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Gaia DR3 and colors of the Solar System

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The Gaia third data release (DR3) includes the mean reflectance spectra of 60 518 asteroids at visible wavelengths (0.374–1.05 μm), which is a 10-fold increase in the number of known asteroid spectra (Galluccio et al. 2022). This huge increase in the number of available asteroid spectra provides more detailed distributions of various taxonomies across the Solar System and thus expands our undestanding of the formation of the Solar System.

The Gaia spectral data are acquired by the blue and red photometers (BP/RP) (Gaia Collaboration 2016; Prusti et al. 2016). For each object, average spectra sampled at 16 wavelengths (in the range between 0.374 and 1.034 μm every 0.044 μm) together with 16 quality flags are provided. These spectra are the result of averaging typically more than 20 individual epoch spectra for each object (Galluccio et al. 2022). One epoch corresponds to a single transit of an asteroid in the Gaia focal plane. Thus each average spectra is composed of individual spectra taken at different phase angles - different phase reddening. The Gaia DR3 asteroid spectra is also burdened with systematic and random errors which are more complex for moving objects.

We focused on clasification of basaltic asteroids with various machine learning methods. These asteroids are thought to be parts of crust of differentiated planetesimals - that is planetary embroys that existed 4 bilion years ago. Their multiplicity, distribution, and physical characteristics are crucial for providing context for and constraining the theoretical evolution models of the Solar system and terestial planets. We were able to identify ~2000 new basaltic asteroids, out of which ~350 pass our validation criteria. We found great diversity of spectral parameters amoung these objects. Furthermore, a few asteroids exhibited peculiar spectra that warrant ground-based follow-up observations.

Author: OSZKIEWICZ, Dagmara (Adam Mickiewicz University)

Presenter: OSZKIEWICZ, Dagmara (Adam Mickiewicz University)

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