GGG (Galician Group for Gaia) contribution to Gaia DPAC

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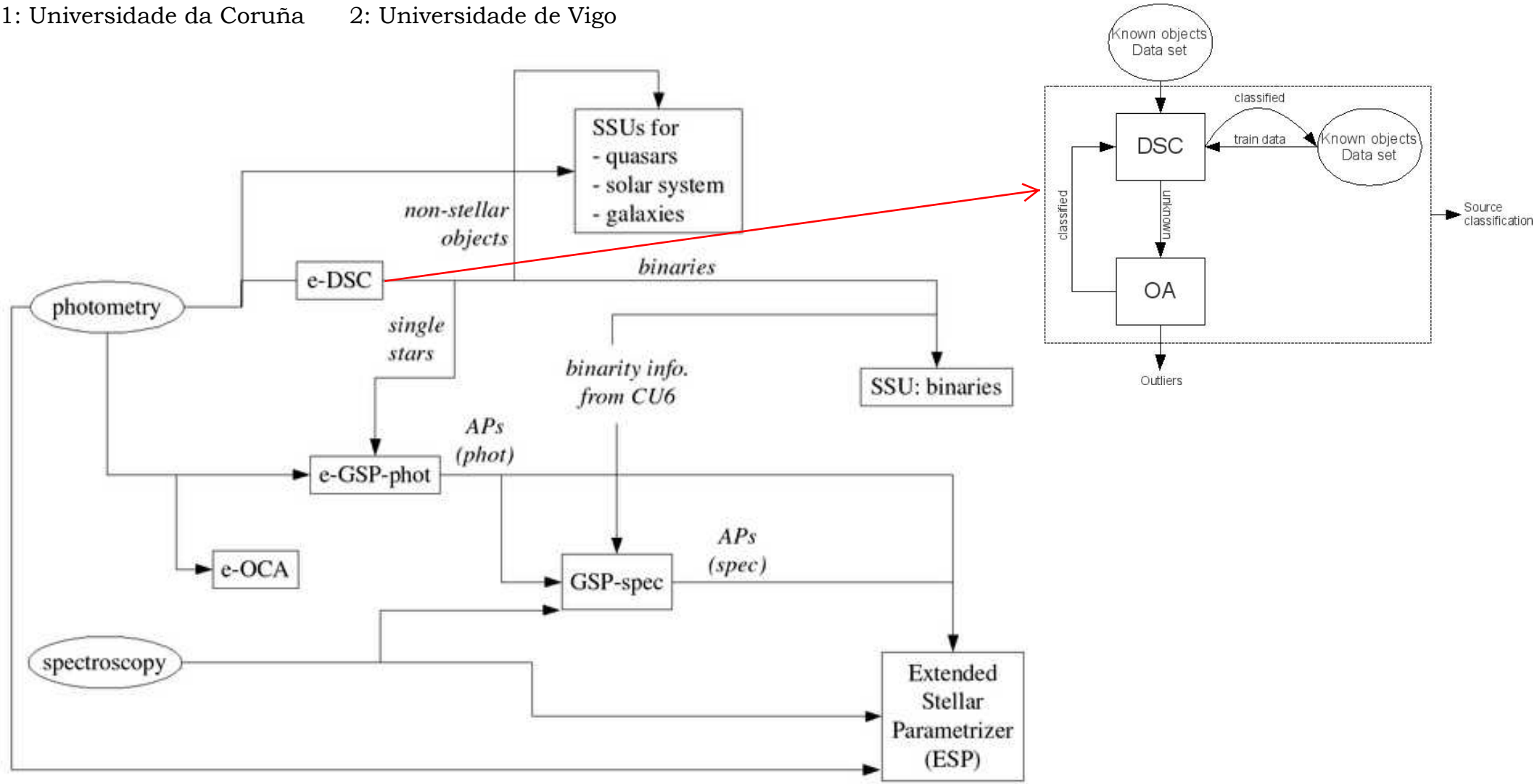


FIGURE 1: CU8 “Astrophysical Parameters” data flow

1.- CU8 ASTROPHYSICAL PARAMETERS MAIN OBJECTIVES:

The Astrophysical Parameters coordination unit is responsible for "classification" tasks. These tasks use fully calibrated photometry, spectroscopy and (to some extent) astrometry to classify objects and estimate their astrophysical parameters. The main objectives of the classification are as follows.

