

# ROCK STEADY: THE HABITABLE WORLDS OBSERVATORY AND ITS CORONAGRAPH INSTRUMENT

## Spirit of Lyot 6

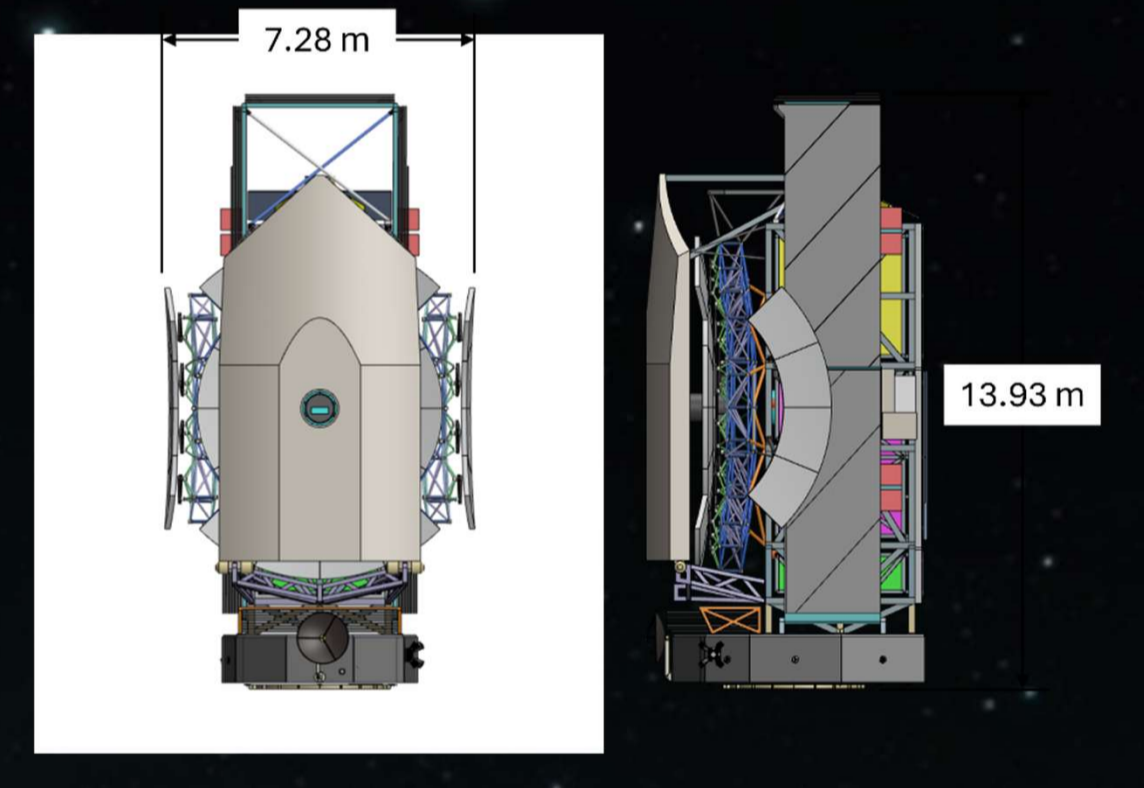
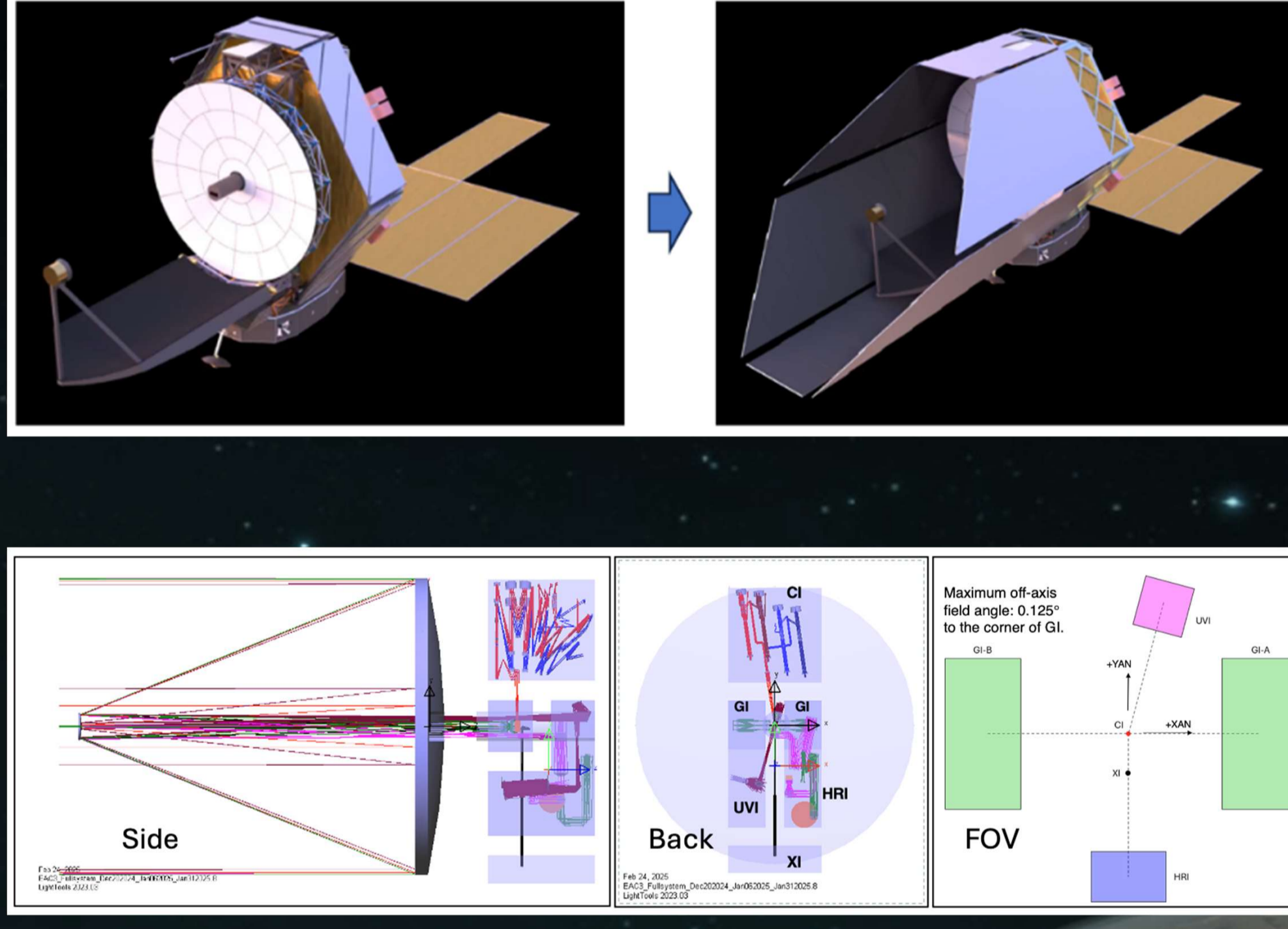
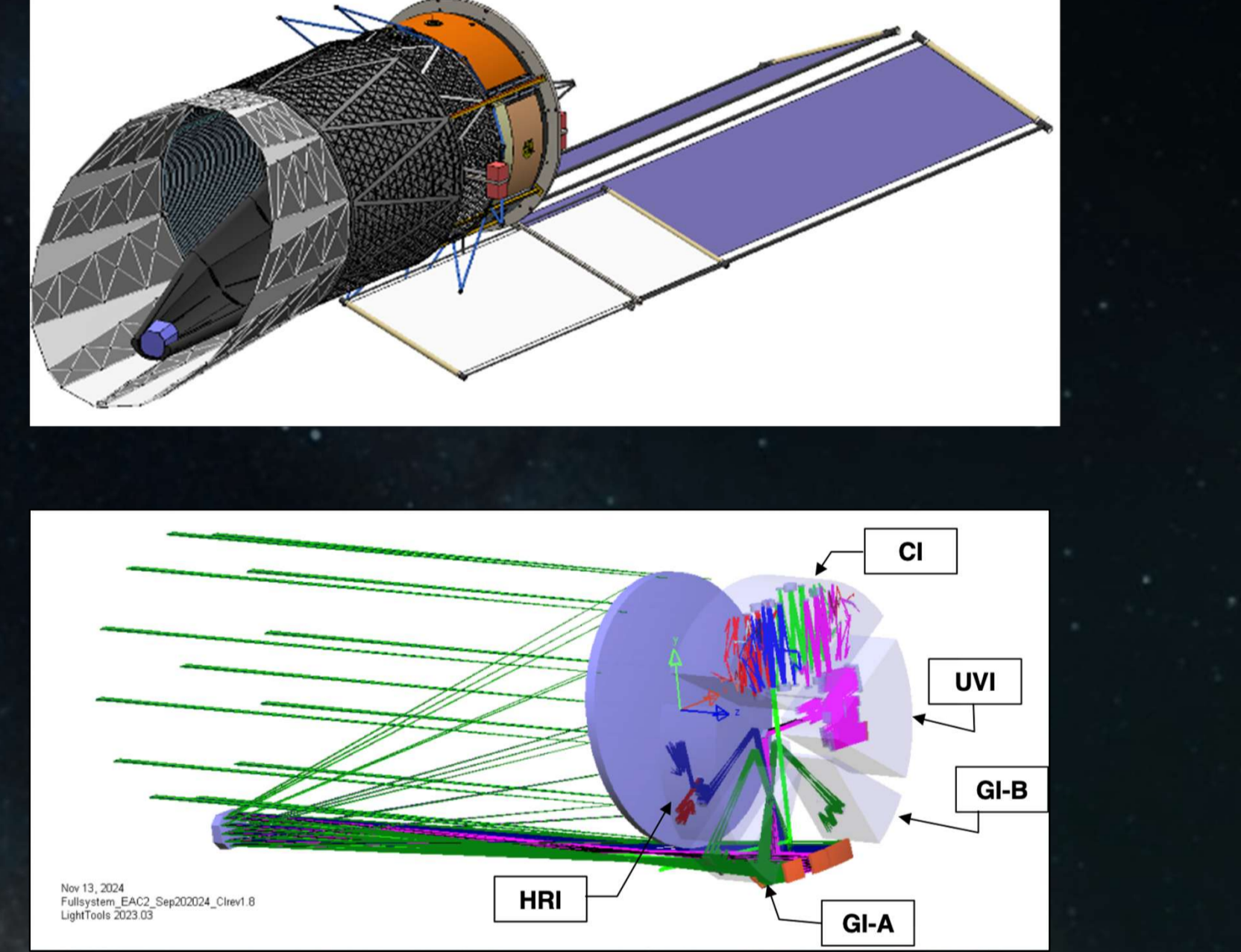
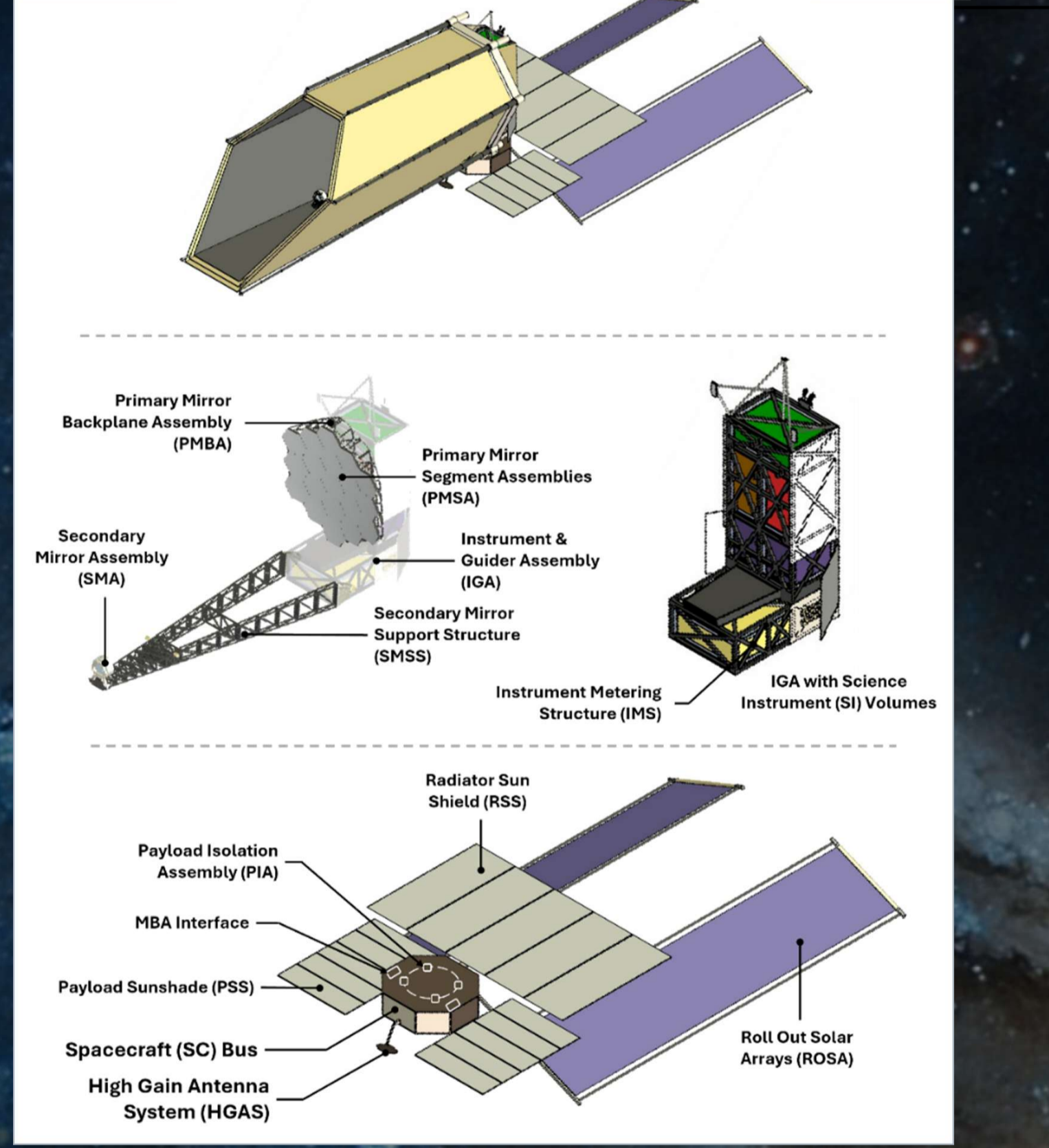
