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Rotationally Excited H_2 in the Magellanic Clouds

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Abstract. We have performed a survey study of rotational excited-state H_2 Lyman-Werner absorption lines in the entire *FUSE* Magellanic Clouds Legacy archive. These lines reflect the UV pumping and formation conditions of H_2, enabling a more comprehensive study of H_2 gas properties, e.g. J-level populations $N(J)$ and b-values (generally indicating the velocity dispersion). Combining with our previous measurements of $N(\mathrm{H\,I})$ and $N(H_2)$, we derived H_2 excitation temperatures, gas volume density $n(\mathrm{H})$, and local UV radiation field strength I_{UV} for each sight line. The results indicate a weaker correlation between $n(\mathrm{H})$ and I_{UV} in Magellanic Clouds than the Galactic sight lines. We also obtained $N(\mathrm{H})/E(B-V)$ ratios from the *Spitzer*-SAGE and previous CO $J = 1-0$ / H I 21 cm surveys at sight line locations, using dust modeling and standard line brightness-column density conversion factors. They show a roughly linear correlation with absorption-based $N(\mathrm{H})/E(B-V)$ values, and have a similar scatter ($\sim$0.7 dex) across the LMC and SMC.

Keywords. galaxies: ISM — Magellanic Clouds — ISM: abundances — ultraviolet: ISM

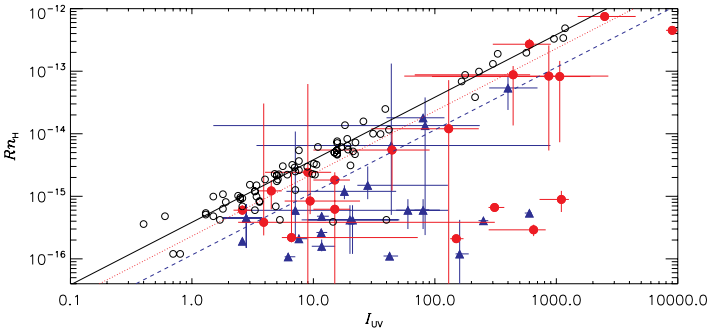

Figure 1. Observed Rn_{H} vs. I_{UV} relations of the Galactic (black open circle), LMC (red filled circle), and SMC (blue triangle) sight lines, compared with the assumption of $Rn_{\mathrm{H}} \propto I_{\mathrm{UV}}$ in Krumholz *et al.* (2009) for metallicities of 1.0×solar (Galactic, black solid line), 0.5×solar (LMC, red dotted line), and 0.2×solar (SMC, blue dashed line). Rn_{H} and I_{UV} were directly derived from $N(\mathrm{H\,I})$, $N(H_2)$, and $N(J)$. The galactic sight line values are from a collection of literature. R is the H_2 formation rate, with a value of $3 \times 10^{-17}\,\mathrm{cm^3\,s^{-1}}$ in typical interstellar conditions of the Milky Way. Krumholz *et al.* (2009) assumed that n_{H} and I_{UV} were linearly correlated at galactic scales in their atomic-to-molecular transition model, with a coefficient which slightly increased when the metallicity changed from the solar to a typical SMC value. In addition, R was linearly scaled with the metallicity.

References

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