The Atsa Suborbital Observatory

Using crewed suborbital spacecraft for a low-cost space-borne telescope

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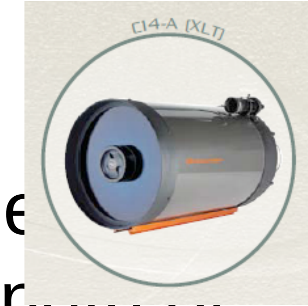
Introduction

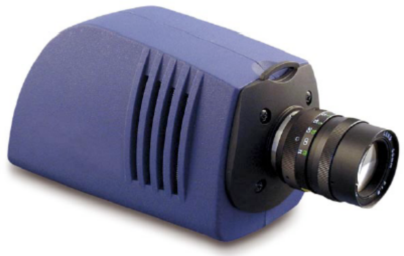
Why take an IR telescope on a trip like this?

- Above telluric water in the Earth’s atmosphere
  - allowing access to the complete IR spectrum of an object.
- Inexpensive spaceborne telescope can observe inside the solar exclusion angles of robotic orbital telescopes
  - If it breaks, a new CCD is easy and cheap to replace
  - Exclusion angle for the Hubble Space

Atsa Instrument Concept



- Schmidt-Cassegrain telescope
  - Ruggedized commercially-available Cele tube; aperture of 356 mm and a focal length of 3.97 m
- Infrared camera
  - Commercially-available Silver 220 infrared camera at the focal plane (Thermovision SC4000 is also poss
    - Accomodates a filter wheel
    - Sensitive to the spectral range of 0.8-2.5 µm
    - Quantum efficiency over 70%.



- Gimbal system and drive motors

Instrument Concept 2

- *Heritage and development status*
  - The telescope and focal plane components are all commercially available.
  - Custom fabricated parts include
    - Interface between the telescope and the camera
    - Mounting system (gimbals, bracket, etc.)
    - Drive system/Control interface (potentially a hull pass-through)
    - Filters
- *Size, mass, power, data*
  - Telescope
    - Diameter is 14 in, length is 31 in.

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OPSCON

- Launch likely with instrument on
- Spacecraft does coarse pointing
  - Start just after engine cutoff
- Gimbal/drive system provides fine pointing
- Collect data until time constraints call for deployments to prepare for reentry
- The data collect lasts only a few minutes
  - Make every second count!

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Requirements on potential spacecraft

- Some targets may require a night launch
  - Might require avionics upgrades
- Single experiment/target per launch?
  - For SpaceShip2, instruments look out of portholes
  - Unless the instruments are looking at the same target (and are in coplanar portholes), it is unlikely that two different telescopes could be accommodated on the same flight
  - But might be great for multi-wavelength (multi-telescope) observations

Flight planning and training requirements

- The period of time above the atmosphere is mere minutes
- Effective time management is critical to mission success
- Choreographing the mission beforehand, and
  - Understanding the timing of critical events to the second
  - Maneuvers (turn telescope to face target)
  - Deployments (open/close payload doors; deploy tailplanes)

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Window

- Best window is ***no window***: direct access to space gives the best transmissivity
- If there is a window:
  - Good transmissivity across the desired spectral range (tentatively, 0.4 – 2.5 µm for the infrared telescope concept).
  - A special window may need to be fitted to the craft (planned for at least one vehicle)
  - Provision must be made in the craft to accommodate the instrument (attachment points, etc.)

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Stray light

- Accommodation for stray light issues will depend on the spacecraft configuration
- Interior considerations (telescope in the cabin)
  - Turn off all lights inside the cabin to avoid reflections from the window
  - Optically shield the telescope from the data acquisition station
- Spacecraft exterior
  - Attitude to put the telescope in the spacecraft shadow

