Detection of 13C17O line emission in the disk around the young outbursting protostar V883 Ori by ALMA observations

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Understanding the spatial distribution of gas and mass evolution in protoplanetary disks are essential for elucidating the formation and evolution processes of planetary systems. Therefore, a lot of statistical observations of the disk gas distribution using 13C16O and 12C18O emission lines have been carried out (e.g., [1]). However, if these emission lines are optically thick, the disk gas mass will be underestimated. Here, by using the 13C17O emission line, which is the rarest and thus most optically thin among the stable carbon monoxide isotope species, it becomes possible to measure the gas mass with higher precision, including disk midplane. In recent ALMA observations, the 13C17O emission line was detected for the first time in two protoplanetary disks (HD 163296: [2]; HL Tau: [3]), and the estimated disk masses are about 2-10 times heavier than those estimated from previous 12C18O emission line observations. In this presentation, we report the detection of the 13C17O J=3−2 emission line by ALMA observations (Band 7 (~0.9 mm), spatial resolution: ~0.3-0.4") in the disk around the Class I protostar V883 Ori, a typical young outbursting FU Ori type star. We found that the 13C17O line emission has ring-like distribution within the disk surrounding the optically thick dust emission (radius r~40 au) near the protostar, similar to the 12C17O line emission line obtained in past observations ([4]). In addition, the 13C17O line emission extends further to the outside of the disk (r~200 au) compared with H2O and CH3OH line emission (r~80 au). We derived the column density and the total gas surface distributions in the disk radial direction, and discuss the gas to dust mass ratio G/D, Toomre Q values (= Index of gravitational stability in the disk), and 12C/13C isotope ratio in the V883 Ori disk. We also conduct the comparative discussion of the 12C/13C ratio between CO (this study) and complex organic molecules (Yamato, Notsu et al. in prep.).

References

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