Spectrophotometric characterization of minor planets using VISTA-VHS survey - MOVIS catalog

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A new large database with NIR colors of asteroids

- This large set of photometric data in the 0.8 - 2.5 um, where diagnostic spectral features are expected, will allow to refine and complement the asteroids big picture.
- VISTA (Visible and Infrared Survey Telescope for Astronomy) is a 4-m class telescope which performs a survey with Y, J, H, Ks filters.

The sky area covered by VISTA surveys (the telescope is shown in upper-left corner).

VISTA filter response curves compared with two asteroid spectral types.

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Methods: Search in VISTA-VHS observations and retrieve the data that corresponds to solar system objects (SSo).

Block diagram of MOVIS solar system objects recovering pipeline.

Number of objects characterized with different colors.

Distribution of objects in semi-major axis vs eccentricity plot.


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Compositional information from color-color plots

- The colors found for asteroids with known spectral properties reveal well-defined patterns corresponding to different compositions;
- All diagrams that use \((Y-J)\) color separate the taxonomical classes more efficiently than the \((J-H)\) and \((H-Ks)\) plots used until now.

(J-Ks) and (Y-J) colors of asteroids. Left: those with visible spectra and taxonomic classification. Middle: colors computed for the template spectra of the taxonomic classes from DeMeo et al. (2009) compared to the MOVIS-C data with color errors less than 0.033. Right: MOVIS-C data obtained with a color error less than 0.1 compared to the colors of the Sun (yellow dot).

Taxonomic classification based on near-infrared colors

- **Method I.** Map the Y-J versus J-Ks plot; objects with accurate photometry can be easily classified. **Method II.** Find the probability that a set of observations are compatible with a taxonomic class (following Carvano et al. 2010). Data from other surveys can be integrated with this method.

- We were able to classify about 10,000 objects based on their NIR colors. The end-member classes (A, V, O, D) can be easily identified even for large photometric errors.

The regions corresponding to Bus-DeMeo taxons. Distribution of classes found for objects with all MOVIS colors and geometrical albedos.

Popescu et al., Paper in preparation
Case study: V-types identified by 
\((Y - J) \geq 0.5\) and \((J - K_s) \leq 0.3\)

- We found 477 V-type candidates in MOVIS-C, 244 of them outside the Vesta dynamical family.
- We identified 19 V-type asteroids beyond the 3:1 mean motion resonance, and 16 V-types in the inner main belt with proper inclination \(i_p \leq 3.0^\circ\), well below the inclination of the Vesta family.
- We computed that \(\sim 85\%\) of the members of the Vesta dynamical family are V-type asteroids, and only 2\% are primitive asteroids unlikely members of the family.

Color distribution of the V-type candidates.

Distribution of V-type candidates in the proper orbital elements.

Licandro et al., Paper submitted to A&A

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Conclusions

- The near-infrared colors and the magnitudes of 35,000 asteroids observed by the VISTA survey are presented (Popescu et al. A&A 2016).
- The distributions of MOVIS-C data in color-color plots shows clusters identified with different taxonomic types.
- All the diagrams that use (Y-J) color separate the spectral classes more efficiently than the (J-H) and (H-Ks) plots used until now. The end members A, D, R, and V-types occupy well-defined regions.
- We taxonomically classified about 10,000 asteroids.
- We found 477 V-type candidates in MOVIS-C, 244 of them outside the Vesta dynamical family. We studied their distributions relative to the colors and to the proper elements (Licandro et al., paper submitted to A&A 2016.)

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Additional plots

- Histogram showing the number of objects vs. time in minutes.
- Scatter plots comparing magnitude errors for different bands (Y, J, Y-J, Y-H, Y-Ks, J-H, J-Ks, H-Ks).

Axes:
- X-axis: Predicted magnitude (V_{predicted})
- Y-axis: Error (Magnitude error)
Additional plots
Additional plots
Additional plots
How many objects

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<th></th>
<th>$(Y - J)_{errlim}$</th>
<th>$(J - Kₛ)_{errlim}$</th>
<th>$(H - Kₛ)_{errlim}$</th>
<th>$(J - H)_{errlim}$</th>
<th>$N_{YJKₛ}$</th>
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