

$t\bar{t}H$ production in ATLAS Phase-II

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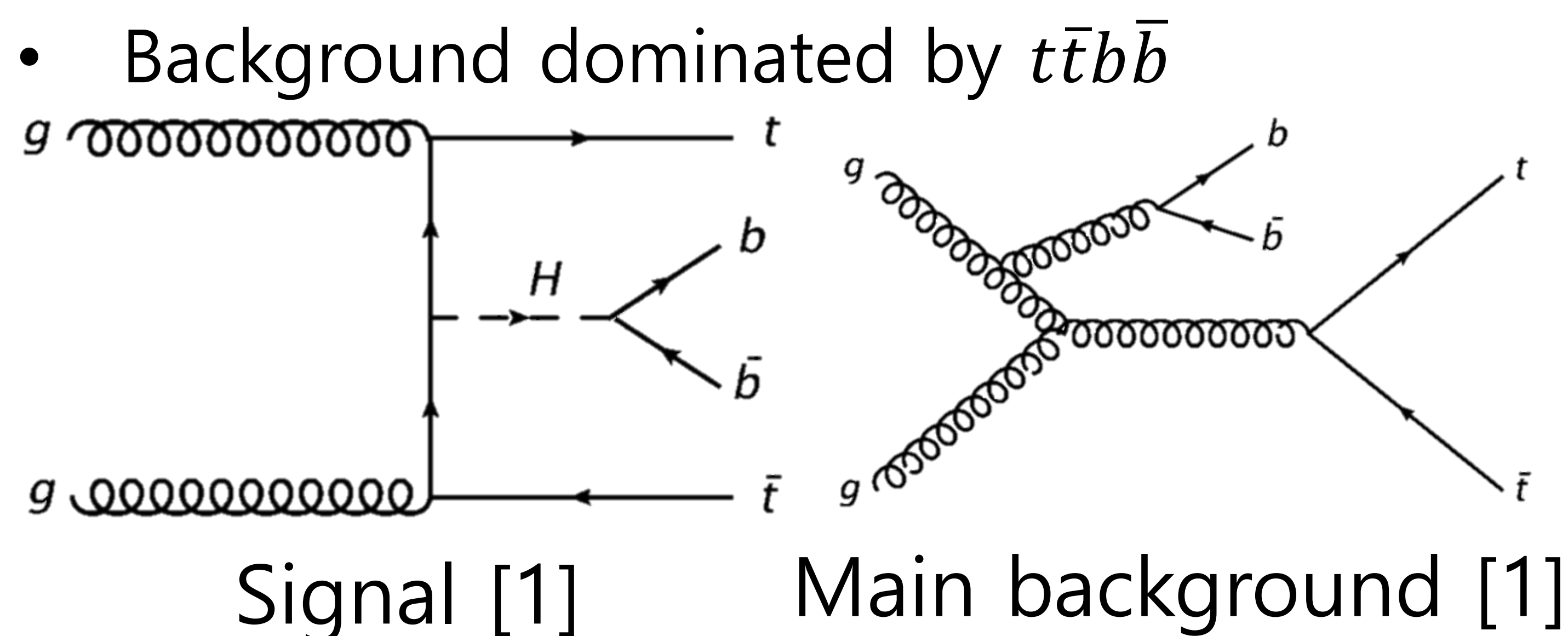
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Motivation

- The coupling of the Higgs boson to top quarks can be directly measured in the $t\bar{t}H$ process
- An interesting probe for new physics is this coupling and, in particular, its CP nature
- In this beyond the Standard Model scenario, the most general Lagrangian term for the coupling is

