# Space TeraHertz Observatory (STO): A Terahertz Observatory for Origins Research

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The 10-meter-class Space Terahertz Observatory (STO) has been proposed as a NASA Origins concept study and is designed to 1) conduct origin studies of planets, stars, and molecular clouds; 2) trace the life cycle of the Interstellar Medium (ISM) and star formation rate throughout the Galaxy; 3) measure the gas content of formative pre-planetary disks; and 4) observe the distribution of atomic and molecular gas in both nearby and distant galaxies. STO will achieve these goals through high spectral and angular resolution observations of $C^+$, O, $N^+$, HD, and $H_2O$ lines in the far-infrared. The science goals of STO can be achieved either through a dedicated mission with an uncooled 8–10 meter primary or by implementing heterodyne instrumentation on SAFIR and extending its operational lifetime. As part of the NASA concept study, we will investigate the relative merits of these two approaches. The STO instrument concept can be used to define technological roadmaps for THz astronomy and instrument development in the coming decades. The instrument utilizes four $8 \times 8$ and two $4 \times 4$ heterodyne receiver arrays to produce a total of 288 diffraction-limited beams in the focal plane, yielding angular resolution from 1.7" at 60 microns to 16" at 540 microns. Each beam will produce a 2048-element spectrum with $\sim$0.3 km/s resolution. STO science objectives are closely aligned with NASA's Origins Roadmap and drive the creation of a new generation of heterodyne array instrumentation that benefits directly from technologies developed for the Herschel HIFI instrument.

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