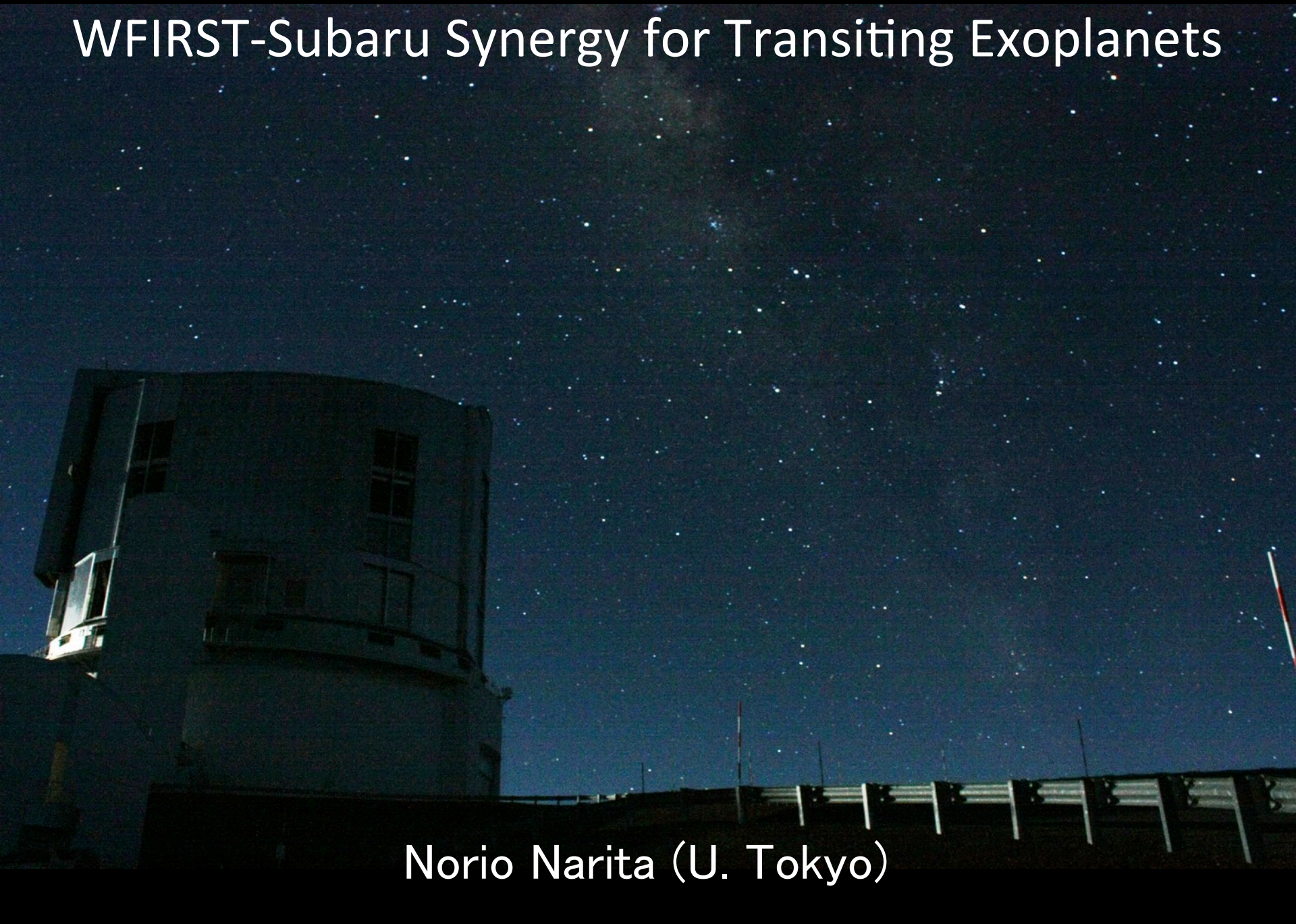
WFIRST-Subaru Synergy for Transiting Exoplanets



