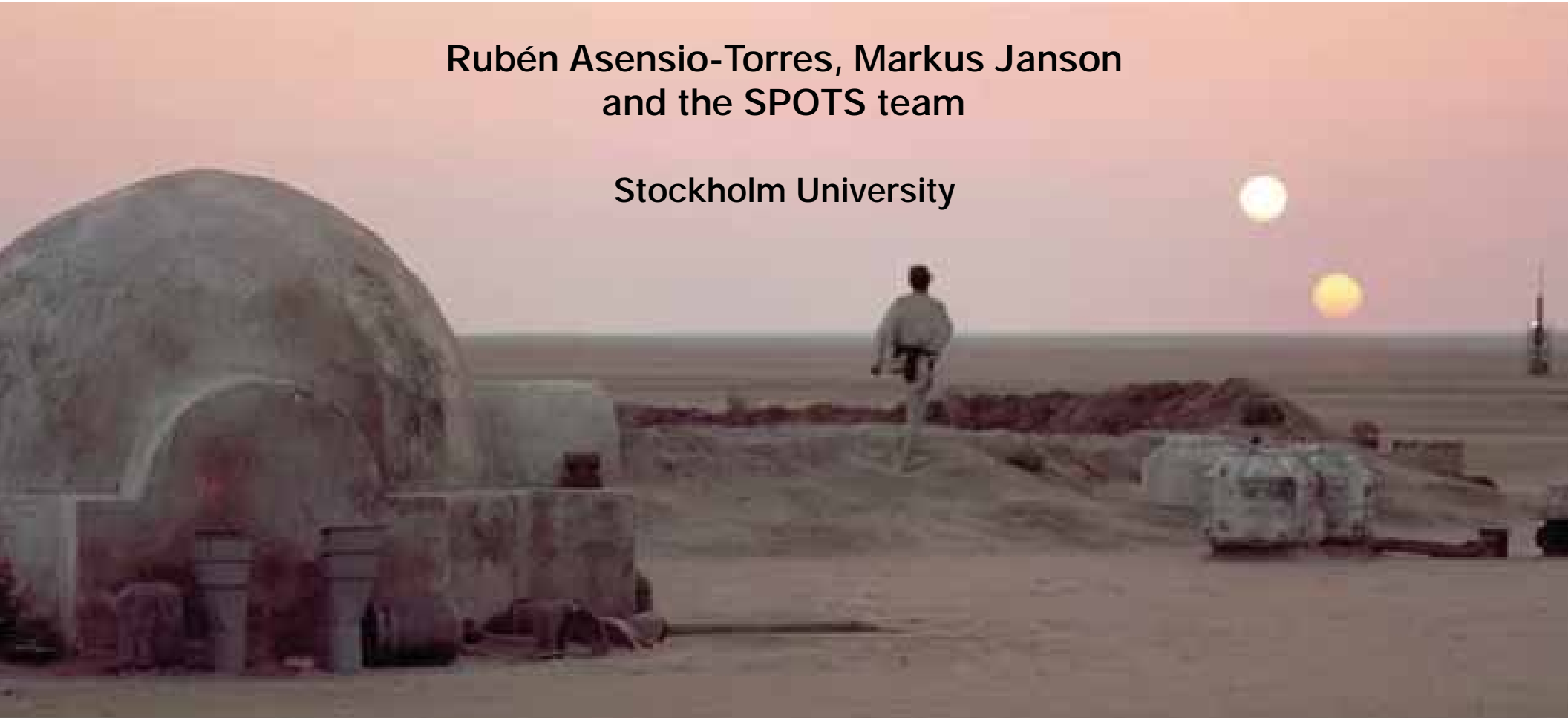# SPOTS

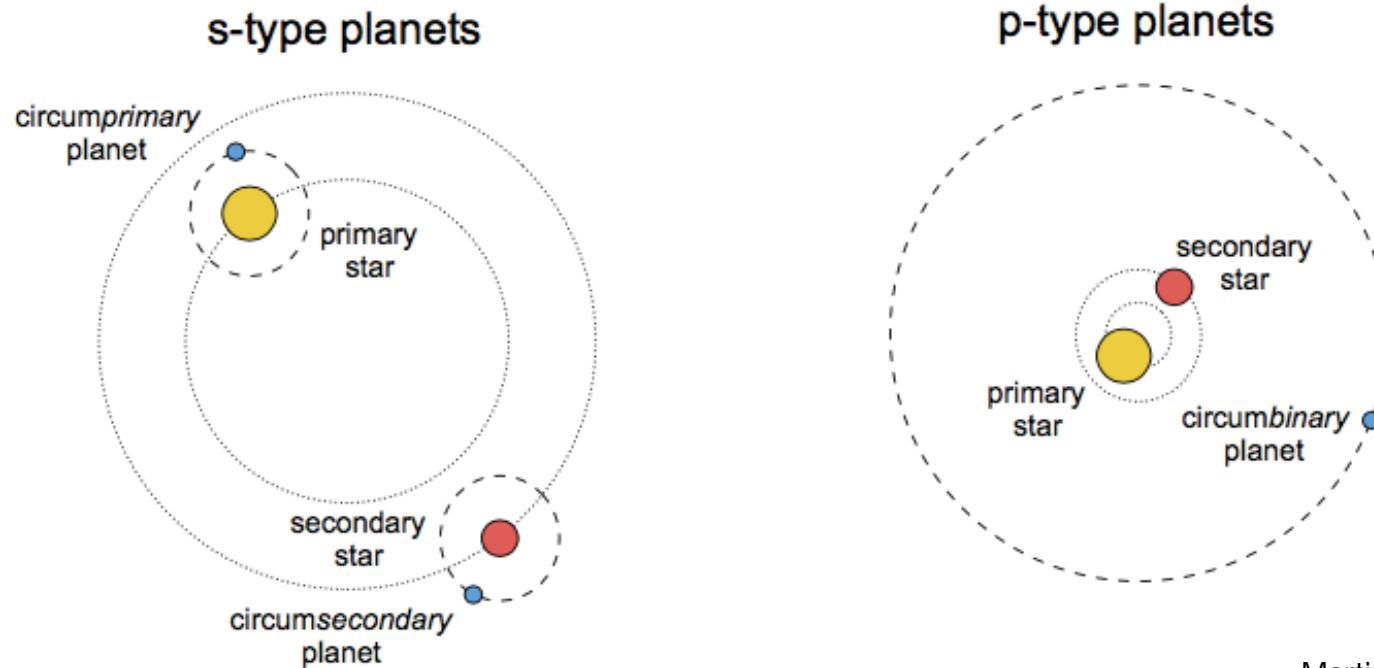## the Search for Planets Orbiting Two Stars

