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Kinematic Study of Ionized and Molecular Gases in Ultra-Compact HII Region Monoceros R2

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Monoceros R2 (Mon R2) is a ultra compact HII region (UCHII; diameter < 0.1pc; density$> 10^4 cm^{-3}$;Churchwell 2002) surrounded by PhotoDissociation Regions (PDRs), and an excellent example to investigate the chemistry and physics of early stage of massive star formation due to its proximity (830pc) and brightness. Previous studies by Jaffe et al. (2003) and Zhu et al. (2005, 2008), based on the 12.8μm [Ne II] observations of 16 UCHII regions, suggest that (a) essentially all of the different UCHII morphologies were the same (flows along cometary shells) but appeared different depending on viewing angle and (b) that these wind-driven cometary shells could have much longer lifetimes than classical UCHII regions. In this picture, the wind from the star holds the ionized gas up against the dense molecular core and the higher pressure at the head drives the ionized gas along the shell. In order for the model to work, there should be evidence for dense molecular gas along the shell walls, irradiated by the UCHII region and perhaps entrained into the flow along the walls.

We obtained the Immersion Grating INfrared Spectrograph (IGRINS) spectra of Mon R2 to study the kinematic patterns in the areas where ionized and molecular gases interact. The position-velocity maps from the high resolution H- and K-band (1.4-2.5μm) IGRINS spectra demonstrate that the ionized gases (Brackett and Pfund series, He and Fe emission lines; $\Delta v \approx 40 km/s$) flow along the walls of the surrounding clouds. This is consistent with the model by Zhu et al. (2008). In the PV maps of the H_2 emission lines there is no obvious motion ($\Delta v \approx 10 km/s$) of the molecular hydrogen right at the ionization boundary. This implys that the molecular gas is not taking part in the flow as the ionized gas is moving along the cavity walls.

REFERENCES

Churchwell, E. (2002) ARA&A, 40, 27
Jaffe, D. T., Zhu, Q., Lacy, J. H., and Richter, M. (2003) ApJ, 596, 1053
Zhu, Q., Lacy, J. H., Jaffe, D. T., Richter, M., and Greathouse, T. K. (2005) ApJ, 631, 381
Zhu, Q., Lacy, J. H., Jaffe, D. T., Richter, M., and Greathouse, T. K. (2008) ApJS, 177, 584