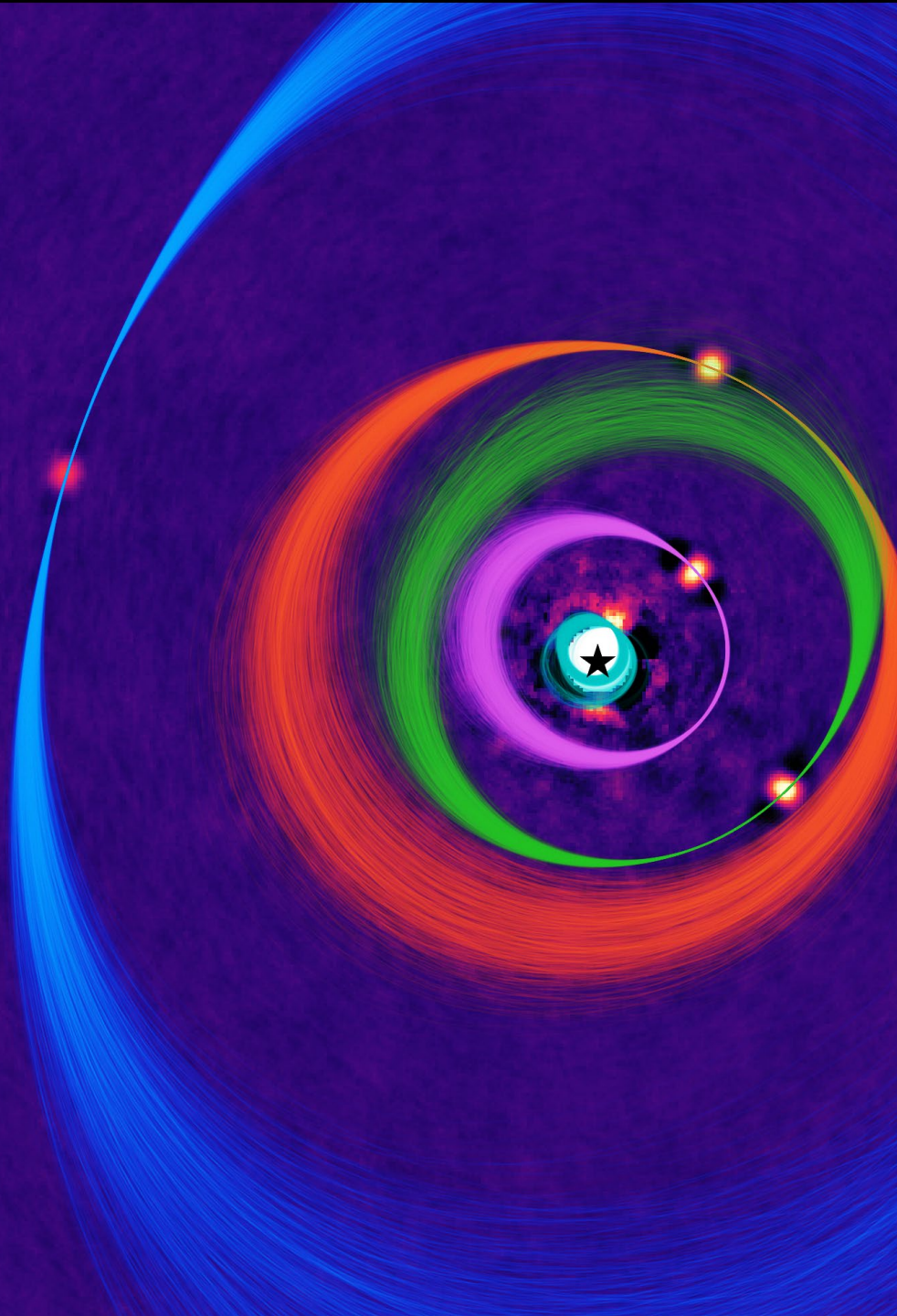
