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Analysis of Atomic Emission Spectra: a refined way to understand the photon concept[1] SARA-JEANNE VOGLER, KEELEY TOWNLEY-SMITH, CRISTIAN BAHRIM, Lamar University — Spectroscopic analysis of atoms and simple molecules reveals the atomic structure, the emission of photons, and the quantum interaction between light and matter. The optics equipment allows us to resolve the emission lines with a precision better than 1 nm. Pressure broadening effect enlarges the emission lines of our light sources to several nm at FWHM. From the relative intensity of the emission lines, de-convoluted using the Maxwell-Boltzmann distribution of atoms in a gaseous discharge at thermal equilibrium, we can find the effective temperature of the atoms and their average speed. Pressure broadening reveals the quantum characteristics of the photon emission by including the uncertainty principle. From the Lorentzian profile of each photon one can find the lifetime of the atomic states in given experimental conditions, and by comparison with their natural lifetime, the effect of the collisional de-excitation can be estimated. Because the photon emission obeys the selection rules for orbital angular momentum, spin, and parity, one can identify the characteristic wavelengths of the atomic constituents of light sources. We are going to present a brief progress report on the applications of the spectroscopic analysis in stellar measurements done under our 2013 Sigma Pi Sigma Undergraduate Research Award.

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