The Role of Molecular Hydrogen in Star Formation

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The ground state hydrogen molecule, with its 348 internal energy states, is perhaps the simplest molecule in chemistry. If the hydrogen molecule did not exist, stars would not exist. How this molecule transfers energy is critical to the formation of stars in the wake of interstellar shocks in molecular clouds in the interstellar medium.

In a shock, the state distribution of molecules is far from equilibrium. The relaxation of a shock in the interstellar medium is governed by the competition of radiative and collisional processes, which in turn govern whether the conditions for gravitational collapse are met. Modelling the cooling of shocks requires detailed information on all the processes that can populate or depopulate all the internal energy states.

Processes involving molecular hydrogen can be rigorously studied theoretically and modelled computationally. This talk explores the various computational approaches from full-dimensional quantum, through quasiclassical methods, to applications of artificial intelligence to provide the information needed to model interstellar shocks.

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