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Interstellar Fullerenes

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Abstract

In this contribution we present an overview of recent results on the detection and study of fullerenes (and related organic compounds) in the diffuse-to-translucent interstellar medium. The results pertain primarily to new observations of interstellar targets obtained with both ground and space-based facilities operating in the optical and infrared wavelength domains.

1. Interstellar fullerenes

Following the recent laboratory confirmation of two interstellar absorption bands arising from the C_{60} cation ([6, 2]) it is now possible to systematically study the presence and abundances of interstellar fullerenes in context of the general, largely unidentified, organic inventory of the interstellar medium (ISM). The near-infrared spectral signature of C_{60}^+ is studied at high-spectral resolution ([7]) with UVES & CRIRES instruments at the VLT and ESPADONS at the CFHT. Furthermore, near-infrared observations from space with the STIS instrument on the Hubble Space Telescope ([3, 4]) allow an unobscured view of this range that is normally, for ground-based observations, heavily contaminated by telluric features. We present results on our astronomical search for the weaker C_{60}^+ bands predicted by laboratory experiments. In addition we discuss the properties (profile substructure) of the two strongest bands. Furthermore, a careful analysis of archival Spitzer space telescope mid-infrared IRS spectra revealed the presence of neutral C60 bands in two regions probing the diffuse and the translucent ISM ([1]). The derived abundances for C60 emission and absorption are in agreement. Finally, we discuss the implication of these recent detections of fullerenes in space for our understanding of the organic inventory of the ISM, in particular in the context of the long-standing enigma concerning the identity of the carriers of the diffuse interstellar bands (DIBs) ([5]).

2. Summary and outlook

The recent laboratory confirmation of C_{60}^+ as the carrier of two prominent near-infrared DIBs, and the prediction and confirmation of two weak near-infrared bands, has re-newed interest in the enigma of the identity of the DIB carriers and offers a fresh view on the chemical complexity of interstellar matter and its organic components. Future facilities like the James Webb Space Telescope will allow us to obtain very sensitive infrared emission spectra of low-density diffuse interstellar gas & dust clouds. Furthermore, advances in near-infrared high resolution spectroscopy and atmospheric modelling of telluric lines will allow us to probe more deeply the physics of C_{60} in space and map their presence in the Milky Way, Local Group galaxies and beyond.

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