A. Automatic classification of stars with BBP and MBP filters

by Audrius Bridzius

The classification method developed at Vilnius was discussed, including some modifications identified for future testing. The main conclusions are summarised below.

1. Performance of the 4-D classification using all possible (61) colour indices combined from the 3G photometric bands was estimated. We found no improvement with respect to usage of only adjacent color indices; moreover the hottest and coolest stars are classified with lower precision.

2. A possible 4-D classification scheme based on the comparison of magnitudes rather than colour indices was discussed. In comparing the different magnitudes for a given star with the standard data base, a constant magnitude offset is determined based on a weighted least square fitting. The residuals of the fit then provide the classification criterion in the same way as for the colour indices. For practical reasons this method could however not be tested during the visit to Lund.

3. The 4-D classification capabilities for two of the photometric systems proposed for GAIA – 1F and 3G, using medium bands (MB) and MB plus broad bands (BB), were investigated. We found rather small improvement of the classification precision at V=17 mag if BB measurements are taken into account, compared with using only MB. The effect at V=19 mag of using only BB compared with MB+BB will be studied later, according to action #18 from the workshop at CUO.

4. The capability of the photometric systems 1F and 3G to determine the main stellar parameters – Teff, log g, [Fe/H], and E(B-V) – were estimated at V=17 mag, using models of solar metallicity without reddening. It was concluded that 3G is significantly better in all the parameters. Numerically, this is illustrated in Table 1,
which gives the limiting deviations of the parameters (defined as 
max(|p05|,|p95|), where p05 and p95 are the 5th and 95th percentiles
of the error distribution). At V=19 the 3G system is still better
than the 1F, but only by 10–20%, as mentioned in the CUO-081 report.

Table 1. Classification performance of 1F and 3G systems at V=17
mag. The table gives the maximum error for 90% of the cases. The
corresponding robust standard error is about 0.6 times these values.

<table>
<thead>
<tr>
<th>system</th>
<th>1F</th>
<th>3G</th>
</tr>
</thead>
<tbody>
<tr>
<td>log Teff</td>
<td>0.032</td>
<td>0.024</td>
</tr>
<tr>
<td>log g</td>
<td>0.64</td>
<td>0.30</td>
</tr>
<tr>
<td>[Fe/H]</td>
<td>0.65</td>
<td>0.46</td>
</tr>
<tr>
<td>E(B-V)</td>
<td>0.07</td>
<td>0.04</td>
</tr>
</tbody>
</table>

B. The Spectro Point Spread Function

by Claus Fabricius

A point spread function (PSF) for the Astro instruments was discussed
by LL in the report SAG-LL-025 from 1998, based on an example of the
wave front errors (WFE) computed by MMS. No similar estimate of
typical WFE for Spectro exists, and instead the values for Astro were
used, but only for the smaller aperture corresponding to Spectro. It
is not clear if this approach is representative for as wide a field
as in Spectro, but it gives a starting point for discussing the
plausible effects of aberrations in that instrument.

The program developed by LL in 1998 was adapted to the Spectro
aperture and the pixel size of that detector. The transverse motion
of the star was assumed to be one pixel also in Spectro because both
the pixel size and integration time is about 3 times larger than in
Astro. Instead of the triangular splines used in the original program
to represent the spectral response (QE times filter curve), a
rectangular response was assumed for the medium bands. Any central
wavelength and width may be chosen.

The first trials resulted in rather unexpected results. This was
eventually traced mainly to the step size and partly to the number
of grid points used in the FFT computations.

Comparisons were made between the PSFs free of WFE and including the
WFE at "point 15" (see SAG-LL-025). The rms WFE in the Spectro
aperture at "point 15" is about 33 nm. At first glance the PSFs look
very similar and no severe problems are expected for normal stars
(fainter than 10 mag). For the brighter stars the image wings have
been mentioned as a possible solution to work around the saturation
of the CCD. At a distance of 10 pixels from the peak, where the
intensity per pixel has dropped by 9 to 10 mag (depending on
wavelength), the typical PSF difference depending on the WFE is of
the order 0.02 mag, and the intensity gradient is 0.2 mag/pixel.
This would make accurate photometric calibration difficult, but
perhaps not impossible.

The main result is perhaps that a Fortran program to calculate the
Spectro PSF for arbitrary spectral bands and WFE is now available
for future simulations.

(End of report)