ABSTRACT

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Observing planetary gaps with ALMA

Circumstellar disks are the birthplace of planets. It is expected that ALMA will be able to observe the signatures of planets, ie the gaps created by the gravitational influence of the planets. The dust dynamic within a disk is strongly dependent on the grain size, due to differential gas drag, and the resulting gap will very different depending on the considered grain size.

In this work, we present predictions for ALMA observations of planetgaps that account for the specific spatial distribution of dust that results from consistent gas+dust dynamics. We use full 3D, two-fluid hydrodynamics SPH simulations of a planet embedded in a gas +dust T Tauri disk for different planet masses and grain sizes. The resulting distributions are passed to the radiative transfer code MCFOST to construct synthetic images, which are transferred to the CASA ALMA simulator to produce realistic maps that include thermal and phase noise for a range of array configurations, wavelengths, and integration times.

Including the details of the dust dynamics is critical to asses the nature of the disks that will be observed by ALMA. Our results clearly demonstrate the importance of correctly incorporating the dust dynamics. We show that the gap carved by a 1 MJ planet orbiting at 40 AU is much more visible than the well-mixed assumption would predict. In the case of a 5 MJ planet we clearly see a deficit in dust emission in the inner disk. We will discuss to which extent the resulting image can be distinguished from that of a transition disk with an inner hole.