Update on $B^0 \to K^{*0}\tau\tau$ at FCC-*ee* : background guesstimation

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- arXiv:2211.05034 : LHC*b* has performed the first measurement of $B^+ \to K^+ D_s^+ D_s^-$ which has the same quark content except the spectator quark $\Rightarrow$ opportunity to make a more educated guesstimate of $BF(B^0 \to K^{*0} D_s D_s)$!
- Main difference in term of process : K vs K^* $\Rightarrow$ corrections for spin/QCD (form factor) and kinematics (phase space) are needed.
- Form factor correction $\Rightarrow$ found two measured equivalent modes one with a K, the other with a K^*, and build the ratio of their branching fractions in order to arise the $K - K^*$ form factor difference :

$$C_{\mathrm{FF}} = \frac{BF(B^+ \to D^0 K^{*+})}{BF(B^+ \to D^0 K^+)} = 1.46 \pm 0.13.$$

- Phase space correction $\Rightarrow$ considering $B^+ \to K^+ D_s^+ D_s^-$ and $B^+ \to K^{*+} D_s^+ D_s^-$, build the ratio of their phase space (numerical computation) :

$$C_{\mathrm{PS}} = \frac{PS(B^+ \to K^{*+} D_s^+ D_s^-)}{PS(B^+ \to K^+ D_s^+ D_s^-)} = 0.326.$$

- Determination of $BF(B^0 \to K^{*0} D_s D_s)$ from the last LHCb measurement :

$$BF(B^0 \to K^{*0} D_s D_s) = BF(B^+ \to K^+ D_s^+ D_s^-) \times C_{\mathrm{FF}} \times C_{\mathrm{PS}}.$$

- $BF(B^0 \to K^{*0} D_s^* D_s)$ and $BF(B^0 \to K^{*0} D_s^* D_s^*)$ from the $B_s^0 \to D_s^{(*)} D_s^{(*)}$ observed hierarchy.
- New guesstimates :

$$\begin{aligned} BF(B^0 \to K^{*0} D_s D_s) &= (5.47 \pm 1.92) \times 10^{-5}, \\ BF(B^0 \to K^{*0} D_s^* D_s) &= (1.73 \pm 0.70) \times 10^{-4}, \\ BF(B^0 \to K^{*0} D_s^* D_s^*) &= (1.79 \pm 0.72) \times 10^{-4}. \end{aligned}$$

- New guesstimates are 5 times smaller than the previous one $\to$ large factor due to uncertainties and maybe some phase space factor that was overlooked.
- This new guesstimate is more educated $\to$ update of the branching fractions w.r.t. him $\Rightarrow$ update of the selection and the precision of the measurements.

