ORIGINS Space Telescope

From the first stars to life

National Aeronautics and Space Administration

Measuring Galactic Feedback with OST

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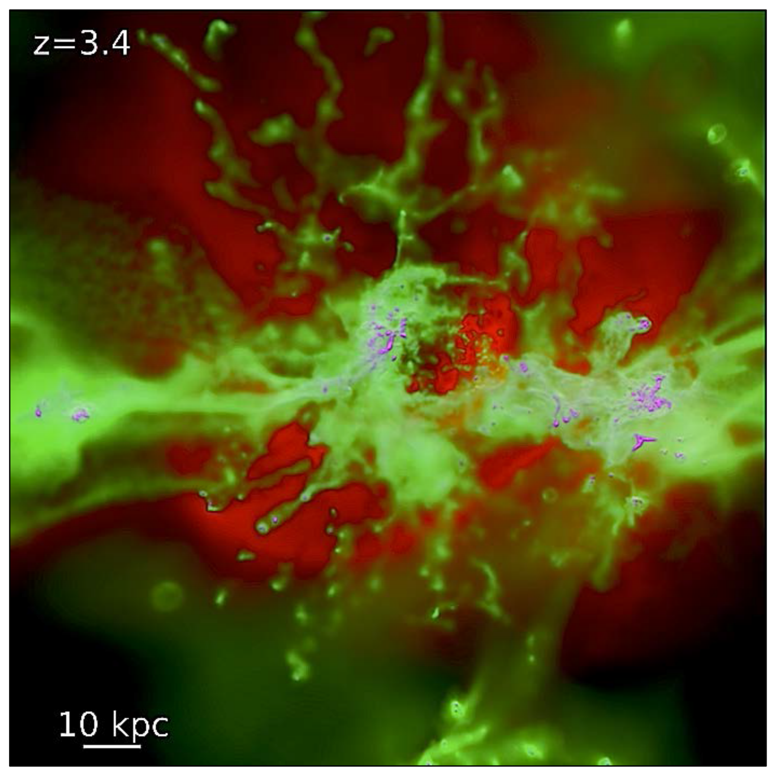
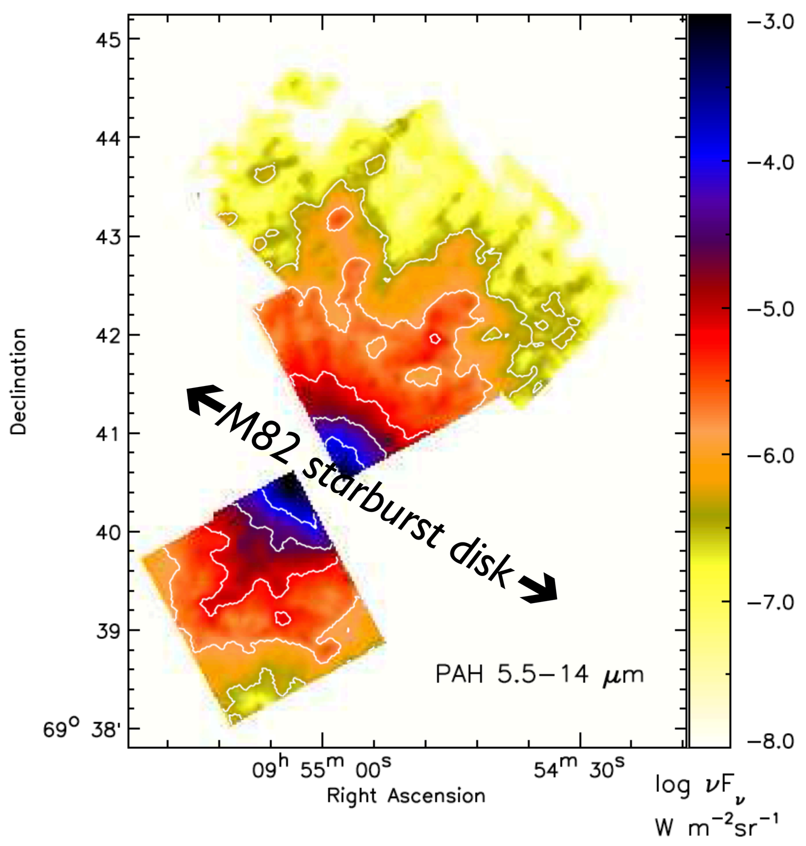
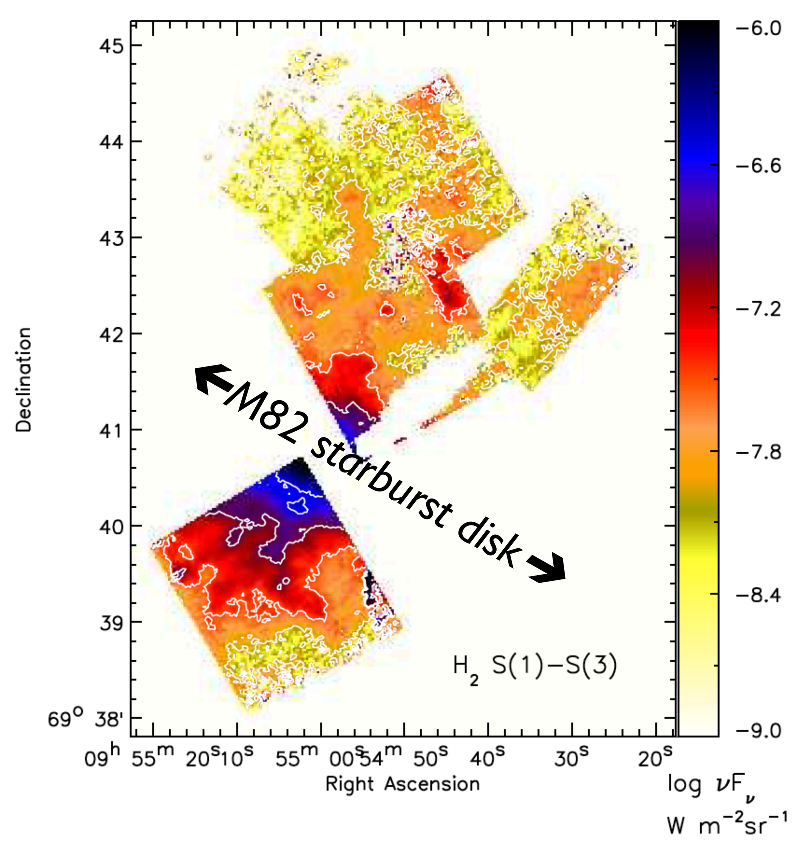


