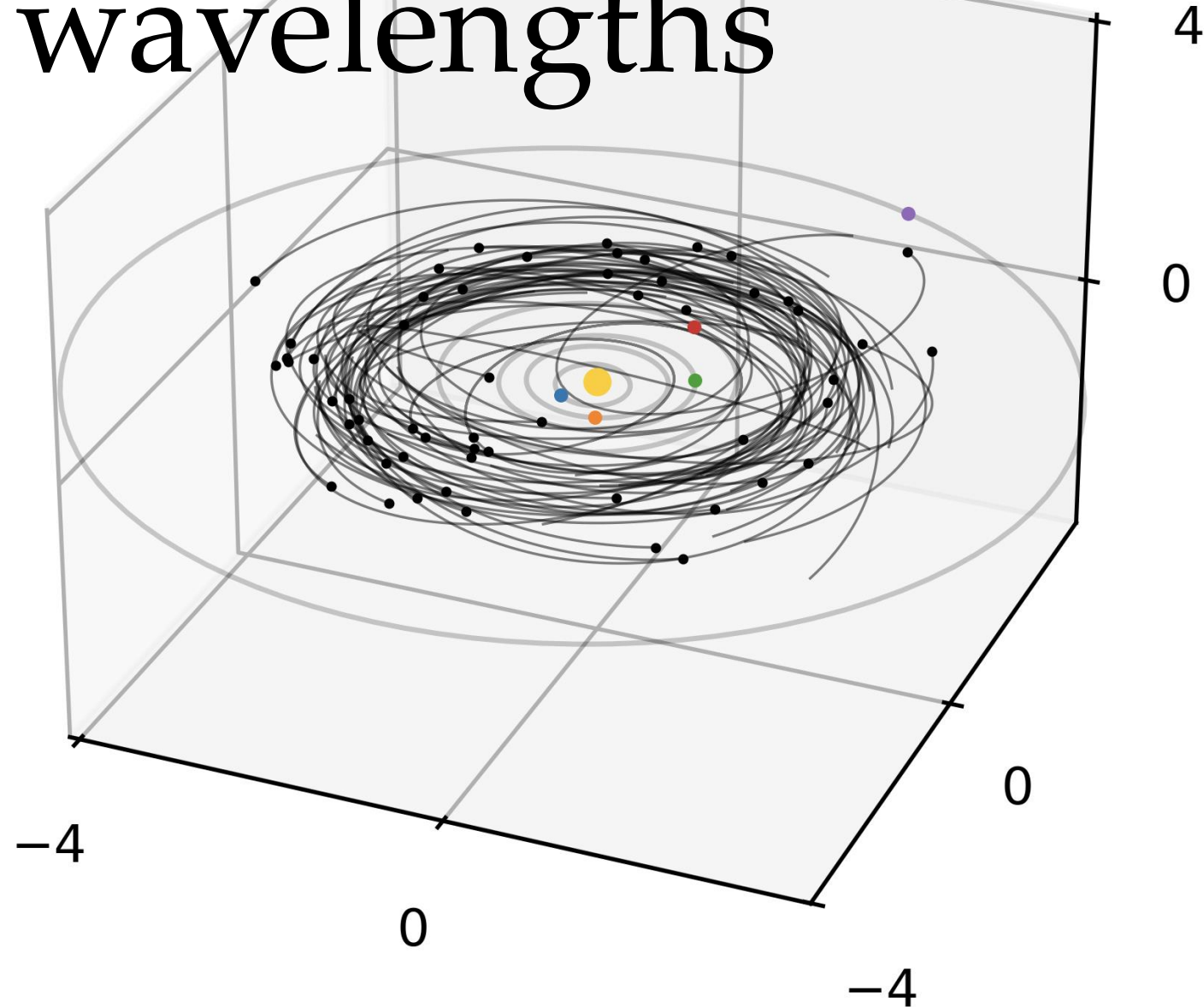


Asteroid polarization at near-infrared wavelengths

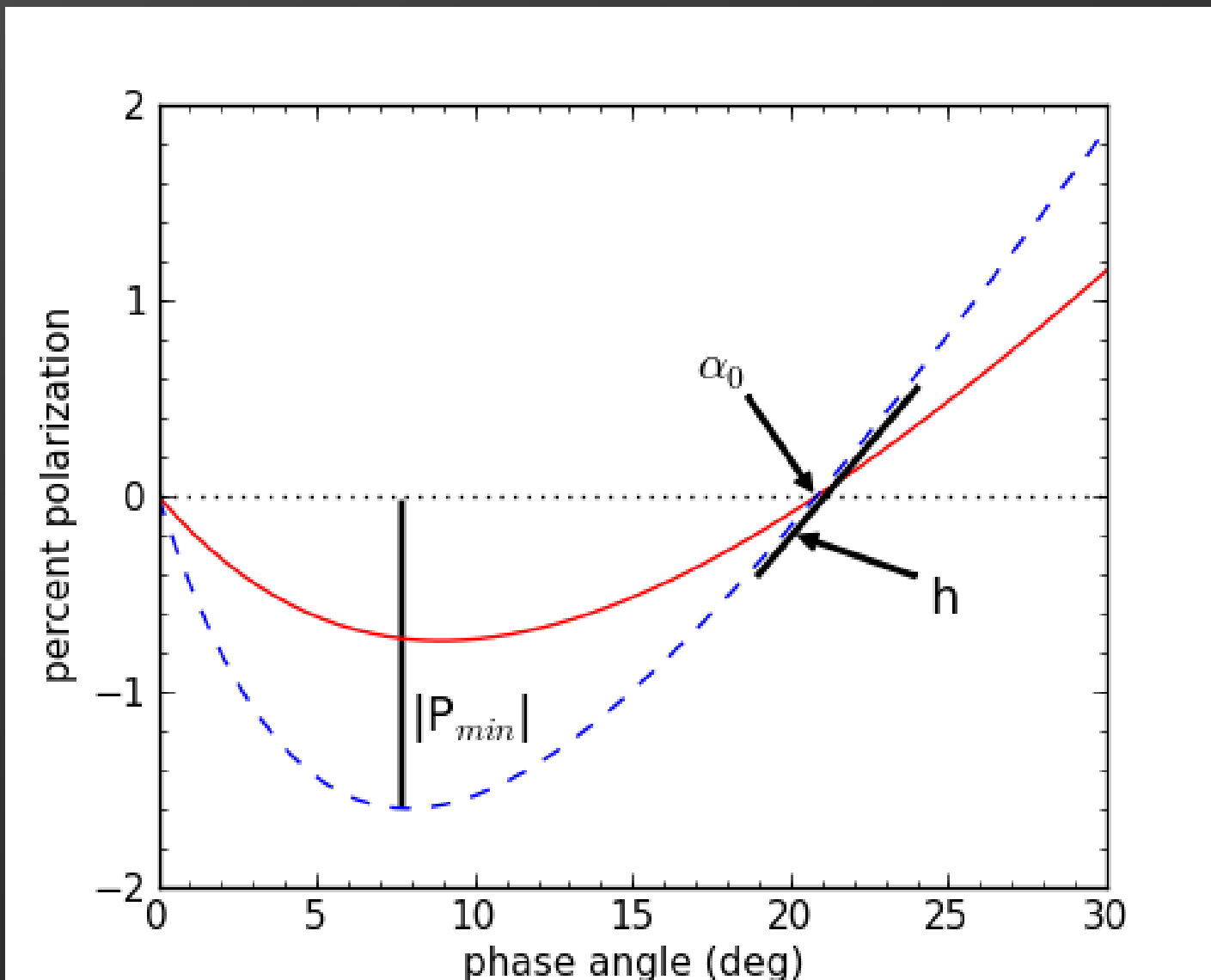
Joe Masiero
Caltech/IPAC

With: Yuna Kwon,
Dar Dahlen, Manaswi Kondapally, Elena
Selmi, Bella Macias, Joahan Castaneda Jaimes