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Preface

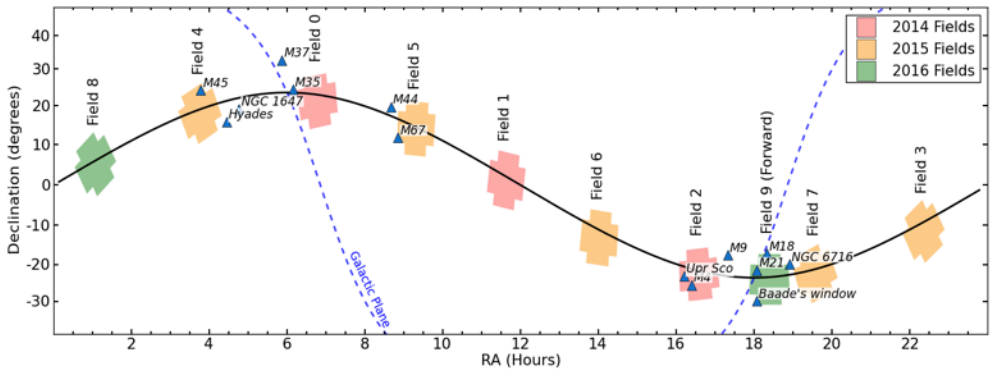
- This is what I proposed to the science white paper in Japanese community in 2016 (before the descope)

- The idea does not take into account the descope of WFIRST, but would still work for GO, if high-contrast small-IWA CGI (hopefully with IFU) is onboard and available

My main points

Good follow-up targets for future coronagraphs (WFIRST CGI and CGI of ELTs) will be discovered by TESS and PLATO

