Mysterious stellar absorption lines could illuminate 90-year puzzle

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The discovery of 13 diffuse interstellar bands with the longest wavelengths to date could someday solve a 90-year-old mystery.

Astronomers have identified the new bands using data collected by the Gemini North telescope of stars in the center of the Milky Way.

Nature reports on its website today findings that support recent ideas about the presence of large, possibly carbon-based organic molecules —"carriers"—hidden in interstellar dust clouds. The paper will also appear in the Nov. 10 print issue of the journal.

"These diffuse interstellar bands—or DIBs—have never been seen before," says Donald Figer, director of the Center for Detectors at Rochester Institute of Technology and a co-author of the study. "Spectra of stars have absorption lines because gas and dust along the line of sight to the stars absorb some of the light."

"The most recent ideas are that diffuse interstellar bands are relatively simple carbon bearing molecules, similar to amino acids," he continues. "Maybe these are amino acid chains in space, which supports the theory that the seeds of life originated in space and rained down on planets."

"Observations in different Galactic sight lines indicate that the material responsible for these DIBs 'survives' under different physical conditions of temperature and density," adds Paco Najarro, scientist in the Department of Astrophysics in the Center of Astrobiology in Madrid.

The low-energy absorption lines Figer and his colleagues discovered provide constraints for determining the nature of diffuse interstellar bands. Future theoretical models that predict wavelengths absorbed by these mysterious particles now must accommodate these lower energies, Figer notes.

"We saw the same absorption lines in the spectra of every star," Figer says. "If we look at the exact wavelength of the features, we can figure out the kind of gas and dust between us and the stars that is absorbing the light."

Diffuse interstellar bands have remained a puzzle since their initial discovery 90 years ago. The 500 bands identified before this study mostly occur at visible and near-infrared wavelengths. The observed lines do not match predicted lines of simple molecules and cannot be pinned to a single carrier.

"None of the diffuse interstellar bands has been convincingly identified with a specific element or molecule, and indeed their identification, individually and collectively, is one of the greatest challenges in astronomical spectroscopy," says lead author Thomas Geballe, from the Gemini Observatory. "Recent studies have suggested that DIB carriers are large carbon-containing molecules."

The newly discovered infrared bands can be used as probes of the diffuse interstellar medium, especially in regions in which thick dust and gas obscure observations in the optical and shorter wavelength bands.

Studying the stronger emissions in the group may lead to an understanding of their molecular origin. Some day laboratory spectroscopy could be used to identify the infrared diffuse interstellar bands. No one has been successful yet at reproducing the interstellar bands in laboratory, Figer notes, due to the multitude of possibilities and the difficulty of reproducing the temperatures and pressures the gas would experience in space.

In addition to Geballe, Najarro and Figer, co-authors of the paper included Najarro's student Diego de la Fuente and former Gemini science intern Barrett Schlegelmilch.

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