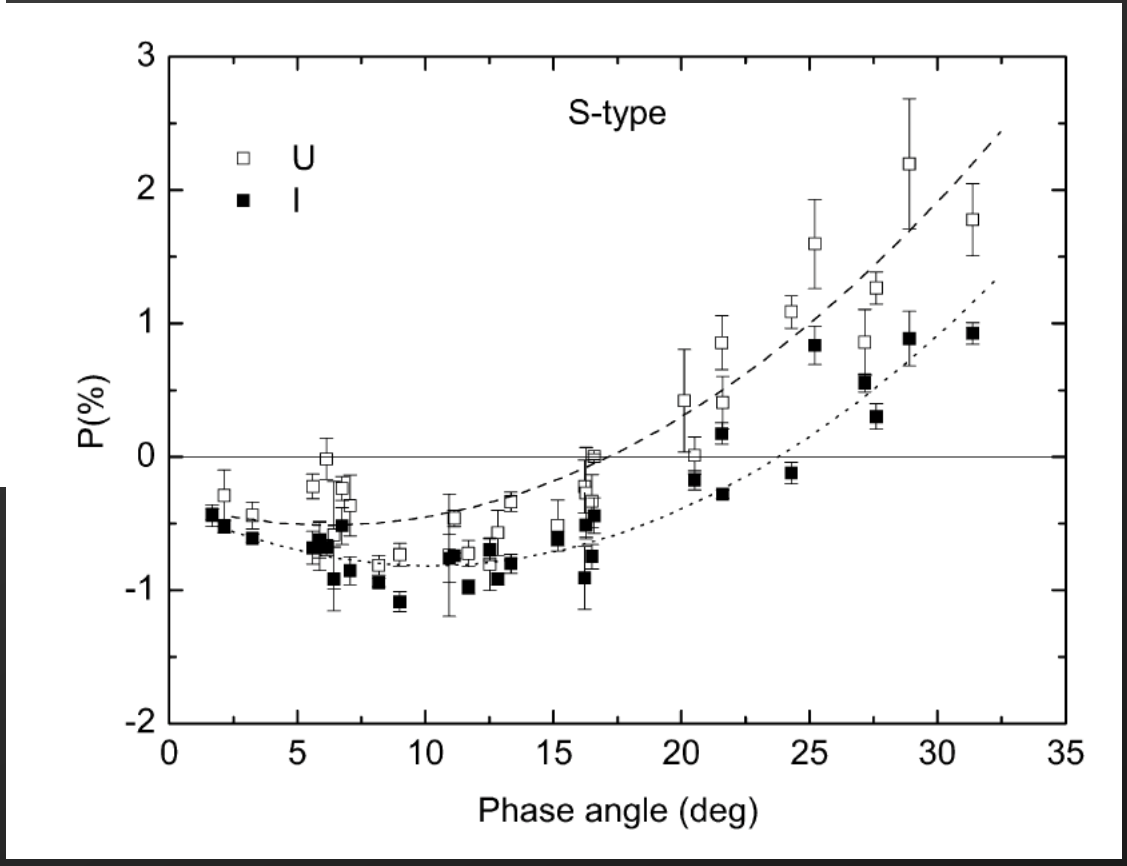
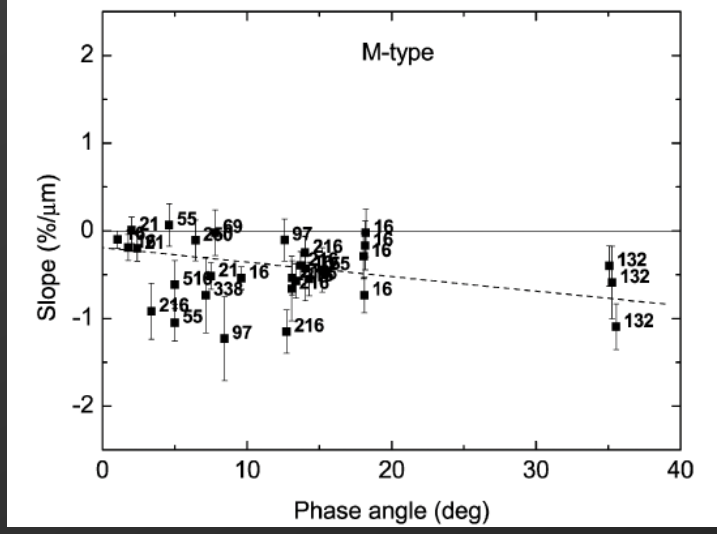
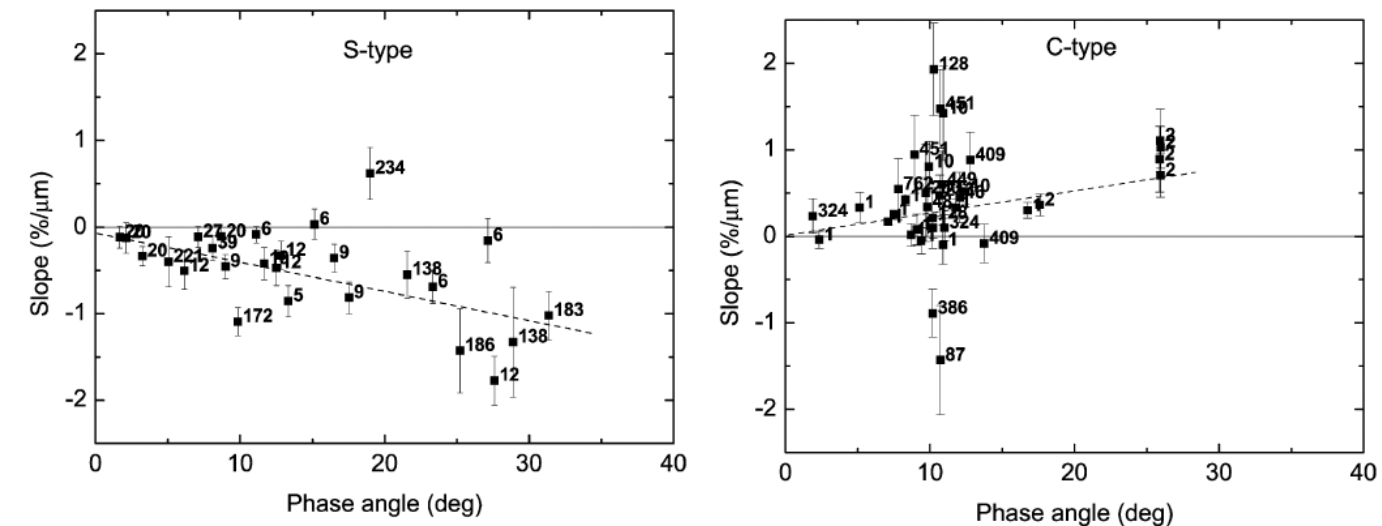
EU-ESA Workshop
2024-11-13



