Wave Packet Dynamics in 2D materials

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Abstract
The emergence of graphene and other graphene like systems has opened a new horizon for both theoretical and experimental studies. The pertinent feature that distinguishes them from other condensed matter systems is that electrons here behave like relativistic (Dirac) particles. This makes them an ideal playground for studying several relativistic phenomena which is impossible otherwise. One of such remarkable features is *zitterbewegung*, i.e. the oscillatory motion of a free relativistic particle. The occurrence of zitterbewegung in a condensed matter system itself is fascinating prediction [1,2] as it contradicts with Newton's first law and consequently stimulated a large number of theoretical and experimental work in last decades [3,4]. We further find that these oscillations carry important information about the topology of the system. For example, in case of zigzag graphene nanoribbon, the presence of an edge state manifests itself as a resonance in zitterbewegung [5] which comes from the interference between the bulk and edge states. We further extend our study to silicene and find that the oscillation carries the signature of different topological phases [6] and can be exploited to spot the spin Chern number in different regions of the phase space. In this presentation we will give a brief description of how we understand different features of a Dirac system by studying the wavepacket dynamics

References

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Figures

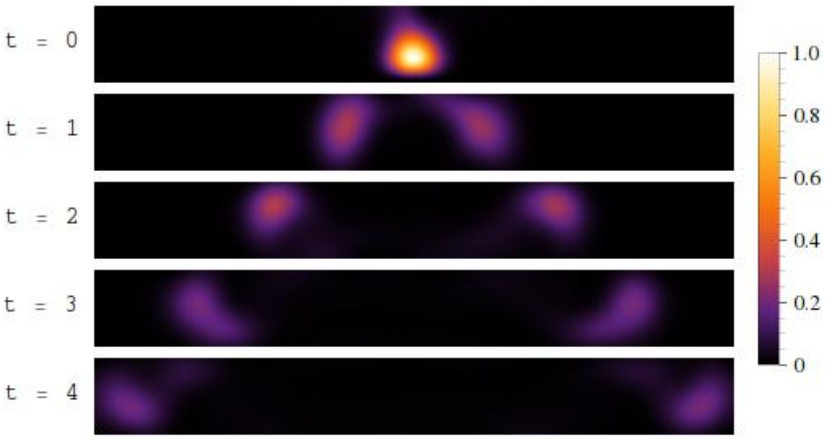

Fig1. Evolution of wavepacket on a zigzag grapheme nanoribbon. The unit of time is $100L/v_F$ (~10^{-13}s for L=100nm) where L is the width of nanoribbon.