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High frequency shot noise measurements through a low temperature mechanical break junction LELAND RICHARDSON, PATRICK WHEELER, DOUG NATELSON, Rice University, NATELSON GROUP TEAM
— The systematic measurement of shot noise allows one to directly measure the transmittance of individual conductance modes, and can lead to useful inferences on the nature of quantum transport in various materials. At low temperatures (4.2 K) the contribution of heating-induced Johnson noise is reduced significantly; however, high-frequency lock-in detection techniques are used to further amplify the relative contribution of shot noise compared to Johnson noise. We have designed and built a cryogenic mechanical break-junction system with sufficient spatial resolution and minimal electronic background noise to perform such measurements. Geometrically, a reduction factor of 10^{-6} in spatial resolution is obtained from the gap spacing to the movement of the mechanical arm. An additional axial-to-linear reduction is gained from gearing, leading to an overall theoretical spatial precision between the electrodes on the order of 10^{-12} meters per revolution of the stepper motor powering the arm, providing sufficient precision to perform measurements on single atomic point contacts and molecules. Using this setup, quantum shot noise suppression at integral values of G_0 has been measured on Au junctions demonstrating the effectiveness of the device.

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