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AGENCIA ESTATAL DE INVESTIGACIÓN

Kink states scattering in bilayer graphene

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Abstract

We investigate the topological kink states in bilayer graphene with double kink potential. Back-scattering has been observed in the systems (constriction and detaching loop) with and without a magnetic field. The back-scattering in the constriction manifests band structure and the detaching loop manifests the energy levels.

System

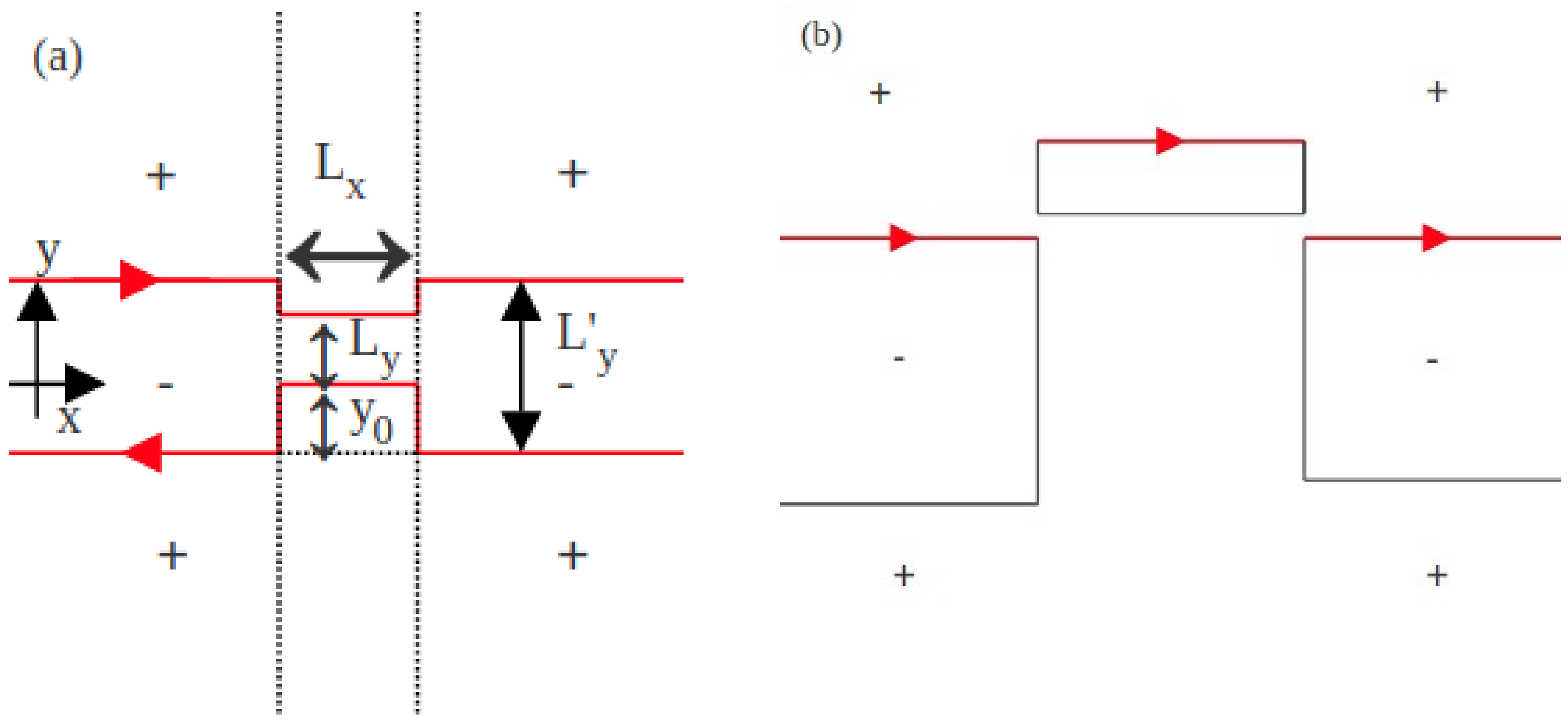

Figure 1: (a): Bilayer graphene double kink with constriction configuration, (b): representing the bilayer double kink with detaching loop. Both systems acting as a scatterer.

