

CMS Higgs CP measurement via ttH

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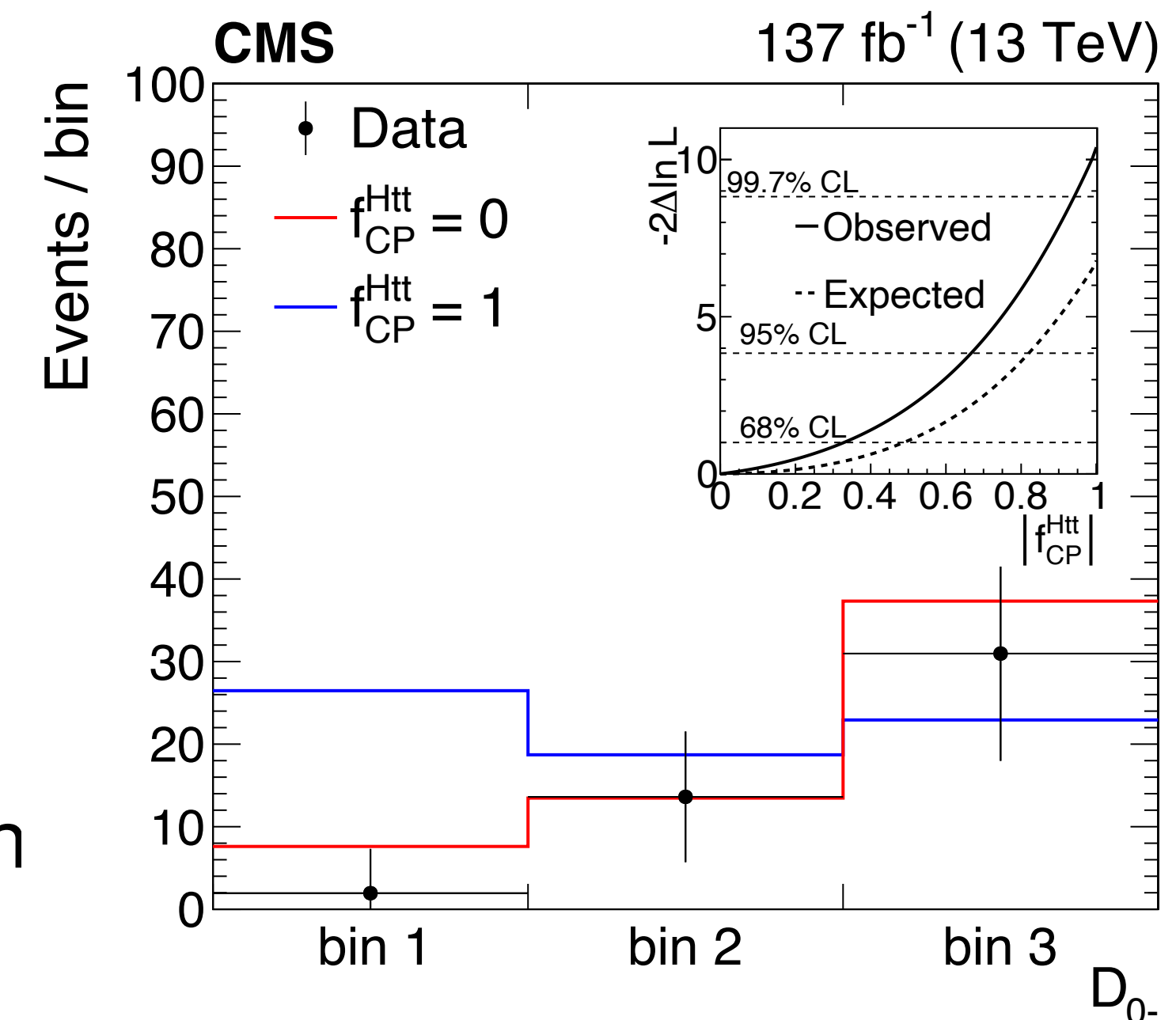
Introduction

$$A(\text{Hff}) = -\frac{m_f}{v} \bar{\psi}_f (\kappa_f + i \tilde{\kappa}_f \gamma_5) \psi_f.$$