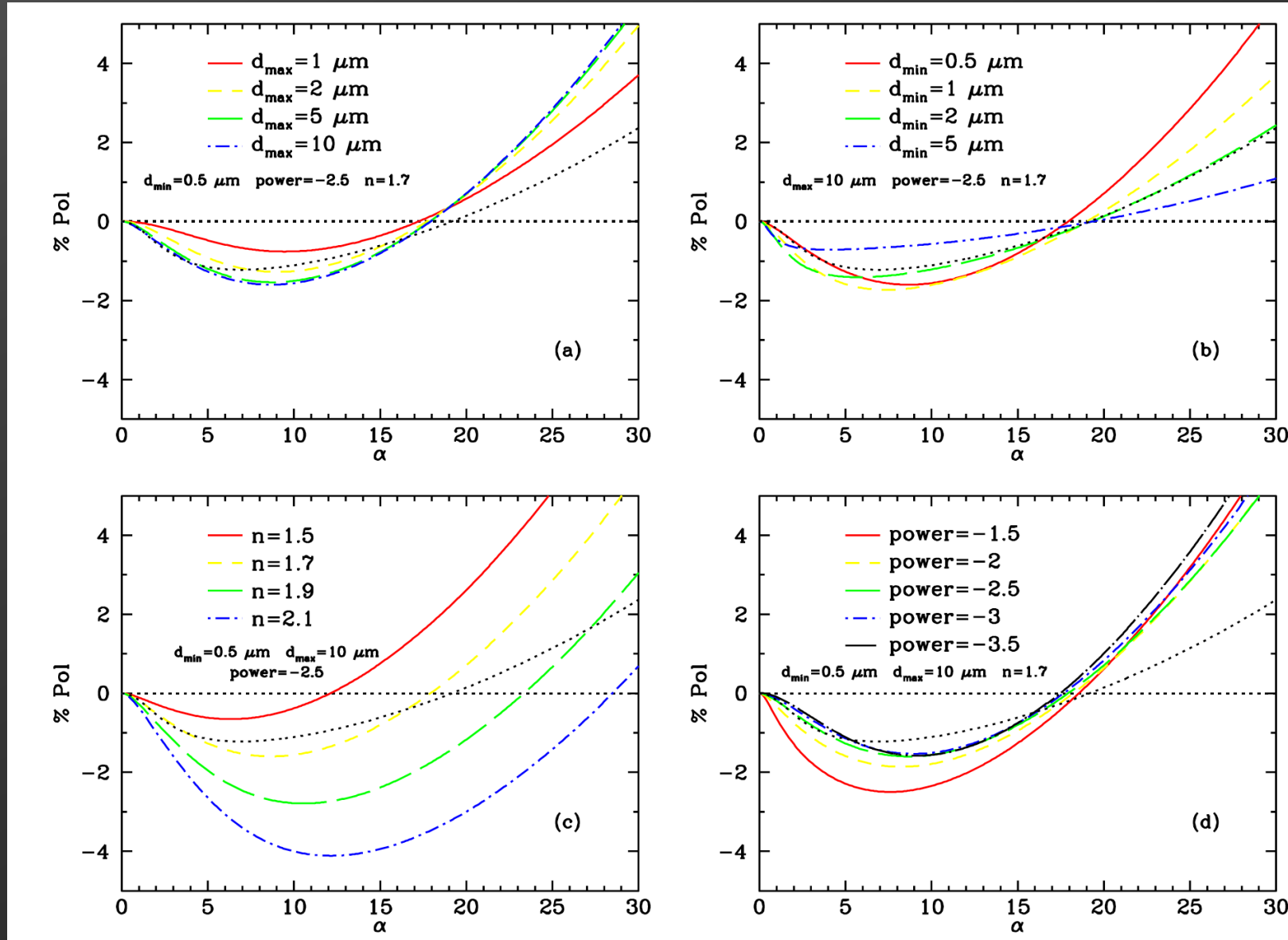
Asteroid Polarization Phase Curves



Polarization changes with wavelength



Polarization changes as a function of dust properties



Palomar



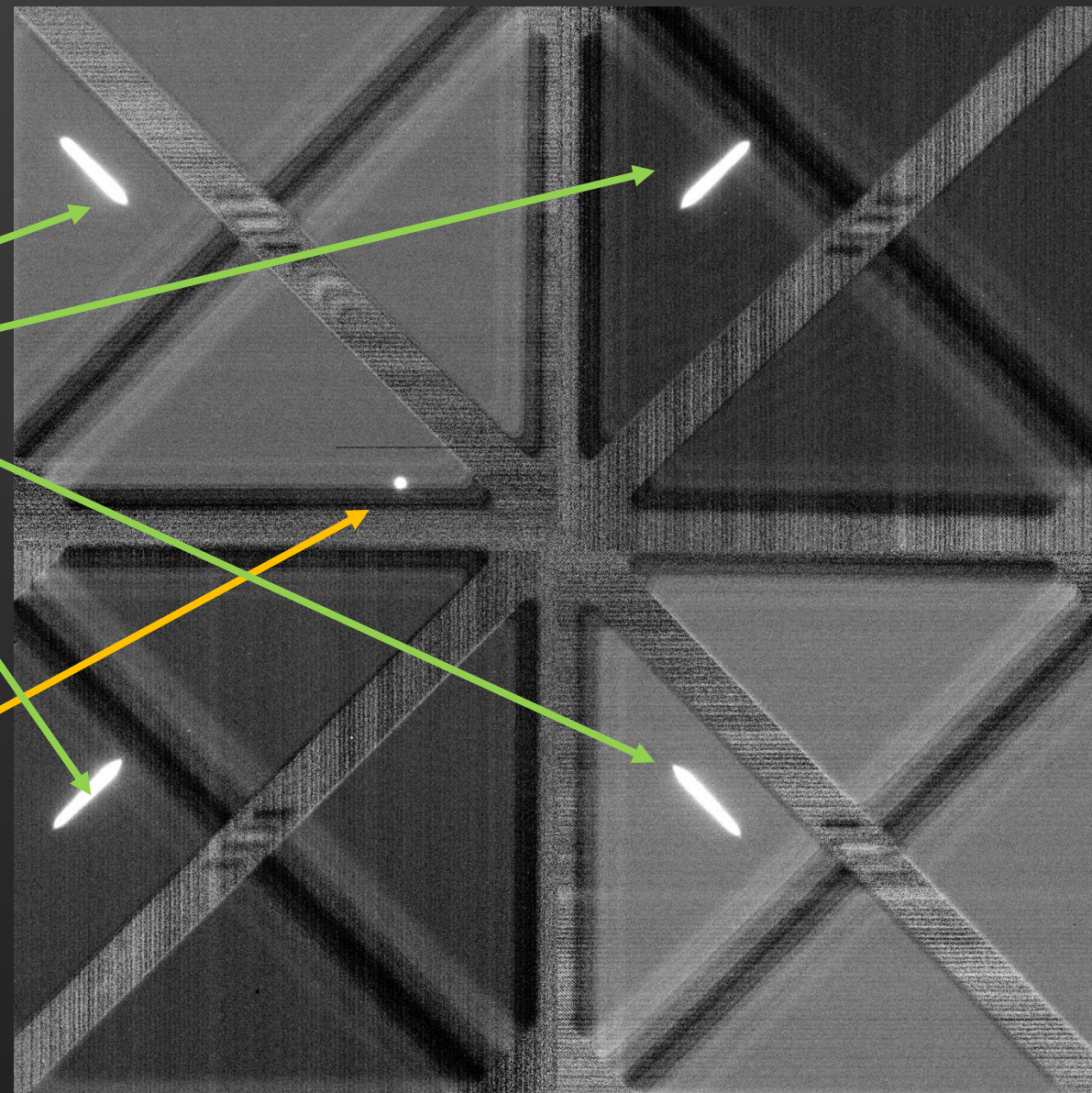
NIR polarimetry with WIRC+Pol on Palomar

WIRC-Pol on the 5m Palomar telescope provides polarimetric capabilities in J and H band.

WIRC+Pol uses a polarization grating to simultaneously obtain low-resolution spectra of the +Q, +U, -Q, -U Stokes components.

A half-wave plate upstream of the grating allows the components to be beam-swapped, further improving polarimetric sensitivity

An example WIRC+Pol image is shown at the right. The zeroth order from the grating is visible as the point source.



