Big planets, little stars: Directly imaged companions to young M-stars

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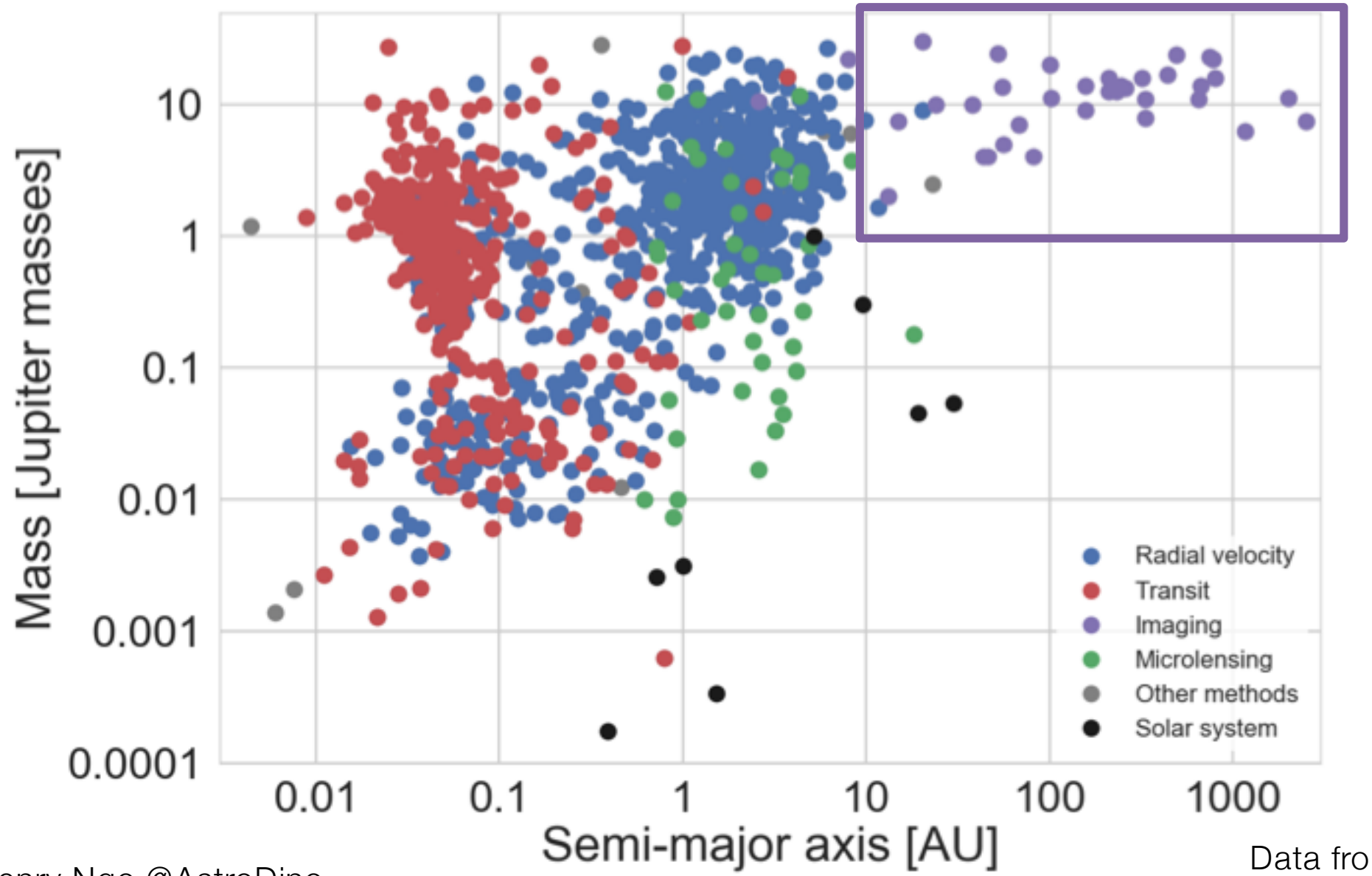
National Research Council Canada Conseil national de recherches Canada

