A library of synthetic spectra over the Gaia/RVS spectral range

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We present a library of about 9 000 high-resolution stellar synthetic spectra covering the spectral domain that will be observed by the Radial Velocity Spectrometer (RVS) on-board of the ESA/Gaia mission. It is based on a new generation of MARCS model atmospheres and mostly devoted to FGK dwarf and giant stars.

This grid of theoretical spectra was computed with the turbospectrum code (Alvarez & Plez 1998, and further improvements by Plez) in plane-parallel and spherical geometry depending on the gravity (see below).

The adopted line list consists in all the atomic lines found in the VALD database (Kupka et al., 1999) and molecular lines. The molecular line list includes ZrO, TiO, VO, CN, C_2, CH, SiH, CaH and MgH lines with their corresponding isotopic variations.

TiO lines are from Plez (1998). VO and ZrO linelists have been compiled by Plez using the best available laboratory data (see TiO and Plez et al., 2003). C_2 lines are from Querci et al. (1971). CN and CH lists were assembled from the best available data and are described in Hill et al. (2002) and Cayrel et al. (2004). MgH and SiH lines come from Kurucz (CD-Rom No. 13) and CaH from Plez, using the best available laboratory data (see TiO).

Regarding the model atmospheres, we used a new grid of MARCS (version of november 2004) one-dimensional, plane-parallel and spherical LTE model atmospheres (Gustafsson et al., 2005). Turbulence pressure was included and convection was simulated according to the local mixing-length recipe. The grid consists in 1 858 stellar models with effective temperatures between 4 000 K and 8 000 K (step 250 K), logarithmic surface gravities between -1.0 to 5.0 (step 0.5), and overall metallicities between -5.0 and 1.0 (with a variable step from 1.0 to 0.25 dex).

The synthetic spectra have been computed with the same geometry as in the model atmosphere. Plane-parallel models have been used for log$g$ from +3.0 to +5.0. They have a microturbulent-velocity parameter of 1.0 km/s. Models with spherical geometry have been considered for giant stars with log$g$ <+3.0. These models have been computed for masses of 1.0 $M_{\odot}$ and with a microturbulence parameter of 2.0 km/s.

The adopted solar abundances for C, N and O in the atmospheric models are 8.41, 7.80 and 8.67 according to the recent revision by Asplund et al. (2005). Solar abundances of other chemical species are from Grevesse & Sauval (1998). For metal-poor models, the following α-enhancements were considered: [α/Fe]=+0.10 for [Fe/H]=-0.25, [α/Fe]=+0.20 for [Fe/H]=-0.50, [α/Fe]=+0.30 for [Fe/H]=-0.75 and [α/Fe]=+0.40 for [Fe/H]$\leq$-1.00. Chemical species treated as α-elements are Ne, Mg, Si, S, Ar, Ca and Ti. Oxygen also follows the same enhancements.

From this grid of model atmospheres, synthetic spectra have been computed in the range $\lambda = 8\,475$Å to $\lambda = 8\,745$Å with a step of 0.02Å. This would correspond to a spectral resolution of $R = \lambda/\delta\lambda \simeq 210\,000$, taking two pixels per resolution element. Normalized and absolute fluxes are provided. These spectra can be easily convolved and re-sampled to match the RVS spectral resolution (R $\sim$ 11 500) and/or any macroturbulence and rotational broadening. Similar abundances as in the model atmospheres were considered. For each model atmosphere, we furthermore considered α-elements abundance variations of +0.4, +0.2, +0.0, -0.2, -0.4 dex, with respect to the original abundances in the model. Five synthetic spectra have thus been computed per model atmosphere. It has to be pointed out that such strong departures in the abundances of electron-donors for the calculation of the synthetic spectra could be inconsistent with the T-Pe-Pg relation read in the model atmosphere.

The final computed library is composed of 9 290 spectra over the Gaia/RVS spectral domain. An individual spectrum consists in a 3-columns ASCII file (wavelength in Å, normalized flux and absolute flux in erg.cm^{-2}.s^{-1}Å^{-1}). They will be available from the ESA/Gaia Webpages (Gaia Resources / Tools, data & Software).

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