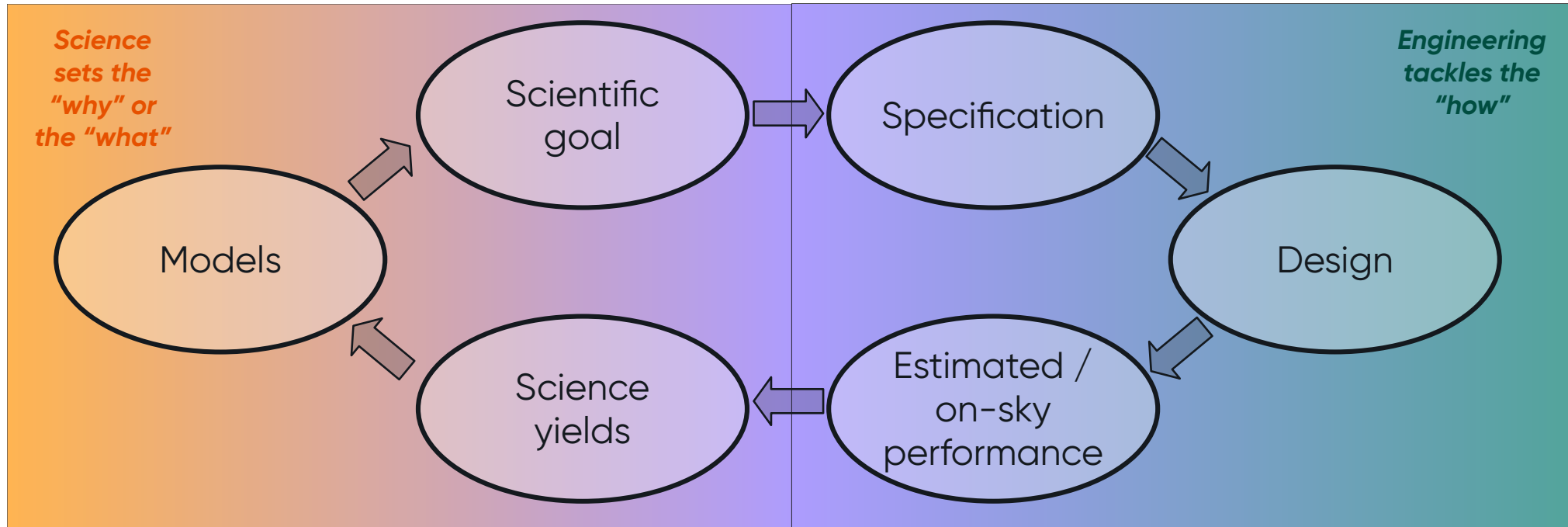


# Science & Engineering interface

E. Huby, LESIA, Observatoire de Paris  
HALO (HABitability and Life on Other worlds) workshop  
Fréjus, December 6, 2024

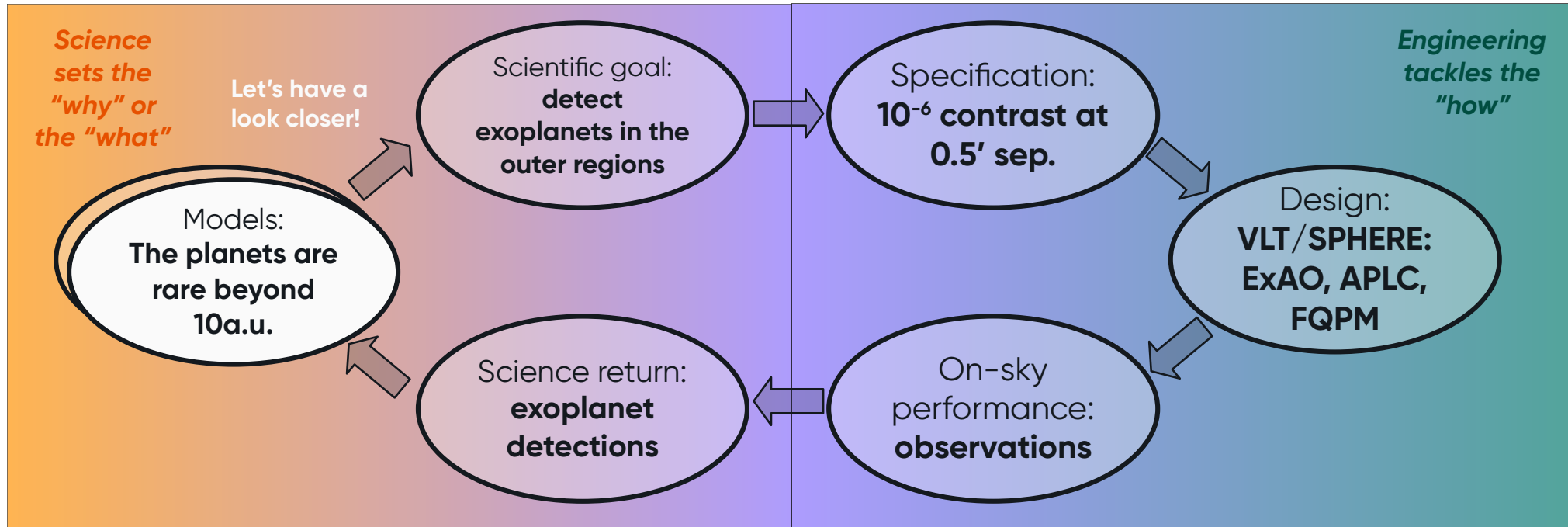
# What?

- A definition: "a situation, way, or place where two things come together and affect each other" (Cambridge dictionary)
- Feedback loop



