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ASTHROS

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ASTHROS

ASTHROS - Astrophysics Stratospheric Telescope for High Spectral Resolution Observations at Submillimeter-wavelengths

Jet Propulsion Laboratory
California Institute of Technology

ASTHROS Mission Overview

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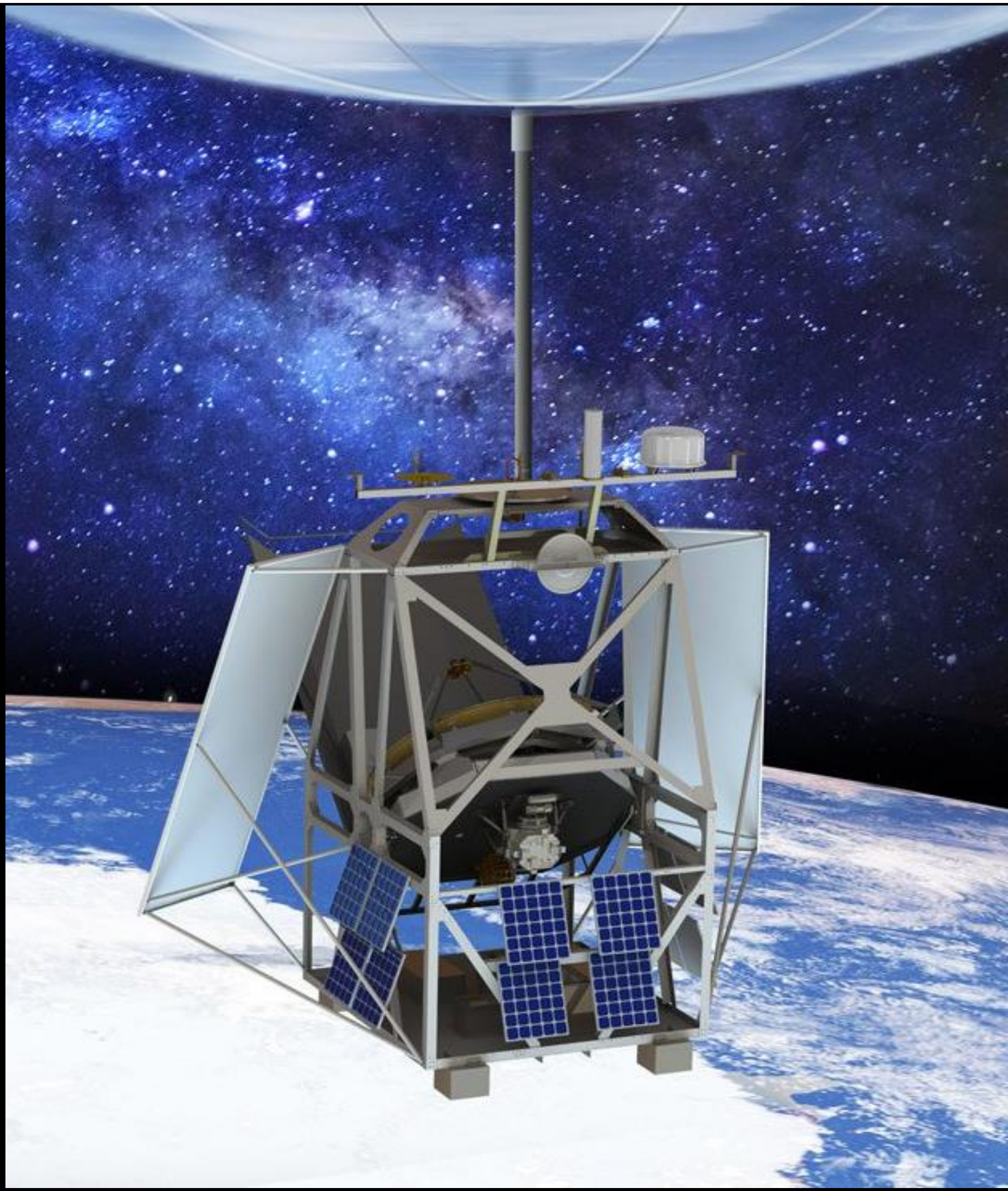
ASTHROS is a balloon borne far infrared observatory that is scheduled to fly December 2023 from Antarctica at an altitude of 40 km for 21 days.