Model

We consider chiral and topological states in the double kinks, those states are confined along y and propagating along the x-direction.

We used for the system the effective Hamiltonian model, The Hamiltonian reads :

$$H = v_F(p_x - \hbar\frac{y}{l_z^2})\tau_z\sigma_x + v_F p_y\sigma_y + t(\lambda_x\sigma_x + \lambda_y\sigma_y) + V_s + V_a\lambda_z$$

With the valley τ , sublattice σ and layer λ are the tree characteristic pseudospins .

Results

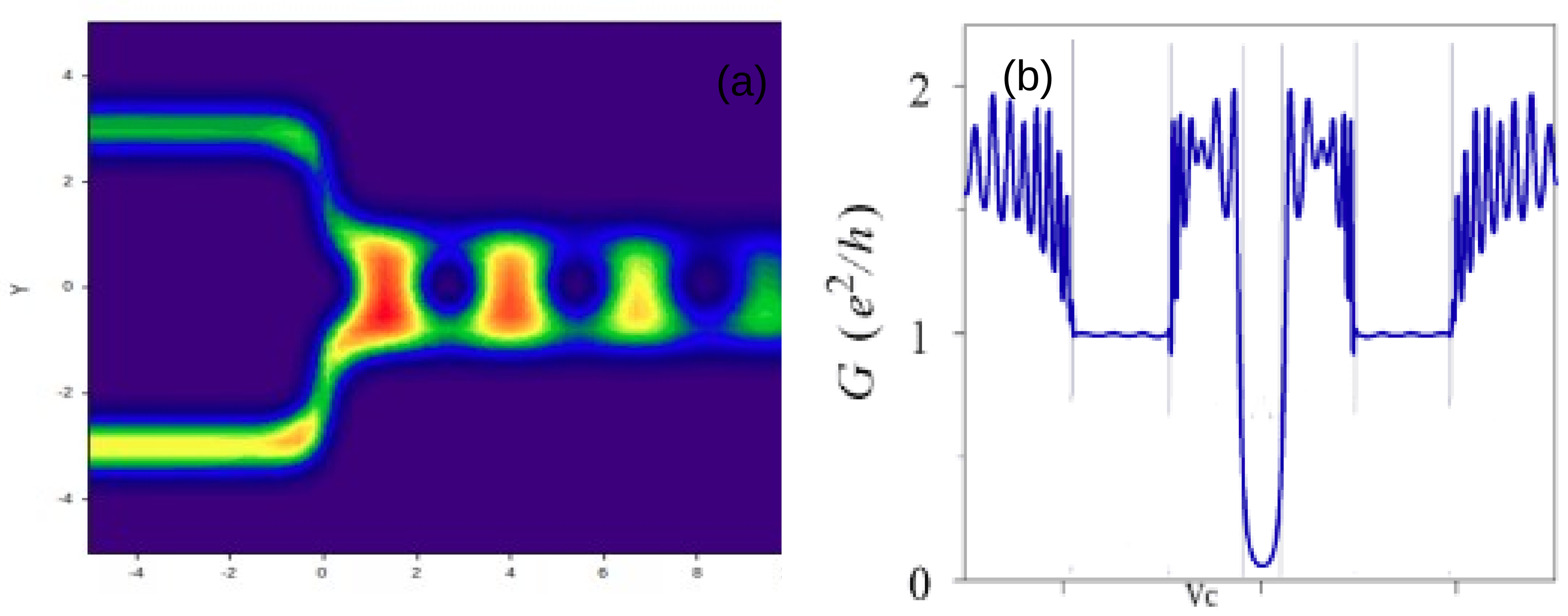

Figure 2: (a): Density distribution in the constriction configuration, (b): Transmission for Lx= 1 µm as a function of the potential Vc in the center.

