Protoplanetary disk material found to be too sparse to form planet populations

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A trio of researchers with the European Southern Observatory and Université Côte d'Azur has found evidence showing that the gas and dust disks that form around early stars systems do not contain enough material to form the planets that develop. In their paper published in the journal *Astronomy Astrophysics*, Carlo Manara, A. Morbidelli and T. Guillot describe their study of data from the Atacama Large Millimeter Array (ALMA) in Chile and what they found.

In this new effort, Manara, Morbidelli and Guillot were studying data from ALMA to learn more about protoplanetary disks. To that end, they looked at how much material is contained in such disks around stars that were just 1 to 3 million years old—the time period before planets had evolved. Next, they measured the masses of older star systems with mature planets. By comparing the two, they found that the disk matter in early star systems did not have enough mass to create the planets that would eventually develop.

Until now, space scientists have believed that star systems form due to space dust coalescing into a star. Once the star gets going, a protoplanetary disk usually forms around the star. It is believed the gas and dust that make up the disk are leftovers from material involved in creating the star. As more time passes, the material in the disk tends to clump together until gravity takes over, attracting more of the material in the disk. Eventually, most of the material from the disk is incorporated into planets that orbit the star. But this new evidence suggests that there is not enough material in the disk of the average early star system to create the average number and size of planets that come to exist a few million years later.

The researchers did not attempt to find a reason for the discrepancy, but suggest several possibilities. It could be that planet formation starts earlier than thought, or there could be larger bits of dust than those found by radio waves that were detectable by ALMA. There is also the possibility that star systems pull in more dust from the space around the system as planets develop.

More information: C. F. Manara et al. Why do protoplanetary disks appear not massive enough to form the known exoplanet population?, *Astronomy & Astrophysics* (2018). DOI: 10.1051/0004-6361/201834076