Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Derivative relations between electrical and thermoelectric quantum transport coefficients in graphene[1] XINFEI LIU, Department of Physics and Astronomy, University of California, Riverside, ZHONGSHUI MA, School of Physics, Peking University, JING SHI, Department of Physics and Astronomy, University of California, Riverside — We find that the empirical relation between the longitudinal and Hall resistivities (i.e. R_{xx} and R_{xy}) and its counterpart between the Seebeck and Nernst coefficients (i.e. S_{xx} and S_{xy}), both originally discovered in conventional two-dimensional electron gases [1,2], hold surprisingly well for graphene in the quantum transport regime except near the Dirac point. These empirical relations can be described by the following equations:

$$R_{xx} = \alpha_r \cdot \frac{B}{n}\frac{dR_{xy}}{dB}, \quad S_{yx} = \alpha_s \cdot \frac{B}{n}\frac{dS_{xx}}{dB}$$

Here R and S are electrical resistivity and thermoelectric conductivity tensor respectively. The validity of the relations is cross-examined by independently varying the magnetic field and the carrier density in graphene. We demonstrate that the pre-factor, α_s, does not depend on carrier density in graphene. By tuning the carrier mobility therefore the degree of disorders, we find that the pre-factor stays unchanged. Our experimental results validate both derivative relations for massless Dirac fermions except near the Dirac point.

[1] A. M. Chang and D. C. Tsui, Solid State Commun. **56**, 153 (1985).
[2] B. Tieke et al, Phys. Rev. Lett. **78**, 4621 (1997).

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[1]This work is supported in part by DMEA/CNN, DOE and NSF.

Date submitted: 20 Nov 2011 Electronic form version 1.4