Imaging giant planets < 10 AU

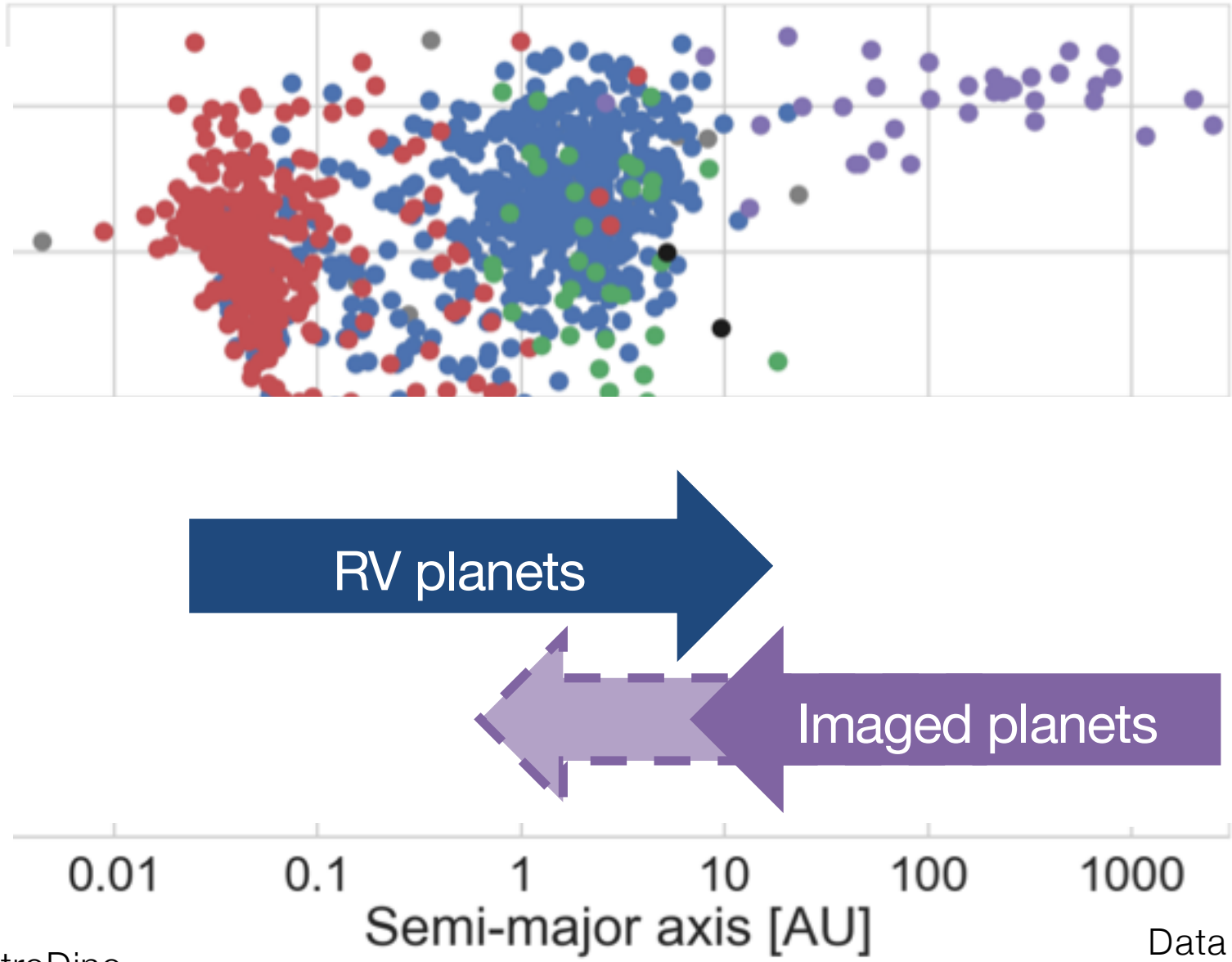


Are these the biggest planets or smallest stars?

Data from NASA Exoplanet Archive

Henry Ngo @AstroDino

Imaging giant planets < 10 AU

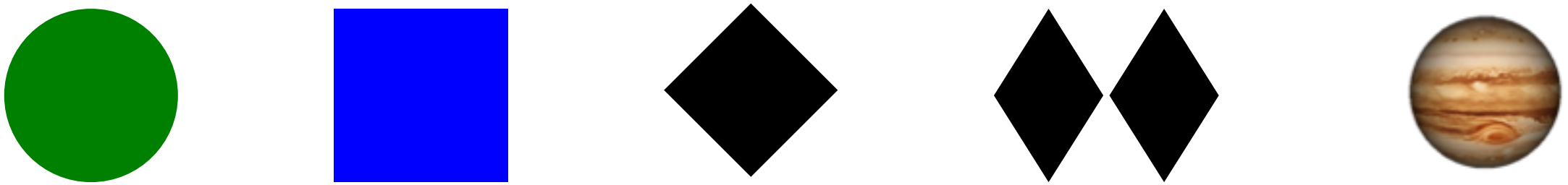


Are these the biggest planets or smallest stars?