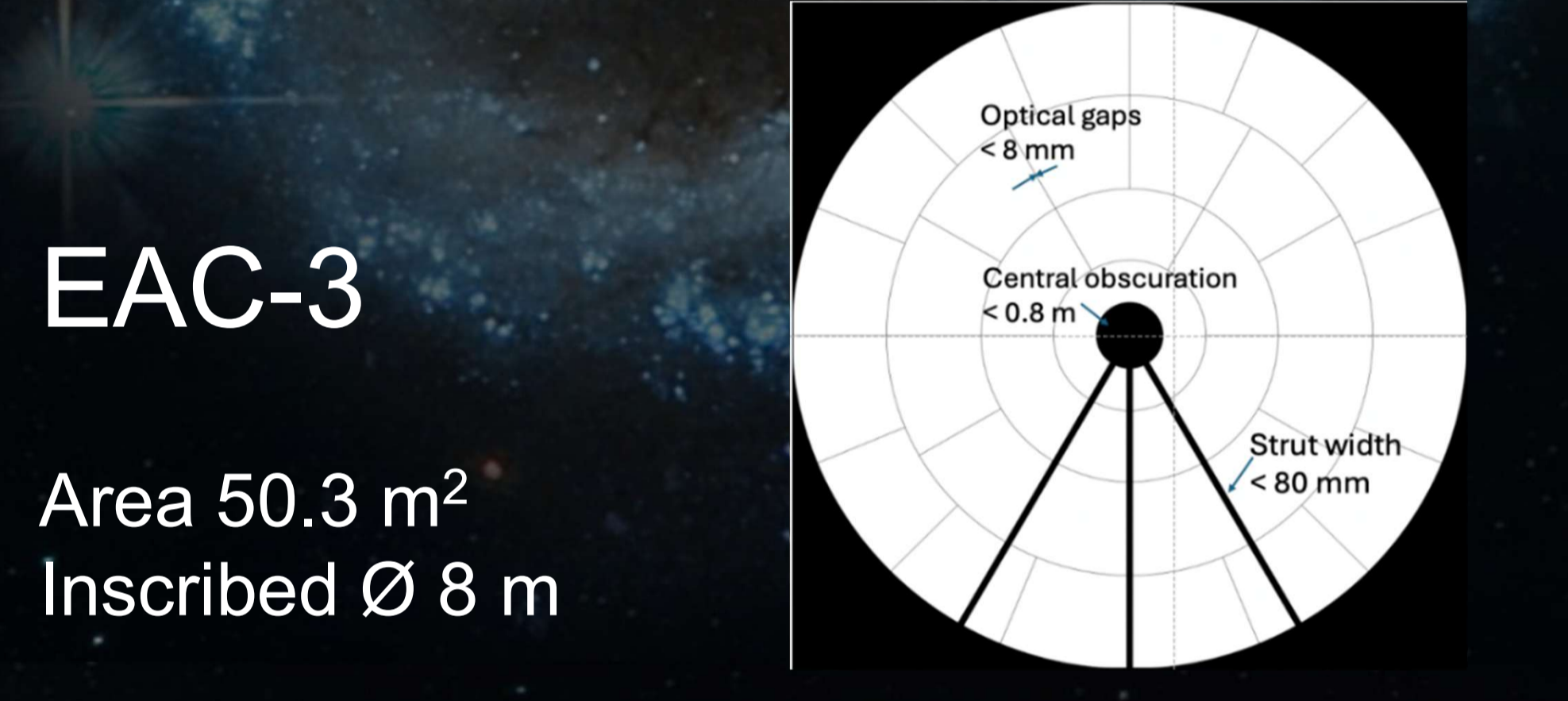
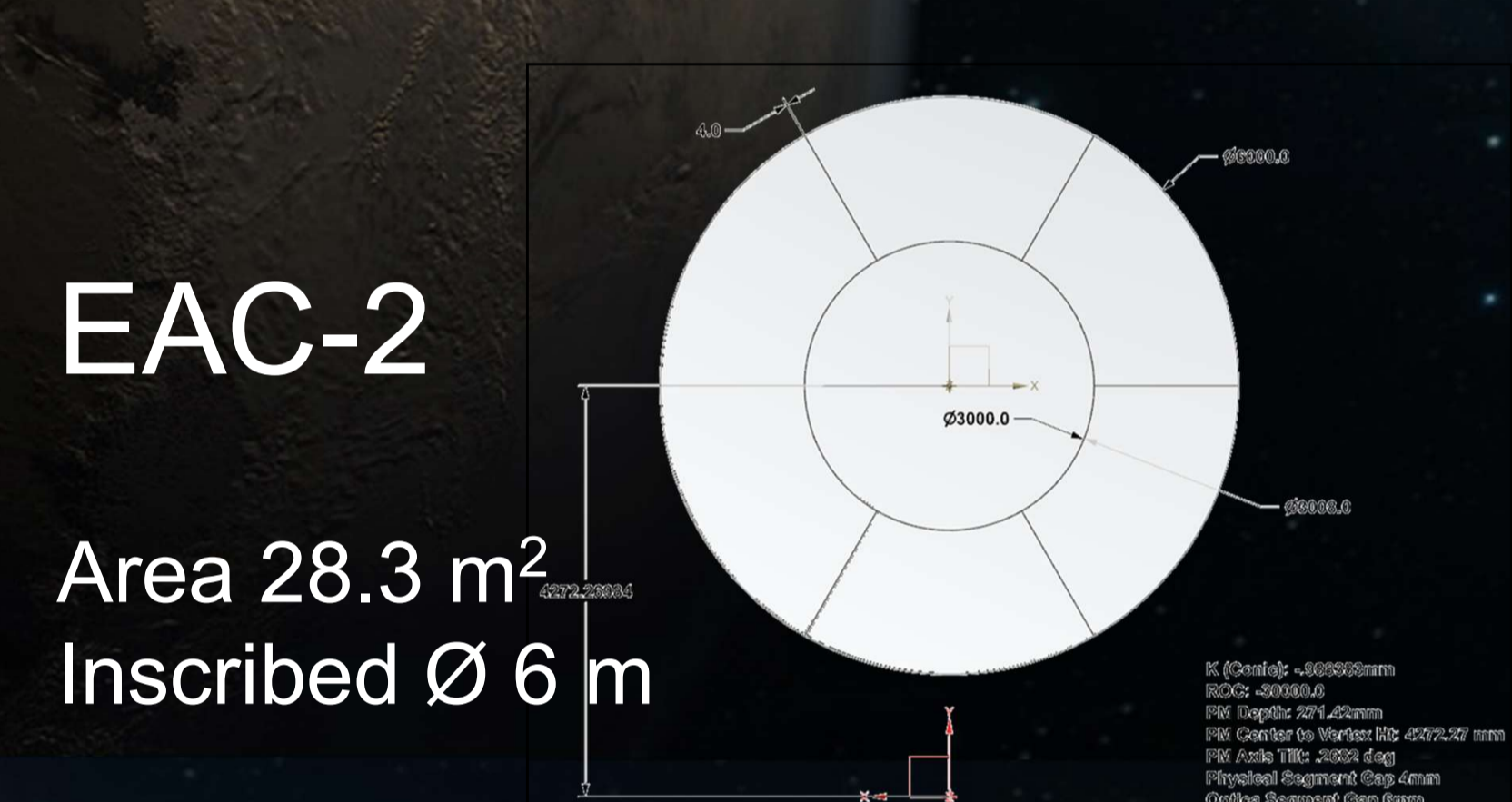
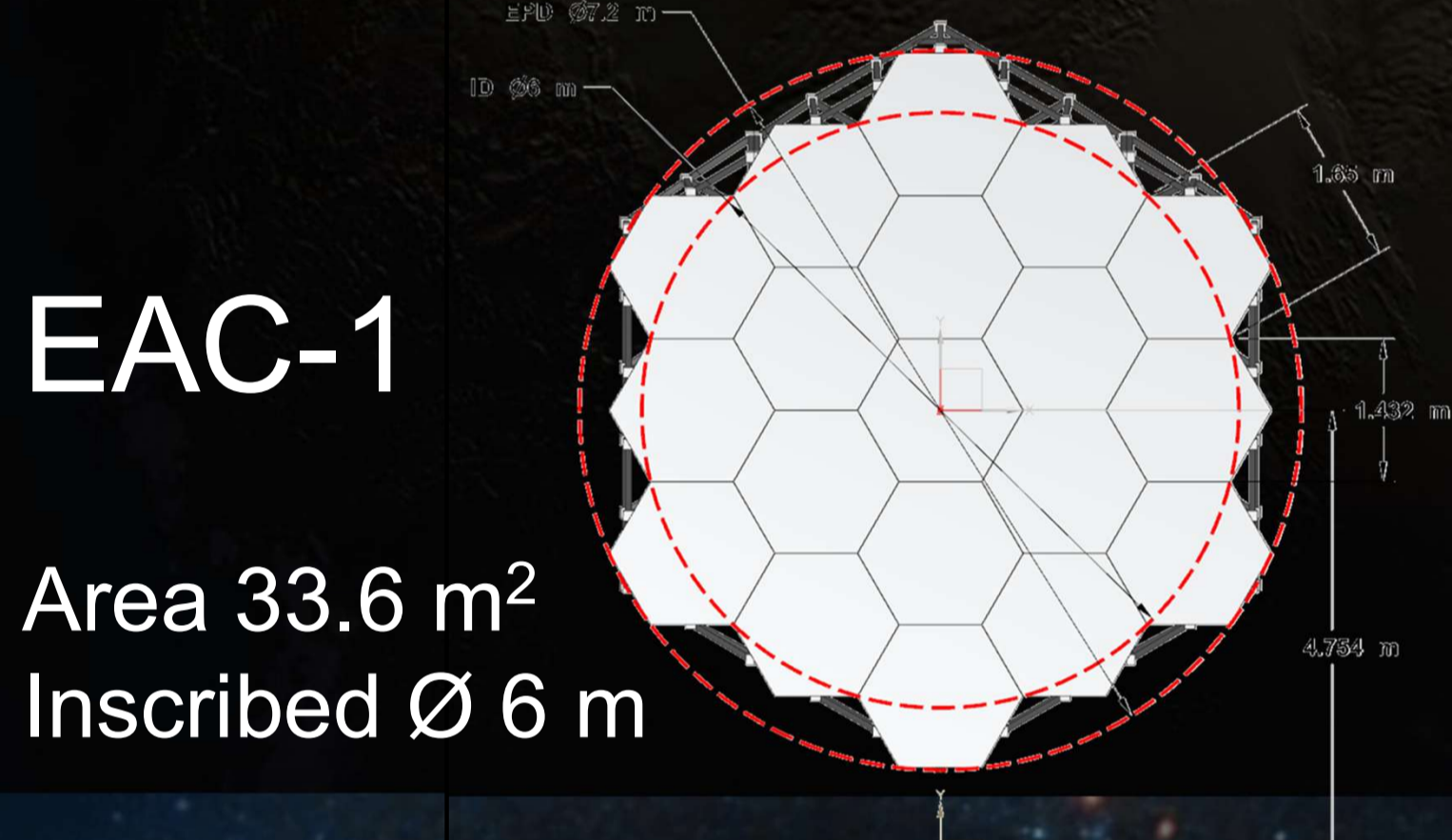
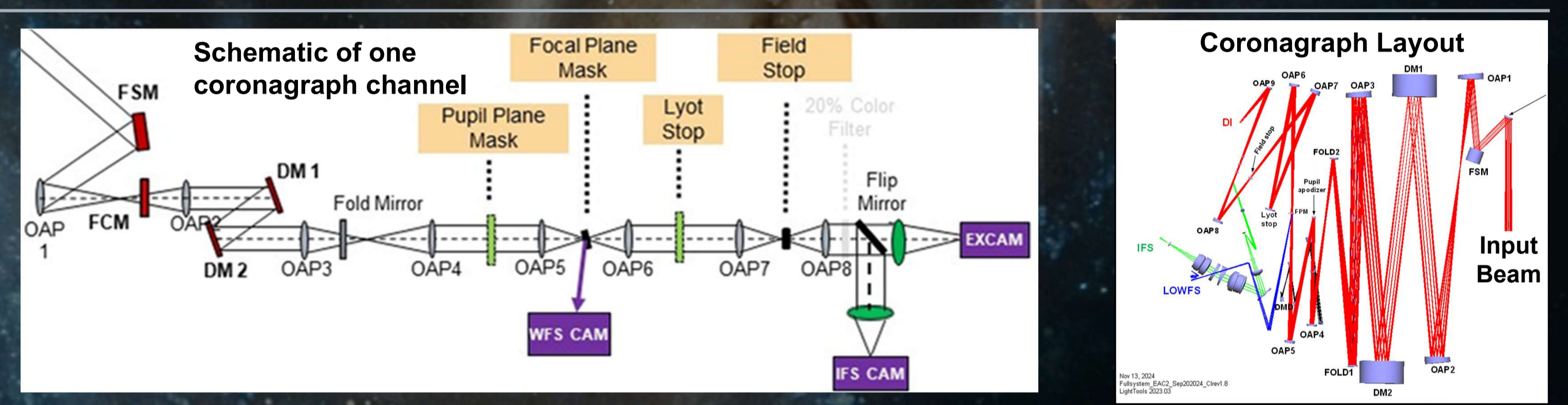
Charley Noecker,<sup>a</sup> Bertrand Mennesson,<sup>a</sup> Marie Levine,<sup>a</sup> Alice Liu,<sup>b</sup> Lee