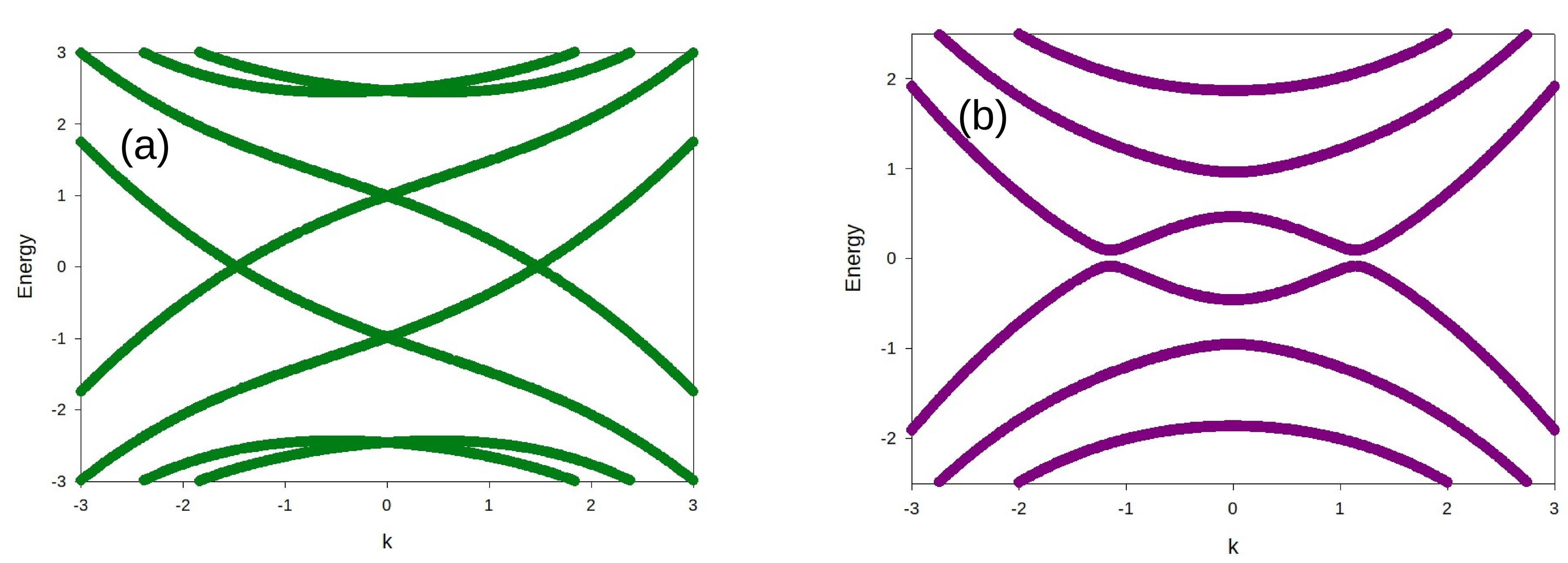

Figure 3: (a): Energy bands of a translationally invariant double kink (left and right in fig1), (b): Energy bands of a finite double kink(in the center).