1. **Discrete classification**. Determination of whether an object is a star, galaxy, quasar or asteroid etc. This could also include the use of morphological information.
2. **Estimation of Astrophysical Parameters**. For those objects identified as stars, determine their intrinsic physical properties. The relevant (and obtainable) ones are effective temperature, Teff, surface gravity, logg, metallicity, [Fe/H], and line-of-sight interstellar extinction, Av. Although this last one is of course not intrinsic to the star, we would ideally determine it on a star-by-star basis, so we can consider it as such. Other APs of interest (and which could be determined for bright stars with the spectroscopy from the RVS instrument) include: alpha-process elements, CNO abundance anomalies and activity.
3. **Identification of unresolved binaries**. Most stars are in multiple systems. Some of these can be recognised from the astrometry, and a few will be visual binaries, but most will go undetected in this way. Nonetheless, with favourable brightness ratios, a binary could be detected from the shape of its composite spectral energy distribution.
4. **Identification of new types of objects**. As a major survey, Gaia must be open to the prospect of detecting new types of objects. This includes new types of variable stars, rare stars (e.g. brief phases of stellar evolution), abnormal abundance patterns or multiple systems. Those supervised classification methods which are commonly used for determining stellar parameters from spectra are generally forced to classify new types of objects into pre-existing classes. New objects would therefore go undetected (and samples of known types of objects would be contaminated). Thus special attention, including the use of unsupervised methods, is required to deal with this.

GGG contribution to photometric data classification: **Outliers Analysis.**

- Classify unknown object into Gaia classes
- Segmentation of remaining outliers → rare objects, new class of objects

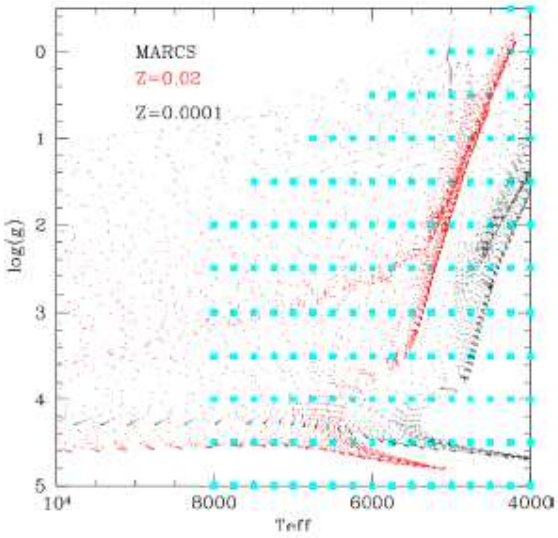
GGG contribution to spectroscopic RVS stellar parameterization

- Derivation of main stellar parameters for single stars by the use of ANN trained with synthetic spectra

2.- GGG CONTRIBUTION TO GSP-SPEC

The main stellar atmospheric parameters are derived by the use of ANNs trained with synthetic spectra transformed to the best suited data domain, from the following:

- FFT domain
- Wavelet approaches and details decomposition
- Plain wavelength domain



