XXVI DAE-BRNS High Energy Physics Symposium 2024



Contribution ID: 287

Type: Oral

Anatomy of the Real Higgs Triplet Model

We examine the Y = 0 real Higgs triplet model. In addition to the SM Higgs, it contains a CP-even neutral Higgs (Δ^0) and two charged Higgs bosons (Δ^{\pm}), which are quasi-degenerate in mass. We first study the theoretical constraints from vacuum stability and perturbative unitarity and then calculate the decay widths of Δ^0 and Δ^{\pm} , including the loop-induced modes $\gamma\gamma$ and $Z\gamma$. In the limit of a small mixing between the SM Higgs and Δ^0 , the latter decays dominantly to WW and can have a sizable branching ratio to photons. The model predicts a positive definite shift in the W mass, which is in agreement with the current global electroweak fit. At the LHC, it leads to a (i) stau-like signature from $pp \to \Delta^+ \Delta^- \to \tau^+ \tau^- \nu \bar{\nu}$, (ii) multilepton final states from $pp \to \gamma^* \to \Delta^+ \Delta^- \to W^+ W^- ZZ$ and $pp \to W^* \to \Delta^\pm \Delta^0 \to W^\pm Z W^+ W^$ as well as (iii) associated di-photon production from $pp \to W^* \to \Delta^{\pm}(\Delta^0 \to \gamma \gamma)$. Concerning (i), the reinterpretation of the recent stau search by ATLAS and CMS excludes $m_{\Delta^\pm} < 110$ \,GeV at 95\% CL. From (ii), some of the signal regions of multilepton searches lead to bounds close to the prediction cross-section, but electroweak scale masses are still allowed. For (iii), the recast of the associated di-photon searches by ATLAS by performing a combined log-likelihood fit of signal and background to data finds that out of the 23 signal regions provided by ATLAS, 8 provide relevant limits on $Br(\Delta^0 \rightarrow \gamma \gamma)$ at the per cent level. Interestingly, 6 signal regions show excesses at around 152\,GeV, leading to a non-zero di-photon decay rate with $\approx 4\sigma$ significance.

Field of contribution

Author: MAHARATHY, Siddharth Prasad (Institute of Physics)

Co-authors: Dr CRIVELLIN, Andreas (PSI Center for Neutron and Muon Sciences); Prof. MELLADO, Bruce (School of Physics and Institute for Collider Particle Physics, University of the Witwatersrand); Mr COLORETTI, Guglielmo (PSI Center for Neutron and Muon Sciences); Dr ASHANUJJAMAN, Saiyad (Institute of High Energy Physics); Dr BANIK, Sumit (PSI Center for Neutron and Muon Sciences)

Presenter: MAHARATHY, Siddharth Prasad (Institute of Physics)

Track Classification: Higgs physics