Above: *Simulation of a MW-type galaxy at z=3.4 showing feedback-driven structure in the cold (<1000K magenta), warm (10^4K green) and hot (10^6Kred) gas (Hopkins +14).*

Below: *Spitzer/IRS maps of PAH and warm H_2 in the bipolar outflow in M82 (Beirao +15)*





Feedback, from Active Galactic Nuclei (AGN) and star formation plays a large, but poorly understood role in regulating the growth of galaxies and black holes over a wide range of mass scales and a large fraction of Cosmic time. Feedback can inhibit accretion, halt star formation and BH growth, and seed the CGM and IGM with dust and metals.

The mid and far-infrared provides a unique window on the multi-phase nature of feedback in galaxies, allowing us to directly measure the energetics and outflowing mass in the atomic and molecular ISM and the dust in galaxies with powerful outflows. Fast (300–1200 km s^{-1}), high mass (100–1000 $M_\odot$ yr^{-1}) outflows of molecular gas have been measured in local ULIRGs in multiple H_2O and OH FIR transitions *(Fischer +10; Sturm +11; Veilleux +13; Gonzalez-Alfonso +14, +17).*

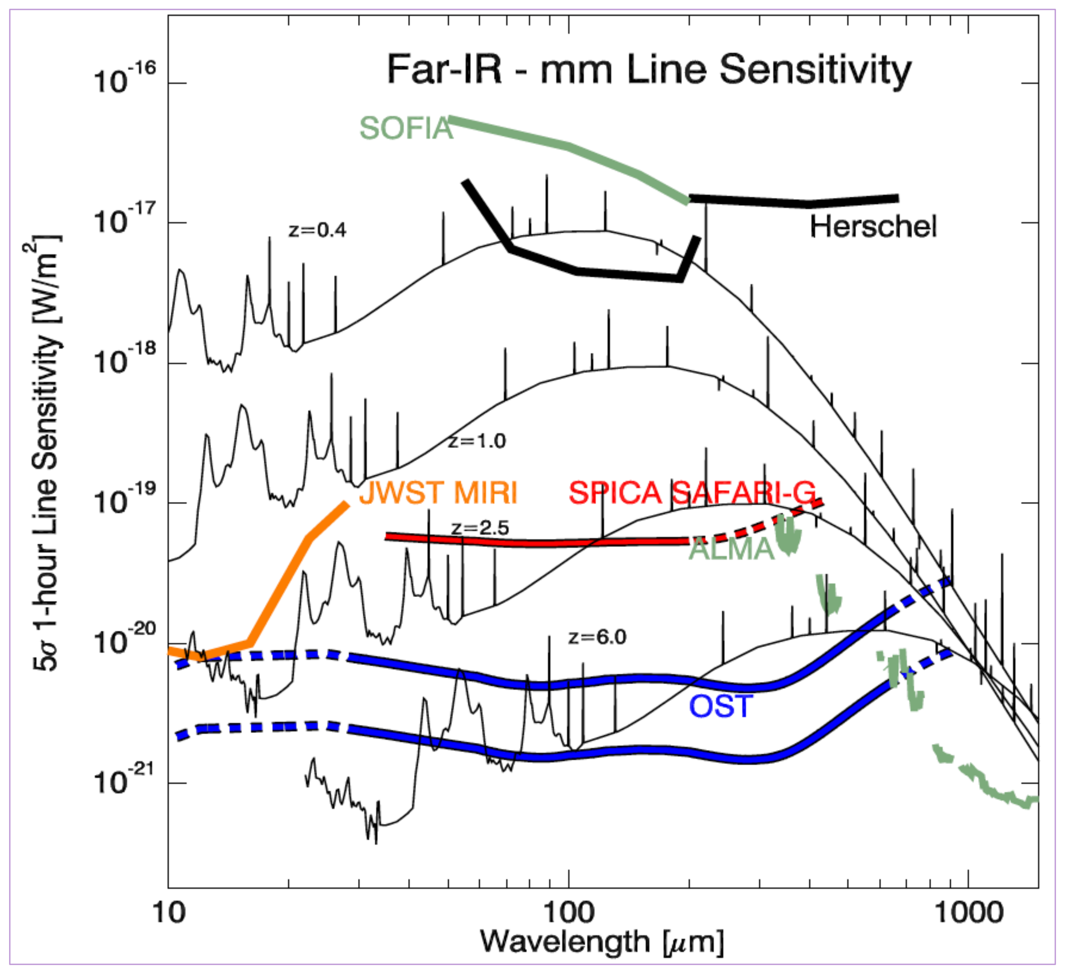
Identifying and studying these outflows in large samples of low and high-z galaxies requires an extremely sensitive telescope in space with wide wavelength coverage and high sensitivity.

