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Oliver E. Buckley Prize: Graphene and Beyond

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Graphene, a single atomic layer of graphite, has been provided physicists opportunities to explore an interesting analogy to the relativistic quantum mechanics. The unique electronic band structure of graphene lattice yields a linear energy dispersion relation where the Fermi velocity replaces the role of the speed of light. The exotic quantum transport behavior discovered in these materials including unusual half-integer, fractional and fractal quantum Hall effect owing to approximate SU(4) symmetry from spin and valley spin degree of freedom combined with the quasi relativistic dispersion relation. In this presentation I will discuss the exotic quantum transport behavior discovered in graphene and its nanostructures. In addition, I will discuss the new type of material classes based on 2-dimensional van der Waal materials and their heterostructures extending the graphene based research into quasi 3-dimensional systems.