Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Spontaneous polarization of composite fermions in the $n = 1$ Landau level of graphene[1] AJIT COIMBATORE BALRAM, Pennsylvania State University, CSABA TŐKE, Budapest University of Technology and Economics, ARKADIUSZ WÓJS, Wroclaw University of Technology, JAINENDRA JAIN, Pennsylvania State University — Motivated by experiments that reveal expansive fractional quantum Hall states in the $n = 1$ graphene Landau level and suggest a nontrivial role of the spin degree of freedom [Amet *et al.*, Nat. Commun. **6**, 5838 (2014)], we perform accurate quantitative study of the the competition between fractional quantum Hall states with different spin polarizations in the $n = 1$ graphene Landau level. We find that the fractional quantum Hall effect is well described in terms of composite fermions, but the spin physics is qualitatively different from that in the $n = 0$ Landau level. In particular, for the states at filling factors $\nu = s/(2s \pm 1)$, s integer, a combination of exact diagonalization and the composite fermion theory shows that the ground state is fully spin polarized and supports a robust spin wave mode even in the limit of vanishing Zeeman coupling. Thus, even though composite fermions are formed, a mean field description that treats them as weakly interacting particles breaks down, and the exchange interaction between them is strong enough to cause a qualitative change in the behavior by inducing full spin polarization. We also find that the fully spin polarized composite fermion Fermi sea has lower energy than the paired Pfaffian state at the relevant half fillings.

[1]Award No. DE-SC0005042 (ACB, JKJ), Hungarian Scientific Research Funds No. K105149 (CT), the Polish NCN grant 2014/14/A/ST3/00654 and the EU Marie Curie Grant PCIG09-GA-2011-294186 (AW)

Ajit Coimbatore Balram
Pennsylvania State University

Date submitted: 04 Nov 2015 Electronic form version 1.4