



## Abstract

A new era is foreseen to arrive around 2030 with a huge pool of exoplanets amounting to around ten thousands, including tens of habitable terrestrial rocky planets, thanks to the space-borne transits surveys and ground-based transit and radial-velocity (RV) surveys. However, astronomers may not be fully prepared for detailed characterization of those terrestrial planets, especially those with wide orbits that may be habitable for life. We propose a next approach mission towards the ultimate aim, i.e., the detection of biological signatures outside the Solar system. It has been in discussion for a while in China the possibility to build a space-borne 4-m class telescope dedicated for the characterization of habitable rocky planets, that shall start its operation within the next 10 – 15 years and last for 5 years or longer. This project starts its concept study from 2019. We are looking for international collaborations from various institutes and research groups to join this big effort by collaborating in the aspects of science, instrumentation, platform, and funding resources.

## Current status

Detecting atmospheric (bio)signal from habitable Earth-like planets is one of our ultimate goals in astronomy and science. However, it is extremely difficult to achieve. Until now,  $\sim 3900$  planets have been detected and confirmed; among them, 49 are habitable Earth-like planets, or Earth twins. Most of the currently known Earth twins are discovered by the Kepler mission and other ground-based transit surveys or RV surveys, and they are mostly orbiting active M-type stars, thus the possibility to develop life therein is small.

The NASA *TESS* mission and ESA *PLATO* mission will deliver  $\sim 250$  (Barclay et al. 2019, ApJSS, 239, 1) Earth-sized planets and 6 – 280 habitable Earth-like planets around by the 2030s (cf. PLATO definition study report). There are also several space missions that either dedicated for exoplanets, or have contributed a lot to this field, including *Spitzer*, *Kepler*, and *HST* (cf. Fig 1). There is currently only one approved mission called *ARIEL* that is dedicated for the characterization of exoplanets. However, given its small aperture size, it should be only capable of probing atmospheric compositions down to warm Super-Earths. American astronomers have proposed several mega missions including *HabEx*, *Lynx* and *OST*, and these monsters will be extremely important for the characterizations of exoplanetary atmospheres and the detection of bio-signatures. However, even with these big space telescopes finally approved, built and successfully launched, tens or hundreds of hours should be spent on one single target to achieve this ultimate purpose. Therefore, more space missions are highly demanded.

