Discovery space and science with the PLACID stellar coronagraph

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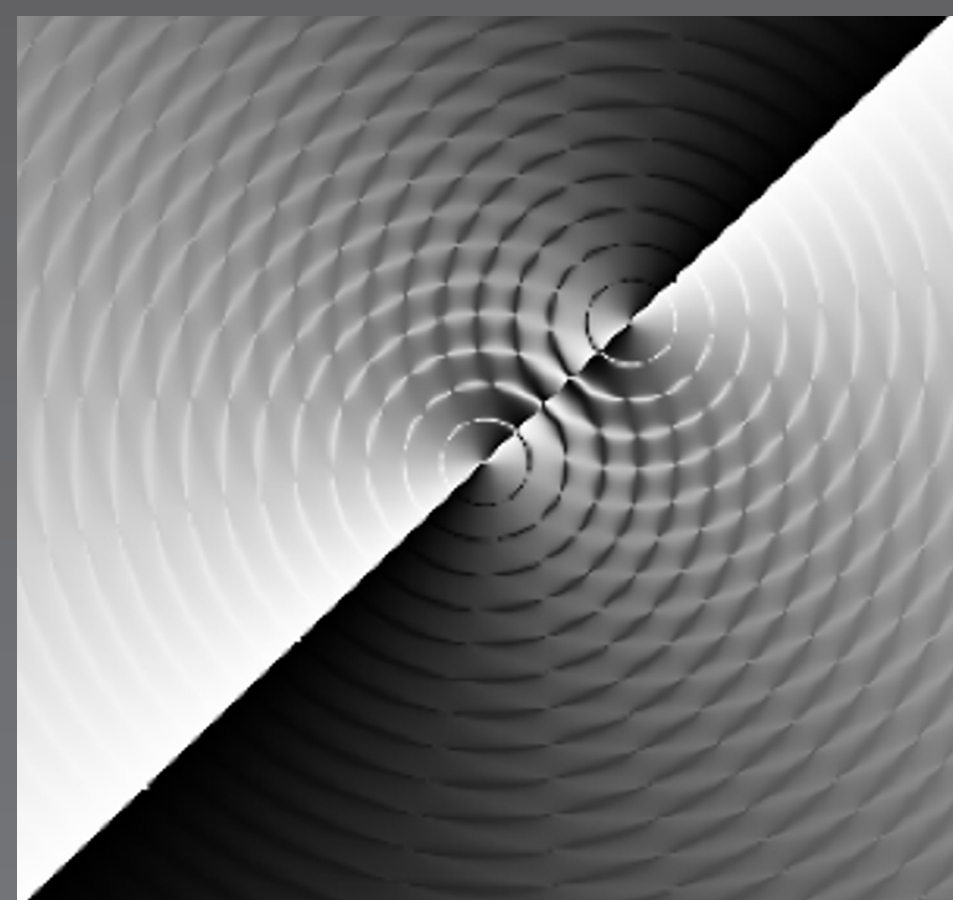[2] University of Applied Sciences HEIG-VD, Route de Cheseaux 1, 1401 Yverdon-les-Bains, Switzerland
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Introduction

- PLACID (Programmable Liquid-crystal Active Coronagraph Imager for the DAG telescope) is a coronagraphic instrument, providing adaptive high-contrast imaging capbilities from H - to Ks - band

- PLACID uses a pixelated Spatial Light Modulator (SLM) to generate coronagraphic focal-plane masks (FPMs) for the first time on a telescope (4 m, DAG observatory, Erzurum, Turkey)

- Instrument delivered in March '24, first light expected by end of 2024

- Remote reconfiguration on-demand to adapt to e.g. observing conditions, multiple star coronagraphy, correcting aberrations, segmented primary mirrors (ELTs, HWO, ...)

