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# Photodissociation Regions in the Large Magellanic Cloud and IC 10

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Both theory and observation suggest that metallicity profoundly alters the properties and structure of the Photodissociation Regions (PDRs; e.g., Madden et al. 1997). Several factors contribute to the differences between high and low metallicity systems: altered gas phase and grain surface chemistry due to the low Si, C and S elemental abundances, and diminished dust shielding because of the low dust-to-gas ratio. Since there is less dust shielding, UV photons penetrate more deeply into the molecular clouds leaving $H_2$ unaffected but photodissociating most other molecules everywhere except in the most opaque clumps. Thus, a low-metallicity system contains large regions where hydrogen remains molecular but the usual tracers of molecular gas like CO are photodissociated.

The Large Magellanic Cloud (LMC) and IC 10 are two irregular galaxies with low metalicities, and therefore provide excellent sites to study the behavior of PDRs in low-metalicity environments. We have measured the $^3P_1 \rightarrow ^3P_0$ fine structure transition of neutral carbon ([C I], $\lambda = 609\ \mu$m), as well as other tracers of dust and molecular gas. These measurements were performed using the Antarctic Submillimeter Telescope and Remote Observatory (AST/RO) at the South Pole station, and the James Clerk Maxwell Telescope (JMCT) at Mauna Kea, Hawaii. Neutral carbon originates in the PDRs, where CO is split into its atomic components by UV radiation. [C I] emission is thus thought to trace this transition occurring at a visual extinction of a few ($A_v \sim 1 - 3$). The results of our study are summarized in Fig. 1 for the LMC and Fig. 2 for IC 10.

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## References

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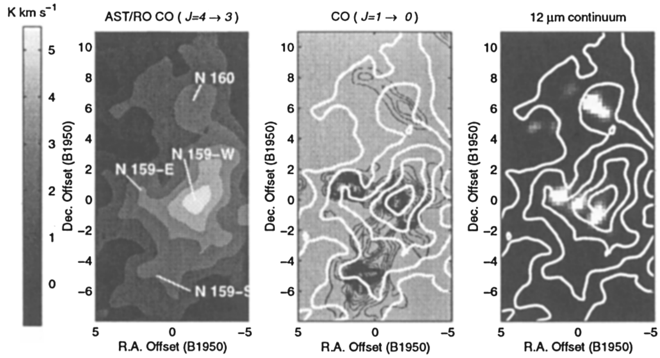


Figure 1. The molecular cloud/ HII region complex N 159/N 160 in the Large Magellanic Cloud. This complex is part of a increasingly young progression of star-forming regions south of 30 Doradus. (*Left*) AST/RO's CO ($J = 4 \rightarrow 3$) map (resolution $\approx 2$ arcmin, preliminary calibration). (*Center*) Comparison with published SEST CO ($J = 1 \rightarrow 0$) observations (resolution $\approx 1$ arcmin; Israel et al. 1996). (*Right*) Comparison with HIRES IRAS 12 $\mu$m showing the star formation activity in the area. The CO ($4 \rightarrow 3$)/CO ($1 \rightarrow 0$) ratio is affected by both the density and the temperature of the molecular gas and is similar for N160 and N159-W, the two active star forming clouds, while N159-S appears to harbor very little warm or dense gas.

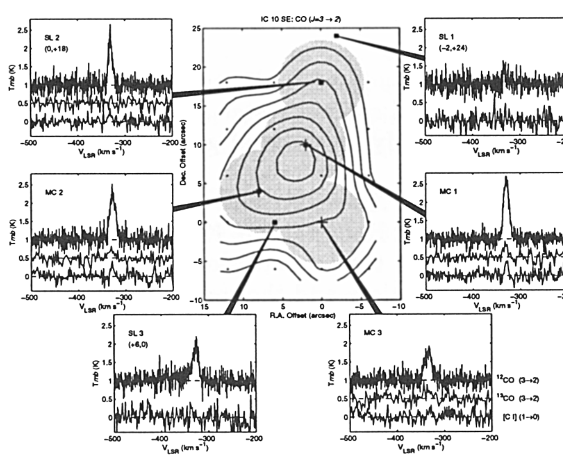


Figure 2. [C I] and CO ($J = 3 \rightarrow 2$) in the low metallicity, dwarf irregular galaxy IC 10. The contour map corresponds to the $^{12}$CO integrated intensity. The dots show the actual CO pointings that constitute the map. The crosses are placed at the positions of CO clumps identified interferometrically (Wilson & Reid 1991). The squares show the placement of our [C I] observations, while the circles illustrate the size of the JCMT [C I] beam. Our six [C I] spectra (bottom) are shown here together with the corresponding $^{12}$CO ($J = 3 \rightarrow 2$) (top) and $^{13}$CO ($J = 3 \rightarrow 2$) (middle, scaled up by a factor of 2).