

3D Infrared Surveys of Star Formation and Black Hole Growth in Galaxies over Cosmic Time

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With a **wealth of lines probing the interstellar medium** in **thousands of galaxies** over cosmic time, Origins Space Telescope (OST) 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.

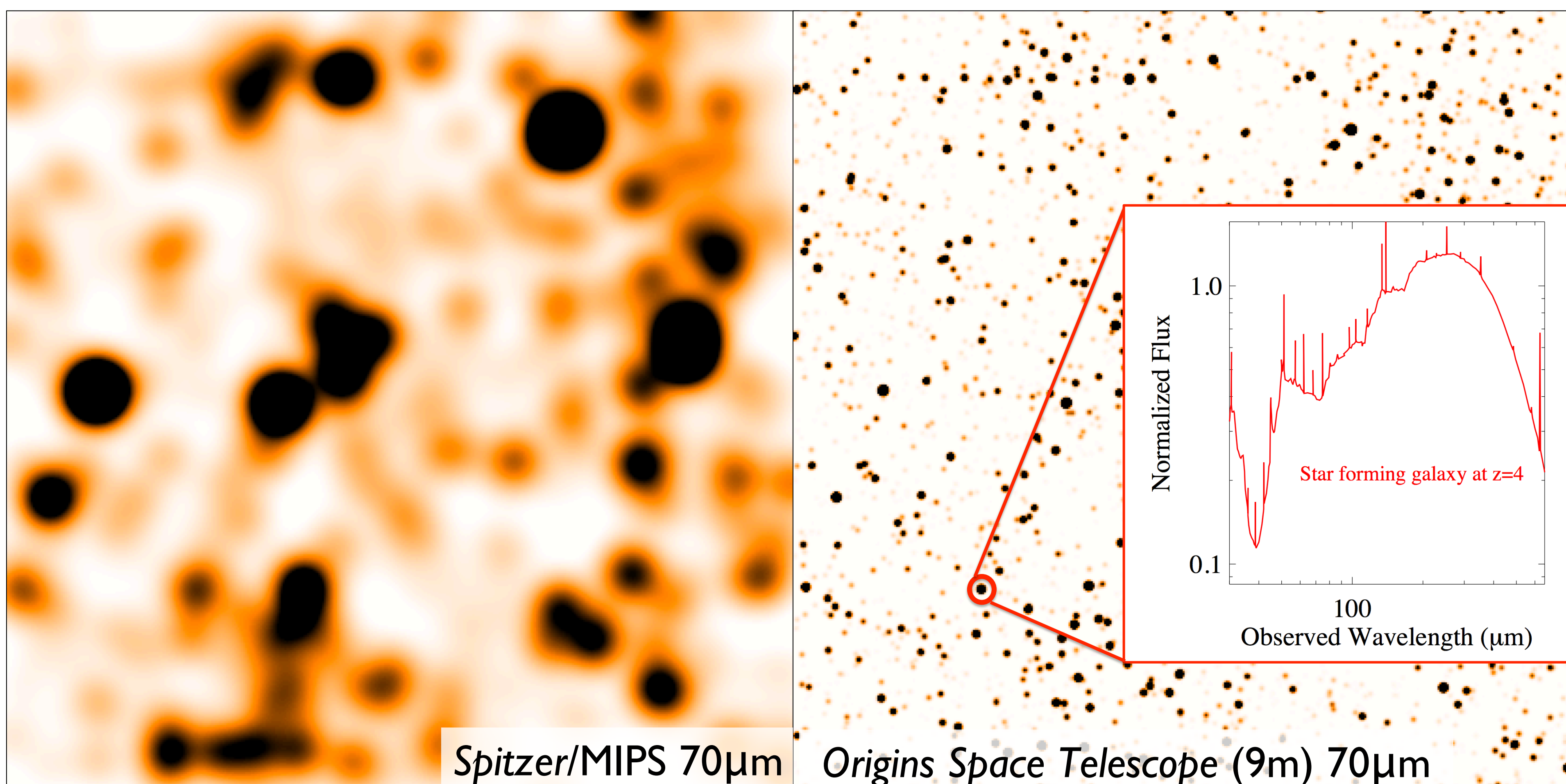


Fig. 1: Simulation of a 5'x5' patch of the Universe at 70 μ m with Spitzer (left) and OST (right) based on the Béthermin et al. (2017, A&A, 607, 89) models that fit the observed number counts and redshifts distributions and include spatial clustering. With the Medium Resolution Survey Spectrometer (MRSS) on OST, we will simultaneously obtain an infrared spectrum (see inset) for every galaxy in the 2D image.

