

GRAPHENE TESTS OF KLEIN PHENOMENA

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Graphene is characterized by chiral electronic excitations. As such it provides a perfect testing ground for the production of Klein pairs (electron/holes). If confirmed, the standard results for barrier phenomena must be reconsidered with, as a byproduct, the accumulation within the barrier of holes.

We have presented the results of the three dimensional interaction of a chiral (Weyl) fermion with first a step and consequently (using the step results) with a barrier. We have considered separately the case of diffusion and Klein zone. We have bypassed tunneling in this work. Some of our results: (1) There are additional head-on resonances for chiral fermions which are absent for massive particles. (2) Klein creation occurs at zero cost of energy, helicity etc. because particles and antiparticles live in separate potential regions. (3) Our diffusion results for transmission agree with the very elegant and concise form used by graphene researchers. (4) The diffusion amplitudes cannot be extended to the Klein energy zone, unless considered a short-hand for a divergent series. (5) For head on collision, we have total transmission. Strange as this appeared when first discovered the hypothesis of Klein pair production is even more radical since it implies an unlimited number of electrons beyond the barrier albeit created at the well/barrier edge and not transmitted through the barrier. The question of Klein pair production is one more hypothesis that graphene could help to test. If valid it implies a very different physics for above potential" (Dirac/Weyl diffusion) and below potential" (Klein diffusion) phenomena. As always we leave final judgement to experiment.

- The collaboration is now formalized as part of the interuniversity agreement between the State University of Campinas (Brazil) and the University of Salento (Lecce, Italy).

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