

LLR report

Case study

“Measurement of Higgs parameters at FCC-ee”

* **the total $e^+e^- \rightarrow ZH$ cross section σ_{HZ}** at two energies to achieve a model-independent demonstration of the existence of the trilinear Higgs boson self-coupling

* **the Higgs boson total decay width Γ_H** focus on the requirements on the detector design (Si-based calorimeter) and on jet clustering algorithms to achieve an effective separation between the $H \rightarrow ZZ$ and $H \rightarrow WW$

People involved :

Roberto Salerno + Cesare Cazzaniga (M2 - Ecole Polytechnique/ETH - 03/2021 to 07/2021)

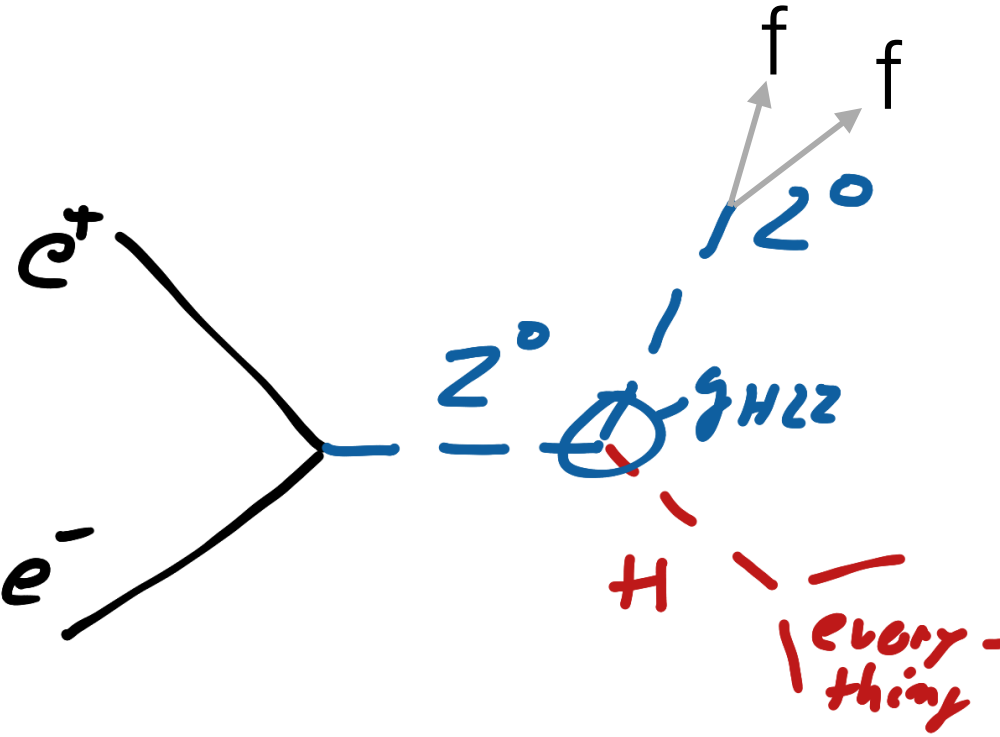
Report today

Introduction

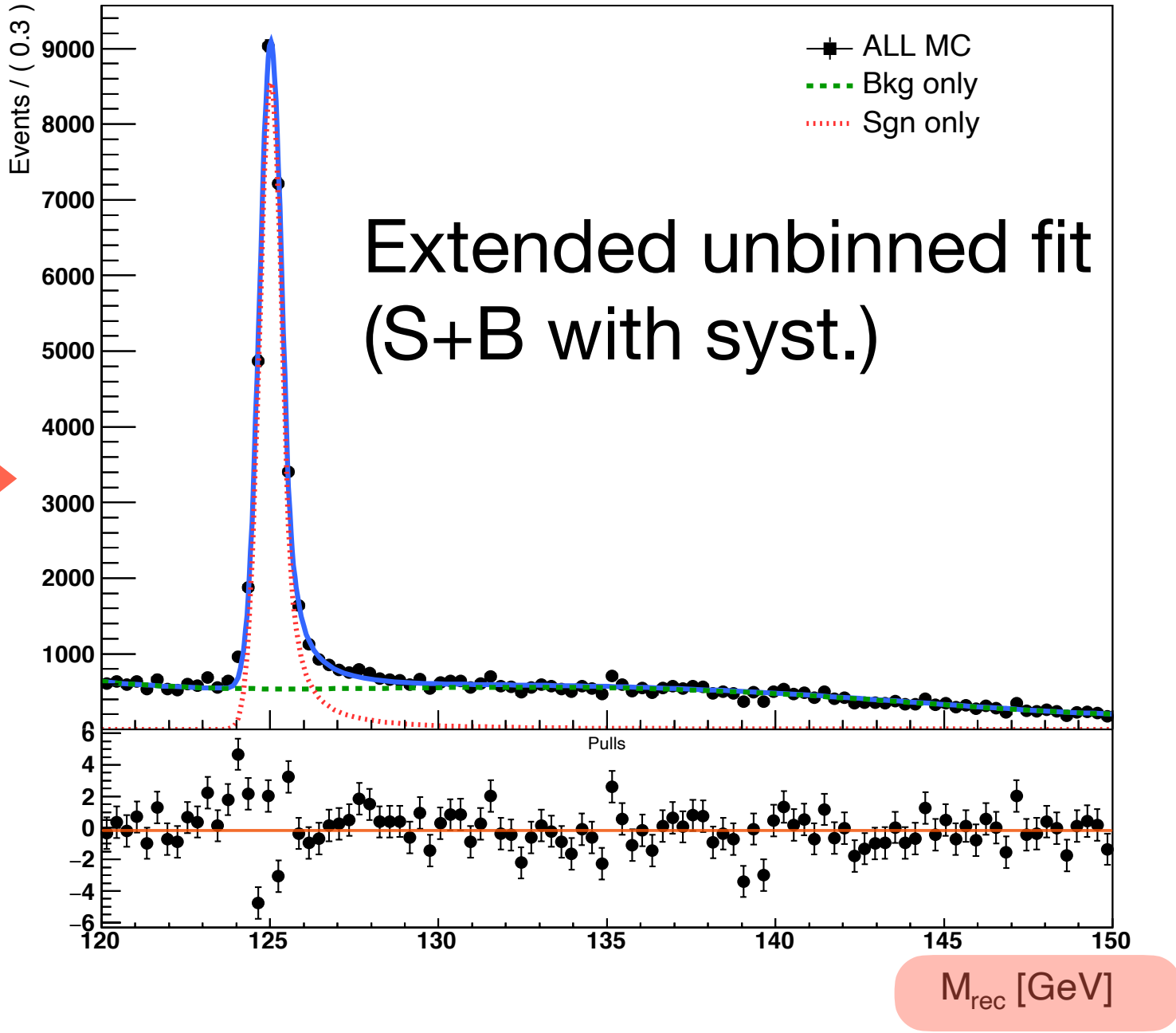
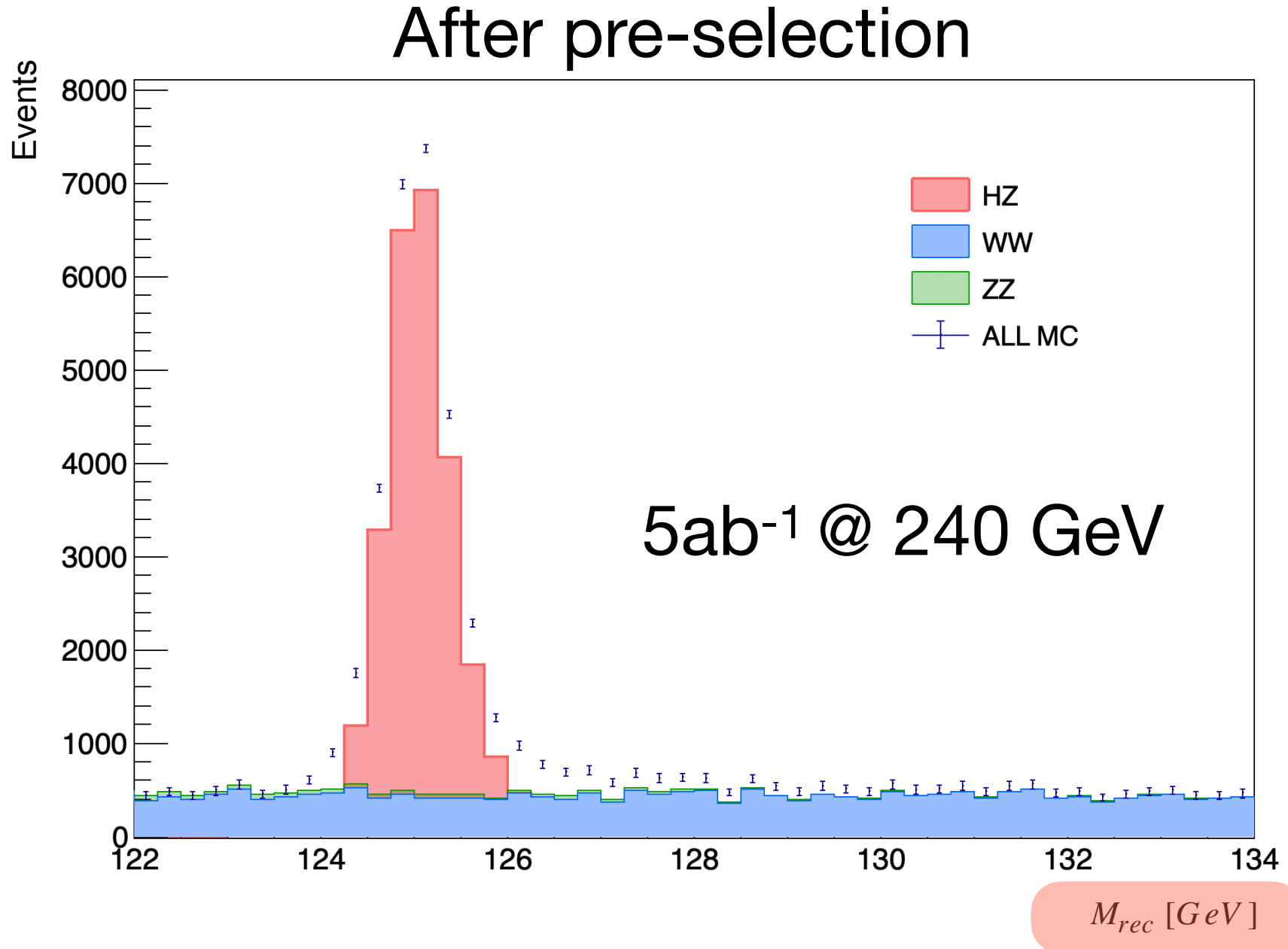
Event generation: Madgraph + pythia8 (for particles decays)

