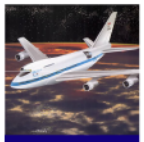
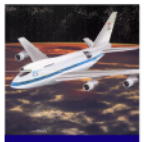


SOFIA Stratospheric Observatory for Infrared Astronomy

Meteorological Necessities for the Stratospheric Observatory for Infrared Astronomy

Franzeska Houtas
NASA Dryden Flight Research Center
Edwards, CA

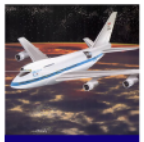
Outline



SOFIA Stratospheric Observatory for Infrared Astronomy

- What is SOFIA?
- Weather requirements for flight testing
- Weather requirements for line operations
- Air Data Calibration
- Milestones

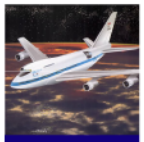
What is SOFIA



SOFIA Stratospheric Observatory for Infrared Astronomy

- NASA and German Aerospace Center (DLR) joint project of an airborne observatory
- Highly modified Boeing 747-SP with a large door in aft fuselage
- 2.5 meter diameter reflecting telescope designed for infrared astronomy
- Predecessor: Kuiper Airborne Observatory (KAO)
- Flies above 99% of water vapor in Earth's atmosphere (>FL400)
- Multiple instruments used to look at various ranges of the infrared spectrum
- 20 year life expectancy

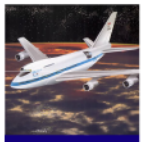
Flight Testing



SOFIA Stratospheric Observatory for Infrared Astronomy

- Modifications to aircraft
  - Large opening was created in the aft section of the airplane
  - New pressure bulkhead was added
  - New structure added to support telescope
  - Flight control cables were re-routed
  - Outer mold line was modified
- Concerns
  - Potential for acoustic resonance
  - Potential for effects on airplane stability and control
  - Potential for increase in drag, resulting in reduced airplane performance
- New systems
  - Door system
  - Cavity environmental control system
  - Telescope Assembly
- Observatory functionality had to be verified
  - Both on the surface and airborne

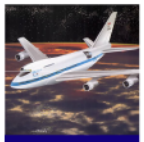
Weather Restrictions



SOFIA Stratospheric Observatory for Infrared Astronomy

- **Flight Limitations (Envelope Expansion)**
  - No sustained flight in visible moisture. Brief climbs and descents through thin layers of clouds are permitted with URD Closed and seal inflated.
  - Envelope expansion testing to be conducted only in Visual Meteorological Conditions.
  - Due to potential stuck open door situations, consider closing the URD when sustained surface winds at destination are >25 knots or significant blowing dust is observed.
  - No flight through moderate or greater turbulence

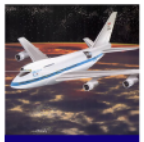
Weather Restrictions



SOFIA Stratospheric Observatory for Infrared Astronomy

- **Line Operation Limitations**
  - No lightning within 35NM
  - Ambient dew point temperature and Telescope temperature > 3 deg C difference
  - No winds > 20 knots
  - 'On sky' testing
    - Only thin cirrus clouds in direction of sighting
    - No precipitation

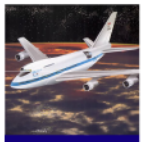
Reduced Vertical Separation Minimum (RVSM)



SOFIA Stratospheric Observatory for Infrared Astronomy

- Reduce the vertical separation above FL290 from the current 2000-ft minimum to 1000-ft minimum
- Air data calibration of aircraft instrumentation
  - Radiosondes
  - Surface Conditions
  - Map analysis
  - Z-Hp Calculations

October 11, 2007: First Envelope Expansion Flight



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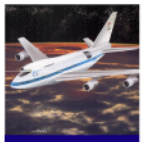
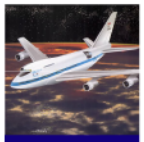
December 18, 2009: Open Door



SOFIA Stratospheric Observatory for Infrared Astronomy

Line Operations



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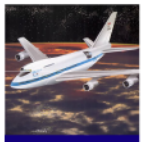
Telescope – Inside



