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Controlled Quantized Conductance Steps Using a Simple Mechanical System: An Undergraduate Lab Experiment CHRISTOPHER BURNETT, ROBERT TOLLEY, ANTONY SILVIDI, KHALID EID, Miami University — We demonstrate clear quantized conductance steps in mechanical break junctions (MBJ) based on a gold wire, a springy-steel bending beam, a micrometer, a 1.5V battery , and a Teflon disc that we rotate manually. The voltage across the wire is measured using a NI-DAQ assistant unit and a simple LabVIEW program. As the wire is stretched, its resistance (i.e. voltage across it) increases gradually then follows a stair-case- like shape, which is a hallmark of quantized conductance, with steps at values of 25.8 kΩ/2n, where n is an integer. The resistance jumps are clearer and more distinct for smaller n and become closer for larger n, which is a demonstration of the Correspondence Principle. The quantization occurs when the wire is thin enough that its diameter is comparable to the de Broglie wave length of the current-carrying electrons and is a direct consequence of confinement. This experiment is designed for sophomore/junior level undergraduate labs.

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