Rubén Asensio-Torres, Markus Janson
and the SPOTS team

Stockholm University

s-type planets

circum*primary* planet

primary star

secondary star

circum*secondary* planet
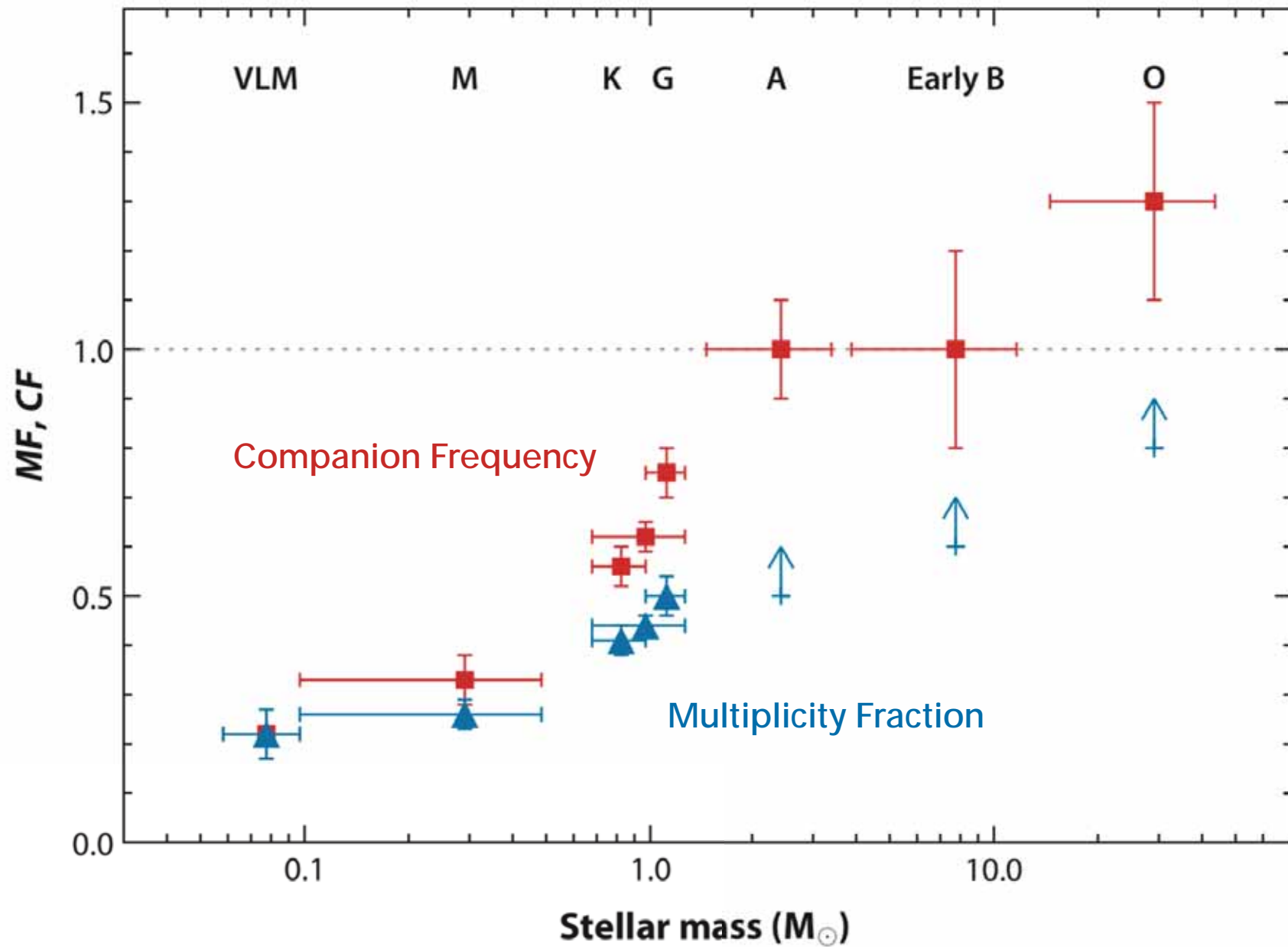
p-type planets

secondary star

primary star

circum*binary* planet

Martin + 2018

Stability

$$a_{cs} = f(\mu_{binary}, e_{binary}) \leq 0.5 \times a_{binary}$$

$$a_{cb} = f(\mu_{binary}, e_{binary}) \sim 2\text{–}3 \times a_{binary}$$
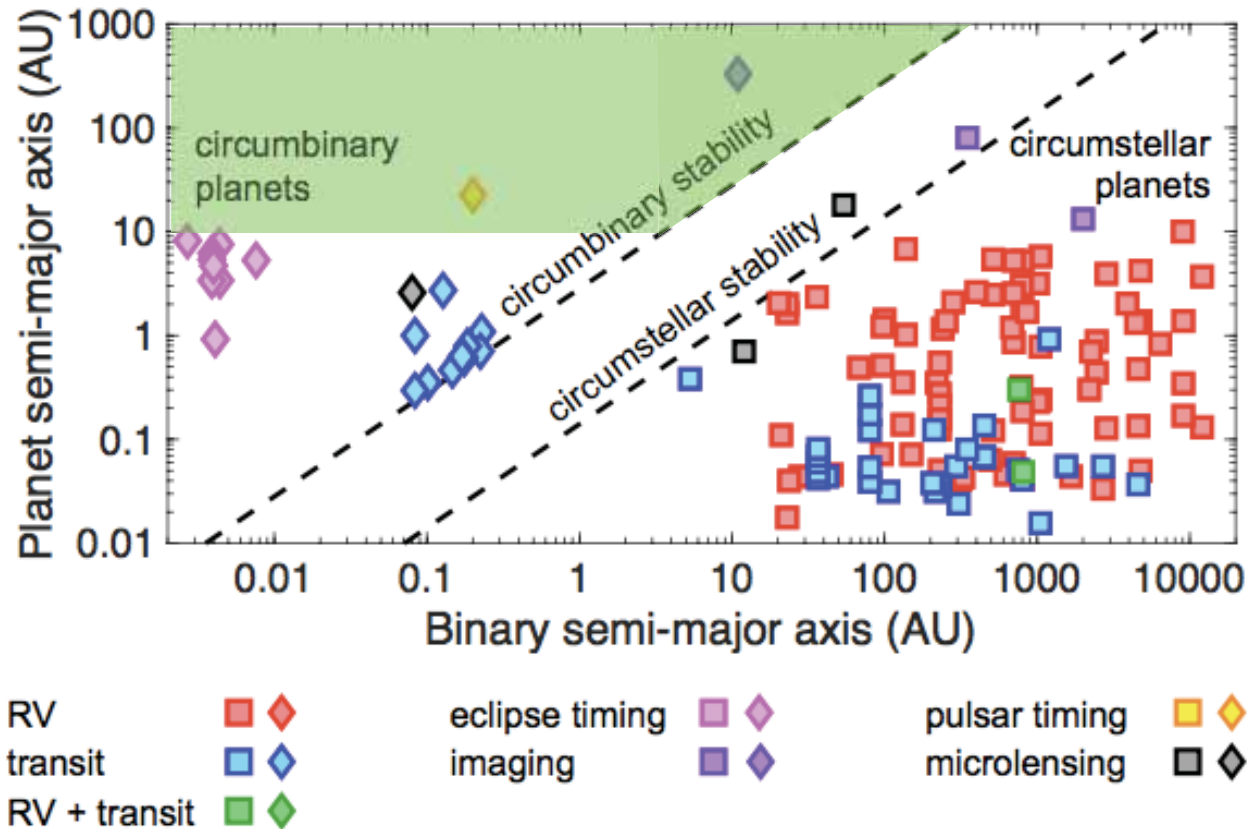
Holman & Wiegert, 2008

