

Subject : Planet Formation

Title: From Protoplanetary Disks to Planetary Systems: Planet Formation and Material Evolution

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Outline :

Thanks to the recent development of infrared and (sub)millimeter observations, detailed structures of dust and gas in protoplanetary disks have been revealed, which give us information on planet formation and material distributions around planet forming regions. In protoplanetary disks, dust particles stick each other and grow into larger particles, leading to formation of planets, while gas disperses at the end of planet formation after gas giant planets form. Snowline is one of the keys to understand planet formation, which is thought to divide rocky and gaseous planet forming regions. Meanwhile, materials, including water and organic molecules, evolve in the disks, which give us information on origin of diversity of exoplanets, while the materials are thought to evolve into life in planetary systems at the end, depending on the environments.

Learning objectives :

- Planet formation and ALMA & JWST observations of protoplanetary disks
- Dust evolution and gas dispersal
- Snowline and planet formation
- Material evolution from protoplanetary disks to planetary systems

Textbooks and references :

“Astrophysics of Planet Formation”, P.J. Armitage, 2020, Cambridge University Press
Andrews, S.M. 2020, “Observations of Protoplanetary Disk Structures” ARA&A, 58, 483
Oberg, K.I. et al. 2023, “Protoplanetary Disk Chemistry” ARA&A, 61, 287
Oberg, K.I. & Bergin, E.A. 2021, “Astrochemistry and Composition of Planetary Systems”, Physical Reports, 893, 1