Phase transitions in the distribution of the Andreev conductance of superconductor-metal junctions with multiple transverse modes

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We compute analytically the full distribution of Andreev conductance G_{NS} of a metal-superconductor interface with a large number N_c of transverse modes, using a random matrix approach. The probability distribution $\mathcal{P}(G_{\mathrm{NS}},N_c)$ in the limit of large N_c displays a Gaussian behavior near the average value $<G_{\mathrm{NS}}>= (2-\sqrt{2}) N_c$ and asymmetric power-law tails in the two limits of very small and very large G_{NS}. In addition, we find a novel third regime sandwiched between the central Gaussian peak and the power law tail for large G_{NS}. Weakly non-analytic points separate these four regimes---these are shown to be consequences of three phase transitions in an associated Coulomb gas problem.

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