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Conductance fluctuations in graphene as a probe of broken-symmetry and fractional quantum Hall states

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The observation in macroscopic transport studies of the interaction induced broken symmetry and fractional quantum Hall states in graphene normally requires very clean samples and/or strong magnetic fields. Here we report that even when these fragile states are not developed well enough to produce any of the quantum Hall signatures, they are strongly visible in differential conductance fluctuations that appear as a result of charge carrier localization when the system breaks up into compressible islands with incompressible areas in between when the corresponding integer or fractional filling factor is approached. The conductance fluctuations give access to local information even though a macroscopic measurement is performed. The existence of a landscape of compressible islands is unambiguously proved in Coulomb blockade phenomena in the quantum Hall insulating regime where all other conduction channels are switched off. This work has been carried in collaboration with D.S. Lee, V. Skakalova, R.T. Weitz, K. von Klitzing.