Feinberg,<sup>b</sup> Breann Sitarski,<sup>b</sup> Tyler Groff,<sup>b</sup> Ruslan Belikov,<sup>e</sup> Brian Kern,<sup>a</sup> Bijan Nemati,<sup>g</sup> Gary Kuan,<sup>a</sup> Mitchell Troy,<sup>a</sup> Alan Gostin,<sup>b</sup> Jon Lawrence,<sup>b</sup> Joshua Abel,<sup>b</sup> Michael Akkerman,<sup>c</sup> Eric Anstadt,<sup>d</sup> Pin Chen,<sup>a</sup> Kenneth Dziak,<sup>c</sup> Jordan Efron,<sup>b</sup> James Govern,<sup>c</sup> Cameron Haag,<sup>a</sup> Joseph Howard,<sup>b</sup> Milan Mandic,<sup>a</sup> Carson McDonald,<sup>h</sup> Connor Mulrenin,<sup>b</sup> Jon Papa,<sup>b</sup> Fang Shi,<sup>a</sup> Samuel Sirlin,<sup>a</sup> Cory Smiley,<sup>c</sup> J. Scott Smith,<sup>b</sup> Philip Stahl,<sup>f</sup> Christopher Stark,<sup>b</sup> Gregory Walsh,<sup>b</sup> John Ziemer<sup>a</sup>