Search for the "missing link" of giant planet formation

Data from NASA Exoplanet Archive

Imaging planets is really hard

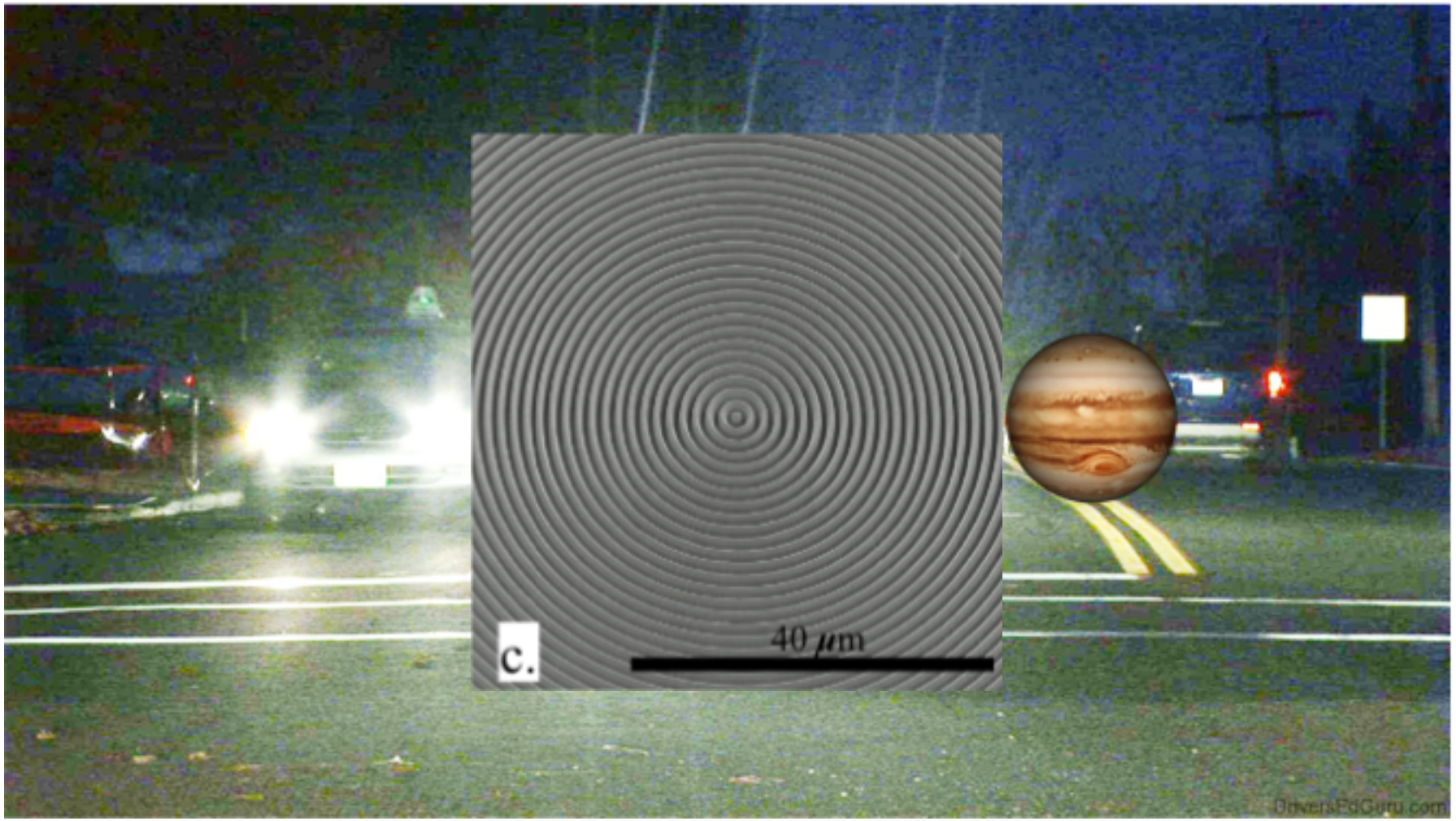


- Need the right ~~equipment~~ instrumentation
- Need smart ~~slope~~ target selection

Cannot block out bright starlight when it's smeared out by atmosphere

Solution: Use an adaptive optics system to "fix" the messy image

Finding planets with a coronagraph



Keck/NIRC2 L-band vector vortex coronagraph

Target Selection (200 stars)