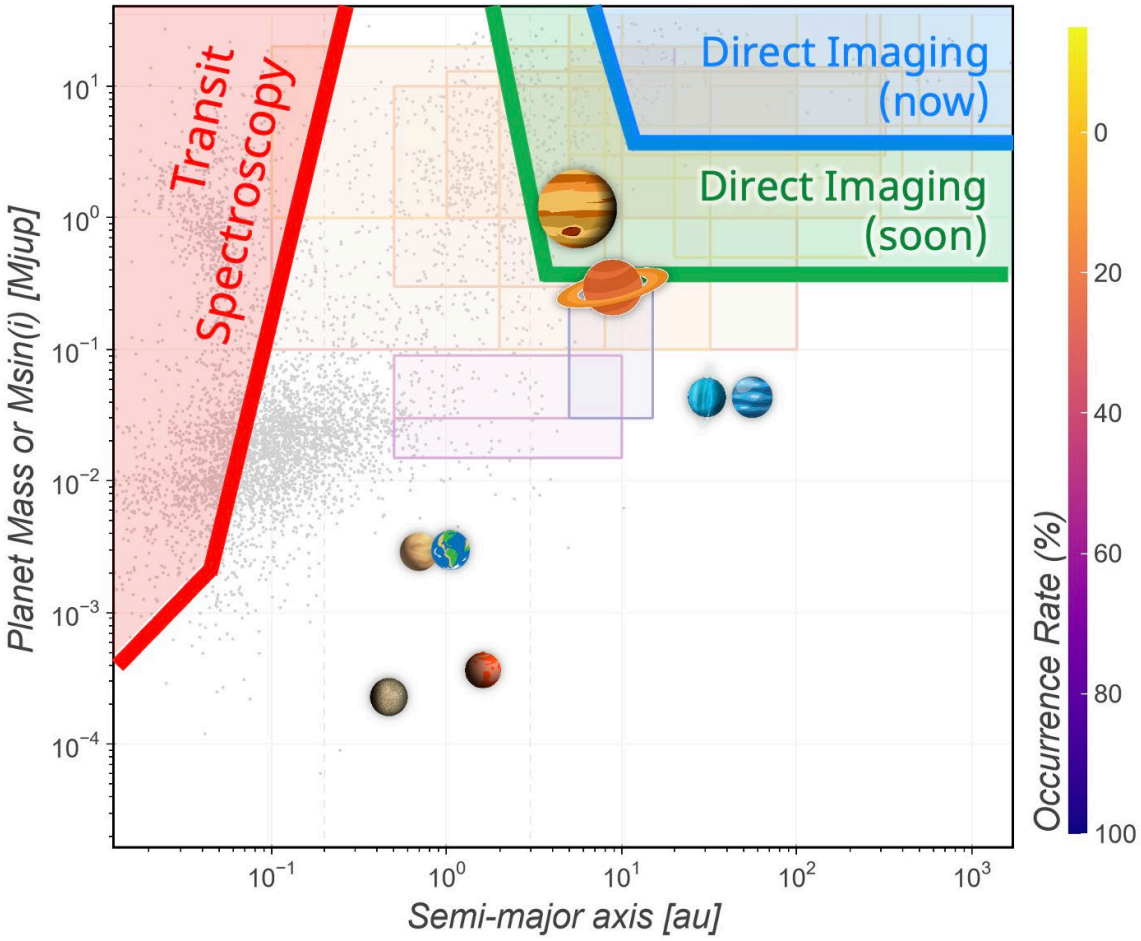
NTCO Flash Talk