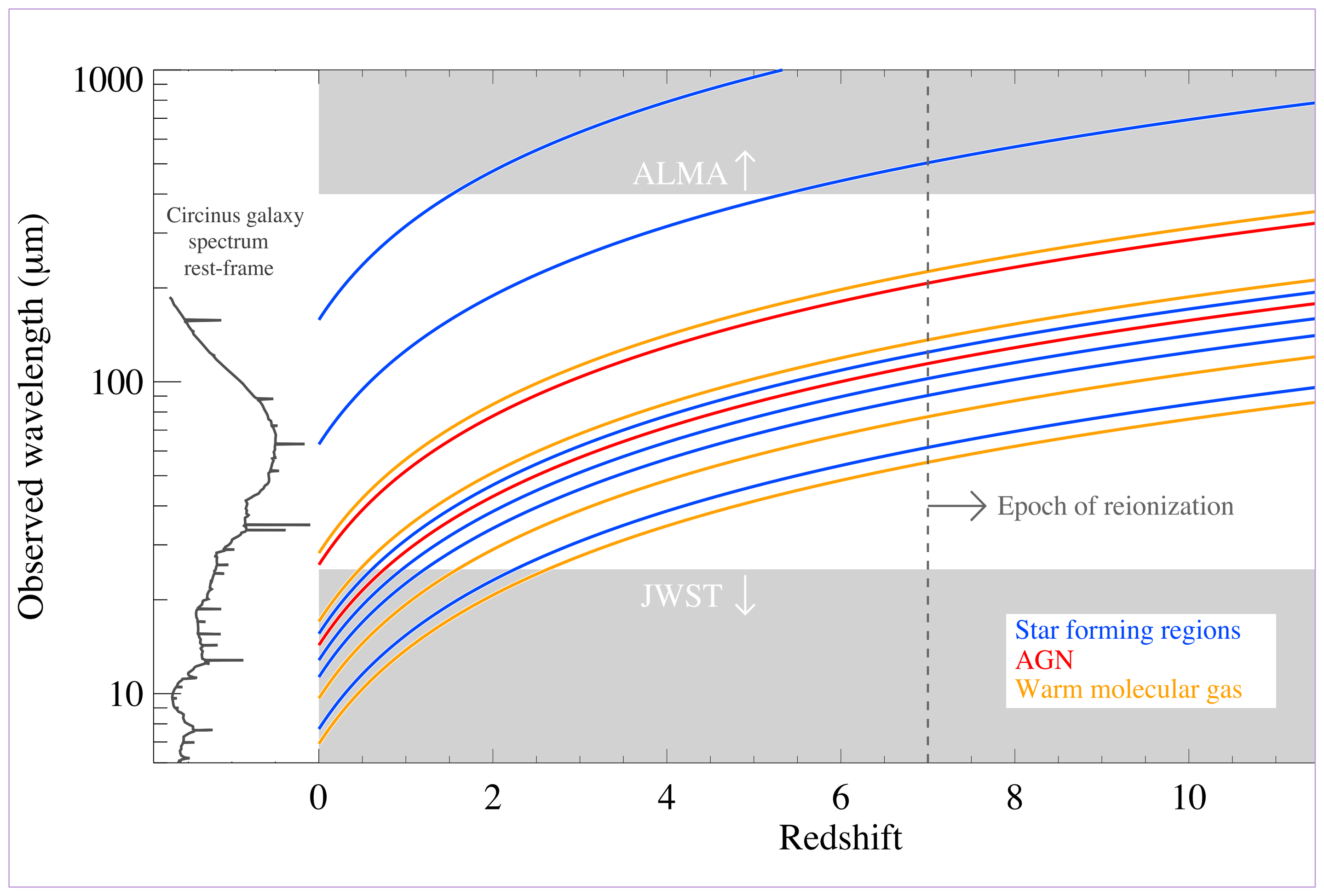
The **Origins Space Telescope (OST)** will allow us to answer key questions in feedback physics, such as:

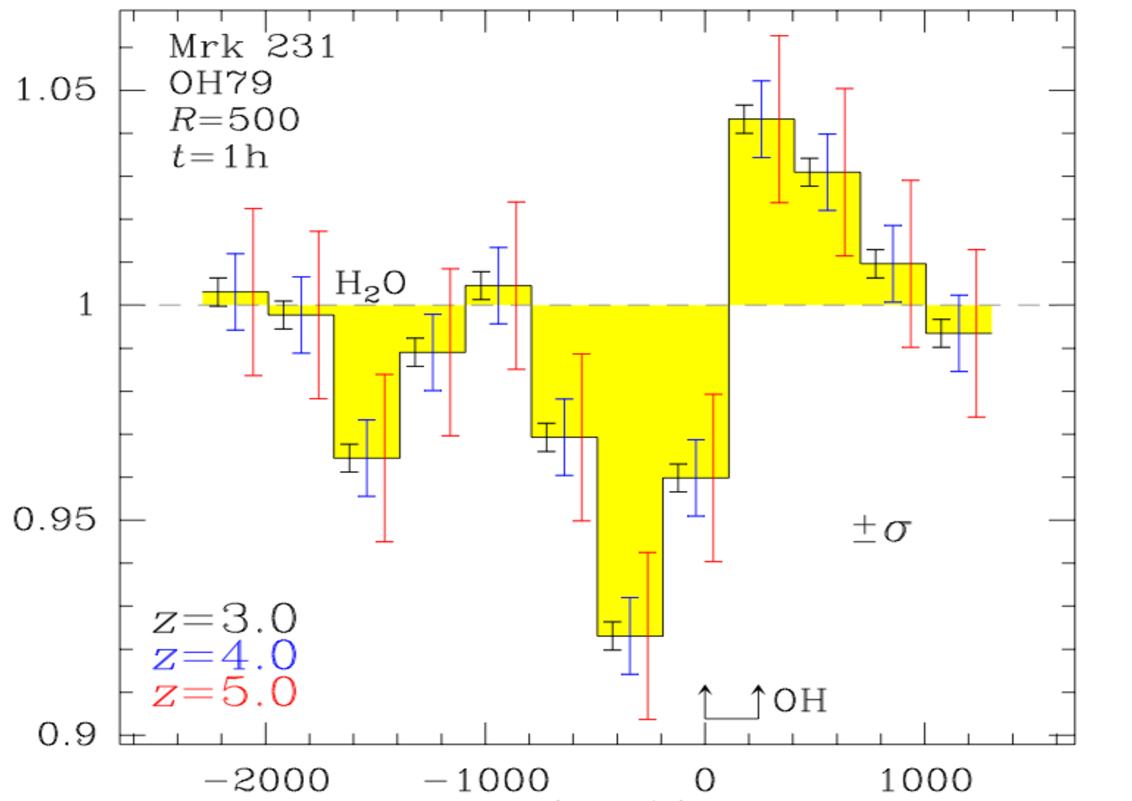
- What is the role of energetic feedback from AGN and SNe in regulating star-formation and galactic growth over cosmic time?
- How do outflowing winds drive metals from stars to the IGM and how does this depend on environment, morphology, galaxy mergers, and the small-scale conditions in the dusty ISM?

