The Stratospheric Terahertz Observatory

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The Stratospheric Terahertz Observatory (STO) is a long-duration balloon (LDB) experiment designed to address a key problem in modern astrophysics: namely, understanding the life cycle of the galactic interstellar medium (ISM). STO is a collaborative effort led by the University of Arizona and APL with a significant contribution from the JHU Department of Physics and Astronomy.

STO is a balloon-borne observing platform that will carry an 80-cm-aperture telescope in the stratosphere at an altitude of ~120,000 ft. The telescope will feed a heterodyne receiver consisting of eight phonon-cooled hot-electron bolometer (HEB) mixers, four optimized for the dominant interstellar cooling line [CII] (at 158 μm) and four for the important star-formation tracer [NII] line (at 205 μm). The spectrometer has a resolving power, R, of >1,000,000 and an angular resolution of 1 arcmin, which is sufficient to spatially resolve atomic, ionic, and molecular clouds at 10 kpc. It will have sufficient bandwidth to detect all clouds participating in galactic rotation in each of the 8 pixels. STO is capable of detecting every giant molecular cloud in our galaxy, every HII region of significance, and every diffuse HI cloud with visual extinc-

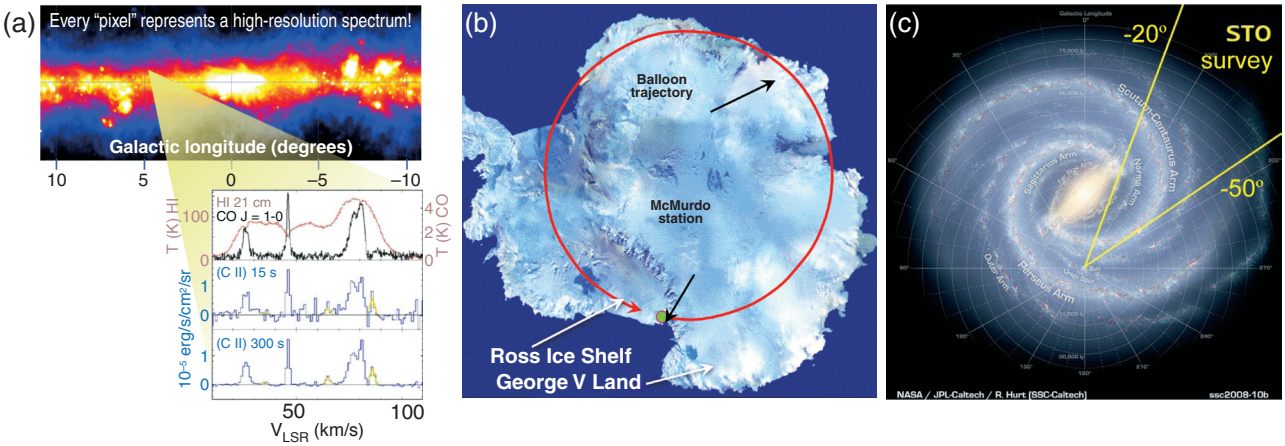

Figure 1. (a) Sample ISM map and the corresponding spectrum. (b) Map of Antarctica with the projected path of the STO flight. (c) Region of our galaxy surveyed by STO.

tion greater than 0.3 magnitudes (Fig. 1a).

STO had a 1-day test flight in mid-October 2009 from Fort Sumner, NM. In December 2010, it will have its first LDB flight of approximately 15 days from Antarctica (Fig. 1b).

During the Antarctic flight, it will survey a section of the galactic plane in both CII and NII (Fig. 1c). Combined with previous HI and CO surveys, STO will create 3-D maps of the structure, dynamics, turbulence, energy balance, and pressure of the Milky Way's ISM, as well as the star-formation rate. Our mission goals for this survey are to (*i*) determine the life cycle of galactic interstellar gas, (*ii*) study the creation and disruption of star-forming clouds in our galaxy, (*iii*) determine the parameters that affect the star-formation rate in the galaxy, and (*iv*) provide templates for star formation and stellar/ interstellar feedback in other galaxies.