It features a 2.5 meter telescope (20” at 205um and 12” at 122um) that will enable high dynamical range, high spectral resolution observations of galactic and extragalactic star forming regions.

ASTHROS will have two 4 pixel Heterodyne ($R>10^6$) arrays covering the 1.4-1.5 THz and 2.5-2.7 THz spectral range, enabling simultaneous observations of the the fine structure lines of ionized nitrogen [NII] 205um and [NII] 122um and other key spectral lines.

ASTHROS will fly for the first time a 4-K class low-power cryocooler and thus will not require LHe, enabling extended lifetime missions

The space like observing conditions at balloon altitudes enable ASTHROS to observe for the first time the [NII] 122um line at high spectral resolution, which is obscured by the atmosphere at SOFIA flying altitudes.



ASTHROS Science Overview

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The main science goal of ASTHROS is to understand the role of stellar feedback on the regulation of star formation in galaxies, which is in turn a key parameter on galaxy evolution.

We will do so by observing large scale, high dynamic range, high spectral resolution maps of the ionized gas component of the interstellar medium in Galactic and extra galactic sources.

We will use the ratio of the [NII] 205um and [NII] 122um to determine the electron density distribution in these regions.

The density distribution together with the kinematics information, provided by the high spectral resolution observations, will enable us to quantify the energy input and impact that different feedback mechanisms have into the interstellar medium.

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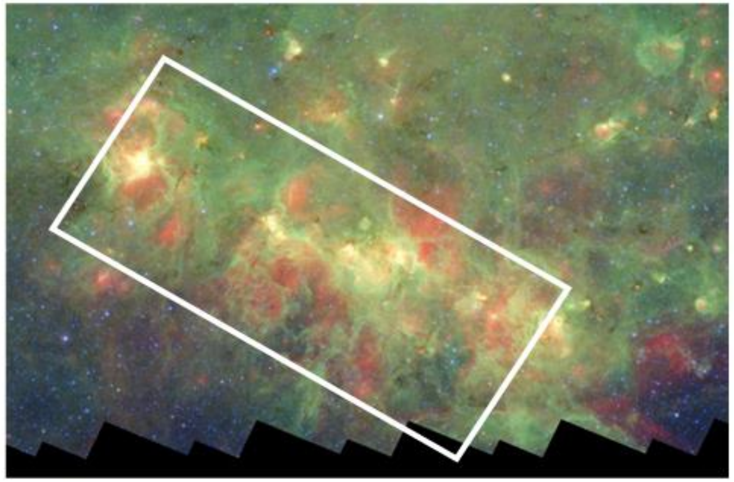
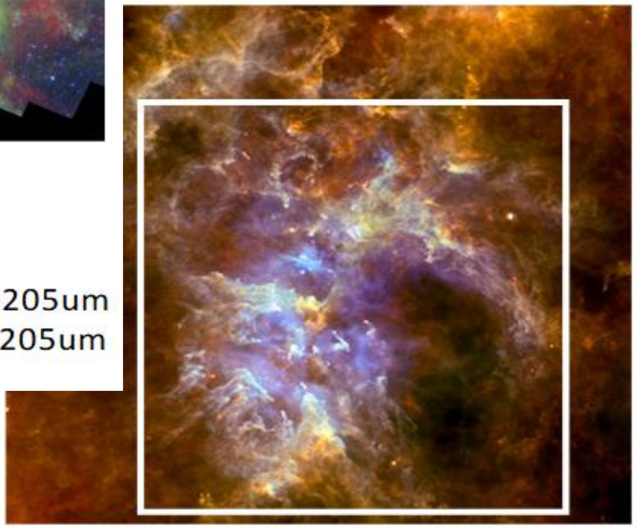
- **ASTHROS will produce high dynamic range, large scale maps** of three Galactic star forming regions, G305, G336.3-0.2 and the Carina Nebula.
- G336.2-0.2 and G305 regions are at relatively early stage of evolution, before the action of supernova explosions, while the Carina region has clearly been affected by supernovae.
- **By comparing the ionized gas distribution in these regions, we will determine the relative effect of different stellar feedback mechanisms, line supernovae, on the ISM.**

