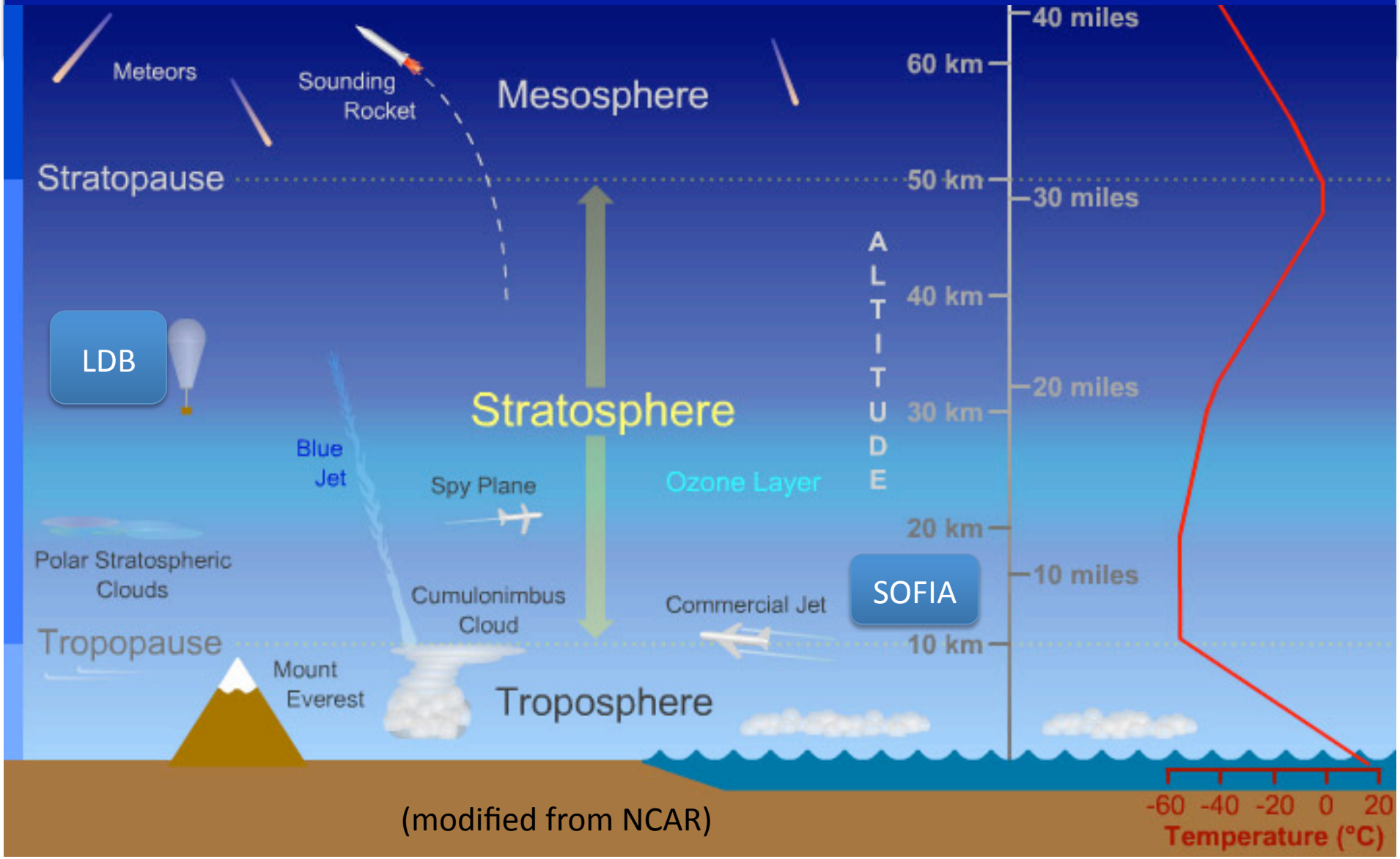
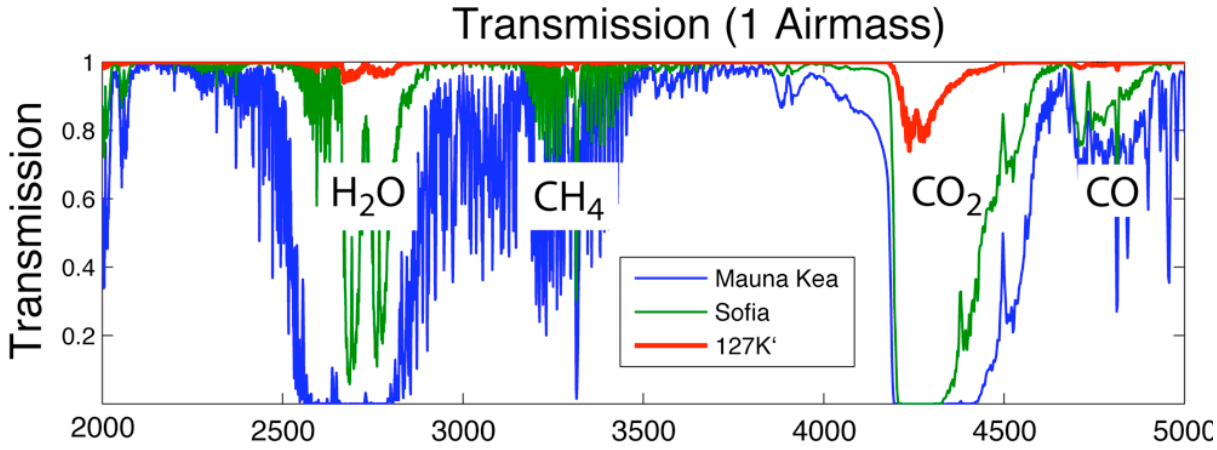
What's Hot in the IR at 120'K

