

Asteroid Colors: Observations and Data Reduction

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Setting Up Your Observations

1. Select one or more asteroids to observe from the latest observing list. In addition, select one or more standard stars from the standard star list that will be high in the sky at the time and location of your observations.
2. Reserve observing time on the NMSO or other appropriate telescope. Since these observations require use of the Johnson UBVRI set of filters, the telescope you use must have this set of filters available.
3. On the date of your scheduled telescope time, find the coordinates for your selected asteroid(s) from the Minor Planet center (or other appropriate source).

Making the Observations

1. Sign on to your telescope.
2. Follow the directions for entering the coordinates of your asteroid and moving the telescope to the location. Take one image of the asteroid in each of the five Johnson filters. Be sure and set long enough exposure times (at least a minute for fainter asteroids). Repeat for all asteroids on your observing list.
3. Observe at least one standard star (two or more are better) using the same five Johnson filters.

Reducing Your Data

1. Download your images from the NMSO ftp site, and save them to a permanent storage device. (It is always a good idea to back up your data to a CD in case of problems.)
2. Measure the Normalized Intensity for each filter.
 - A. For each image of your asteroid, use ImageJ and the Astronomy plug-in to measure the raw intensity of the asteroid.
 - B. Divide the raw intensity by the time of exposure in seconds to get the normalized intensity, I_u , I_b , I_v , I_r , I_i , for each filter.
 - C. Repeat for each asteroid and each standard star you observed.
3. Make extinction correction to each filter (TBD)
4. Calculate the Observed Uncalibrated Color Ratios for each asteroid and standard star:
 $(B-V)_{obs} = -2.5 \log (I_b/I_v)$
 $(U-B)_{obs} = -2.5 \log (I_u/I_b)$
(B, V, I ratios – define)
5. Determine Color Ratio Correction Using Standard Star
 - A. Get the Standardized color ratios (B-V, etc.) for each standard star from the table of Standard Stars.
 - B. Calculate the difference between the observed and standard value for each color ratio for each star: $d(B-V) = (B-V)_{obs} - (B-V)$, etc.
 - C. If you have more than one standard star for an evening's observations, average the differences for each color ratio. If you only have one standard, just use the differences for that star.

D. Calculate the standardized color ratio for each asteroid:
 $B-V = (B-V)_{\text{obs}} - d(B-V)$, etc.

Determine the Class of Your Asteroids

Plot the corrected B-V and U-B colors in the reference UB-V Color Diagram below. Your point should fall in or near one of the clusters of colored points representing a particular class of asteroid. In some cases, your asteroid's class will be clear, but in other cases the point will fall in areas of overlap, so that the class may be uncertain. (Eventually, we will have a second, independent color-color plot that will give an additional measure.)

Once you have determined the class of your asteroid, use Table 1 to find the corresponding meteorite class. See "The Meteorite Connection" for a discussion of meteorite types. Then see "Asteroids, Meteorites, and Geologic Processes" for information about possible geologic processes and history of your asteroid.

Submit your measurements and images to the project archive.

Table 1. Asteroid Classes

C	"Carbonaceous" type, like C1 and C2 carbonaceous chondritic meteorites
S	"Silicaceous" type, like ordinary chondrites
M	"Metallic" or "stony-iron" types, like irons or stony-iron meteorites
B	"Modified Carbonaceous" type, like C3 and C4 carbonaceous chondritic meteorites
V	"Vesta" type, like basaltic achondrite meteorites

Note: there are several other classes of asteroids, including F, G, E, etc., which represent variations on these basic types.

UBV Color Diagram

