PROJECT SUMMARY

The Stratospheric Terahertz Observatory

Solicitation: NNH06ZDA001N-APRA

This lead proposal for the Stratospheric Terahertz Observatory (STO) describes a Long Duration Balloon (LDB) experiment designed to address a key problem in modern astrophysics: understanding the Life Cycle of the Interstellar Medium (ISM). Rapid, high resolution spectral line imaging allows STO to survey roughly one-fourth of the Milky Way's ISM to probe uniquely the pivotal formative and disruptive stages in the life cycle of interstellar clouds and the relationship between global star formation rates and the properties of the ISM. Combined with previous HI and CO surveys, STO will create 3D maps of the structure, dynamics, turbulence, energy balance, and pressure of the Milky Way's ISM, as well as the star formation rate. Once we gain an understanding of the relationship between ISM properties and star formation in the Milky Way, we can also better understand the observations of nearby galaxies and the distant universe. STO will first survey a section of the Galactic plane in the dominant interstellar cooling line [C II] (158 μm) and the important star formation tracer [N II] (205 μm) at 1 arcminute angular resolution, sufficient to spatially resolve atomic, ionic and molecular clouds at 10 kpc. Our mission goals for this survey are to:

1. Determine the life cycle of Galactic interstellar gas.
2. Study the creation and disruption of star-forming clouds in the Galaxy.
3. Determine the parameters that affect the star formation rate in the galaxy.
4. Provide templates for star formation and stellar/interstellar feedback in other galaxies.

To achieve the angular resolution requirement STO will have a 80 cm aperture. In order to discriminate clouds in a given beam and determine their distance from Galactic rotation, STO will utilize a heterodyne receiver system with a resolving power, $R > 10^6$. The first flight receiver will consist of eight, phonon-cooled HEB mixers; four optimized for the [C II] line and four for the [N II] line. The STO spectrometer 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 the Galaxy, every HII region of significance, and every diffuse HI cloud with $A_V \geq 0.4$. Once the [C II] and [N II] surveys are completed, we will propose to use STO to perform complementary surveys in emission lines of [O I], HD and the [NII] (122 μm) line.