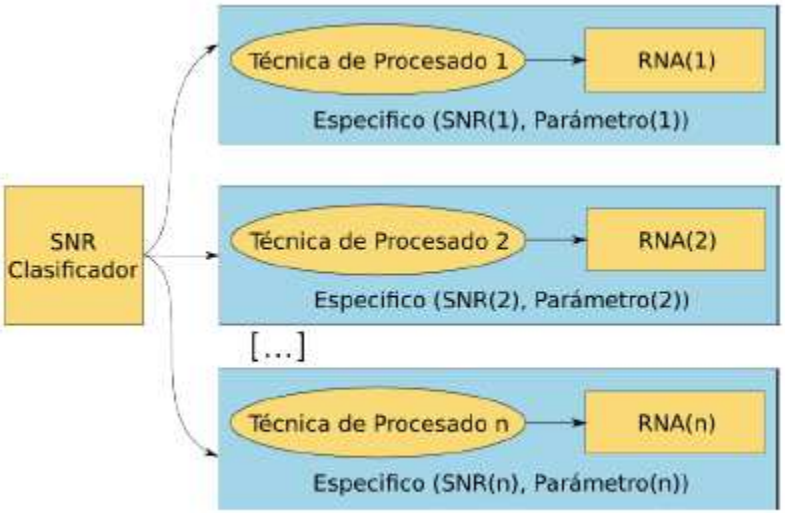


Figura 14: Esquema del clasificador final para el paquete de trabajo GSPspec

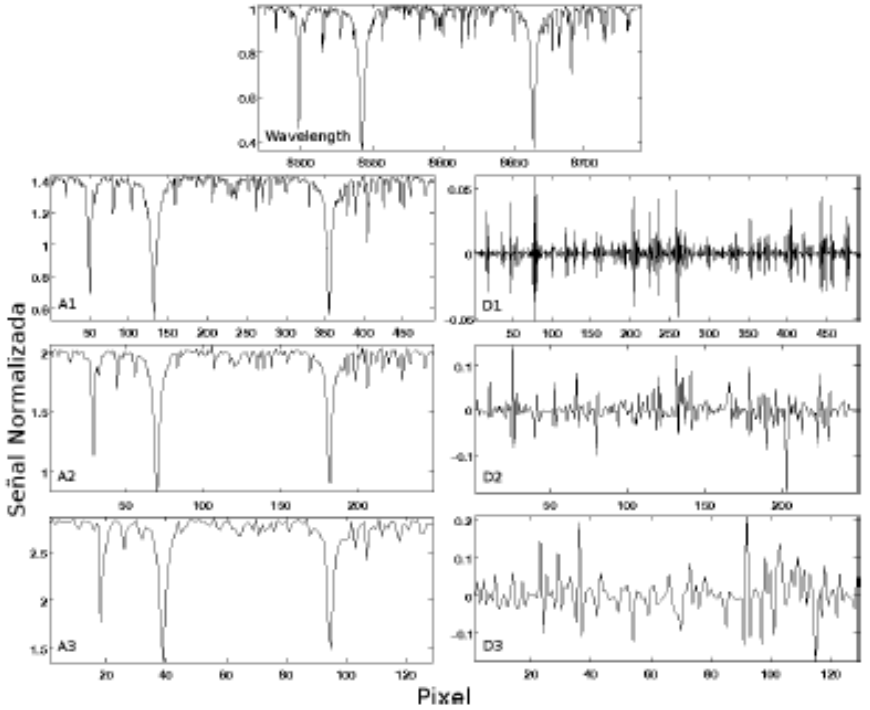


Figura 18: Análisis multinivel aplicado a espectros

GSP-SPEC RESULTS

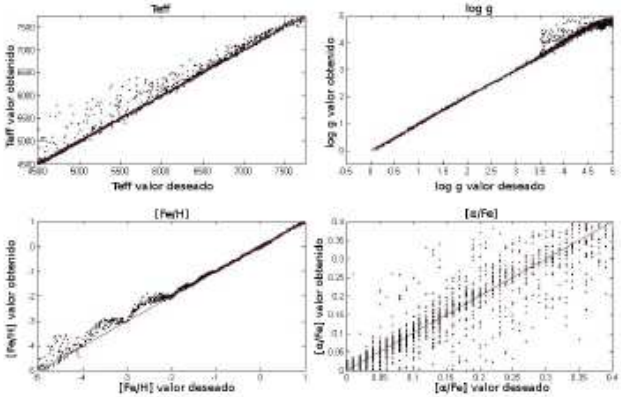


Figura 23: Diagrama de puntos para alta resolución (HR): Parámetros recuperados vs parámetros teóricos