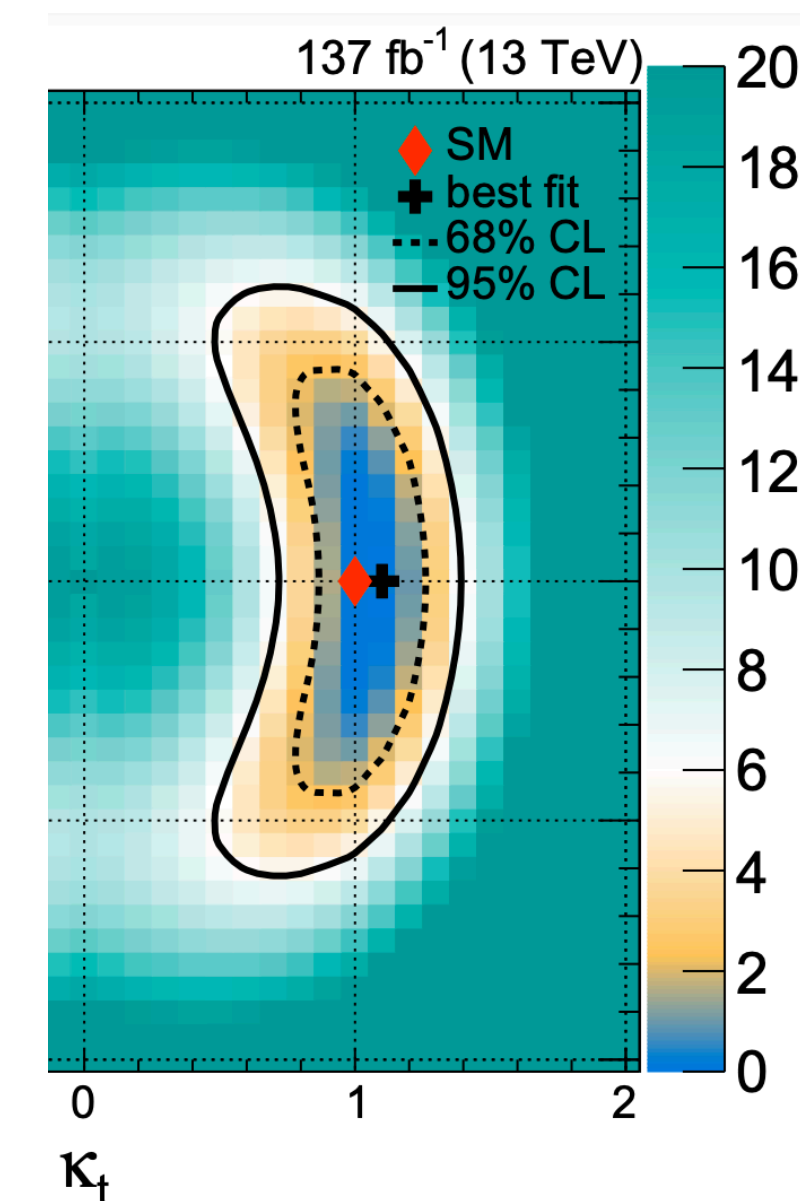
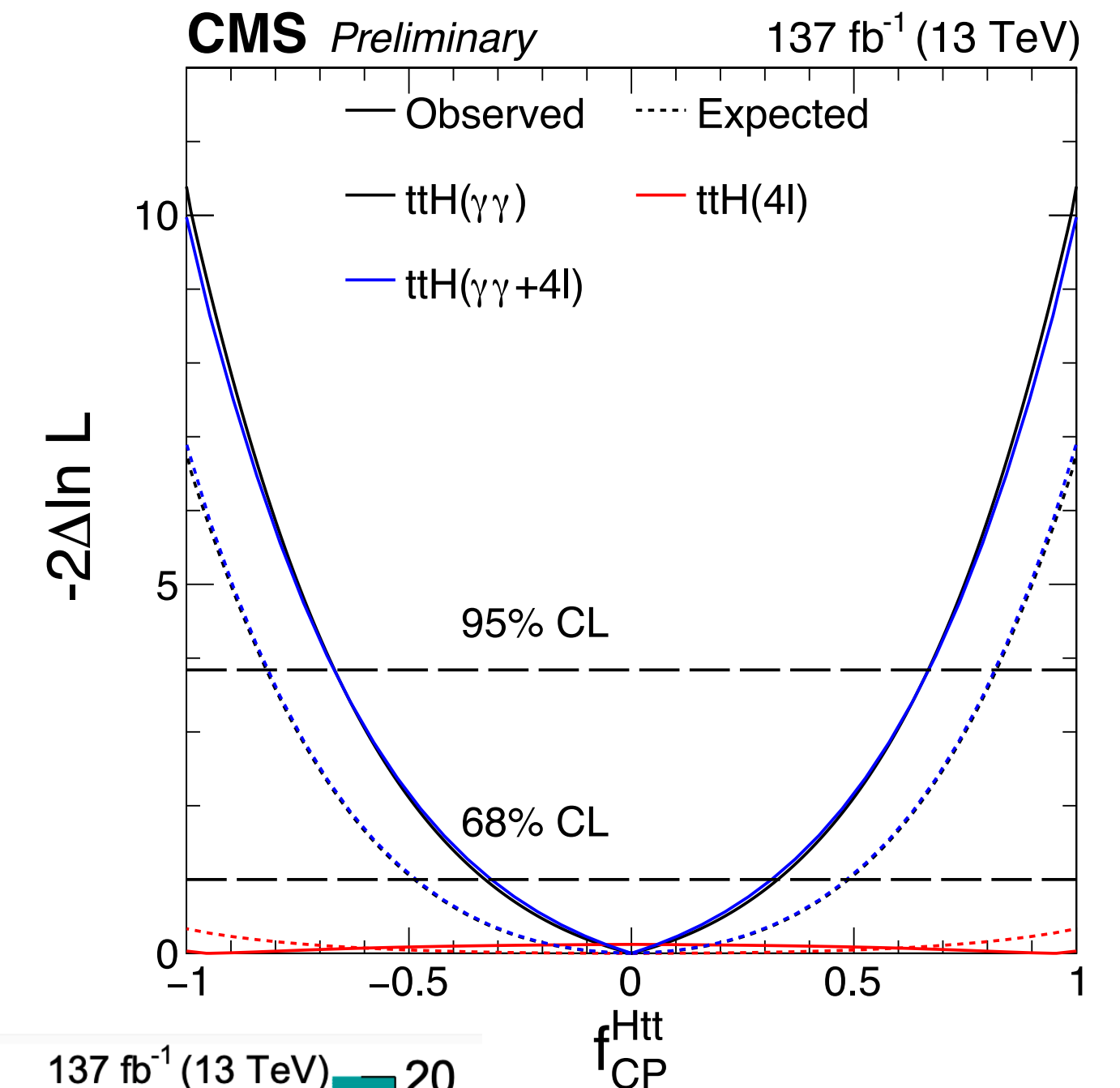
- We're interested in H-tt CP-even and CP-odd couplings κ and $\kappa\sim$
- Measure either $(\kappa, \kappa\sim)$ or (μ, f_{CP})

