Contribution ID: **291** Type: **Poster**

Predictive extended 3HDM with S_4 family symmetry.

Thursday 12 January 2023 16:20 (20 minutes)

We propose two extended 3HDM theories where the SM gauge symmetry is enlarged by the inclusion of the spontaneously broken S_4 discrete symmetry group, supplemented by the preserved Z_2 and broken Z_4 cyclic symmetries. The first one has an extra inert scalar singlet field, whereas the second one has an inert scalar doublet. Both models yield the same structure of the mass matrices for the fermion sector, where a radiative seesaw generates the tiny light active neutrinos masses at one-loop level. The presence of flavor changing neutral currents mediated by heavy scalars allowed us to study the $(K^0 - \overline{K}^0)$ and $(B^0_{d,s} - \overline{B}^0_{d,s})$ meson mixings, in the parameter space that currently satisfy the experimental constraints. The extra scalars in our model provide radiative corrections to the oblique parameters, where due to the presence of the scalar inert doublet, model 2 is less restrictive than model 1. Due to the preserved Z_2 symmetry, our proposed models has stable scalar and fermionic dark matter candidates. Furthermore, these models are consistent with the current pattern of SM fermion masses and mixings, with the measured dark matter relic abundance and successfully accommodate the constraints arising from meson oscillations, oblique parameters and W mass anomaly.

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Session Classification: poster Session