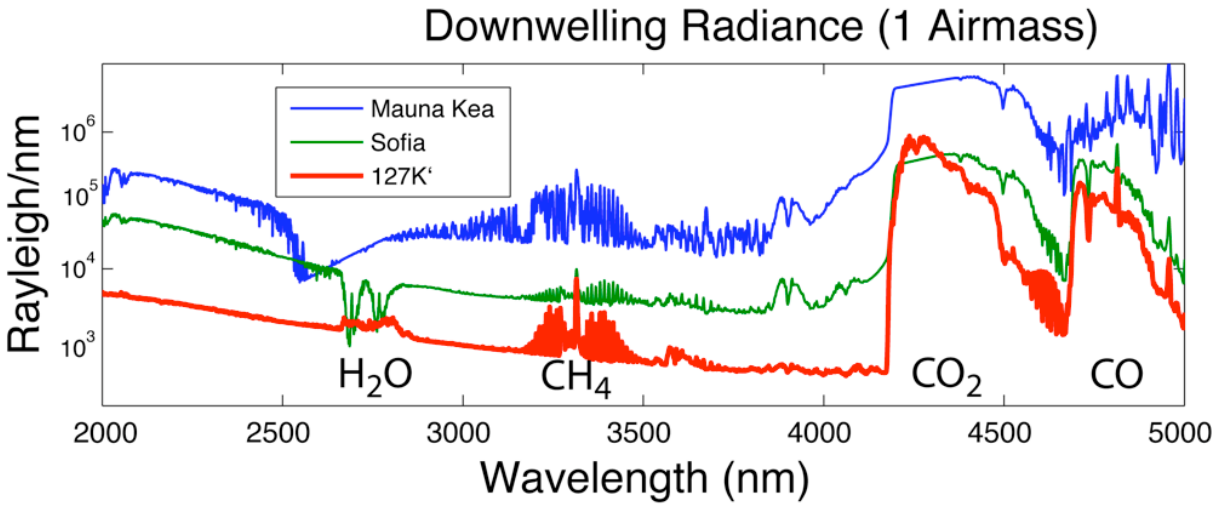


(modified from NCAR)

