OBSERVATIONS AND ANALYSIS OF EXTENDED TAIL TOWARD RED IN THE DIFFUSE INTERSTELLAR BANDS OF HERSCHEL 36

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In the studies of the Diffuse Interstellar Bands (DIBs), the sightline toward Herschel 36 near the center of the HII region Messier 8 is unique. It shows spectra of CH^+ and CH in the first excited level indicating the presence of a cloud with high radiative temperature. The heating is most likely due to far infrared emission from the adjacent intense infrared source Her 36 SE at a distance of 0.25" from Her 36.[a]

The effect of the high radiative temperature on some DIBs is spectacular. It produces on a normally symmetric bell-shape line a very prominent Extended Tail toward Red (ETR) on prototypical DIBs λ 5780.5, λ 5797.1, and λ 6613 while other DIBs λ 5849.8, λ 6196.0, and λ 6379.3 are little affected. We interpret this as indicating that the carriers of the former 3 DIBs that are seriously affected by the radiation are polar molecules and the pronounced ETRs are the result of the decrease of rotational constant B (3 - 5 %) upon electronic excitation. High J rotational levels are pumped radiatively and with the negative (B' - B) produces the ETR.

We have developed a model calculation of rotational distribution taking into account of both radiative and collisional processes. In view of the complexity of the problem linear molecules are considered. 7 parameters enter into the calculation but we find the fractional variation of B and the radiative temperature T_r are the most decisive. Although molecules with a general shape is beyond the scope of this work, we conclude that the 3 DIBs which show the pronounced ETRs are due to polar molecules and the requirement of high variation of B indicates that the molecules are not that large perhaps composed of 3-6 heavy atoms. The 3 DIBs that do not show the pronounced ETRs are likely due to non-polar molecules or large polar molecules with small fractional variation of B.[b]

[a] Goto, M., Stecklum, B., Linz, H., Feldt, M., Henning, Th., Pascucci, I., and Usuda, T. 2006, ApJ, **649** 299.

[b] Oka, T., Welty, D. E., Johnson, S., York, D. G., Dahlstrom, J., and Hobbs, L. M. 2013, ApJ, submitted