The Advanced Technology Large-Aperture Telescope (ATLAST)
FY15 End of Year Narrative
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1. Task Overview and Objectives

Fiscal year 2015 was the second full-year IRAD funding of the GSFC-led multi-institutional design study for a large-aperture space observatory operating over ~0.1 – 2.5 μm. The ATLAST observatory is intended to continue the heritage of HST as a powerful, broadly capable program that will also be the first astronomy mission capable of an extensive search for evidence of life beyond Earth. The overarching, long-term objective of the project is selection by the next NRC Decadal Survey as the highest-priority new space mission for the 2020s. This will require a compelling science case, detailed engineering design, and key technologies at least at TRL = 5 in the early 2020s. Success with the Decadal Survey will lead to a major new mission for which GSFC is likely to be the lead center. Our IRAD support primarily supported 2.3 FTEs in both 660 and 690 to develop in depth the science case for ATLAST. Engineering design work was primarily supported during FY15 via Directed Research & Technology (DR&T) FTEs.

Nota bene: Our ATLAST team expects to achieve its highest-priority near-term goal early in FY15 when GSFC is named by NASA HQ SMD as the lead Center for the in-depth study of the Large-Aperture UVOIR (LUVOIR) concept.

2. Accomplishments

Our FY15 IRAD supported GSFC scientists and engineers, and contractors, who (1) assessed the ATLAST concept with respect to its ability to achieve the priority science goals; (2) developed in greater depth the ATLAST technology roadmap, which was presented (often by invitation) to SMD ASD, STMD, and the NASA Chief Technologist; (3) advanced the detailed engineering design, with significant improvements in the architecture especially in the areas of mechanical and thermal stability; and (4) reported on this work usually by invitation (see the closing section). More specifically:

ATLAST Technology Activities in FY15
The ATLAST technology roadmap team had a number of accomplishments this past year. Our technology roadmap was presented for discussion and review at the January AAS and June SPIE meetings. This was followed by a presentation requested by NASA's Chief Technologist. In parallel, the ATLAST technology needs were submitted to the Cosmic Origins Program Office for its technology prioritization process, which is used as input and selection in ROSES solicitations. In addition, members of the technology roadmap team contributed significantly to the AURA study, *From Cosmic Birth to Early Earths.*

ATLAST Reference Mission Design Activities in FY15
Work concentrated on assessing an initial wave front error budget to support the allocation and validation of performance requirements across the telescope-instrument system. We

formulated preliminary observatory mass estimates for the purposes of guiding engineering design trades. This involved requirements and design contributions from across the flight system engineering disciplines. Initial thermal analysis supported by IRAD procurement funds was carried out in order to understand thermal stability requirements. Work continued in the development of models to analyze the effects of jitter on the observatory performance, again supported by IRAD procurement funds. Our results are being reported at several professional conferences as part of our campaign to establish among major stakeholders the credibility of our designs. Just as with our science team analyses, we contributed significant supporting material to the AURA study.

ATLAST Science Activities in FY15

The science emphasis at GSFC for this past year continued to be advancing our simulations of major challenges in observing exo-Earths. Our ATLAST Exoplanet Science Team (Domagal-Goldman, Roberge, Mandell, Stapelfeldt, and colleagues outside GSFC) assisted the engineering effort by exploring the impact of various design decisions on the final yield of directly-imaged exoplanets, specifically the discovery and spectroscopic characterization of Earth-like planets. Through our work in FY15 we improved our initial set of mission simulation tools, the "Design Reference Mission (DRM) Simulator," which allows us to evaluate the importance of critical mission architecture parameters (aperture size, inner working angle, pointing stability, mission lifetime, etc.) on our ability to achieve the detection of Earth-like planets around nearby stars. We increased the sophistication of the analysis, including factors such as instrument characteristics, telescope and instrument overheads, requirements on spectral coverage and resolution, and the importance of re-visits for detection verification must be implemented. We also began tackling the complex problem of quantifying how well we understand the different input parameters to these simulations: sources and levels of noise and confusion in high-contrast imaging architectures, realistic observing efficiencies due to data analysis requirements, and the actual spectral resolution, wavelength coverage and S/N required to unambiguously confirm habitability. For this effort we began developing a realistic 2-D image simulator for coronagraphic imaging, which includes a realistic source field, source confusion due to background galaxies, and field motion due to time delays between repeat images.

3. Future Funding

Our priority goal for future funding is via NASA HQ SMD and STMD identification of ATLAST as a sufficiently significant and plausible major future mission to justify substantial new funding in FY16 and beyond. In meetings at NASA HQ, we have requested that annual funding in the range of $5 – 10 M be made available. However, despite multiple recommendations by advisory groups to NASA for even greater funding, we are yet to be successful. In the meantime, the ATLAST technology team has succeeded in winning smaller competitively selected SMD grants.

4. Budget

As noted above, ATLAST was awarded 2.3 FTEs for FY15, which was distributed to support 600 and 690 scientists. An average of about 0.4 FTEs each were allocated to Drs. Roberge, Mandell, Domagal-Goldman, with a smaller distribution to Drs. Stapelfeldt and Thronson.

We also received $50 K in procurement, which was used to support detailed thermal design and stray light shielding via Chuck Perrygo, whohas unique skills in thermal design that he has been working on for JWST. Rather than duplicate his capabilities, we wanted to use these skills to be more efficient. Chuck is working to transfer his data sets to Goddard civil servant mechanical engineers.

4. Recognition and Papers

As noted above, we presented the status, future plans, priority technologies, and major science goals at the January AAS conference in Seattle and August SPIE conference in San Diego. In addition, our science work on exoplanets was presented Astrobiology Science Conference 2015 and Pathways to Habitable Planets II, as well as at multiple meetings of NASA's Exoplanet and Cosmic Origins Program Analysis Groups (ExoPAG and COPAG). We also established a regular every-other-Wednesday seminar series on topics relevant to relevant to a future large-aperture observatory (http://asd.gsfc.nasa.gov/colloquia/atlast/) in addition to a Google Hangout on future space science missions, including the search for life (https://plus.google.com/u/0/events/ctmuvcgmi57opjes0o13dk2nr0g).