The Stratospheric Advantage
Shortwave IR - Mid IR

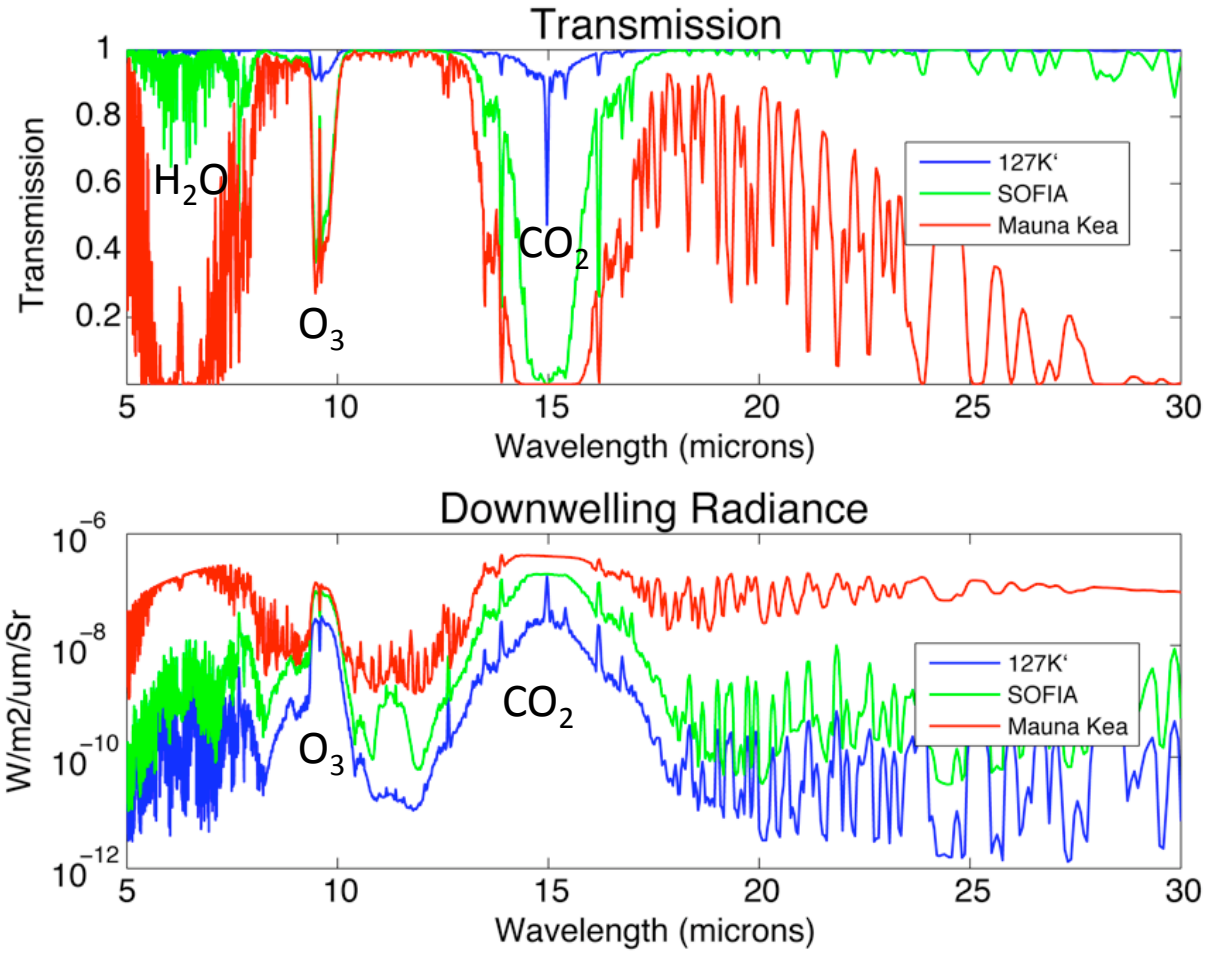


The telluric methane and water lines are almost completely absent and transmission exceeds 70% within the CO_2 band.



Considerably lower downwelling radiance than at lower altitudes, enabling longer observing for dim objects.

