Gondola for High Altitude Planetary Science – Optical Telescope Assembly: GHAPS - OTA

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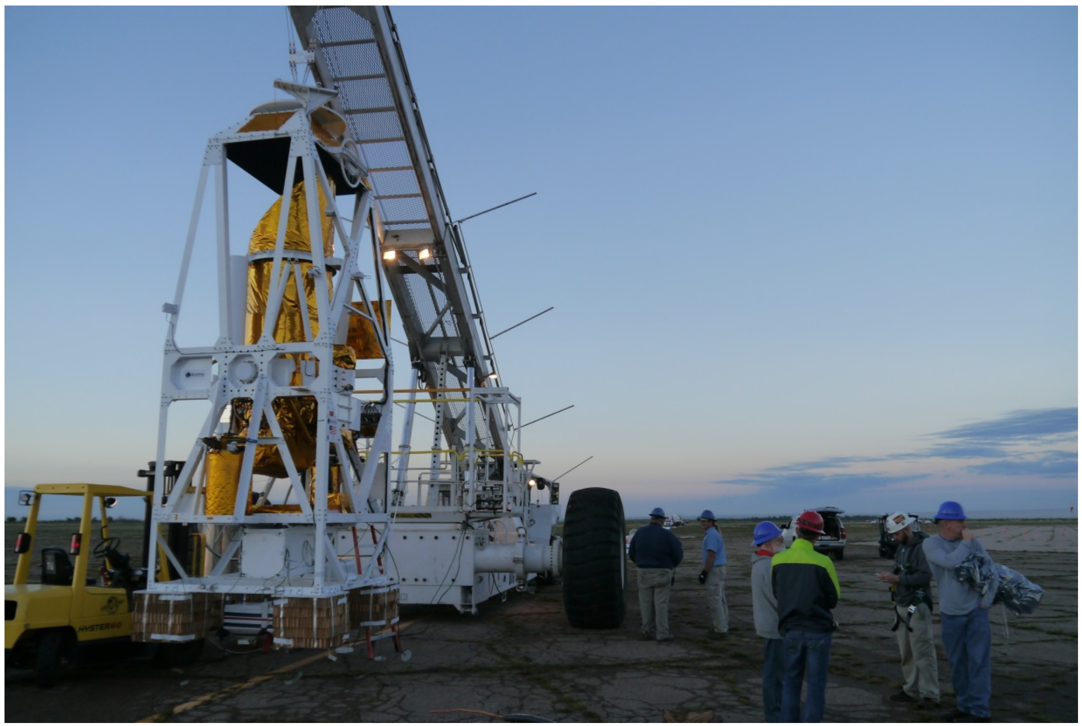
Topics

- Background
- Current Configuration
- Mirror Design
- Mirror Support Structure
- Metering Structure
- Thermal Considerations

Background

- GHAPS Heritage:
  - Balloon Rapid Response for Comet ISON (BRRISON)
    - Flown September, 2013 from Fort Sumner, NM
    - 80-cm CA telescope, UV, visible and IR bands
    - Target - Comet ISON
    - Jammed telescope launch latch prevented image acquisition
  - Balloon Observation Platform for Planetary Science (BOPPS)
    - Flown September, 2014
    - Reflight of BRRISON telescope and instruments
    - Targets were Comets PANSTARRS and Siding Spring

