Controlling the Efficiency of the Superconducting "Diode Effect" Using Microwave Radiation

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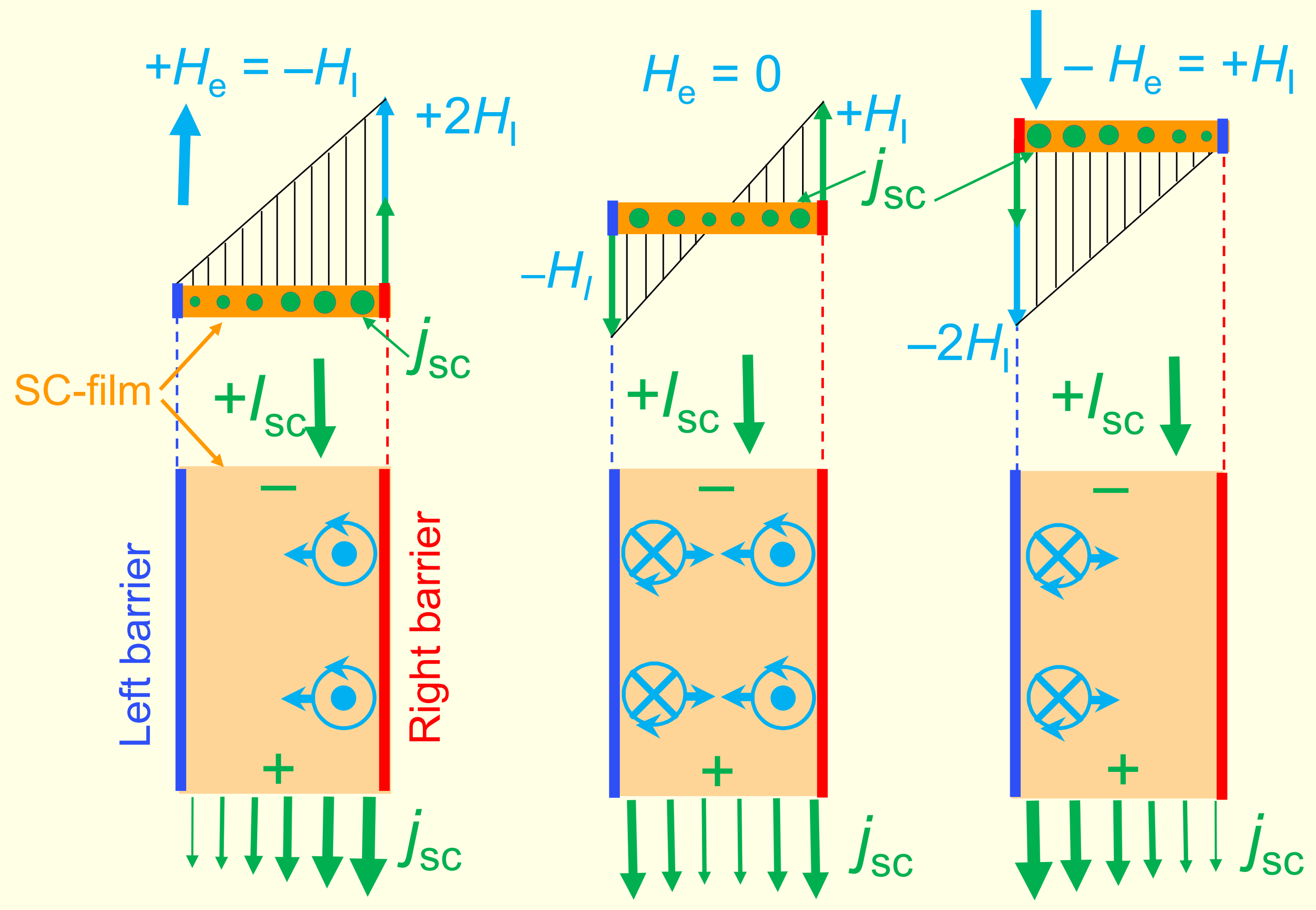
1. The emergence of critical state in current-driven thin films in low magnetic fields

