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Overview of the Starshade Technology Development to TRL5 Activity (S5)

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A Brief History of NASA Starshade Development

- NASA typically develops technology for exoplanet observations through a competed grant program known as SAT (Strategic Astrophysics Technology)*
  - Grants are made to close technology gaps identified by NASA ApD; list is available at https://apd440.gsfc.nasa.gov/tech_gap_priorities.html
  - Much coronagraph technology development is funded in this way
  - Starshade technology development was funded through SAT for about a decade
- Starshade technology development requires a more integrated approach to ensure that technology gaps can be closed in a mutually consistent way:
  - Optical shapes that deeply suppress starlight must also be mechanically robust in space
  - Starshade edges with low levels of solar glint must also be robust against starshade deployment

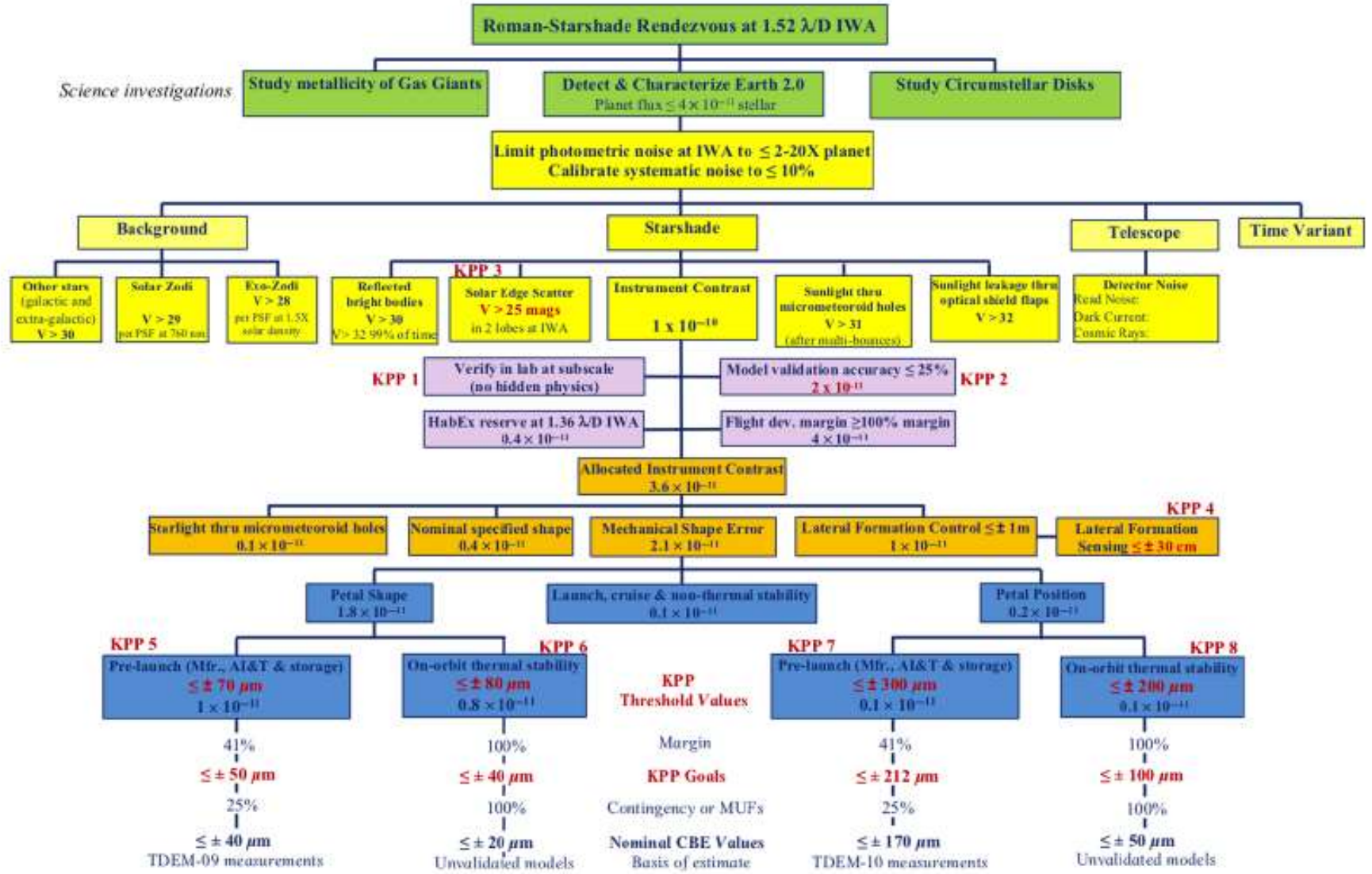
* Formerly known as TDEM (Technology Development for Exoplanet Missions)

Birth and Status of S5

In 2018, NASA combined most of its starshade technology development into a directed activity called S5

- Closes, in a mutually consistent, system-engineered approach, the three technology gaps to starshade missions:
  - Formation flying (gap closed in 2019)
  - Starlight suppression, both exoplanet host starlight and sunlight scattered from starshade itself
  - Precise and stable mechanical deployment
- Originally planned to close all three gaps by FY23, S5 has decelerated its activity to bring starshades to TRL5 by FY25 at NASA's instruction

S5 Noise Budget



S5 Adapts to the Changing Exoplanet Field

As we learn more about exoplanets and about starshades, we can modify S5's goals and activities to best advance the technology for future mission needs. One mechanism for this is periodic Assessment Reviews:

- First Review was in Fall 2019
  - Led to the creation of this data challenge
- Second Review will follow the release of the Decadal Survey
  - Recommendations of DS will certainly impact the timescale of S5 and possibly also its goals
  - Early results from this data challenge may also impact second review
- Third Review likely in 2023, assuming S5 schedule is unchanged by Decadal Survey
  - Full results of data challenge will inform third review

How the Data Challenge Can Help S5

By validating the S5 noise budget:

- The S5 noise budget refers most of its contrast and stray light requirements to the inner working angle of the starshade, where these signals are bright. Does better starshade performance at larger angles dominate the science yield of starshade missions?
- Even at the inner working angle, is the assumed mix of noise sources optimal for exoplanet detection and spectroscopy?
- S5 noise budget assumes that various stray light sources can be calibrated away at differing levels in searching for exoplanets. Can we realize these levels of calibration in the data challenge?
- Are the completeness assumptions of starshade mission concepts borne out in practice? Are spectral signal to noise ratios realizable?