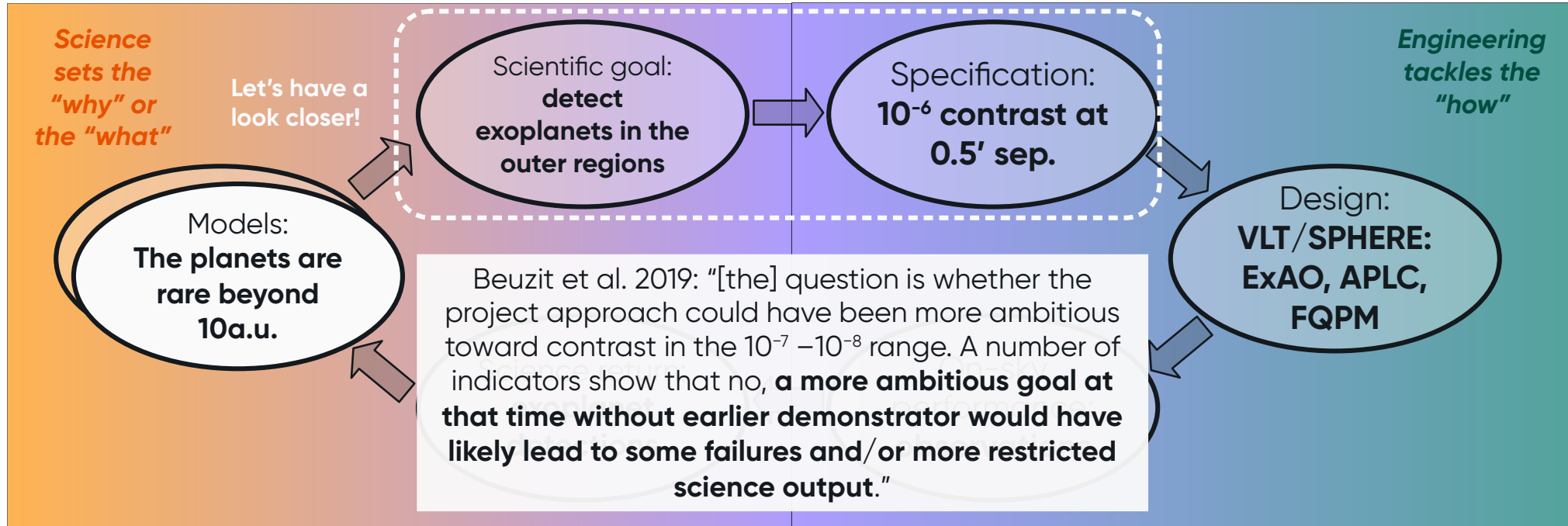
# An example: SPHERE

- Feedback loop



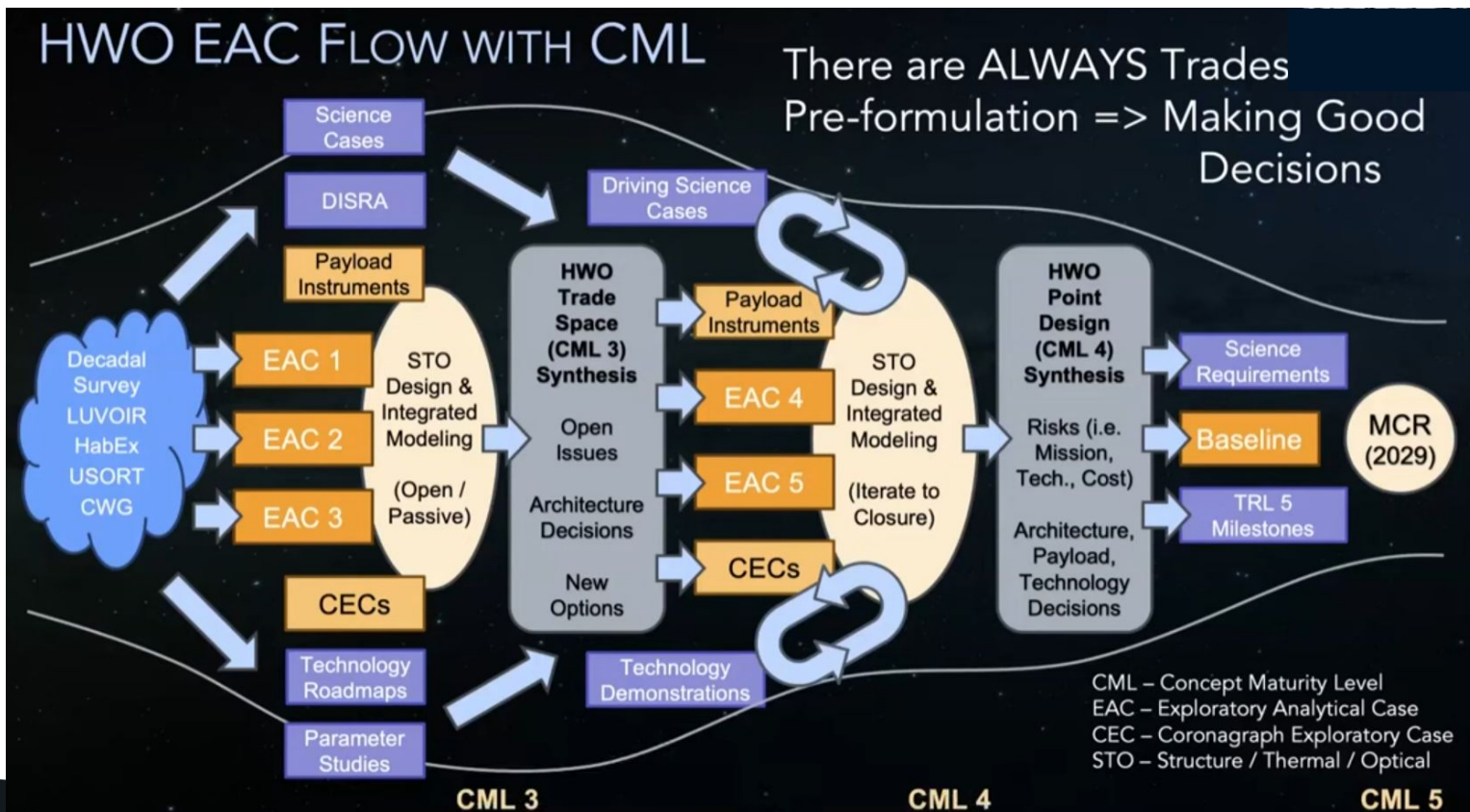
# An example: SPHERE

- Feedback loop



# Co-development approach

- Astro2020 Recommendation:** "The NASA Astrophysics Division should establish a Great Observatories Mission and Technology Maturation Program, the purpose of which is to **co-develop the science, mission architecture, and technologies** for NASA large strategic missions identified as high priority by decadal surveys."

