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Confinement, transport gap, and valley polarization from a double barrier structure in graphene[1] DANIEL GUNLYCKE, CARTER WHITE, Naval Research Laboratory — Engineering a gap in graphene without degrading its exceptional transport properties is arguably the main obstacle preventing a breakthrough in graphene-based nanoelectronics. To create such a gap, a lot of effort has been devoted to making graphene nanoribbons. Unlike ordinary nanoribbons, we propose a structure formed between two thin parallel transport barriers that is penetrable by electrons in surrounding graphene states. The transport across this railroad track structure is governed by resonant tunneling through quasi-bound states within the confinement. The transport barriers, modeled by chemically decorated line defects, are highly reflective, causing the resonances to form continuous bands closely matching the band structure of a zigzag ribbon. Because boundary-localized states cannot carry any transport, the resonance bands must terminate at the dimensional crossover between extended and boundary-localized states. As the confined region contains no states near the Fermi level extending across the railroad track structure, electrons approaching it experience a transport gap $E_g = 2\hbar v_F/W$, where W is the separation between the barriers. In addition to offering confinement and a transport gap, the structure allows for nearly perfect valley polarization.

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