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Quantum Optomechanics with Superfluid Helium YOGESH PATIL, JIAXIN YU, SEAN FRAZIER, JACK HARRIS, Yale University — Superfluid Helium has in recent years been demonstrated to be a very good platform to realize quantum optomechanics owing to its extremely low losses, both optical (it combines a ≈19eV bandgap with a near total absence of chemical or structural defects) and mechanical (it has zero viscosity) [1]. Moreover, it offers access to the qualitatively novel and unexplored regime of *fluid* quantum optomechanics. Building on our previous work with superfluid-Helium filled fiber cavities, which couple an acoustic mode of the Helium to an optical mode of the cavity [2], we report here the first results on photon-phonon counting in such a device using a scheme modified and adapted from [3]. We further report progress toward the conditional preparation and detection of a non-Gaussian single-phonon Fock state of this superfluid resonator. [1] A. D. Kashkanova et. al., Nat. Phys. **13**, 74 (2017) [2] A. B. Shkarin et. al., arXiv 1709.02794 (2017) [3] R. Riedinger et. al., Nature **530**, 313 (2016)

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