The Stratospheric Advantage
Thermal IR



At 36 km, transmission is nearly 100% throughout the TIR and downwelling radiance is several times less than at 40K', and orders of magnitude less than at Mauna Kea. O_3 and CO_2 minimally absorb. Similar measurement advantages to Mid-IR

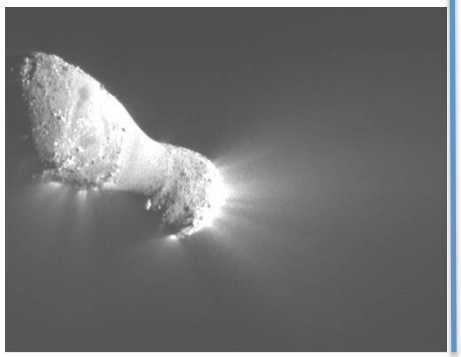
Example Potential Small Body Investigations

Condensed Phase Organic and Volatile Investigation

Science Goal: What is the organic and volatile compositions of asteroids, comets, and other small bodies? Is CO_2, CO, water, or other volatile the primary driver for comet outbursts?

Measurement Concept: Mid-IR spectroscopy. Non-imaging, 2.5 – 5-μm. → measure CH_n, CO, CN, CO_2, water, hydroxyl, and trace species.

Potential targets: NEA, Moon, MBA, irregular satellites, Jupiter Trojans, Centaurs, KBOs.

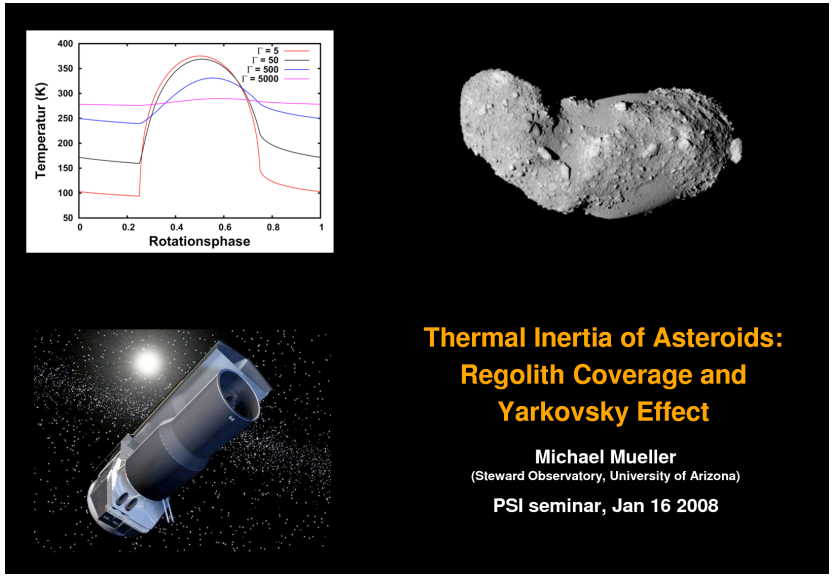


Thermal & Compositional Investigation

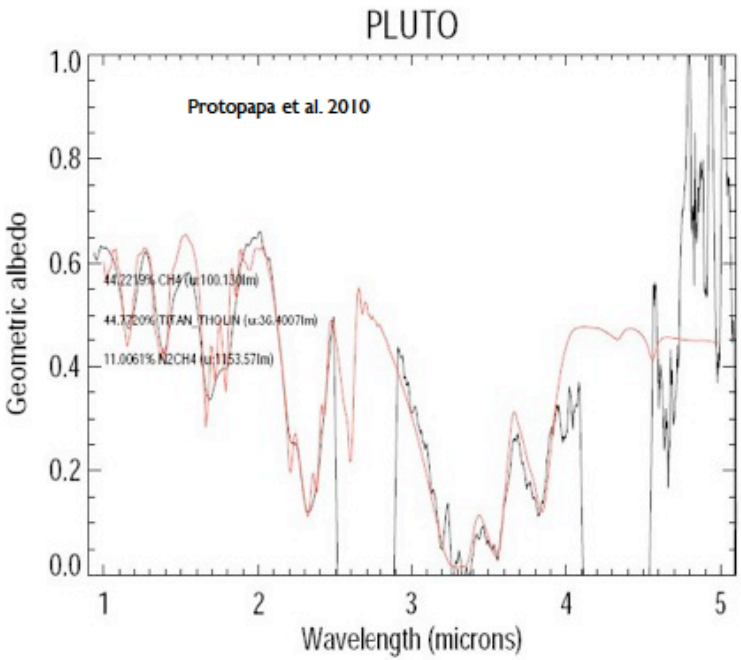
Science: including thermal flux and beaming parameters, non-gravitational forces on small bodes (Yarkovsky effect, YORP, etc.), and composition. Phase resolved.

