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A proposal for measuring fractional charge and statistics in fractional quantum Hall states through noise experiments

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Quasiparticles of fractional quantum Hall (FQH) fluids are predicted to be finite energy vortices carrying fractional charge and fractional statistics. These properties reflect the non-trivial topological order which characterizes each FQH state as a distinct phase. However, strong evidence for fractional statistics has remained an open experimental challenge. We propose a three-terminal "T-junction" as an experimental setup for directly detecting fractional charge and statistics of fractional quantum Hall quasiparticles via cross current noise measurements. Through a careful non-equilibrium calculation of the quantum noise in the T-junction setup for FQH Jain states, we showed that the cross current correlation (noise) can be written in a simple form with all the statistics dependence captured in a factor of $\cos\theta$ in one of two contributions, where the statistical angle θ is defined by the phase gained by a two quasiparticle wave function upon exchange. By analyzing these two contributions for different parameter ranges that are experimentally relevant, we demonstrated that the noise at finite temperature reveals signatures of generalized exclusion principles, fractional exchange statistics and fractional charge. We also predicted that the vortices of Laughlin states exhibit a "bunching" effect, while higher states in the Jain sequences exhibit an "anti-bunching" effect.