Signal (HZ/VBF) + main backgrounds (WW/ZZ) @ 240/365 GeV

Detector simulations : Delphes / IDEA detector



Cross section is measured with the **recoil method** (Higgs boson tagged by a $Z \rightarrow \mu\mu$)



λ_{HHH} does not enter single-Higgs processes at LO but it affects production/decay at NLO

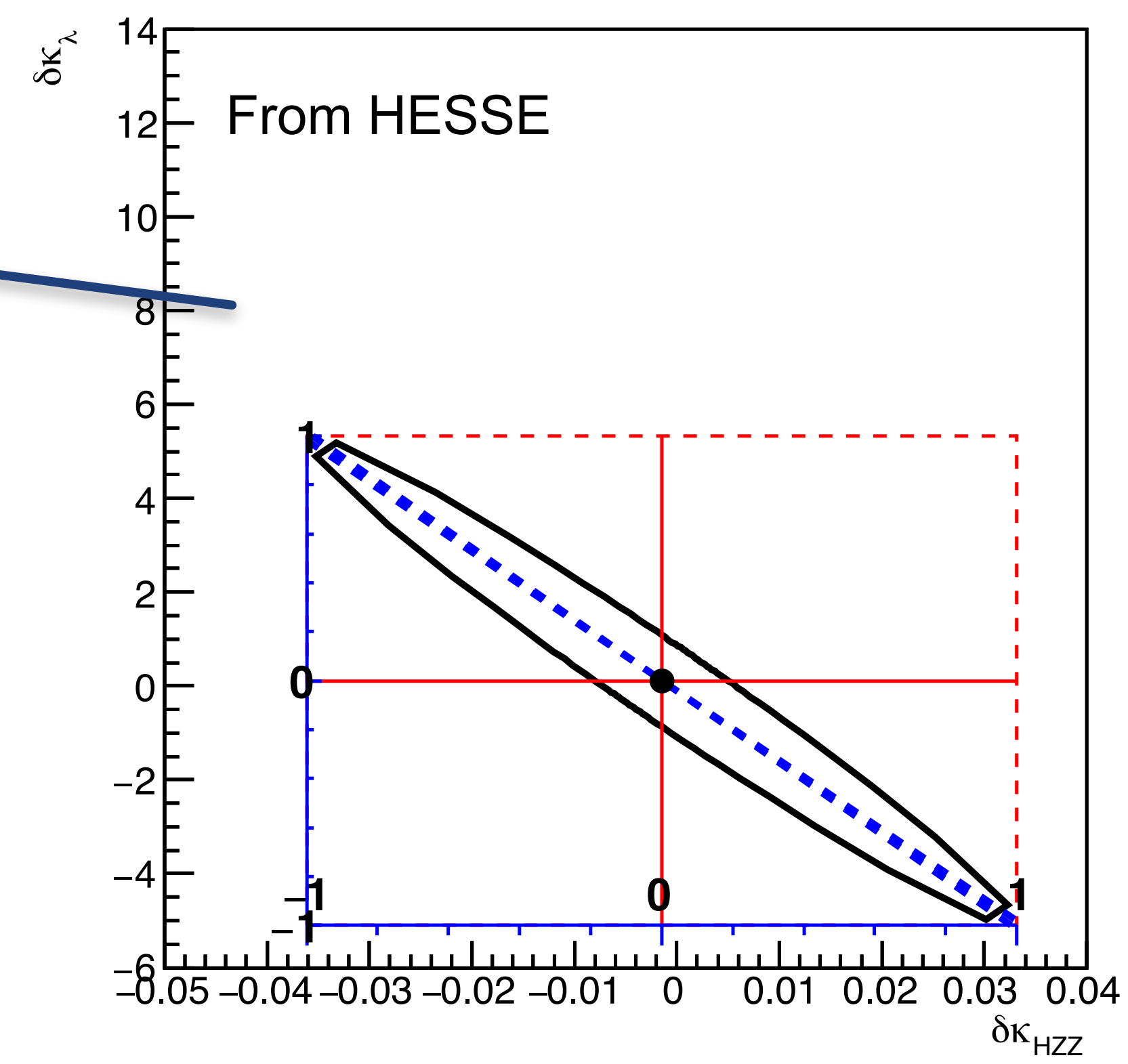
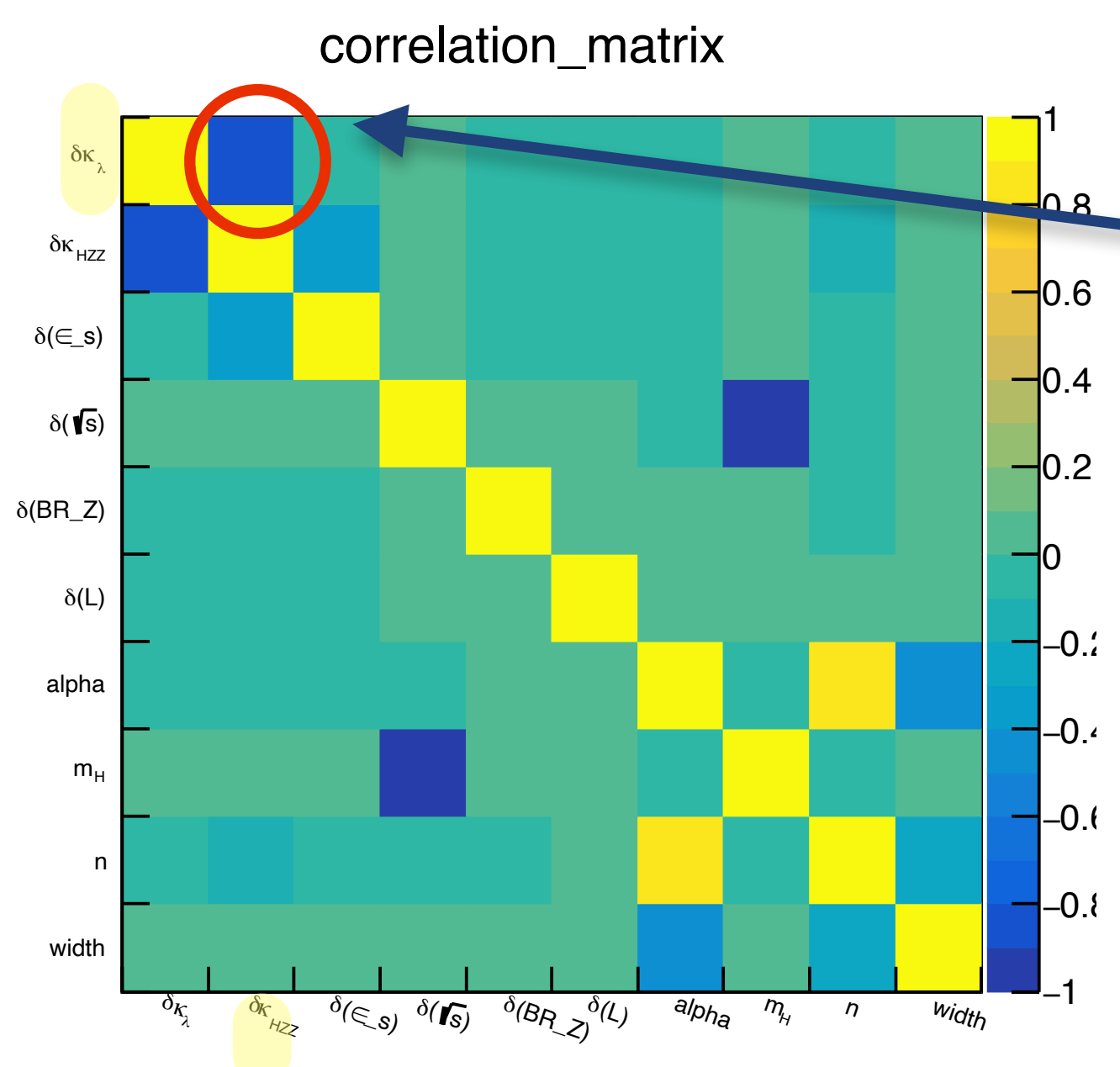
Signal model for couplings extraction