G336.2-0.2



Map area = 0.5 square degrees
Number of spectra = 1.5×10^5
Sensitivity = 0.07K @ 122um , 0.1K @ 205um
SNR= 4 sigma @ 122um ; 10 sigma @ 205um

Carina Nebula



Map area = 1 square degree
Number of spectra = 3×10^5
Sensitivity = 0.1K @ 122um , 0.15K @ 205um
SNR= 3 sigma @ 122um ; 10 sigma @ 205um

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- **ASTHROS' 2.5 meter telescope enables observations in extra-galactic sources.**
- **We will map, for the first time, the entire disk of the M83** barred-spiral galaxy in spectrally resolved [NII] 122μm & 205μm emission.
- **This data will be used to study the distribution of electron densities and star formation** over the entire disk.
- **This allows to characterize the effects of large-scale dynamical effects on ionized gas** component of this galaxy under the influence of spiral density waves and a bar.

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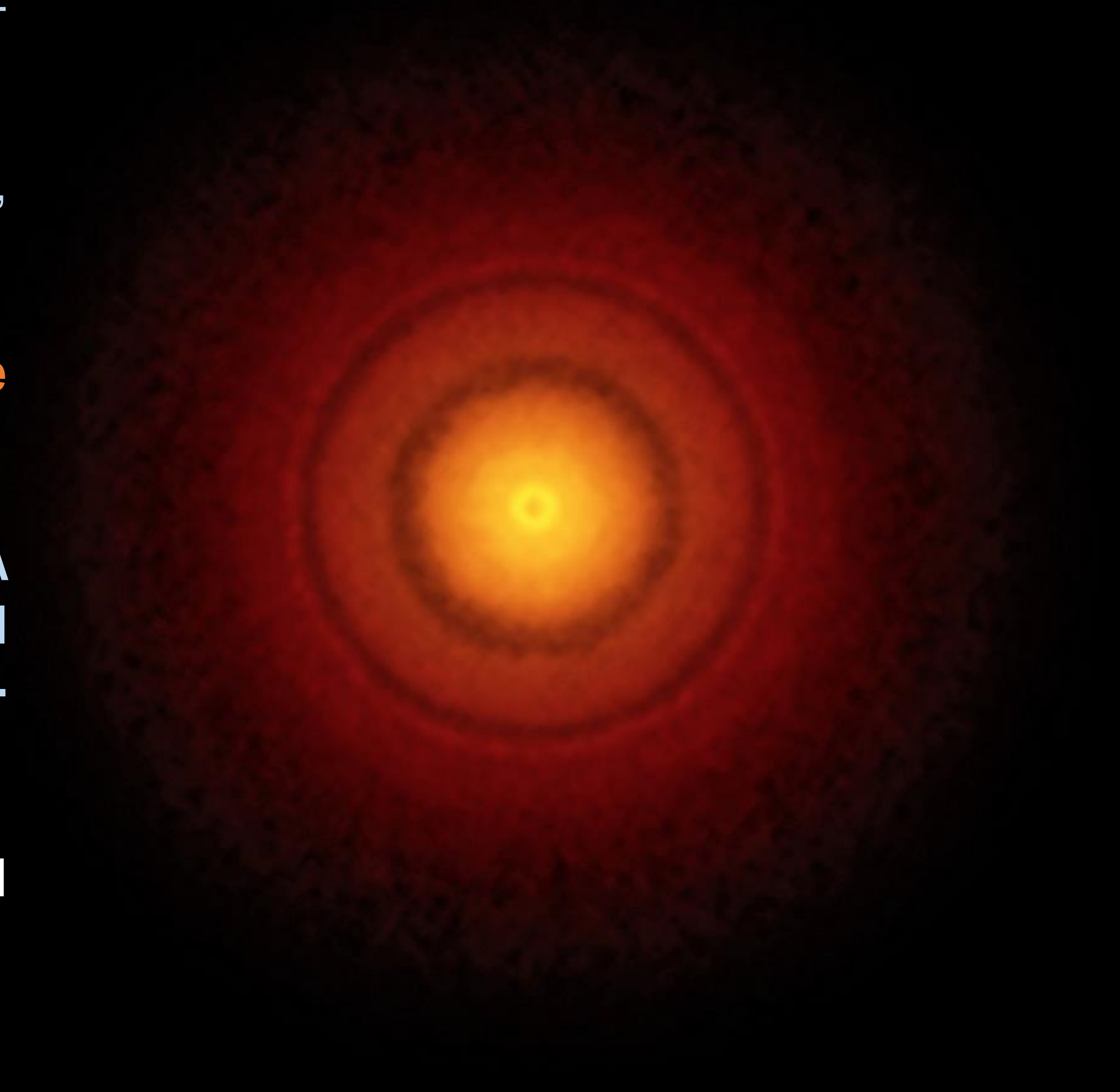
- We also plan to observe for the first time the HD 1-0 line at 2.67 THz in the TW-Hydra protoplanetary disk at high spectral resolution.
- **HD is the best tracer of the gas mass of protoplanetary disks**, which is currently not well constrained.
- **High-spectral resolution observations are required to determine the mass distribution within the protoplanetary disks.**
- **With a model of the rotation curve of the disk (from e.g. ALMA data), a spectrally-resolved measurement of HD 1-0 line will allow us to determine mass distribution within the spatially-unresolved disk.**
- **Shared risk, open time observations are being considered during ASTHROS' first flight.**

