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H_2 excitation and mapping in the Orion Bar with IGRINS

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The Orion Bar, with its known illumination and edge-on geometry, is a perfect nearby laboratory for the study of high-density photodissociation regions illuminated by powerful ultraviolet fields. In such regions, the ro-vibrational lines of molecular hydrogen have significant diagnostic power about conditions at the H/ H_2 transition. To exploit this power, we must examine a large range in level energies by observing many H_2 lines. Since PDRs were first described 30 years ago by Tielens & Hollenbach (1985), technology for infrared spectroscopy has improved tremendously. The Immersion Grating INfrared Spectrograph (IGRINS) has high spectral resolution (~ 7.5 km s^{-1}) and instantaneous coverage of the entire H & K bands ($1.4 - 2.5\mu$m, Park et al. 2014). We used IGRINS to make a deep integration and velocity-resolved, spatially registered, 6" by 15" maps of the Orion Bar in many H_2 transitions. The results include detections of ~ 90 lines, including first detections of many high V lines (up to $V_u = 8$) in both the H & K bands. The detections range up to $E_u/k \sim 45000$ K. With the broad range of upper state energies, the data reveal the effects of radiative and collisional excitation and collisional de-excitation in the level populations. The large number of detections includes 12 pairs and 1 triple from a common upper state, in some cases bridging from the H to K band, that allow us to determine the extinction from the emitting region. We compare our results with PDR models to test the underlying assumptions of the models, to determine the physical conditions in the emitting regions, and to study variations in physical conditions from the ionization front into the cloud and between clump and inter-clump gas on arc-second scales.

REFERENCES

Park, C., Jaffe, D. T., Yuk, I., Chun, M., Pak, S., et al. (2014) Proc. SPIE, 9147
Tielens, A. G. G. M. and Hollenbach, D. (1985), ApJ, 291, 722