Doğu Anadolu Gözlemevi (DAG, Eastern Anatolia Observatory)

TROIA: AO-system developed by HEIG-VD Yverdon, Switzerland

Spatial Light Modulator (SLM)

DAG 4m-telescope

Nasmyth platform

DIRAC NIR camera: developed by Macquarie University Sydney, Australia

PLACID: active (SLM-based) coronagraph instrument jointly developed at University of Bern and HEIG-VD Yverdon, Switzerland
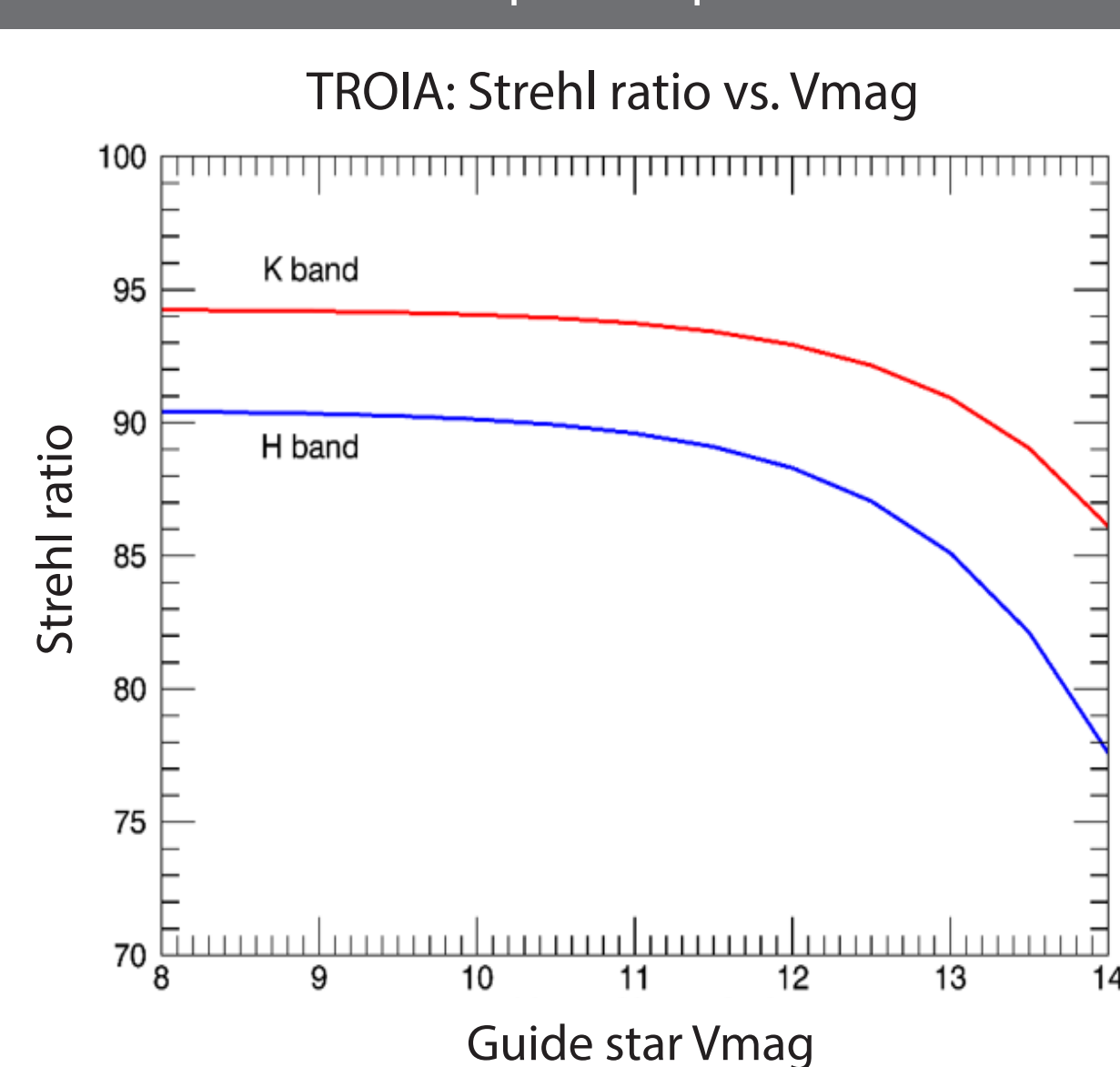

Vortex FPM (n=2) programmed for a binary star (can be rotated in time to perform ADI) [1]