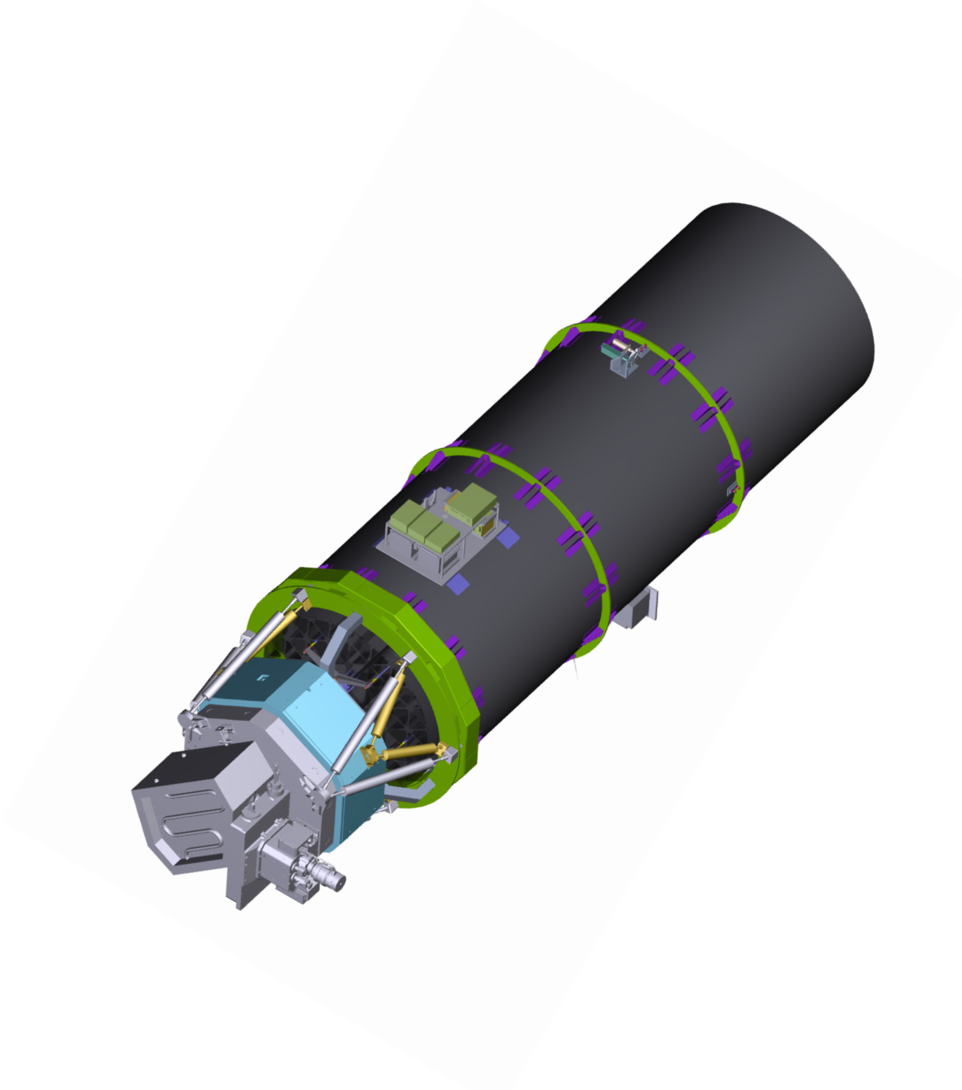
BOPPS Gondola



GHAPS OTA Current Configuration

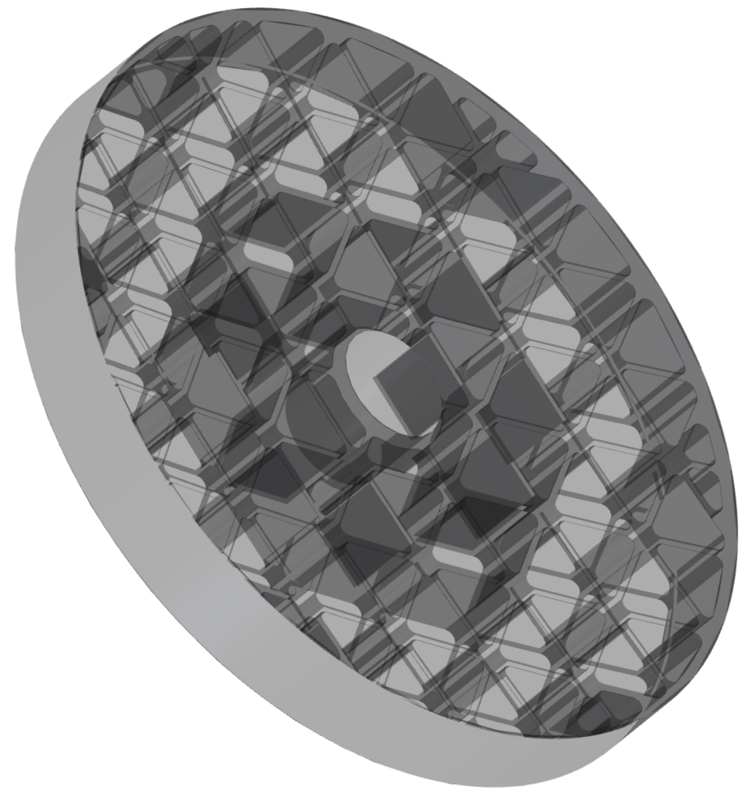
- 1-m, F/14 Ritchey-Chretien
  - Focal length is compromise between desire correctly match image spot size to instrument pixel dimension
    - Baseline IR (same as used on BRRISON/BOPPS) incorporates a small Ritchey-Chretien ('mini-RC') as a focal reducer.
    - Existing UV-visible instrument currents works at OTA focal ratio
      - May be modified for longer efl
