P223a The Necessity of Far-infrared Space-based Observatory for Star and Planetary Science

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Understanding the origin of solar-type planetary systems has been one of the persisting questions in astronomy. Formed in dense dusty clouds, the high extinction challenges direct observational characterizations of the physical and chemical processes at the onset of star and planet formation. In the last decades, most studies rely on sub-mm and mm interferometric observations using ALMA to probe the cold dust and gas ($\sim 10-100$ K), constraining the structures and chemistry of planet-forming disks. In recent years, the JWST provides unprecedented sensitivity at mid-infrared wavelengths, characterizing the hot gas and dust ($\gtrsim 1000$ K). However, the bulk energy of protostars and protoplanetary disks lies at far-infrared wavelengths ($100-1000$ K), where we used to have access via ISO, AKARI, SOFIA, and Herschel but not anymore. The PRobe far-Infrared Mission for Astrophysics (PRIMA) is a mission concept primed to provide a unique access to probe the dominant components of gas and dust in protostellar and protoplanetary systems. In this talk, I will discuss the unique science cases on protostars and disks that PRIMA's 24-235 μm imaging and spectral coverage can enable. Particularly, I will highlight PRIMA's impact of characterizing protostellar outbursts as well as the search for protostars at outer galaxy. I will also discuss a case for using PRIMA to constrain the origin of gas in debris disks. Finally, I will highlight the opportunities for Japanese researchers on star and planetary science as well as PRIMA's synergy with ground-based facilities such as ALMA and ngVLA.