physics of the Type-X two Higgs doublet model (THDM) shows many distinctive features from the other type of extended Higgs sectors. For example, H and A decay mainly into $\tau^+\tau^-$ when $\tan\beta \gtrsim 3$ and $\sin(\beta-\alpha) \simeq 1$ [20]. There are basically two DM candidates, η^0 and N_R^α. The mass of $S^\pm$ is strongly constrained by the current data and the requirement for strongly first order phase transition [6, 14]. The coupling constant of S^+S^-h is required to be of $\mathcal{O}(1)$, whose indirect effect appears in the quantum correction to the hhh coupling constant as a large deviation from the SM prediction [14, 28]. As long as kinematically allowed, $S^\pm$ decays via $S^\pm \to H^\pm\eta^0$ by 100%.

III. PHENOMENOLOGY IN RADIATIVE SEESAW MODELS AT THE LHC

The existence of the extra Higgs bosons such as charged scalar bosons, which are a common feature of radiative seesaw models, can be tested at the LHC. Details of the properties of such extra Higgs bosons are strongly model dependent, so that we can distinguish models via detailed measurements of extra Higgs bosons. In addition, as the (SM-like) Higgs boson h is expected to be detected, its mass and decay properties are thoroughly measured [29]. The radiative seesaw models with a DM candidate can also be indirectly tested via the invisible decay of h as long as its branching ratio is more than about 25% for $m_h = 120$ GeV with $\mathcal{L} = 30$ fb^{-1} [30]. The phenomenological analyses at the LHC in each model are in the literature [9–12, 14, 16, 17, 20–24]. We here review some remarkable features.

At the LHC, $\omega^\pm$ and $k^{\pm\pm}$ in the Zee-Babu model can be produced in pair, via the Drell-Yan s-channel processes $q\bar{q} \to \omega^+\omega^-$ and $q\bar{q} \to k^{++}k^{--}$. The direct detection of $k^{\pm\pm}$ can be a signature for this model. The $\sigma(q\bar{q} \to k^{++}k^{--})$ is around 0.1 fb for $m_k \sim 800$ GeV. If $k^{\pm\pm}$ mainly decay into 4μ (or $4e$), the number of the signal event with $\mathcal{L}$=100 fb^{-1} [31] is enough for the discovery for $m_k \lesssim 800$ GeV [9]. The doubly-charged Higgs bosons are however also predicted in the models with complex triplet scalar fields, $\Delta = (\Delta^{\pm\pm}, \Delta^\pm, \Delta^0)$. The gauge coupling $W^\pm\Delta^\pm\Delta^{\mp\mp}$ induces the single doubly-charged Higgs production $q\bar{q}' \to W^{\pm*} \to \Delta^{\pm\pm}\Delta^\mp$, whose cross section is comparable to that of $q\bar{q} \to \gamma^*, Z^* \to \Delta^{++}\Delta^{--}$ [32]. The absence of the gauge coupling $W^\pm\omega^\pm k^{\mp\mp}$ is an important distinctive feature of the Zee-Babu model with gauge singlet doubly-charged Higgs bosons from the triplet model. The singly-charged Higgs boson $\omega^\pm$ would be more difficult to see the signal at the LHC because the final state from $\omega^+\omega^-$ is $\ell^+\ell^-$ plus a missing energy.