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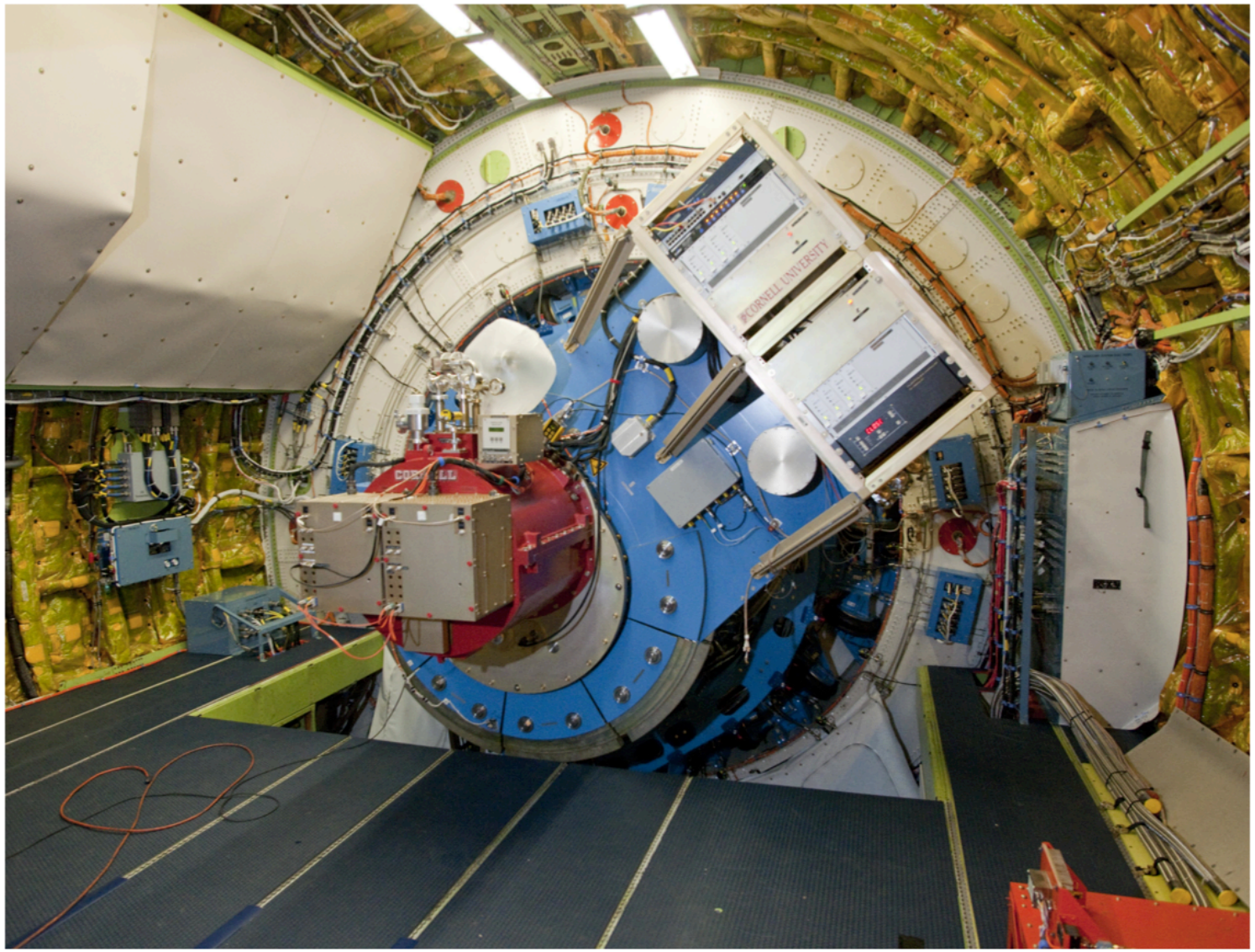
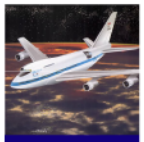


