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# Taxonomy of asteroid spectra using density-based clustering methods in the Gaia era

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## Abstract

In 2021, the Gaia mission will release its third data set of measurements including for the first time thousands of reflectance spectra of asteroids. For the final release of Gaia, this number is expected to increase to 100 000. The reflectance spectra are derived from spectro-photometric detectors covering wavelengths from blue to red (from 325 to 1100 nm). The official full Gaia Taxonomy of asteroids will be delivered during the final data release. In this presentation, we will describe the density-based clustering methods used for deriving this taxonomy but also other modern approaches that could be considered in the future.

## 1. Introduction

The ESA Gaia mission has delivered, during its second data release in 2018, its first observations of solar systems objects (SSOs) [1]. The content of the Gaia SSO products was mainly focusing on astrometry and first estimates on integrated photometry. For the data release (DR) 3 planned on 2021, spectro-photometric data will be first delivered. The payload of Gaia is composed of two spectro-photometric detectors covering wavelengths from the blue (Blue Photometer: BP) to the red (Red Photometer: RP) [2]. In the figure 1, the BP/RP passbands of the Gaia DR2 photometric system are presented. Using BP/RP spectra, reflectance spectra of thousands of asteroids will be delivered in the Gaia DR3. It is expected for the DR4 to have more than 100 000 asteroid reflectance spectra. Based on this, a robust taxonomic classification will be provided by Gaia that will be the state of the art.

## 2. Spectral Clustering

Asteroid taxonomical classification are mainly based on spectra (e.g. Tholen taxonomy, Bus taxonomy and Bus & De Meo taxonomy). The most widely used is the one of Bus & De Meo that first embed the data into a space where the variances is maximal using the Principle Component Analysis technic. In [3], we introduced the method developed for processing Gaia data that use the concept of graphs to highlight overdensities of asteroids having similar spectra. In the future, we can also envisage other density-based clustering that could be used for spectra clustering of asteroid reflectances, such as density peak [4]. Here, we will present the method, its applications to asteroid spectroscopy and some results. We will also describe comparison with established asteroid taxonomies.

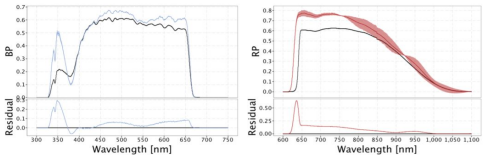


Figure 1: Revised set of calibrated Gaia passbands for $G_{BP}$ (left) and $G_{RP}$ (right)

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# References

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