THE SDSS QUASARS AS A TESTBENCH FOR THE GAIA FUNDAMENTAL REFERENCE FRAME GRID-POINTS

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ABSTRACT. The ESA mission Gaia will furnish a complete census of the Milky Way, delivering astrometry, dynamics, and astrophysics information for 1 billion stars. Operating in all-sky repeated survey mode, Gaia will also provide measurements of extra-galactic objects. Among the later there will be about 500 000 quasars that will be used to build the reference frame upon which the several independent observations will be combined and interpreted. Not all the quasars are equally suited to fulfill this role of fundamental, fiducial grid-points. Brightness, morphology, and variability define the astrometric error budget for each object. The quasars spectroscopically certified from the SDSS catalog offer an optimum sample to discuss the future Gaia quasar population. We present a new method, based on the Gaia quasar database, to derive absolute magnitudes, on the SDSS filters domain. The method can be extrapolated all over the optical window, including the Gaia filters.

1. THE PROBLEM & HOW TO MINIMIZE IT

Quasars live in galaxies, which are extended objects. The later, if detectable, may influence the accuracy of the centroid position of the AGN. In terms of Gaia, considering pixel size, and assuming typical angular sizes of the host galaxy, the uncertainty in position can reach 60 μas, and that can not be ignored in an astrometric mission as Gaia. To warn on the likeness of such problem for a given QSO, we developed a method to reveal the presence of the host galaxy [1], [2]. We make use of 3 morphological parameters which measure the skewness (SHARP), the circularity (SROUND), and normalness (GROUND) of the PSF. It relies on comparing the QSO profile against the average PSF of nearby stars. The differences are interpreted as host galaxy tracers. We are testing this method using the 105 783 QSOs (spectroscopically confirmed) sample of the SDSS DR7 [3], which have 0.065< redshift(z) <5.46.

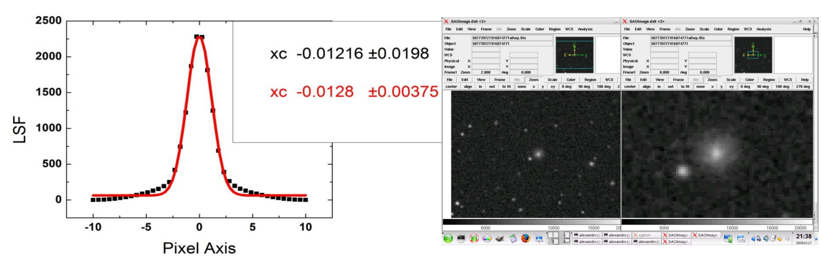

Figure 1: Simulation of the effect of a host galaxy component in the determination of the centroid position. One can see a variation in the measured position and an increment of the error.

2. FIRST RESULTS

We obtained frames in *ugriz* bands for all SDSS DR7 QSOs, this means: 528 915 frames with 2048x1489 pixels (0.39"/pix) totaling ~2TB of data. We run an IRAF pipeline on all frames to derive the 3 PSF parameters. When a QSO has any of the 3 parameters $> 2\sigma$ from the mean PSF, that difference is interpreted as due to the presence of an extended component, i.e. the host galaxy. Schneider et al.[3] found ∼4% of extended objects ($psfmag - modelmag > 0.2$ mag). As one can see in table 1 we found a higher fraction of extended objects. In figure 2 is noticeable that redder bands tend to be more sensitive to the presence of a host galaxy component, as expected.

	u	g	r	i	z
Objects classified	80.86%	89.34%	83.15%	75.74%	60.83%
Extended objects	15.07%	11.23%	13.26%	15.00%	19.21%

Table 1: QSOs for which we obtained morphological indices and percentage of extended objects relative to the total (105 783).

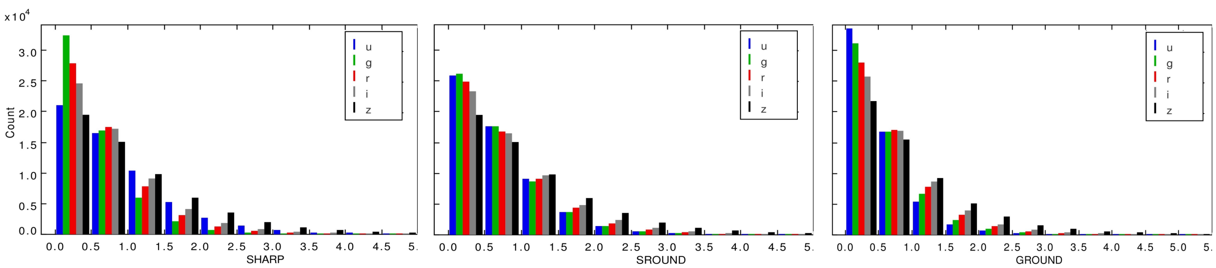

Figure 2: Distribution of the morphological indices for the 57 893 objects for which we obtained morphological classification in the 5 bands. From left-right:SHARP, SROUND, GROUND.

3. OBTAINING ABSOLUTE MAGNITUDES

Considering the redshift range of the objects, it is necessary to apply k-corrections to compute the absolute magnitudes, the correction is a function of redshift, filter used, and SED of the source. The SED continuum of QSOs is usually approached by a power law were the flux is proportional to $\nu^{-\alpha}$, being α the spectral index. It is common to use for QSOs α=0.5. An important fraction of QSOs emission arrives us as emission lines [4], so an additional correction for that becomes necessary. We are developing a new method to compute absolute magnitudes in the 5 bands (*ugriz*) of SDSS that also takes into account corrections for both Lymanα-forest and extragalactic dust effects. We make use of the Gaia spectral library[5], which contains synthetic spectra built with the modified template technique. We adopted α=0.5, to take advantage of the calibration from the available absolute magnitude Mi [3], but in principle different spectral indexes can be used.

4. STUDYING THE HOST GALAXY POPULATION

It is in general accepted a relationship between the AGN and the host galaxy, involving masses, sizes, brightness, morphological types, and star formation. however the particulars are far from being known or agreed upon. In our investigation we seek how the *ugriz* absolute magnitudes and morphological indexes differences can inform about those characteristics, and what they may reveal about the story of host/AGN co-evolution. Besides, simply from the observational point of view such relationships must be worked out because, due to the size of the spectrometers fibers and the smallness of the QSO emitting regions, there is always a large fraction of light from the host when the core is studied.

5. REFERENCES

[1]Andrei, A. et al., 2009, Gaia CU3 Plenary Meeting, Turin, Italy
[2]Andrei, A. et al., 2010, Journées 2010, Paris, France
[3] Schneider et al., 2010, AJ, 139, 2360
[4] Richards et al.,2006, AJ, 131, 2766
[5] Claeskens et al., 2006, MNRAS, 367, 879