

## ALMA Observation of AB Aur: the Inner Gaseous Spirals Observed inside the Dust Cavity

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We report the results of ALMA observations of protoplanetary disk surrounding a Herbig Ae star AB Aur. We obtained high-resolution ( $\sim 0.1$  asec, corresponding to  $\sim 14$  AU) images in  $12\text{CO}$  ( $J=2-1$ ) emission and dust continuum at the wavelength of 1.3 mm. The continuum emission shows a ring-like structure with the radius of  $\sim 120$  AU and the CO gas emission shows (at least) two prominent spiral arm like structures within the dust continuum ring. Gas kinematics is consistent with the Keplerian rotation with the inclination of 23 degrees, and the CO spiral arms appear to be about four times brighter than the surrounding medium. Comparison with near infrared (NIR) polarized intensity image (Hashimoto et al. 2011) shows that both CO and NIR images show similar pattern, with NIR polarized emission (scattered light from the central star) locating slightly closer to the central star.

One possible scenario to explain the observed morphology of dust and gas is the disturbances by (an) unseen companion(s). A massive planet at approximately 80 AU from the central star may explain the both spiral structures in gas and dust ring. It is known from near infrared imaging observations that the disk morphology in the outer part of the disk does not change over 5.8 year period. The companion at this radius is far enough from the central star so that the patterns that the companion induces do not change very much. However, this 80 AU companion only does not explain all the morphology. Additional companion at inner radii (which is inaccessible with near infrared imaging observations about a decade ago) or disk warp could be responsible for inner disk structures.

This presentation is based on Tang et al. (2017), which is submitted to AAS Journals.

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