WIRC+Pol asteroid survey

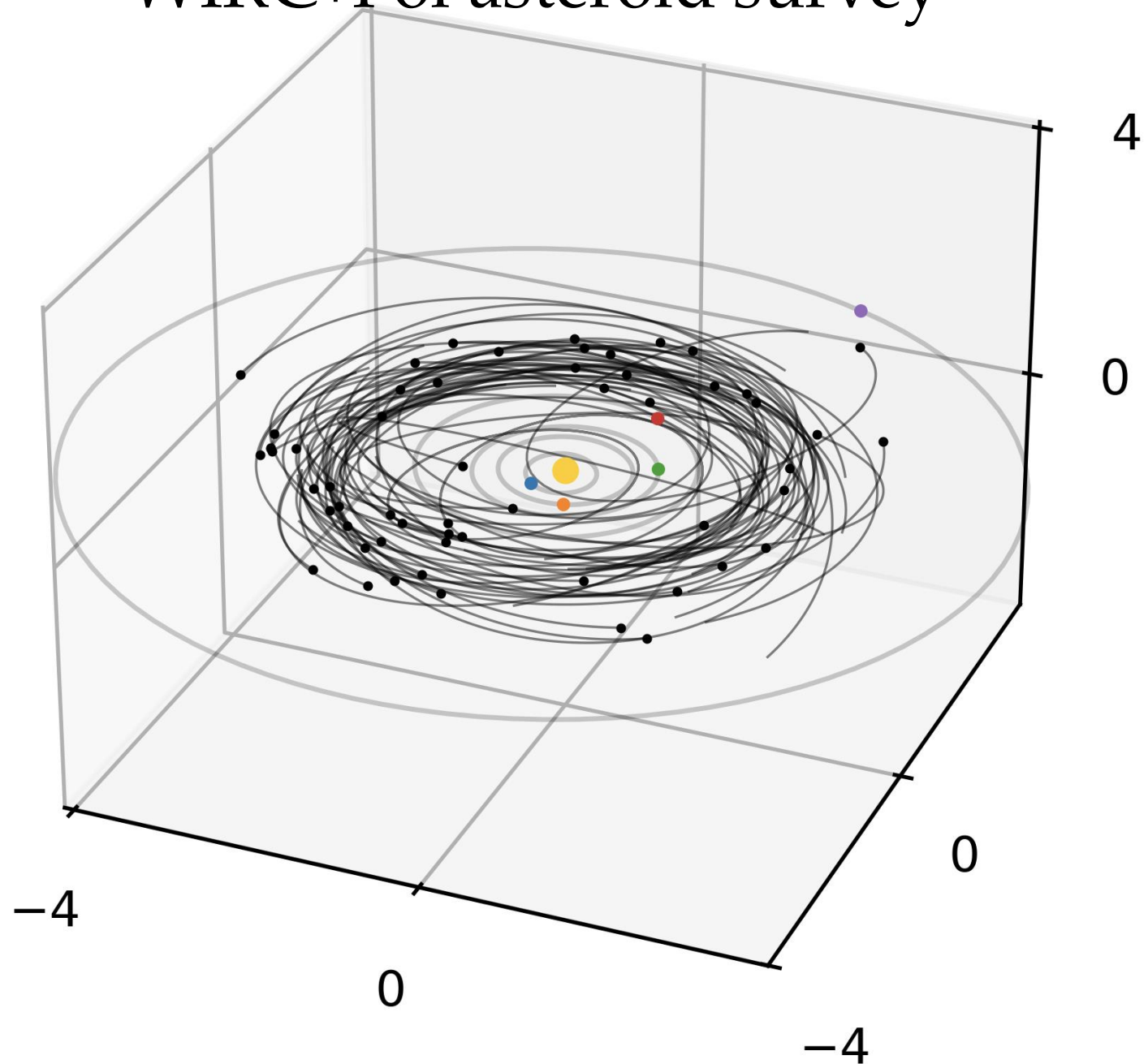
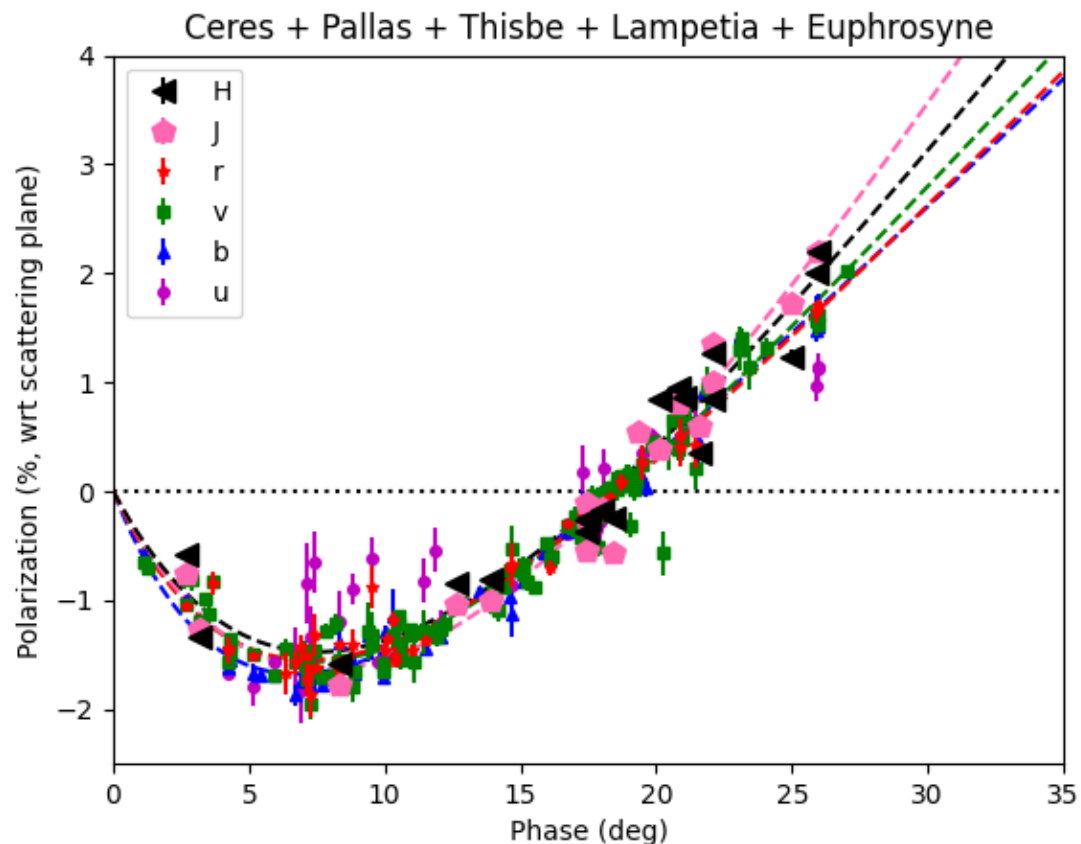


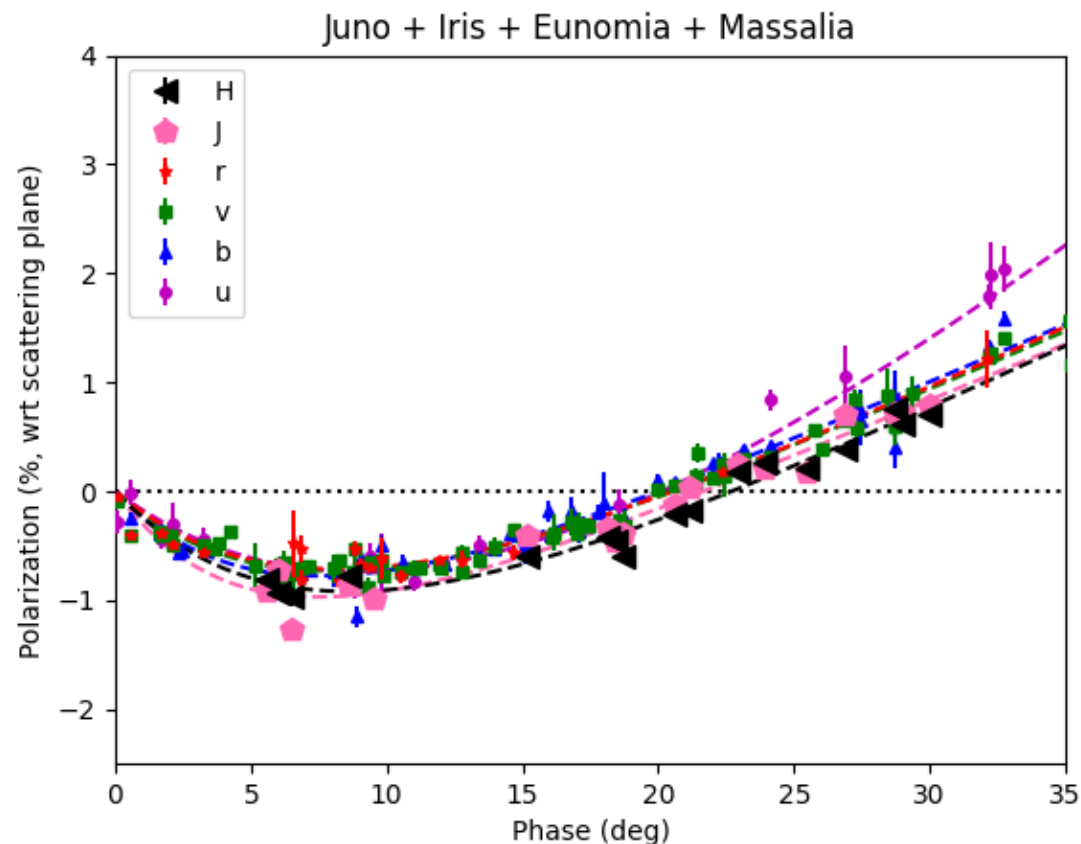
Figure made with kete
([github/Caltech-IPAC/kete](https://github.com/Caltech-IPAC/kete))