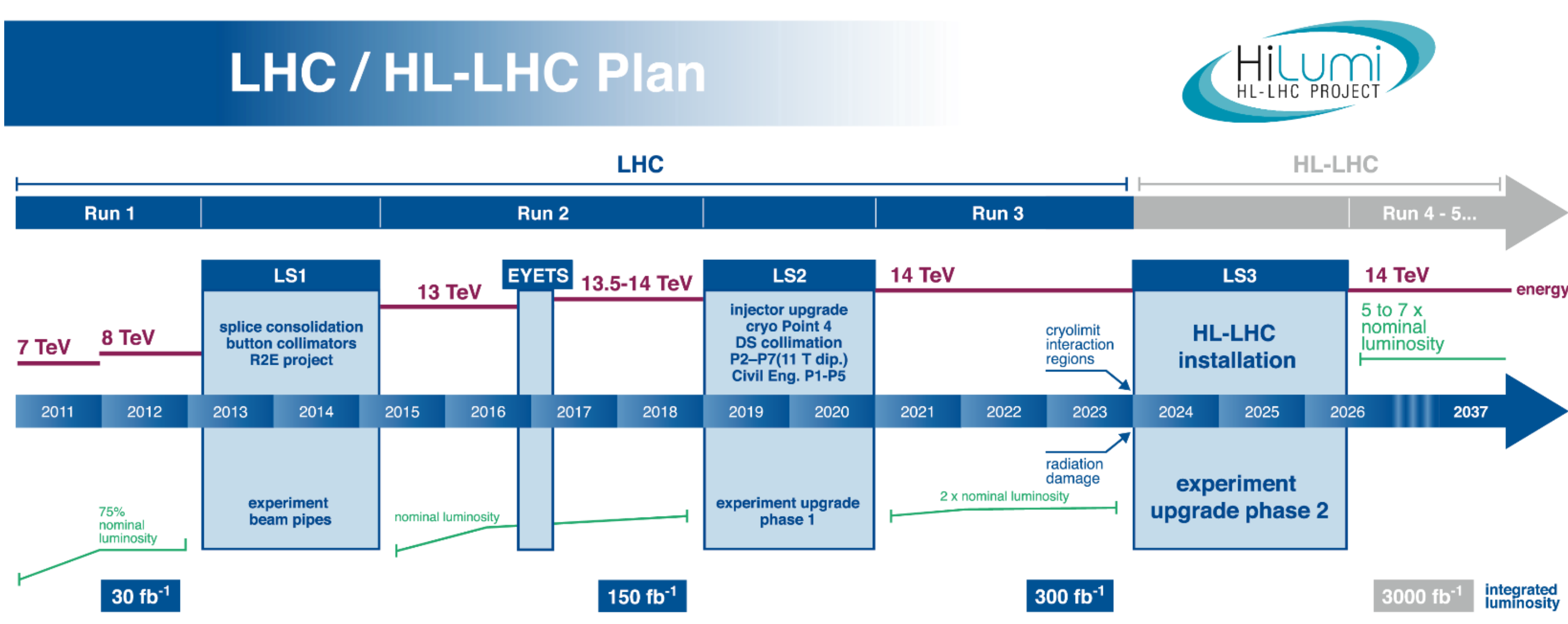
$$L = \kappa y_t \bar{t}(\cos \alpha + i \gamma_5 \sin \alpha)tH$$

- y_t is the SM Higgs boson coupling to the top quark
- $\cos \alpha = 1$ recovers the SM interaction while $\cos \alpha = 0$ corresponds to the pure pseudo-scalar case
- A mixture of the two components gives a new source of CP violation
- Search for the most probable Higgs decay $H \rightarrow b\bar{b}$
- Background dominated by $t\bar{t}b\bar{b}$