Telescope - Outside



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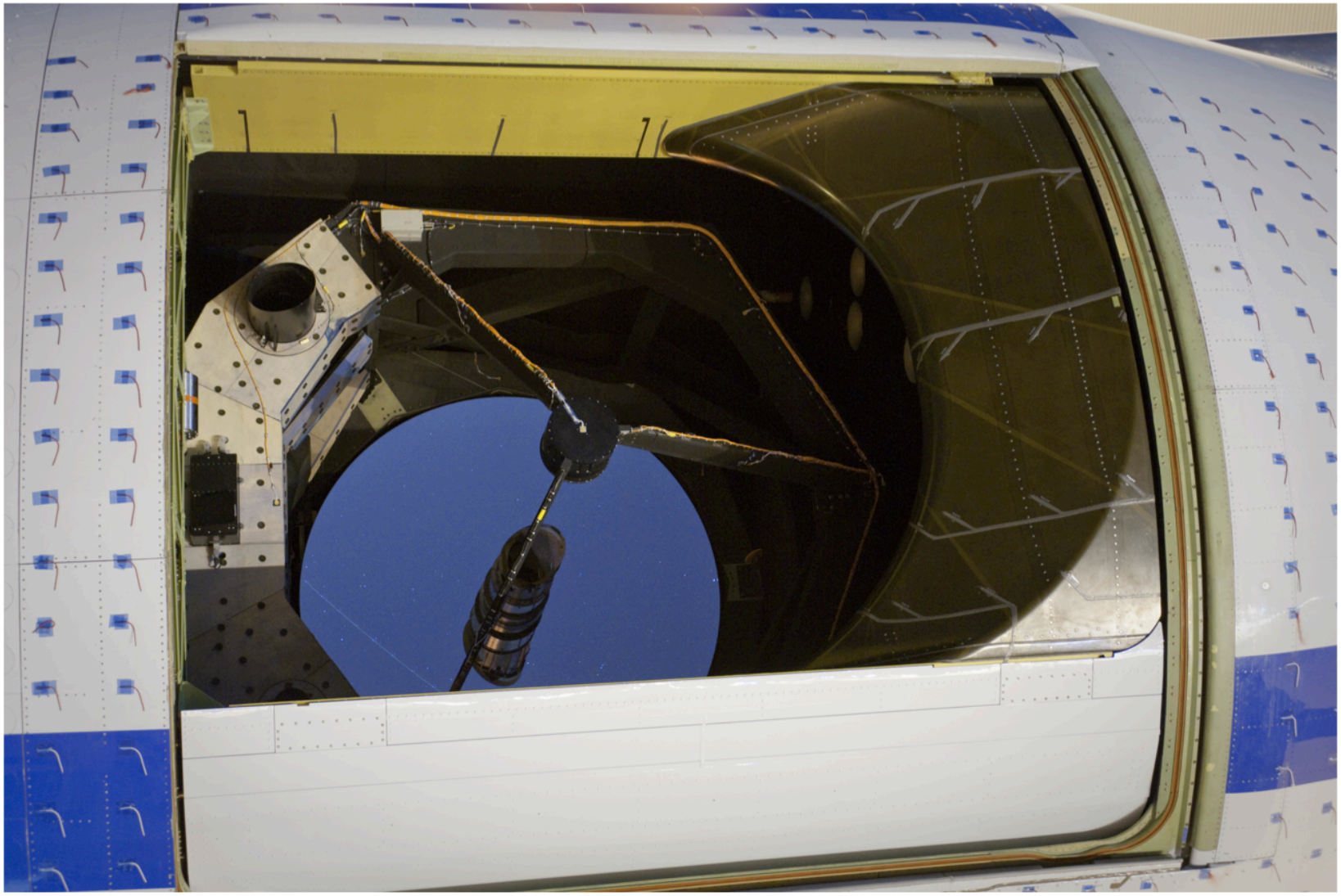