Circumbinary Planets (CBPs)

Duchene & Kraus 2013
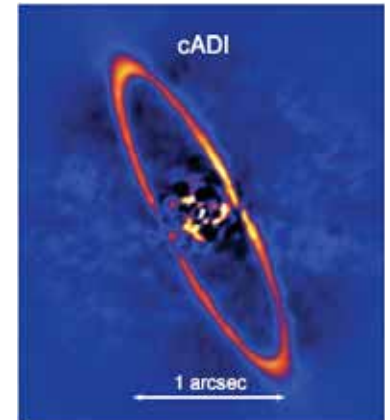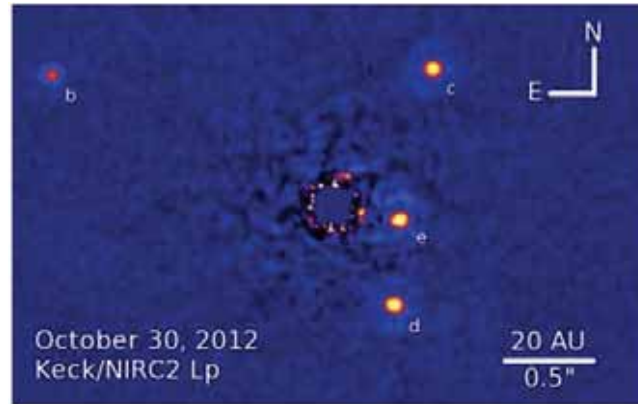
Very few (or no) CBPs on wide orbits

Martin + 2018

…but maybe abundant

- Poorly explored by indirect methods
- Stable orbits beyond a_{CB}
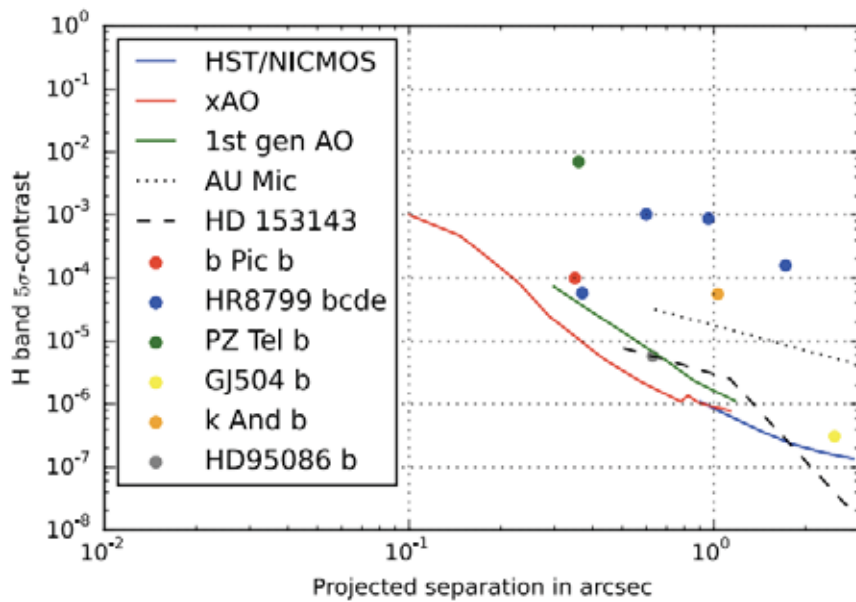- Scattering and binarity-related processes