Polarization Trends from Visible to Near-Infrared

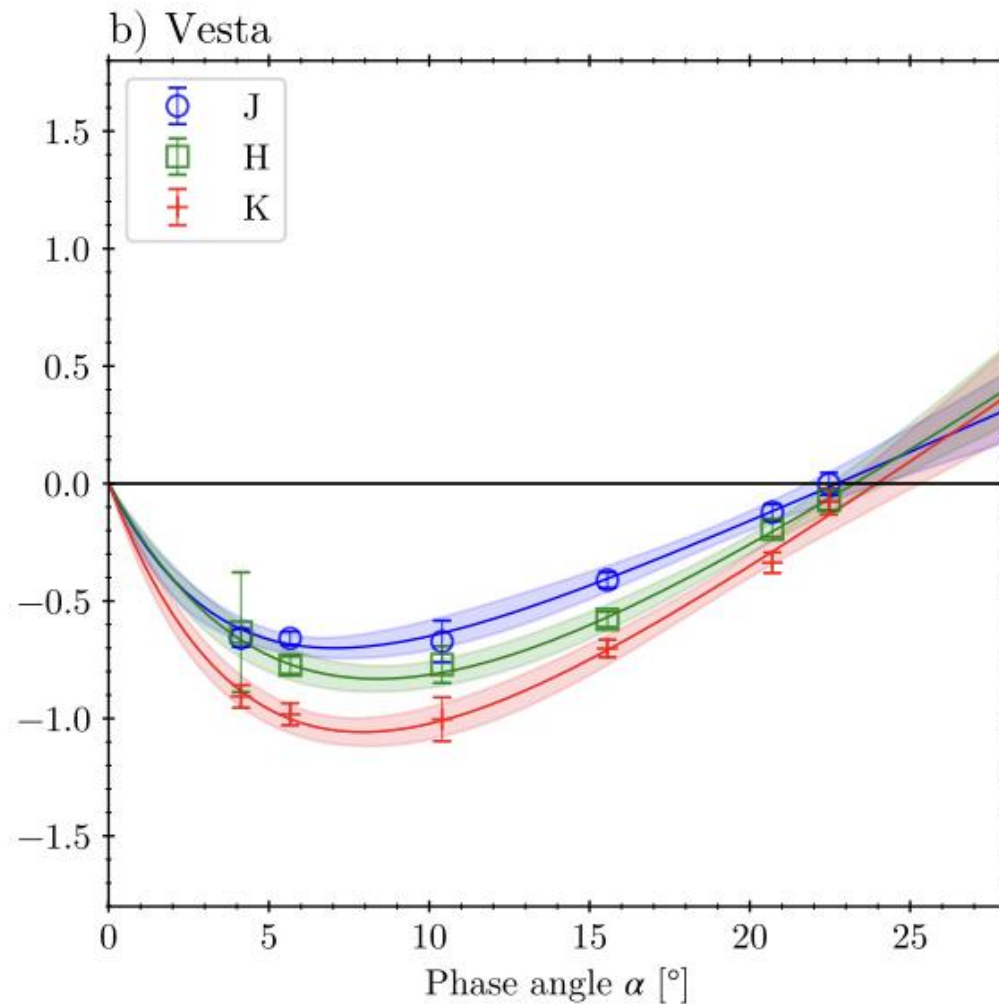
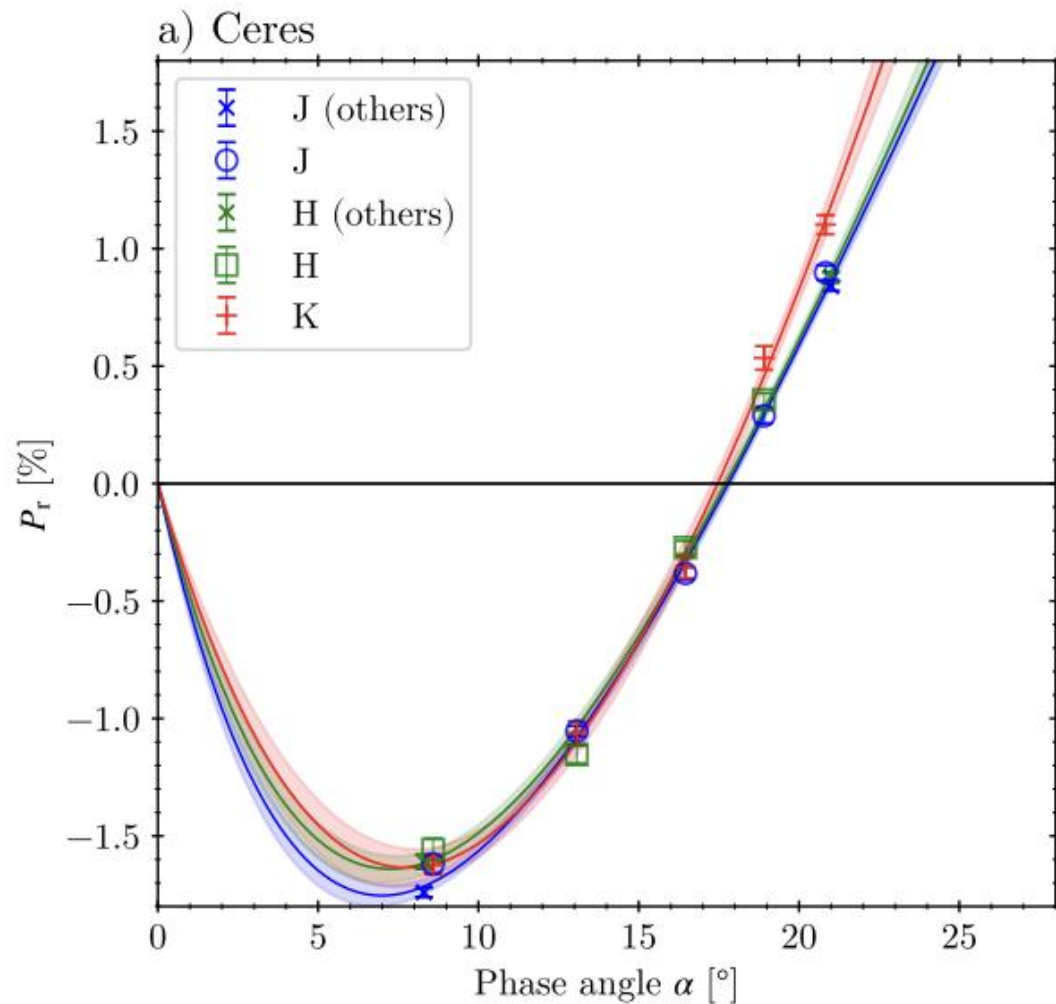
C-complex – CC-like



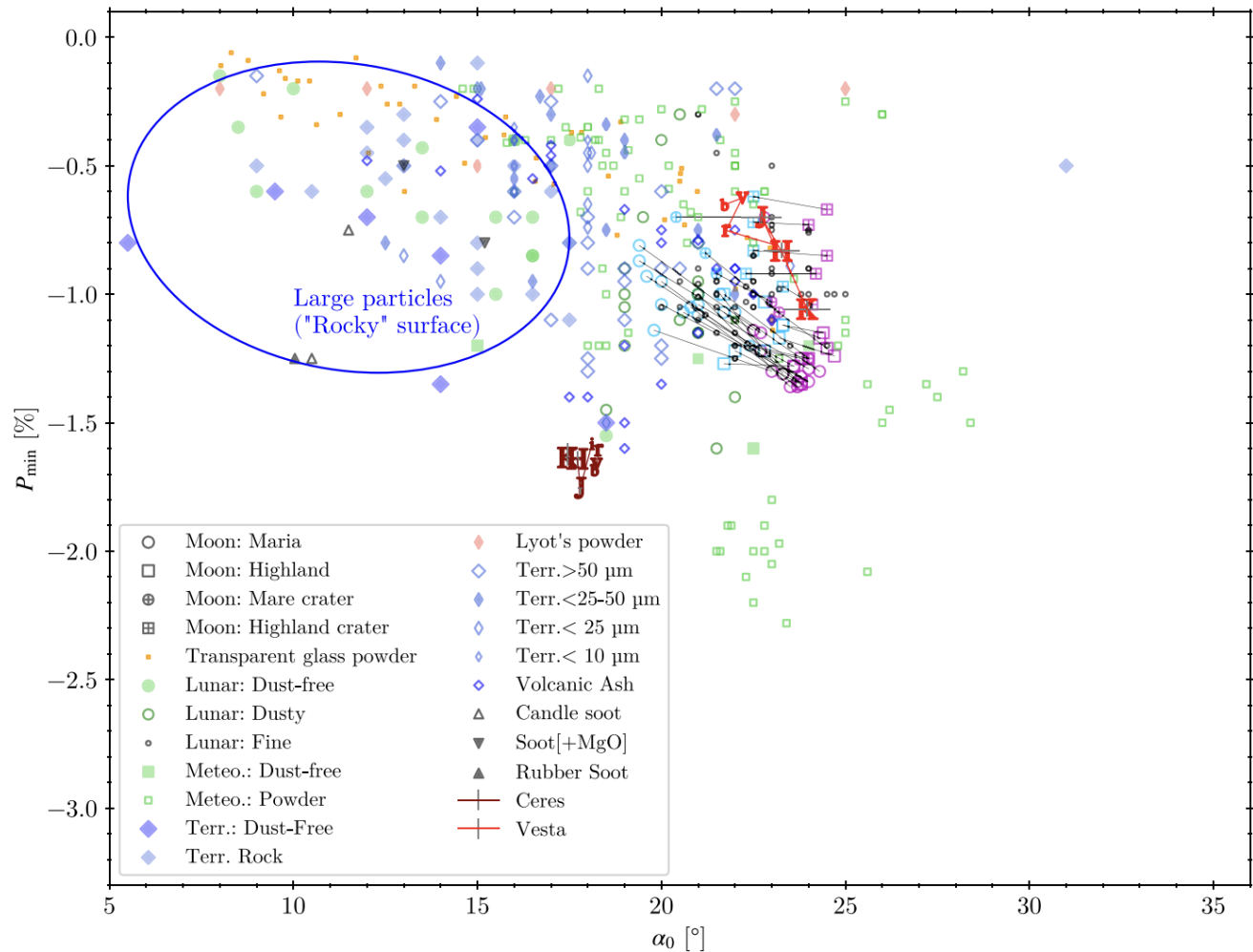
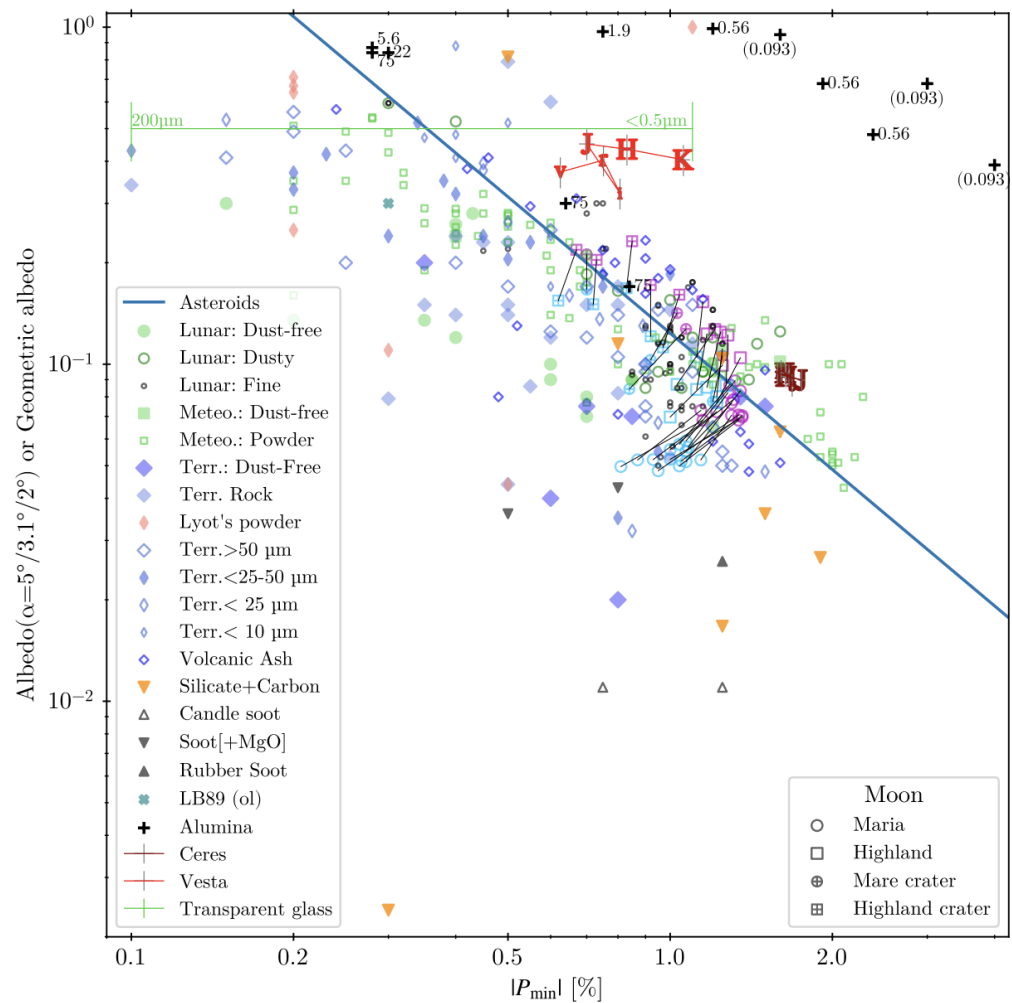
S-complex – OC-like



