Collective transport of charges in charge density wave sytem based on traveling soliton lattices

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A charge density wave (CDW) system is a low dimensional crystal (quasi-1D or quasi-2D) made of spatially correlated electrons. Although the static CDW state is now well understood, the dynamical one is still debated. Indeed, the most spectacular property of a CDW system is its ability to carry correlated charges when submitting the sample to an external electric field. Above a threshold field E_{th}, a nonohmic resistivity is observed. The voltage becomes periodic with a fundamental frequency f_0 proportional to the applied field as well as several harmonics. This evidence of collective transport through CDW systems has received considerable interest for more than 35 years. However, the understanding of the type of charge carriers and their propagation mode remains incomplete.

Solitons are localized excitations that appear in many theory when dealing with non-linear interactions, such as in magnetism, optics, fluids mechanics. We show here that this collective transport of charge in blue bronze $K_{0.3}MoO_3$ can be explained using a theory of a travelling soliton lattice. Coherent x-ray diffraction experiment performed in the sliding state of the CDW reveals peculiar diffraction patterns in good agreement with this assumption [1]. In this semiclassical description, charges are carried by phase shifts of the CDW modulation which can travel through macroscopic samples without deformation on top of the CDW ground state. This single theory explains why charges remain spatially correlated over very long distances and reconciles the main features of sliding CDW systems, either observed by transport measurements or diffraction.

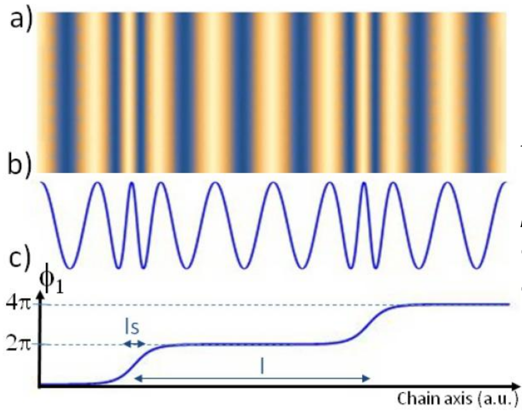

Figure 1: Sketch of the static soliton lattice in real space. (a) CDW in the presence of a soliton lattice with (b) the corresponding electronic density profile and (c) the corresponding phase ϕ_1.

[1] A. Rojo-Bravo, V. L. R. Jacques, and D. Le Bolloc'h. *Collective transport of charges in charge density wave systems based on traveling soliton lattices*. Phys. Rev. B,94:201120, Nov 2016.
[2] David Le Bolloc'h, Ewen Bellec, Isabel Gonzalez-Vallejo, Vincent Jacques. *Fluctuating soliton lattice.* Article in preparation.