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Light states in real multi-Higgs models with spontaneous CP violation

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In models with extended scalar sectors that include multiple Higgs doublets responsible for spontaneous electroweak symmetry breaking, it may appear that the numerous dimensionful quadratic terms in the scalar potential could support a scenario where, aside from the would-be Goldstone bosons and a neutral Higgs-like particle, all additional scalars acquire masses well above the electroweak scale. However, in scenarios where CP symmetry is preserved in the Lagrangian but broken by the vacuum, we show that this expectation is unfounded. Imposing perturbativity constraints on the dimensionless quartic couplings leads to a scalar spectrum that necessarily includes one charged and two additional neutral states, with masses that cannot be much greater than the electroweak scale.

Primary authors: Mr MIRÓ ARENAS, Carlos (IFIC (CSIC - U. Valencia)); QUEIROZ CORREA, Daniel; Dr NEBOT GÓMEZ, Miguel Ruben (U. of Valencia - IFIC)

Presenter: QUEIROZ CORREA, Daniel

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