<sup>a</sup> NASA Jet Propulsion Laboratory/California Institute of Technology    <sup>b</sup> NASA Goddard Space Flight Center    <sup>c</sup> Aerodyne Industries, LLC  
<sup>d</sup> Quartus Engineering    <sup>e</sup> NASA Ames Research Center    <sup>f</sup> NASA Marshall Space Flight Center    <sup>g</sup> Tellus1 Scientific, LLC    <sup>h</sup> Vertex Aerospace, LLC

**Abstract:**  
 The Habitable Worlds Observatory is a NASA mission concept now in Pre-Phase-A study. It was a key recommendation of the Astro2020 decadal review, with a goal of launching in the early 2040s. It will be able to detect and spectrally characterize Earth-sized planets orbiting nearby stars.

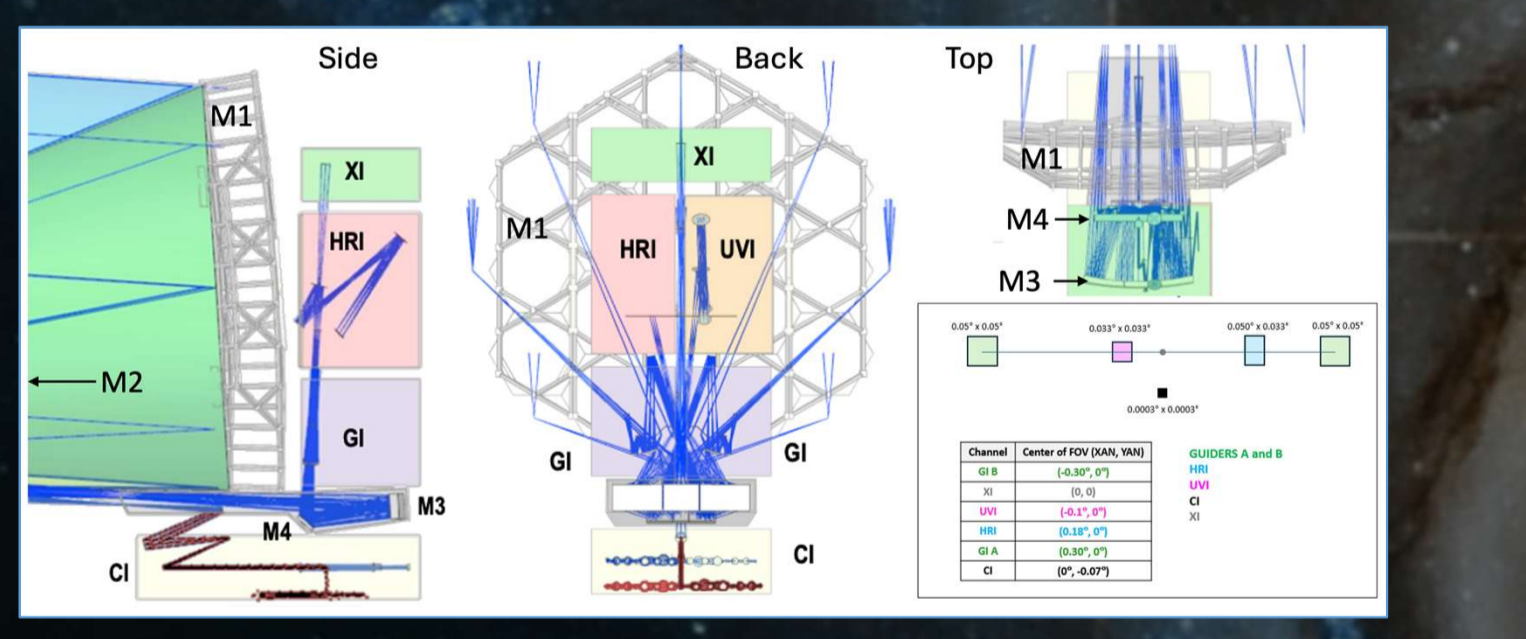
Its ultra-stable telescope will also enable a broad range of transformational astrophysics in visible, near UV, and near IR wavelengths. We describe the coronagraph and observatory designs now being studied, and outline the technical challenges and the path to mission formulation.

