ORIGINS Space Telescope

From the Rise of Metals to Water for Habitable Worlds

National Aeronautics and Space Administration

Origins Space Telescope: Solar System Science

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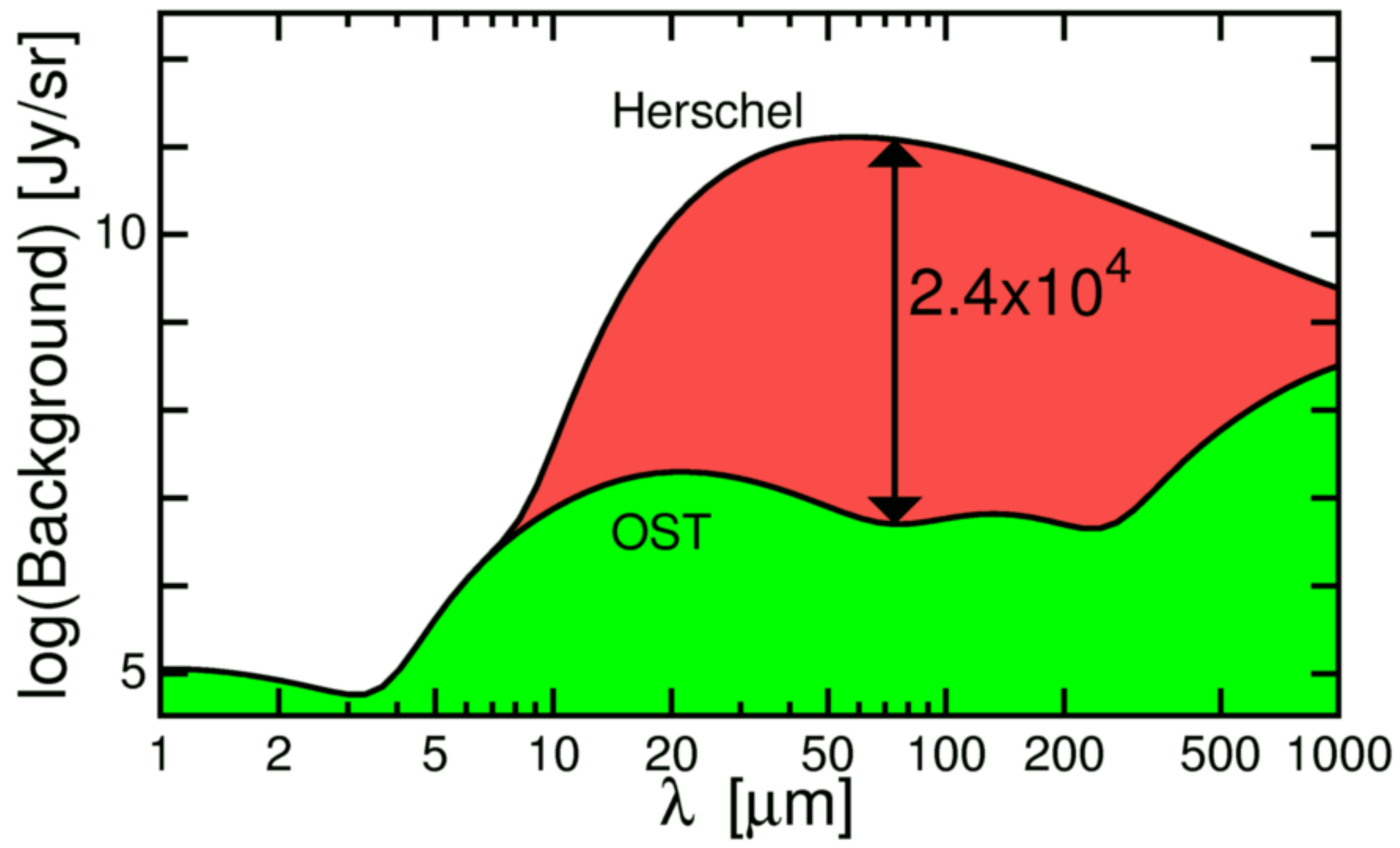
The Origins Space Telescope (OST) is the mission concept for the Far-Infrared Surveyor, a study in development by NASA in preparation for the 2020 Astronomy and Astrophysics Decadal Survey. Origins is planned to be a large aperture, actively-cooled telescope covering a wide span of the mid- to far-infrared spectrum. Its imagers and spectrographs will enable a variety of surveys of the sky that will discover and characterize the most distant galaxies, Milky-Way, exoplanets, and the outer reaches of our Solar system. Origins will enable flagship-quality general observing programs led by the astronomical community in the 2030s. The Science and Technology Definition Team (STDT) would like to hear your science needs and ideas for this mission. The team can be contacted at firsurveyor_info@lists.ipac.caltech.edu.