William Thompson
2024-02-22

Thank you NTCO, the NEW-EARTH Lab, UVic, NRC and NSERC.



Motivation



- Study closer in / older / smaller planets
- Occurrence rate increases
- Amenable to both RV & imaging
  - Guide surveys
  - Measure mass
  - Measure density

Bright stars scatter glare, or "speckles" across our images and obscure planets

Speckles look like planets!

- Residual starlight due to evolving optical errors from atmospheric turbulence & the instrument itself
- Direct imaging is limited by speckle noise in almost all contexts

---

- 100 × reduction in speckle noise would provide access to nearby young Jupiter analogues
- Access to closer separations:

  approx. 10 × higher planet yield

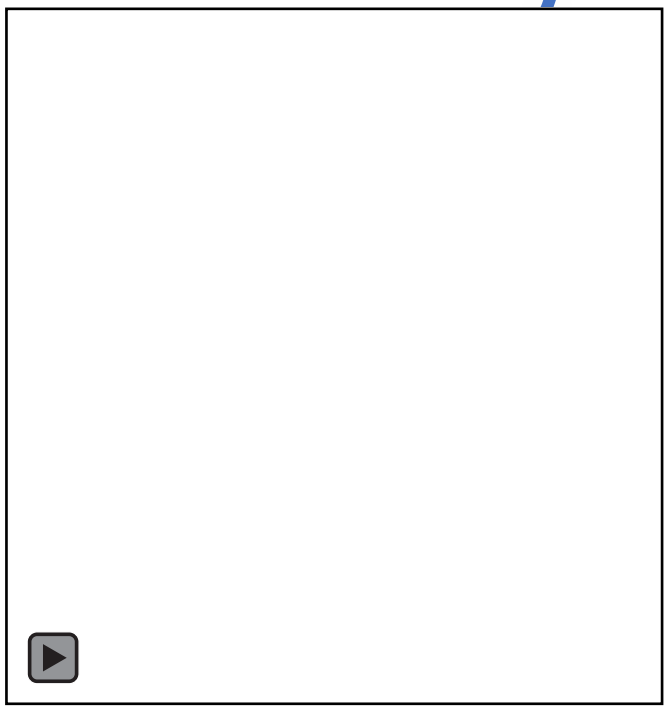
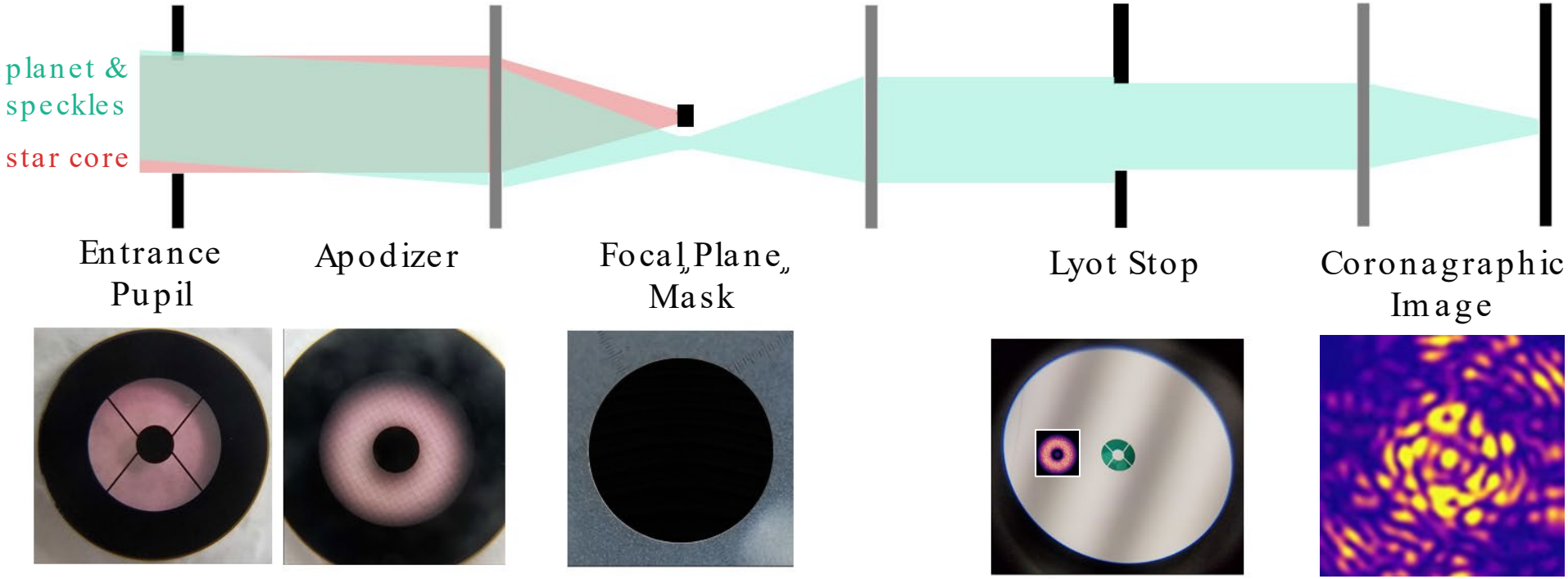