- $\mu_{\text{ttH}} \propto \sqrt{(\kappa^2 + \kappa\sim^2)}, \quad f_{\text{CP}}^{\text{Hff}} = \frac{|\tilde{\kappa}_f|^2}{|\kappa_f|^2 + |\tilde{\kappa}_f|^2} \text{sign} \left(\frac{\tilde{\kappa}_f}{\kappa_f} \right)$

- f_{CP} scan result presented
 - D0-: separate κ and κ_{\sim} terms, D_{CP} : extract the interference
 - ME or machine learning, in this paper BDT
 - D_{CP} requires flavor of tt decay particles, not possible in full hadronic and semi-leptonic, dropped in this analysis
 - μ_{ttH} is floated
 - tH is a function of κ and κ_{\sim} (SM HWW coupling), expressed with μ and f_{CP} as well
 - Other production modes like ggH is fixed to the SM
 - Very little impact to the result



- Both f_{CP} and $(\kappa \text{ vs } \kappa\sim)$ scan are presented
- $\mu_{ttH(4l)}$ and $\mu_{ttH(\gamma\gamma)}$ are floated independently
- tH is a function of κ and $\kappa\sim$, expressed with μ and f_{CP} as well
- Other production modes in 4l floated
- Other production modes in $\gamma\gamma$ fixed to SM



ttH+ggH(4l+γγ)

- Both f_{CP} and $(\kappa \text{ vs } \kappa\sim)$ scan are presented
 - ggH loop assumed to be only from κ and $\kappa\sim$
 - $\mu_{ttH}(4l)$ and $\mu_{ttH}(\gamma\gamma)$ are floated independently
 - tH is a function of κ and $\kappa\sim$, expressed with μ and $f_{CP} \varepsilon$ well
- Other production modes in 4l and $\gamma\gamma$ floated
 - $H\gamma\gamma$ loop expressed with κ and $\kappa\sim$, floated
 - $\kappa_b = \kappa_t$, floated in the H total width

