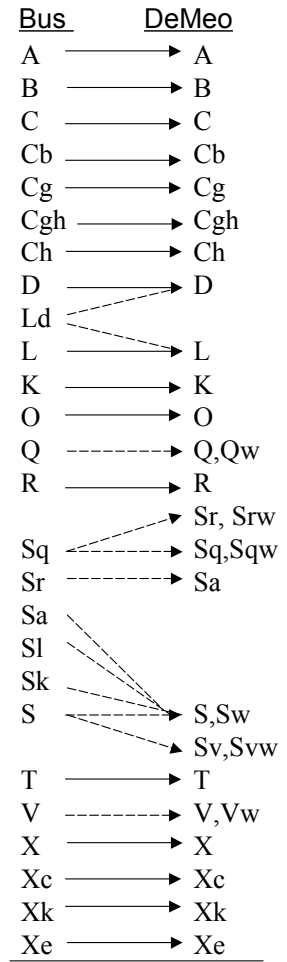# BUS-DEMEO TAXONOMY: EXTENDING ASTEROID TAXONOMY INTO THE NEAR-INFRARED

F. E. DeMeo[1], S. J. Bus[2], R. P. Binzel[3], S. M. Slivan[3], [1]Observatoire de Paris, 5 Place Jules Janssen, F-92195 Meudon Cedex, France, francesca.demeo @ obspm.fr, [2]Institute for Astronomy, 640 N. Aohoku Place, Hilo, HI 96720, sjb @ ifa.hawaii.edu, [3]Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139, rpb @ mit.edu, slivan @ mit.edu.

**The Taxonomy:** Tholen [1] and Bus [2], classify asteroids based on their spectral properties over visible wavelengths. With the advent of near-infrared instrumentation (such as SpeX on the NASA IRTF [3]), an increasing number of asteroids have available spectra covering the entire range 0.45- to 2.45-microns. We seek to extend the current Bus asteroid taxonomy to take advantage of the further spectral information provided over these longer wavelengths. We begin with 0.45- to 2.45-micron measurements of 365 asteroids, sampling all 26 of the classes defined by Bus [2]. We determine which of these classes remain robust (or converge or diverge) when extended to longer wavelengths. The new taxonomy is comprised by 24 classes. The definitions for these classes are quantified by spectral slope and five dimensions of Principal Component Analysis, accounting for a combined 99.9% of the variance. The most striking feature in this new principal component space is the separation of objects based on the presence or absence of a 2-micron absorption feature. We eliminated three Bus classes: Ld, Sl, and Sk. We are able to clarify, and in some cases redefine the Bus S sub-classes (Sa, Sl, Sk, Sq, Sr). A new intermediate class, Sv, bridges the S- and V-classes. We introduce a "w" ("weathered") notation to denote, for example, S-type objects that differ only in slope from their spectral neighbors. (We emphasize "w" is a notation only: S- and Sw-type objects are the same class.) High-sloped S, Sa, Sq, Sr, Sv, V and Q objects are given a "w" notation. We present eigenvectors, a flow chart for classification, plots of the taxonomy boundaries in principal component space, and average spectra for each new class. We also introduce a web based tool for the utilization of this extended taxonomy by other researchers.

**Class Evolution:** The figure to the right [4] demonstrates the evolution of classes from the Bus [2] system to those of this work. Most classes remained fairly consistant with the visible-only system and simply had new boundaries created to encompass the extended wavelength range.

**References:** [1] Tholen, D. J. (1984) Doctoral Thesis. University of Arizona. [2] Bus, S. J. (1999) Doctoral Thesis. MIT, Cambridge, MA. [3] Rayner, J. T. et al. (2003) Astron. Soc of the Pacific 115 362. [4] DeMeo, F. E. (2007) Masters Thesis. MIT, Cambridge, MA.

| Bus | DeMeo |
|-----|-------|
| A | A |
| B | B |
| C | C |
| Cb | Cb |
| Cg | Cg |
| Cgh | Cgh |
| Ch | Ch |
| D | D |
| Ld | |
| L | L |
| K | K |
| O | O |
| Q | Q,Qw |
| R | R |
| | Sr, Srw |
| Sq | Sq,Sqw |
| Sr | Sa |
| Sa | |
| Sl | |
| Sk | |
| S | S,Sw |
| | Sv,Svw |
| T | T |
| V | V,Vw |
| X | X |
| Xc | Xc |
| Xk | Xk |
| Xe | Xe |

Total:   26        24

Eliminated: Ld, Sk, Sl    Created: Sv

w notation does not denote a distinct class.