Evidence for Inflow in High-Mass Star-Forming Clumps

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We analyze the HCO+ 3-2 and H13CO+ 3-2 line profiles of 27 high-mass star-forming regions to identify asymmetries that are suggestive of mass inflow. Three quantitative measures of line asymmetry are used to indicate whether a line profile is blue, red or neither - the ratio of the temperature of the blue and red peaks, the line skew and the dimensionless parameter delta_v. We find nine HCO+ 3-2 line profiles with a significant blue asymmetry and four with significant red asymmetric profiles. Comparing our HCO+ 3-2 results to HCN 3-2 observations from Wu et al. (2003, 2010), we find that eight of the blue and three of red have profiles with the same asymmetry in HCN. The eight sources with blue asymmetries in both tracers are considered strong candidates for inflow. Quantitative measures of the asymmetry (e.g. delta_v) tend to be larger for HCN. This, combined with possible HCO+ abundance enhancements in outflows, suggests that HCN may be a better tracer of inflow. Understanding the behavior of common molecular tracers like HCO+ in clumps of different masses is important for properly analyzing the line profiles seen in a sample of sources representing a broad range of clump masses. Such studies will soon be possible with the large number of sources with possible self-absorption seen in spectroscopic follow-up observations of clumps identified in the Bolocam Galactic Plane Survey.

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