A Substellar-Mass Protostar and its Outflow of IRAS 15398-3359 revealed by Subarcsecond-Resolution Observations of H_2CO and CCH

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Subarcsecond (0”.5) images of H_2CO and CCH line emission have been obtained in the 0.8 mm band toward the low-mass protostar IRAS 15398-3359 in the Lupus 1 cloud as one of the Cycle 0 projects of the Atacama Large Millimeter/Submillimeter Array (ALMA). We have detected a compact component concentrated in the vicinity of the protostar and a well-collimated outflow cavity extending along the northeast-southwest axis. The inclination angle of the outflow is found to be about 20º, or almost edge-on, based on the kinematic structure of the outflow cavity. This is in contrast to previous suggestions of a more pole-on geometry. The centrally concentrated component is interpreted by use of a model of the infalling rotating envelope with the estimated inclination angle, and the mass of the protostar is estimated to be less than 0.09 Msun. Higher spatial resolution data are needed to infer the presence of a rotationally supported disk for this source, hinted at by a weak high-velocity H_2CO emission associated with the protostar. Although IRAS 15398-3359 and L1527 are both the warm-carbon-chain chemistry sources, their physical properties in the vicinity of the protostar are found to be much different from each other. Thus, Chemical variation of the protostellar envelope do not originate from the present physical structure.