

# Empirical Near-UV Line Parameters from Hubble Spectroscopy

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*Astrophysical Advances and UCO/Lick*

We describe our Hubble Treasury program aimed at calculating the near-UV spectra of solar-type stars accurately enough to characterize the age and metallicity of old stellar systems. The primary difficulty with such *ab initio* calculations is the incompleteness of lists of line parameters for atomic transitions identified in the laboratory. The best way to overcome this deficiency is with additional laboratory measurements. In the meantime, we have undertaken a program of empirical line identifications and parameter assignments based on the comparison of the observed echelle spectra of individual stars.

As described by Peterson, Dorman, & Rood (2001, ApJ, 559, 372), we use an iterative procedure to modify the near-UV line list of laboratory lines available from the Kurucz web site at <http://cfaku5.harvard.edu>. The *gf*-values for lines identified in the laboratory are first modified to best match observed line strengths in Hubble Space Telescope STIS echelle spectra. Unidentified transitions are assigned FeI or FeII identifications and lower excitation potentials, based on the change in line strength seen among stars of different temperature and/or gravity. Our bootstrap procedure begins with the weakest-lined stars, for which most lines have laboratory identifications, and proceeds to successively stronger-lined cases. In this way, line list changes and additions have been made that allow our calculations to model reasonably well the spectra of solar-type stars of metallicity as high as one-fourth solar.

We have been awarded a Hubble Treasury program to extend this procedure to stars of solar metallicity and beyond. A total of 110 STIS orbits was awarded over cycles 11 – 13. In Cycles 11 and 12, we plan  $\sim 50$  orbits using the highest-resolution echelle configuration to obtain high S/N spectra of a half-dozen calibrating standards, including three Hyades stars and one more star of greater-than-solar metallicity. We plan lower-resolution spectra of near-solar-type stars in the old open clusters M67 and NGC6791, to confirm the ability of our calculations to reproduce the spectra of known high-metallicity turnoff stars and blue stragglers. In the third year we will combine the calculated spectra for individual stars, using weights derived from stellar isochrones, to reproduce the spectra of the integrated light of old stellar systems, and will test these against observed spectra of moderately- to extremely-metal-rich globular clusters in the nearby Andromeda Galaxy (M31).

As a Treasury program, our observations are nonproprietary, becoming available immediately. We will contribute to the Hubble Archive all the results of our calculations, including the line list itself. Our aim is to make useful contributions to researchers studying a wide range of problems, from laboratory astrophysics to stellar evolution to galaxy formation.

## Acknowledgments:

We thank Space Telescope Science Institute and NASA for the award of our Treasury program GO-9455.