Outline/Comments

November 10, 2021

Outline

- Motivation: strengthened δa_μ deviation from SM expectation (no significant change in central value, reduced uncertainty), together with different δa_e scenarios
- "arguments"
  - simple class of models: 2HDM's with tree level neutral flavour conservation (+CP conservation)
  - reproducing δa_μ alone appears to be feasible in $\mathbb{Z}_2$ models (I, II, X, Y) or in Aligned model, BUT already in conflict with perturbativity since $\frac{n_\tau}{n_\mu} = \frac{m_\tau}{m_\mu}$ in these models
  - next simple model is gℓFC, more parameters and no perturbativity problem, δa_μ and "old" value of δa_e (-8.7×10^{-13}) can be reproduced in certain regions of parameter space (previous paper)
  - one can consider a "new" value of δa_e (4.8×10^{-13}) and an "average" value (-2.0×10^{-13}) in addition to the "old" value: they cover $\pm$ signs and different sizes (a factor $\frac{1}{4}$ between "old" and "average")
  - one can consider different perturbativity assumptions for n_ℓ (relevant for example to analyse if δa_e can be obtained at one loop)
  - one can address the excess in $pp_{\text{ggF}} \to S \to \tau^+\tau^-$, in which case we have non-SM hints related to e and μ through the $g-2$'s, and to τ through this excess, 3 anomalies for 3 n_ℓ couplings
- analyses
  - for 2 different perturbativity assumptions (same bound $\simeq$ 100 GeV as in previous paper, or bound $\simeq$ 246 GeV); it is not just the allowed regions in the different n_ℓ that might change
  - for 4 different δa_e hypotheses (using the same prescription as in previous paper), "old", "new" "average" and "no constraint on δa_e", the last one in order to see the constraints from δa_μ alone (not exactly alone, there is just a bound on δa_e)
  - specific analysis with old δa_e, large perturbativity "tolerance", and forcing the appearance of an excess in $pp_{\text{ggF}} \to S \to \tau^+\tau^-$
- "minimal results": updated analysis with results that illustrate that non-SM δa_μ AND δa_e can be obtained for different scenarios concerning δa_e, in different allowed regions of parameter space in each case; impact of perturbativity "tolerance".

Collected results

- File SUMMARY_MuPh reproduces δa_μ and for δa_e there is only a bound $|\delta a_e| < 20 \times 10^{-13}$
- File SUMMARY_AoPh reproduces δa_μ and "old" value of δa_e considering two different perturbativity requirements on n_ℓ's, and the results with an excess in $pp_{\text{ggF}} \to S \to \tau^+\tau^-$
- File SUMMARY_APh reproduces δa_μ and three different possibilities for δa_e ("old", "new", "average")

Detailed results for each single analysis in separate files.

Comments on SUMMARY_MuPh

- $\text{Re}\,(n_e)$ is constrained even if there is only a loose bound on $|\delta a_e|$ (effect of other constraints, check if universality alone explains this):
  - $\text{Re}\,(n_e)$ vs. m_{H}, $\tan\beta$ regions are non-trivial
  - $|\text{Re}\,(n_e)| < |\text{Re}\,(n_\mu)|$
- $\text{Re}\,(n_\mu)$ vs. m_{H} regions enlarged in $\text{Re}\,(n_\mu)$ due to enlarged perturbativity allowed range and also new regions in m_{H}, in particular region around 1 TeV.
- $\sigma(pp \to \text{H} \to \mu^+\mu^-)$ around 1 TeV has a rather narrow range

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Comments on SUMMARY_AoPh

- Much larger allowed regions for new perturbativity requirement, not only in n_ℓ's, but also in other parameters, for example the scalar masses
- Appearance of new "peculiar" regions which can reproduce δ_ℓ's only with large n_ℓ's
- Regions with $pp_{\text{ggF}} \to S \to \tau^+\tau^-$ are small, require large $\text{Re}\,(n_\tau)$ and give narrow ranges for other observables

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Comments on SUMMARY_APh

- No big differences in $\text{Re}\,(n_\mu)$ vs. m_{H}, m_{H} vs. $\tan\beta$ for different δa_e assumptions
- $\text{Re}\,(n_e)$ necessarily different
- differences related to $\text{Re}\,(n_e)$ might be expected (?) (rescaling of $\text{Re}\,(n_e)$ to obtain δa_e); some "peculiar" region for the average δa_e which can correspond to a 1-loop explanation?