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Entanglement suppression and low-energy scattering of heavy mesons

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This talk is based on [Phys.Rev.D 110 (2024) 1, 014001]. Recently entanglement suppression was proposed to be one possible origin of emergent symmetries. Here we test this conjecture in the context of heavy meson scatterings. The low-energy interactions of $D^{(*)}\bar{D}^{(*)}$ and $D^{(*)}D^{(*)}$ are closely related to the hadronic molecular candidates $X(3872)$ and $T_{cc}(3875)^+$, respectively, and can be described by a nonrelativistic effective Lagrangian manifesting heavy-quark spin symmetry, which includes only constant contact potentials at leading order. We explore entanglement suppression in a tensor-product framework to treat both the isospin and spin degrees of freedom. Using the $X(3872)$ and $T_{cc}(3875)^+$ as inputs, we find that entanglement suppression indeed leads to an emergent symmetry, namely, a light-quark spin symmetry, and as such the $D^{(*)}\bar{D}^{(*)}$ or $D^{(*)}D^{(*)}$ interaction strengths for a given total isospin do not depend on the total angular momentum of light (anti)quarks. The $X(3872)$ and $T_{cc}(3875)^+$ are predicted to have five and one isoscalar partner, respectively, while the corresponding partner numbers derived solely from heavy-quark spin symmetry are three and one, respectively. The predictions need to be confronted with experimental data and lattice quantum chromodynamics results to further test the entanglement suppression conjecture.

Primary authors: HU, Tao-Ran (University of Chinese Academy of Sciences); CHEN, Su (University of Chinese Academy of Sciences); GUO, Feng-Kun (ITP, CAS)

Presenter: HU, Tao-Ran (University of Chinese Academy of Sciences)

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