In the Solar System, OST will provide km/sec resolution on lines from planet, moons and comets. OST will measure molecular abundances and isotope ratios in planets and comets. OST will be able to do continuum surveys for faint moving sources such as Kuiper Belt Objects, enabling a census of smaller objects in the Kuiper Belt. If the putative Planet IX is massive enough to be self-luminous, then OST will be able to detect it out to thousands of AU from the Sun.

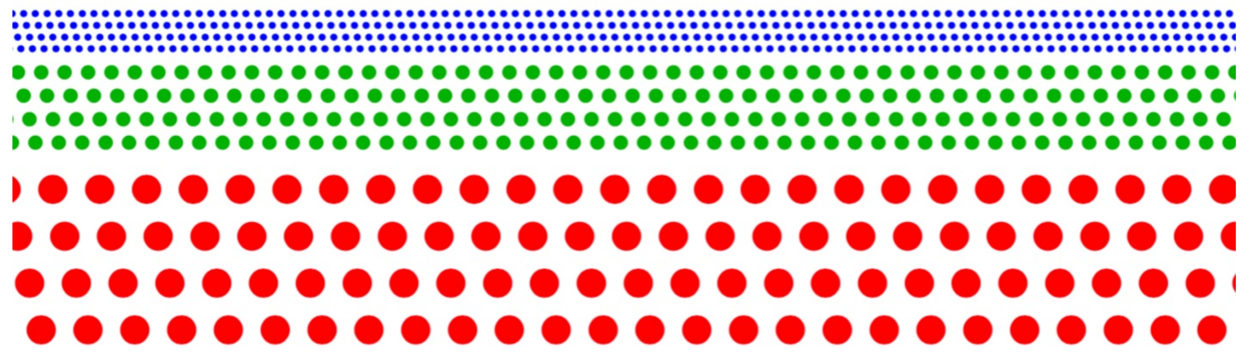


The low detector background due to using a cold telescope and the larger aperture make OST >1000x more sensitive that Herschel.

Continuum Surveys in the Outer Solar System

The low background seen by a cold telescope in space allow very high sensitivity in a very short time. A backround-limited diffraction-limited detector with DQE=0.15 behind a 10 m telescope can detect 1 mJy at nearly 10σ in 10 ms at both 60 and 100 µm, using the median sky brightness measured by DIRBE as the background.. Thus a simple IRAS style focal plane instrument with a long but narrow FoV could cover 200''/sec by the FoV length, which could easily be 30', leading to an areal coverage rate of 1 square degree in 36 sec, or 100 sq.deg per hour. In principle a repeated all-sky survey to check for moving sources could be done.

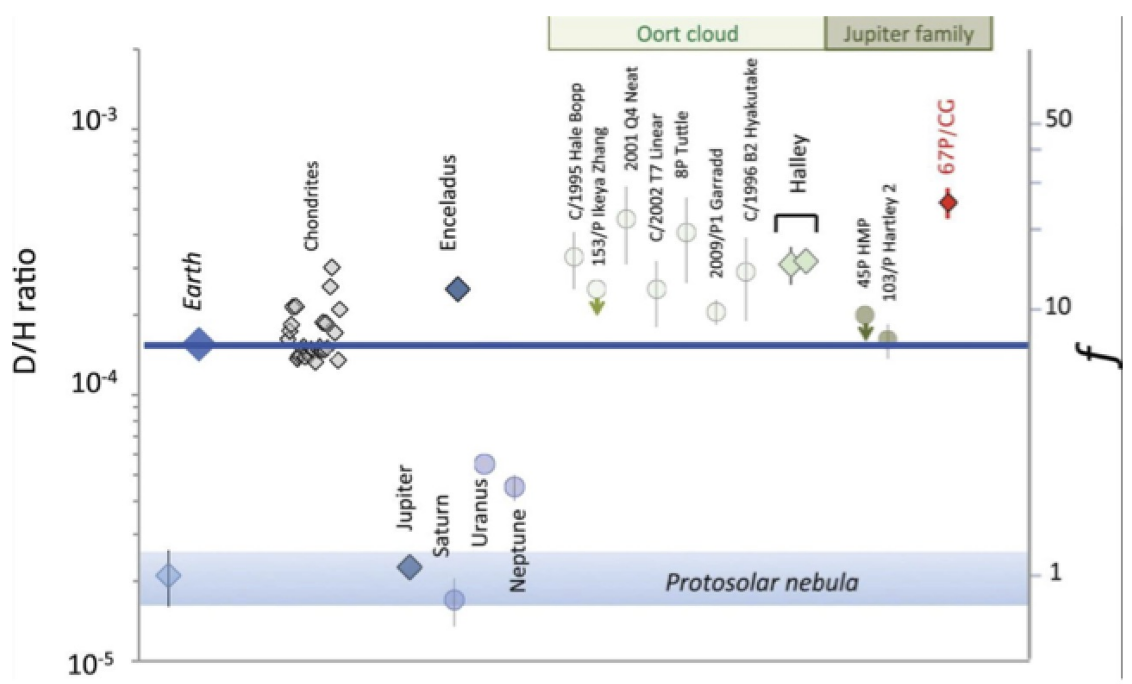
The putative 10 Earth mass planet IX will likely have internal heat sources amounting to 10^{-12} $L_\odot$, whether we scale linearly up from the Earth or quadratically down from Neptune. This will give 1 mJy out to 6000 AU from the Sun, which covers the aphelion of the proposed elliptical orbit.