- Weight : 262 kg + 15% Growth Allowance (Total: 301 kg)

Current GHAPS Configuration



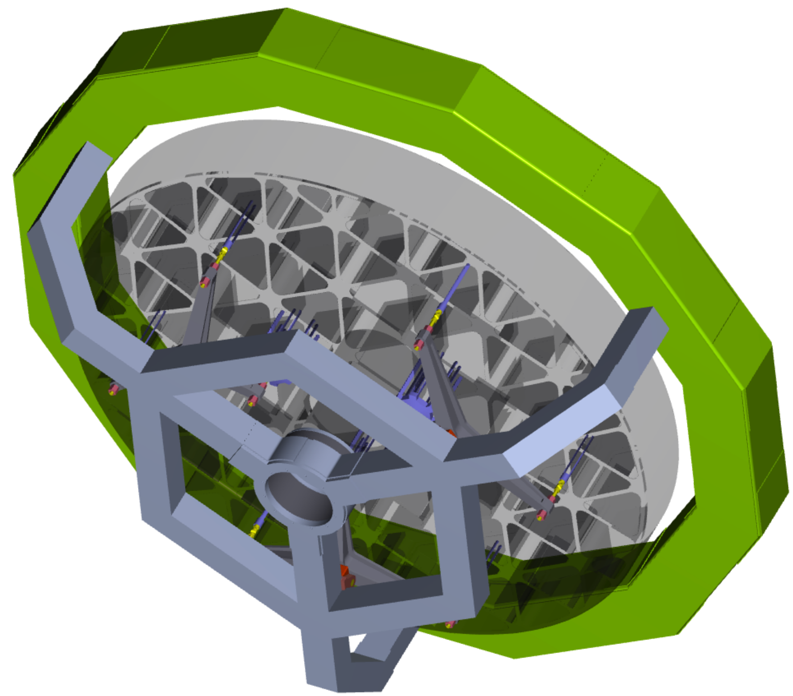
Mirror Design

- Primary Mirror
  - Open-back isogrid design
  - Lightweighting fraction ≈ 70%
  - Margin allows roll bevel at edge for protection against chipping while allowing
  - F/2.5
  - Material: Zerodur
  - Currently specifying Expansion Class 0
    - May need to use Tailored expansion grade to accommodate lower mean operating temperatures (depending on thermal model results)



