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Title:Low-temperature water-hydrogen-molecule collisions probed by pressure broadening and line shift

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Abstract:Theoretical $\text{H}_2\text{O-H}_2$ pressure broadening and line shifts are compared with experimental values for three water rotational transitions. These transitions, which occur at terahertz frequencies, are primary radiant coolants for collapsing interstellar clouds that contain water. They are observed by the submillimeter/FIR Herschel space observatory. Systematic effects in previous pressure-broadening measurements that were due to ortho-hydrogen to para-hydrogen conversion have been overcome, and the present results follow the expected behavior predicted by collision theory. The systemic error, discovered through comparisons between theory and experiments, is due to conversion of ortho hydrogen to para hydrogen by water ice below 40 K. This process occurs on a time scale very short compared to astrophysical processes and may be pertinent to ice-grain interactions in the interstellar medium. ©2012 American Physical Society.

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Controlled terms:Water vapor

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