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Resonant tunneling of fluctuation Cooper pairs: Shapiro steps above superconducting critical temperature ALEXEY GALDA, Materials Science Division, Argonne National Laboratory, ALEXANDER MEL'NIKOV, Institute for Physics of Microstructures, Russian Academy of Sciences, VALERII VINOKUR, Materials Science Division, Argonne National Laboratory — Superconducting fluctuations have proved to be an irreplaceable source of information about microscopic and macroscopic material parameters that could be inferred from experiments. According to common wisdom, the effect of thermodynamic fluctuations in the vicinity of the superconducting transition temperature, T_c, is to round off all of the sharp corners and discontinuities, which otherwise would have been expected to occur at T_c. Here we report the current spikes due to radiation-induced resonant tunneling of fluctuation Cooper pairs between two superconductors which grow even sharper and more pronounced upon approach to T_c. This striking effect offers an unprecedented tool for direct measurements of fluctuation Cooper pairs' lifetime, which is key to our understanding of the fluctuation regime, most notably to nature of the pseudogap state in high temperature superconductors. Our finding marks a radical departure from the conventional view of superconducting fluctuations as blurring and rounding phenomenon.

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