Contribution ID: **112** Type: **Oral Presentation**

Searching for Low-Mass Resonances Decaying into W Bosons

Wednesday, 5 July 2023 16:20 (20 minutes)

The Brout Englert-Higgs boson, discovered at the LHC, provided the final piece of the puzzle for the Standard Model (SM) of particle physics, which has undergone extensive testing and verification both at the precision and at the high energy frontier. However, this does not exclude the existence of additional scalar bosons as long as their role in the breaking of the SM electroweak gauge symmetry is sufficiently small. In fact, searches for new resonances at the LHC, including additional scalar bosons, have been intensified since the Higgs boson discovery. While the LHC experiments ATLAS and CMS did not observe unequivocally the production of such a new particle, interesting hints for a new scalar with a mass around 95 GeV and 151 GeV arose, as well as anomalies in multilepton final states. The latter include hints for the enhanced nonresonant production of different-flavour opposite-sign di-leptons which can be explained by the decay of a neutral scalar with a mass between 130 GeV and 170 GeV decaying into pairs of W bosons. In this study, we recast and combine the CMS and ATLAS analyses of the Standard Model Higgs boson decaying to a pair of W bosons in order to search for low-mass resonances in this channel. In the first part of the analysis, we consider a new neutral scalar S with mass m_S at the LHC, that is produced directly via gluon fusion and decays dominantly into a pair of W bosons (one of which can be off-shell) which subsequently decay leptonically. Next, we use a simplified model to advocate this low mass resonances search as well as the multilepton anomalis by the decay of a neutral scalar H (270 GeV) into a pair of lighter one S (150 GeV) and i.e. $H \to SS$, as realized within the 2HDM+S model.

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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Session Classification: Nuclear, Particle and Radiation Physics

Track Classification: Track B - Nuclear, Particle and Radiation Physics