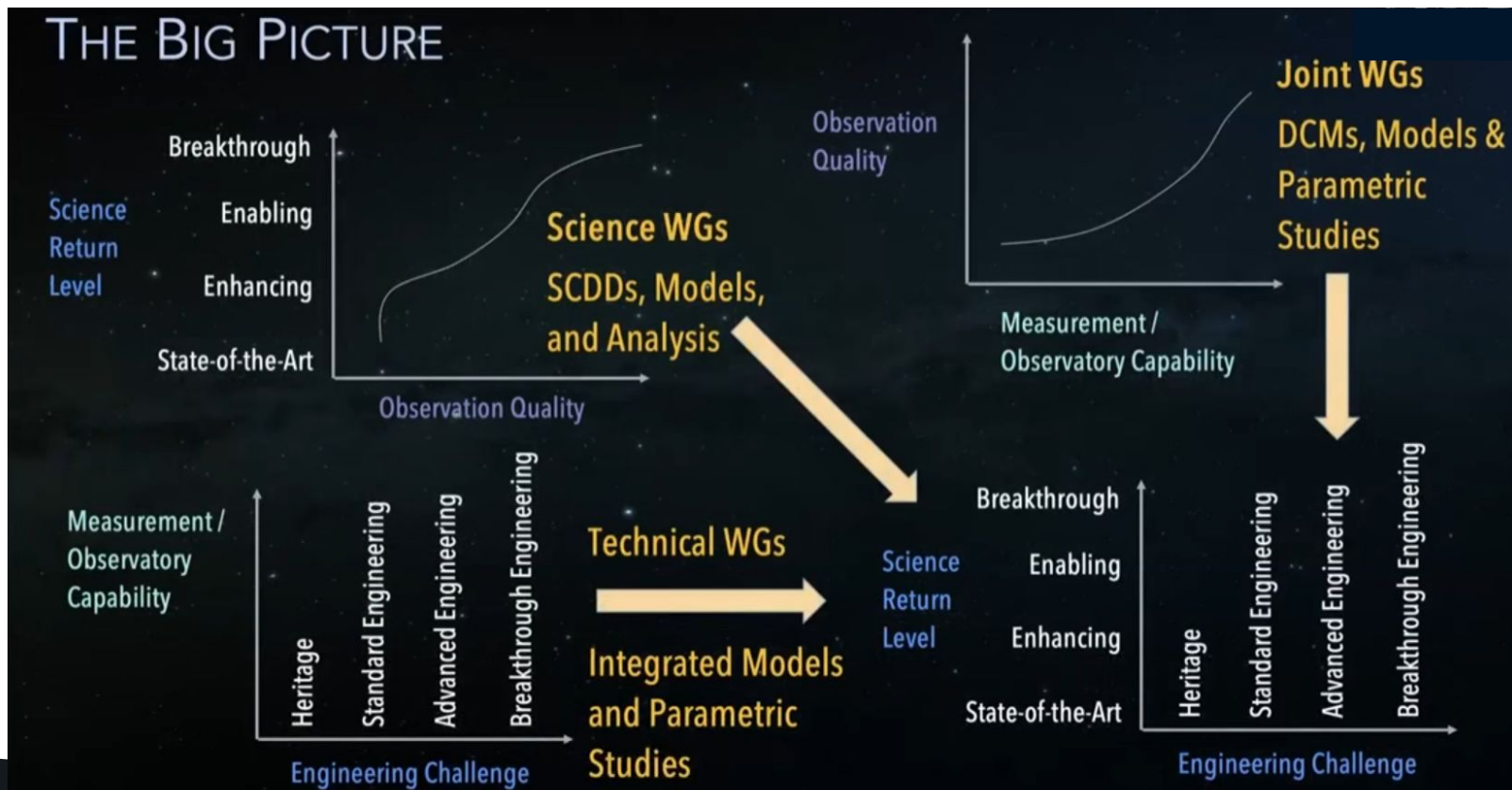


HWO Working Groups F2F -  
Rochester, NY - October 2024  
John Ziemer (JPL)

<https://science.nasa.gov/astrophysics/programs/habitable