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Mapping out the Superconductor-Insulator Phase Diagram for Nanowires.

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We establish the superconductor-insulator phase diagram for quasi-one-dimensional wires by measuring about 100 MoGe nanowires with length in a range 30-500 nm. All wires can be clearly separated into two groups: superconducting ones with the wire resistance dropping rapidly with cooling, roughly following the Arrhenius activation law, and insulating wires, which exhibit a weak Coulomb blockade behavior. The phase boundary between superconducting and insulating wires is consistent with the Chakravarty-Schmid-Bulgadaev criteria, namely with the critical resistance of a wire being equal to quantum resistance, i.e. 6.5 kOhms. We argue that small deviations from this phase boundary in short thin wires are caused by magnetic moments that forms on a wire surface. The evidence for the presence of the moments comes from an anomalous enhancement of the critical current by magnetic field detected at low temperatures.