DEPARTMENT OF PHYSICS AND ASTRONOMY

COLLOQUIUM IN-PERSON ONLY EVENT

The stellar environment's influence on protoplanetary discs and planet formation

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The majority of stars born in dense stellar clusters are part of binary star systems. Circumbinary discs of gas and dust commonly surround binary star systems and are responsible for accreting material onto the binary. Misalignments between the circumbinary disc and the binary orbital plane are commonly observed in various phases of stellar evolution. Dissipation causes the disc to evolve to align coplanar with the binary orbital plane or perpendicular (i.e., polar) to the binary orbital plane. I present 3-dimensional hydrodynamical simulations and linear theory on the evolution of highly misaligned circumbinary discs. I show that polar-aligned circumbinary discs are favorable environments for forming polar circumbinary (P-type) planets. Moreover, misaligned and polar circumbinary material flows around each binary component, forming misaligned and polar circumstellar discs. These circumstellar discs undergo long-lived Kozai-Lidov oscillations that may prompt the formation of giant circumstellar (S-type) planets in binary star systems. Not only can bound binary stars impact protoplanetary disc evolution and planet formation, but unbound perturbers can as well. I present 3-dimensional hydrodynamical simulations of a circumstellar disc perturbed by a non-grazing or grazing encounter. In the non-grazing encounter, the perturber excites a two-armed spiral structure, with evolving pattern speeds and pitch angles. In the grazing encounter, the flyby captures material, forming a second-generation protoplanetary disc. We find a strong correlation between the captured disc's tilt and the tilt of the flyby orbit. In summary, the stellar environment plays a crucial role in shaping the formation of protoplanetary disks and, consequently, the formation of planets.

Thursday, November 21, at 3:55 PM

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