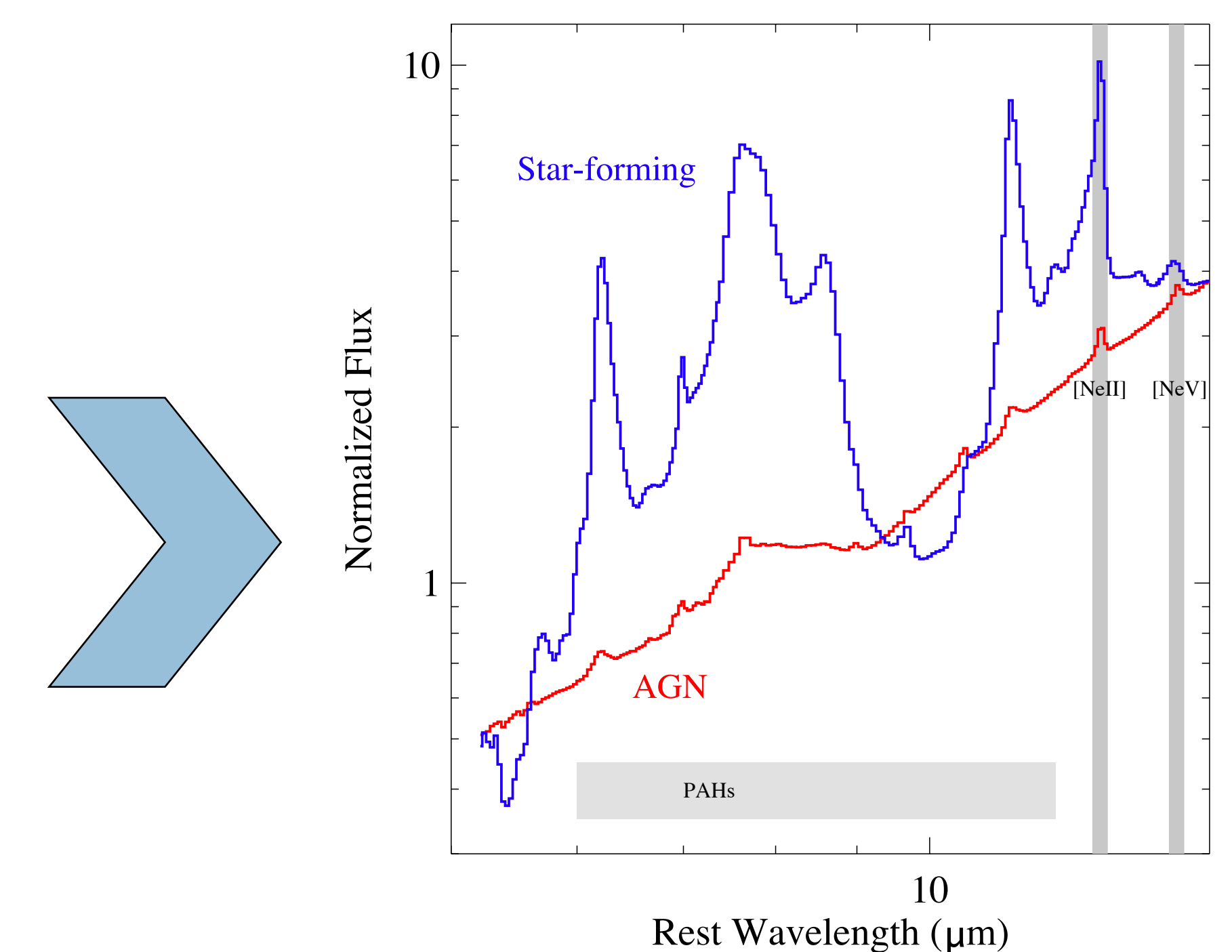


Fig. 2: Rest-frame mid-IR spectra comparing a **star forming galaxy** and **strong AGN** (Stierwalt et al. 2013, ApJS, 206, 1), normalized at 15 μ m. The [NeV]/[NeII] ratio and the PAH bands can be used to separate AGN and star formation activity.