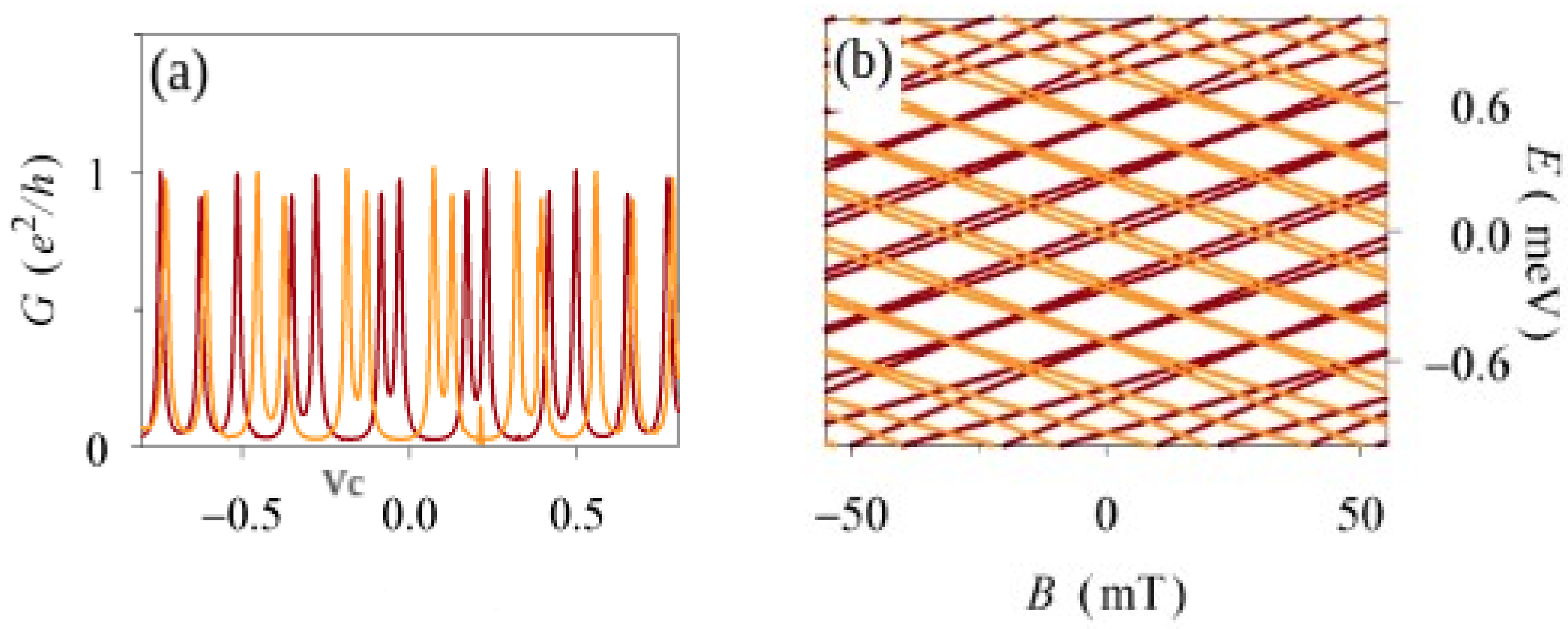

Figure 4: (a): Transmission for Lx= 1 µm as a function of the potential Vc in the center for the detaching loop for the two valleys (orange line: valley 1 and brown line: valley 2), (b): Energy levels for the finite loop as a function of the magnetic field for the two valleys.

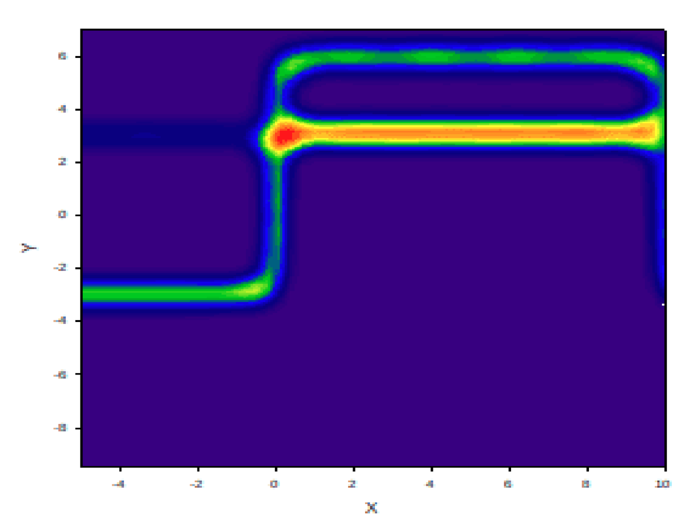

Figure 5: Density distribution in the detaching loop for one valley

Discussion

- The constriction leads to a conductance that manifests the band structure of the constriction. We observed that the transmission can differ from one valley to another (in valley1 can be transmitted and valley 2 can be reflected).
- In the detaching loop the conductance manifests the spectrum of the closed-loop and we observed that it can be seen as a sensitive device with valley and current accumulations that can be tuned electrically.