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SUPERCONDUCTING DIODE EFFECT IN THIN FILMS WITH 100% EFFICIENCY

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The term **"superconducting diode effect" (SDE)** was introduced in the context of advancing superconducting quantum electronics. However, the ac rectification was observed in the 1960s in dc SQUIDs caused by asymmetry in their current–voltage characteristics in magnetic fields. Later, similar behavior was identified in wide thin films due to asymmetry in the Bean–Livingston edge barriers.
Visualization of the critical and resistive states in wide tin films with low-temperature laser scanning microscopy [1] shows that the critical current is locally determined at one of the film edges. Externally applied magnetic field induces nonreciprocity in the critical currents of up to 65% [2]. This phenomenon is intrinsic to all superconducting thin film structures and must therefore be considered and excluded when investigating new quantum mechanisms for SDE.
Our experiments demonstrate that this approach is the most effective for implementing SD as a superconducting microbridge controlled by magnetic field and driven by current into a resistive state characterized by phase slip lines. Moreover, when the system is additionally exposed to 10 GHz microwave radiation, the rectification efficiency approaches **100%**.

[1] A. G. Sivakov et al., Low Temp. Phys. 44, 226 (2018)
[2] Y. Hou et al., Phys. Rev. Lett. 131, 027001 (2023)

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