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Abstract for an Invited Paper
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Even-denominator fractional quantum Hall effect in multi-terminal suspended bilayer graphene

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I will discuss magneto-transport experiments through multi-terminal suspended bilayer graphene devices of very high quality (mean-free path larger than the device size; density of charge inhomogeneity 10^9 cm^{-2}). The multi-terminal geometry enables independent measurements of the longitudinal and transverse magneto resistance, which are essential to properly measure quantum Hall states. At high magnetic field, different fractional states emerge on the hole side, including states at ν = -4/3 and ν = -1/2 that are fully developed (plateau in R_{xy} quantized with an accuracy better than 0.5%, and a concomitant minimum in R_{xx}) and other states (e.g., at -5/2, -2/3, -8/5), which manifest themselves through a clear minimum in R_{xx} occurring at a fixed value of filling factor. The more pronounced states are consistent with predictions of a recent theory by Papic and Abanin, that describes the mixing of the degenerate, zero-energy N=0 and N=1 Landau levels of graphene bilayers due to e-e interactions, and which indicates that the even denominator ν =-1/2 state is of the Moore-Read type. If time allows, I will also discuss our recent experiments of suspended multi-terminal 4-layer graphene, on which we made different interesting observations. One is an integer quantum Hall effect consistent with an even larger degeneracy of the E=0 Landau levels, for which it may be interesting to start exploring theoretically possible new physics in the fractional regime. The second is the occurrence of an unexpected gapped insulating state at zero magnetic field. Together with previous experiments on suspended mono, bi, and trilayers, this observation points to an even-odd effect of e-e interaction (at zero magnetic field) in graphene multilayers: even layers are gapped by e-e interactions while odd layers stay conducting, due to the presence of a Dirac-like band in their electronic structure. A comparison of the gapped state in bilayers and four-layers show that the magnitude of the effect of e-e interaction is not becoming smaller with increasing layer thickness, suggesting that interactions remain important in even thicker layers.

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