ORIGINS Space Telescope

From the Rise of Metals to Water for Habitable Worlds

National Aeronautics and Space Administration

Origins Space Telescope: Galaxy and Black Hole Evolution over Cosmic Time

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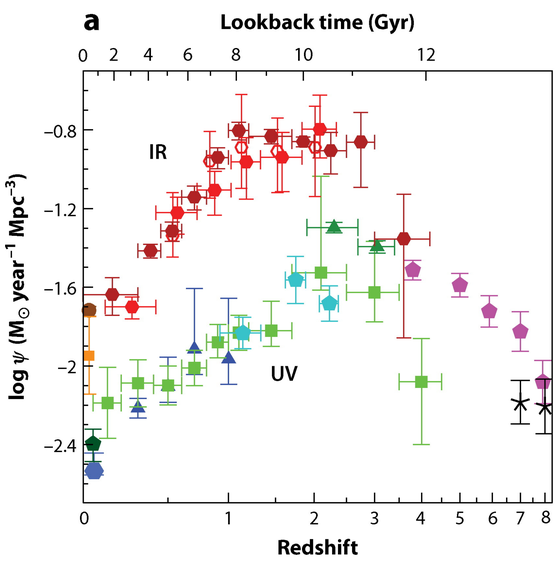
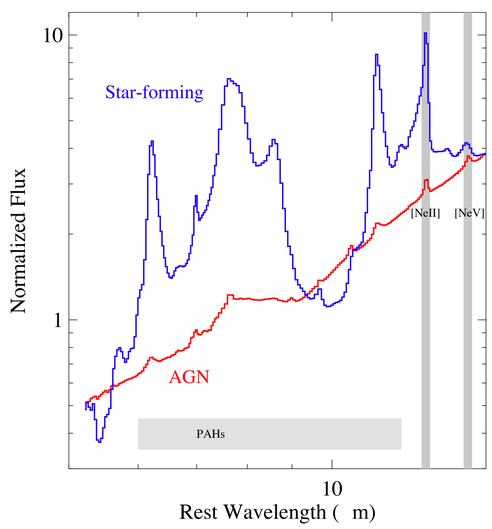


*Star formation rate density traced by **obscured** (IR) and **unobscured** (UV) activity. Most of the power emerges in the IR to z~3, but the landscape at earlier epochs is unknown. Observations of AGN accretion follow a similar relation over cosmic time but are also incomplete at z>2, especially for Compton-thick sources. Figure from Madau & Dickinson (2014).*



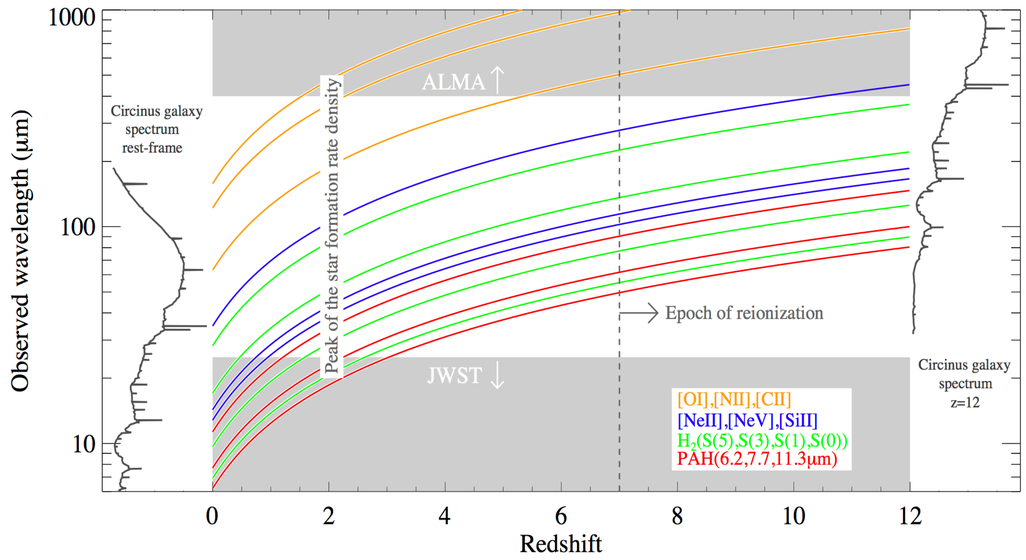
Rest-frame mid-IR spectra comparing a star forming galaxy and strong AGN (Stierwalt et al. 13), normalized at 15 microns. The [NeV]/[NeII] ratio and the PAH bands can be used to separate AGN and star formation activity in even the most heavily obscured galaxies.