Choose smaller stars

to improve star/planet contrast

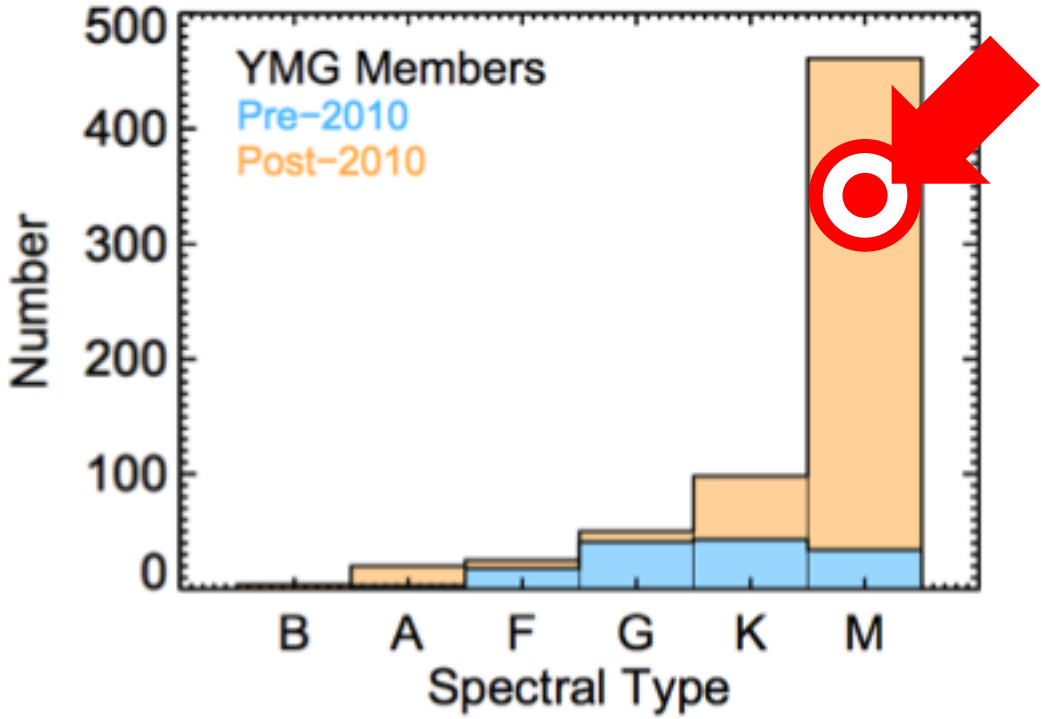
Choose younger stars

to catch planets still hot and bright

Choose closer stars

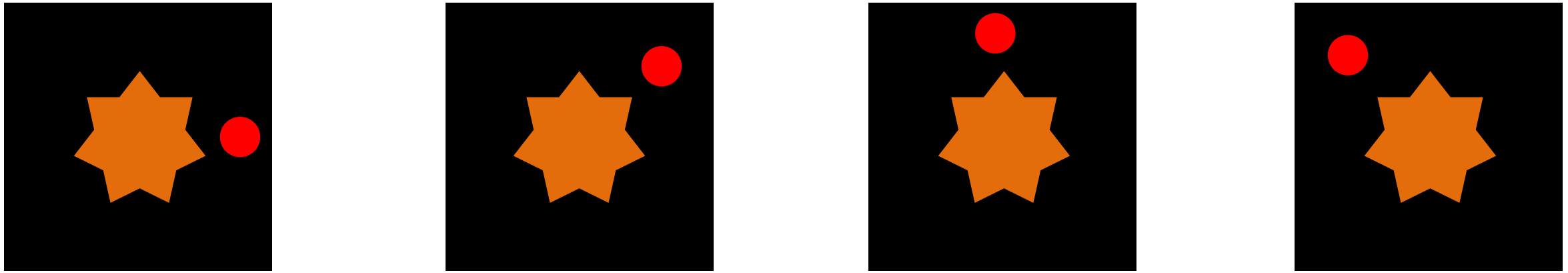
to probe closer projected separations

Young Moving Group stars are ideal



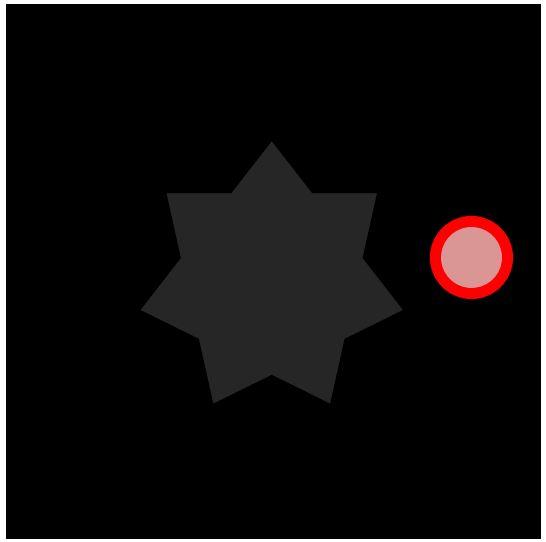
Bowler (2016)

Angular differential imaging



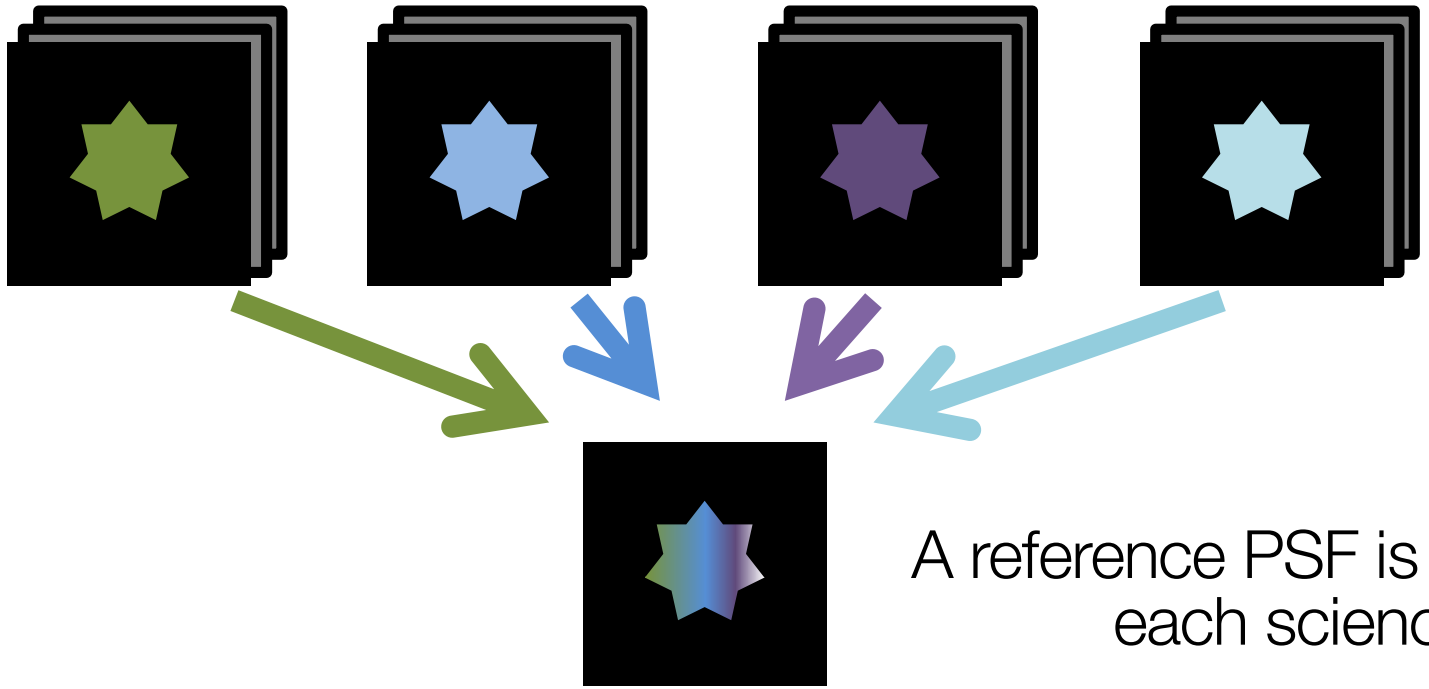
Self-subtraction issue for ADI at low rotation & close-in separations