AO + CORONAGRAPHY

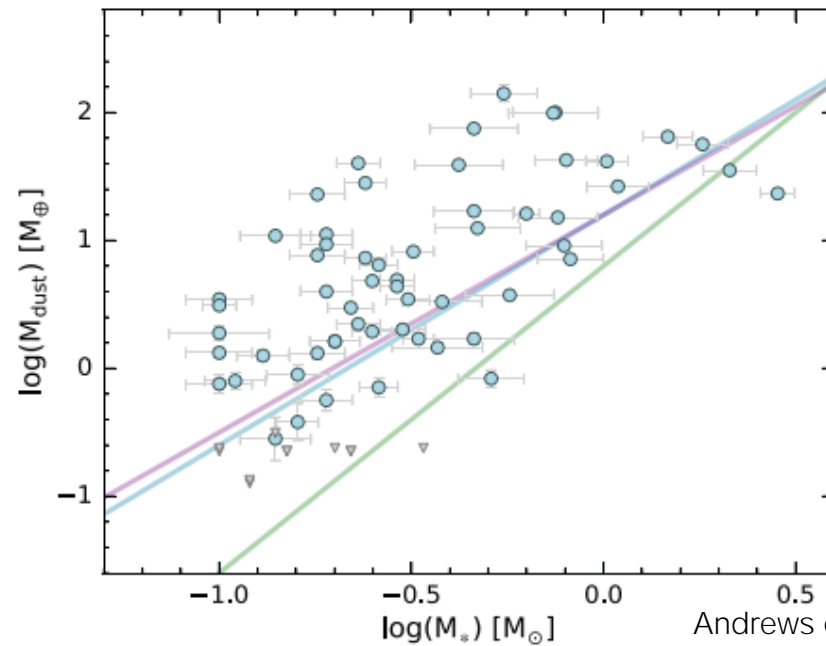+ POST-PROCESSING

October 30, 2012
Keck/NIRC2 Lp

20 AU
0.5"
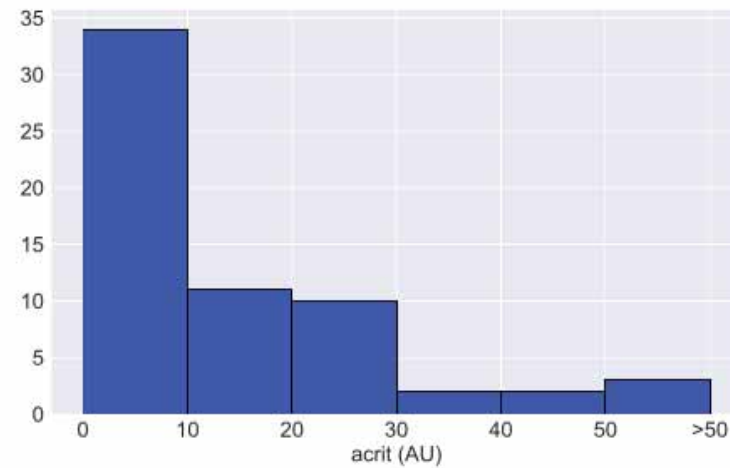
cADI

1 arcsec

Currie et al. 2014

Milli et al. 2017
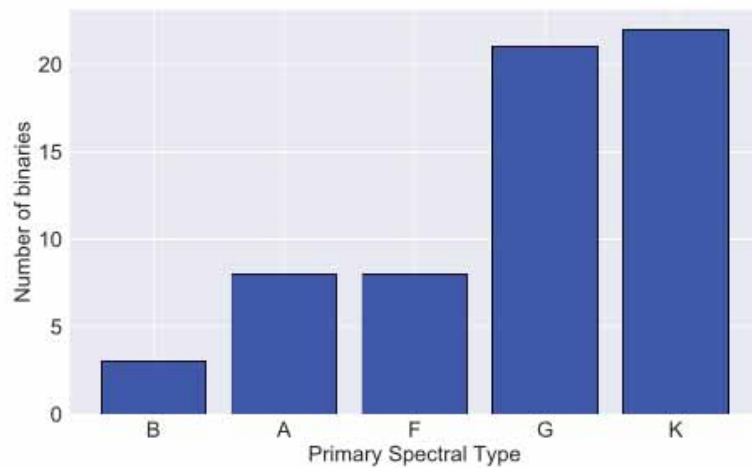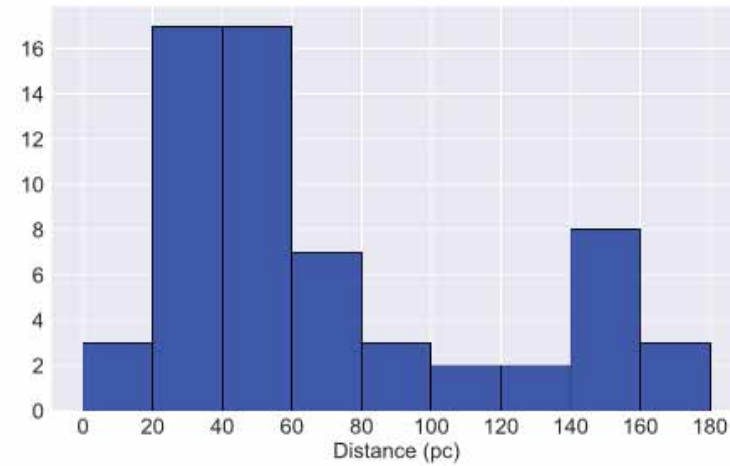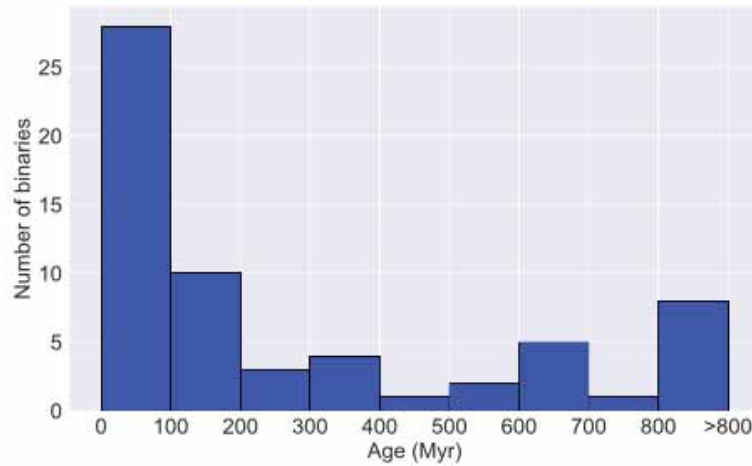

