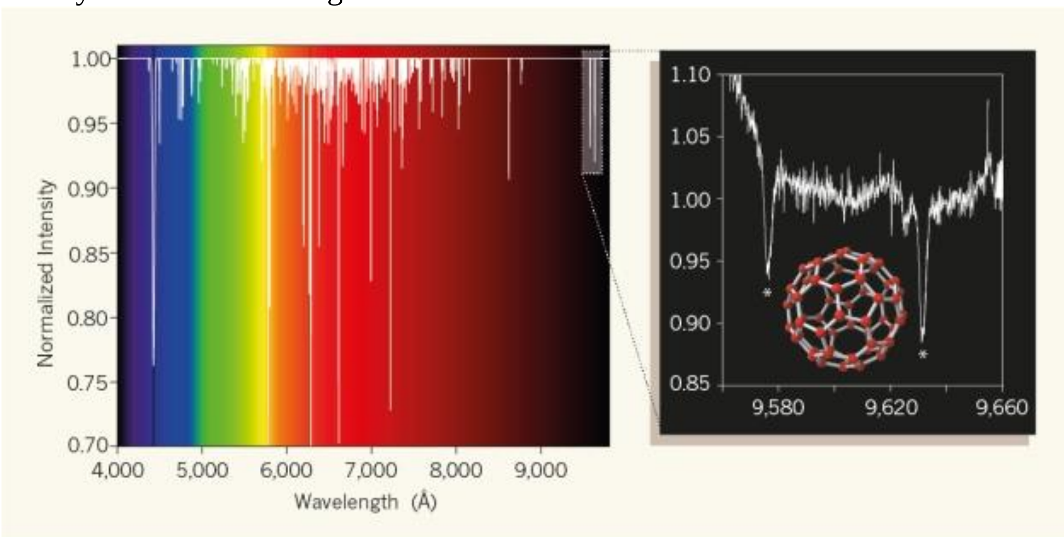
**Buckyballs in space solve 100-year-old riddle**

Spheres of carbon-60 responsible for mysterious cosmic-light features.

- Elizabeth Gibney

15 July 2015 - Nature Magazine

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A spectrum of the interstellar medium (left) shows 400 ‘diffuse interstellar bands’, where unknown molecules absorb specific wavelengths of light. Buckyballs (right) have been identified as responsible for two of these mysterious features. (Image: P. Ehrenfreund & B. Foing *Nature* **523,** 296–297; 2015).

Carbon cages floating in the space between the stars have been confirmed as the cause of cosmic-light features that have puzzled astronomers for almost 100 years.

Elizabeth Gibney asks John Maier about buckyballs in space.

In 1919, Mary Lea Heger, a graduate student at the University of California’s Lick Observatory on Mount Hamilton, saw that particular wavelengths of light were dimmed in the emissions from certain stars, in a way that seemed unrelated to the stars themselves. As astronomers spotted more such features, they attributed them to molecules in the interstellar gas that absorb wavelengths of light on their way to Earth, and called them diffuse interstellar bands (DIB). Some 400 DIBs have now been observed, from across the Milky Way and beyond.

Dust grains, carbon chains and even floating bacteria emerged as candidates to explain these features, but none proved conclusive. Now, a laboratory analysis of the light absorbed by buckyballs — hollow, soccer-ball shaped molecules made up of 60 carbon atoms — under space-like conditions has provided direct match for DIBs seen in 1994[1]. They are the first DIBs to be explained.

The finding, published in *Nature* on 15 July[2], opens the door to identifying other molecules floating in interstellar space. “As far as I'm concerned this is the scientific paper of the year,” says Harry Kroto, the British chemist who shared the 1996 Nobel Prize in Chemistry for the discovery of buckminsterfullerene with colleagues Robert Curl and Richard Smalley.

**Buckyballs in space**

Ever since buckyballs were accidentally discovered in 1985[3] during experiments designed to simulate conditions in gas flowing out of ageing, carbon-rich stars, scientists have hoped to find them in space, says John Maier, a chemist at the University of Basel in Switzerland and an author of the latest report.

It was not until 2010 that NASA’s Spitzer infrared space telescope first spotted buckyballs in remnants of a white-dwarf star[4]. But in 1993, Maier’s team had already measured the wavelengths of light that buckyballs absorbed when encased in an unreactive frozen solid[5], and astrophysicists had quickly found a tentative match to DIB patterns in the cosmos[1].

Yet without knowing how gaseous buckyballs behave in space-like conditions, no one could claim a definitive match.

Maier’s team analysed that behaviour by measuring the light-absorption of buckyballs at a temperature of near-absolute zero and in an extremely high vacuum, achieved by trapping the ions using electric fields, in a buffer of neutral helium gas. “It was so technically challenging to create conditions such as in interstellar space that it took 20 years of experimental development,” says Maier.

“Assuming the identification holds up, this is a tremendous victory,” says Ben McCall, an astronomer at the University of Illinois at Urbana-Champaign, who cautions that further astronomical measurements of DIBs are needed to prove beyond doubt that they exactly match the patterns seen in Maier’s lab work.

It is “certainly now appealing”, says Maier, that other DIBs are buckyball-related molecules, perhaps bonded with metals and other elements. But he adds that laboratory verification of this would be extremely demanding. “I would probably need another life to accomplish this,” he says. “But maybe a few youngsters somewhere in the world will take this up.”

Finding buckyballs in interstellar space shows that they are more abundant than previously thought, says Kroto. And the study suggests buckyballs can remain intact for millions of years and travel over great distances between the stars, adds McCall. "It's enormously exciting to think that such huge gas phase molecules could be ubiquitous throughout the interstellar medium of our galaxy!" he says.

Journal name: Nature
DOI:
doi:10.1038/nature.2015.17987