Planet overlaps with previous position



Planet sensitivity reduced by self-subtraction

Reference star differential imaging



Use library of science targets to create a reference PSF

A reference PSF is constructed for each science target

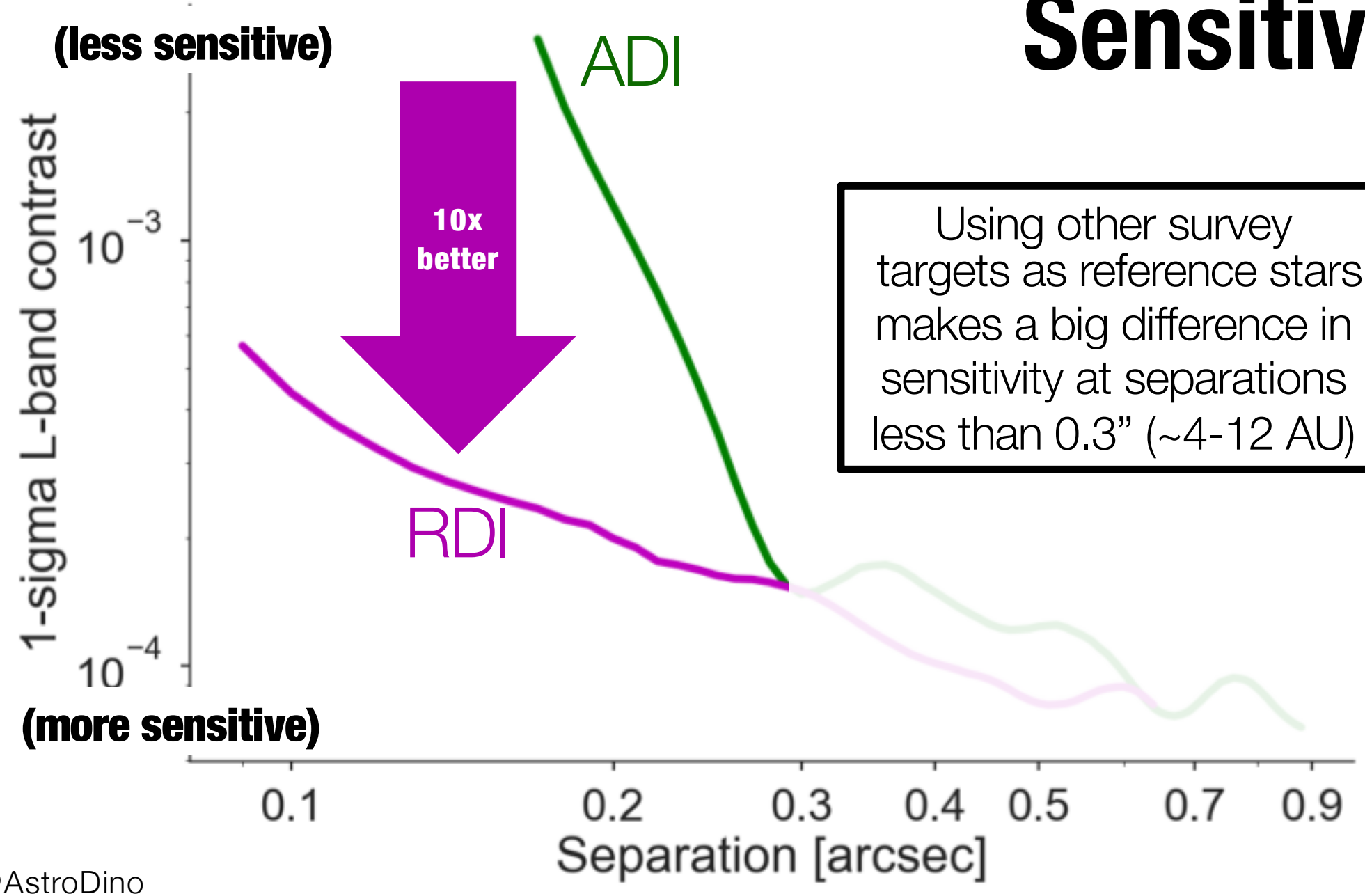
Challenge: Need an automatic pipeline + database to choose best reference stars

Wenhao Jerry Xuan

Pomona College

Applying to grad programs!

Sensitivity



Using other survey targets as reference stars makes a big difference in sensitivity at separations less than 0.3” (~4-12 AU)

