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Emergent Localization from Many-Body Physics in Clean Quantum Point Contacts CASPAR H. VAN DER WAL, M.J. IQBAL, E.J. KOOP, J.B. DEKKER DEKKER, J.P. DE JONG, J.H.M. VAN DER VELDE, University of Groningen, The Netherlands, D. REUTER, A.D. WIECK, Ruhr-University Bochum, Germany, R. AGUADO, Instituto de Ciencia de Materiales de Madrid, Spain, Y. MEIR, Ben-Gurion University of the Negev, Israel — Quantized conductance in quantum point contacts (QPCs) is the signature of control over electron transport at the nanoscale. As a function of channel width the conductance then increases in steps of $G_0 = 2e^2/h$. However, experiments often show an additional feature with a conductance plateau near $0.7G_0$, known as the 0.7 anomaly. This has been studied since 1995 but its full understanding is still an open problem. Spontaneous localization due to many-body effects in open QPCs, and the associated Kondo effect, has emerged as a promising theory for the 0.7 anomaly [1]. This theory work predicted that the many-body effects should for certain QPC geometries not give a single localized state but a pair of localized states, but signatures of this were till now not reported. For the first time, we have fabricated length-tunable QPCs in clean semiconductors and we discovered a periodic modulation of the 0.7 anomaly as a function of length. This modulation correlates with signatures for single and paired quasi-localized states, in the form of single- and two-impurity Kondo physics. Our results demonstrate that Friedel oscillations and emergent impurity states from many-body physics are fundamental to these phenomena. [1] T. Rejec and Y. Meir, Nature 442, 900 (2006).

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