AN OPEN QUANTUM SYSTEMS APPROACH TO THE FORMATION OF PREBIOTIC MOLECULES.
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Introduction: The identification of quantum effects in primitive organisms such as bacteria [1,2] has resulted in the successful application of open quantum systems models to energy and charge transfer processses in photosynthetic systems [3-5], as well as suggesting that quantum effects may have played an important role in the emergence of the very first living systems from the inanimate matter of which they are constituted.

The detection of the molecular precursors of life in interstellar ices suggests that the building blocks of life may have emerged in space and been delivered to Earth by objects such as comets or meteorites.

Hydrogen cyanide (HCN) oligomers are likely to have played a significant role in the synthesis of a range of prebiotic molecules [6-10]. Recently, dimeric forms of HCN (cyanomethanimine) [11], as well as other molecules likely to be precursors of amino acids and nucleotides [12-14], have been detected in the interstellar medium.

Gas-phase modelling cannot account for the variety and richness of chemistry occurring in the interstellar medium. For example, it has been found that interstellar gas-phase production routes are incapable of producing significant amounts of cyanomethanimine [15,16]. However, experiments have demonstrated the spontaneous generation of amino acids in interstellar ice analogues irradiated with UV light [17-19].

The theoretical study of the spontaneous generation of prebiotic molecules in the interstellar medium is performed most fundamentally in the framework of open quantum systems. A low temperature interstellar icy environment strongly coupled to a simple molecular system such as HCN, and excited by incident UV radiation, can be conveniently investigated using appropriate well-known approximations from the field of open quantum systems. We report our progress on this topic.

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