Milli et al. 2017
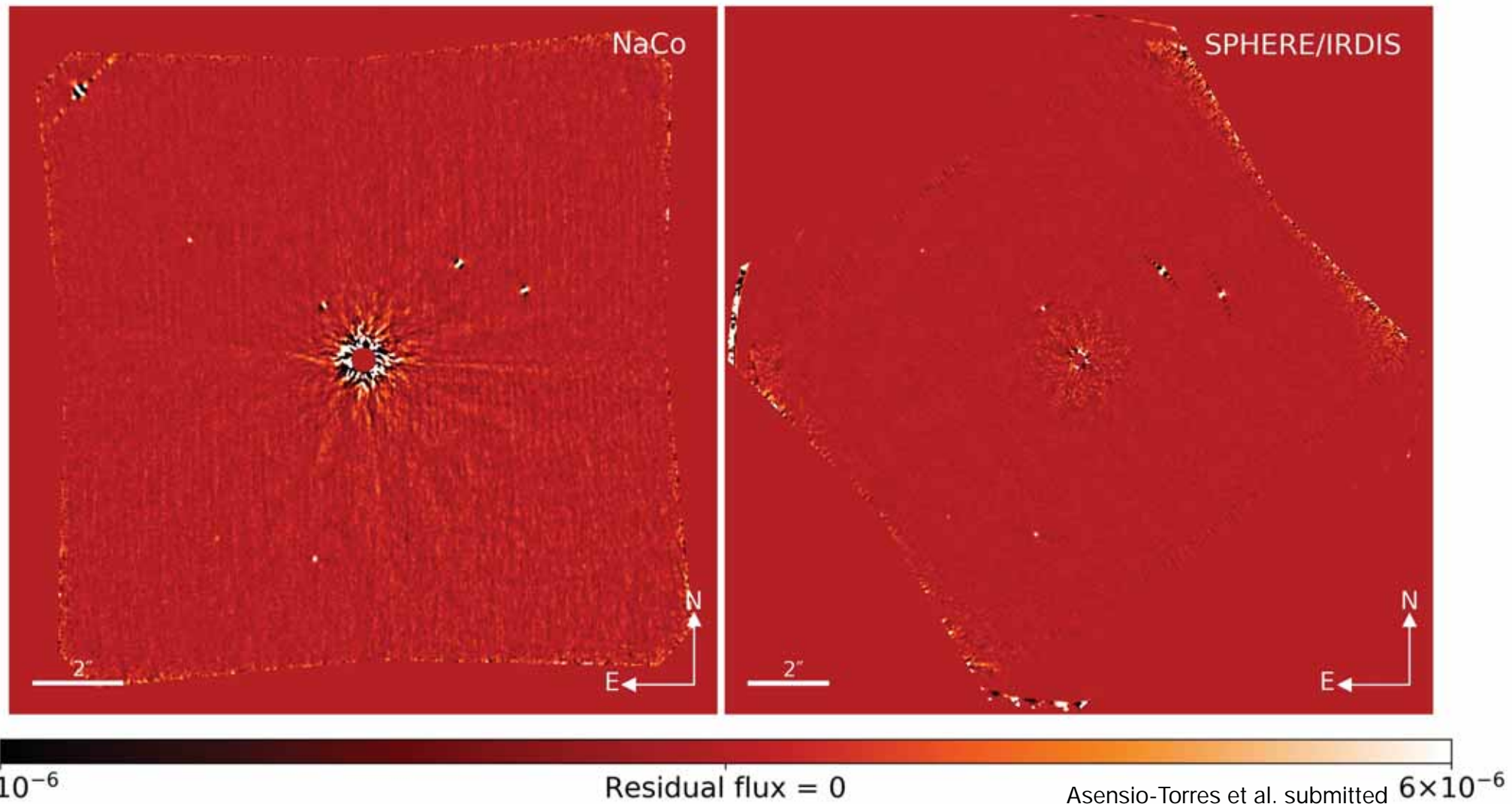
Andrews et al. (2013),
Ansdell et al. (2016, 2017),
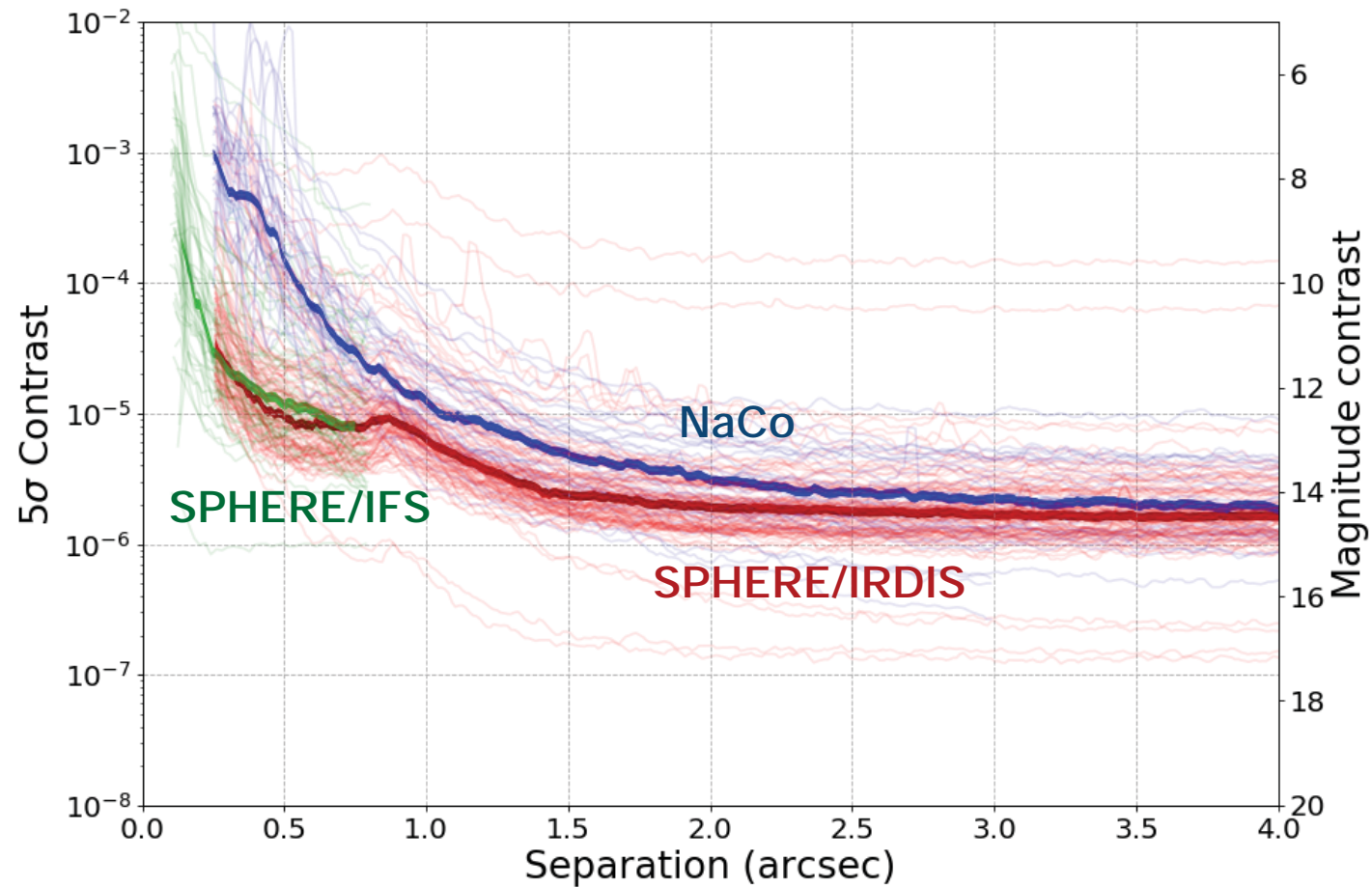
62 young, nearby and tight binaries

Asensio-Torres et al. submitted

> 90 observations in total, including follow-ups

VLT/NaCo (*H* band) and VLT/SPHERE (IRDIFS mode) over a timespan of 5.5 years
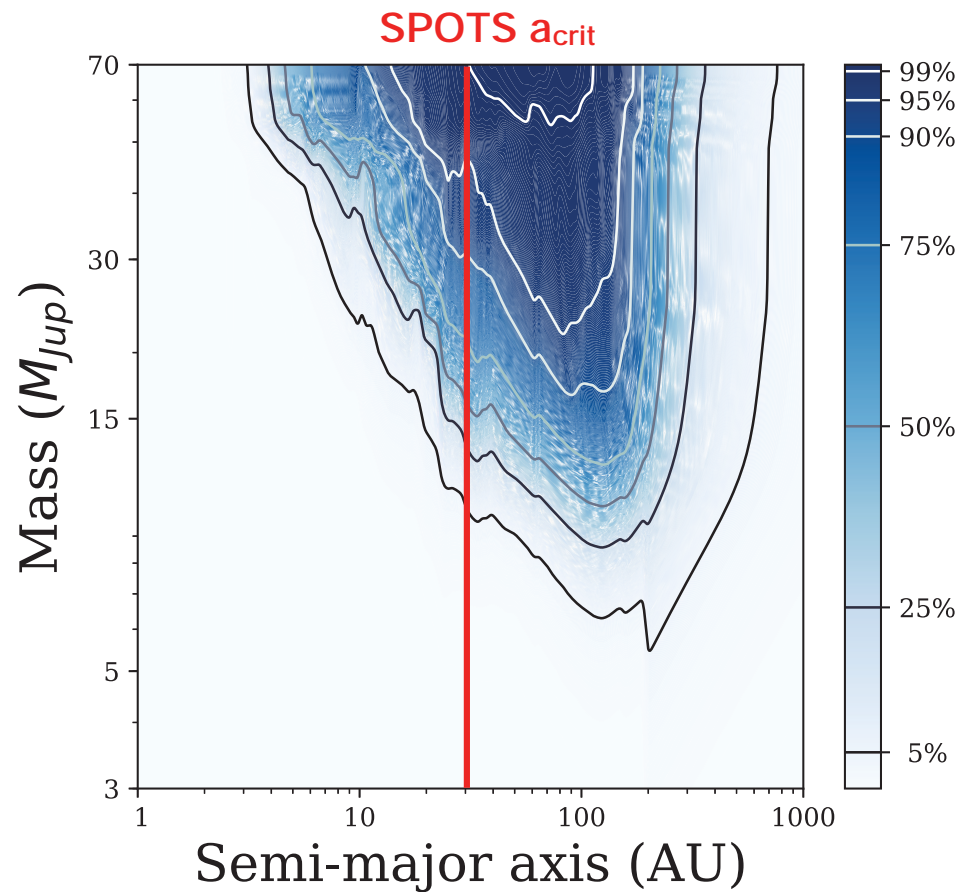

