Chemical Change Associated with Envelope-Disk Transition in Massive Star Formation

Y. Zhang,[1] J. C. Tan,[2,3] N. Sakai,[1] K. Tanaka,[4,5] J. M. De Buizer[6], M. Liu,[3] M. T. Beltrán,[7] D. Mardones,[8] and G. Garay[8]

[1]RIKEN, Japan
[2]Chalmers University of Technology, Sweden
[3]University of Virginia, USA
4Osaka University, Japan
5NAOJ, Japan
6SOFIA-USRA, USA
7INAF, Italy
8Universidad de Chile, Chile

We report ALMA observation of the massive protostellar source G339.88-1.26. We discovered a highly collimated SiO outflow extending from the 1.3 mm continuum peak, which connects to a slightly wider but still highly collimated CO outflow. Rotational features perpendicular to the outflow axis are detected in many molecular lines, especially in SiO, SO_2, and H_2S. The highest rotation velocity detected in SiO is up to ~25 km s^{-1}. On the other hand, in SO_2 and H_2S, rotational features are seen within similar radii but only reach a velocity up to ~15 km s^{-1}. The peaks of the emissions of H_2CO, CH_3OH and other complex organic molecules (COMs) are offset from the central source. They appear to be dominant in the more extended region, probably tracing the outer envelope, as well as the outflow cavity walls. One possibility to understand these features is that the SO_2 and H_2S are tracing the inner envelope and/or the centrifugal barrier, where the warm temperature or the accretion shock may have released them to the gas phase from the dust grain mantle. On the other hand, the accretion shock, internal shock, or the strong radiation field may also have destroyed some fraction of the dust grain to release SiO which will remain in gas phase in the innermost part of the disk and therefore reach higher rotational velocities. Such strong radiation or shocks also reduce COMs in the inner envelope. These results indicate that the picture of transition from a rotating/infalling envelope to a Keplerian disk through the centrifugal barrier accompanied by change of chemical composition may be also valid in at least this high-mass source.

References