$$f_{model}(M_{rec} | \sigma, m_H, \vec{\theta}) = N_{sig} \cdot CBS\text{hape}(M_{rec}, m_H, \delta_{br}, \delta_{isr}, \delta_L, \theta_s) + N_{bkg} \cdot Chebychev(M_{rec}, \theta_b)$$

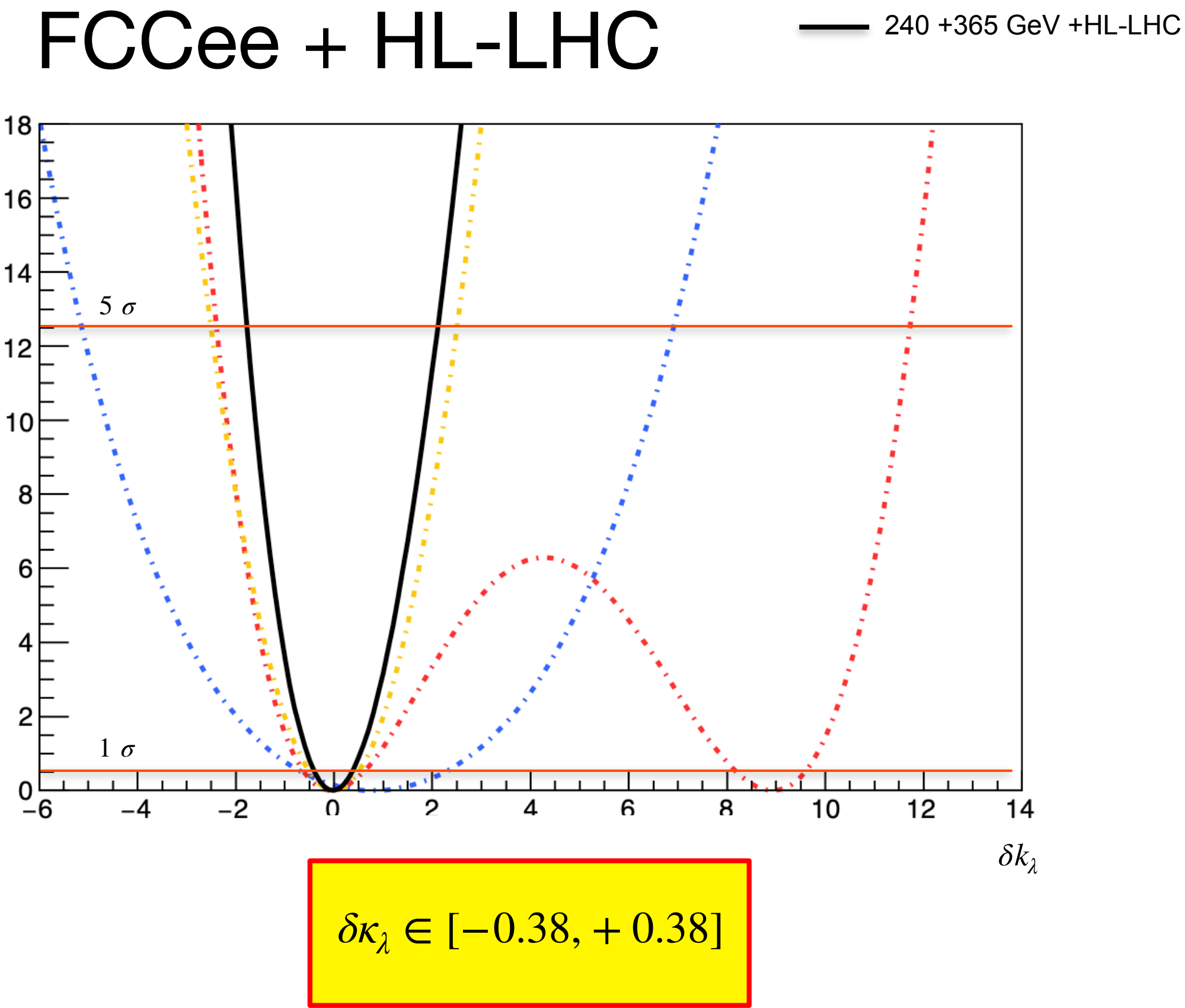
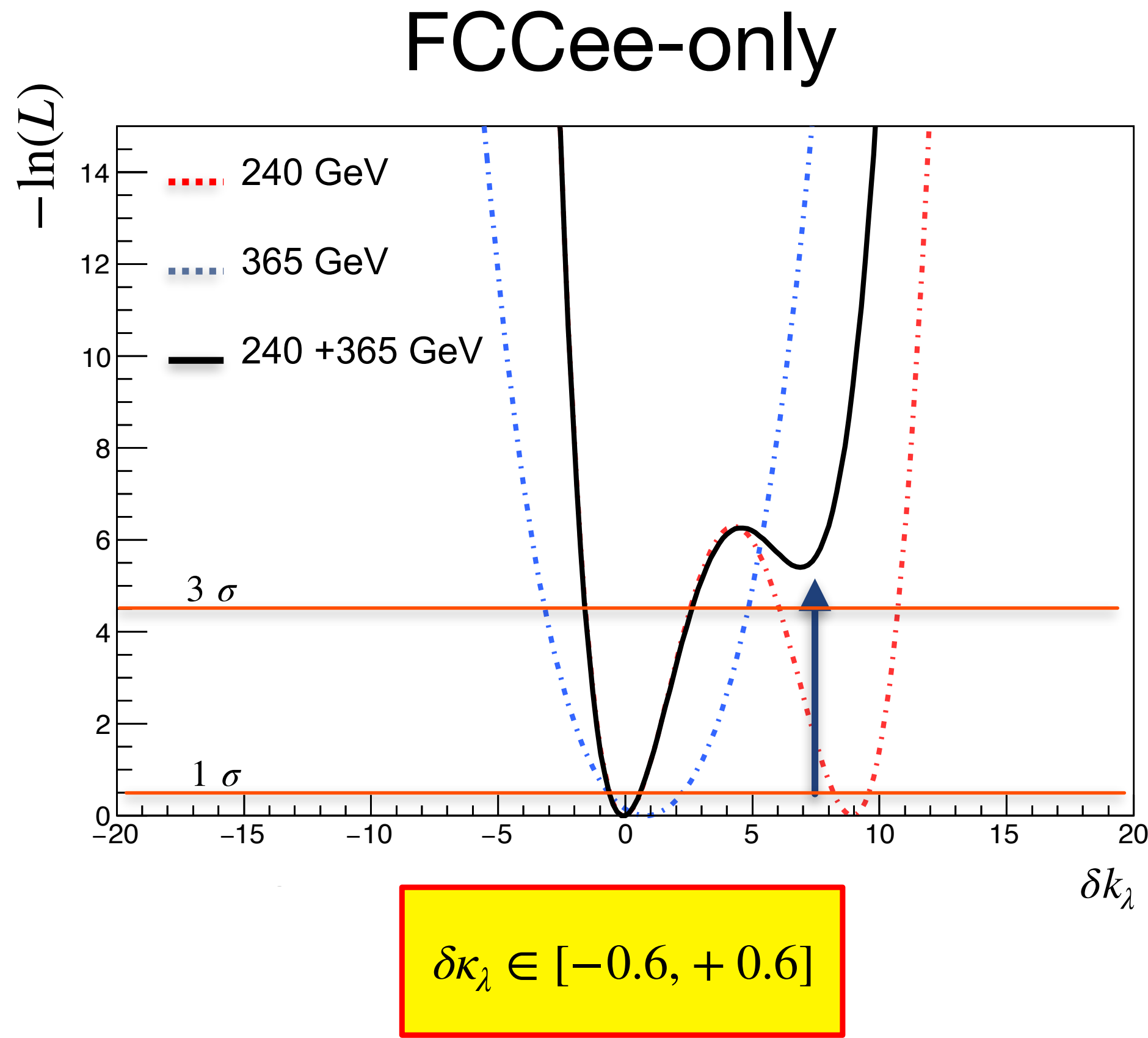
$$N_{sig} = \sigma_{NLO} \cdot BR \cdot (1 + \delta_{BR}) \cdot \epsilon(1 + \delta_\epsilon) \cdot L_0 \cdot (1 + \delta_L) \cdot ISR \cdot (1 + \delta_{ISR})$$

$$\sigma_{NLO} = (1 + \delta\kappa_{HZZ})^2 \frac{1}{1 - \delta Z_H \kappa_\lambda^2} \sigma_{LO} (1 + C_1 \kappa_\lambda) \cdot \sigma_{HZ,true}$$