- We have studied three Exploratory Analytical Concepts to develop an understanding of
- Coronagraph observing strategies and science data processing
  - Flow of science goals to engineering needs
  - Launch vehicle limitations
  - Integrated Modeling of Observatory and Instrument performance
  - Space environment including micrometeoroids
  - Technology development needs

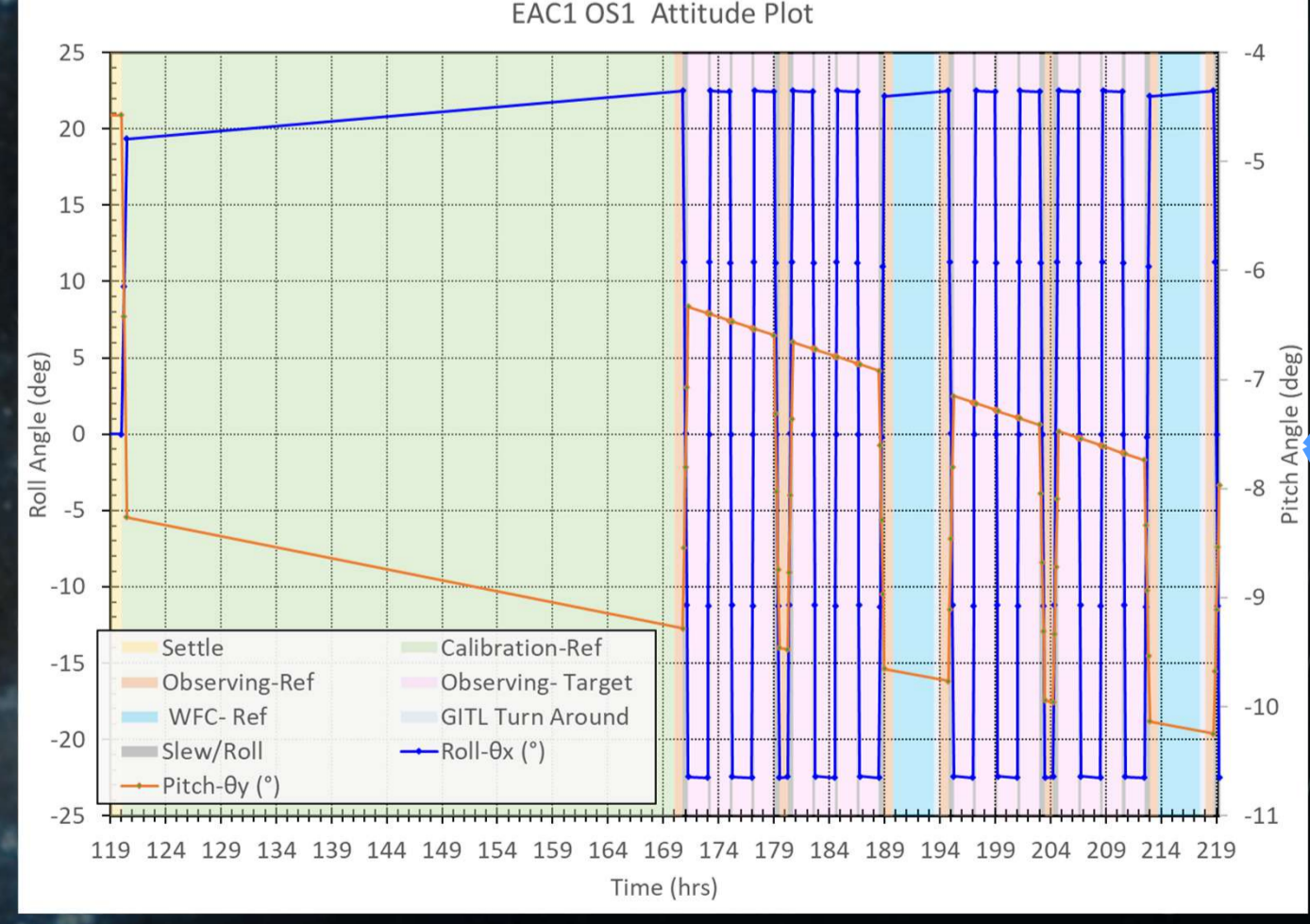


**Preliminary tolerances**

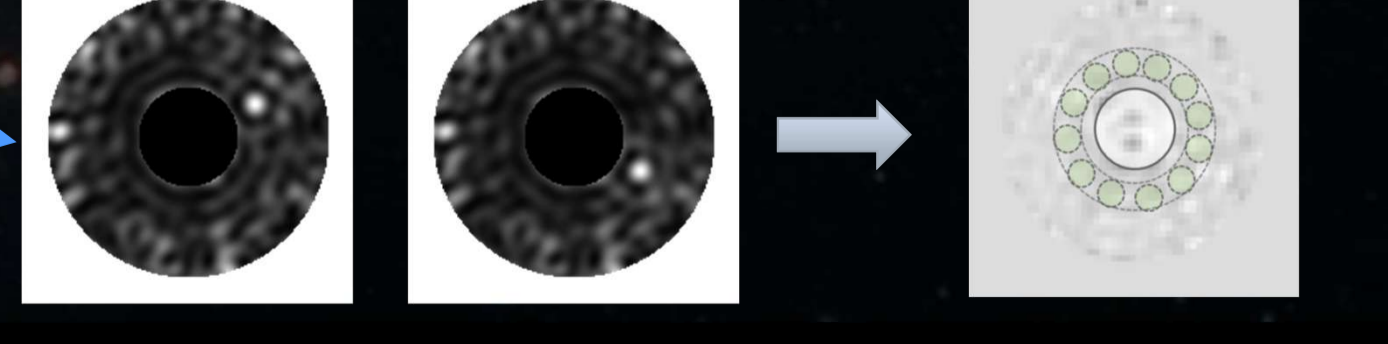
Performance Metric Name	Performance Goals (preliminary)	Units
Mean	2.0	pm
Variance	4.0	pm <sup>2</sup>
Delta Mean	0.2	pm