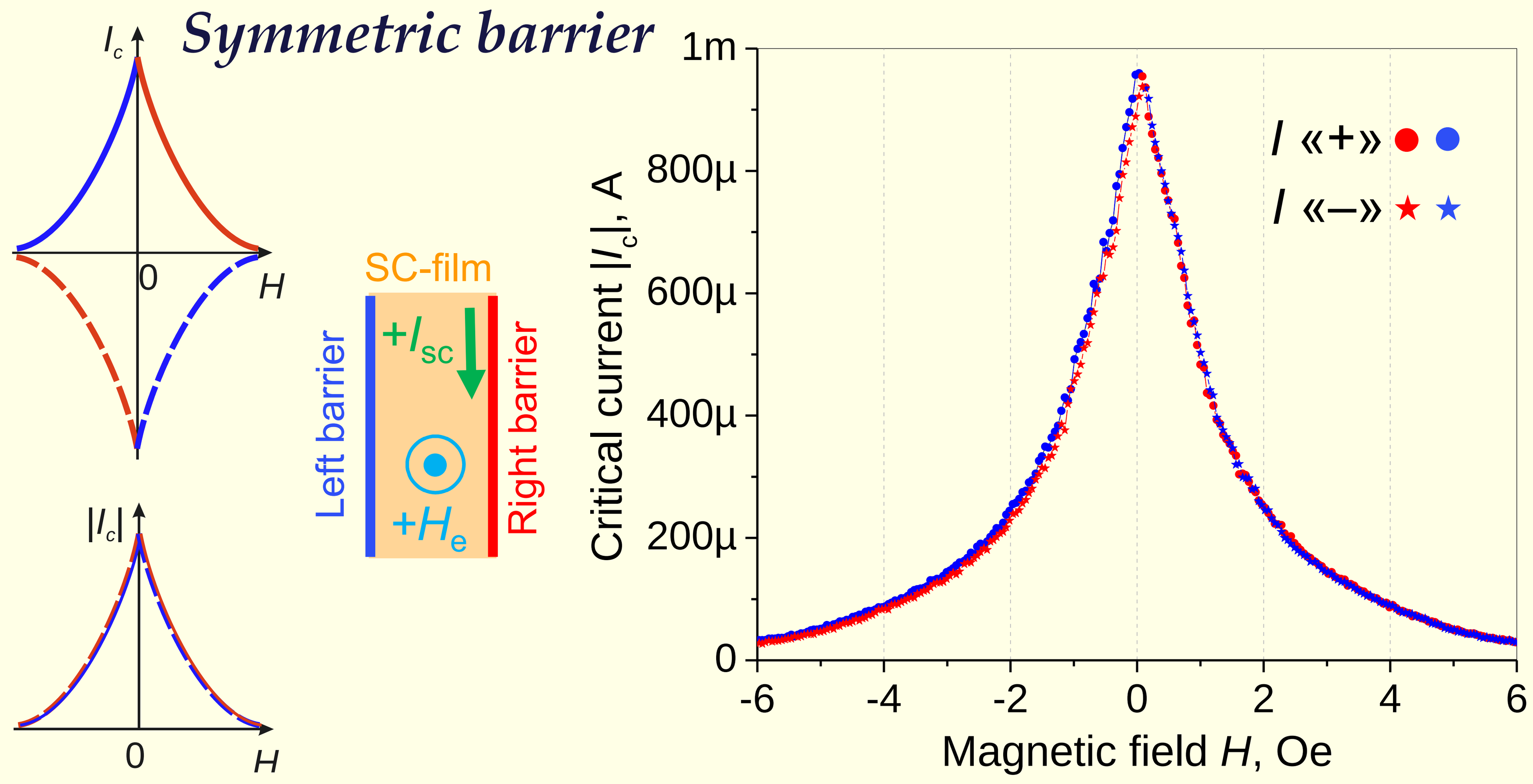
It is not the transport current itself that is critical, but rather its density.