-worlds-observatory/hwo-f2f-oct24/>

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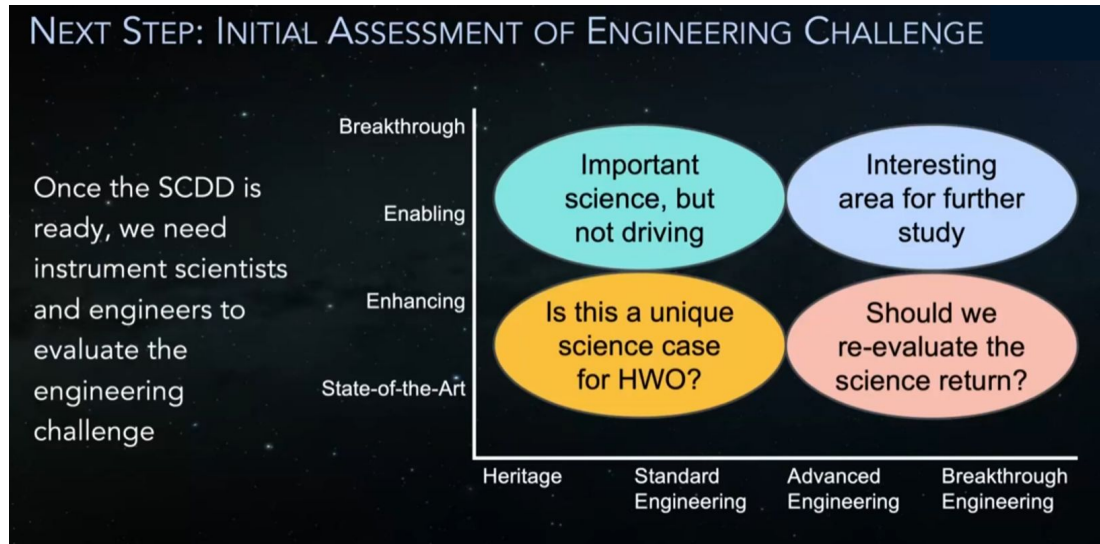
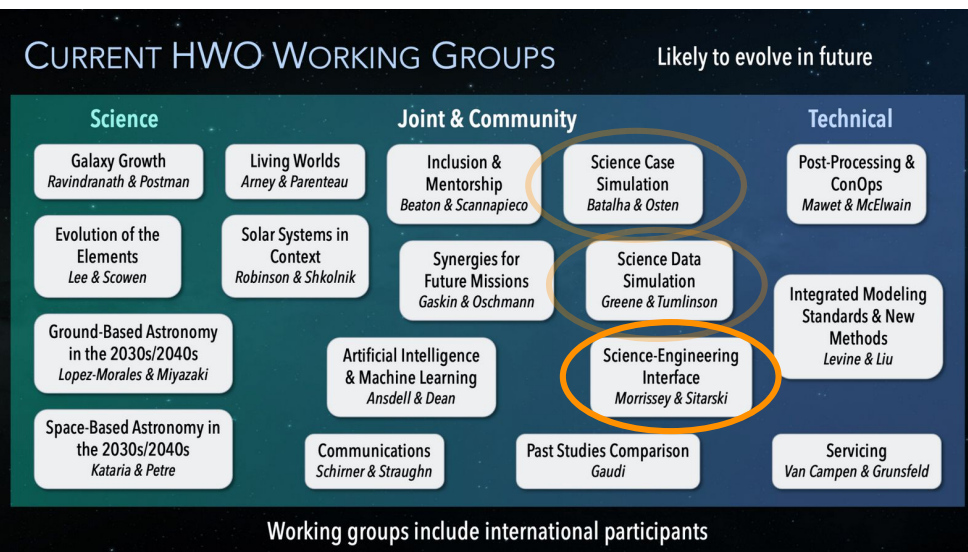


