Hubble Space Telescope

Cycle 15 AR Proposal

Using Archival Data to Improve Atomic Data and Address the Nebular Iron Problem

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Abstract

Ever since the first detection of an [Fe IV] line in an H II region (in the Orion Nebula about 10 years ago), it has been recognized that there is a serious problem with the iron abundance derived from the observations. The initial detection was made with HST/GHRS of the UV line at 2836.57 A, which is expected to be the brightest [Fe IV] line under all nebular conditions. The measurement of the flux is not in question. However when the gas-phase iron abundance is inferred using photoionization models, it is found to be much smaller than those derived from lines of other iron ions. This dilemma, which has acquired the name "[Fe IV] problem", persists even with the measurement of a few more [Fe IV] lines that also include ones from a few planetary nebulae (PNs) and galaxies. With our best modeling efforts, the discrepancy is smaller but still goes up to a factor of ~4. Under a program to enlarge the very meager dataset for [Fe IV], we found several PNs in the IUE archives with a possible 2836.57 A line blended with an O III line 0.57 A redward. We propose to use archival HST spectra of the extremely rich emission line sources RR Tel and eta Car to (1) test new state-of-the-art calculations of transition probabilities (A-values) for the pertinent lines of [Fe IV] and O III; (2) derive the ionic iron abundances for these objects; (3) use the results of step 1 to deblend the IUE emission feature in ~25 PNs. We are confident we will enlarge the slim existing set of [Fe IV] emission lines. This is a crucial step in the hope to resolve the [Fe IV] problem. The new quantum mechanical A-value calculations will provide a legacy for future astrophysical spectroscopic applications.

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