4.5 Prospects

- Advance `FlexibleEFTHiggs` to NNLO + NNLL
- Improvement on theoretical uncertainties

4.5.1 Study of non-SM low-energy limits of the MSSM

If the non-SM Higgs bosons are significantly lighter than all other BSM particles, the low-energy EFT is better described by an effective THDM instead of the SM. The hybrid approach implemented in `FeynHiggs` can straightforwardly extended to such scenario. In Fig. 3 we show some example results for such scenarios. M_S is chosen equal to 100 TeV. The electroweakino scale is set to 500 GeV, $X_t^{\overline{\rm DR}}/M_S = 1.8$. And $\tan\beta$ is set to 2.

4.5.2 Study of MSSM extensions

As mentioned above, the hybrid calculation implemented in `FlexibleSUSY` and `SARAH/SPheno` can be applied to a broad class of Standard Model extensions. In Fig. 4 an NMSSM scenario is shown where all $\overline{\rm DR}$ mass parameters are set equal to M_S, except $m_{Q_3} = 2M_S$, $m_A = M_S/2$ and we have chosen $X_t = -\sqrt{6}M_S$, $\tan\beta = 20$ and

$$A_\lambda = \frac{m_A^2 \tan\beta}{\mu_{\rm eff}(\tan^2\beta + 1)} - \frac{\kappa}{\lambda}\mu_{\rm eff}\,, \qquad A_\kappa = -\lambda\frac{m_A^2}{\mu_{\rm eff}}\,. \tag{10}$$

The dimensionless NMSSM superpotential parameters λ and κ are set equal at the SUSY scale and are fixed to 0.01 (upper two lines) and 0.2 (lower two lines). [AV: Maybe show an additional scenario where the difference between the fixed-order and hybrid calculation is clearer?] As λ and κ are increased the tree-level Higgs mass becomes smaller due to mixing effects with the heavier CP-even Higgs bosons. Similarly to the MSSM we find that in this NMSSM scenario the fixed-order calculation of `FlexibleSUSY` accidentally stays close to the hybrid calculation for SUSY scales up to $\sim$ 10 TeV, although the uncertainty is expected to be significantly larger.