What is the cosmic history of star formation and black hole growth?

What is the role of star formation and AGN feedback in galaxy growth with redshift?

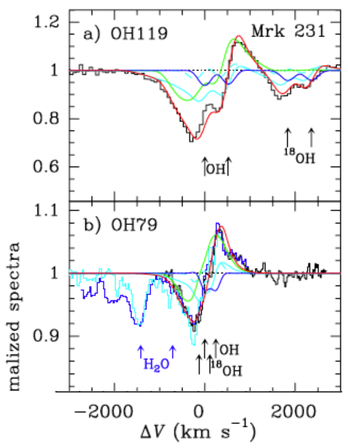
How was the Universe enriched with metals?

How do stars form in galaxies over cosmic time?

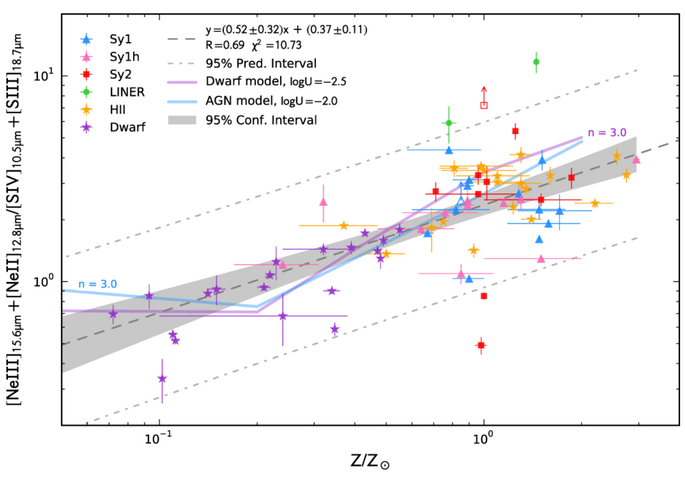


With a **wealth of lines probing the interstellar medium** in **thousands of galaxies** over cosmic time, Origins Space Telescope will:

- uniquely separate the star formation and AGN emission based on robust MIR/FIR diagnostics to determine the cosmic star formation rate density and black hole accretion rate density from the peak through Reionization
- find and characterize galactic feedback as a function of AGN/SF power, mass, age and environment over the past 12 Gyr
- accurately trace the rise of metals across cosmic time (z=1-8) using MIR/FIR fine structure lines as abundance indicators that do not suffer from the degeneracies of common optical indicators
- measure heating and cooling of the multi-phase ISM to infer the physical phenomena that regulate SF efficiency at the peak of cosmic star formation



(top) Dramatic outflows coming from M82 (HST image in green/yellow/orange) as viewed by Spitzer (red) and Chandra (blue). (left) Herschel/PACS OH spectra and fits of the molecular outflow in Mrk 231. A high velocity outflow (1700 km s^{-1} light blue) drives 100 M$_\odot$ yr^{-1} sr^{-1} (Gonzalez-Alfonso et al. 2014).



A mid-IR abundance indicator for OST; Neon and Sulfer lines, vs optical metallicities demonstrating the line ratio as a tracer of metallicity (Fernández-Ontiveros et al. 2016).

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: SECRET WORD