↓ Universal coefficient → Process dependent coefficient



Some preliminary results

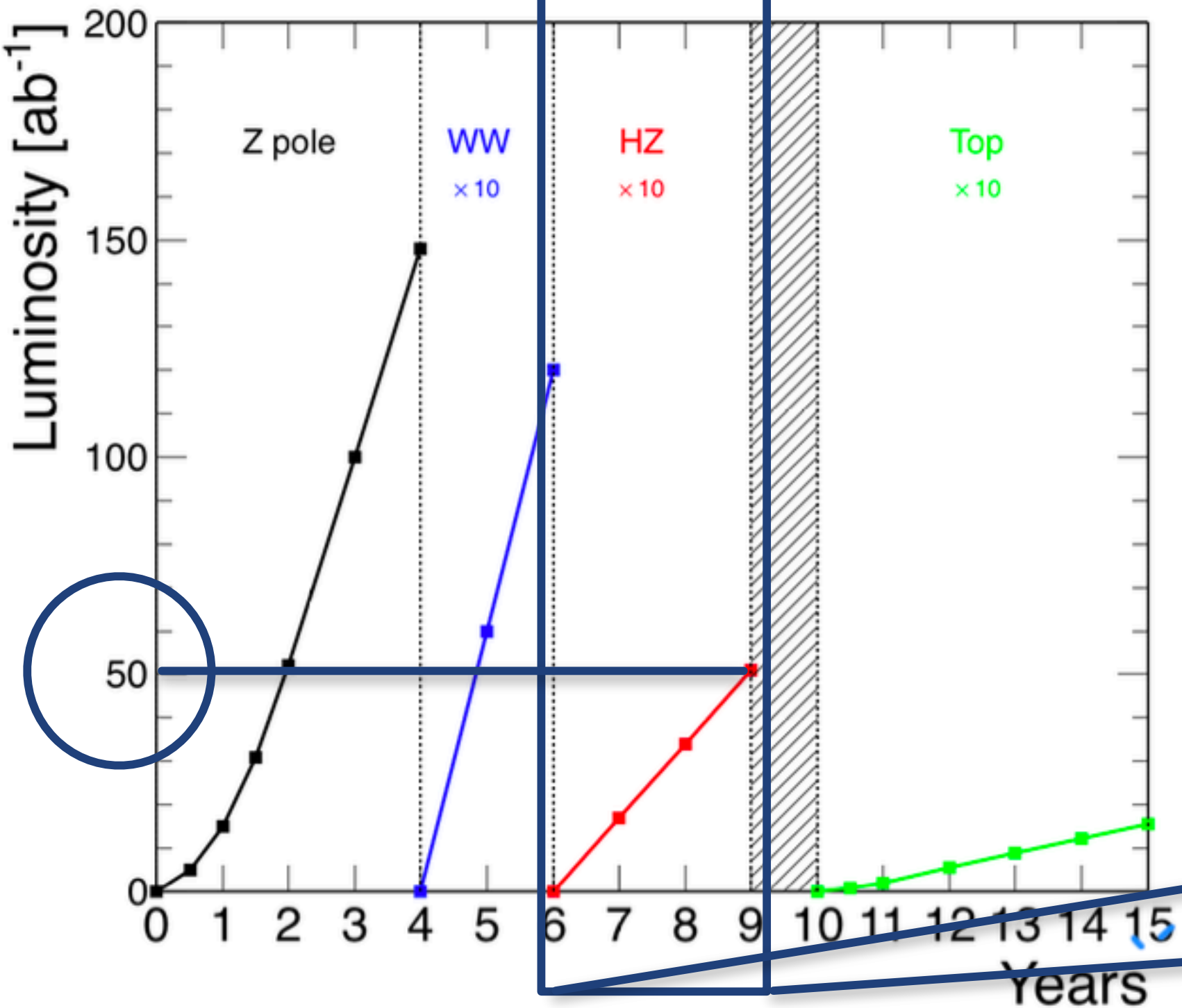


Exclusive analysis at the moment considering only deformation of the Higgs boson cubic coupling.