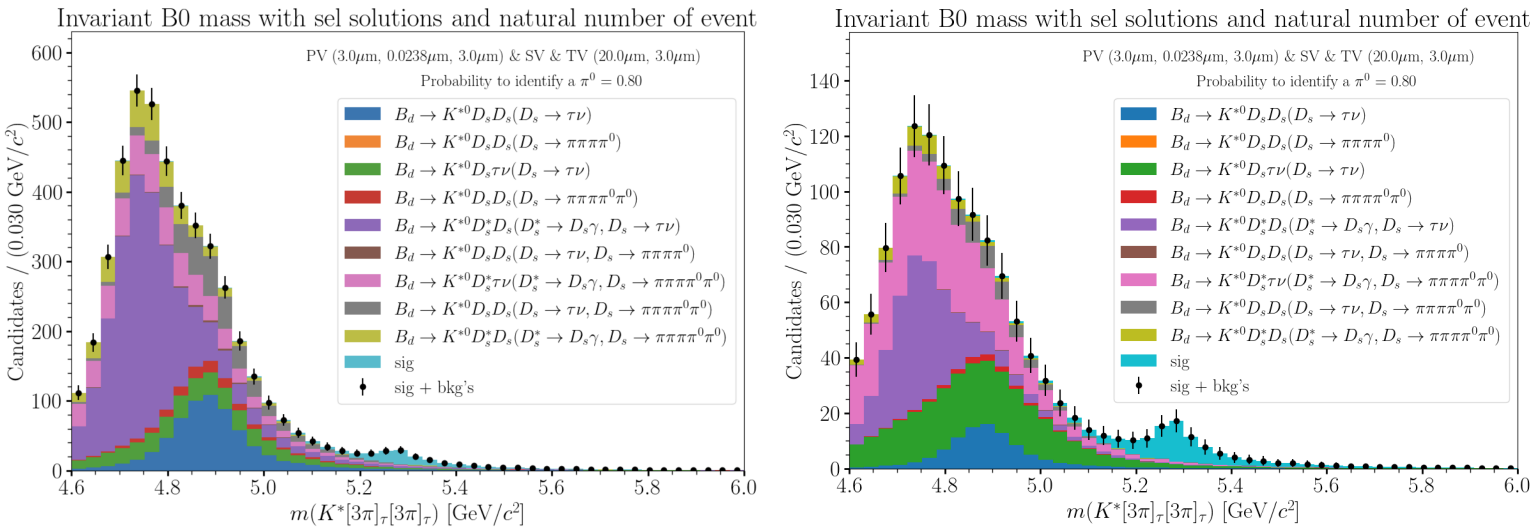
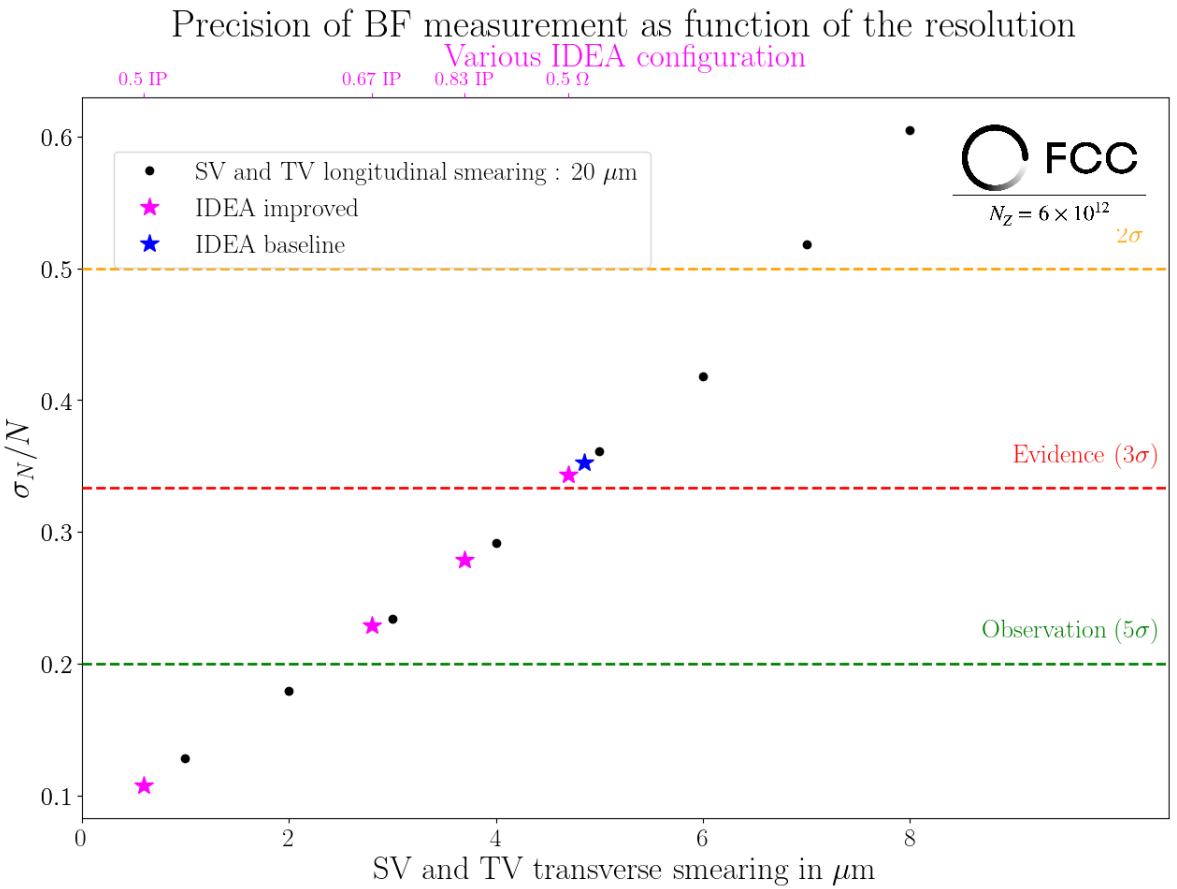


Figure – B^0 invariant mass distribution after XGB selection previous (left) and new (right) version. Warning $8 \times 10^{12} Z$ was considered in the previous version vs $6 \times 10^{12} Z$ now.



- Improvement of the performances → IDEA baseline close to the evidence.
- IP measurement improvements (50%) could bring us close to the observation.

- Evaluating resolutions of new signal samples, with various Delphes card produced by Emmanuel and Michele, to check the tracking improvements.
- Continue to fill the ANAnote.

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Thanks !