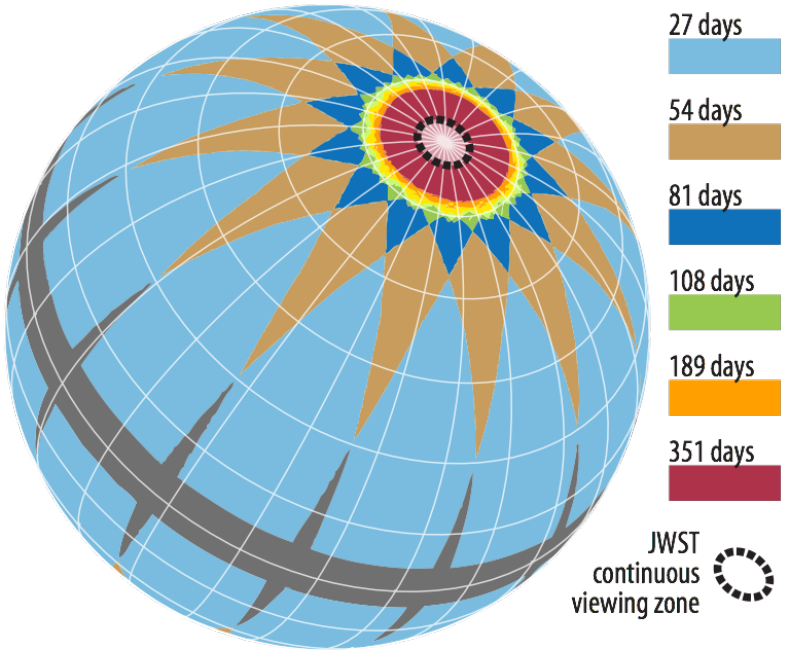
Transit Survey Missions

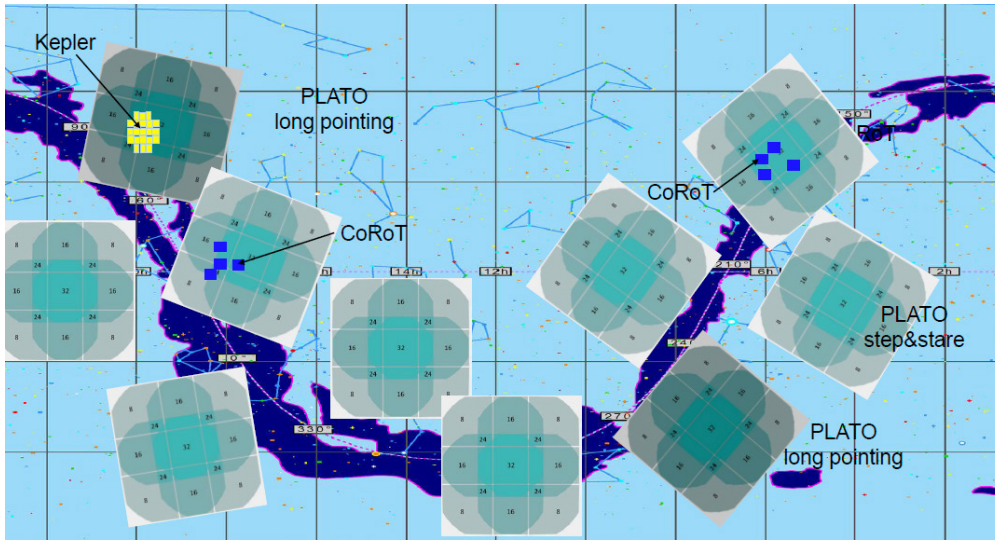


K2 (2014-2018): ecliptic plane

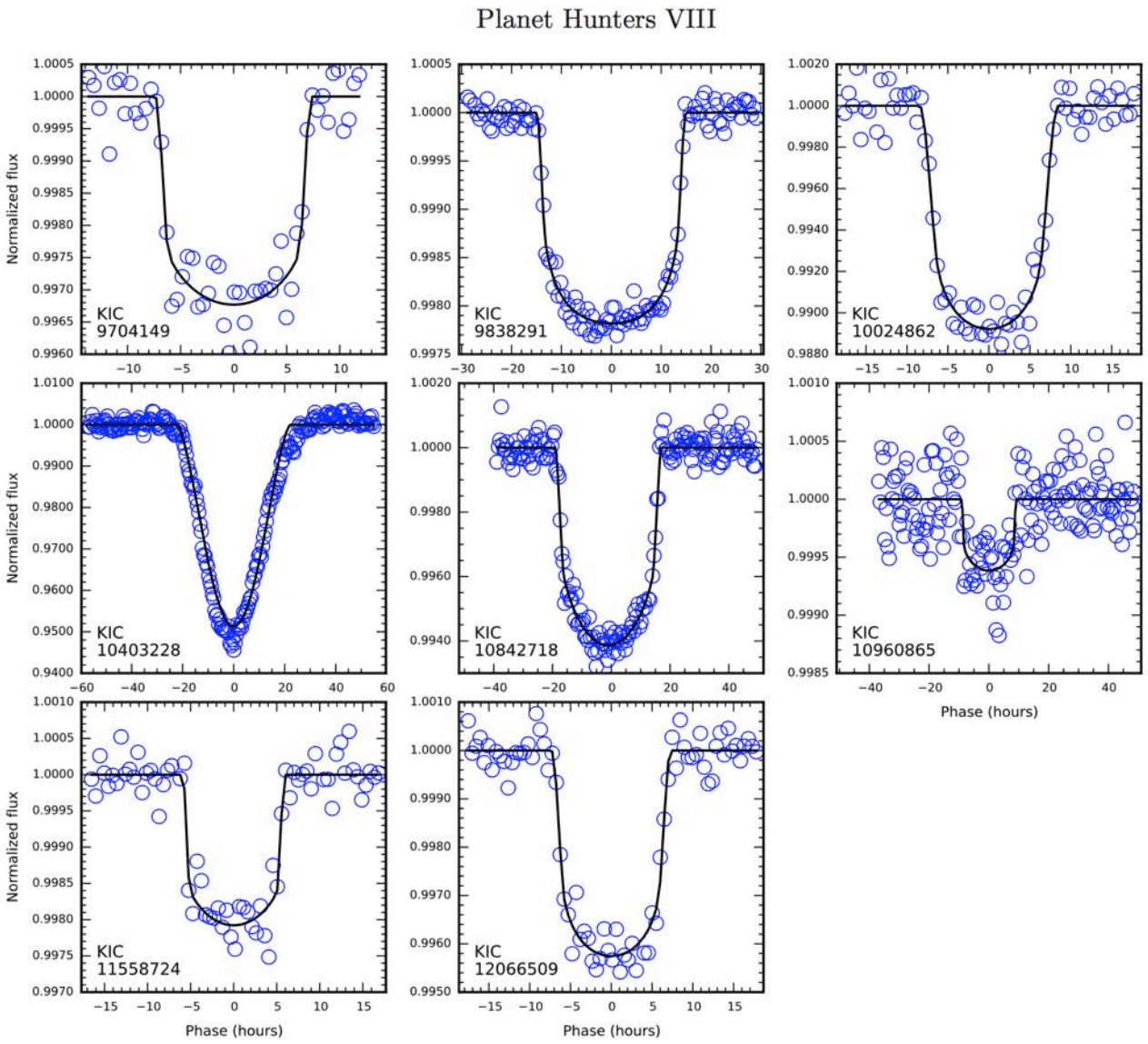
TESS (2018-2020): ~80% of sky

PLATO (2024-2030): ~25% of sky





Single−Transit Planetary Candidates from Kepler

