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Stellar libraries as used in ISM modelling

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Abstract. I present the use of stellar libraries in interstellar medium work. Stars are used as background sources against which interstellar absorption lines are observed and their modeling is necessary in order to set the baseline against which the interstellar parameters are derived. Here I discuss our own work and the context in which we use stellar models.

Keywords : stellar models, interstellar medium

1. Introduction

Stellar models have been critical for interstellar absorption line spectroscopy ever since the beginning of the field (Hartmann 1904). Until quite recently (e.g. Dring 1997), it was common to use simple techniques such as second order polynomials to fit the continuum. We have now graduated to more sophisticated models but only to the minimum extent required by our analysis. I will describe here two approaches used by our group in our analysis of interstellar medium observations.

2. Sample cases

Gas and dust are seen in every line of sight without exception but usually without sufficient spatial or spectral resolution. The most direct means of observation is through absorption line spectroscopy as seen in Fig. 1 for interstellar carbon lines. These lines are made up of multiple blended components which make it difficult to derive a unique set of parameters for the interstellar gas. In order to remove this degeneracy, we have used relatively weak Mg II features to derive the velocity structure along the line of sight. The stellar continuum, shown as red lines in the Figure, clearly affects the overall shape of the lines and must be modeled accurately. We have used

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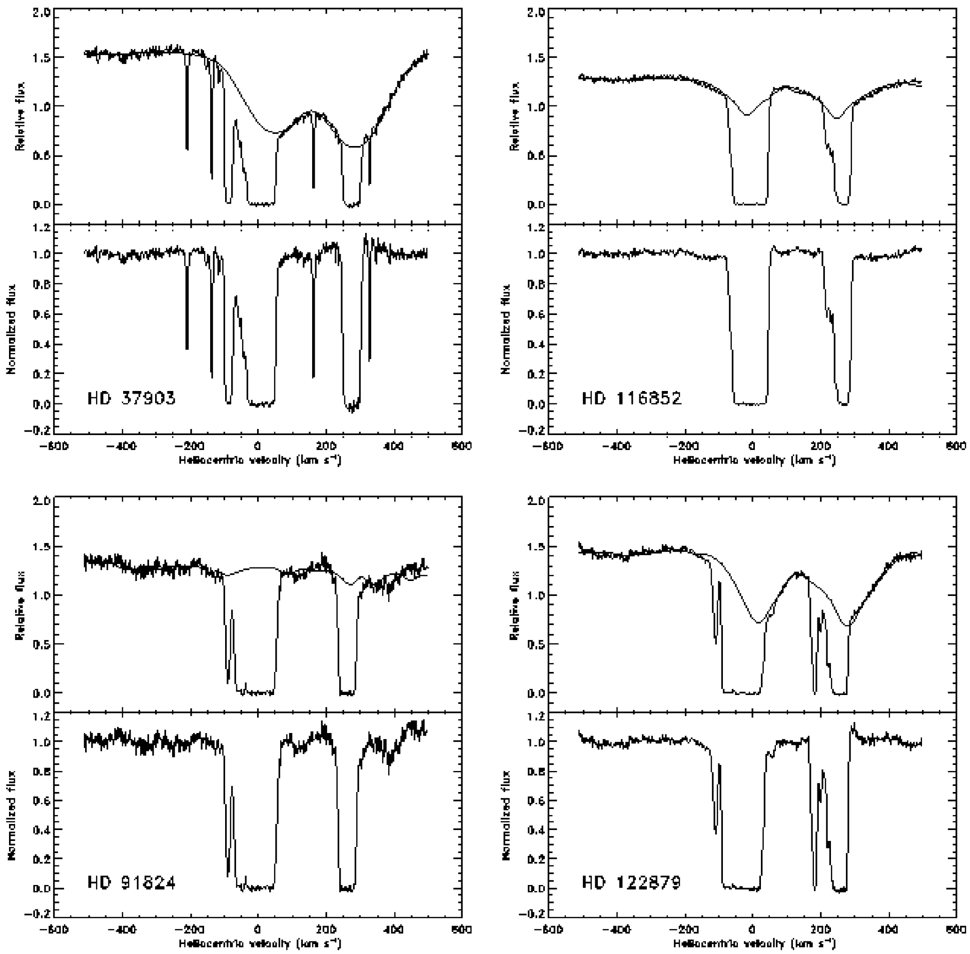

Figure 1. The observed stellar spectra are shown with interstellar line absorption from CII in velocity space. The stellar spectrum from the UVBLUE models is shown as a red line in each of the upper plates and is divided out in the bottom plates which are then used to derive the interstellar absorption.