NIRC2 Vortex: RDI vs ADI

Wenhao Jerry Xuan

Pomona College

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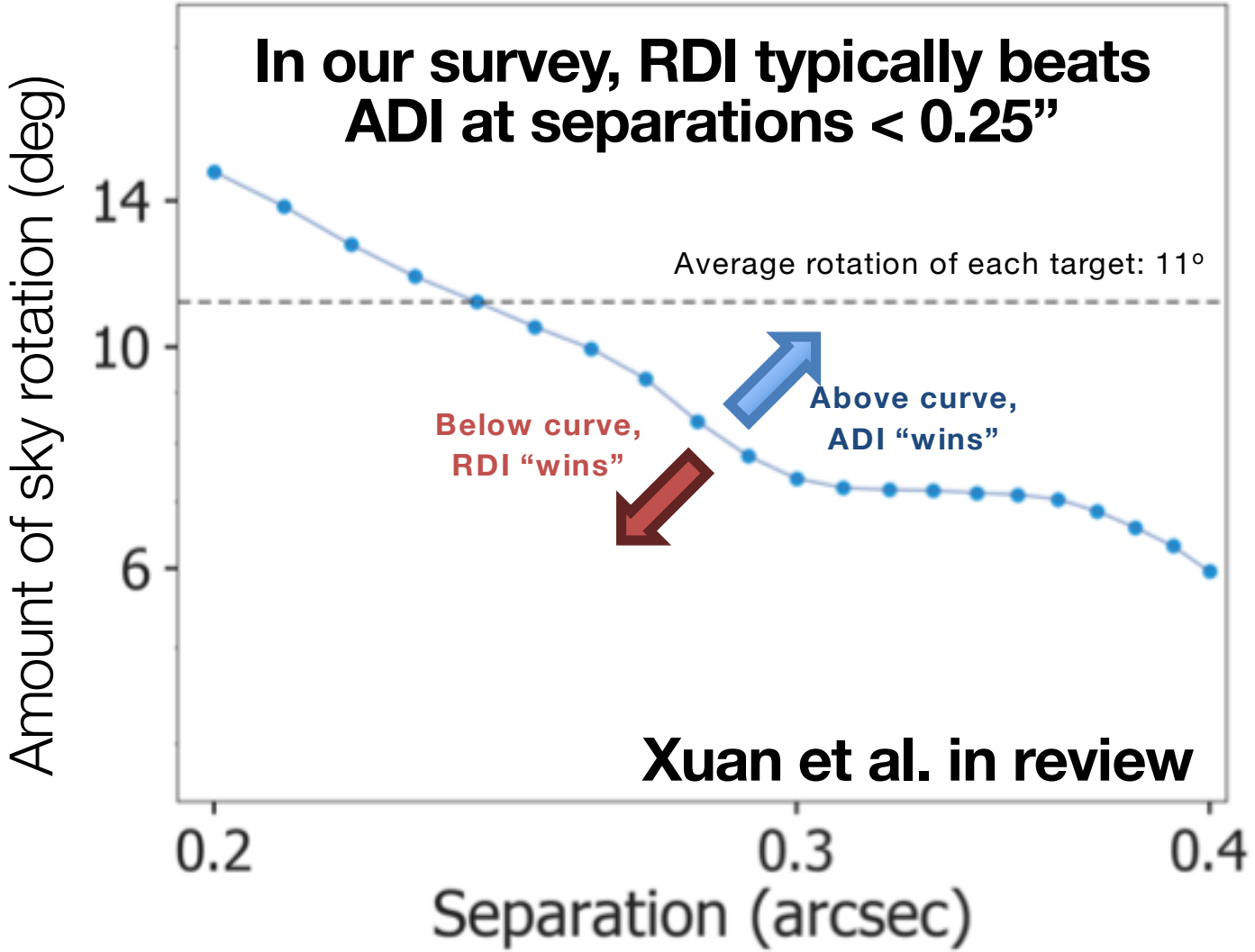
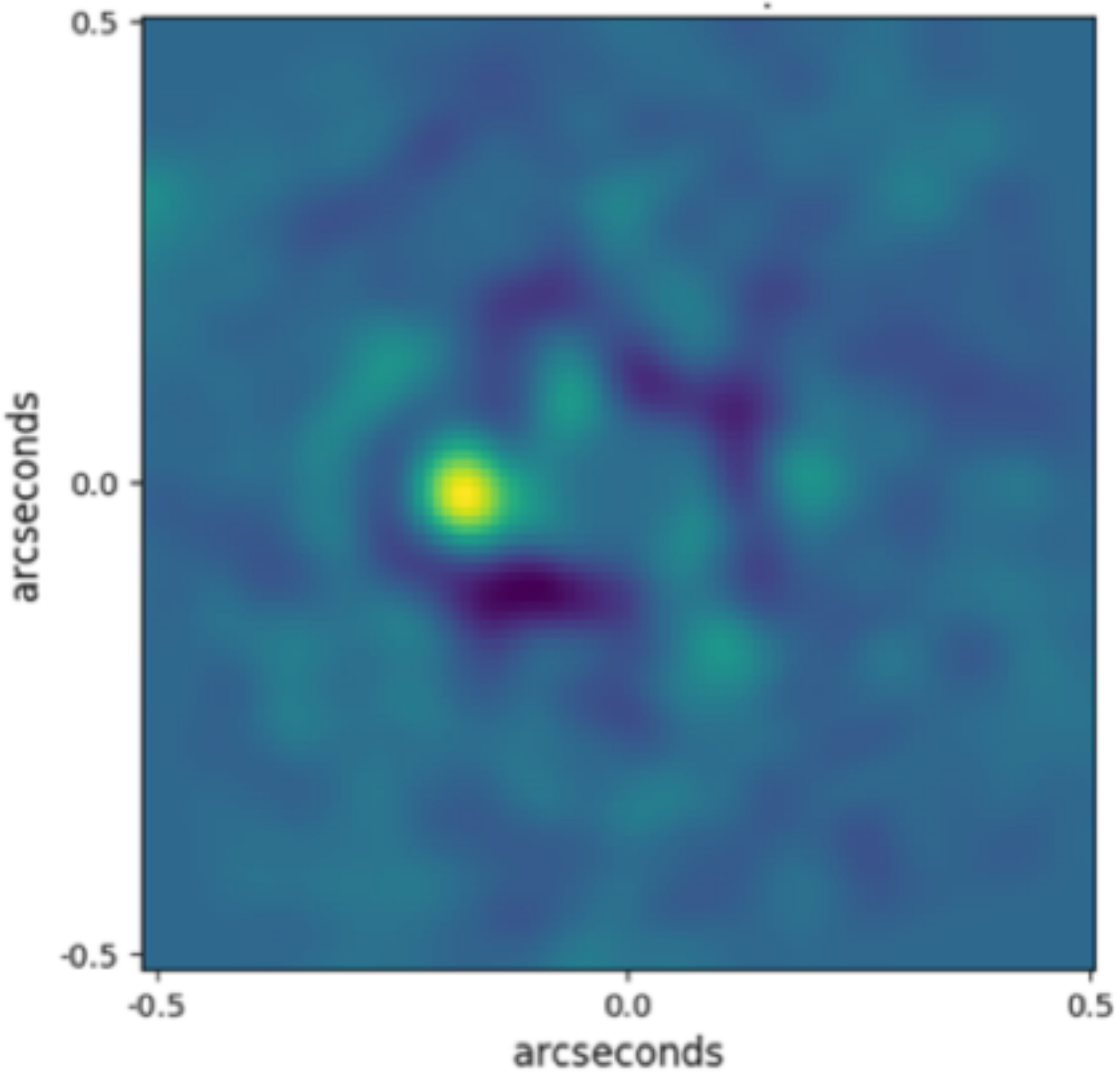
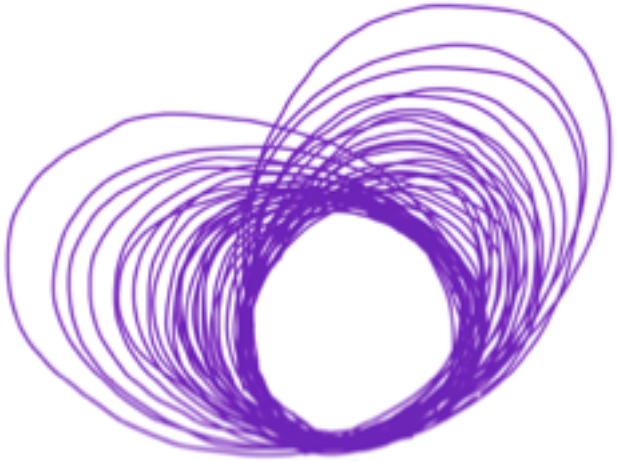