-6×10^{-6} Residual flux = 0   Asensio-Torres et al. submitted 6×10^{-6}

SPOTS contrast curves

Asensio-Torres et al. submitted

SPOTS

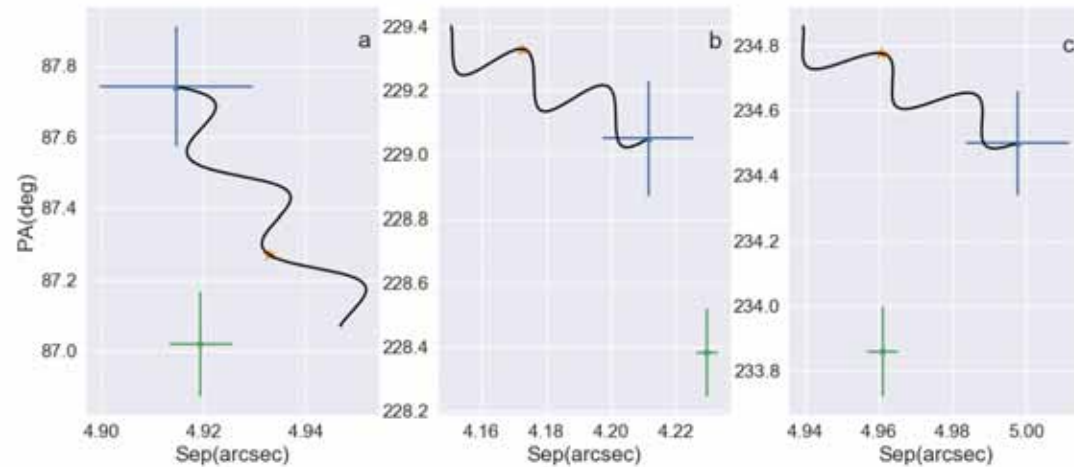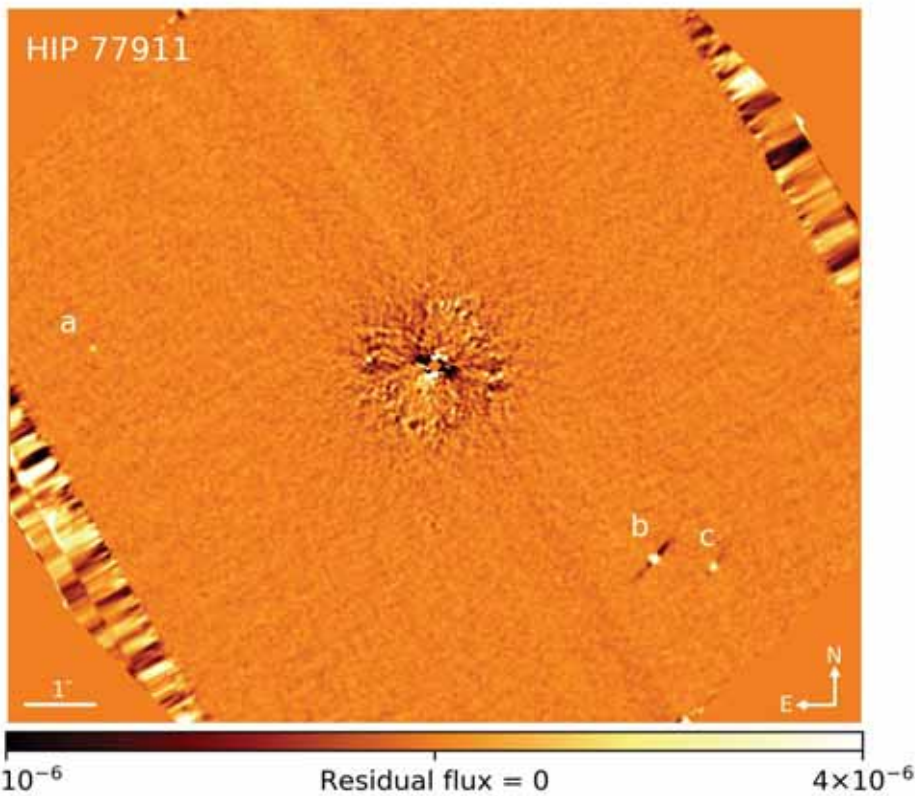# Mean detection probability map

