

The TRAPPIST and SPECULOOS contribution to TFOP SG1

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1. Introduction:

TFOP Sub-Group 1 is dedicated to the confirmation/rejection of TESS Objects of Interest (TOIs) with seeing-limited ground-based photometry. We present the contribution of the TRAPPIST and SPECULOOS networks of robotic telescopes to this effort.

[Link to interactive poster](#)

2. Observatories:

TRAnsiting Planets and Planetesimals Small Telescope

- Primary mirror : 0.6m
- Network of 2 robotic telescopes
- North : Oukaïmeden Observatory, Morocco
- South : ESO La Silla Observatory, Chile
- Pixel size : 0.65 arcsec/pixel
- Field of view : 20x20 arcmin
- Sub-mmag photometric precision for I-mag ~8.5 - 14
- **50% of observing time dedicated to TESS follow-up**



The TRAPPIST project is dedicated to the detection and characterization of transiting exoplanets, and the study of comets and other small bodies of the Solar system. It provides seeing-limited high-precision photometric time series of transit signals (on average 1.5ppt/5min), which is required to confirm the planetary nature of potential planet candidates. It also enables the study of the physical and chemical properties of bright comets using specific filters. The research made possible with TRAPPIST aims at understanding the formation and evolution mechanisms of planetary systems. (Jehin et al. 2011)

3. The TESS follow-up so far:

- TRAPPIST-North : 76 candidates in total
- TRAPPIST-South : 129 candidates in total
- SPECULOOS : 37 candidates in total
- **More than 10% of our TRAPPIST observations published so far**
- **30% of our SPECULOOS observations published so far**

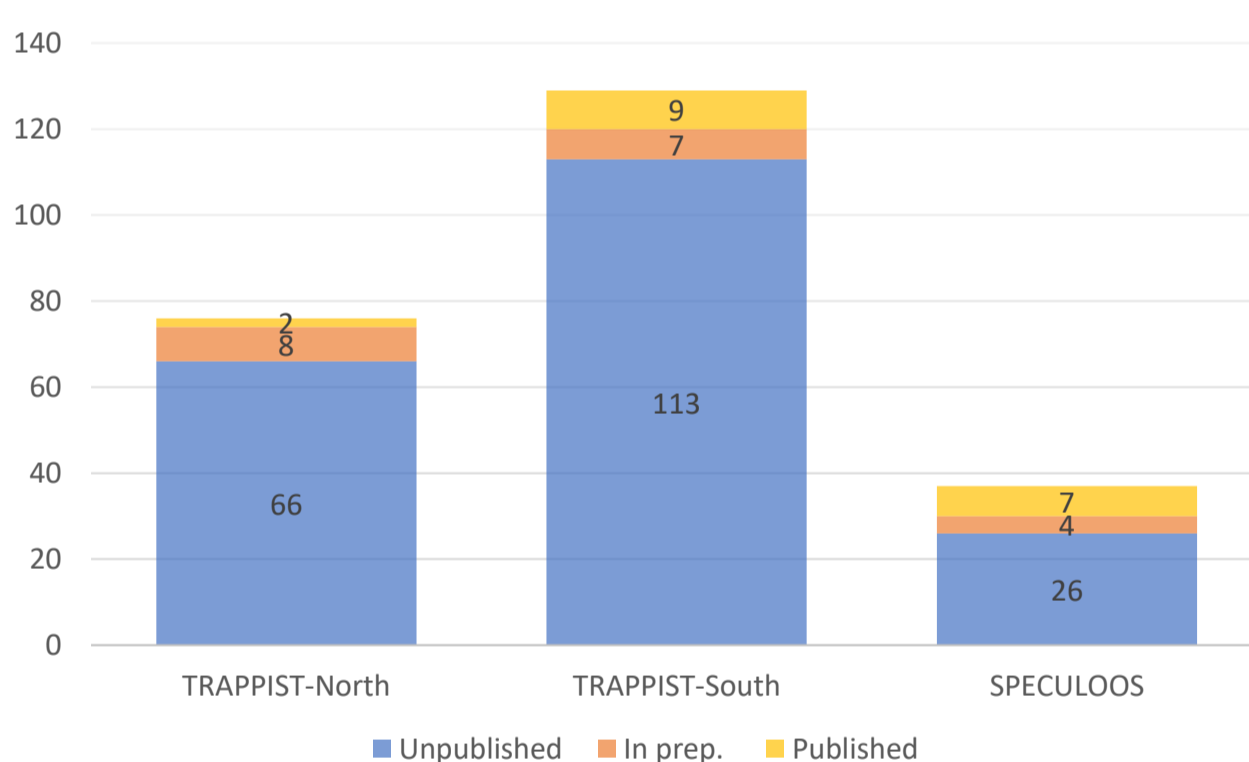
Search for habitable Planets Eclipsing ULtra-cOOl Stars

