On the current flow in superconductors: universal trends and holographic analysis

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The superconducting state can be destroyed by the increase of temperature, magnetic field or current flow beyond their critical values. The critical current $I_c$ is of special interest as most of the practical applications of superconductors crucially depend on its limiting value. Recent analysis of experimental data in many families of superconductors have discovered \cite{1} an interesting universal relation between critical current, critical magnetic field $H_c$ and the penetration depth $\lambda$. Using the holographic analogy we have calculated the temperature dependence of the critical current in strongly coupled superconductors \cite{2}. It turns out that the calculated critical current dependence on temperature in 2d systems is $I_c \propto (T_c - T)^{3/2}$ and agrees with observed in thin films. Similar calculations for 3d systems reveals linear T-dependence $I_c \propto (T_c - T)^1$.

\textbf{References:}