Image Data: J. Chilcote / GPI

Current Starlight Suppression:

Apodized Lyot Coronagraph

- Blocks starlight but leaves speckles

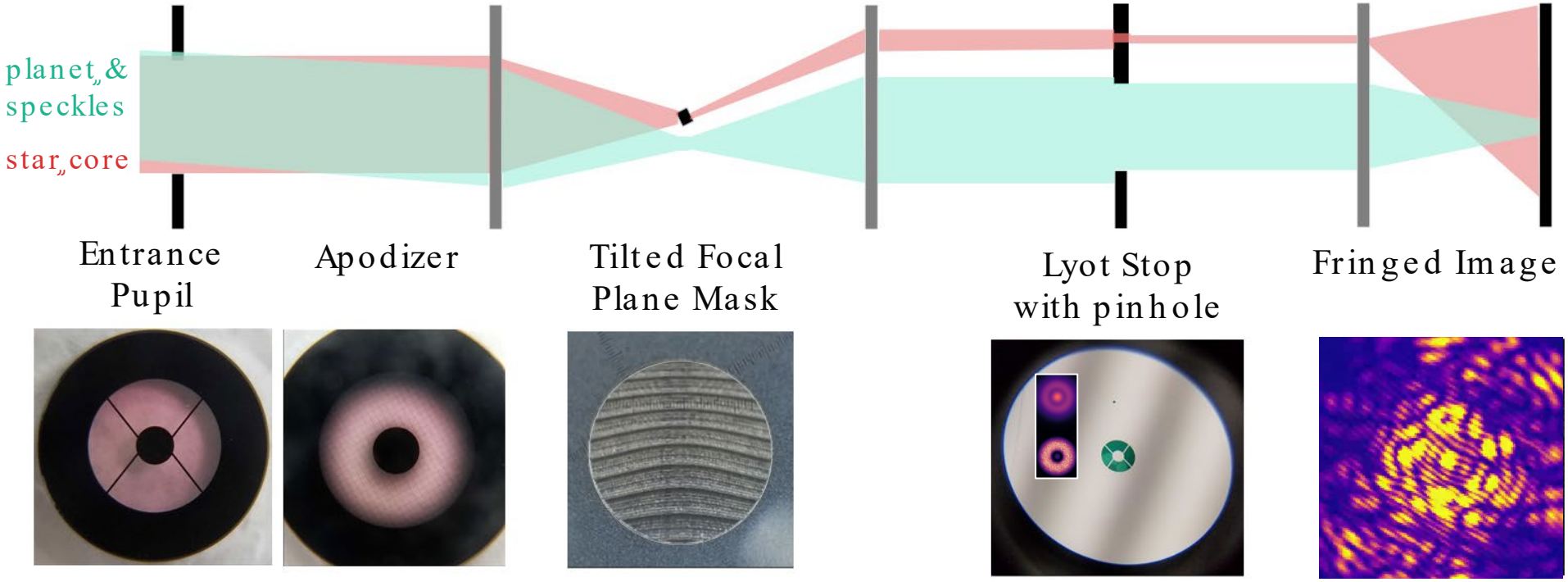


Concept: Baudoz, Galicher, Gerard, FPM: KASTI (Fu & Wolfgang), Images: O. Lardière, A. Johnson

Solution:

