[JJ] Evening Poster | P (Space and Planetary Sciences) | P-CG Complex & General

[P-CG22]New Developments of Planetary Sciences with ALMA

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The Atacama Large Millimeter/Submillimeter Array (ALMA) starated its science operation in 2011, and long-baseline observations have become available since 2014. ALMA, with its high sensitivity and resolution, has provided us with qualitatively new information on star and planet formation and small bodies in our Solar System. For example, the discovery of narrow gap structures in the protoplanetary disks around young stars HL Tan and TW Hya enabled us to actually compare the long-standing theoretical models of planet formation with real observations. In our solar system, 60km pixel-scale non-uniform brightness distribution and the rotation of the asteroid Juno are detected. Spatially-resolved thermal mapping of Europa icy surface enables us to search for thermal anomaly in possible plume source regions. As of Cycle 4, Solar observations are available, enabling us, for example, to determine the physical parameters of plasmoid quantitatively. In this session, we overview the latest results of ALMA observations in the field of planetary sciences. We also accept any theoretical and experimental works that are closely related to the observations and discuss the impact on the planetary science community.

[PCG22-P09]The Flared Gas Structure of the Transitional Disk around Sz 91

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Transitional disks are believed to be a good laboratory for the investigation of the planet formation process because of its inner hole structure. Sz 91 is a nearby young low-mass star surrounded by the transitional disk. Previous ALMA observations have resolved the inner hole structure and have revealed the symmetrical ring-like distribution of the remaining dust materials. The gas disk structure, however, has not been understood well because of the lack of sensitivity and resolution. Therefore, the improvement of the image quality is essential to determine the overall structure of the Sz 91 disk in detail.

Thus, we have conducted 0.14 arcsec resolution high-sensitivity observations of the dust continuum at band 7, and the CO(3-2) and HCO^+(4-3) line emissions toward the transitional disk around Sz 91 with ALMA. The dust disk appears to be an axisymmetric ring, concentrated within a radius of ~120 au, as found by the previous study with ALMA. The widths of the dust ring from the Gaussian fitting of the radial profile are 31.2 and 30.0 au for the major and the minor axes, respectively.
The similar values of the widths along the major and minor axes indicate that the dust ring is not geometrically thin, while it is difficult to estimate about the actual height of the dust ring with the spatial resolution of this study. Keplerian rotation is found in both the CO and HCO^+ images. The gas disk extends out to ~400 au and is also detected in the inner hole of the dust ring. A twin-line pattern is

found in the channel maps of CO, which can be interpreted as the emission from the front and rear of the flared gas disk. This is the first direct imaging of the two-layered velocity pattern of the gas emission towards a transitional disk around a low-mass star. We perform the radiative transfer calculations using RADMC-3D, to check whether the twin-line pattern can be reproduced under the assumption that the flared gas disk has a power-law form for the column density and $T_{gas}=T_{dust}$. The thermal Monte Carlo calculation in RADMC-3D shows that the disk temperature has a gradient along the vertical direction beyond the dust ring, as it blocks the stellar radiation. We conclude that the twin-line pattern can be naturally explained by the flared gas disk in combination with the dust ring. In addition, no significant depletion of the CO molecules in the cold midplane achieves a reasonable agreement with the observed twin-line pattern. This result indicates that the CO emission from the warm surface layer on the rear side of the Sz 91 disk must be heavily absorbed in the cold midplane.