Iranian Journal of Physics Research, Vol. 26, No. 1, 2026
DOI: 10.47176/ijpr.26.1.12225

Composite Higgs Model Involving a Light Scalar Sigma and the study of Phenomenological Constraints

R Asgharzadeh Jelodar, K Bitaghsir Fadafan*, and M Ahmadvand

Faculty of Physics, Shahrood University of Technology, Shahrood, Iran.

E-mail: kbitaghsir@gmail.com

(Received 12 November 2025 ; in final form 04 January 2026)

Abstract

In this research, we consider Composite Higgs Models with a relatively small global symmetry-breaking scale, f, in the strong coupling sector, where the Higgs boson emerges as a pseudo-Nambu-Goldstone boson. The model also includes a singlet scalar resonance, the sigma particle (σ), which mixes with the Higgs. Using an effective chiral Lagrangian, the structure of the vacuum minima of the theory is analyzed. It is shown that, in the absence of σ, achieving values of f above 1 TeV requires a small amount of fine-tuning to be consistent with experimental constraints. However, mixing with this light scalar particle resolves this tension and allows for a lower value of f. Subsequently, we impose up-to-date experimental constraints based on combined LHC Run-2 fits to the Higgs couplings to gauge bosons and the top quark. By also applying limits from searches for exotic Higgs decays, the parameter space of the model is quantitatively determined, and viable benchmark points are extracted. Furthermore, an alternative scenario based on the CDF results is investigated to illustrate the model's sensitivity to independent collider data. The analyses demonstrate that the presence of the light scalar σ can effectively alleviate constraints arising from the electroweak precision parameters S and T, as well as from deviations in the Higgs couplings.

Keywords: Composite Higgs,- Beyond Standard Model - Electroweak Theory - Symmetry Breaking.

For full article, refer to the Persian section