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Multimode strong coupling of laser-cooled atoms close 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 is 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]. The atoms are coupled to the resonator mode via evanescent coupling trough an optical nanofiber where light is naturally strongly confined. 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 = 2FSR. Furthermore, we characterise the experimental platform by measuring second-order correlations at the output of the resonator. The 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., et al., Phy. Rev. A 74(6), (2006).
[2] Schneeweiss, Ph., et al., Opt. Lett. 42(1), (2017).

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