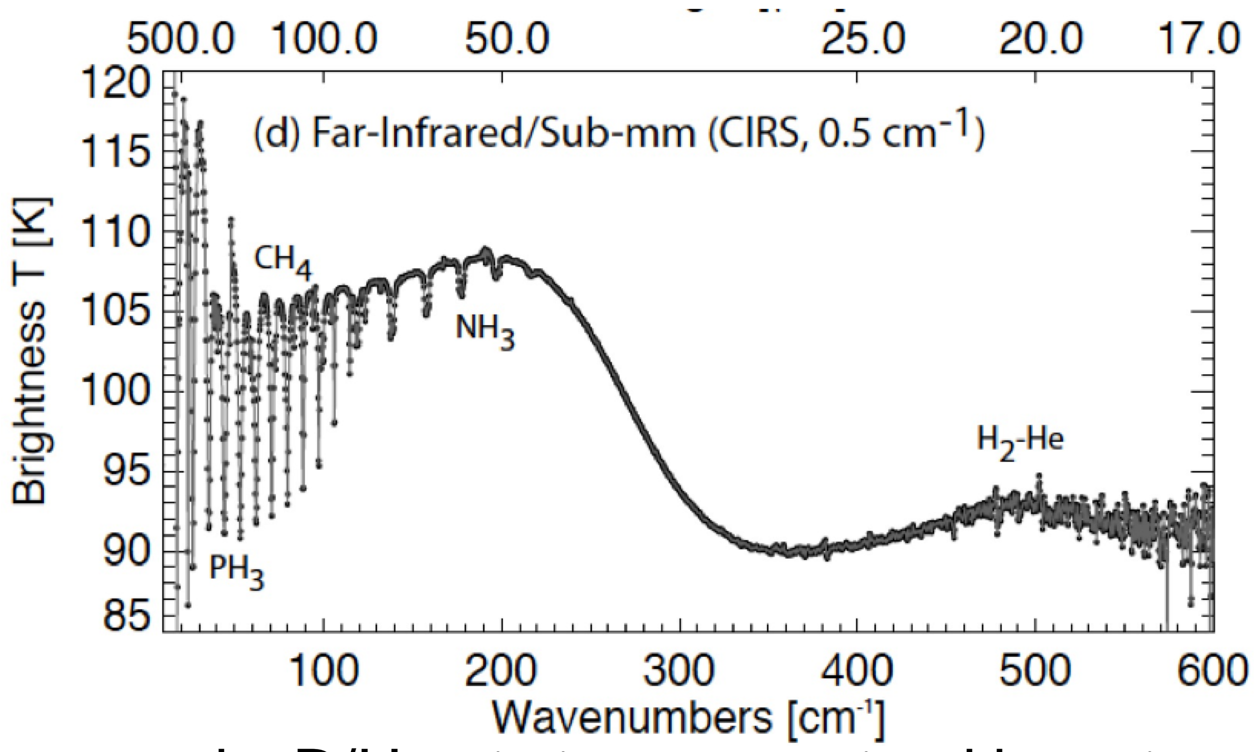


Possible focal plance arrangement for a three band fast scanning photometer.

A deeper, slower survey with 100 second exposure time reaches 10 µJy depth allowing a search for KBOs independent of their albedos. Since KBOs are not self-luminous, the flux goes like R^{-4}, but 10 µJy at 100 µm corresponds to V=29.4 for a 10% albedo. With a 10'×10' FoV, 1 sq.deg per hour can be surveyed.

Spectroscopy of Known Objects





Observing from space, OST can easily measure the D/H ratio in water emitted by active comets and help identify the source region for the Earth's water.

The wide wavelength coverage allows OST spectra to measure the H2-He CIA and the rotational lines of other hydrides, and the high angular resolution will allow mapping these features across the disk of a giant planet.

The **Origins Space Telescope** is the mission concept for the **Far Infrared Surveyor**, a study in development by NASA in preparation for the *2020 Astronomy and Astrophysics Decadal Survey*.

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Secret OST Word: Planet IX