ICFO COLLOQUIUM PABLO JARILLO-HERRERO 'Magic Angle Graphene Superlattices: a New Platform for Correlated Physics and Superconductivity'

PABLO JARILLO-HERRERO

June 22, 2018

Friday, June 22, 2018, 12:00. ICFO Auditorium

PABLO JARILLO-HERRERO Associate Professor of Physics, MIT (USA) $$Professor Jarillo-Herrero?s research interests lie in the area of experimental condensed matter physics, in particular quantum electronic transport and optoelectronics in novel low dimensional materials, such as graphene and topological insulators (TIs).

He joined MIT as an assistant professor of physics in January 2008. He received his M.Sc. in physics from the University of Valencia, Spain, in 1999. Then he spent two years at the University of California in San Diego, where he received a second M.Sc. degree before going

to the Delft University of Technology in The Netherlands, where he earned his Ph.D. in 2005. After a one-year postdoc in Delft, he moved to Columbia University, where he worked as a NanoResearch Initiative Fellow. His awards include the Spanish Royal Society Young Investigator Award (2007), an NSF Career Award (2008), an Alfred P. Sloan Fellowship (2009), a David and Lucile Packard Fellowship (2009), the IUPAP Young Scientist Prize in Semiconductor Physics (2010), a DOE Early Career Award (2011), a Presidential Early Career Award for Scientists and Engineers (PECASE, 2012), and an ONR Young Investigator Award (2013).

The understanding of strongly-correlated quantum matter has challenged physicists for decades. Such difficulties have stimulated new research paradigms, such as ultra-cold atom lattices for simulating quantum materials. In this talk I will present a new platform to investigate strongly correlated physics, based on graphene moire superlattices. In particular, I will show that when two graphene sheets are twisted by an angle close to the theoretically predicted ?magic angle?, the resulting flat band structure near the Dirac point gives rise to a strongly-correlated electronic system. These flat bands exhibit half-filling insulating phases at zero magnetic field, which we show to be a Mott-like insulator arising from electrons localized in the moire superlattice. Moreover, upon doping, we find electrically tunable superconductivity in this system, with many characteristics similar to high-temperature cuprates superconductivity. These unique properties of magic-angle twisted bilayer graphene open up a new playground for exotic many-body quantum phases in a 2D platform made of pure carbon and without magnetic field. The easy accessibility of the flat bands, the electrical tunability, and the bandwidth tunability though twist angle may pave the way towards more exotic correlated systems, such as quantum spin liquids.

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