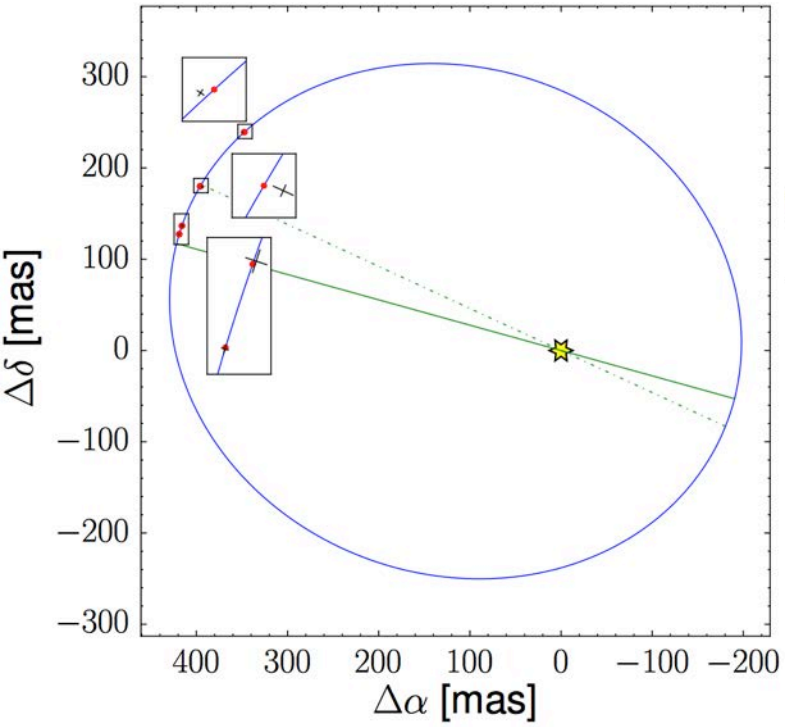


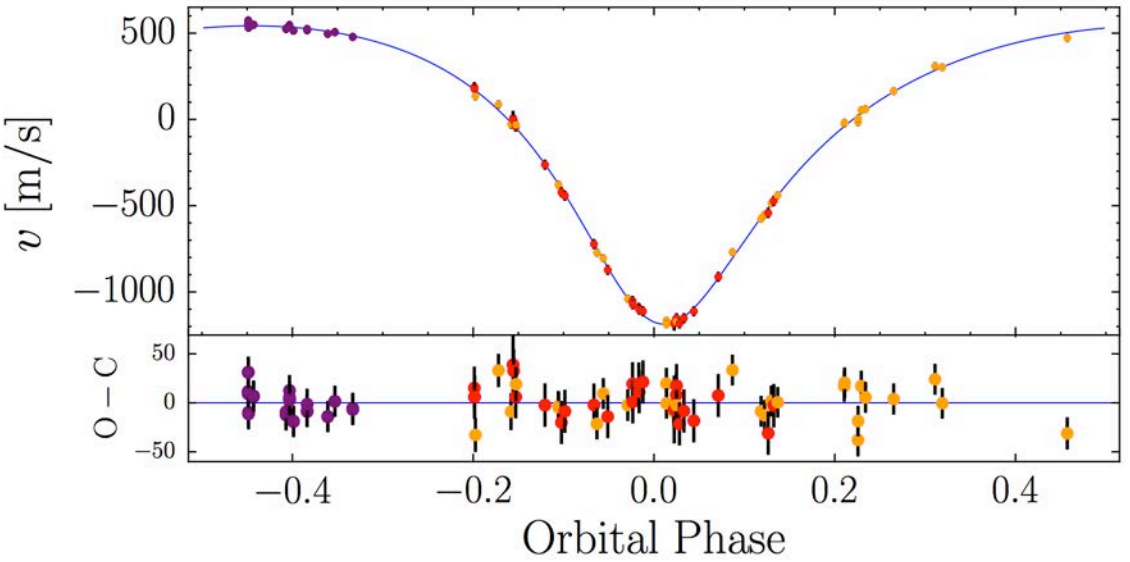
Detectability of those targets

- Single-Transit targets from TESS have the period of longer than 27 days (or 351 days for the ecliptic poles)
  - The number of detections would depend on the frequency of long-period planets (which WFIRST microlens survey can answer) and their geometric transit probabilities
  - Would not many, but those targets can be detected around nearby host stars (mainly mid-late M dwarfs)

➢ Neptunes or larger planets with the orbital period of one - a few years would be detectable and can be chased with both WFIRST CGI and Subaru IRD

