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Molecular Spectroscopy in Hollow-Core Photonic Crystal Fiber at the 10 kHz Level CHENCHEN WANG, KEVIN KNABE, SHUN WU, JINKANG LIM, KARL TILLMAN, BRIAN WASHBURN, KRISTAN CORWIN, Physics Department, Kansas State University, 116 Cardwell Hall, Manhattan, KS 66506 USA, NATALIE WHEELER, FRANCOIS COUNY, FETAH BENABID, Centre for Photonics and Photonic Materials, Dept. of Physics, University of Bath, BA2 7AY, UK — High-accuracy spectroscopy in hollow-core photonic crystal fiber (HC-PCF) is desirable for many applications, including frequency references and trace gas analysis. We demonstrate the narrowest sub-Doppler linewidths attained in HC-PCF using large-core kagome structured fiber. Such fibers can yield highly accurate frequency measurements that are about two orders of magnitude higher than previously reported. A fiber laser is locked to the $^{12}C_2H_2$ $\nu_1 + \nu_3$ P(13) transition inside kagome fiber, and compared with two optical frequency combs referenced to a GPS-disciplined Rb oscillator. The absolute frequency of the measured line center agrees with those measured in power build-up cavities to within 9.3 kHz (1 σ error). Approaches to further narrow the linewidths and improve systematic errors are investigated. The present system thus combines accuracy approaching that of power build-up cavities with the potential to be compact, robust, and integrated into an all-fiber system for a portable near-infrared frequency reference. Supported by AFOSR FA9950-05-1-0304 and NSF ECS-0449295.

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