Precision Thermal Control (PTC) Technology to Enable Thermally Stable Telescopes

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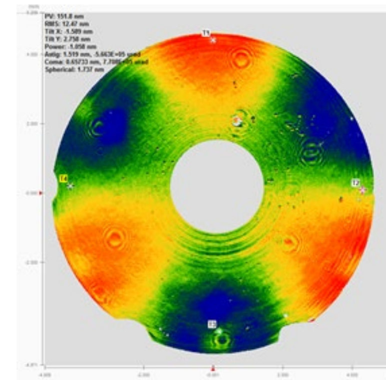
Objectives and Key Challenges:

- Validate models that predict thermal optical performance of real mirrors and structure based on their structural designs and constituent material properties, i.e., CTE distribution, thermal conductivity, thermal mass, etc.
- Derive thermal system stability specifications from science-driven wavefront-stability requirement
- Demonstrate utility of PTC system for achieving thermal stability

Significance of Work:

- Thermally stable space telescopes enable the desired science of potential HabEx and LUVOIR missions
- Integrated modeling tools enable better definition of system and component engineering specifications

PTC control system achieved 2K accuracy with 2mK stability of 1.5-m AMTD-2 ULE® mirror



Thermal zones able to impose 150 nm of trefoil

Approach:

- Science-driven systems engineering
- Mature technologies required to enable highest-priority science resulting in high-performance, low-cost, low-risk system
- Mature technology in support of 2020 Decadal process

Key Collaborators:

- Thomas Brooks, Richard Siler, and Ron Eng (NASA/MSFC)
- Carl Rosoti, Keith Harvey, and Rob Egerman (Harris Corp)

Funded Period of Performance:

Jan 2017 – Sep 2021
(awarded as competed SAT, converted to ISFM directed work)

Accomplishments:

✓ Successfully completed all initial PTC objectives and milestones
✓ Demonstrated PTC multi-zone thermal control via test of a 1.5-m ULE® mirror in a relevant thermal/vacuum environment
✓ Demonstrated figure correction via multi-zone thermal control
✓ Published study results in JATIS journal paper

Applications:

- Flagship and Explorer-class optical missions
- Department of Defense and commercial observations

*TRL_{In} = **3** $TRL_{Current}$ = **5+** TRL_{Target} = **4 - 5***
(values depend on specific technology)