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Hydrogen clusters that remained fluid

KIRILL KUYANOV-PROZUMENT, ANDREY VILESOV — *Para*-H_2 may constitute the only other superfluid besides helium. The superfluid transition temperature is predicted to be around 2 K, well below freezing of H_2 at 13.8 K. Numerous attempts to supercool macroscopic H_2 samples proved to be unsuccessful. Our approach includes formation of H_2 clusters in a pulsed cryogenic nozzle beam expansion of a neat pH_2 gas as well as $\boldsymbol{X}$**%** of pH_2 diluted in He and interrogation via Coherent Anti-Stokes Raman Scattering. At $\boldsymbol{X = 2 - 100}$ **%** the frequency of the vibrational $Q_1(0)$ line in clusters remains constant at about $\nu = 4149.7$ cm^{-1} very similar to 4149.6 cm^{-1} as in solid pH_2 and lower than in liquid pH_2at 18 K (4151.9 cm^{-1}). The rotational $S_0(0)$ transition show some characteristic crystal field splitting having magnitude of about 6 cm^{-1}. The splitting pattern is different from that in the *hcp* solid, suggesting different structure in solid pH_2 clusters. At $\boldsymbol{X \leq 2}$ **%**, the frequency of the $Q_1(0)$ line increases to about 4150.5 cm^{-1}, which is consistent with that expected in the supercooled liquid. The $S_0(0)$ transition in these clusters, consisting of about 5 x 10^4 molecules, appears as a single line at the same frequency as in liquid pH_2. The temperature of these supercooled clusters is estimated to be less than about 1 K. Possible superfluidity of the clusters is discussed.

[X] Prefer Oral Session
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