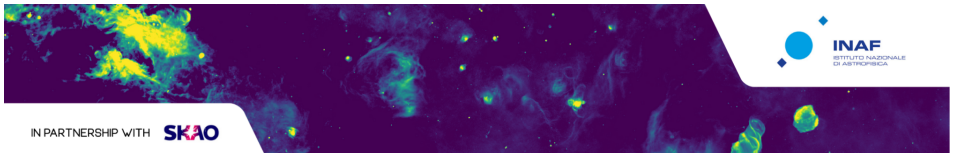

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Dust evolution in protoplanetary disks with SKA and precursors

Tuesday 25 November 2025 14:36 (3 minutes)

Among the variety of structures that can be observed at millimeter and sub-millimeter wavelength within disks, some present an inner cavity depleted from gas and dust. Such disks are called transitional disks (TDs). Cavities, are generally attributed to the formation and evolution of one or more giant planets (as it is the case for PDS 70), severing the connection between the outer and inner disks, which is then rapidly depleted by accretion onto the star. At the same time, these planets are modifying the disk gas pressure profile leading to the creation of a pressure trap and, consequently, a ring-like structure in the dust distribution, as large grains are confined as they drift in from the outer disk.
This scenario, thus implies that the planets inside the ring greatly stops the exchange of pebbles between the outer and the inner part of the disk. Even though, observations show that material continues to pass through the planet to the star, the stellar mass accretion in TDs is lower than for full disks of same age or mass. On top of it, since large grains are trapped within the ring, only small grains and gas can filtrate through the cavity, failing to fully explain the large amount of material needed by the central star. As a result, within the inner cavity, no significant dust emission at (sub-)millimeter wavelength should be observe. On the contrary, a compact millimeter emission it observed for about 50% of TDs by ALMA, as it is the case for the TD surrounding CQ Tau, a nearby, intermediate mass pre-main sequence star of spectral type F2.

As of today, it is not clear if such compact emission is due to the presence of pebbles or whether it is due to non-thermal emission related, e.g., an ionized wind. To quantify this possibility, we performed a detailed multi-wavelength analysis to study the emission in the inner disk of CQ Tau, combining a large set of sensitive and high angular resolution continuum observations from ALMA and VLA, from 0.87 mm to 6 cm. Our goal is to try and separate dust and gas emission in the inner region of this system.
We present the results and conclusions of a detailed spectral index analysis, as a first attempt to characterize the nature of the emission in every part of the disk, extrapolate the free-free emission present and then finally separate between this emission and dust thermal emission for CQ Tau. Even though these results are very interesting, we noticed that they are limited by either the resolution of the centimetric observations, by the number of observations or the optical depth of the emission of the millimetric observations, which gap could be filled by the use of SKA data. Finally, we present further initial attempts to extend these results to a broader sample of TDs.

Topics

Cradle of Life & Our Galaxy

Author: ARMANTE, Melanie Isabelle Monique (Istituto Nazionale di Astrofisica (INAF))

Co-authors: Dr NATTA, Antonella; FEDELE , Davide (Istituto Nazionale di Astrofisica (INAF)); TESTI, Leonardo (Dipartimento di Fisica e Astronomia, Università di Bologna)

Presenter: ARMANTE, Melanie Isabelle Monique (Istituto Nazionale di Astrofisica (INAF))

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