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Musing on the deepest millimetre-wavelength observations of PDS 70

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The study of Gyr-old cold gas giants is on the verge of a revolution: the forthcoming Gaia data releases will precipitate their detection, and, thanks to the ESA/ARIEL space mission, the number of such Jupiter-like planets with well-characterized atmospheric composition will also skyrocket in the years to come. Interpreting the results of these forefront campaigns requires a significant leap forward in our understanding of how gas giants come to be. In this regard, catching Myr-old, embedded, Jupiter-like planets in the act of formation is our best chance of understanding how their cores are assembled and their atmospheres accreted, thus providing a highly sought-after framework for explaining the properties of the or older and fully formed siblings. Although the current dearth of directly imaged embedded planets happens to be a rather arduous obstacle to this quest, such scarcity of targets in fact comes with the advantage of an unparalleled wealth of data for the few systems with planet detections. This is especially true for PDS 70, the only planet-forming disc hosting two directly imaged accreting gas giants, often considered to be a larger-scale version of the early Solar System. In fact, in less than a decade, ALMA observed such a target for approx. 24 hrs on-source, corresponding to a total of approx. 4 Tb of data, in Band 7 (0.89 mm) alone. I plan on presenting the first results of my effort of
re-reducing and combining those data together with state-of-the-art calibration techniques. These include the deepest (approx. 3.5 times higher sensitivity than the well-known images that led to the detection of mm emission around PDS 70c by Benisty et al., 2021) and highest angular resolution (2 au) continuum images of this target, as well as state-of-the-art spectral line cubes of CO isotopologues, UV chemistry, ionization, and shock tracers. Such a joint dataset provides the unique opportunity of revealing with unprecedented detail how gas giants interact with their hosting disc by clearing their orbits, accreting gas, and halting
material delivery to the terrestrial planet formation zone. These are all crucial aspects to understand how giant planets come to be and their impact on multi-planetary system formation and architecture.

Presenter: ZAGARIA, Francesco (Max Planck Institute for Astronomy, Germany)

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