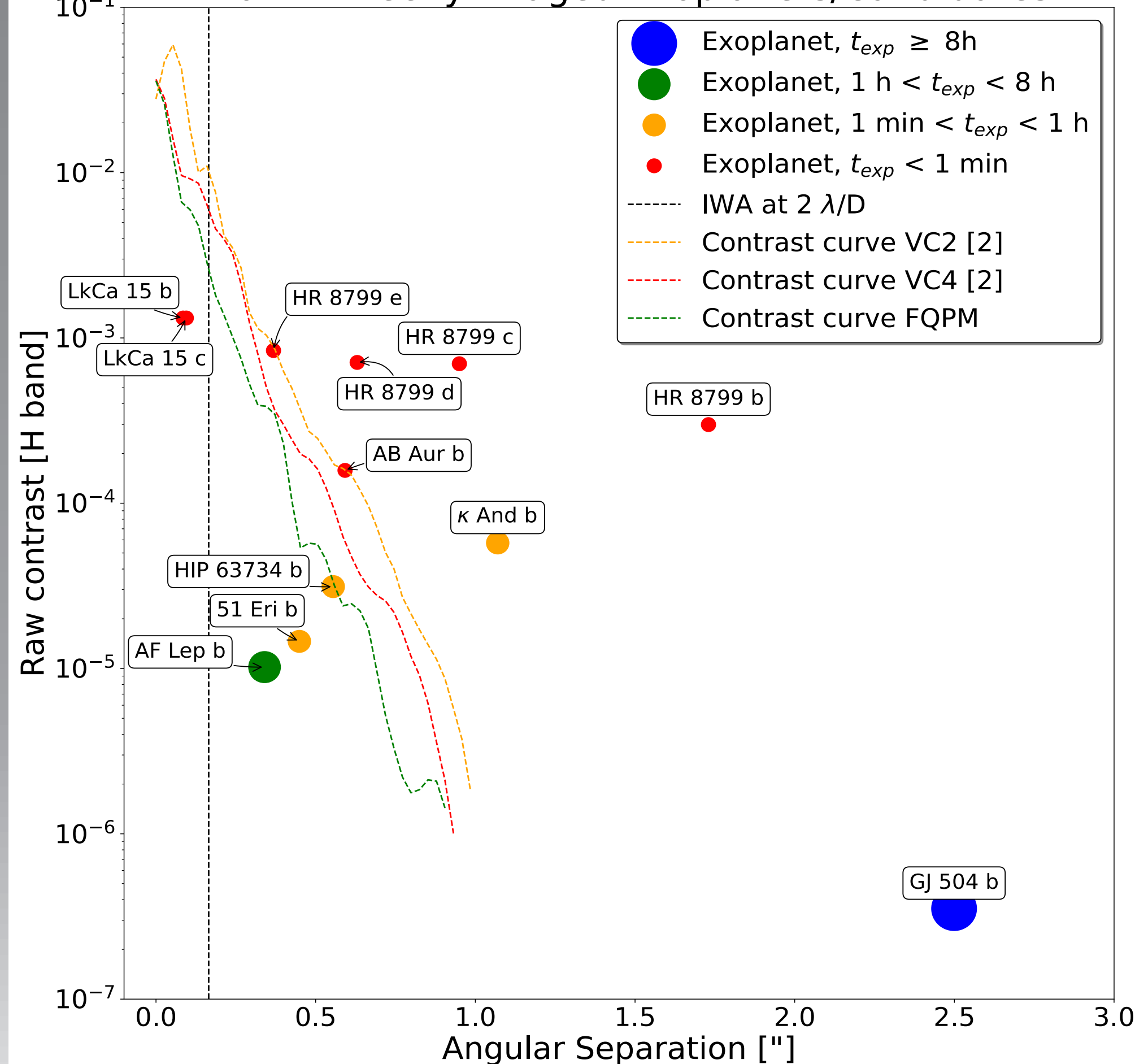Have a look at a related poster on simulations of an SLM-based coronagraph!

TROIA AO expected performance

TROIA: Strehl ratio vs. Vmag

PLACID targets and discovery space

- Known exoplanets / candidates, Brown Dwarfs, circumstellar disks, binaries/triples