- Primary mirror : 1.0m
- Network of 6 robotic telescopes
- North1 : Teide Observatory, Canary Islands (1)
- North2 : National Astronomical Observatory, Mexico (1)
- South : ESO Paranal Observatory, Chile (4)
- Pixel size : 0.35 arcsec/pixel
- Field of view : 12x12 arcmin
- Sub-mmag photometric precision for I-mag ~9.5 - 15
- **Up to 20% of observing time available for TESS follow-up**



SPECULOOS is a ground-based transit survey which explores the nearest ultra-cool dwarf stars searching for potentially habitable Earth-sized planets amenable for atmospheric characterization with upcoming facilities such as the JWST (Delrez et al. 2018, Sebastian et al. 2020, Burdanov et al. 2018). By design, the SPECULOOS telescopes allow the observation of fainter TESS targets compared to TRAPPIST and offer an increased photometric precision which enables the detection of shallower transits (up to 1ppt/5 min).

NUMBER OF TOIS OBSERVED AND PUBLISHED PER OBSERVATORY



4. Upcoming validation papers led by SPECULOOS/TRAPPIST team members:

- **TOI-1955.01:** an exceptional temperate mini-Neptune orbiting an M4.5 star, member of a triple M-dwarf system located at 22 pc. The period is 16.33 days, yielding an equilibrium temperature of 285K assuming an albedo of 0.3 similar to Earth. The brightness of the host star in J-band gives this planet a Transmission Spectroscopy Metric of **123** (Kempton et al. 2018), which makes it presumably the best candidate in its category for transmission spectroscopy. (*In prep*, lead: *Mathilde Timmermans*)
- **TOI-2096.01 & .02:** a system consisting of a super-Earth and a mini-Neptune orbiting a 0.2 M_☉ M-dwarf star 48.5 pc away, in near 2:1 MMR with periods of 3.12 and 6.38 days respectively. We performed an intense follow-up campaign with TRAPPIST & SPECULOOS to measure TTVs and derive upper limits on the masses of the planets. (*In prep*, lead: *Francisco J. Pozuelos*)
- **TOI-2257.01:** a rare long period (35.19 days) mini-Neptune orbiting an M3 star at 57.8 pc. The particular characteristics of this candidate make it a promising target for atmospheric studies as well as searching for exomoons. (*In prep*, lead: *Nicole Schanche*)
- **TOI-2084.01:** a mini-Neptune orbiting an M2 star with a period of 6.08 days. A combination of TESS data and ground-based follow-up observations yield a planet radius of 2.3 R_⊕ for a transit depth of 2.2 ppt. The equilibrium temperature is 533K with an incident flux of 13.55 S_⊕, making it a good target for atmospheric characterization. (*In prep*, lead: *Khalid Barkaoui*)
- **TOI-2406.01:** a large sub-Neptune transiting a metal-poor M4 V star. The low metallicity of the star added to the size and period of the planet, respectively of 2.94 R_⊕ and 3.077 days, make it an unusual system and its characterization provides an important observational constraint for planet formation models. (*Submitted*, lead: *Robert Wells*)

We are open to collaborations, don't hesitate to contact us! 😊

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References:

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