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A progress report on the observations of ASTRA targets in the POLLUX database

R. Monier

GRAAL – Université Montpellier II, Place E. Bataillon, 34095 Montpellier, France e-mail: Richard.Monier@graal.univ-montp2.fr

Abstract. A progress report on the ASTRA targets observed in the frame of the POLLUX database is presented. POLLUX hosts high resolution échelle spectra of standard stars and a library of synthetic spectra as well. This set of observed and synthetic spectra will eventually provide a broad coverage of the atmospheric parameters and spectral types across the HR diagram. Currently 81 ASTRA targets have been observed in the frame of POLLUX. Reduction of their spectra is in progress.

Key words. Stars: atmospheres

1. Introduction

A programme to obtain high resolution high quality échelle spectra of standard stars was launched in 2003 at GRAAL, the Astronomy and Astrophysics Laboratory at the University Montpellier 2. We have also started the computation of a massive grid of synthetic spectra whose physical parameters match those of the observed standard stars. The incentive for this project is to provide a comprehensive library of stellar spectra (both observed and theoretical) which will provide a broad coverage of the atmospheric parameters $T_{\rm eff}$, $\log g$ and [Fe/H] as well as spectral types across the HR diagram. This brief paper describes the POLLUX project , its connection to the ASTRA project (Adelman et al., 2005) and the current status of the observations of ASTRA targets in POLLUX.

2. The POLLUX database

The set of stars we ultimately intend to observe in POLLUX are stars with fairly well known atmospheric properties. Our target list was originally constructed from 4 lists of primary or secondary standard stars. Specifically, we have used Garcia's (1989) list, Gray and Garrison's (1987, 1989a, 1989b) and Garrison and Gray's (1994) reclassification of B, A and F stars and the list of secondary spectrophotometric standards pertaining to the ASTRA project (Adelman, 2005). We have currently observed about 250 O, B and A stars. New stars with well known atmospheric parameters are regularly added to the POLLUX star list. For instance, I have recently started to observe some of the F and G dwarfs observed by Edvardsson et al (1995) in their survey of the Galactic disk.

All spectra are obtained with ELODIE (Baranne et al., 1996), the echelle spectrometer at the Observatoire de Haute Provence

Send offprint requests to: R. Monier

(OHP, France) attached to the 193 cm telescope. Light from the Cassegrain focus is fed into the spectrograph through a pair of optical fibers. In a single exposure, a spectrum at a resolution of 42000 ($\frac{\lambda}{\delta\lambda}$ at 5000 Å) is recorded on a 1024X1024 CCD. By using a combination of a $\tan\theta = 4$ echelle grating and a combination of a prism and a grism which act as a cross-disperser, the spectra stretch from 3906 Å to 6811 Å. The instrument is entirely controled by a computer and a standard data reduction pipeline automatically processes the data and computes cross-correlation functions. ELODIE was indeed primarily designed to perform very accurate velocity measurements. We routinely obtain spectra at S/N ratios varying from 100 to 500 according to magnitude. For a given magnitude, we attempt as much as possible to get the best S/N ratio.

The spectra are reduced in a uniform manner. We follow Erspamer and North's (2002) procedure based on IRAF routines to extract the spectra from the raw image, correct them for the scattered light and merge the orders. Specifically the procedure relies on the imred.ccdred and imred.echelle IRAF packages. The calibration exposures (offsets, darks and flat fields) are combined and averaged. Then the stellar exposure is corrected from the offset, the dark and bad pixels. We then proceed to find, center, resize and trace the orders. The scattered light is removed from all raw images. The flat field are recentered, resized and extracted. The thorium arc image is extracted and calibrated. The stellar spectrum is extracted using the variance weighting method and divided by the extracted flat field. The stellar spectrum is then wavelength calibrated and the 67 orders are merged using a FORTRAN program. The final product is the merged wavelength calibrated spectrum from 3920 Å to 6800 Å in form of an ASCII file (λ,flux). The spectra cannot be calibrated into absolute fluxes as the amount of stellar light entering the fiber is highly variable (depending on atmospheric conditions) and the figure of the star usually exceeds the diameter of the fiber.

The merged ASCII spectra are being gathered into the POLLUX database which can be accessed at http://www.isteem.univ-montp2.fr/pollux. We will eventually make them available to the community via a user-friendly web interface. Users will be able to search for spectra using a variety of criteria (star ID, celestial coordinates, list of objects, date of observation, observer's name, spectral type,....).

POLLUX will also host a library of synthetic spectra whose fundamental parameters match those of the observed standard stars. We intend to use various codes to calculate the synthetic spectra at $R \simeq 10^6$ and then convolve them with suitable instrumental and rotational profiles. Quick-look analysis tools will also be available to perform simple measurements (radial velocity, equivalent widths,....). Provision for adjustments of models to the observations will be made. This task is not obvious since it is not always possible to locate accurately the continuum in stellar spectra. The ability to perform automatic determinations of stellar parameters ($T_{\rm eff}$, $\log g$, [Fe/H], $v_e \sin i$....) is also foreseen using the TGMET programme (Soubiran et al., 1998) for instance. So far, POLLUX contains only ELODIE spectra but it is designed to host spectra from future instruments (in particular spectropolarimetry data).

3. Recent observations of ASTRA targets

POLLUX observations have recently focused on ASTRA targets. 81 ASTRA targets have been observed with ELODIE at OHP in 2004 and 2005. These stars are mostly bright O, B, A and F field stars. The exposure times ran from a few minutes to 75 minutes. All the spectra have S/N ranging from 200 to 500 around 5000 Å, they are usually noisy shortwards of 4000 Å due to the poor sensitivity of ELODIE in the blue. The reduction of these spectra is under progress.

4. Conclusion

We expect the homogenized POLLUX spectra will be useful to stellar astrophysicists in several respects . We might quote a few: i) abundance determinations, ii) accurate derivation of fundamental properties of stars (v_r, $v_e \sin i$,...),

iii) multiwavelength coverage (they will complement ultraviolet data from the IUE, HST, FUSE archives), iv) test of the current state of the art of model atmospheres, v) study of dynamic phenomena in atmospheres. POLLUX will contain observations that cannot be repeated and, as such, are unique and highly valuable for the study of variable phenomena. The POLLUX spectra will also provide reference informations to calibrate instruments of future missions. The comparison of spectra of non-variable standard stars obtained with different instruments should allow one to estimate systematic effects: percentage of scattered light, flat fielding errors, non linearity of the detector, instrumental profiles. We anticipate that the POLLUX spectra of ASTRA targets may ultimately be calibrated into absolute fluxes which will also be of interest to scientists working on stellar population synthesis.

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