THE INDEX OF REFRACTION OF SOLID HYDROGEN

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The most abundant baryonic substance in the universe, hydrogen, has played a critical role in the development of atomic and molecular physics. It has served as the theoretical and experimental proving ground for exploring everything from quantum mechanics to the physical processes in the interstellar medium. From superfluid behavior in the solid state to the strange physics of small clusters, the properties of molecular hydrogen have continued to open doors of understanding. Of particular interest to spectroscopists is the use of the condensed phases of hydrogen as a medium with which to generate infrared light via Stokes downconversion. The Raman gain of solid hydrogen has been shown to be 7000 times larger than that of gaseous hydrogen. This suggests that solid hydrogen could be an ideal medium with which to generate infrared light for spectroscopy. As a next step, a better understanding of the interaction of solid hydrogen with light would be useful. To the best of our knowledge, the index of refraction of solid hydrogen has never been measured. Our two groups have collaborated to measure this index at selected wavelengths in the visible and infrared regions of the electromagnetic spectrum. Specifically, we used $> 99.9\%$ para hydrogen to form a solid hydrogen crystal in cryostats held between 4 and 6 Kelvin. Measurements were made in Kyoto using a nanosecond Optical Parametric Oscillator (OPO) laser between 430 and 1100 nm, and independent measurements are being made in Urbana using a helium neon laser, an argon ion laser, and a diode laser operating in the 950 nm range.