The Study of Protoplanetary Disks in the ALMA Era

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Abstract /
Protoplanetary disks are an integral part of the star-formation process and the sites where planets are formed. Understanding their evolution is crucial for planet formation theory. Protoplanetary disks evolve through various physical mechanisms, including accretion onto the star, grain growth and dust settling, dynamical interactions, photoevaporation, and planet formation itself. However, the relative importance and time-scales of these processes are still poorly understood. Recent observations from the Atacama Large Millimeter Array (ALMA) are revolutionizing our view of disk evolution and planet formation. Resolved disk observations show intriguing features, such as spiral arms, rings, narrow gaps, and asymmetries. These features are often interpreted as evidence for planet formation processes. However, resolved studies have so far been very biased toward the brightest systems and/or transition objects (protoplanetary disks with inner holes and gaps), which are clearly not representative of the entire disk population. Since current statistics on extrasolar planets imply that most circumstellar disks should be forming planets (big or small), it is important to investigate the full distribution of disk properties present in star-forming regions. I will summarize the physical processes that control the evolution of circumstellar disks as they evolve from optically thick to optically thin and discuss the properties of protoplanetary disks, with a focus on observational studies of transition objects. I will also discuss recent ALMA results and the constraints they might impose to both disk evolution and planet formation theory.

Keywords / protoplanetary disks — planets and satellites: formation — stars: pre-main sequence

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Invited report