On the relevance of displacement current in the graphene-based novel technologies

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Graphene is characterized by being a high mobility material with associated low scattering rates. Hence, high electron velocities are ubiquitous, and the electric field induced by the carriers does change very rapidly with time. Therefore, the usually overlooked displacement current [1,2] becomes an attractive means for realizing new graphene-based technologies.

It has been recently shown [3] that the measurement of the displacement current can provide information about the position and momentum of a quantum state. The displacement current measured over a large surface (that detects the electric field due to particle's movement even when it is very far from the surface) provides a weak measurement of the momentum of the quantum particle [3]. On the contrary if the surface is very small, the electric field will be detected only when the electron is crossing such a surface, and thus it corresponds to a strong measurement of the position [3]. A weak value constructed from such weak and strong measurements can provide information about the (expectation) value of the local velocity of the particle [3].

On the same principles, in this conference we will present some strategies to measure the displacement current through a set of surfaces at different locations which will help to keep the track of electron trajectories. This new multi-time and multi-position weak measurements could open up new fundamental tools to study foundational issues of the quantum theory and also new paradigms for developing quantum computing technologies.

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