Asensio-Torres et al. submitted

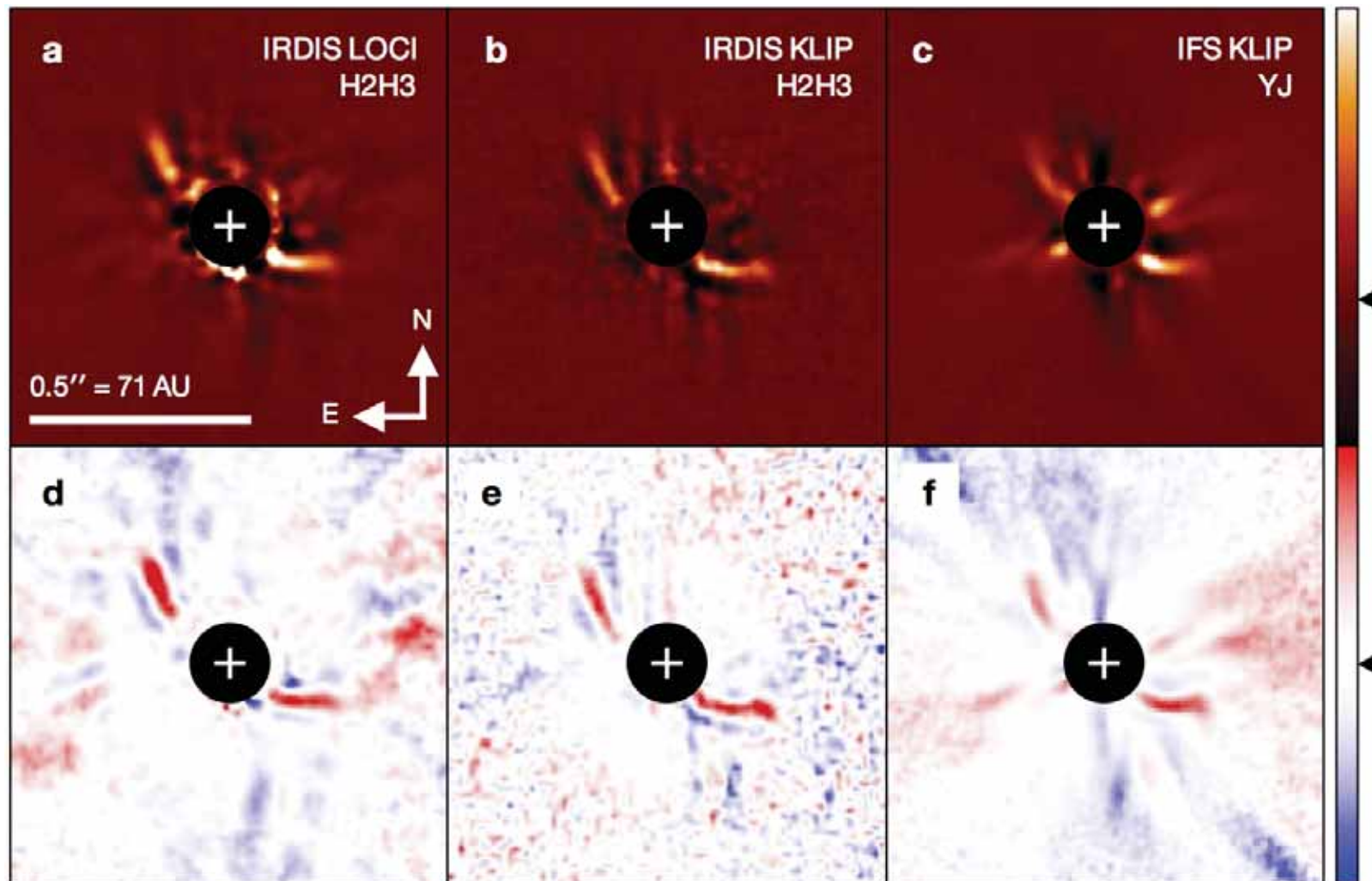We did not find any CBP within 300 AU

Possible indications of non-background planetary-mass candidates around HIP 77911

Earlier HiCIAO epoch recovered from June 2014, compared to the
SPOTS/SPHERE March 2016 observation
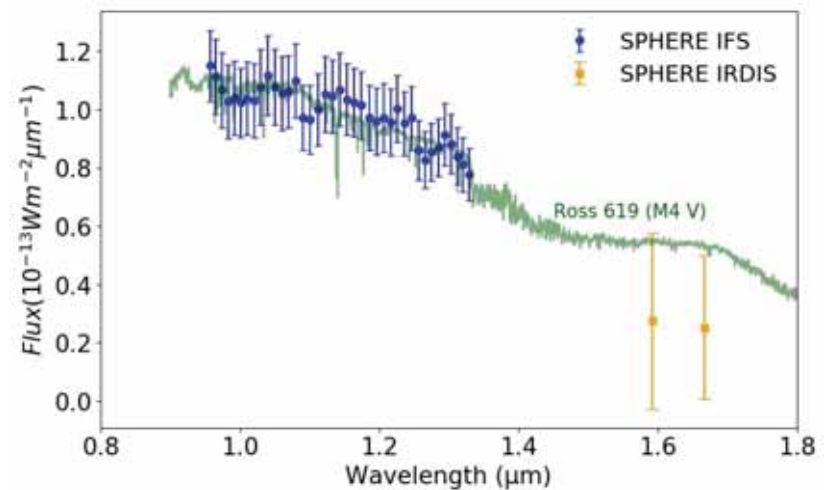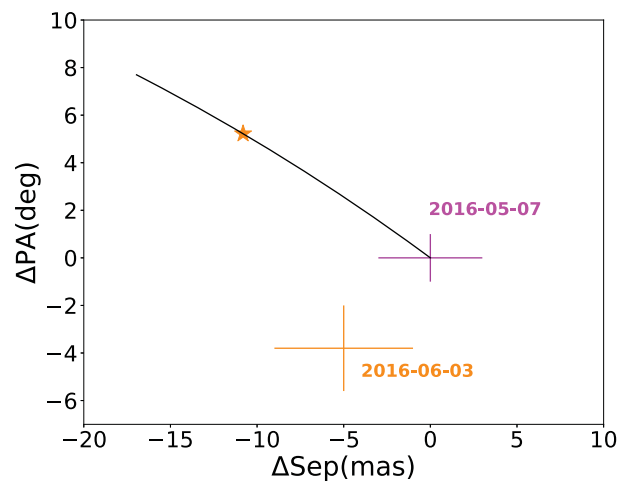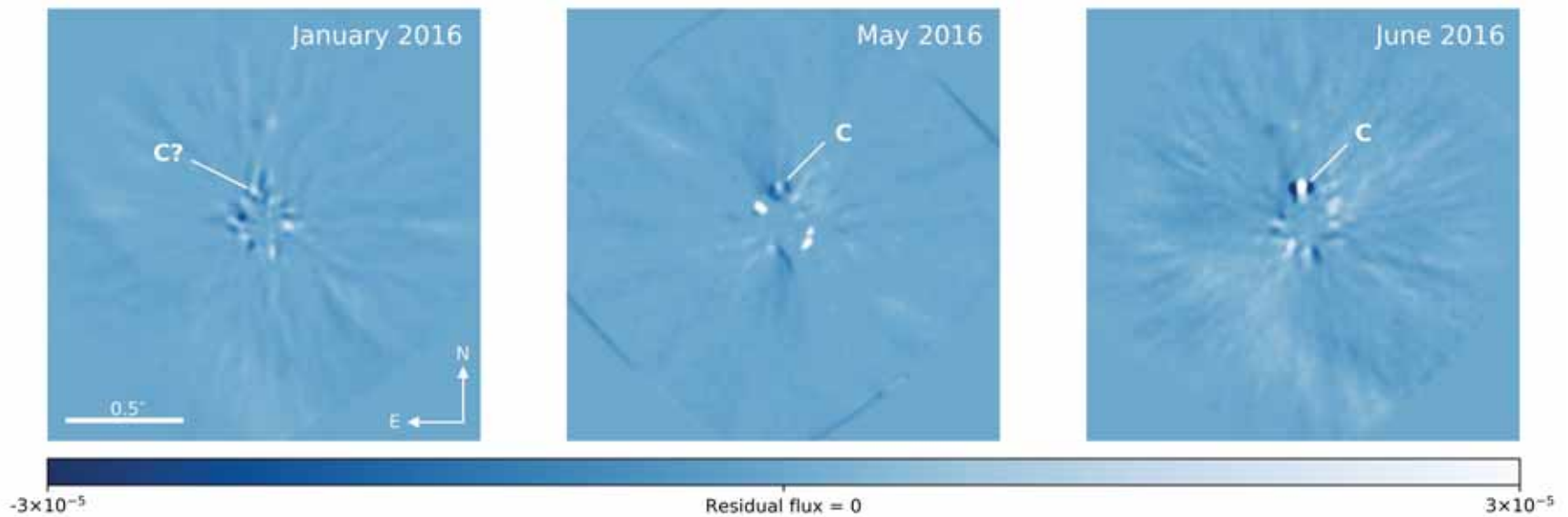
Asensio-Torres et al. submitted

