

# Using Gravitational Lensing to Dissect Galaxies

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In hundreds of known cases, "gravitational lenses" deflect, distort, and magnify images of galaxies behind them. Lensing can magnify galaxies by factors of 10–100, transforming them from barely detectable smudges to bright objects that can be studied in detail. Studies of lensed galaxies push each major observatory past its normal limits of sensitivity and spatial resolution. I will summarize a large program of diagnostic spectroscopy of lensed galaxies, to determine the physical conditions of galaxies across most of cosmic time, and to understand how the processes of star formation has evolved over the last 10 billion years. Such high-quality spectroscopy is normally impossible for galaxies beyond our cosmic backyard. Using the Magellan twin telescopes in Chile, the Keck twin telescopes in Hawaii, and the Hubble Space Telescope in space, our team studies gas being blown out of galaxies, the hot nebular gas, and the short-lived massive stars that power the nebulae and push out the gas. We have developed spectral diagnostics that will be heavily used by the James Webb Space Telescope (JWST), scheduled to launch in late 2021. The resulting spectral atlases will be definitive until 20–30m ground-based telescopes come online in the late 2020s, and give insight into the processes by which galaxies evolve over cosmic time.

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