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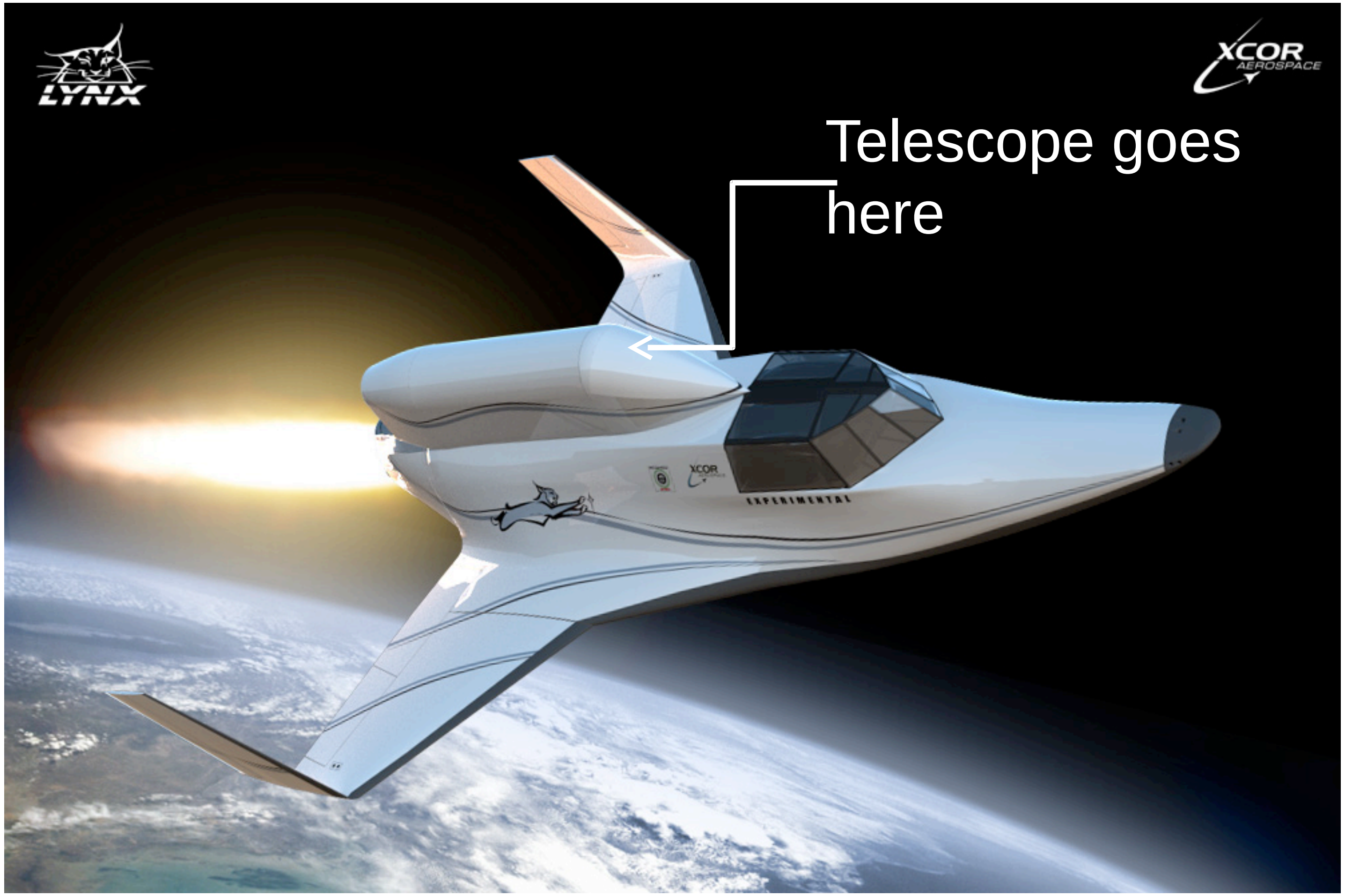
Practical Considerations

- NASA has a long history of suborbital science
  - Including observatories
  - Black Bart sounding rockets from Wallops Island (and other places)
  - Program has produced a lot of great results
- Crewed suborbital craft
  - Lower cost/launch
  - Return the instrument in the same condition as it left

7 More flights for the same cost, or lower

Let’s get flying



XCOR’s Lynx vehicle