

Role of nuclear spin configuration of H₂ in low temperature plasmas – experimental studies

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As H₂ molecules play an important role in many plasmas, thus it is essential to understand reactions of hydrogen molecules with ions. An impact of nuclear spin configuration of H₂ may be significant, especially in low temperature environments.

H₂ exists in two nuclear spin configurations denoted as ortho and para that describes spin orientation of nuclei. These configurations split rotational states of H₂ in two manifolds which do not convert mutually easily. The lowest states of these manifolds differ by 170 K in energy [1]. The rotational excitation of H₂ may influence reaction processes of nearly thermoneutral reactions considerably at low temperatures.

For our studies we use an ion trapping technique where confined ions interact with hydrogen at low temperatures from 10 K to 300 K [2]).

We studied reaction of $N^+ + H_2 \rightarrow NH^+ + H$ and we observed dependence on nuclear spin configuration of H₂ as well as dependence on energy of fine structure states of N⁺ [3].

In progress is study of reaction $O^- + H_2 \rightarrow OH^- + H$. We already observed a significant effect of temperature caused by complex system of energy paths of the reaction [4]. We plan to study effect of para- and ortho-H₂ to understand aforementioned reaction process.

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