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Deblending of Gaia BP/RP spectra: a progress report

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Abstract. With an expected catalogue of 1 billion MW stars in addition to a huge number of extragalactic and solar system's objects, Gaia mission will drastically change our vision of the sky. Considered that the photometric cameras will produce low resolution spectra in two bands, BP (300-660 nm) and RP (650-1000 nm), the expected fraction of crowded stars will be of the order of 20%. In this context, the deblending of crowded images will be a real challenge for the algorithms of flux extraction.

Key words. Stars: abundances – Stars: Population II – Galaxy: globular clusters – Stars: Population I –Galaxy: abundances – Cosmology: observations

1. Introduction

For each source, Gaia will provide low resolution spectra through two different prisms, one for the "blue" channel (300-660 nm) and the other for the "red" channel (650-1000 nm). The dispersion of the prisms ranges from 3 to 29 nm/pixel for BP and from 7 to 15 nm/pixel for RP. Gaia will detect sources with magnitude $6 < G < 20$ in 60 X 12 pixel (Along Scan X Across Scan) windows which will transmitted to the ground with the following samplings:

1 X 1 (AL X AC) pixel 720 samples for G=6-13 stars
1 X 12 (AL X AC) pixel 60 samples for G=13-20 stars.

This implies that most of the data will be sent to the ground in one-dimension. Spectrophotometry will be used to derive astrophysical parameters ([M/H], T, logg, Av) for about 1 billion stars of the Milky Way, creating a new, exciting vision of our Galaxy.

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2. Task and approach

In order to obtain accurate values for the astrophysical parameters, the BP/RP flux extraction must be performed correctly: an error in the extraction could involve a variation of the spectral morphology and produce large errors in the estimate of parameters. Considering the dispersion along-scan of the spectra, the superimposition of two field of views, and the large stellar density in many regions of the sky, stellar images will be often overlapped. At the first order, morphology of the spectra is a function of (see fig. 1):

1) Temperature (Teff)

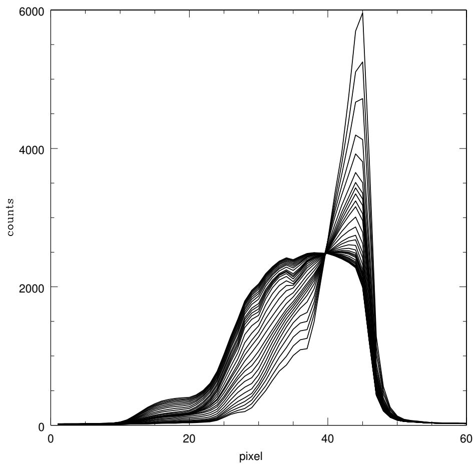

Fig. 1. Series of BP Gaia spectra with [M/H]=0.00 and $3500 < T_{eff} < 20000\,^\circ K$;

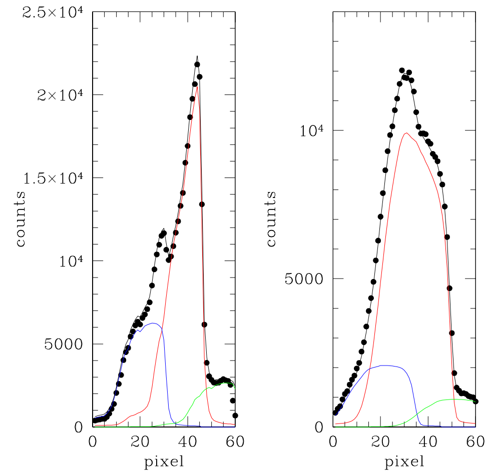

Fig. 2. BP (on the left) and RP (on the right) fit for three sources with Teff=6000-8000-10000 and [M/H]=-0.5, 0, 0.5

2) Metallicity ([M/H])
3) Gravity (logg)
4) Interstellar absorption (Av)

but that morphology depends on a number of additional parameters as optical distortion, charge transfer inefficiency due to radiation damage, variation of the dispersion curve of the prisms, cosmic rays, gates and several others. Deblending BP/RP spectra in crowded field without any information about astrophysical parameters is a new challenge in photometry, and requires the development of specific algorithms for reduction.

2.1. Deblending algorithm

Using GIBIS (http://gibis.cnes.fr:/), we have simulated 1d spectra for a large range in temperature and metallicity ($3500 < T_{eff} < 20000^\circ K$, $-5.00 < [M/H] < 1.00$) and reduced them with the package we are presently developing. Our software is based on a numerical best-fit of a grid of templates to the observed spectrum, performed simultaneously for the BP and RP channels.

3. Conclusions

We have applied our package to a large number of cases and concluded that we are in condition to deblend up to three Gaia BP/RP sources which centroids are in the same window, discriminating effectively the contribution of each source to the overall flux (see fig. 2). So far we have studied spectra within the ranges $-5.00 < [M/H] < 1.00$ and $3500 < T_{eff} < 20000^\circ K$ and fixed logg and Av. At the present time we are studying the effects on the spectral shapes of logg and Av variations, next steps will be the study of the effects of ”truncated windows“ and the contamination from sources that lie outside the window.

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