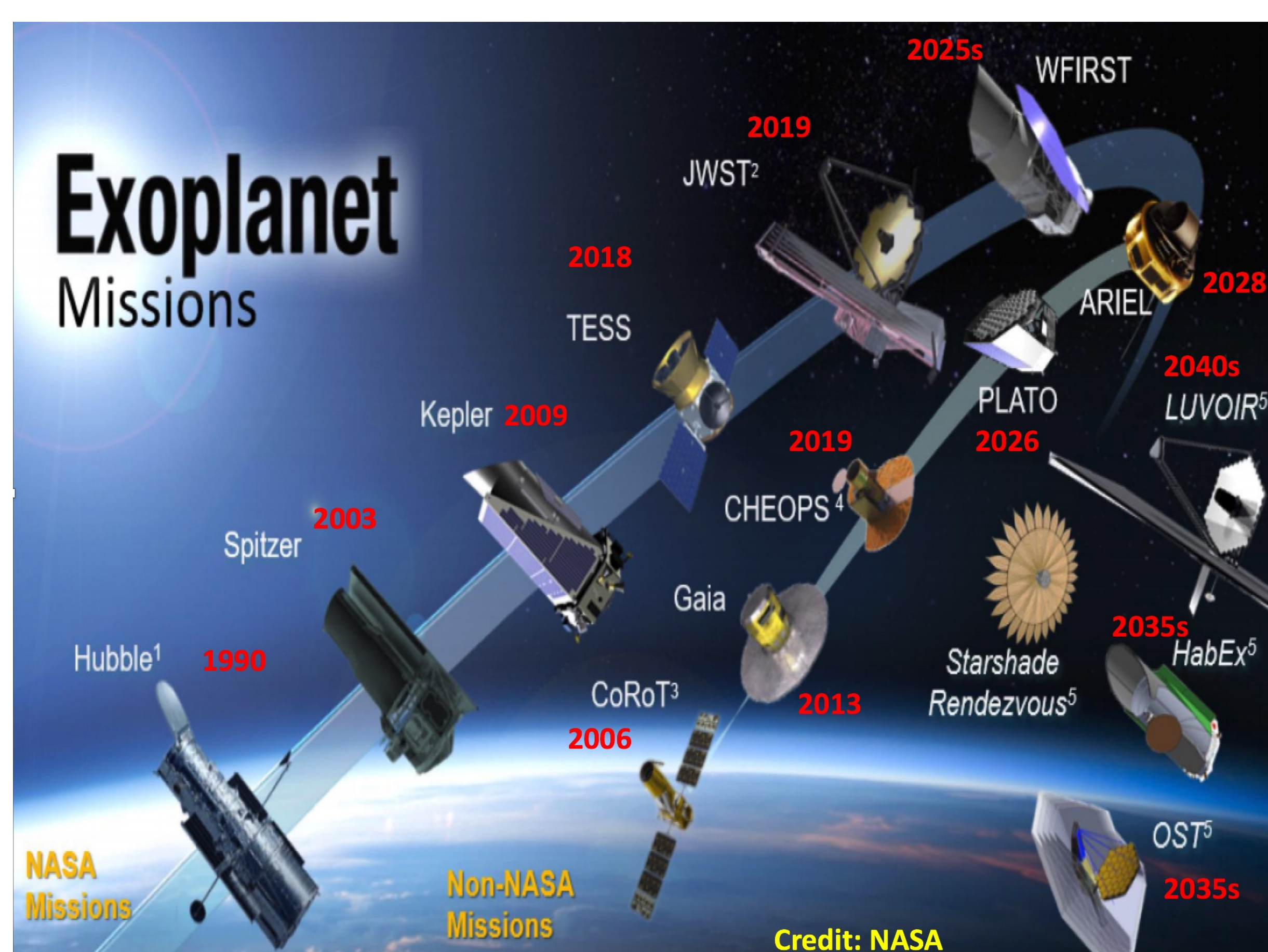


Fig. 1: A summary of the ongoing or proposed NASA and ESA space missions dedicated for the study of exoplanets, or have contributed a lot to this field. Credit: NASA/JPL-Caltech

## Our mission

A China-led space mission: Space Telescope dedicated for Exoplanet Characterizations (STEC). Our preliminary considerations are followed:

- ▶ 4 – 6m single SiC mirror with fabrication accuracy down to  $\sim 15$  nm (cf. Fig. 2)
- ▶ 0.15 degree Field of view
- ▶ L2 orbit for the stability of dynamical and thermal environment
- ▶ Focus and instrument cool down to  $\sim 50 - 70$  K

This telescope has the following science instruments:

- ▶ 4 Fine Guiding System (FGS) cameras for real-time precise guiding
- ▶ Low-R spectrograph:  $0.2 - 1.0$ ,  $1.1 - 1.7\mu\text{m}$ ,  $1.7 - 2.5\mu\text{m}$ ,  $2.5 - 5\mu\text{m}$ , with the latter two channels to be bonus
- ▶ Compact high-R fiber-fed optical spectrograph ( $R \sim 20,000$ )
- ▶ Chronograph and narrow-band wide-field cameras

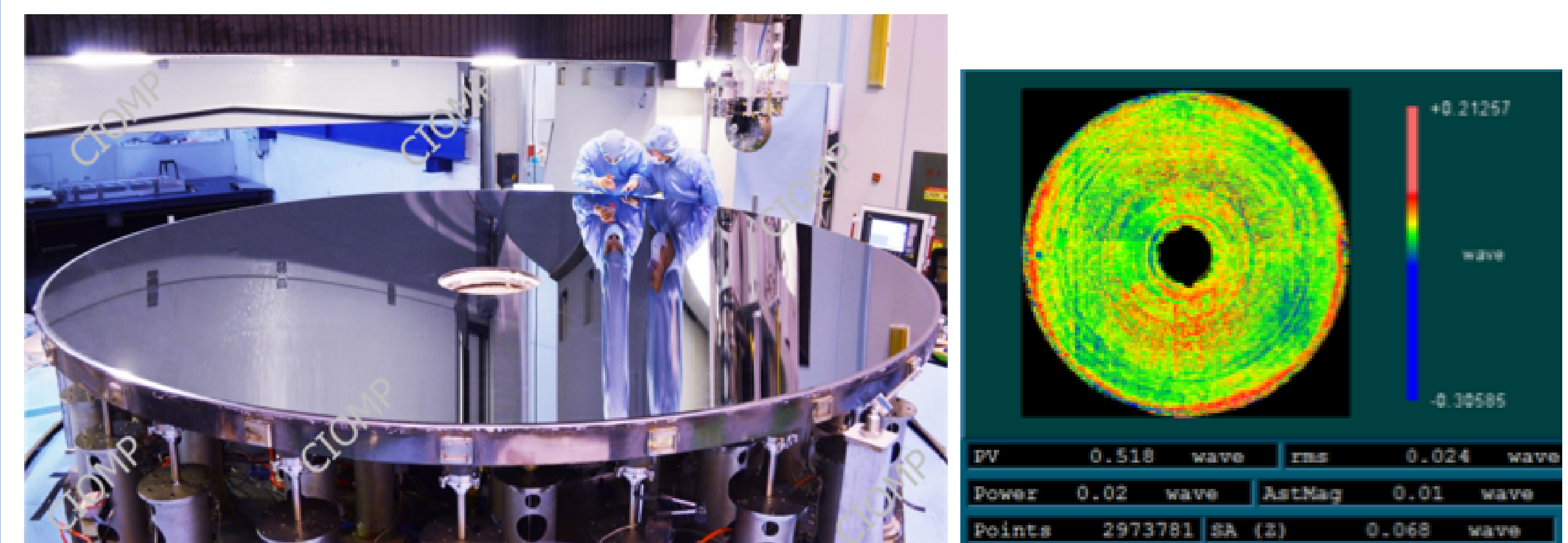


Fig. 2: The 4-m SiC main mirror (Left) and its surface fabrication accuracy (Right).