UVBLUE (Rodríguez-Merino et al. 2005) to provide high spectral resolution stellar models which reproduce the stellar continuum around the lines of interest. We then divide by the stellar continuum to yield a normalized continuum against which we can model the interstellar lines. We have found this procedure to be stable but nevertheless our final result does depend on the quality of the stellar continuum.

Another major project is to derive extinction over the sky based on multi-band photometry of stars. We have combined GALEX two band (FUV: 1521 Å; NUV: 2361Å) photometry with SDSS 5 band (u: 3551 Å; g: 4686 Å; r: 6165 Å; i: 7481 Å; z: 8931 Å) photometry to give low-resolution spectra of stars. Using standard SQL tools on the CASJobs server at the Johns Hopkins University, we have extracted those stars with one and only one match between the SDSS and GALEX identifications. The criterion used for matching was purely positional; i.e., those stars within 5" of

Figure 2. The density over the North Galactic Pole of stars with both GALEX and SDSS observations is shown. the bright regions are deep observations with fainter stars and thus a higher stellar density while the others are observations of as little as 100 s taken as part of the all-sky survey.

the GALEX position were counted as being a match. This resulted in a large number of matches and we found over 350,000 stars with both GALEX and SDSS matches in the 15deg from the North Galactic Pole (Fig. 2), with each star having 7 bands.

We then created models of the stellar spectra in which we convolved UVBLUE spectra of a given spectral type with a standard extinction curve and fit to the data. We assumed error bars of about 0.1 magnitude in each of the bands and performed a χ^2 minimization to find the best fit parameters. A sample fit is shown in Fig. 3 and our preliminary work has shown us that we can expect tight constraints on these parameters. The goal of this work is to directly provide an extinction map over the sky.

3. Conclusions

We have used stellar models combined with interstellar absorption profiles to constrain interstellar parameters over the sky. We have used both high resolution spectroscopy and broad band photometry for this purpose and have used the UVBLUE

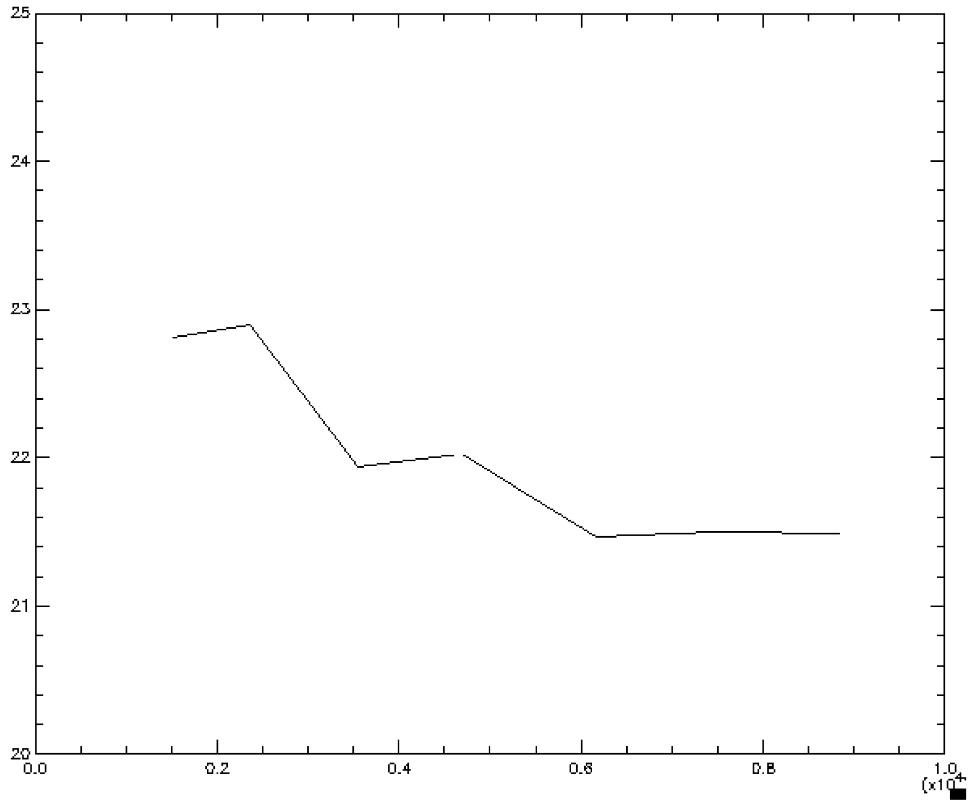

Figure 3. A sample fit to one of the stars in our extinction survey is shown with the observations as plus symbols. We are sensitive to both the spectral type of the star and the foreground extinction.

stellar atmosphere models. While these are probably adequate for our purpose, we note that the derived interstellar parameters are critically dependent on the stellar models and it is important that stellar libraries be made generally available for the use of interstellar researchers and their availability publicized.

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