HL-LHC

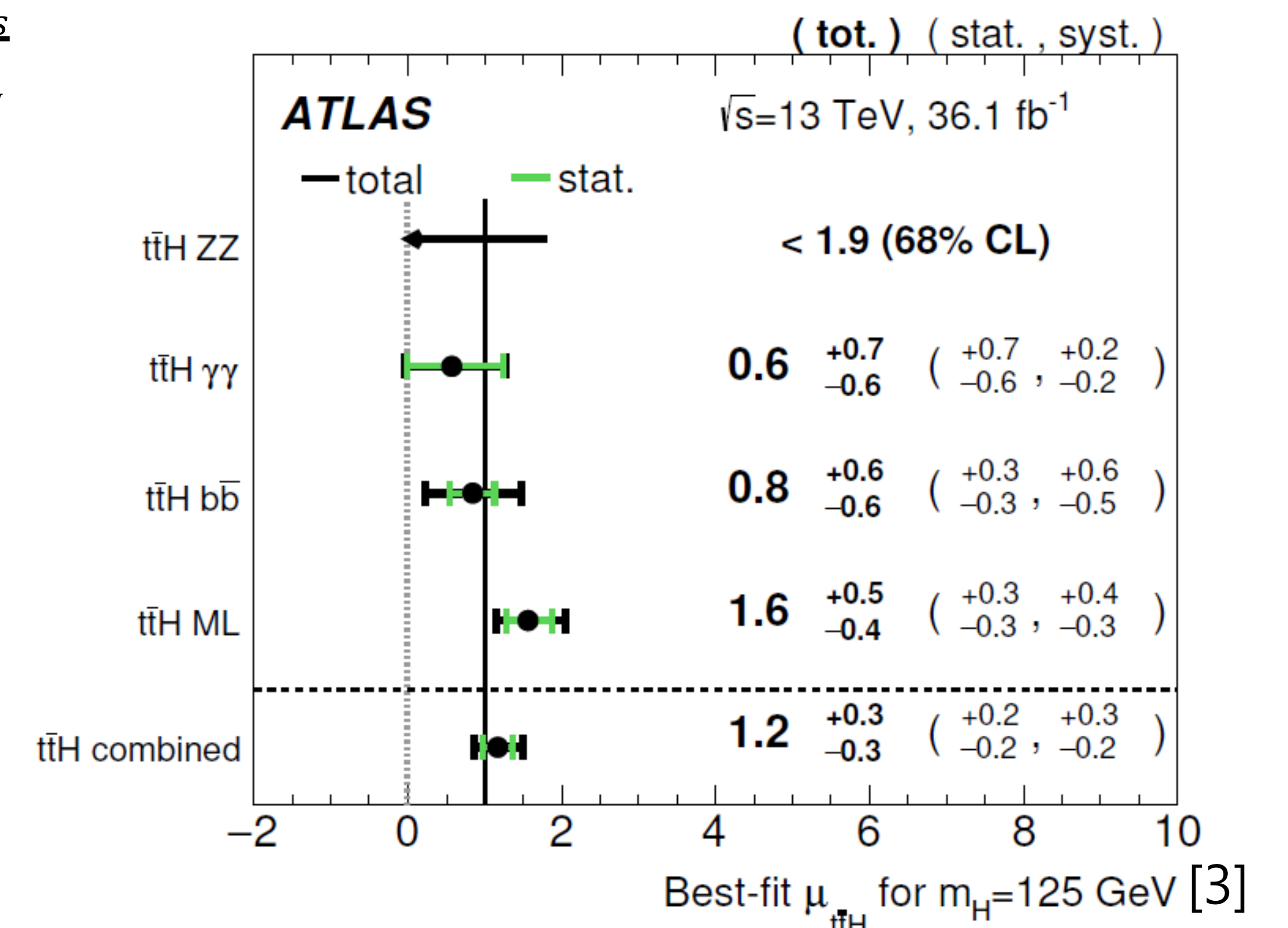
- The Luminosity Plans of the High Luminosity LHC (Phase-II) [2]



State of the art

- Events are classified into control and signal regions
- These regions are combined in a profile likelihood fit to test for the signal strength