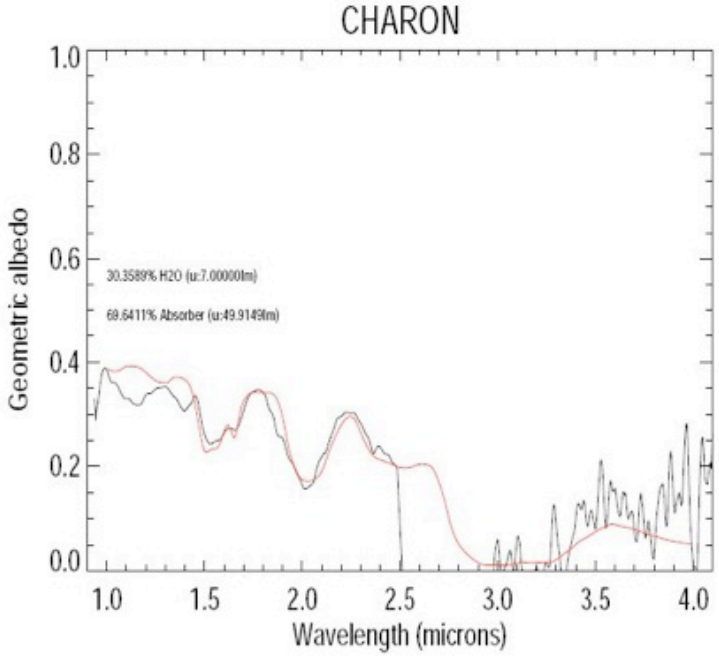
Measurement Window: the full TIR 3 → 30 μm (and longer).

Potential targets: NEA, MBA, satellites, Jupiter Trojans, Centaurs, KBOs.



PLUTO, TRITON & Large TNOs: 3 - 5μm Spectra





Broad Science Goals:

- Inventory of compounds, including amino acid precursors (e.g., HCN, NH_3, Methanol)
- Understanding basic properties of remote surfaces: grain sizes, temperatures, dilution/ mixing of constituents, crystalline form.

- Much stronger lines at 3 - 5 μm than the overtones shortward of 2.5 μm.
- Better chance of detecting weak isotope lines, (e.g. ^{13}C).
- With 3-5 μm spectra, Hapke-type modeling will provide more powerful constraints of surface properties and, in conjunction with 1 - 2.5 μm spectra, allow better modeling of frost layers.

Balloon Science Opportunites:

- Much lower background than even the best terrestrial sites (Pluto's M-band spectra represents 4 consecutive nights from the 8-m VLT!).
- Better spatial resolution: enables separate spectra of countless close-spaced object pairs or spatially resolved spectra of many objects at the 0.1" level.

Planetary Atmospheres Thermal-IR

Science Goal:

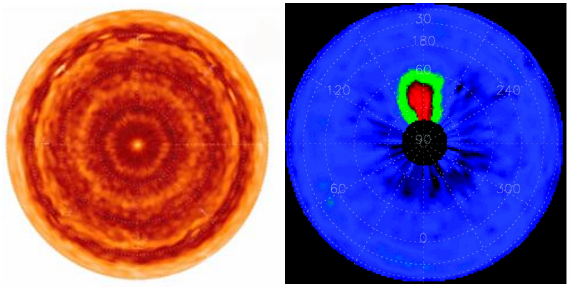
- What is the interplay between the chemistry, heat flow, and dynamics of planetary atmospheres?

