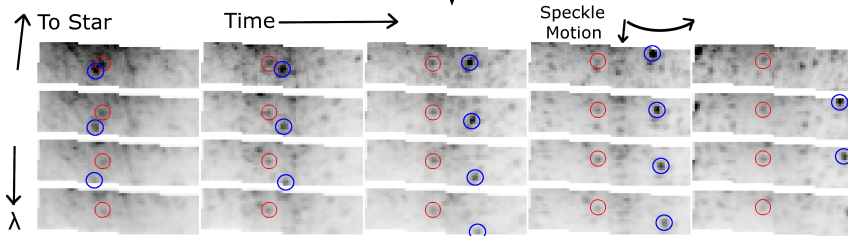
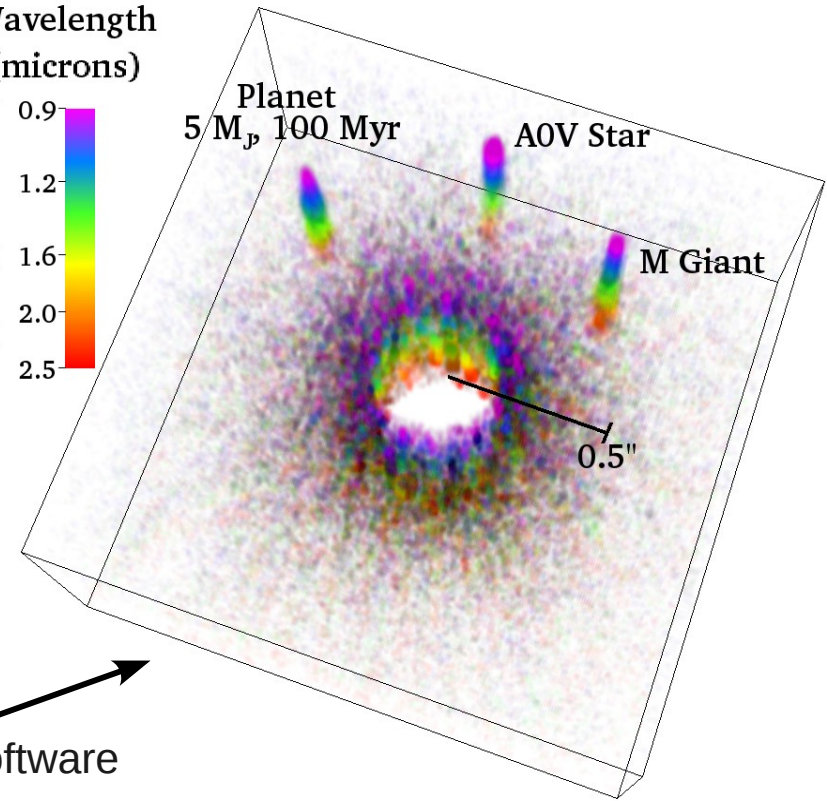
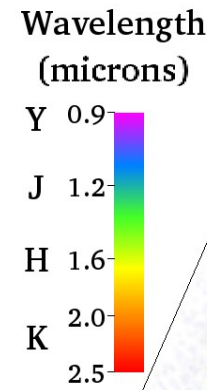


Image credit: GPI team

Software



Software



Simulated image from CHARIS, after processing

As a Sagan fellow, I will:

- Write the software and develop the algorithms to extract images like the one on the right; and
- Use the spectra we will measure to determine things like the planets' temperature and composition.