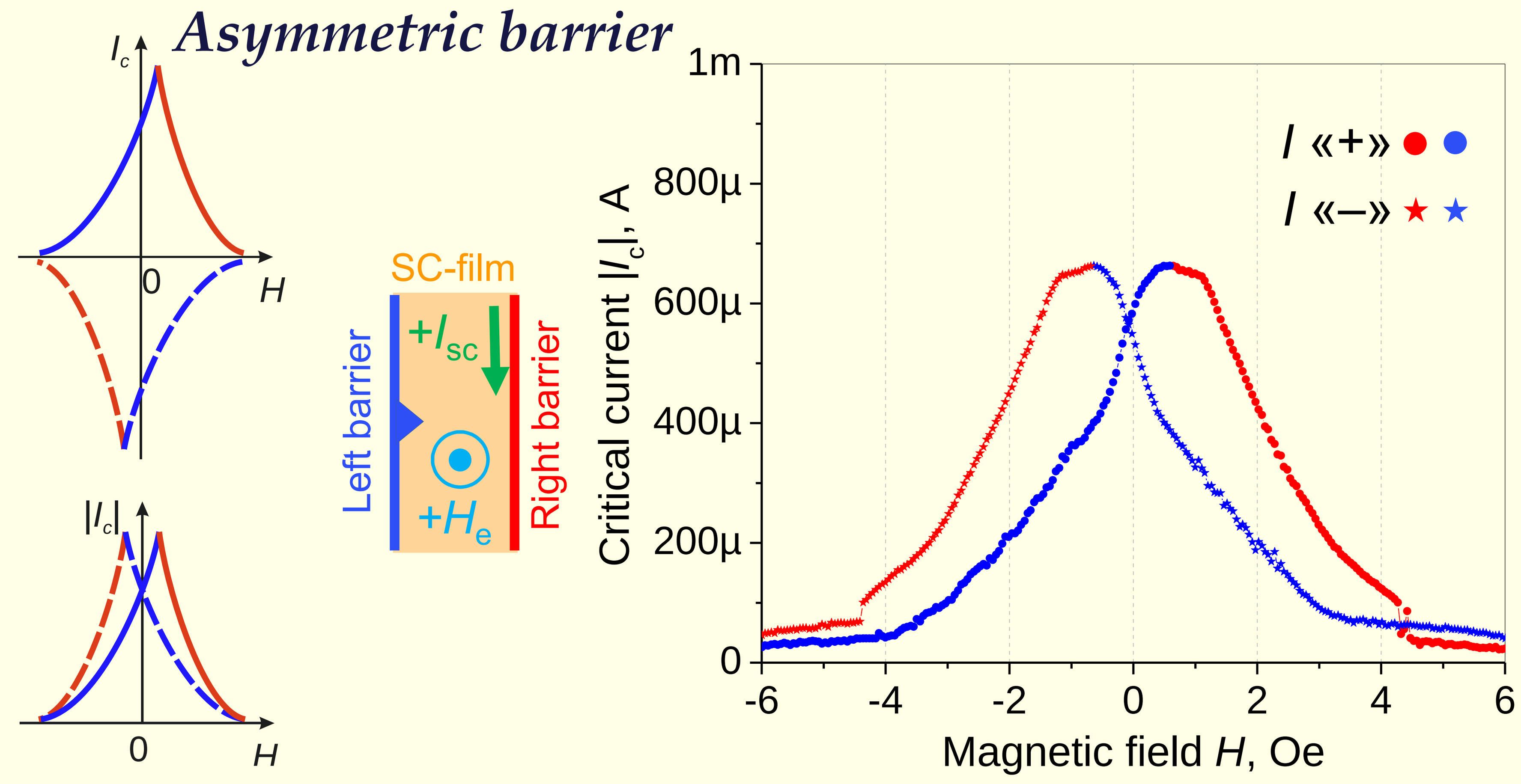
The critical current density is not uniformly distributed over the cross section and is a local characteristic.



