HALF-METAL AND OTHER FRACTIONAL METAL PHASES IN DOPED AB BILAYER GRAPHENE

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This presentation is dedicated to theoretical study of many-body low-temperature physics of AB bilayer graphene (AB-BLG). We argue that for this graphene-based material electron-electron interaction can give rise to the spontaneous formation of fractional metal phases. These states are generalizations of a more common half-metal. The half-metallic state is characterized by perfect spin polarization of single-electron states at the Fermi level. For the fractional metal states of AB-BLG, the states at the Fermi energy are perfectly polarized not only in terms of a spin-related quantum number, but also in terms of the valley index. The mechanism, which we propose, relies on the assumption that at zero temperature the undoped AB-BLG is a spin density wave insulator, with a finite gap in the single-electron spectrum. Upon doping, the insulator is destroyed, and replaced by a fractional metal phase. As doping increases, transitions between various types of fractional metal (half-metal, quarter-metal, etc.) are triggered. Our findings are consistent with recent experiments on doped AB bilayer graphene, in which a cascade of phase transitions between different isospin states was observed [1].

References

[1] Sergio C. de la Barrera, Samuel Aronson, Zhiren Zheng, Kenji Watanabe, Takashi Taniguchi, Qiong Ma, Pablo Jarillo-Herrero, Raymond Ashoori, , *Cascade of isospin phase transitions in Bernal bilayer graphene at zero magnetic field.* Nature Physics, **18**, 771-775 (2022)