Studying atomic hydrogen during cloud formation by means of HI self absorption

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Probability distribution functions (PDFs) of the column density of hydrogen are a common tool to examine molecular clouds. Due to turbulent motion, the initial PDFs have a log-normal shape and evolve into a power-law tail at high column densities due to gravity and collapse. To date, these studies are mostly limited to the molecular content of the clouds. Here, we present a study of the cold atomic content of the giant molecular filament GMF38.132.4 (Ragan et al. 2014), presenting column density PDFs and the corresponding kinematics. We extracted a long HI self absorption (HISA) feature, which correlates partly with the CO emission. The peak velocity of the HISA and CO shows a close correlation on one side of the filament, whereas a velocity step is visible on the other side. The column density of the cold absorbing HI is on the order of 10^{20}-10^{21} cm^2. In contrast to this, the column density of the molecular hydrogen, traced with CO, is an order of magnitude higher. The shape of the atomic and molecular column density PDF reveal mostly log-normal shapes, indicating turbulent motion as the main driver. We speculate that we observe different evolutionary stages within the filament. The atomic and molecular hydrogen is well mixed on the left side forming a molecular cloud out of the atomic environment, which could indicate an early evolutionary stage, whereas the right sub-region already shows high column density peaks and active star formation. Such studies are an important characterization of the transition between the atomic and molecular phase and influence simulations as well as theoretical studies.

Molecular Clouds