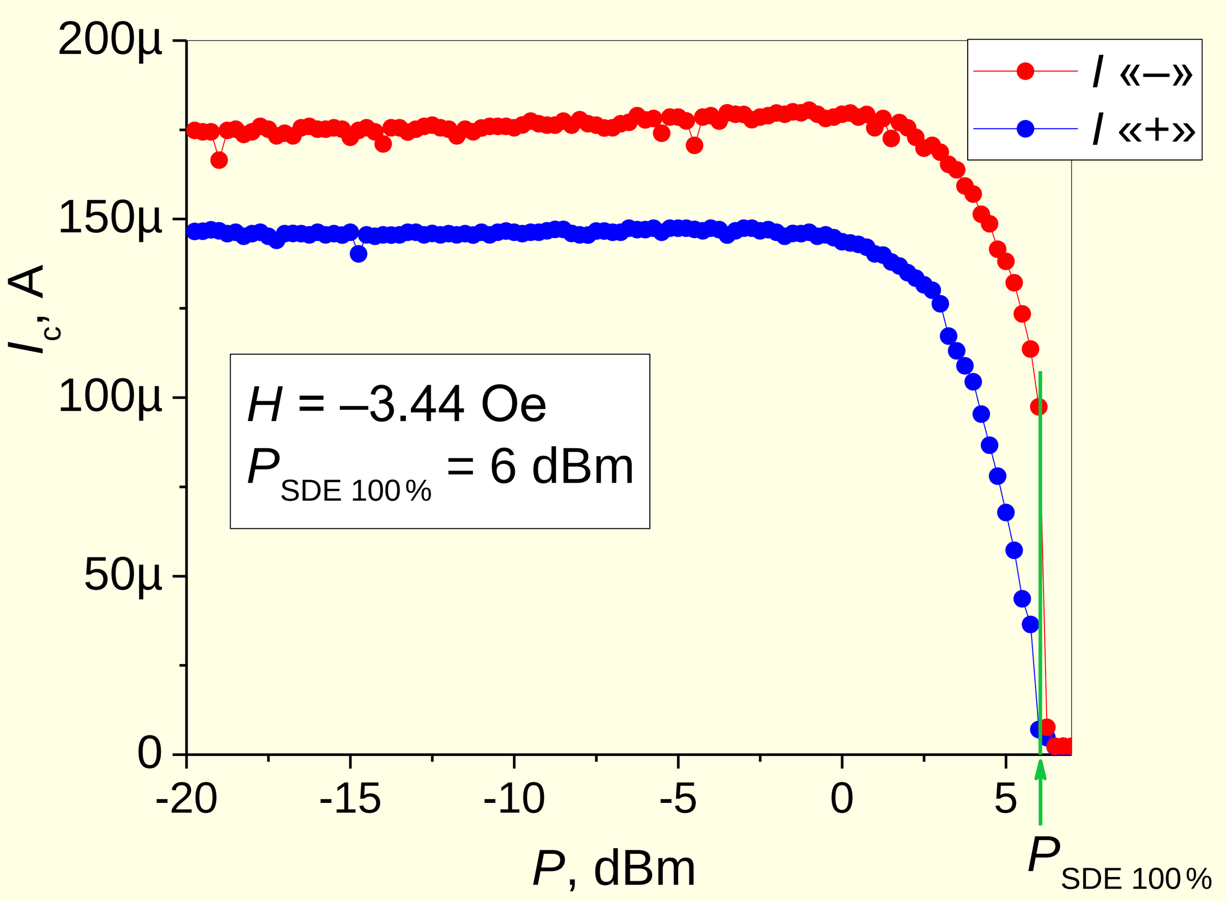
A number of quantum effects are considered that result in the nonreciprocity of the current, but with paying no attention to the fundamental features of the superconducting current flow and the resistive state nature .
However, it must be taken into account that, in a magnetic field, the critical current density is achieved only at one edge of the sample where the magnetic fields of the transport current and the external one add up.