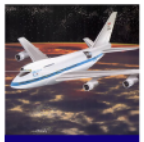
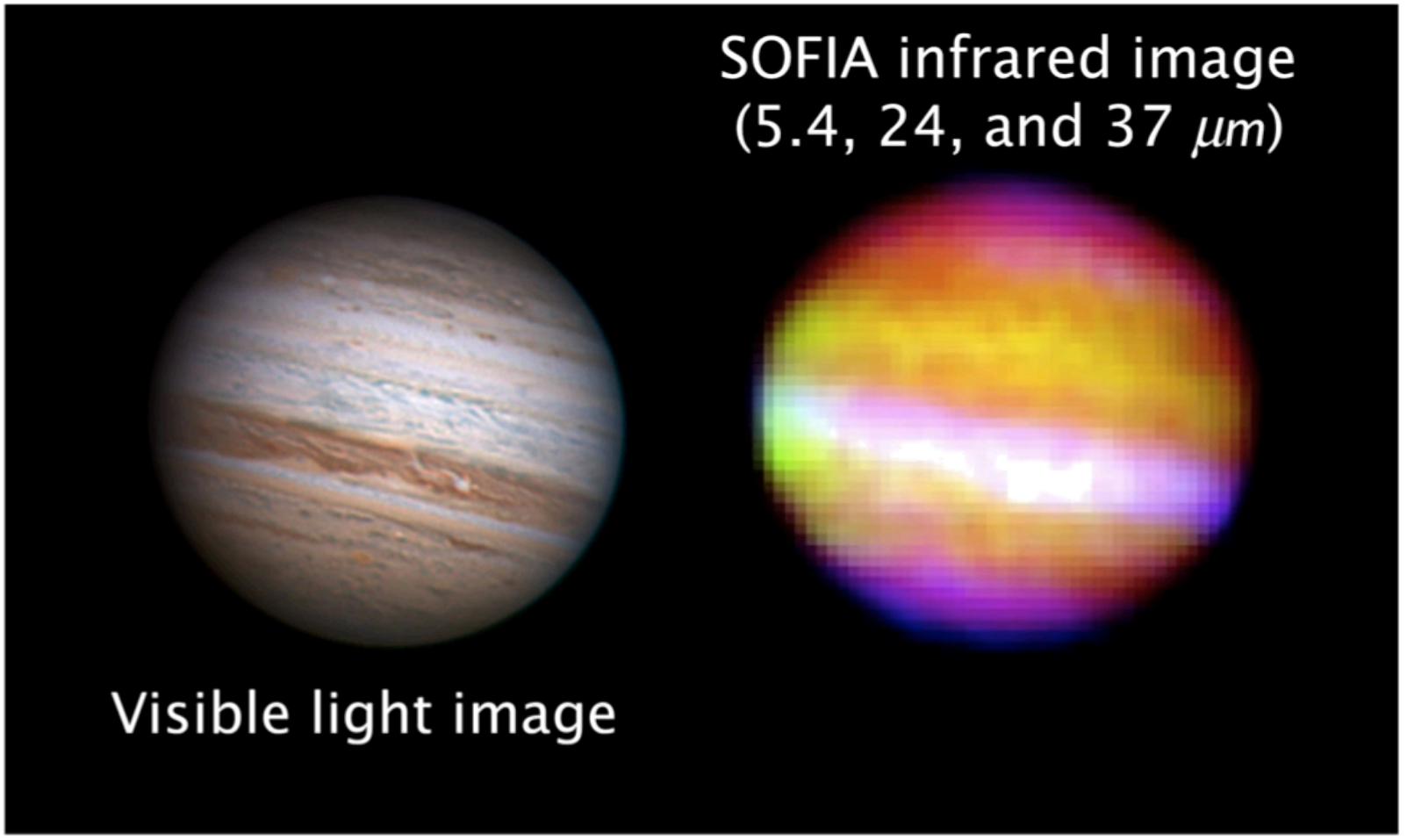


