IDENTITY OF THE CARRIER OF λ5797 DIFFUSE INTERSTELLAR BAND and λ5800 RED-RECTANGLE EMISSION BAND

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The remarkable Red Rectangle nebula is well known for its emission bands (RRBs), excited by the central binary star HD 44179.[a] The proximity in wavelength between the strong λ5800 RRB and the long known and intense Diffuse Interstellar Band λ5797 DIB has led to speculation that these two bands originate from identical molecules. This speculation, however, has been challenged on the grounds that the peak wavelength of λ5800 RRB fails to converge to 5797 $\mathring{A}$ when observed at large angular offsets from HD 44179. Consequently, λ5800 RRB has been interpreted as being caused by various PAHs.[b]

We investigate the possibility that λ5800 RRB and λ5797 DIB originate from the same molecule. We speculate that absorption in the foreground gas causes the peak wavelength discrepancy, and that the red-shifting of the λ5800 RRB peaks is a combined effect of the extended tail toward the red (ETR)[c] resulting from the high radiative temperature near HD 44179 and the foreground gas absorption. We use the temperatures and luminosities of the binary star reported by Witt et al.[d] for calculating the emission. However, radio to far infrared radiation emanating directly from the stars is far too weak to produce ETR, and we rely on stellar heating of the environment. We find that radiative temperatures on the order of 1000 K are sufficient to explain the largest tail and red-shifted peak at the smallest angular offset. We believe the molecules causing λ5797 DIB[e] and λ5800 RRB are identical.

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[a] Schmidt, G. D., & Witt, A. N. 1991, ApJ, 383:698

[b] Sharp, R. G., Reilly, N. J., Kable, S. H., & Schmidt, T. W. 2006, ApJ, 639:194

[c] Oka, T., Welty, D. E., Johnson, S., York, D. G., Dahlstrom, J., & Hobbs, L. M. 2013, ApJ, 773:42

[d] Witt, A. N., Vijh, U. P., Hobbs, L. M., Aufdenberg, J. P., Thorburn, J. A., & York, D. G. 2009, 693:1946

[e] Huang, J. & Oka, T. 2015, Mol. Phys. 113, 15