Polarization Trends from Visible to Near-Infrared

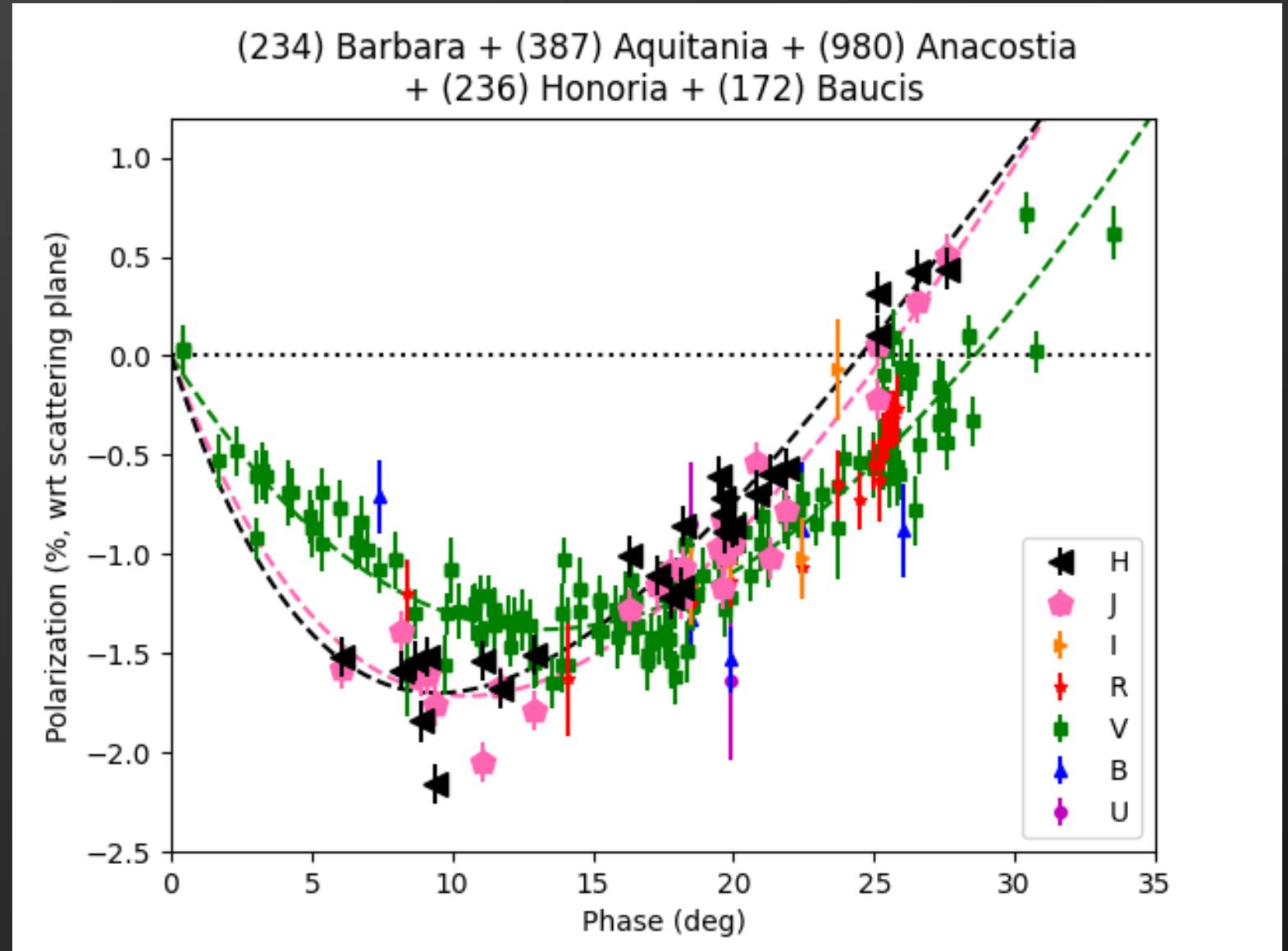


Polarization Trends from Visible to Near-Infrared

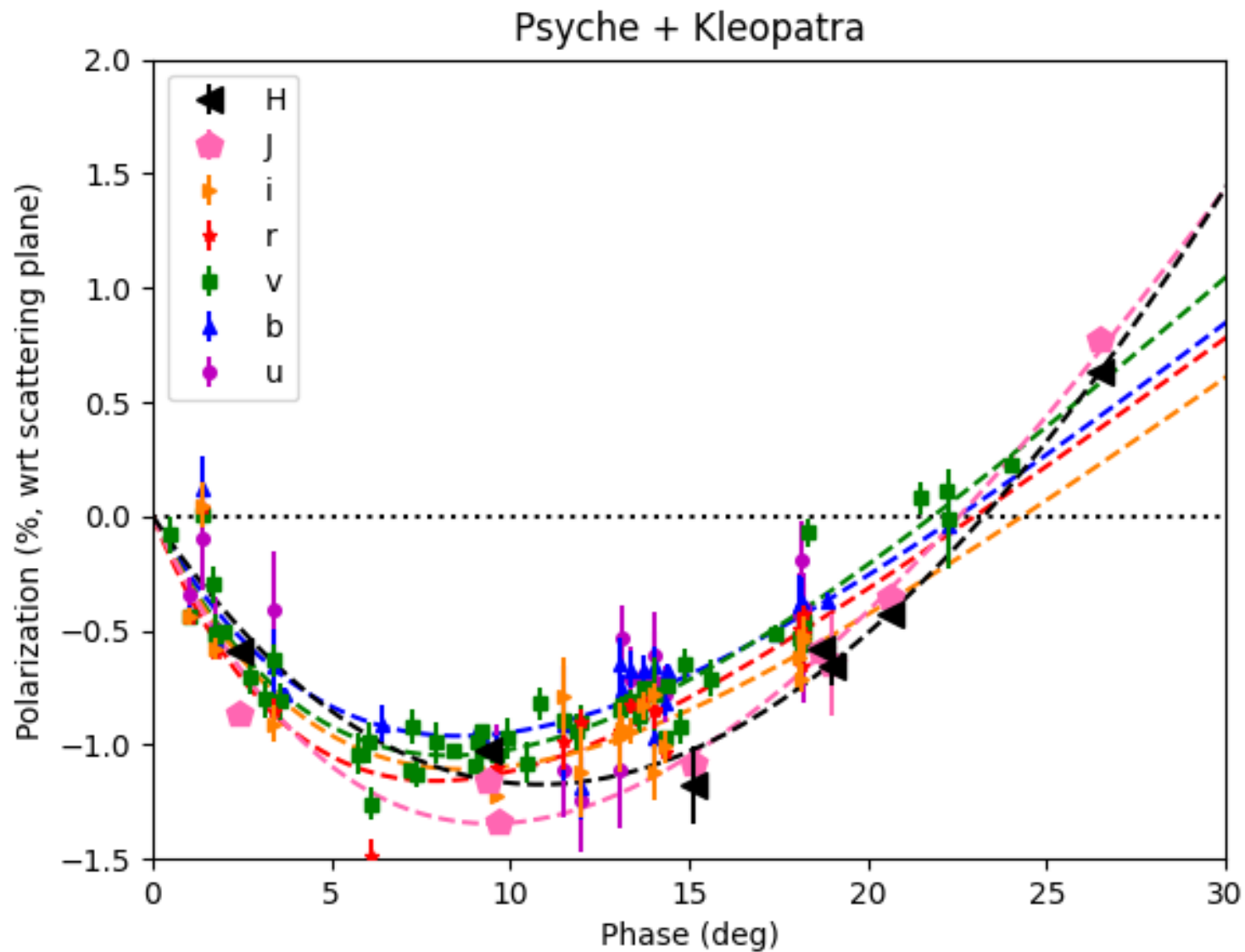


Anomalous objects: The Barbarians

- Asteroid spectra consistent with spinels/CAIs mixed with a dark matrix (Sunshine et al. 2008; Devogele et al. 2018)
- Shift from visible to NIR indicates spinel “grains” are small ($\sim 1 \mu\text{m}$) and thus less efficient at scattering
- J and H polarimetry are then tracing background/matrix material which looks closer to CC-like

