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DIFFICULTIES INVOLVED IN OBSERVING STAR AND PLANET FORMATION

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1. IMF

It is known that star formation occurs in regions where dense molecular clouds undergo gravitational collapse. While observations of cold dusty disks and envelopes require long wavelength detectors to penetrate through obscuring material—from mid-infrared to radio—it is preferred to observe stars in the range between ultraviolet and near-infrared range (Hartmann 2003). One of the fundamental questions of the subject is the initial mass function (IMF) – the fractional distribution in mass of a newly formed stellar system, often assumed to be in a form of a power law, e.g. $\xi(M) \propto M^{-a}$. Since we cannot observe IMF directly, we can only derive it from the current state of the system via its luminosity function which is the number of stars visible per magnitude, and then account for evolution. Because IMF spans a large range of masses and luminosities, the detection is required at a wide range of wavelengths in order to be accurate.

2. MOLECULAR HYDROGEN

Molecular hydrogen (H_2), the most abundant molecule in the universe and the dominant constituent of protostellar cloud cores and protoplanetary disks (proplyds), is difficult to be observed directly. It can be detected at ultraviolet and mid-infrared wavelengths for which the Earth's atmosphere is opaque and partially transparent at best, so space-based missions are preferred. Additionally, most of the H_2 may hide in cool and shielded regions where its excitation is too low to be detected (Habart et al. 2005), so observations of H_2 in young stellar objects pose certain difficulties for interpretation.

3. PROPLYD ACCRETION

Knowing the rate of accretion in proplyds enables to determine the history of the formation of stars and planets. Major part of the luminosity due to accretion occurs at ultraviolet wavelengths (France et al. 2011), so observations below the Earth atmosphere cut-off are necessary for accurate accretion rate estimates that account the whole luminosity continuum.

4. CORONAGRAPHIC OBSERVATIONS

Suppression of scattered light in the vicinity of the star enables to observe proplyd structures in high resolution and detect small amounts of dust and structures involved in planet formation. While this is possible to suppress much of the unaberrated starlight with coronagraphic techniques, some portion of light still leaks into the detector, whose distribution is given by the on-axis point spread function (PSF) of atmosphere and telescope. Thus, it is necessary to estimate PSF with great accuracy in order to remove speckle noise and reach theoretical performance limits of telescopes. Certain models exist to estimate PSF based on atmospheric turbulence models, however true high-resolution observations are only possible with advanced high-Strehl systems, such as coronagraphic telescopes with adaptive optics (Fitzgerald 2007; Ren et al. 2012).

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