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Competition between pressure and magnetic field in melting of charge ordering in $La_{2-2x}Sr_{1+2x}Mn_2O_7$ (x = 0.475 and 0.5) single crystal

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The combined effect of high pressure and high magnetic field on electrical transport has been investigated for a bilayer $La_{2-2x}Sr_{1+2x}Mn_2O_7$ (x = 0.475 and 0.5) single crystal. We prove that the application of hydrostatic pressure up to 2 GPa completely destroys CO in x = 0.475 further application of magnetic field induces the ferromagnetic moments and improves the colossal magnetoresistive properties. In case of x = 0.5 application of 2 GPa is not quite sufficient to suppress CO but application of magnetic field of 7 T with 2 GPa is quite sufficient to suppress CO. The requirement of high magnetic field with pressure to destroy the CO in x = 0.5 is due to the presence of long range charge ordering, where as x = 0.475 shows the weak charge ordering. For both the systems an external magnetic field forceably aligns the t2g spins, enhances the carrier itineracy, and modifies the CO state. In an extreme case, the application of a magnetic field destroys the CO state and induces a FM state from the low-temperature side. Similarly to the magnetic field that directly acts on the spin state, hydrostatic pressure is expected to enhance the ferromagnetic DE interaction through an increase of the bare transfer integral (t0) and hence modifies the charge-ordered state. Applied external pressure increase W, the enhanced ferromagnetic double-exchange interaction increases the TC and suppresses the charge-ordered state. Application of external pressure and resultant enhanced carrier itineracy suppresses the CO transitions.

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Electronic delocalization in bilayer graphene induced by electric field

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Bilayer graphene is a zero-gap semiconductor, in which an energy gap can be opened by an external electric field perpendicular to the layer. We found that, in the smooth disorder with respect to the atomic scale, the gap opening leads to a phase transition at which the localization length diverges. We show that this is a topological effect due to the nontrivial Berry phase in the band structrure. This can be interpreted as the quantum Hall transition even though the magnetic field is totally absent.