The Synthetic ALMA Multiband Analysis of the Dust Properties of the TW Hya Protoplanetary Disk

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As one of the famous protoplanetary disks (PPDs), TW Hya shows clear dust gap structures by ALMA (e.g., Andrews et al. 2016; Tsukagoshi et al. 2016). Multi-band observations of dust continuum is a good tool to understand the physical and chemical properties of these structures. To get dust properties of TW Hya PPD, we had tried to derive the radial profiles of dust temperature T_d, optical depth τ_ν, and opacity power-law index β using ALMA high spatial resolution data with the assumption of $\kappa_\nu \propto \nu^\beta$. As an example, we used ALMA Band 7, 6, and 4 archival data. However, this dataset was too sensitive to the observational error so that only 10% error in intensity makes the estimation ranges too broad, especially for T_d. Thus, we performed Synthetic ALMA Multi-band Analysis for finding the best ALMA dataset to constrain dust properties. Our result suggests that the best dataset is ALMA Band 10, 7, and 3. There are two conditions for good constraint on T_d, τ_ν, and β; (1) the combination of one band from Band 9 or 10 and one band from Band 3 or 4 and (2) enough frequency intervals between the selected bands. Based on the analysis result, we derived the radial profile of T_d, τ_ν, and β using Band 9, 6, and 4 ALMA archival data to check our analysis is consistent with real observation data. Although the result seems to be improved than the result of Band 7, 6, and 4 and consistent with our analysis, we need Band 9 high spatial resolution observation to make the valid consistency of Synthetic ALMA Multi-band Analysis.

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