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Electric Field Tuned Crossover From Semi-Classical to Weakly Localized Quantum Transport in a Quasi 2-Dimensional Electron Gas in $SrTiO_3$[1] J.H. NGAI, Y. SEGAL, F.J. WALKER, S. ISMAIL-BEIGI, K. LE HUR, C.H. AHN, Department of Applied Physics and Center for Research on Interface Structures and Phenomena, Yale University — Quasi 2-dimensional electron gases (Q2DEG) created by doping $SrTiO_3$ (STO) near interfaces and surfaces, have attracted considerable attention. These oxide Q2DEG's potentially offer a wide range of tunable behavior due to the extraordinary properties of STO. Here, we present electric field tuned magnetotransport measurements of a Q2DEG created by Ar-irradiation. The electric field, applied through a back gate bias, modulates both the mobility and sheet density, with a greater effect on the former. For high mobilities, the magnetotransport obeys Kohler's rule, consistent with semi- classical transport. As the mobility is decreased, violation of Kohler's rule is observed and weakly localized quantum transport emerges. This electric field tuned crossover arises from a modulation in the carrier confinement, which is enhanced by the electric field dependent dielectric constant of STO, as shown through self-consistent solutions to the Poisson and Schrödinger equations. The implications of our results on the development of oxide electronic devices will be discussed.

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