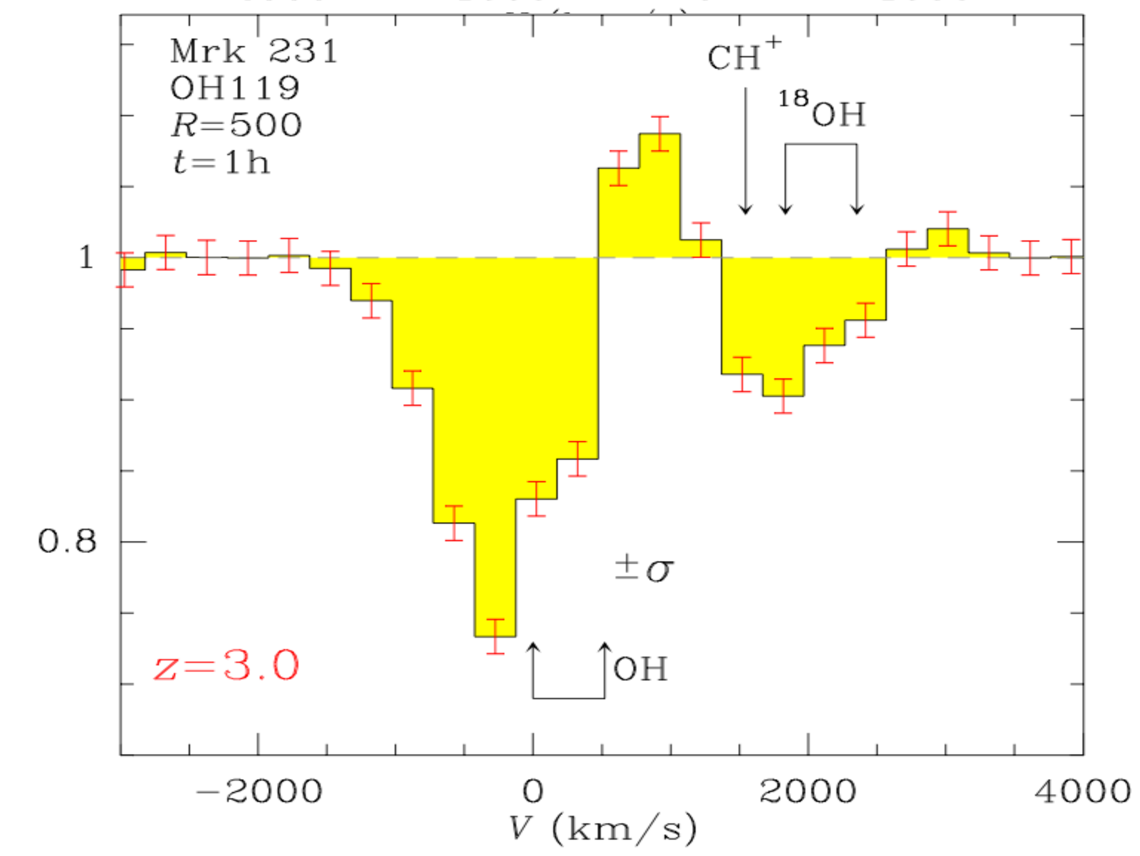
The Medium Resolution Survey Spectrometer (MRSS) on OST *(see poster **355.48**)* can detect columns of extra-planar neutral gas with N_{HI}≈1e20 cm^{-2} and n_H≈1 cm^{-3} via [CII] at sub-kpc resolution out to 30 Mpc in 10 mins, and fine-structure lines in fast moving galactic winds down to f≈2e-21 W m^{-2} in 1 hr.

With a huge leap in line and surface brightness sensitivity over all previous and planned IR missions, high spatial resolution, and the ability to quickly map large areas of the sky to generate unbiased spectroscopic samples *(see poster **355.50**)*, OST will transform our understanding of the physics of feedback and the importance of galactic outflows for galaxy evolution from the present day to over 90% of the age of the Universe.









Above: *Simulated OH line spectra of Mrk 231 as measured with the R=500 mode of the OST/MRSS instrument in 1hr of integration. Spectra are continuum normalized. Outflow signatures (P-Cygni profiles with blueshifted absorption and redshifted emission) are easily detectable even at z=5. Simulations courtesy of E. Gonzalez-Alfonso and F. Rico-Villas.*

Left: *1hr, 5σ line sensitivity and redshift reach of OST, which can detect the bright mid and far-IR emission line tracers of feedback from the present day, to the peak star formation at z~2, and to the epoch of re-ionization. OST fills this important wavelength gap between JWST and ALMA providing a view of the power sources and multi-phase ISM in even the most dust-enshrouded galaxies.*

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: Superwind