TW Hydra



ASTHROS Project Status

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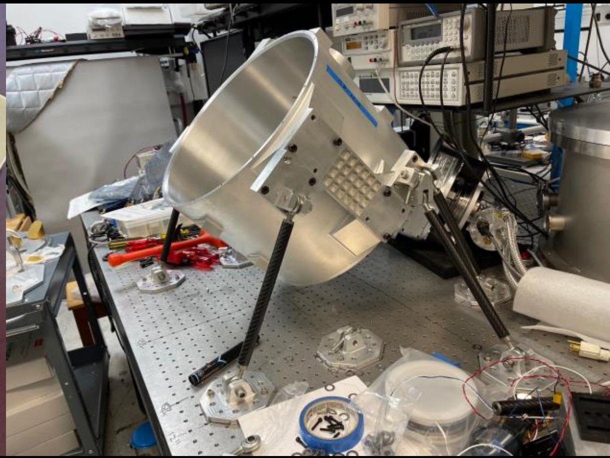
- The antenna design is completed, back structure is being built, and the panel accuracy are being measured. Expected delivery during Quarter 1, 2022.
- Gondola design at the Applied Physics Laboratory (APL) is being completed and assembly and subsystems fabrication will start in Quarter 2, 2022.
- Local oscillator and backend subsystems are completed. Receiver subsystem will be completed in Q1 2022 which will be followed by integration and testing of the full instrument.
- Software pipeline implementation is ongoing.
- The antenna will be integrated with the Gondola at APL on Q1, 2023.
- Thermal vacuum tests will be conducted in Palestine, TX, in the summer of 2023.
- Launch and operations will be on Dec 2023 from Mc Murdo, Antarctica.



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Astrophysics Stratospheric Telescope for High-Resolution Observations at Submillimeter-waves

ASTHROS

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THANK YOU!

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