

Tales From The Loop



Simone Tentori
University: UCLouvain
Advisor: Fabio Maltoni
Favourite Color: #8806CE

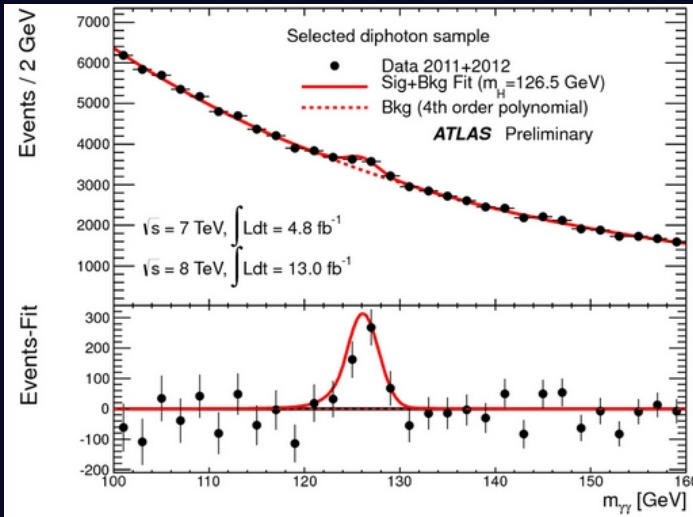
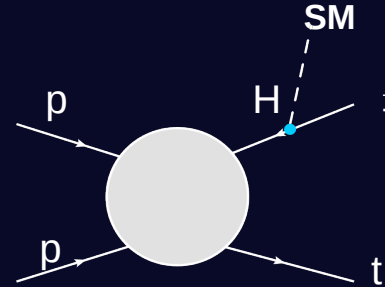
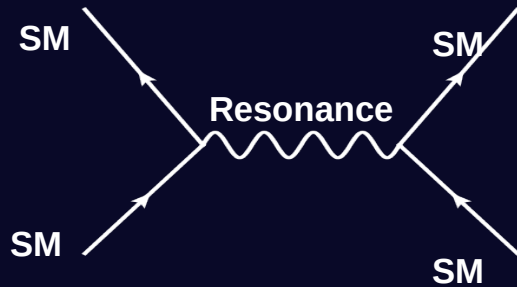


Cargese 2025

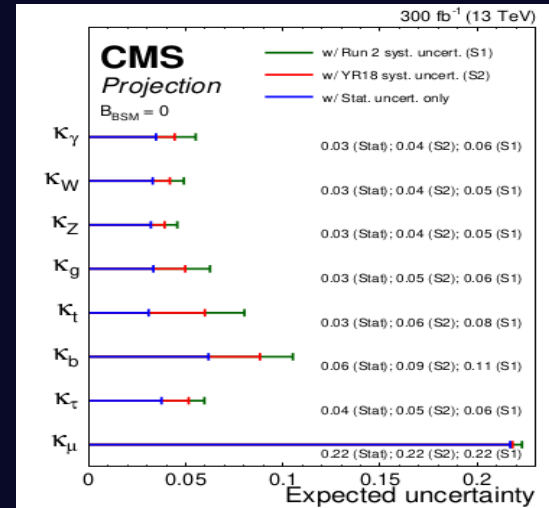
JHEP06(2024)077 [Top-philic ALP phenomenology at the LHC: the elusive mass-window]

JHEP09(2024)098 [Top-quark pair production as a probe of light top-philic scalars and anomalous Higgs interactions]