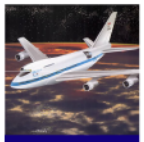
May 26, 2010: First Light



SOFIA Stratospheric Observatory for Infrared Astronomy



December 2011



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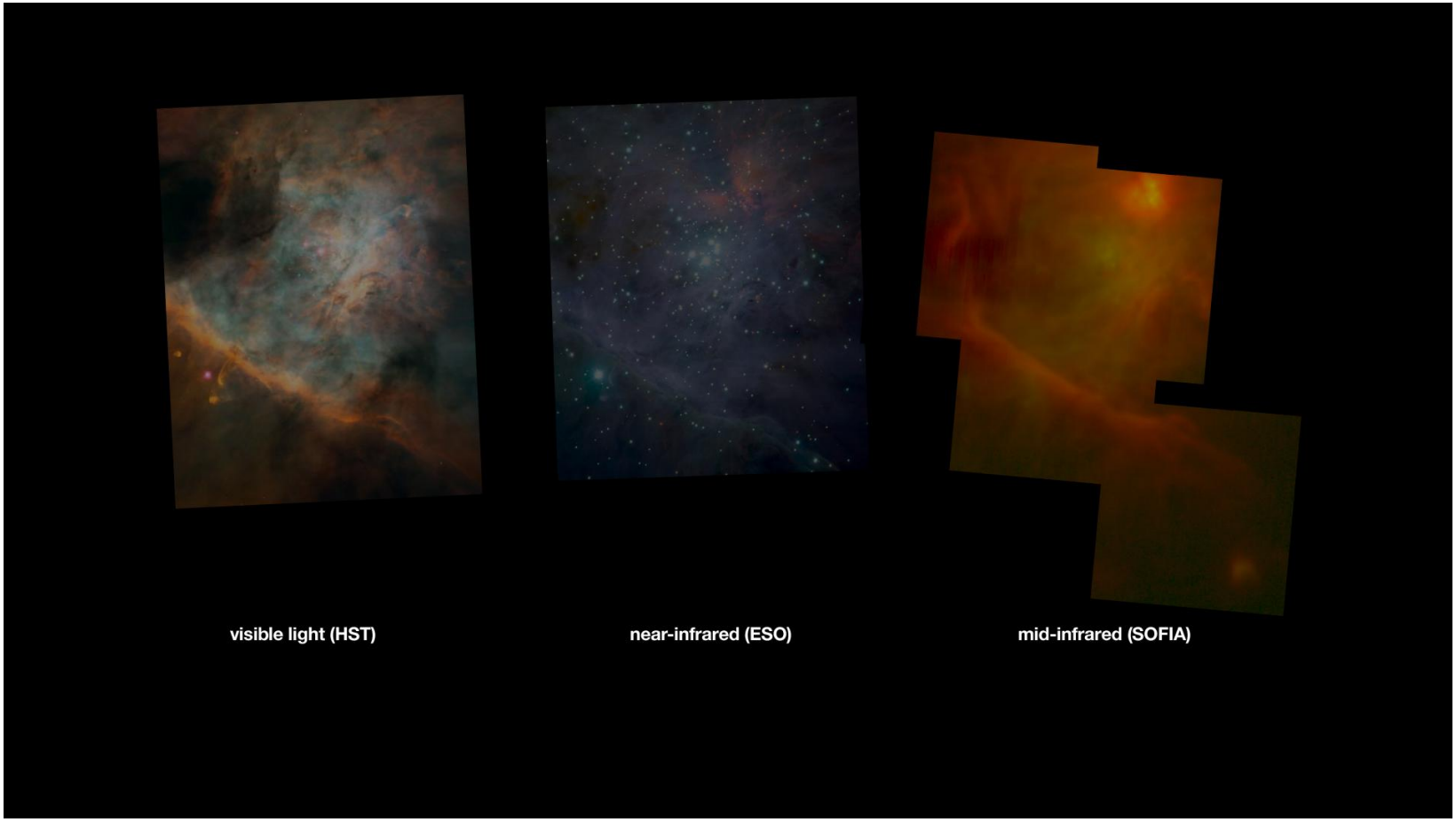
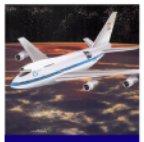


Questions?



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