Delta Variance	3.2	pm <sup>2</sup>
Pointing Stability: ACS	4.0	mas RMS
Pointing Stability: ACS + FSM	0.1	mas RMS
Line of Sight (LOS) Jitter	0.1	mas RMS
WFE Jitter	1.0	pm RMS



**Observatory orientation changes**



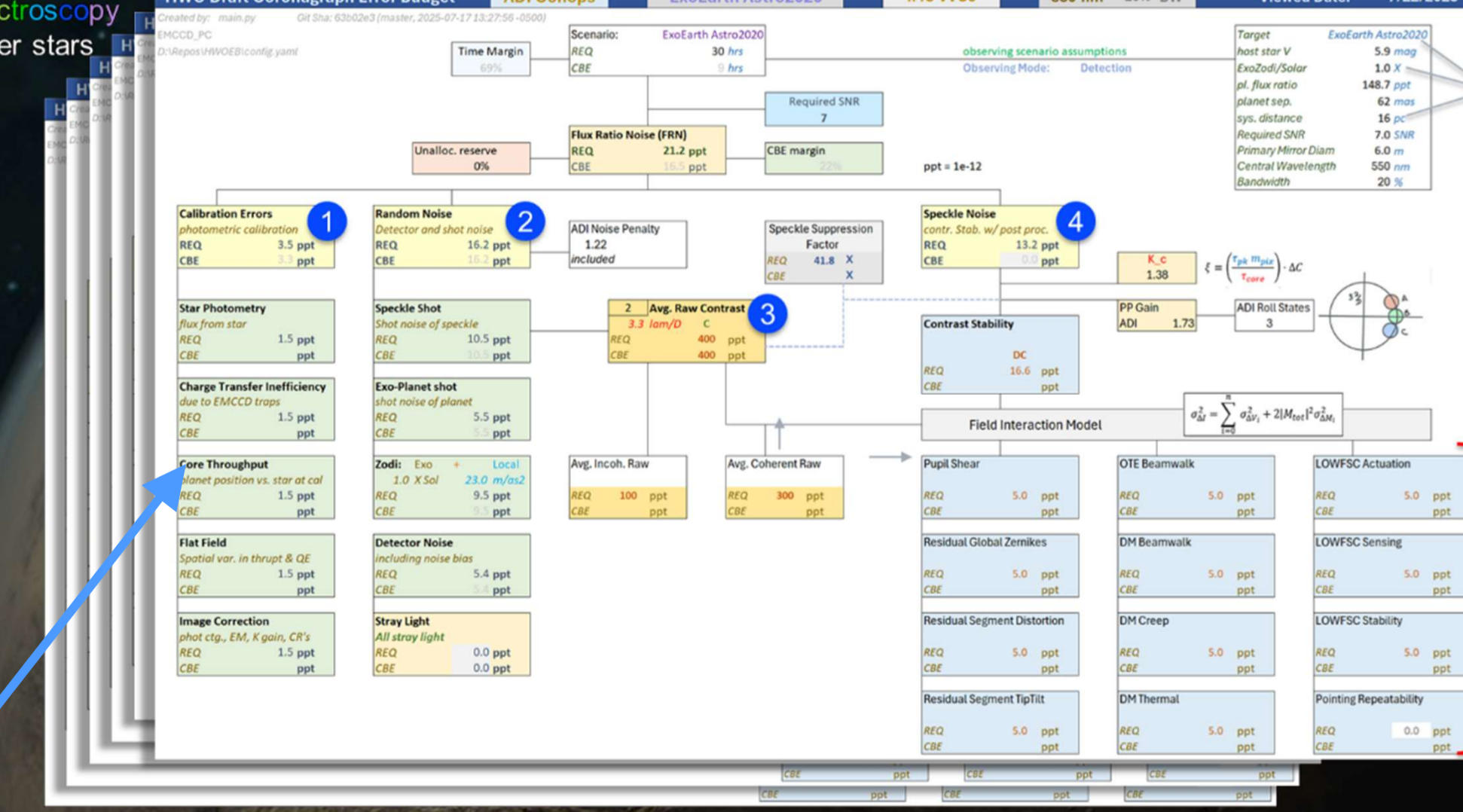
**Image sequences and differencing**



**Concept of Operations and Post Processing (COPP)**

- Measurement strategy
- Data analysis algorithms
- Framework for error budgeting
- Framework for performance modeling
- Framework for life cycle system engineering

**Planet Detection Error Budget**



Compare

Post-Proc

**End-to-End Integrated Model**