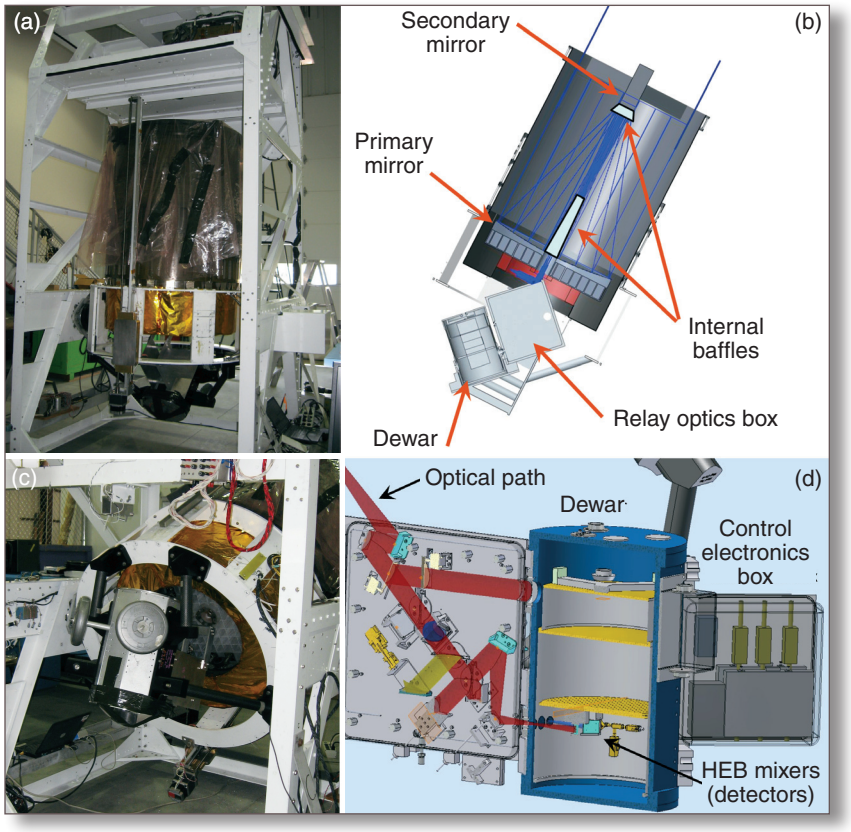

Figure 2. (a) STO telescope assembled and installed on gondola. (b) Diagram of STO telescope optical path and attached test flight relay optics box and Dewar. (c) Dummy Dewar installed on back of telescope. (d) Cutaway of FIR spectrometer for STO test flight.

For the STO program, APL will provide the telescope, the observing platform (gondola), the pointing system, the power system, the command and control system, and the ground support equipment to interface with NASA telemetry system (Fig. 2). The University of Arizona will design, build, and operate the spectrometer. The JHU Department of Physics and Astronomy will provide guidance in determining the observing plan and contribute with the reduction and analysis of the data from the STO flights.

For further information on the work reported here, see the references below or contact pietro.bernasconi@jhuapl.edu.

[1]Bernasconi, P. N., Rust, D. M., Eaton, H. A. C., and Murphy, G. A., "A Balloon-Borne Telescope for High-Resolution Solar Imaging and Polarimetry," in *Airborne Telescopes Systems*, R. K. Melugin and H.-P. Röser (eds.), Proc. of SPIE, Vol. 4014, SPIE, Bellingham, WA, pp. 214–225, doi: 10.1117/12.389100 (2000).

[2]Bernasconi, P. N., Eaton, H. A. C., Foukal, P., and Rust, D. M., "The Solar Bolometric Imager," *Adv. Space Res.* 33, 1746 (2004).