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Metal-poor molecular gas beyond the optical disk of the Galaxy

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Abstract.

The molecular Edge Clouds 1 and 2 (EC1 and EC2) lie at the largest Galactocentric distances known to exist in the Milky Way. With elemental abundances that may be similar to irregular dwarf galaxies, they potentially represent an environment similar to when the disk of the Milky Way was forming. We have searched for many species of molecular emission in EC2, and are doing the same in EC1. Our detections in these sources reinforce the suspected uniqueness of Galactic edge clouds: a temperature of 20 K; n(H_2) = 5000 cm^{-3}; and very low metallicity. We have extended our observations to higher frequency to better trace the dense gas associated with star formation, and to constrain molecular and elemental abundances, density, temperature, and column densities. EC2 is also the most distant star forming molecular cloud in the Milky Way. It has an associated HII region excited by a metal depleted early B star, that appears to have triggered star formation in EC2. Our observations in EC2 indicate an under abundance of nitrogen-bearing molecules, which may be related to the lack of stellar processing at such large Galactocentric distances. We are also mapping EC2 for dust and in CO, ^{13}CO and C^{18}O, in order to establish the CO/dust ratio. We are developing chemical kinetic models of EC1 and EC2, including low metallicity and deuterium chemistry, to determine age, chemical evolution and constrain elemental abundances, comparing our results with those in other dwarf galaxies. Observations of low-metallicity molecular clouds have the potential to aid our interpretation of molecular clouds at high redshift, particularly in determining how the CO/H_2 ratio varies with metallicity and environment.

Keywords. astrochemistry – ISM: clouds – ISM: molecules – ISM: atoms – ISM: abundances