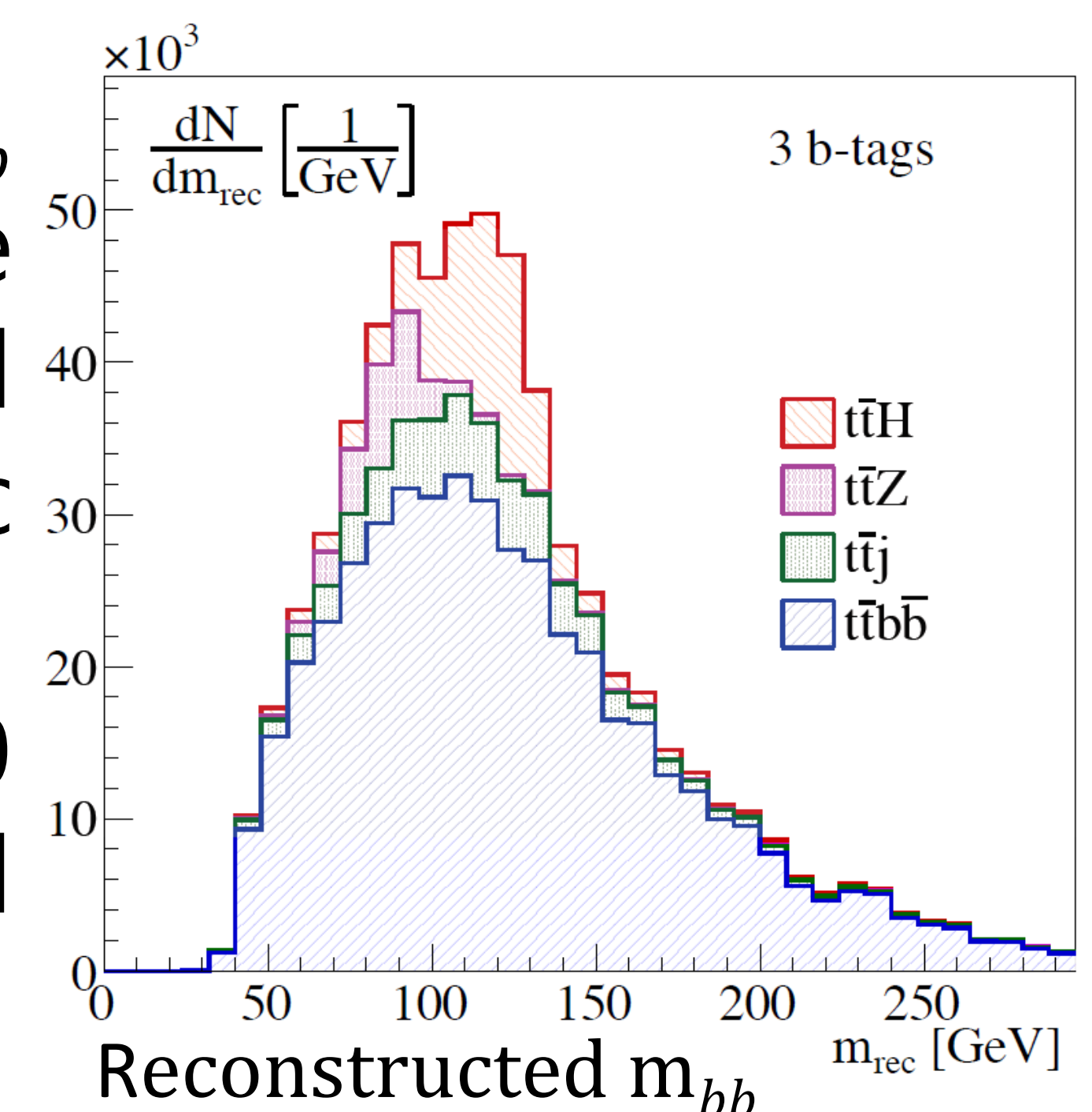
$$\mu = \frac{\sigma_{obs}}{\sigma_{SM}}$$



- The $H \rightarrow b\bar{b}$ analysis is dominated by large systematic errors due to an imperfect modelling of the background
- $\mu_{t\bar{t}H \text{ } b\bar{b}}$ almost compatible with zero (would mean no evidence for signal)

