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Multimode strong coupling of laser-cooled atoms to a nanofiber-based ring resonator — •Martin Blaha[1], Aisling Johnson[1], Alexander Ulanov[2], Jürgen Volz[1], Philipp Schneeweiss[1], and Arno Rauschenbeutel[3] — [1]Atominstitut, TU Wien, 1020 Wien, Austria — [2]Russian Quantum Center, 143025 Moscow, Russia — [3]Institut für Physik, Humboldt-Universität zu Berlin, 10099 Berlin, Germany

We report on the observation of multimode strong coupling between a cloud of cold atoms and a nanofiber-based fiber ring resonator. This novel regime of CQED can be reached when the collective coupling strength g between the atoms and the light field exceeds the free spectral range FSR of the resonator, leading to coupling of the emitters with more than one longitudinal resonator mode[1]. In our cavity an exceptionally small free spectral range of 7.1 MHz, can be reached by using a 30 m long fiber ring resonator[2], with an integrated optical nanofiber of subwavelength-diameter waist. The experimental signature of this regime lies in the transmission spectrum of the loaded cavity, which we measured for increasing couplings until values as large as g = 2 x FSR. Furthermore, we characterise the experimental platform by measuring second-order correlations at the output of the resonator. This photon-statistics contain information on the number of atoms coupled to the cavity as well as evidence of the light-atom interplay in the resonator. [1] Meiser, D., and P. Meystre, Physical Review A 74.6 (2006): 065801. [2] Schneeweiss, Philipp, et al., Optics letters 42.1 (2017): 85-88.

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