Interferometry with the FAST Self-Coherent Camera

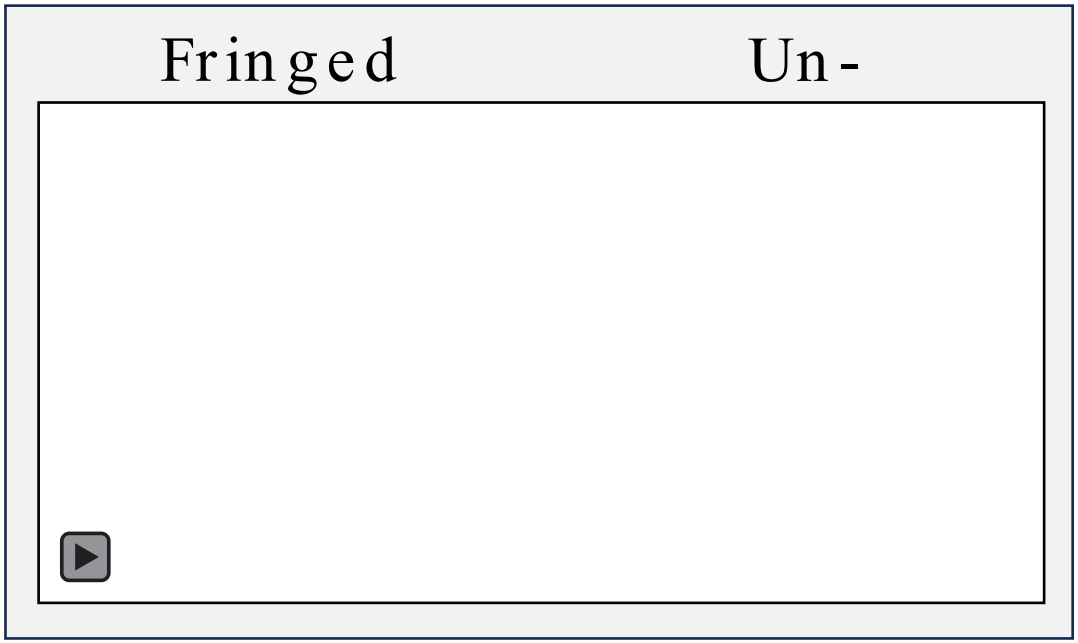
- Keep a small fraction of rejected starlight and create fringes
- Measure the phase & amplitude of each speckle



Concept: Baudoz & Galicher & Gerard ; FPM: KAUST [Fu & Wolfgang] ; Images: O. Lardière & A. Johnson

Result:

≈200× optical speckle subtraction

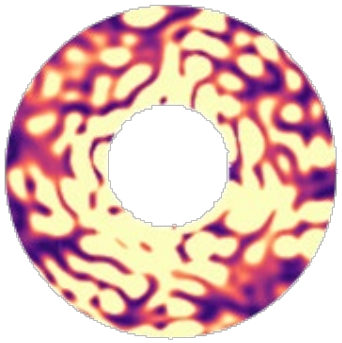


- Made devices talk together (cameras, stages, DM, sources, etc.)
- Developed calibration procedure (mapping between fringe and correction)
- Simplified control math (simpler & more robust)

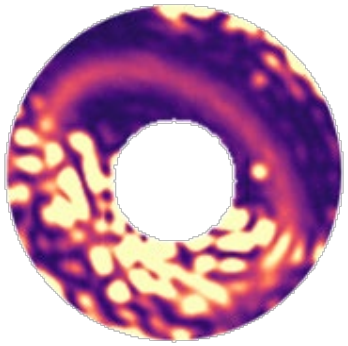
Results

Additional Post Processing with Coherent Differential Imaging

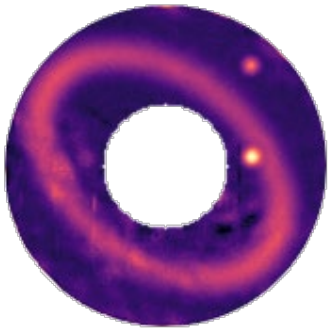
Initial



Active Control



Active Control & Post-Processing



Real lab data with simulated planets and disk

- Add CDI for another ~ 2 × suppression [best result so far]
- Challenges: physical detector pixel response