~40 candidates to follow up



Delta-L ~ 5 mag
Sep: 0.16 arcsec (< 10 AU)
Likely a brown dwarf



orbitize!

for imaging astrometry orbit fitting

learn more / contribute at:

GitHub.com/sblunt/orbitize

(version 1.0 in August 2018)

Sarah Blunt
Caltech->CfA

Jason Wang
Berkeley->Caltech

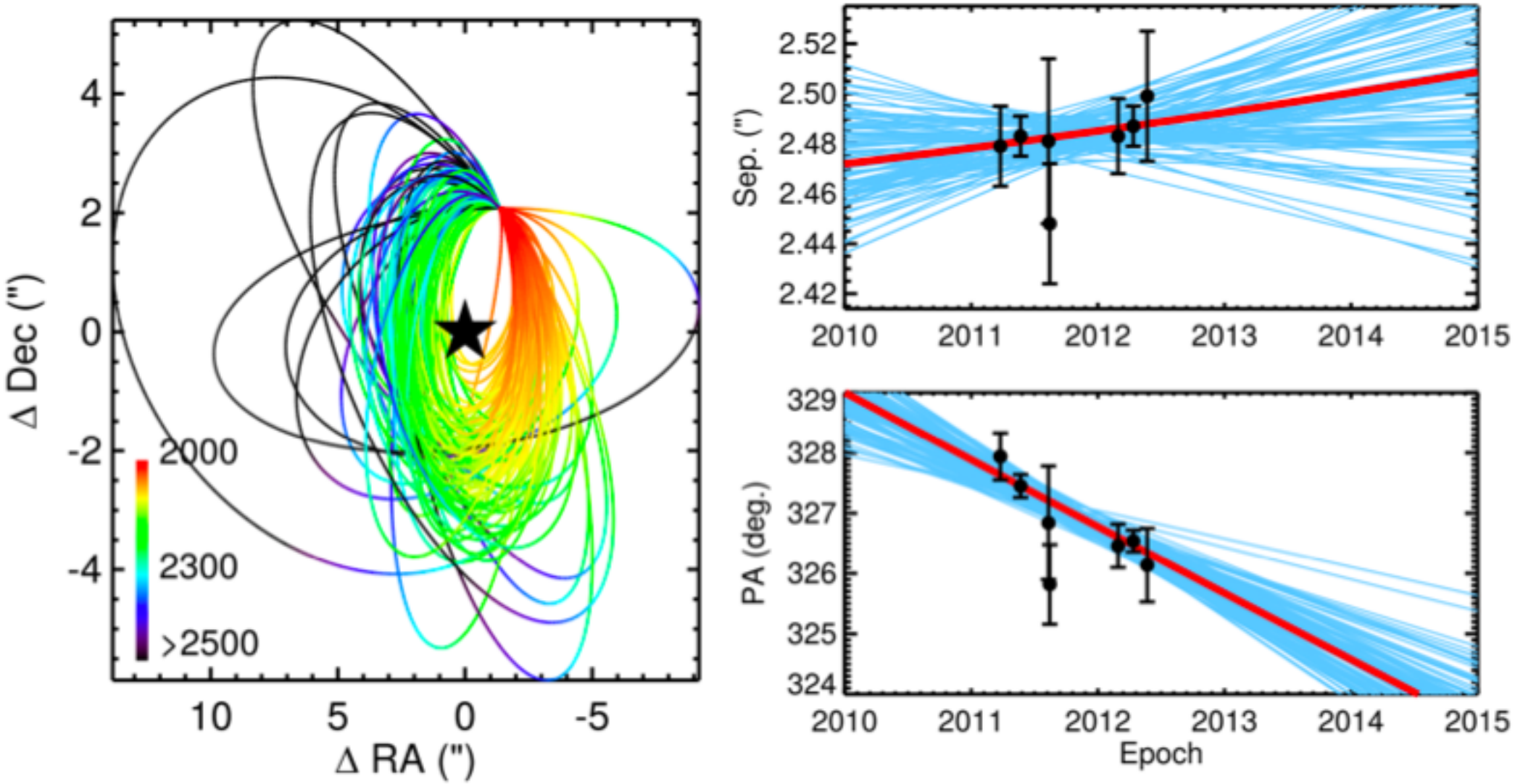
Rob de Rosa
Berkeley

Devin Cody
Caltech

Isabel Angelo
Berkeley->UCLA

Logan Pearce
UT Austin

…. and you?



Blunt et al. (2017)

Sarah Blunt
Caltech->CfA

New horizons in Planetary Systems

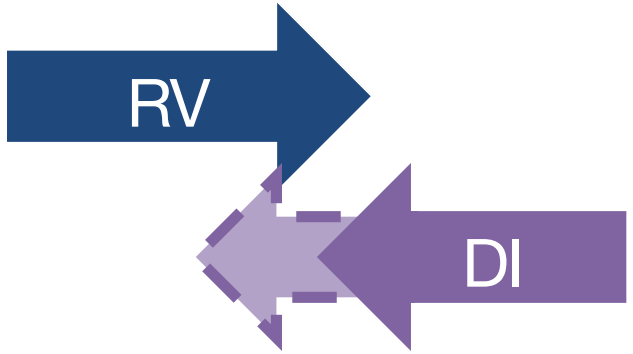
13-17 May 2019 | Victoria, BC

Pre-register @ go.nrao.edu/newhorizons

Invited speakers:

- **Diana Dragomir**: first results from TESS mission
- **Brett Gladman**: theory of planet formation
- **Grant Kennedy**: debris disk constraints on planet formation
- **Heather Knutson**: exoplanet atmospheric composition
- **Emmanuel Lellouch**: mm observations of solar system objects
- **Karin Öberg**: protoplanetary disk composition and chemistry
- **John Spencer**: New Horizons KBO flyby: first results
- **Zhaohuan Zhu**: protoplanetary disk structure and theory

NRC·CNRC NRAO ALMA

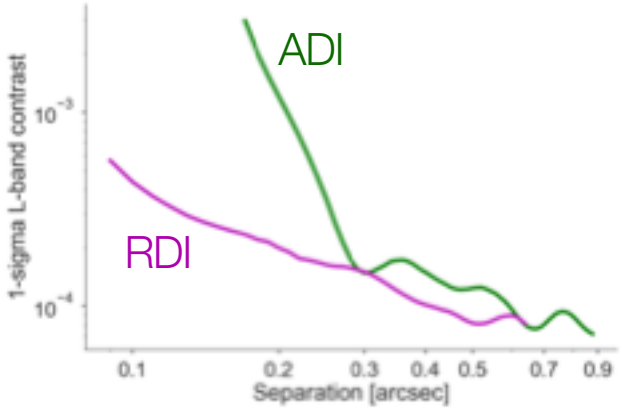


Finding the missing link planets at 1-10 AU

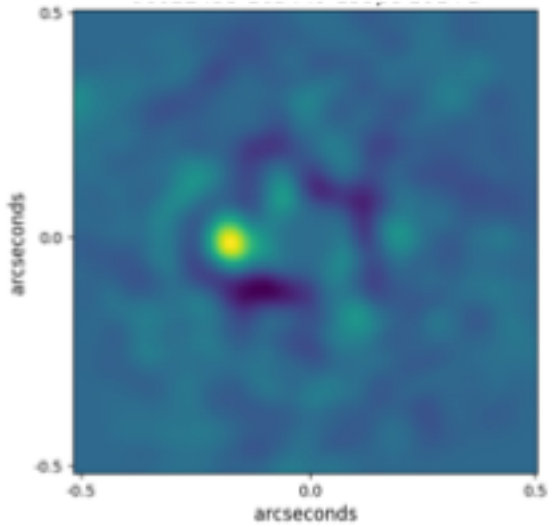
Using the L-band vortex coronagraph on NIRC2

Target 200 young nearby M-stars

Automatic Pipeline by Wenhao Jerry Xuan



Reference stars provide better sensitivity



Stay tuned for more!
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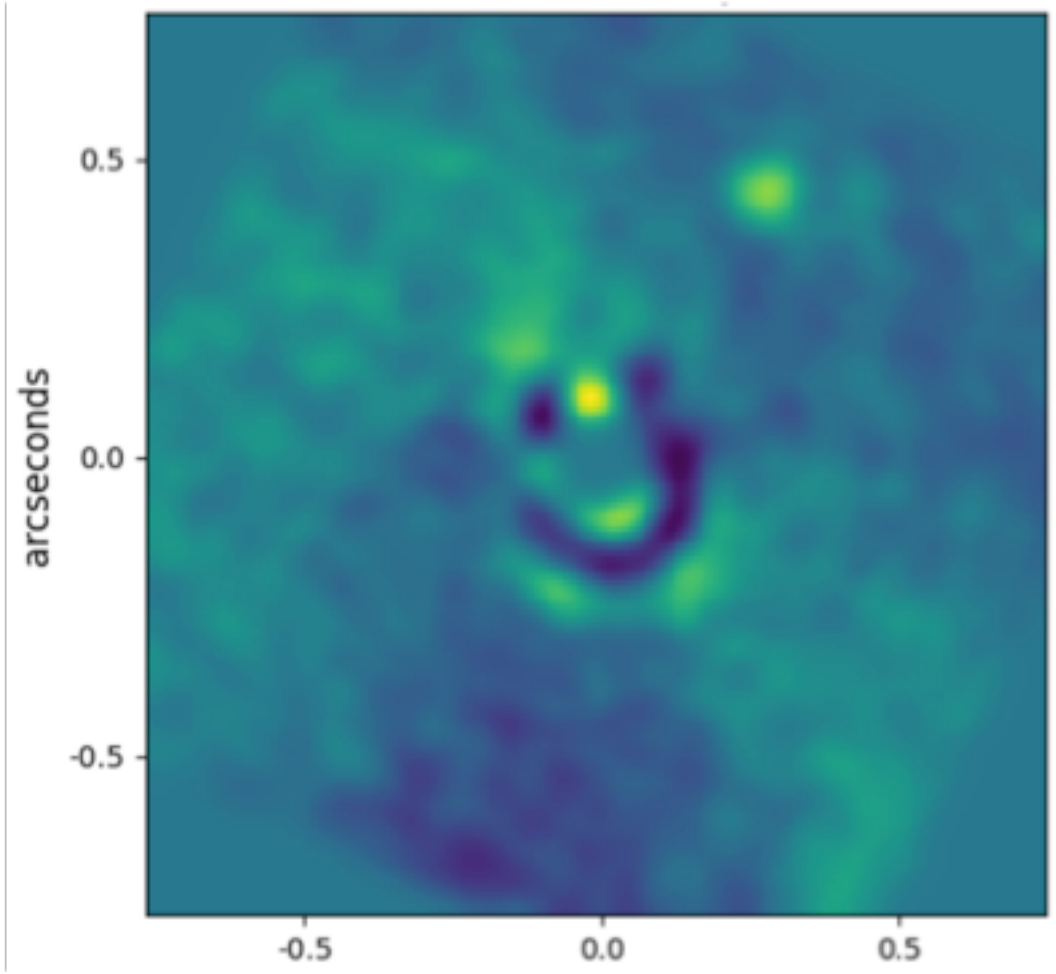
@AstroDino

EXTRA SLIDES

☺ ??



Reference off-centre