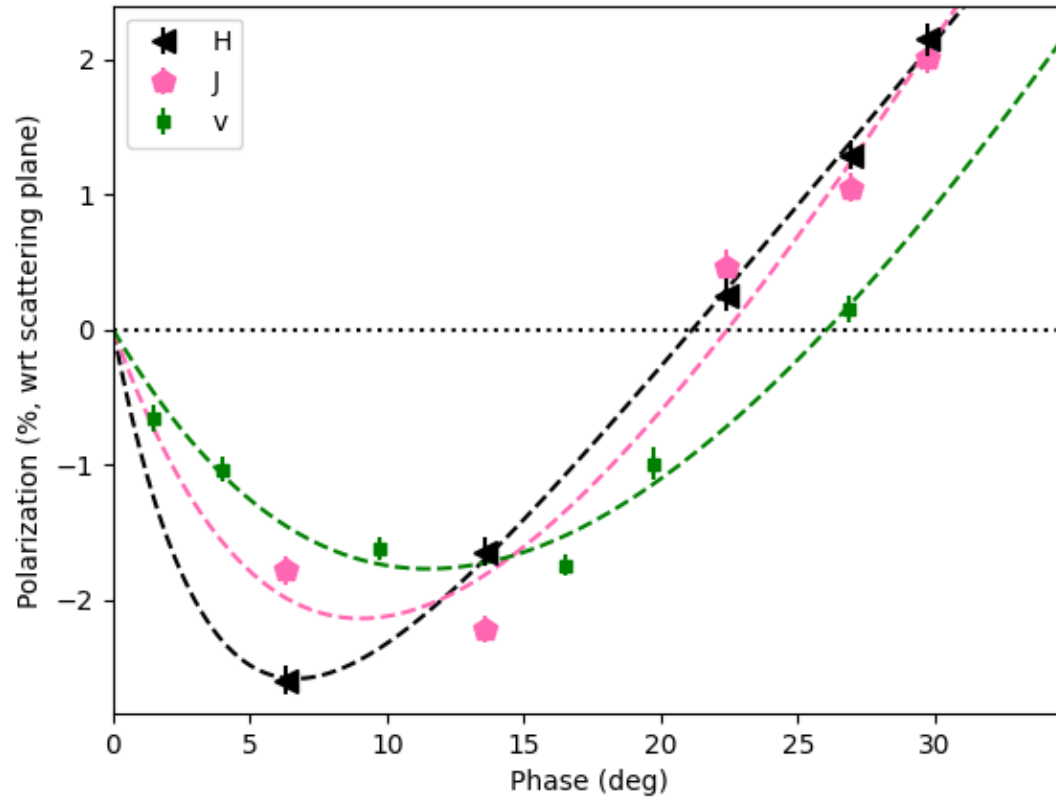


Anomalous objects: The Metallics

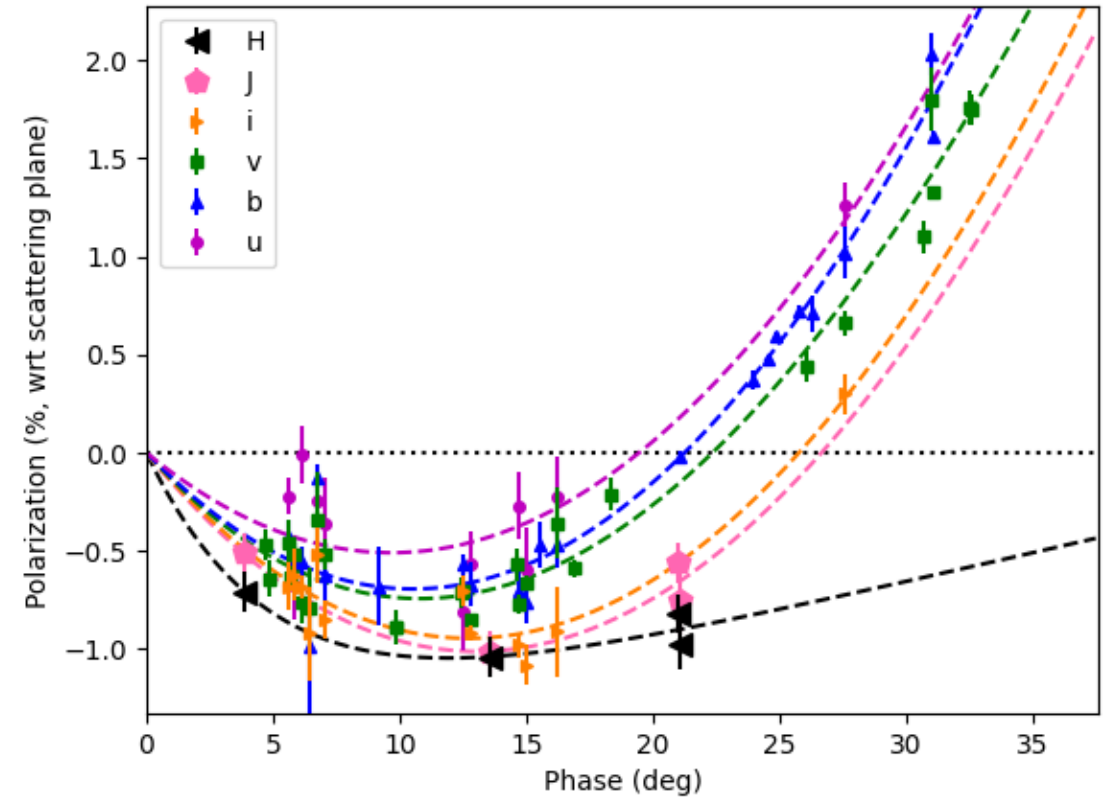


Anomalous objects: The Others

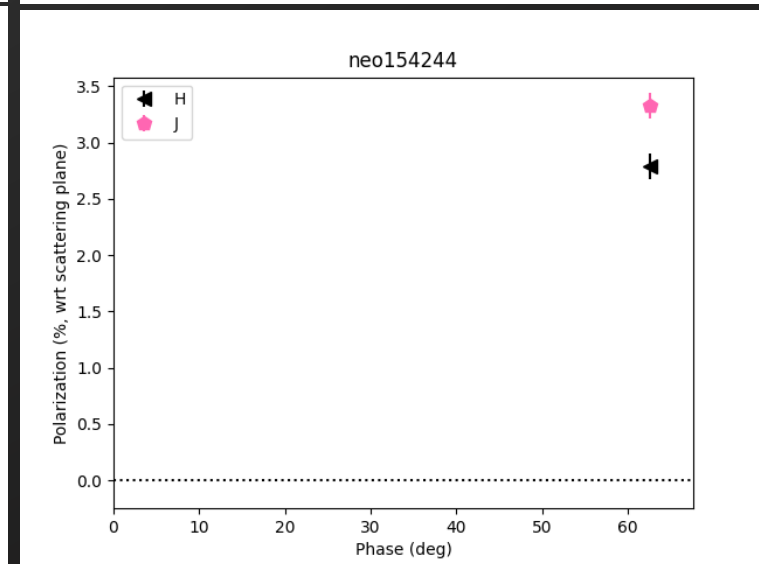
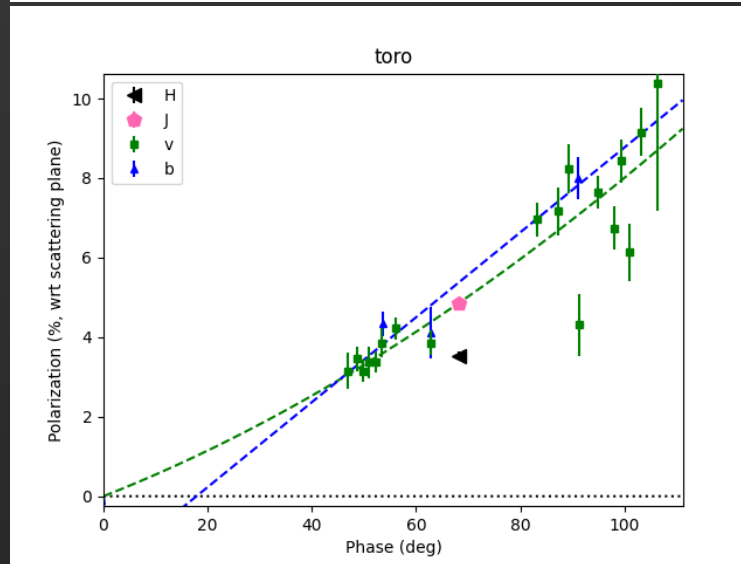
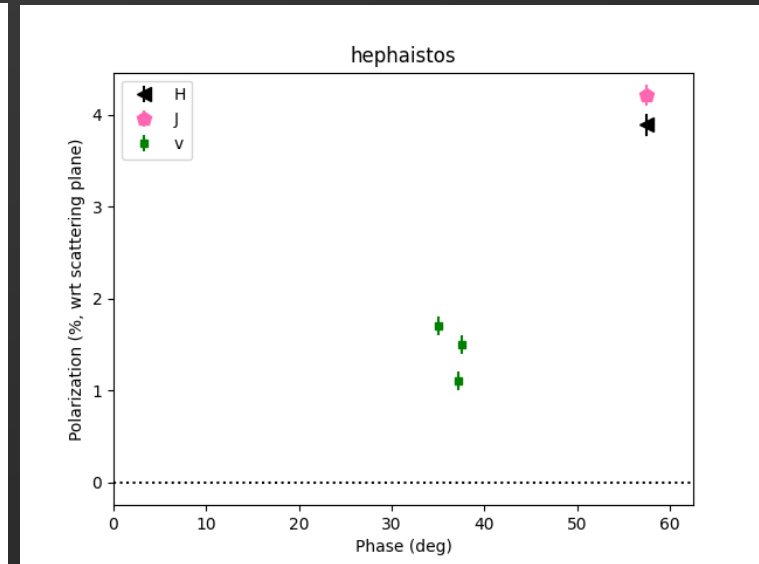
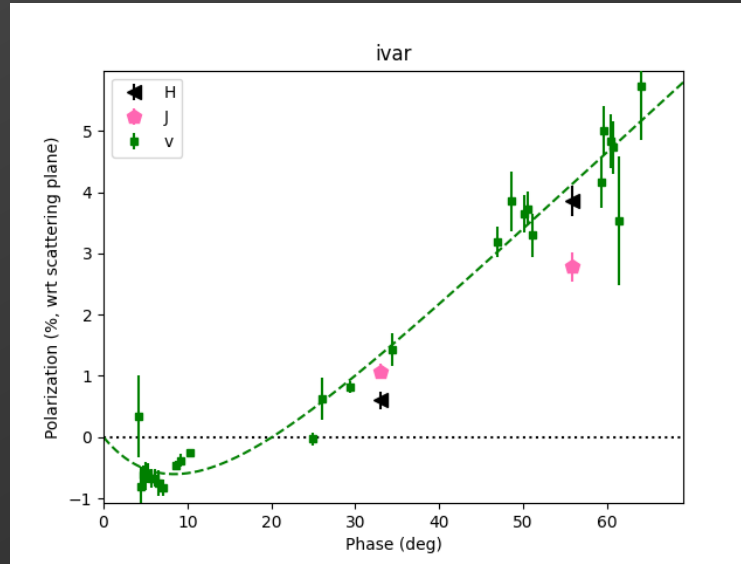
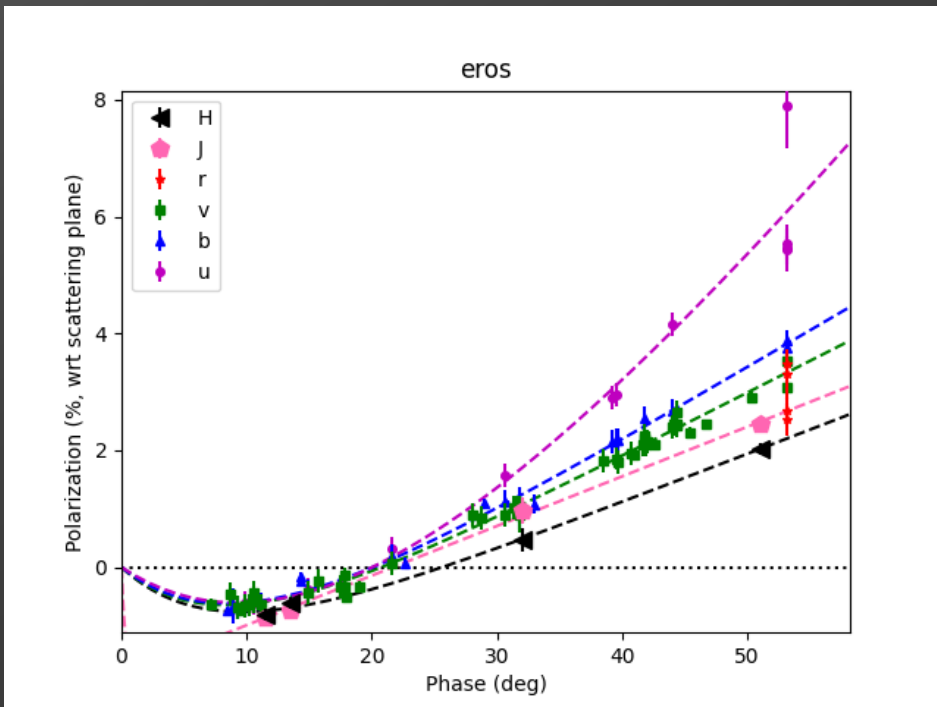
T/D type (Trojan/comet nucleus-like?)



L type (like Barbarians, but opposite behavior)



NEOs with NIR polarimetry



Coming this April: 2023 KU

Conclusions

- Palomar with WIRC+Pol provides a powerful tool for measuring asteroid mineralogical properties that can't be obtained with spectra or photometry
- While most asteroids follow well-behaved trends, some of the less-common taxonomic types show significant differences between Vis and NIR
- These unusual objects are the most likely to have unique evolutionary pathways, and may sample regions of the protosolar disk that have been otherwise completely removed
- Future work is needed to understand the polarimetric behavior of minerals at these wavelengths, to provide templates for comparison to our measurements
- Characterization of NEOs with NIR polarimetry, though difficult, can provide unique constraints on the mineral properties