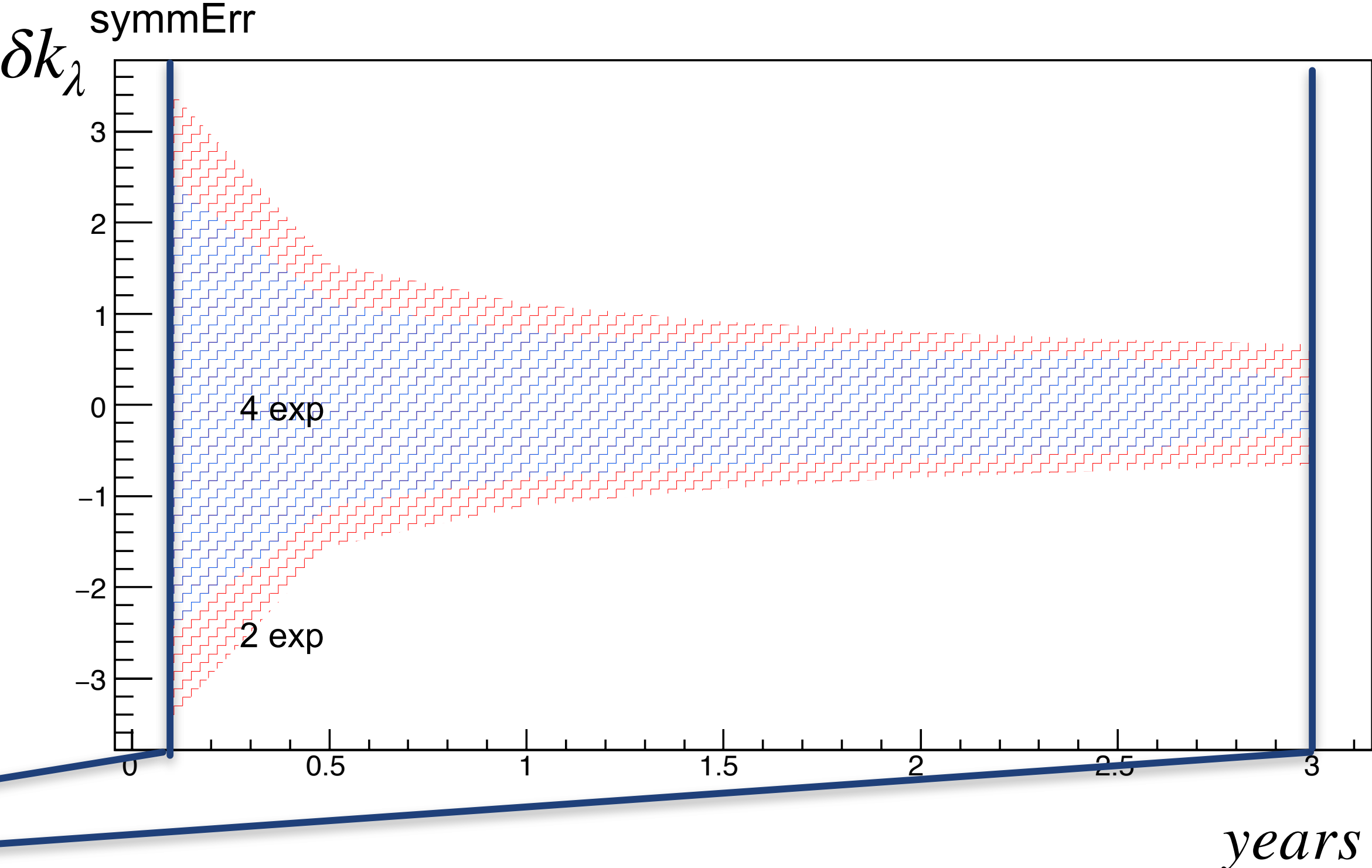
Already considering two energy points that will lift off the degeneracy between δk_{HZZ} and δk_λ deviations

Some preliminary results - number of IP

Plan for FCCee



Self-coupling precision evolution



With 4 exp.

$$\delta\kappa_\lambda \in [-0.30, +0.30]$$

Combined with HL-LHC



$$\delta\kappa_\lambda \in [-0.25, +0.25]$$

Next steps

On-going add an orthogonal VBF category @ 365 GeV
from simple cut based analysis to multivariate one

Make n-POI fit

Include additional variables in the fit (angular distributions and masses
exclusive decay channels)

After pre-selection

