



Examples of colour-colour diagrams showing star and QSO loci in simulated broad-band photometry (left) and medium-band photometry (right). In medium-band filters, QSO emission lines make strong signatures at specific redshifts (see right plot, where the signatures of the CIII], CIV and Ly-alpha emission lines are visible in the distribution of the blue, green, and red objects respectively). The figures refer to an obsolete photometric-filter system studied for Gaia during the assessment phase. The flight-model payload design features two low-dispersion photometers (BP and RP) returning spectra covering the entire wavelength range supported by the telescope plus CCD.

Gaia will provide astrometric and photometric observations for about 500,000 quasars (QSOs) down to 20-th magnitude over the whole sky, 5 times more than the number expected from the Sloan Digital Sky Survey. The Gaia data set will constitute the first all-sky survey of optically-selected active galactic nuclei (AGN) and QSOs.

AGN and QSOs are of prime importance in establishing the relativistic reference frame, one of the scientific objectives of the Gaia mission. Gaia's QSO sample will have a profound impact on studies of the large-scale structure of the Universe. Their spectroscopy will allow the gas content in distant galactic haloes and in intervening intergalactic clouds to be probed. In addition, about 2000 QSOs in the final sample are expected to be lensed by a foreground galaxy, and 50 per cent of these should directly be identified as multiply-imaged objects thanks to Gaia's reconstructed sky-mapper images. This number is an order of magnitude larger than the number of known lensed QSOs. The number and properties of lensed QSOs in a statistical sample contain information on the nature of distant lensing galaxies and on the geometry of the Universe. Thus, Gaia also offers the prospect of constraining the values of cosmological parameters.

Since QSOs only represent 0.05 per cent of the objects detected by Gaia, it is crucial to be able to discriminate them from the much more numerous stars. In principle, Gaia's data will offer three methods to reach this objective, based on three properties of QSOs: (i) their colours occupy a different locus from the one formed by stars in the multi-dimensional colour space built from Gaia's photometric data (see the figure above); (ii) their variability can be detected by photometric measurements collected during the 5-year mission lifetime; (iii) their lack of proper motion and parallax can be determined by the astrometric instruments. Which (combination of) method(s) will be used for QSO selection remain to be decided.

After having built sets of representative simulated QSO spectra, either characterised by their redshift, continuum slope, total equivalent width of emission lines, and reddening, or by weights for a set of spectral principal components, on-going studies aim at determining: (i) the parameter space over which QSOs can be discriminated against stars by photometric means alone; (ii) the rate of contamination of stars by QSOs if only photometry is used; (iii) the accuracy with which the redshift and other spectral parameters can be determined; (iv) the QSO limiting magnitude required to recover their spectra with good accuracy.