MOLECULAR SUPERFLUIDITY IN SMALL CLUSTERS OF $(p\mathrm{H}_2)_N$-HCN STUDIED WITH ROTATIONAL SPECTROSCOPY

STEVE P. DEMPSTER and WOLFGANG JÄGER, *Department of Chemistry, University of Alberta, Edmonton, Canada T6G 2G2*.

In a recent experimental and theoretical study by Li *et al.*[a], direct evidence for molecular superfluidity in small clusters of *para*-hydrogen molecules ($p\mathrm{H}_2$) seeded with CO_2 was discovered. The authors also found that the anisotropy of the CO_2–$p\mathrm{H}_2$ interaction potential promotes localization of the $p\mathrm{H}_2$ molecules at larger cluster sizes ($N \approx 17$ *para*-hydrogen molecules), with a simultaneous reduction of the superfluid $p\mathrm{H}_2$ fraction. It has been suggested that light rotors with a more isotropic interaction potential, such as CO and HCN, are potentially more subtle probes of $p\mathrm{H}_2$ superfluidity that would allow superfluidity to persist, especially at larger values of *N*. In the current study, the hyperfine structures of the end-over-end rotational transitions of $(p\mathrm{H}_2)_N$-HCN clusters were measured using our chirped-pulse Fourier transform microwave spectrometer. Based on tentative assignments, the evolution of effective rotational constants, B_{eff}, as a function of *N* shows evidence for superfluid behaviour by a clear "turn-around" point at a low *N* value. The trend of B_{eff} vs. *N* and the results from the hyperfine structure analysis will be compared to the recent studies on He_N-HCN and $(p\mathrm{H}_2)_N$-CO.

[a] H. Li, R. J. Le Roy, P.-N. Roy, and A. R. W. McKellar, *Phys. Rev. Lett.* **105**, 133401 (2010).