Synergy of Direct Imaging and Radial Velocity

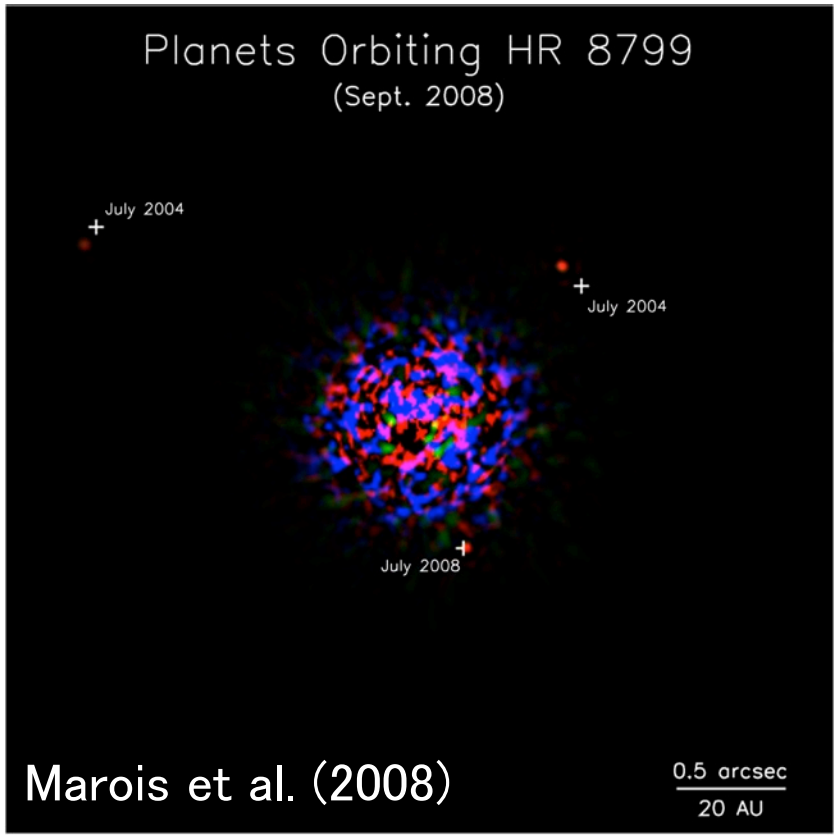


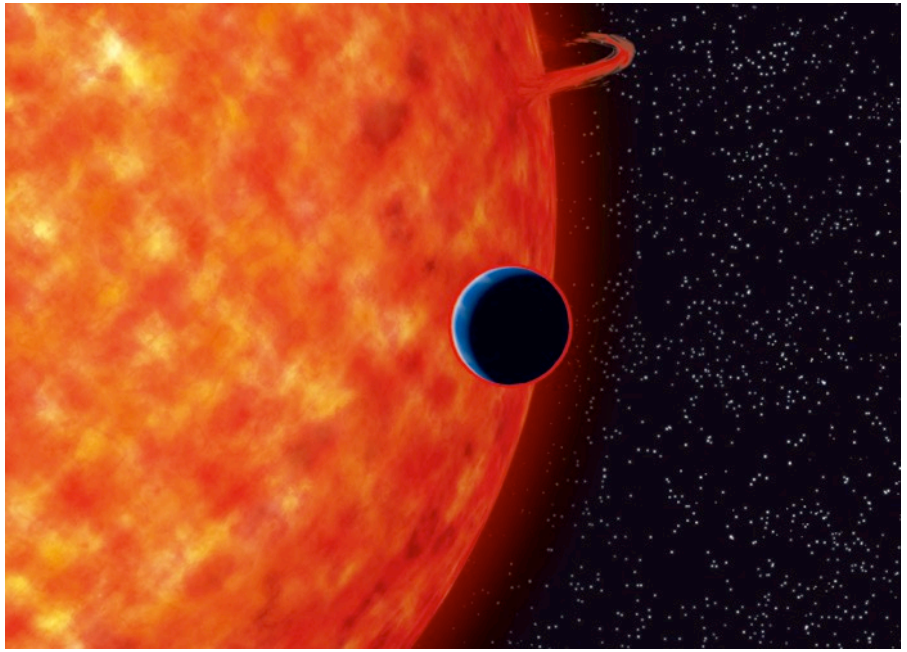


Helminiak et al. (2016)

Combination of direct imaging and radial velocity enable us to determine the 3D orbit and the mass of the planet

Synergy of Direct Imaging and Transit





Combination of direct imaging and transmission spectroscopy enable us to characterize the atmosphere of the planet

Scientific merits of those targets

- Various characterizations are possible
  - Planetary radii are known by transit
  - By chasing RVs right after their discoveries with Subaru IRD, then at least constraints on masses (to validate the planetary nature) are available
  - combination of direct imaging and RVs around the same time allows to determine their masses and 3D orbits (eccentricity and orbital inclination)
  - can determine their albedos from direct imaging, and can probe atmospheres using IFU spectroscopy
  - Orbital information from direct imaging would help to catch transit follow-ups, then their precise periods are also known, and transmission spectroscopy for those planets is also possible
  - Rossiter-McLaughlin or Doppler tomography measurements enable us to learn stellar spin vs planetary orbit obliquities

Summary

Good follow-up targets for future coronagraphs (WFIRST CGI and CGI of ELTs) will be discovered by TESS and PLATO

- Single-Transit planetary candidates would become good future coronagraph follow-up targets
- Combining information from Transit+RV+Direct imaging, those targets will become the most characterized planets in the future