Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Universal quantized spin-Hall conductance fluctuation in graphene[1] ZHENHUA QIAO, JIAN WANG, Department of Physics and the Center of Theoretical and Computational Physics, The University of Hong Kong, Hong Kong, YADONG WEI, Department of Physics, School of Physics, Shenzhen University, Shenzhen, China, HONG GUO, Department of Physics, McGill University, Montreal, PQ, Canada H3A 2T8 — We report a theoretical investigation of quantized spin-Hall conductance fluctuation of graphene devices in the diffusive regime. Two graphene models that exhibit quantized spin-Hall effect (QSHE) are analyzed. Model-I is with unitary symmetry under an external magnetic field $B \neq 0$ but with zero spin- orbit interaction, $t_{SO} = 0$. Model-II is with symplectic symmetry where $B = 0$ but $t_{SO} \neq 0$. Extensive numerical calculations indicate that the two models have exactly the same universal QSHE conductance fluctuation value $0.285e/4\pi$ regardless of the symmetry. Qualitatively different from the conventional charge and spin universal conductance distributions, in the presence of edge states the spin-Hall conductance shows an one-sided log-normal distribution rather than a Gaussian distribution. Our results strongly suggest that the quantized spin-Hall conductance fluctuation belongs to a new universality class.

[1]RGC grant (HKU 704607P).

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Date submitted: 21 Nov 2007 Electronic form version 1.4