2. The only criterion for the existence of SDE is the inequality of critical currents for opposite directions of supercurrents

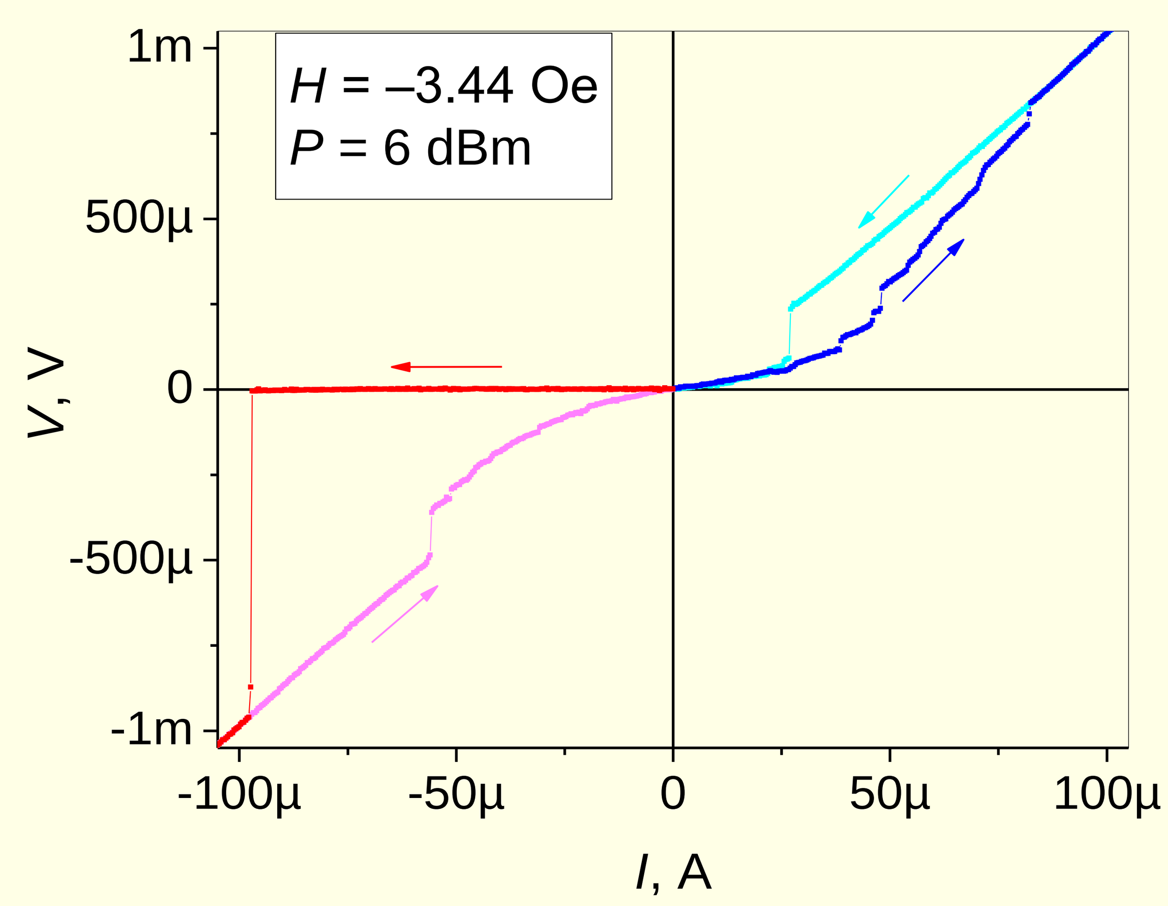


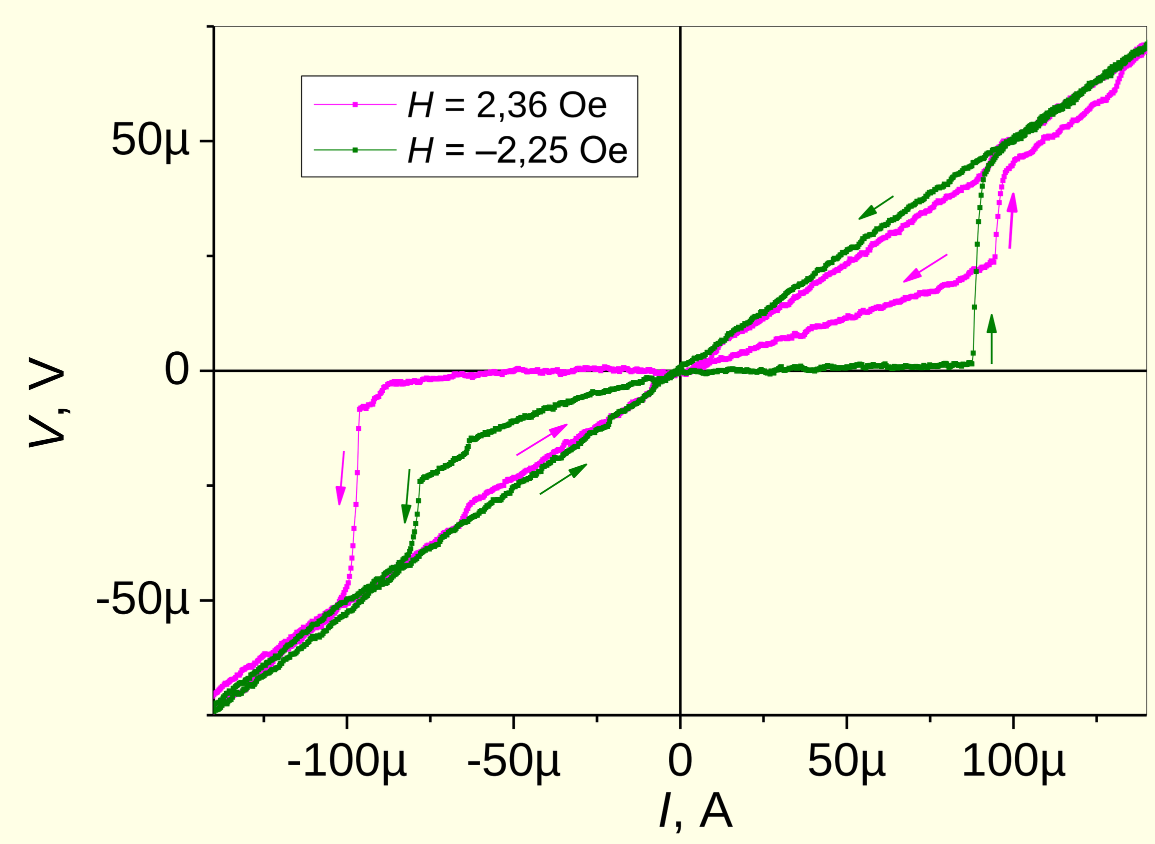


3. I_c vs. microwave power curves for two directions of current in a thin film with unequal edge barriers placed in magnetic field



4. I-V characteristic of a thin film with an ideal superconducting diode effect (SDE 100%)





Conclusion

It has been shown that SDE was attainable without involving complex quantum phenomena (violation of time reversal symmetry, spin-orbit exchange interaction, etc.), but using only the properties of superconducting current. By exposure to external factors (H, T, microwave) it is possible to achieve 100% efficiency of SDE.
In this case, one element can have 4 states — normal, superconducting and diode in two directions of current and may be a new logical element of superconducting electronics.