- Gaia, TESS, PLATO direct-imaging follow-ups in the North

- PLACID observational constraints:
  ◦ Site: DEC: ≥ -24°
  ◦ TROIA AO guide star: V ≤ 13 mag
  ◦ On-sky FOV: 16" x 9.6"
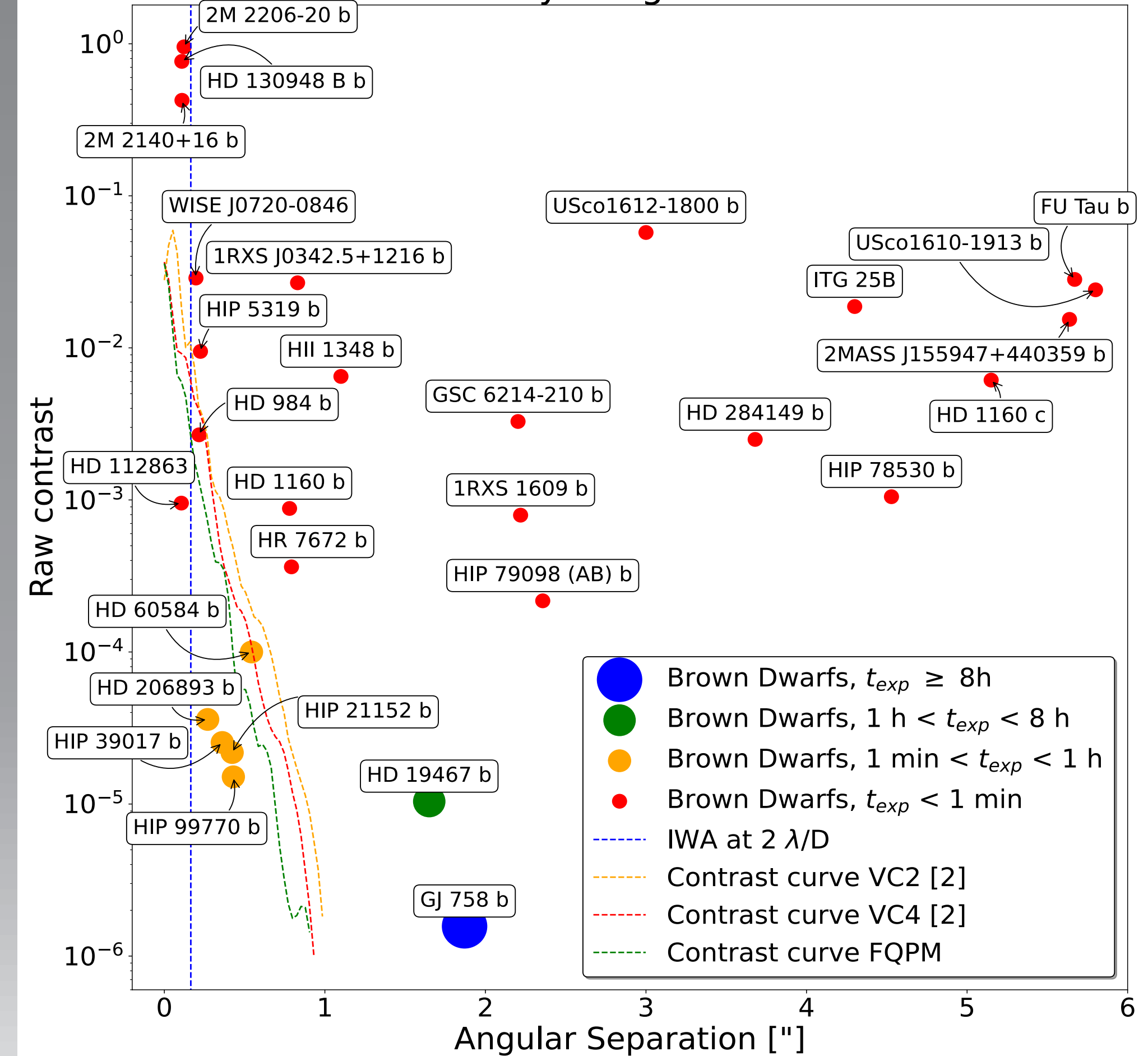

Known Directly Imaged Exoplanets/Candidates

- Plots: no sky degradation

- Lab contrast curves

- Exposure time t_{exp}
  - required for SNR = 5
  - without coronagraph
  - no speckles

- Post-processing, ADI, CDI
  → factor 10 improvement

Known Directly Imaged Brown Dwarfs

Outlook

- Obtaining on-sky contrast curves for PLACID
- Data reduction pipeline

References

[1] Jonas G. Kühn et al. SLM-based digital adaptive coronagraphy: current status and capabilities. Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation III, volume 10706 of SPIE Conference Series, page 107062N, July 2018. doi: 10.1117/12.2312554.

[2] Jonas G. Kühn et al. SLM-based Active Focal-Plane Coronagraphy: Status and future on- sky prospects. Proceedings of SPIE, February 2021. doi: 10.48550/arXiv.2102.03201. 1