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Tunneling through graphene and topological insulators in presence of pn junction: transport properties and device prospects[1] REDWAN SAJJAD, K.M. MASUM HABIB, FRANK TSENG, AVIK GHOSH, Univ of Virginia — We emphasize the role of pn junction (PNJ) in graphene electrical transport. In the ballistic regime, the resistance depends upon two key factors – length to width aspect ratio and the PNJ formed between the doped region of graphene under metal contact. In the diffusive limit, these remain the deciding factors for the minimum conductivity. The PNJ allows us to demonstrate Klein tunneling - by either creating a PNJ electrostatically within the device or through the nature of Fabry-Perot oscillation between the two contacts. We then discuss the details of electron transport - the nature of peak device resistance, minimum contact resistance achievable with commonly used metals, effects such as electron hole asymmetry and negative differential resistance – all being affected by the multiple PNJs formed near the contacts. We then show that PNJ acts as a filter for pseudo-spins in graphene and how this can be manipulated for gate modulation of resistance. The existence of a Dirac cone on the surface of a topological insulator has the potential of similar filtering action but for real spins instead of pseudo-spins. We adopt Non-Equilibrium Green's Function (NEGF) formalism and compare results with recent transport measurements.

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