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High-Resolution Measurements of the Roton Lifetime in Nano-Confinement[1] MATTHEW BRYAN, Indiana University - Bloomington, TIMOTHY PRISK, SOULEYMANE DIALLO, EUGENE MAMONTOV, Oak Ridge National Lab, PAUL SOKOL, Indiana University - Bloomington — At very low temperatures, the phonon-roton spectrum of bulk superfluid helium is sharp and well-defined in energy. As the temperature is increased, the roton energy gap becomes smaller and the roton peak acquires a finite linewidth. The conventional understanding of this effect is that roton-roton scattering drives the softening and broadening of the roton mode where the mean free path is governed by the thermal population of rotons. It is an open question whether the roton mode follows the same behavior when the liquid is confined within sufficiently small mesopores. It is possible that the restricted geometry introduces a new length scale which controls the roton mean free path at low temperatures. We report high-resolution (4 μeV) measurements of the roton energy and linewidth within tubular, silica nanopores 2.8 nm in diameter. The new results provide a critical test of the idea that tight, nanoscale confinement modifies the energy and linewidth of the roton excitation.

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