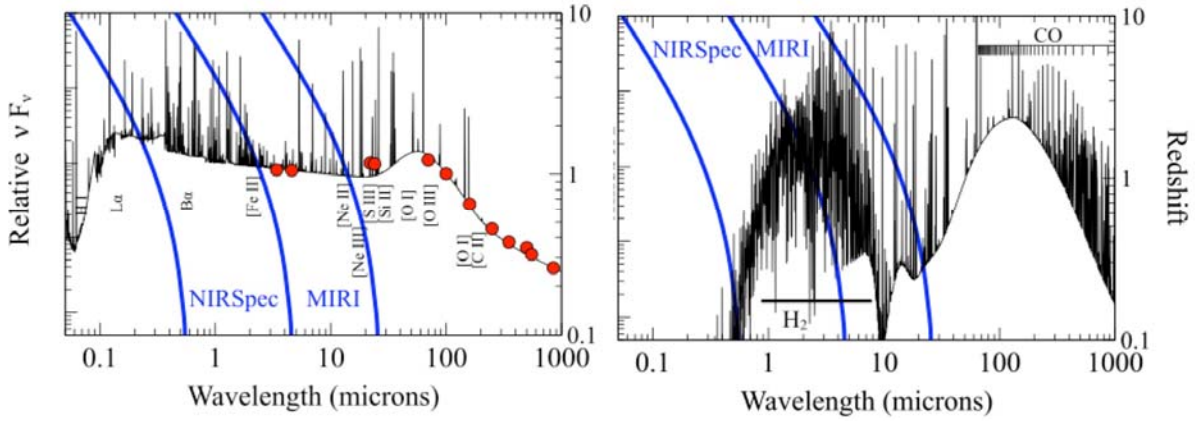
THE ATOMIC PHYSICS CHALLENGES AND ASTROPHYSICAL OPPORTUNITIES POSED BY NASA'S JAMES WEBB SPACE TELESCOPE

Gary J. Ferland[a]

[a]Physics & Astronomy, University of Kentucky, Lexington KY 40506, USA

Astronomy is an observational rather than theoretical science. We must make ad initio predictions of what occurs in deep space to compare with observations and discover what is happening "out there". NASA's James Webb Space Telescope (JWST)'s spectrometers will cover the spectral region from 0.6 μm to 50 μm at low redshift, and correspondingly shorter wavelengths at higher redshift, as shown below. The infrared can peer through dust to detect nearly all parts of a galaxy while detecting matter with a wide range of ionization and chemical state. The optical/UV detects ionized regions in emission and, in absorption, intervening gas with a wide range of properties. JWST will observe these spectral regions at high redshift for the first time and present new demands on the atomic / molecular database.

Cloudy is a code designed to simulate the range of physical conditions JWST will detect. It solves the coupled system of equations describing the physical state of the gas and its resulting spectrum. The physics is discussed in [1], [2] goes into some research questions, and [3] describes the code. I will describe the unique astrophysical opportunities posed by JWST and the atomic physics challenges that are important in simulations of these spectra.



Cloudy models of molecular cores [4]. The blue lines indicate the wavebands detected by spectrometers on board JWST as various redshifts, indicated by the vertical scale on the right. The cloud in the left panel is moderately ionized while that on the right is molecular.

References

[1] D.E. Osterbrock & G.F. Ferland, AGN3, 2nd. ed. University Science Books, 2006.

[2] G.J. Ferland, 2003, Ann Rev Ast Ap 41, 517

[3] G. J. Ferland et al 2013, Rev Mex 49, 137

[4] C. T. Richardson et al. 2013, MNRAS, 430, 1257