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# HWO Science-Engineering Interface Working Group

- 1 sentence description: **"Provide key linkages between science & engineering modeling and manage unified input assumptions."**  
 → Build an **"Integrated Science Model"** that will connect to engineering models.



<https://science.nasa.gov/astrophysics/programs/habitable-worlds-observatory/wgs/>

John Ziemer (JPL)

<https://www.youtube.com/watch?v=eBASYPJyU&t=147s>

# The LIFE Initiative

- LIFE development teams

- **Team 1 Project office** : Coordination and support (contact Daniel Angerhausen)
- **Team 2 "Science"** : Continues to explore science cases; everybody is invited to participate in these activities.
- **Team 3 Instrument science** : Refining yield and performance vs design relationship for requirement
- **Team 4 Technology** : Identification and maturation of technical concepts

Ongoing fundraising for the Concept Study and technology development program

From Sascha Quanz, 2024-11-21



# LIFE paper series

- I. Improved **exoplanet detection yield** estimates for a large mid-infrared space-interferometer mission
- II. Signal simulation, signal extraction, and fundamental **exoplanet parameters** from single-epoch observations
- III. **Spectral resolution, wavelength range, and sensitivity requirements** based on atmospheric retrieval analyses of an **exo-Earth**
- IV. Ideal **kernel-nulling array architectures** for a space-based mid-infrared nulling interferometer
- V. **Diagnostic potential** of a mid-infrared space interferometer for **studying Earth analogs**
- VI. **Detecting rocky exoplanets** in the habitable zones of Sun-like stars
- VII. **Practical implementation** of a five-telescope kernel-nulling beam combiner with a discussion on **instrumental uncertainties and redundancy benefits**
- VIII. Where Is the Phosphine? Observing **Exoplanetary PH<sub>3</sub>** with a Space-Based Mid-Infrared Nulling Interferometer
- IX. Assessing the impact of **clouds** on atmospheric retrievals at mid-infrared wavelengths with a **Venus-twin exoplanet**
- X. **Detectability** of **currently known exoplanets** and synergies with future IR/O/UV reflected-starlight imaging missions
- XI. Phase-space synthesis decomposition for planet detection and characterization
- XII. The **Detectability** of Capstone **Biosignatures** in the Mid-Infrared -- Sniffing Exoplanetary Laughing Gas and Methylated Halogens
- XIII. The **value** of combining thermal emission and reflected light for the characterization of **Earth twins**
- XIV. Finding **terrestrial protoplanets** in the galactic neighborhood [incl. **parametric study** on aperture size & wavelength coverage]

# In practice: how to ensure the interface?

**"The whole point is to guarantee uniformity" (A. Roberge, Oct. 2024)**

- **Exchanges between the two communities:**
  - Join the dedicated WG
  - Meetings, workshops, hands-on sessions...
- **People working at the interface:**
  - scientists/researchers who understand technical constraints → instrumentalists
  - engineers who grasp the scientific objectives → research engineers
- **Unified assumptions:**
  - Science cases
  - Instrument parameter ranges
- **HWO-LIFE Data challenge?**