Effect of dust structure on scattered light images of protoplanetary disks

Ryo Tazaki[1], H. Tanaka[1], T. Muto[2], A. Kataoka[3], S. Okuzumi[4], and H. Nomura[4]

[1]*Tohoku University,* [2] *Kogakuin University,* [3] *National Astronomical Observatory of Japan,*

[4]*Tokyo Institute of Technology*

We study how dust structure affects observational appearance of protoplanetary disks from infrared to millimeter wavelengths. First of all, we show that, at near-infrared wavelength, a disk with porous dust aggregates can show gray or slightly blue scattered light color in both total intensity and polarized intensity at near infrared wavelengths. In addition, by using the modified mean field theory (Tazaki & Tanaka 2018), we find that the effective albedo of large dust aggregates with fractal dimension of 2 show gray for less absorbing composition or slightly blue for absorbing composition, even if the radius is increased up to millimeter size. On the other hand, large dust aggregates with fractal dimension of 3 show reddish color in the effective albedo. Our results indicate that the presence of fluffy dust aggregates is not likely to be a primary solution to the color and brightness problem of scattered light images.

Next, we also study the importance of dust structure on (sub-)millimeter wave polarization due to scattering. We find that millimeter-wave polarization due to scattering is more likely to be detected when dust aggregates have compact structure rather than fluffy structure. Hence, a detection of millimeter-wave polarization due to scattering might require a mechanism for producing less porous particles at the disk regions where the polarization is detected.