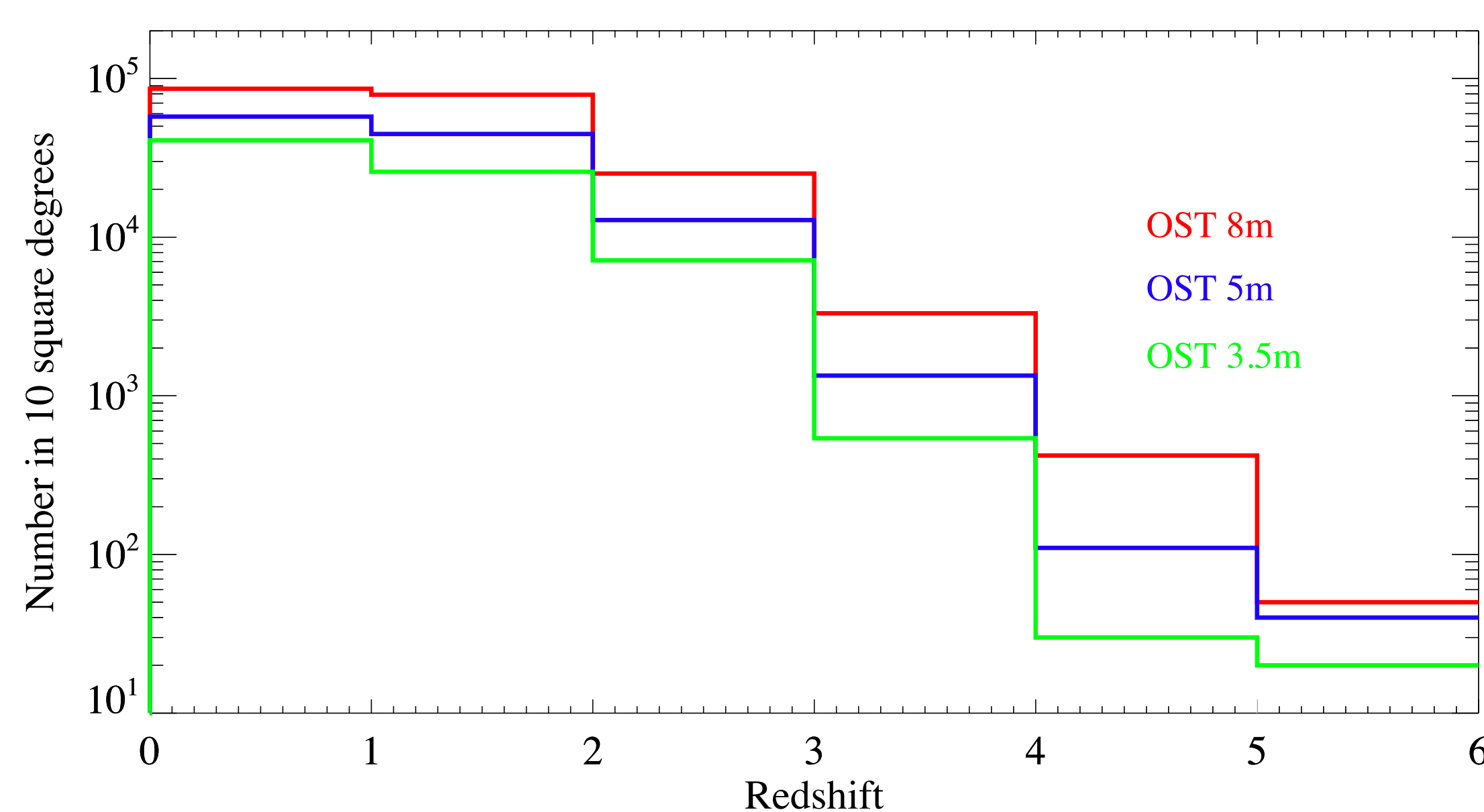


Fig. 4: OST will detect a suite of spectral lines in statistical samples of galaxies out to $z \sim 6$. This shows the predicted number of galaxies in a 10 square degree survey with detected spectral lines (e.g. [NeII], assuming $L_{\text{line}}/L_{\text{IR}} \sim 1e-4$) in 1500 hours with OST/MRSS. Counts are based on the Béthermin et al. (2012, ApJL, 757, 23) empirical model.

Fig. 3: OST will observe these powerful diagnostics of AGN (e.g. [NeV],[OIV]) and star formation (e.g. PAHs, [NeII], [OI]) from the local Universe, through the peak in the cosmic star formation rate density ($z \sim 2$), and all the way back to the first galaxies.