On-shell searches

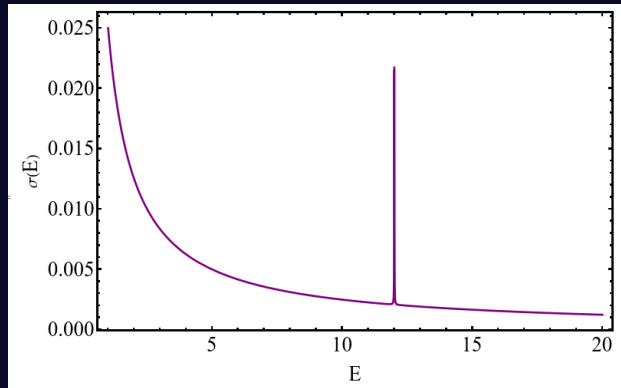


• Higgs discovery



• Yukawa measurements

On-shell searches

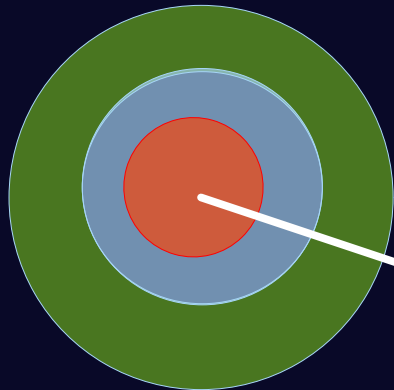


Very Narrow Width

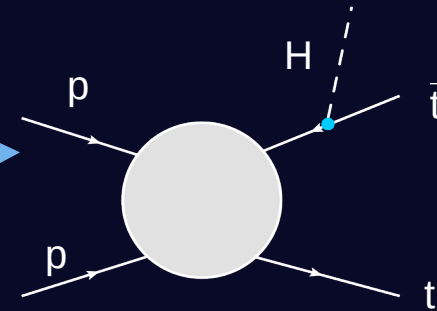
$$\frac{\sigma(i \rightarrow H \rightarrow f)}{\sigma(i \rightarrow H \rightarrow f)_{\text{SM}}} = \frac{\kappa_i^2 \kappa_f^2}{\kappa_H^2}$$

$$\kappa_H = \kappa_H(\kappa_{t,b,c,\tau,g,\gamma,W,Z}, \text{Br}_{\text{inv.}}, \text{Br}_{\text{und.}})$$

Problems

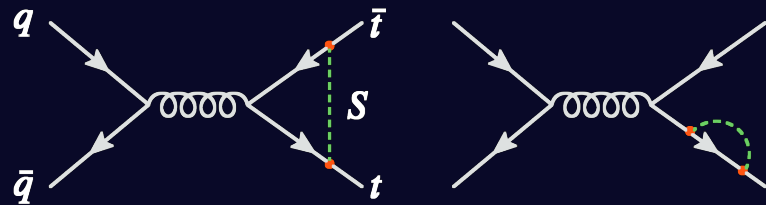
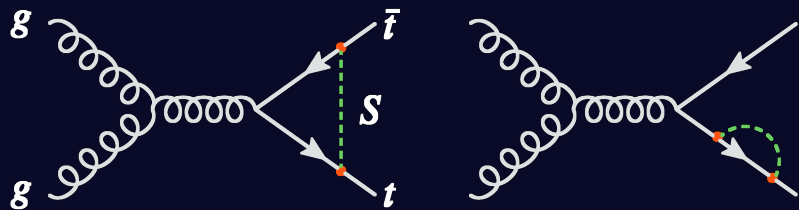
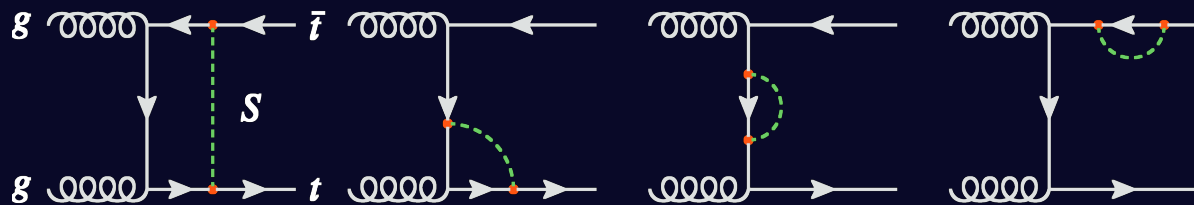
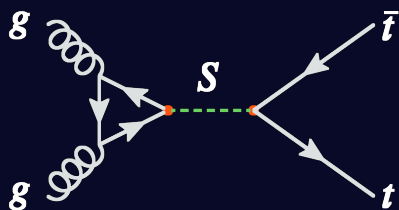


