Contribution pour l'atelier général PCMI à la SF2A 2023

Candidature pour la contribution orale à la journée SF2A 2023

Je soussigné Grieco Francesco, doctorant en astrochimie au troisième année au LERMA-CY Cergy-Paris Université en co-tutelle avec UGent (BE) me propose pour une contribution orale, en anglais, à la journée SF2A 2023.

Titre du sujet: ”Enhanced star formation through the high-temperature formation of H2 on carbonaceous dust grains”.

Abstract du sujet de la presentation

Molecular hydrogen is the most abundant molecule in the Universe and its formation has implications on star formation rates over cosmic times. It is the cooling agent needed to initiate the cloud collapse regulating the star formation efficiency.[1,2]

The results presented here can contribute to changing the H/H_2 photodissociation front location and the respective size of PDR (PhotoDissociation Region), HII and molecular regions in a classical PDR picture.[3]

The dominant H_2 formation route depends on dust grains as catalysts, such as small carbonaceous grains, including PAHs (Polycyclic Aromatic Hydrocarbons), that have been shown to increase the H_2 formation rates.[4,5]

H_2 formation on PAHs was thought to reduce above dust temperatures of 50 K and H atom recombination was believed to be highly efficient only below 20 K. Until now, laboratory and theoretical works have suggested that H_2 cannot form on grains with temperatures above 100 K and they do not provide a direct measurement of the recombination efficiency at dust temperatures >20 K.[6,7,8,9]

Here we report direct laboratory measurements of the high efficiency formation of H_2 at temperatures up to 250 K on a carbonaceous surface mimicking interstellar dust. We observe a plateau above 100 K (20%), elevated values (30%) between 30K-80K, a maximum (45%) around 20 K, a sharp decrease (20%) at 10 K. This efficiency includes accretion, diffusion and reaction steps. The H_2 formation pathway on surfaces can therefore be much more efficient than previously estimated, over an extended range of temperatures. H_2 could start contributing to the cooling of warmer gas (T~50-250 K) and this will have a huge impact on our understanding of H_2 formation in nearby galaxies and the availability of H_2 reservoirs for star formation in high-redshift galaxies, in which significant dust masses have been built up and the CMB (Cosmic Microwave Background) pushes the dust temperatures to >20 K.[10]

This study will enable an estimation of the contribution of PAHs to interstellar H_2 formation at higher temperature. Correctly accounting for H_2 formation over cosmic times is a key ingredient to interpret the James Webb Space Telescope observations of the PAH grain population, the H_2 line emission in local PDRs and nearby galaxies, and to study the formation of the first generations of stars in Early Universe galaxies.[11,12]

References

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L'article associé au sujet à présenter est en cours de publication par Nature Astronomy.

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