Measurement Concept:

- Mid-IR spectroscopy 7 – 15 µm. Moderate imaging. Measure hydrocarbons, NH_3, HCN, O_3, HDO, H_2O_2, CO_2, CO, SO_2, and other trace species.

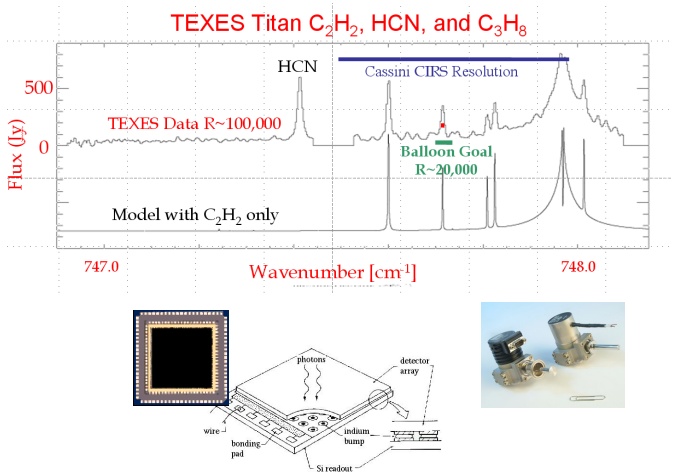
Potential Targets:

- Jupiter, Saturn, Uranus, Neptune, Titan, Io, Mars, Venus, and comets.



Stratospheric Platform:

- Adequate atmospheric transmission (greatly improved in certain spectral windows) with minimal downwelling radiance in the mid-IR (7-15 µm).
- Long duration tracking of interesting features (e.g., hot spots)
- Demonstrate new detector and cryocooler technology



Some specific examples of how a high stratospheric platform may be enabling to IR planetary science

- for future discussion -

Stratospheric Facility for Planetary Science - Potential IR Measurements

1 day to 30 day mission durations with 24/7 observing. Several arcsec pointing for minutes. Excellent seeing from NUV through the entire TIR. Launch opportunities multiple times per year.

	Science Objective	Measurement Concept	Relevant Platform Attributes
1	Condensed organics and volatiles on airless bodies	3-5 um spectroscopy, 10nm resolution	high transmission, low downwelling radiance,pointing stability, long-duration
2	Characterize CO2 on airless bodies	Very high spectral resolution 4-4.5 um	high transmission, low downwelling radiance,pointing stability, long-duration
3	Thermalphysical characterization of airless bodies	Broadband thermal	high transmission, low downwelling radiance,pointing stability, long-duration
4	Hydrocarbons in the atmospheres of Giant Planets, Mars, Venus, Comets, and Titan.	Very high spectral resolution mid-IR 5-25 um	high transmission, long-duration
5	OH and H2O features on the Moon and asteroids	High spectral resolution 2.5 - 4 μm	high transmission, low downwelling radiance,pointing stability, moon: short-duration, asteroids: long duration, icy satellites: very long
6	Venus Atmospheric Chemistry	High resolution imaging 2.3- 2.7 um	high transmission, stable photometry
7	sun grazing comets	UV-Mid-IR spectroscopy	high transmission, low downwelling radiance, long mission times, near Sun pointing
8	Photometry of airless bodies	Vis-IR low resolution spectroscopy or multispectral	high transmision, long mission times
9	Characterize gaseous CO2 in comets	Very high spectral resolution 4 - 4.5 um	high transmission, long mission duration
10	chemistry, heat flow, and dynamics	Moderate spectral resolution 7-15 um	high transmission, low downwelling radiance, long mission duration
11	Surface composition of airless bodies (Christiansen features & Reststrahlen bands)	7-12 micron observations	high transmission, low downwelling

Summary of potential technical strengths of IR observations from LDBs

Dedicated planetary science observatory.

Flexible Mission Capability

Each mission/flight independent of last or next. Many PI's. Specific mission to suite current PI's needs. Multiple levels of TRL can be flown; space qualification not needed.

Potentially enabling superior Atmospheric Transmission and Lower Downwelling Radiance compared to ground-based and lower-altitude airborne platforms.

Long observing time enabling long integration times and secular studies.