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Confinement of superconducting fluctuations due to emergent electronic inhomogeneities in ultrathin films CLÉMENTINE CARBILLET, Sorbonne Universités, UPMC, UMR 7588, Institut des Nanosciences de Paris, F-75005, Paris, France, SERGIO CAPRARA, MARCO GRILLI, Department of Physics, University of Rome "La Sapienza," Piazzale A. Moro 5, I-00185 Rome, Italy, CHRISTOPHE BRUN, TRISTAN CREN, FRANCOIS DEBONTRIDDER, Sorbonne Universités, UPMC, UMR 7588, Institut des Nanosciences de Paris, F-75005, Paris, France, BAPTISTE VIGNOLLE, CNRS/LNCMI, 143 Avenue de Rangueil, 31400 Toulouse, France, KONSTANTIN ILIN, MICHAEL SIEGLER, Institute of Micro- und Nano-electronic Systems, Karlsruhe Institute of Technology, Hertzstrasse 16, D-76187 Karlsruhe, Germany, DIMITRI RODITCHEV, BRIGITTE LERIDON, LPEM-CNRS/ESPCI-ParisTech/UPMC/PSL, 10 rue Vauquelin, 75005 Paris, France — The question of homogeneity, granularity, or glassiness of materials on the verge of a superconductor/insulator transition is fundamental and hotly debated. Here, by combining macroscopic and nano-scale studies of superconducting ultrathin NbN films, we reveal some nanoscopic electronic inhomogeneity that emerges when the film thickness is reduced. While thicker films display a purely two-dimensional behavior in electrical transport measurements, we demonstrate a seemingly zero-dimensional regime in the superconducting thermal fluctuations for the thinner samples. This regime corresponds to a longer survival and anomalous local diffusion of the Cooper pair fluctuations. Remarkably, the typical length scale, 20-40 nm, extracted from the fluctuation conductivity coincides with the correlation length of the electronic inhomogeneities directly revealed by local scanning tunneling spectroscopy.

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