SEMINARIO

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Action-reaction violation and vacuum momentum in asymmetrically excited systems

Abstract: Violation of the action-reaction principle is shown to occur in a simple QED system, namely, a system of two atomic dipoles, one of which is excited. The van-der-Waals forces on each atom are found to differ. This phenomenon is accompanied by the transfer of linear momentum to the quantum fluctuations of the electromagnetic vacuum. The vacuum momentum is shown to emerge from the asymmetric interference of the virtual photons scattered off each atom along the interatomic direction, which is in itself a manifestation of the optical theorem. Ultimately, the vacuum momentum is released through directional spontaneous emission, which allows for an indirect measure, a posteriori, of the total force on the excited system. It is conjectured that action-reaction violation, and hence a nonzero vacuum momentum, are generic phenomena of asymmetrically excited systems in any quantum field theory. This is the case of the weak-nuclear interaction between unstable nuclei. In particular, violation of action-reaction is found in the weak-nuclear forces between a neutron and a hydrogen atom, in which case virtual electrons and neutrinos carry the unbalanced momentum.

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