The application of realistic dust grain shapes to debris disk photometry

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Debris disks are dusty circumstellar disks analogous to our solar system's Kuiper belt, asteroid belt, and zodiacal cloud [1]. The dust in these disks is produced by the destruction of comets, asteroids, and protoplanets. Understanding the composition of the material within these extrasolar systems may provide insight into the planet formation process. At visible and near-infrared (VNIR) wavelengths, dust within debris disks is detected via light from the host star scattered by these dust grains. As debris disks are typically too cold to produce key identifying silicate spectral features in thermal emission near 10 μm [2], scattered light in the VNIR wavelength range is important for making compositional determinations. To interpret scattered light observations of debris disks we need to model the light scattering properties of the constituent dust, which depend on grain composition, size, and structure. Often these models assume compact, spherical particles (e.g., [3]), although other grain shapes such as ellipsoids and distributed hollow spheres have been considered (e.g., [4]). We use the discrete dipole approximation method [5,6] to calculate scattering efficiencies for realistic grain shapes [6] and use these to model the optically thin disk AU Microscopii.

References

[1] Hughes, A. M., G. Duchene, and B. C. Matthews, 2018: Debris disks: structure, composition, and variability. *Annu. Rev. Astron. Astrophys.* **56**, 541–591.

[2] Matthews, B. C., A. V. Krivov, M. C. Wyatt, *et al.*, 2014: Observations, modeling and theory of debris disks. In *Protostars and Planets VI*, University of Arizona Press, Tucson, AZ, pp. 521–544.

[3] Kruegel, E., and R. Siebenmorgen, 1994: Dust in protostellar cores and stellar disks. *Astron. Astrophys.* **288**, 929–941.

[4] Min, M., J. W. Hovenier, and A.de Koter, 2003: Shape effects in scattering and absorption by randomly oriented particles small compared to the wavelength. *Astron. Astrophys.* **404**, 35–46.

[5] Draine, B. T., and P. J. Flatau, 1994: Discrete dipole approximation for scattering calculations. *J. Opt. Soc. Am. A* **11**, 1491–1499.

[6] Zubko, E., D. Petrov, Y. Shkuratov, *et al.*, 2005: Discrete dipole approximation simulations of scattering by particles with hierarchical structure. *Appl. Opt.* **44**, 6479–6485.

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