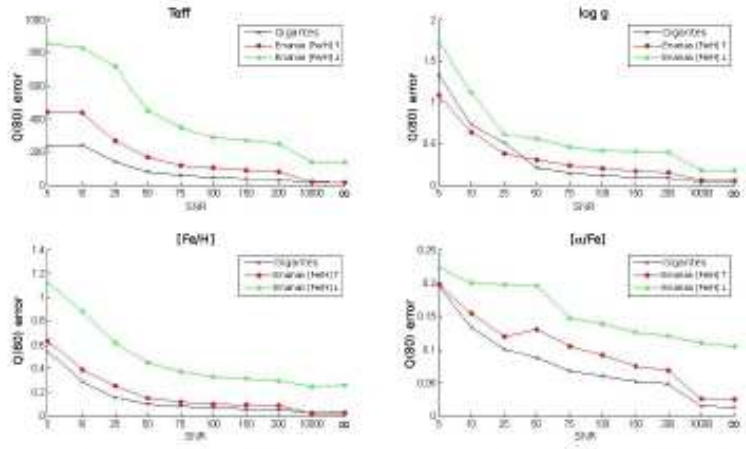
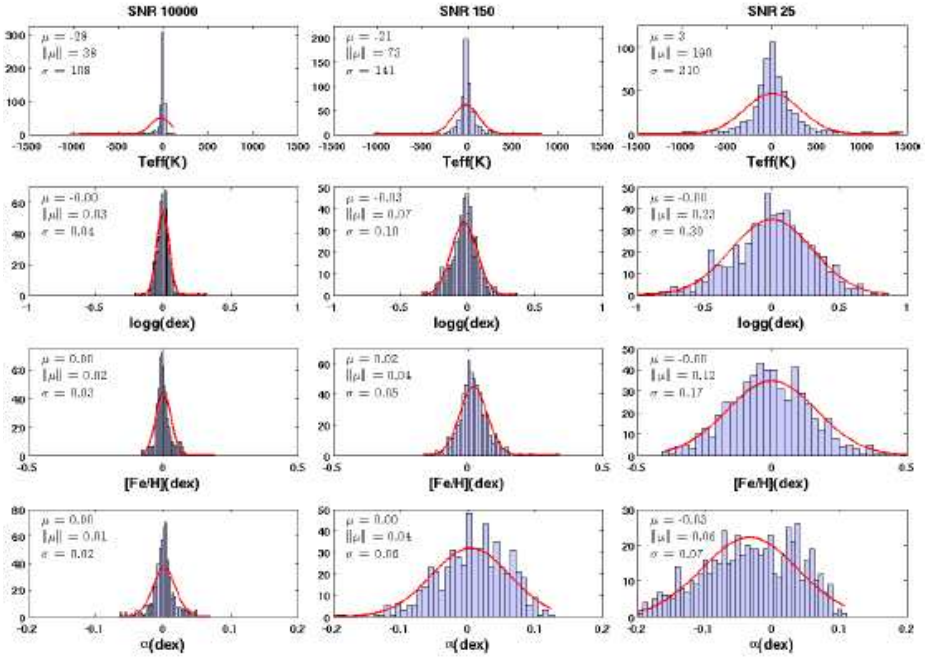


Figura 25: Eficiencia del algoritmo por tipo de estrella y relación señal a ruido (SNR) seleccionando las mejores técnicas



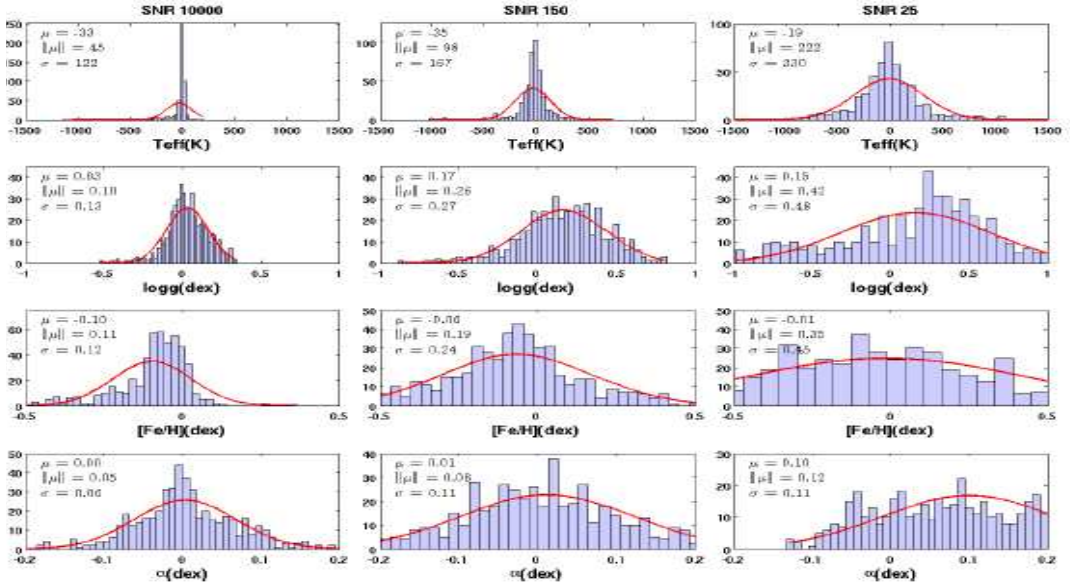


FIGURE 2: ERRORS' DISTRIBUTION OF PARAMETERS DERIVED FOR A SAMPLE OF THIN DISK (LEFT) AND HALO (RIGHT) STARS

3.- GGG CONTRIBUTION TO “OUTLIERS ANALYSIS”

Simulated BP/RP spectrophotometric data among Gaia object classes (stars, physical binaries, dual objects, galaxies, quasars) are used to perform tests on classification of sources. Outliers are those sources that remain unclassified.

