Initial Result of the Subaru SEEDS project: Fine Structures of the Circumstellar Disk around AB Aur

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HiCIAO is a new high contrast instrument used in combination with the Subaru 188-actuator adaptive optics system (AO188). It employs the Lyot coronagraph, having various imaging modes of direct imaging (DI) but also including spectral or polarimetric differential imaging (SDI/PDI). The angular differential imaging can be combined with DI/PDI/SDI. Using HiCIAO, we performed the strategic campign of SEEDS (Strategic Exploration of Exoplanets and Disks with Subaru) for exoplanets and disks survey. The aims of SEEDS are (1) to investigate the morphological and physical evolutions of disk and (2) to directly detect the Jupiter-mass exoplanets around young stars in nearby star-forming regions. In this time, we present the initial results of SEEDS, especially in the disk survey.

As a result of stellar evolution, it is widely known that planets are formed in circumstellar disks around young stars. Thus, investigating the detailed structures of circumstellar disks and their evolutions are of great importance in understanding the nature of planet formation mechanisms. One of the best candidates to investigate the inner (r <50 AU) regions is the prototype young intermediate-mass star AB Aur.

We revealed complicated and asymmetrical structures in the inner part (r <140 AU) of the disk, while confirming the previously reported outer (r >200 AU) spiral structure. We have imaged a double ring structure at ∼40 and ∼100 AU and a ring-like gap between the two. We found a significant discrepancy of inclination angles between two rings, which may indicate that the disk of AB Aur is warped. Furthermore, we found seven dips (the typical size is ∼45 AU or less) within two rings as well as three prominent PI peaks at ∼40 AU. The observed structures, including a bumpy double ring, a ring-like gap, and a warped disk in the innermost regions, provide essential information for understanding the formation mechanism of recently detected wide-orbit (r >20 AU) planets.