Understanding HST observations of IGM and ISM clouds

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Theory: Yes

Abstract

We propose extending the geometry and radiative transport methods used by the spectral simulation code Cloudy to better simulate conditions within IGM and ISM clouds. The gas in these clouds is far from equilibrium and the message in their spectra is best interpreted by reference to numerical simulations of their properties. HST observations reveal their chemical composition, the gas pressure, the shape and intensity of the background source of ionizing radiation, and so probe the chemical and star formation history of the universe. Cloudy is widely used by others to interpret their HST observations of such clouds.

The geometry is now 1D spherical, a point source of ionization is assumed, and line transport is done with escape probabilities. The clouds are actually ionized by the cosmic or galactic background, a continuum produced by a combination of quasar, starburst, and other emission. This continuum strikes the gas from all directions rather than as a single ray. The ionization of the gas is strongly affected by line transport, especially the Lyman lines of helium. The project will upgrade the radiative transfer to do continuum transport with explicit angle averages with short characteristics so that cloud illumination by background radiation can be treated. Line transport will be done with accelerated lambda operator, a method with known convergence and stability properties. The result will be better simulations and deeper insights into the nature of IGM and ISM clouds.

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