ASTHROS - Astrophysics Stratospheric Telescope for High-Spectral Resolution Observations at Submillimeter-waves: Mission Overview and Development Status

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The Astrophysics Stratospheric Telescope for High-spectral Resolution Observations at Submillimeter-wavelengths, ASTHROS, is a 2.5-m (SOFIA-like size) balloon-borne observatory that will make the first detailed spectrally-resolved high spatial resolution 3D map of ionized gas in Galactic and extragalactic star forming regions via simultaneous observations of the 122µm (2.459 THz) & 205µm (1.461 THz) fine structure lines of ionized nitrogen.

ASTHROS builds on the success of heterodyne instruments on Herschel and SOFIA, providing a low-risk low-cost stepping stone for future heterodyne missions. A 21-day Antarctic flight in 2023 will focus on mapping two template Galactic star forming regions and the entire disk of the M83 barred spiral galaxy at high angular resolution, complementing existing datasets from SOFIA, WISE, Herschel, Spitzer and HST. ASTHROS will be capable of tuning to nearby spectral lines (OH, HDO, HF, HD, CO) for Target of Opportunity observations. One compelling target is the HD 112µm (2.674 THz) line that traces the gas mass in protoplanetary disks. ASTHROS' angular resolution of 12" at 122 µm and 20" at 205 µm corresponds to 0.2 pc and 0.35 pc at 122µm and 205µm, respectively, for a source 4 kpc from the Sun. This high angular resolution will enable us to resolve structures ~750 times smaller than the typical size of star forming regions (~150 pc). Combined with large-scale mapping, we will begin to understand how different stellar feedback mechanisms affect ionized gas over a wide range of spatial scales in the Milky Way and the M83 galaxy.

ASTHROS payload will consists of a 4-pixel dual band cryogenic superconducting heterodyne array camera for high-spectral resolution imaging at 1.4-1.5 THz and 2.4-2.7 THz. The instrument design features a straightforward receiver architecture, simple optical layout, and subsystems that have high degree of flight heritage, pedigree, and proven performance through suborbital and space missions such as STO-2 and Herschel. ASTHROS will fly for the first time a 4-K class low-power cryocooler and thus will not require liquid helium. A cryocooler will enable extended lifetime missions, and its use will serve as a pathfinder for future NASA missions.

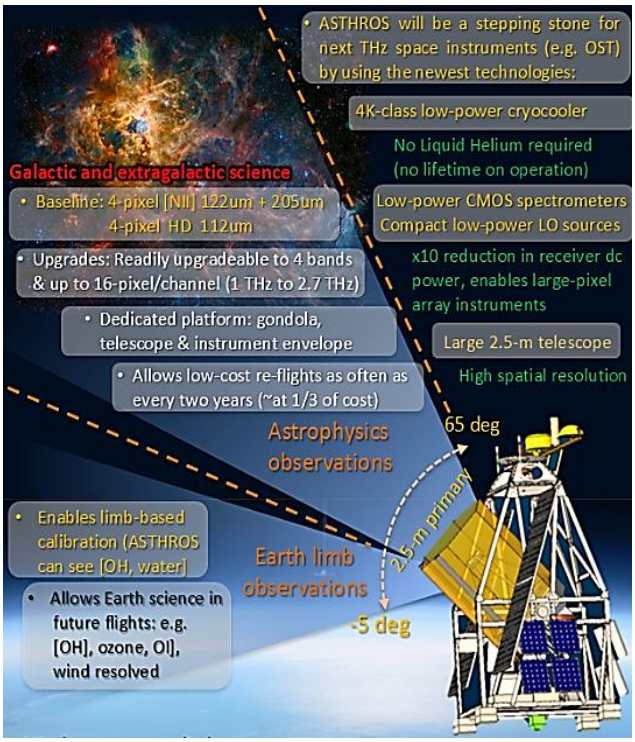

Fig. 1. General overview of the ASTHROS observatory capabilities.

We will present the overall mission science objectives and requirements, the overall payload architecture and initial subsystem designs and tests: telescope and optical subsystem, receiver subsystem, local oscillator subsystem, and gondola architecture.

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