Questions and answers - Jorge de Blas Lecture

The following questions were submitted through Google Form. Some / all may have been answered in the Q&A session already. Nevertheless, we request our lecturers to provide written answers here for the benefit of those who could not attend that session. Thank you!

Slide 9. The blue band of theory uncertainties is asymmetric about the central fit value for the left plots and becomes symmetric for the right plots. Is there an easy way to understand this?

If I understand correctly the original references, the blue bands are obtained as the envelope of the \Delta \chi^2 curves resulting from independently shifting the SM prediction for each observable within the estimated theory uncertainty as implemented in ZFITTER. Unfortunately, I cannot see at the moment an easy way to understand the effect described in the question without looking at both the data available at the time of each plot, as well as how the corresponding theory uncertainties are simulated in the version of the codes used in producing the corresponding figures. (Looking at the ZFITTER documentation, one can read that the methods used to simulate theory uncertainties changed when NNLO corrections started to become available.)

Page 15. I am curious what are the values and uncertainties of the other two Delta terms?

The leptonic contribution is \Delta \alpha_{lept}(M_Z)=314.97 x 10^-4. The result is known including four-loops but the 3-loop is already 10^-6 and negligible, and so it is the theory uncertainty.

For \Delta \alpha_{top}, to second order in \alpha_s the correction is -0.72 x 10^-4, with a theory uncertainty that can also be considered negligible.

Page 26. What can one expect the NNLO corrections to Ab, and charm asymmetries given the Afbb correction ?

Unfortunately, current studies only revisited the effect on the LEP measurement. However, given that these QCD corrections affect the FB asymmetry, which is also used together with a LR one to obtain Ab, I would expect the corrections also have an effect in the extraction of this asymmetry.

For the charm asymmetries, given the smaller mass and, especially, the lower experimental precision, it is likely these effects are not important now, but should certainly be taken into account in measurements at future colliders.

Page 65. We have heard that FCC-ee and CEPC are virtually identical. While many numbers in this table are similar, some differ significantly. Can you comment?

As these are projections for observables whose uncertainties at FCCee and CEPC will be, in many cases, systematic dominated, the projections depend quite a bit on the assumptions for such systematics made by the different projects. Indeed, during these future collider studies for the ESU2020 and the Snowmass 2021, several of these discrepancies between projects were “ironed out” by using similar assumptions, but others still persist. (Also, and although this is also a minor effect, the luminosities at the Z and WW runs are somewhat higher at FCCee, also affecting a bit the statistical uncertainties.)

Page 69. How should I read this figure? Is it saying that HL-LHC has minor impact beyond baseline? Does baseline include LHC?

The figure is showing, for each operator, the ratio of the 95% C.L. intervals

R=[cmin,cmax](baseline + X)/[cmin,cmax](baseline)

for X= HLLHC (blue), HLLHC+FCCee (orange). The baseline is defined as the LEP/SLD+LHC fit presented in arXiv:2404.12809. For the LHC, the authors include Run II data from Higgs/diBoson/Top measurements so, indeed, their results seem to indicate that, using the projections they worked out for the HLLHC measurements, the improvement of going to HLLHC in several operators already constrained by LHC Run II data won’t be large.