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great interest within the astronomy community. Maier is a leader in the field of laboratory spectroscopic astrophysics and, using a variety of newly developed techniques, has been amazingly productive in discovering new visible and ultraviolet spectra of carbon-containing unstable molecules, which are likely carriers of DIBs (only the almost collision-free environment of interstellar space allows such molecules to exist in abundance there; in the lab, they are difficult to prepare). This particular candidate molecule had already been observed by radio emission in dense interstellar clouds (~100 times denser than diffuse clouds where DIBs are observed) nearly 20 years ago (7). Cyclic C_3H_2 has been observed in diffuse clouds (8), so the presence of l-C_3H_2 may not be surprising. Related molecules such as C_2, C_2H, and C_3 have also been seen in diffuse clouds, and such a simple molecule is more appealing than very complicated molecules whose spectra are difficult to obtain in the laboratory.

Maier's group had previously recorded sharp fingerprints of l-C_3H_2 in the laboratory in the 6150 to 6330 Å region, which correspond to this molecule's lowest-energy electronic transition (9, 10). The major breakthrough in the present work was the proof that two much broader bands at 4881 and 5450 Å are also caused by a higher electronic transition of l-C_3H_2. The broad spectral lines of a simple molecule like l-C_3H_2 appear to be the result of the extremely short lifetime (~3 × 10^{-13} s) of the second electronic excited state. This interpretation follows from the uncertainty principle—a shorter transition time corresponds to higher uncertainty in energy and hence a broader spectral line.

The match of the two broad bands to DIBs seems reasonable, but with such "blurry fingerprints," it does not constitute proof beyond a reasonable doubt. In panel B of the figure, the interstellar spectra (solid curves) and simulations from laboratory data (dashed curves) are shown, with the 4881 Å DIB at left, and the 5450 Å DIB at center. Maier et al. also searched for the sharp transitions of l-C_3H_2 in the 6150 to 6330 Å region; the match with their spectra of interstellar clouds is promising, but not entirely convincing (panel B of the figure, lower right). Unfortunately, different stars were used in the searches for the broad and sharp bands, so it remains to be seen whether all of the supposed l-C_3H_2 transitions appear in a single diffuse cloud, and whether the intensities of all these transitions have a constant ratio in all clouds (as they should if they are caused by the same molecule).

Another aspect of the work by Maier et al. that is difficult to accept is the apparently high abundance of l-C_3H_2 toward the star HD 183143 (center of panel B of the figure). This line of sight, which has been famous in the DIB community since the pioneering work of Herbig (11), is remarkable in that it contains very few carbon-chain molecules, such as C_2 (12) or C_3 (13). In this respect, HD 183143 is an extreme case; its polar opposite is the star HD 204827, which has by far the highest C_3 and C_2 column densities of all sightlines so far studied and led to the discovery by our co-workers and ourselves of a group of DIBs called "C_2 DIBs" whose intensities correlate well with the C_2 column densities (12). These two sightlines have also served as contrasting prototypes for detailed compilations of the DIBs (14, 15). If Maier's claim about l-C_3H_2 is correct, this molecule must be more than two orders of magnitude more abundant than C_2 and C_3 in HD 183143. Although the chemical mechanism for producing hydrocarbon molecules in diffuse clouds is not well understood, it is hard to imagine such a tremendous discrepancy in the abundance of C_3 and l-C_3H_2.

At present, we conclude that there is insufficient evidence to "convict" l-C_3H_2 as a carrier of the DIBs. Searches for both the sharp and broad l-C_3H_2 bands in a number of diffuse clouds could establish whether the sharp bands are a perfect match, and whether the broad bands have a constant intensity ratio in different clouds. It may also be possible to search for l-C_3H_2 in diffuse clouds through its pure-rotational transitions (16); however, a direct comparison of absorption in the optical and the radio spectrum would require a background source that is bright at both wavelengths.

References and Notes

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MICROBIOLOGY

Another Microbial Pathway for Acetate Assimilation

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In a salt-loving Archaeon, a patchwork of enzymes creates a variation of the glyoxylate cycle.

Countless students in introductory biochemistry classes have heard the adage "fats burn in the flame of carbohydrates." It refers to the inability of vertebrates to convert acetyl coenzyme A (acetyl-CoA), an important metabolic molecule, into intermediate compounds that replenish carbon in the citric acid cycle and enable the synthesis of glucose. In contrast, plants and certain bacteria, fungi, and invertebrates have solved this barrier to "anabolism from acetate" by using a variation of the citric acid cycle. This variation is called the glyoxylate cycle, and it allows acetyl-CoA to be used as a replenishing source for carbon in the synthesis of glucose and other important reactions (1). However, a number of acetate-using microorganisms lack one of the signature enzymes involved in the glyoxylate cycle, isocitrate lyase, demonstrating that other pathway(s) for acetate assimilation must exist (2–4). In 2007, fully 50 years after the discovery of the glyoxylate cycle, investigators revealed the first complete details of one of these alternate pathways (5). Now, on page 334 of this issue, Khomyakova et al. (6) describe yet another acetate-assimilation pathway. It is in a salt-loving (halophilic) microorganism belonging to the Archaea, and incorporates

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