

# Condensed Matter Physics Seminar Series

## Spin and valley orders and superconductivity in Bernal bilayer graphene

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Recent experiments on Bernal bilayer graphene in a finite displacement field discovered a cascade of phase transitions into ordered states at small but finite doping. I list and compare 15 particle-hole orders, associated with spin and valley degrees of freedom and show that the Landau functional for the corresponding order parameters has an approximate  $SU(4)$  symmetry. I show which combinations of spin and valley orders develop and relate the results to the observation of “half-metal and quarter-metal” states. I next consider superconductivity, observed near the onset of a half-metal state. I argue that in the  $SU(4)$ -symmetric case the pairing interaction, mediated by a soft near-critical boson, is enhanced, but remains repulsive. I will discuss how one can still obtain superconductivity in the presence of either a magnetic field or an Ising spin-orbit coupling.

Andrey Chubukov was a Research Scientist at the P.L. Kapitza Institute for Physical Problems, Moscow from 1985-1990. In 1990, he became a Postdoctoral Fellow at the Department of Physics, University of Illinois, Urbana IL. In 1992, he became a Postdoctoral Fellow at the Department of Applied Physics, Yale University in New Haven, CT. He became a Professor at the Department of Physics at the University of Wisconsin-Madison in 1993. He was also a professor at the Department of Physics at the University of Maryland in College Park, MD from 2004-2005. He is currently a William M and Bianca I Fine Professor at the School of Physics and Astronomy, University of Minnesota, and Fine Institute for Theoretical Physics.

**Wednesday, October 18th, 2023 at 4:00PM**  
**Schwinger Lounge (4-740 PAB)**