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Abstract Title: Development Progression of an All Composite Primary Mirror for the FIRST Telescope

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Presentation: Oral Presentation

Abstract: NASA/JPL will provide the 3.5-meter telescope to ESA for the FIRST mission. The FIRST mission is a collaborative effort between ESA and NASA. The 3.5-meter aperture of the FIRST telescope introduces several rather unique challenges due to its considerable size. The selection of a material system from which to build the primary mirror is driven by the challenges of size, not the least of which is producibility.

Based upon a review of the "state of the practice" and the "state of the art" of the various material candidates for this application, JPL selected graphite fiber reinforced composites (GFRC). Applying GFRC materials to the FIRST primary mirror required additional development work. But it was believed that the required development necessary with composite materials was incremental in nature and would provide the lowest risk solution to the mission from the available candidate materials.

JPL selected Composite Optics, Incorporated (COI) in San Diego as its industry partner in the development of this telescope based upon recent advances in mirror development with composite materials and experience working with instrument structures.

COI had previously developed many of the technologies necessary for the successful build of the FIRST primary mirror under IRAD and SBIR (Small Business Innovative Research) contracts. Due to the success of the development work, composite materials were selected as the primary mirror materials on other flight hardware programs. This hardware was successfully developed, produced, tested and delivered.

JPL and COI developed a technology development/development article demonstration plan to incrementally demonstrate the performance of the design with subscale articles. One of the development articles is a 2-meter aperture primary mirror. This spherical 2-meter article incorporates many of the design features of the 3.5-meter mirror and will

serve as an effective gauge for the incremental development of the technology ultimately required for the 3.5-meter mirror.

The primary mirror must be manufactured from near zero coefficient of thermal expansion materials as it is built at room temperature but operates at 80K. A unique feature of the primary mirror design is that the front and back face skins are each built from six individual laminates. Individual face skin segments are bonded to a continuous egg-crate GFRC core. Quality and producibility benefit greatly from selecting this approach, as well as general program risk reduction. It also serves as a pathfinder for building even larger aperture mirrors for the scientific community.

Key Words: Mirror, Composites, Submillimeter

Biography: Dr. Connell received his Ph.D. in Materials from the University of California, Santa Barbara in 1996, after earning a B.S. degree in Mechanical Engineering from UCSD. Prior to joining COI, Dr. Connell was a postdoctoral Research Fellow at UCSD's Institute for Mechanics and Materials. Dr. Connell joined COI as a Principal Investigator in Product Development in April 1997. His primary responsibilities have been in the proposal, organization and completion of research programs related to stable composite structures. Currently, Dr. Connell is COI's Principal Investigator for JPL's "FIRST Mirror Technology Development Program."