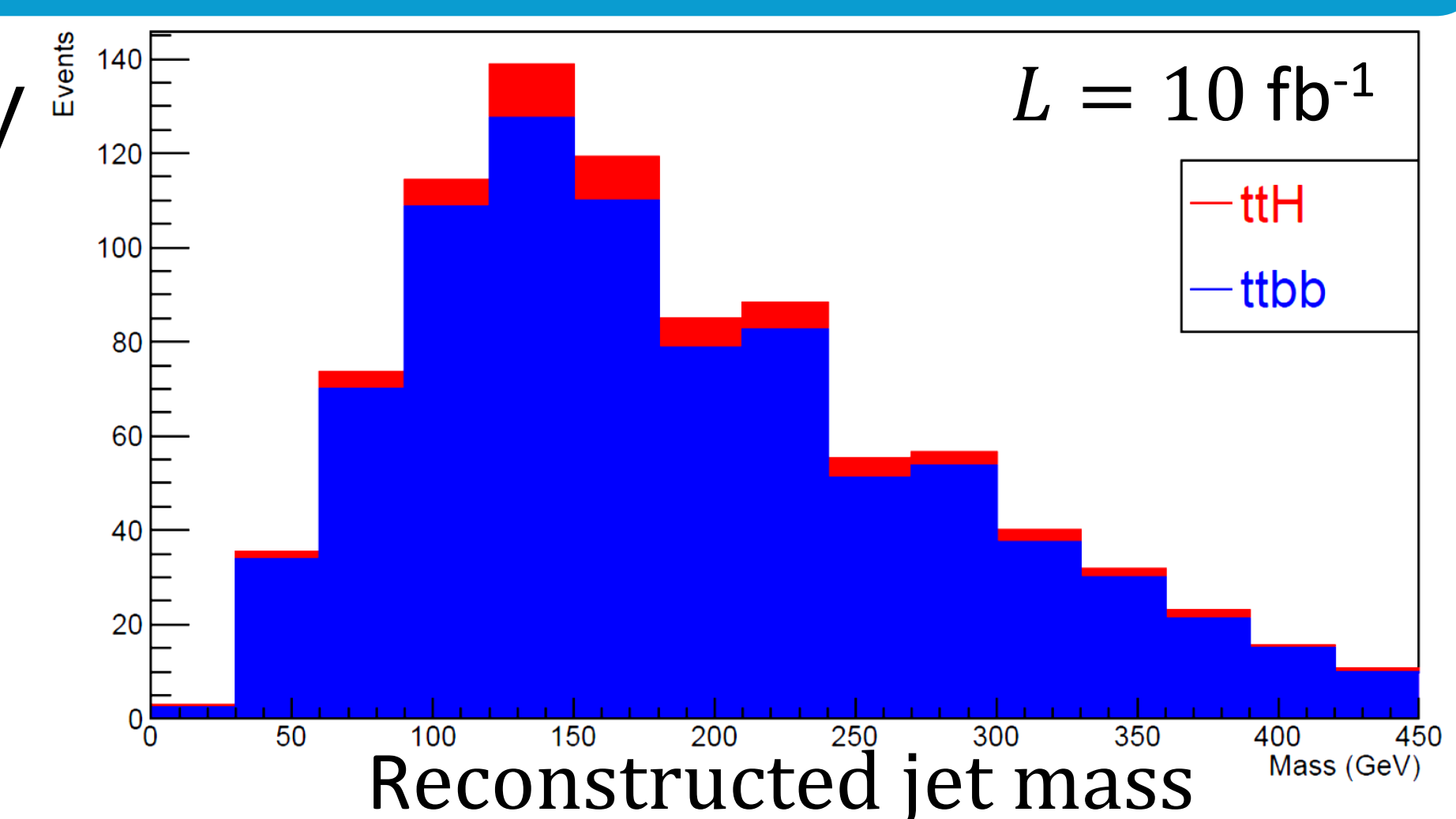
Going Beyond

- Use side bands in m_{bb} distribution to estimate the background and reduce systematic uncertainty
- Studies at $\sqrt{s} = 100 \text{ TeV}$ with boosted regime [4]



Analysis Status

- Very preliminary simplified analysis at $\sqrt{s} = 14 \text{ TeV}$
- Using truth and jet substructure



Next Steps

- Conclusion of the implementation of the original analysis
- Optimization of the analysis
- Uncertainty on the top quark Yukawa coupling
- Estimation of the sensibility of the measurement to anomalous couplings