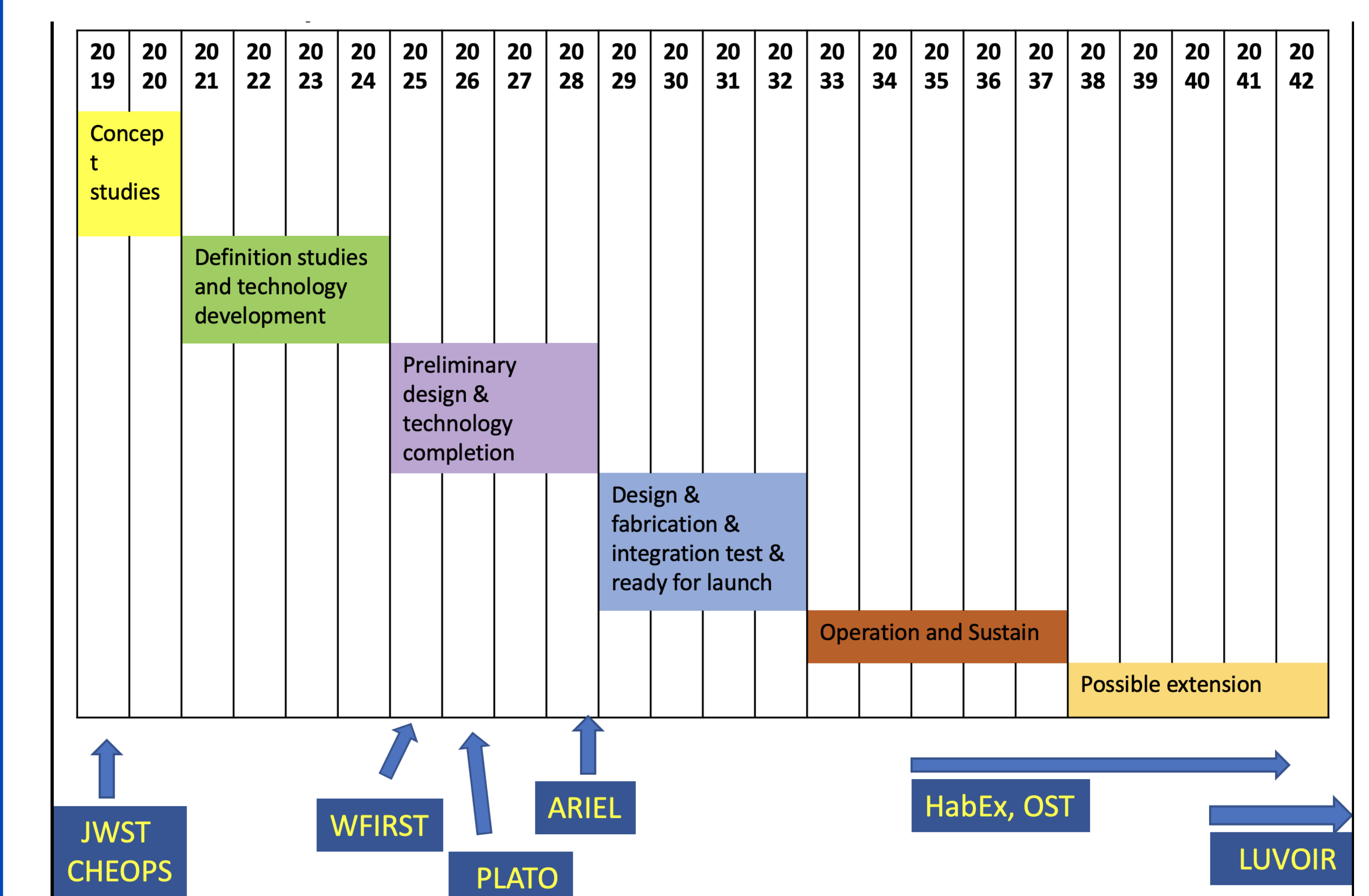


Fig. 3: Preliminary timeline for the STEC mission.

## Summary

- ▶ The characterization of habitable rocky planets and detection of astrobiology signals is a key research direction in the 21st century;
- ▶ NASA and ESA have proposed or are discussing several dedicated projects to achieve this purpose;
- ▶ China is considering to build a 4m class space mission. A concept study is on the way!
- ▶ This project is open to international collaborations at all levels. If you have interest to join us, please do not hesitate to contact us.