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Phase diagram and the metallic state in destructive regime in ultrathin doubly connected superconducting Al cylinders HAOHUA WANG, NEAL STALEY, BEN CLOUSER, YING LIU, Department of Physics, The Pennsylvania State University — We measured ultrathin, doubly connected superconducting cylinders of Al for which the kinetic energy due to a flux- dependent superfluid velocity, determined by fluxoid quantization, becomes comparable to or higher than the superconducting condensation energy. When the cylinder diameter, d, is less than zero-temperature superconducting coherence length, $\xi(0)$, superconductivity is lost around half-integer flux quanta, leading to a destructive regime predicted by de Gennes. Extending our previous work that confirmed de Gennes' prediction, we have discovered the existence of a new phase diagram in which the destructive regime emerges around three-half flux but not half-flux quanta in a cylinder with $d > \xi(0)$, a case not considered by de Gennes. We also measured systematically the resistance in the destructive regime and found that the normal state resistance was fully recovered at $d/\xi(0) \leq 0.77$. The implications of these observations will be discussed.

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