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Klein Tunnelling in Graphene

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In 1929 Oskar Klein solved the Dirac equation for electrons scattering off of a barrier. He found that the transmission probability increased with potential height unlike the non-relativistic case where it decreases exponentially. This phenomenon can also been in a graphene lattice where the energy bands form a structure known as a Dirac cone around the points where they touch. In this project we analyze phenomenon without substituting the graphene hamiltonian for the Dirac hamiltonian. First we analyse the propagation of gaussian wave packets on the one dimensional lattice, the two dimensional square lattice, and the graphene lattice. Here we look at how the wave packet evolves in time as it propagates. We then study how the packet tunnels through barriers on the graphene lattice, focusing on the region where the Dirac cone is formed We compare this tunnelling to the case of the non-relativistic and the relativistic free particle.

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