The circumbinary disk around AK Sco

Janson + 2016

A new M-type star found around λ Muscae

Asensio-Torres et al. submitted

R. Asensio-Torres   SPOTS: The Search for Planets Orbiting Two Stars

SPOTS sample
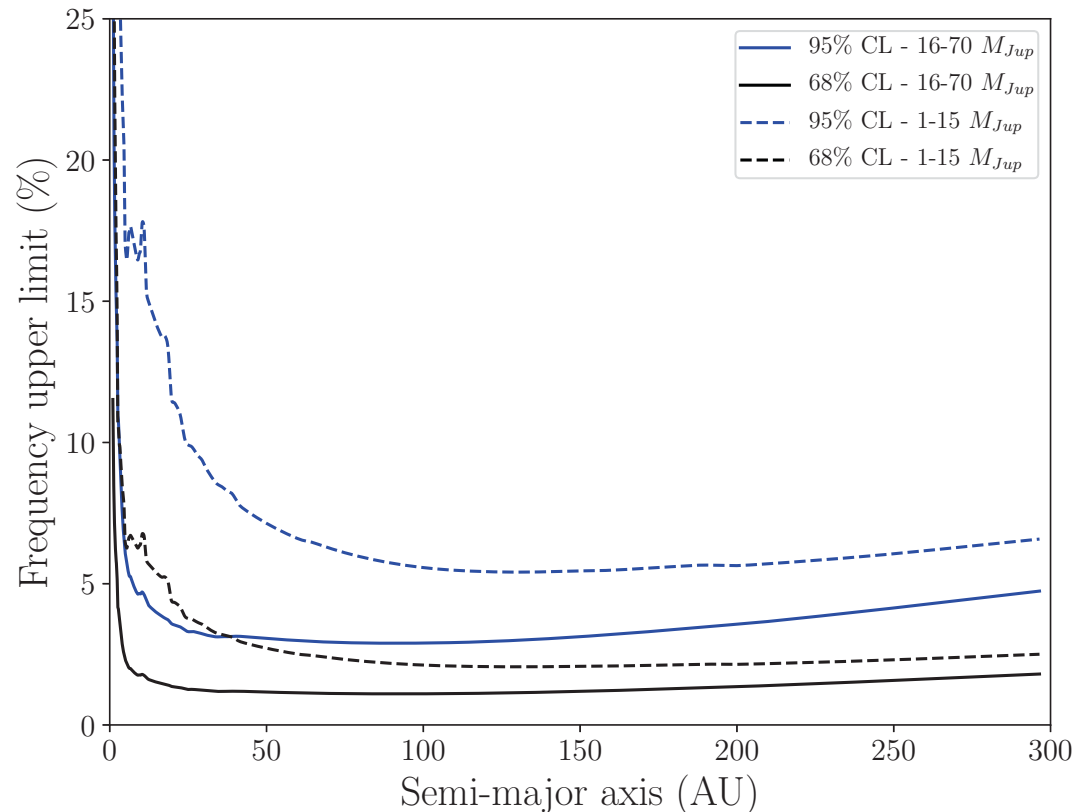
- Only the inner 300 AU used to compute companion frequencies, which is interior to all the sources of unknown companionship in the survey
- CBPs frequency < 10% in the range 30—300 AU
- Maximum Brown dwarf frequency of <5% from 5—300 AU

Asensio-Torres et al. submitted

SPOTS + Bonavita et al. 2016
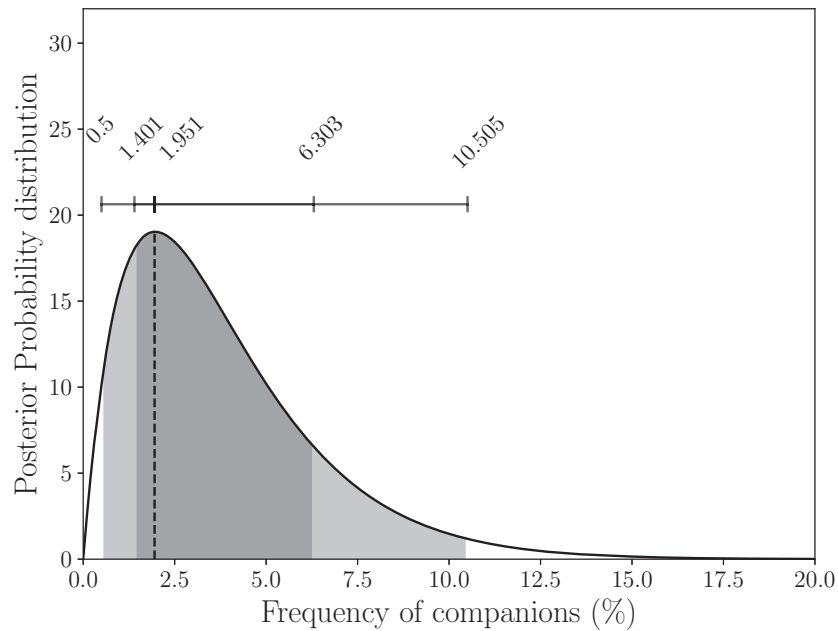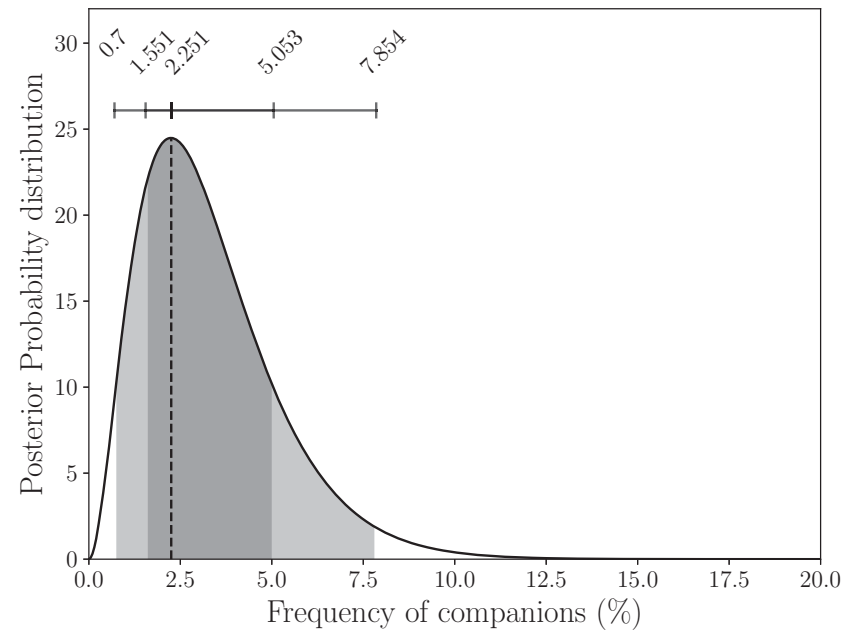
Statistical analysis of CBPs and Brown Dwarfs around 163 binaries in total

CBP (1–15 MJup)

Brown Dwarfs (16–70 MJup)

- The archival study of Bonavita et al. 2016 incorporates 5 substellar circumbinary companions

SPOTS

1. No substellar companion has been found around any of the 62 binaries inside 300 AU, although there are a few interesting candidates further out

2. Upper limit on CBPs and BDs of <10% and <7%, respectively.

3. Including the archival Bonavita et al. 2016 sample (163 binaries in total), best fit CBP frequency of 1.95 % and 2.25% for BDs

4. Very similar to the occurrence rate around single stars (Bowler 2016)