Kohomen networks and a hierchical clustering algorithm is used to recover the identity of some of the outliers and to segment and analyse the remaining unidentified objects.

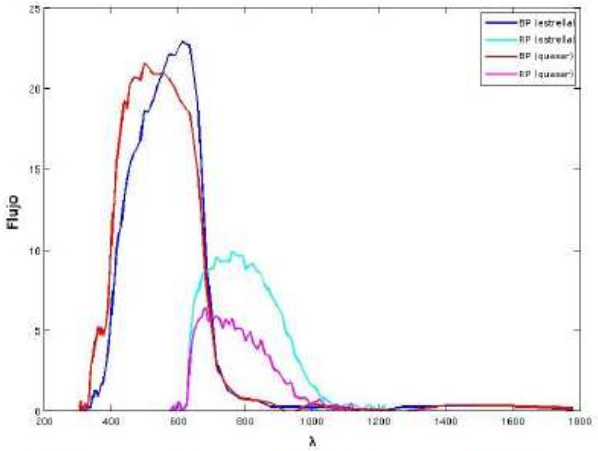


Figura 58: Información espectral. Espectro BP/RP de dos objetos diferentes (Estrella Vs. Quasar)

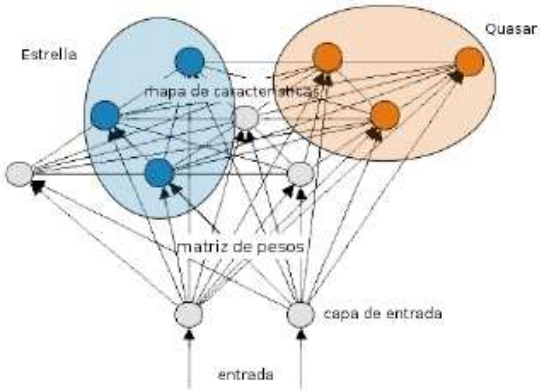


Figura 59: Ejemplo de identificación de zonas en el mapa de salida

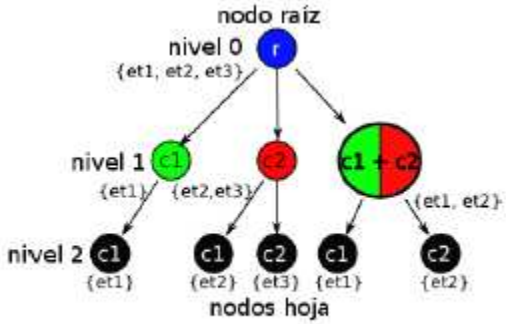


Figura 72: Estructura Jerárquica, nodos y etiquetas

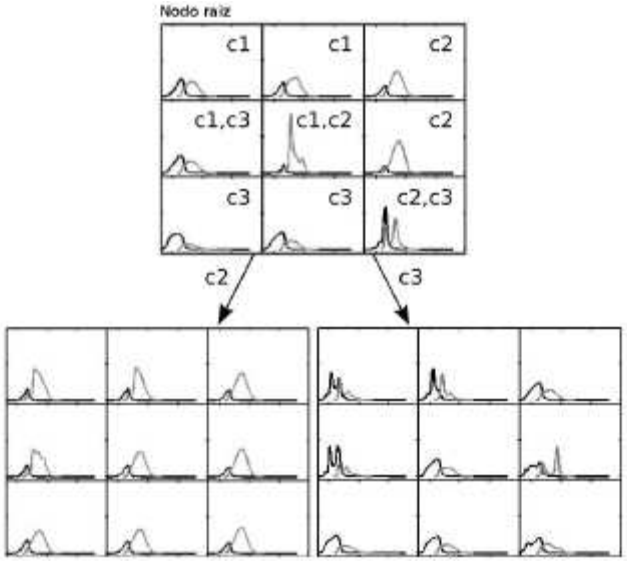


Figura 70: Descomposición jerárquica de la clasificación en mapas más detallados

Tabla 54: Matriz de confusión en las predicciones a una clase, conjunto postclase

%	Estrella	Galaxia	Binaria	Quasar	Desconocido	Num. Ejemplos
Star	0	85 %	15 %	0	0	33
Galaxy	0	100 %	0	0	0	13
PhysBin	0	0	100 %	0	0	16
Quasar	0	0	0	97 %	3 %	30