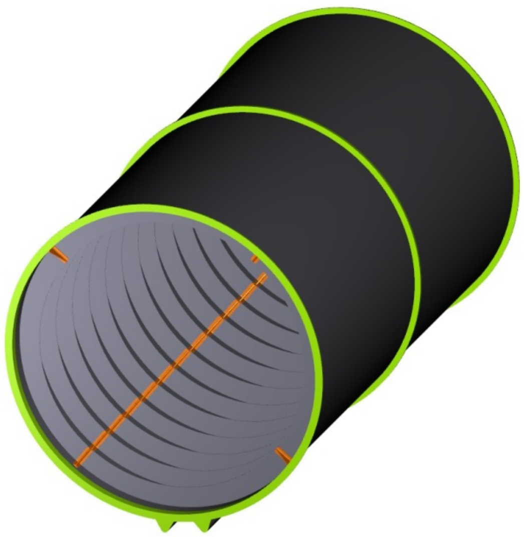
Mirror Support Structure

- OTA operates over a range of elevation angles (≈ 0° to 67°)
  - Mirror support structure must support mirror over this range without excessive distortion
  - Current design is a 9-point whiffletree for axial support and tangent bars for radial support.
  - Considering 18-point, 2-level whiffletree for lower mirror distortion.



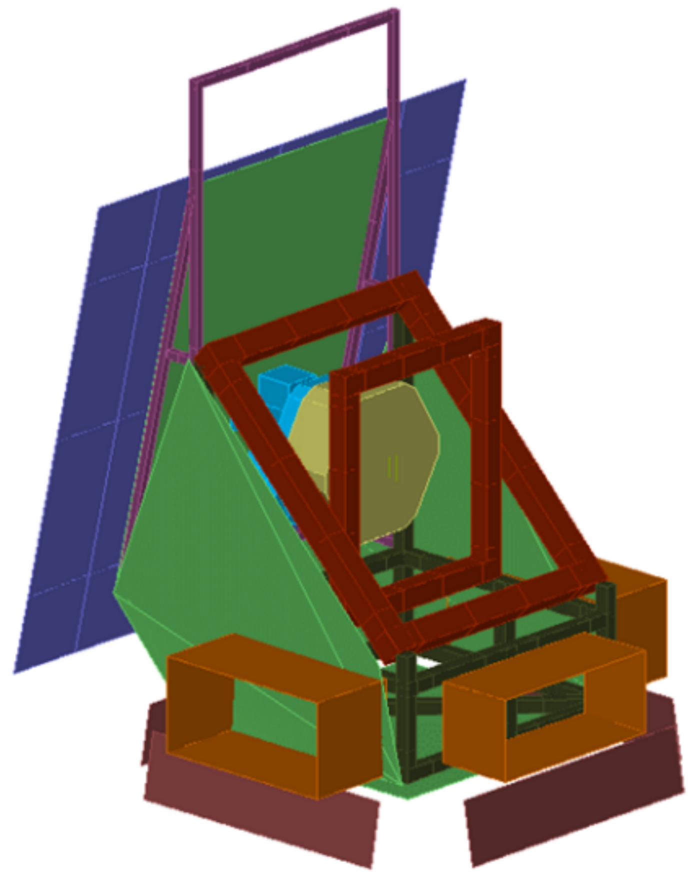
Metering Structure/Light Baffle

- Current design utilizes a combined metering tube with internal vanes for stray light control
  - Original concept used a separate truss-type metering truss with a non-structural light baffle.
  - Tubular metering structure selected as lower profile solution.
- Material selection will be made based on strength of material, CTE of the laminate and material availabilty
- Baffle separates into sections <48 inches long to allow recovery after an Antarctic flight



Thermal Considerations

- IR signal-to-noise ratio (snr) is affected by temperature of optics and by IR emissivity of mirror coatings
- Optics temperature will be a function of mirror coating emissivity, ambient air temperature, and view factor of the optics and telescope to sources of thermal radiation.
- Thermal sources can be local to the optics and telescope, such as the interior of light baffle, other equipment mounted on the telescope or gondola and pointing system attachment.
- Other sources include solar radiation (direct and reflected from the Earth's surface), IR radiation from the Earth ('Earthshine').
- Methods of control include insulation around the telescope, surface treatment to control emissivity and absorptivity, careful placement of heat sources and operational strategies to regulate mirror temperature.
- Challenge is attaining low temperatures for IR performance and maintaining mirror figure and telescope alignment for UV-visible imaging.



Thank you for your attention!