millimeter-wave polarization as a tool of investigating the planet formation

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Constraining the grain size in protoplanetary disks is a key to understand the first stage of planet formation. The grain size has been estimated by measuring the spectral index at millimeter wavelengths, while it has huge uncertainties. Here, we propose that millimeter-wave polarization is another method to constrain the grain size. We show that thermal dust emission is scattered off of other dust grains and the residual polarization is up to 2.5 %, which is detectable with ALMA. This self-scattering polarization is efficient only if the maximum grain size is comparable to the wavelengths. Therefore, we can constrain the grain size from millimeter-wave polarization of protoplanetary disks. Furthermore, we have observed the protoplanetary disk around HD 142527 with ALMA polarization mode, and found the evidence of the self-scattering plays a role in the protoplanetary disk. We will also discuss what is the essential observations to distinguish the mechanisms between the self-scattering and magnetic field alignment and what is needed for future observations.

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