Mapping the Dust Distribution in Circumstellar Debris Disks by Combining Multiwavelength Images

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We have developed an inversion procedure (referred to as DISKFIT) designed to estimate the two-dimensional spatial distribution of dust optical depth (or relative column density) in the plane of a circumstellar debris disk, given a set of observed images at multiple wavelengths with or without SEDs and certain model assumptions. Specifically, we assume that the disk is geometrically thin and is heated entirely by the star, and that the wavelength dependence of opacity is the same throughout the disk. The input data can be any combination of wavelengths, image sizes, and pixel sizes or SEDs at selected positions. The traditional approach has been to compare data at each wavelength with the disk model predictions. DISKFIT is a new approach to combine multi-wavelengths in a robust way, taking into account the PSF shape and spectral responses, to produce a single optical depth (tau) map which can be directly compared with disk models. The inversion is based on the Richardson-Lucy algorithm and achieves some degree of super resolution. We present results on the debris disks applying this technique to recent Spitzer (MIPS) images at 24, 70, and 160 μm, supplemented with submm images.

Acknowledgment. This work was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.