LLP Escaping Detection

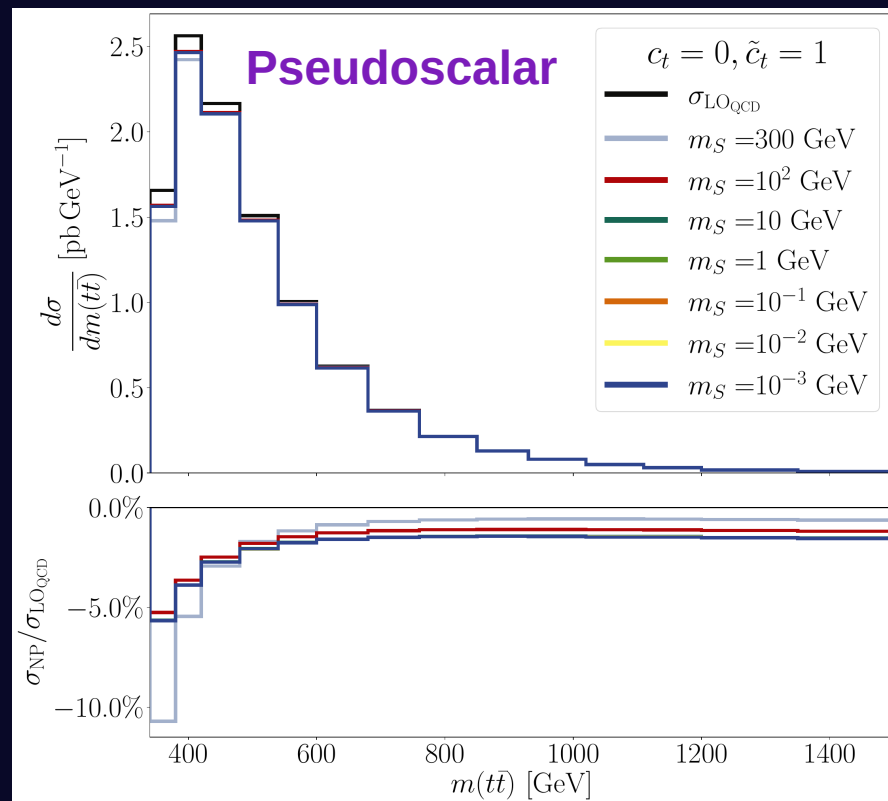
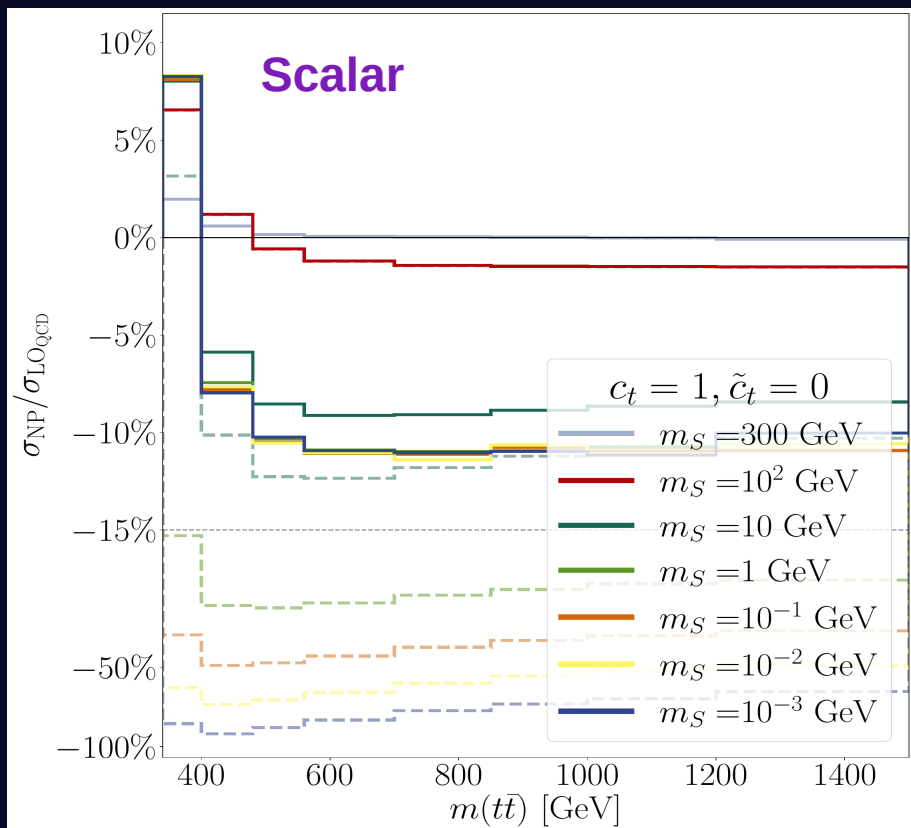


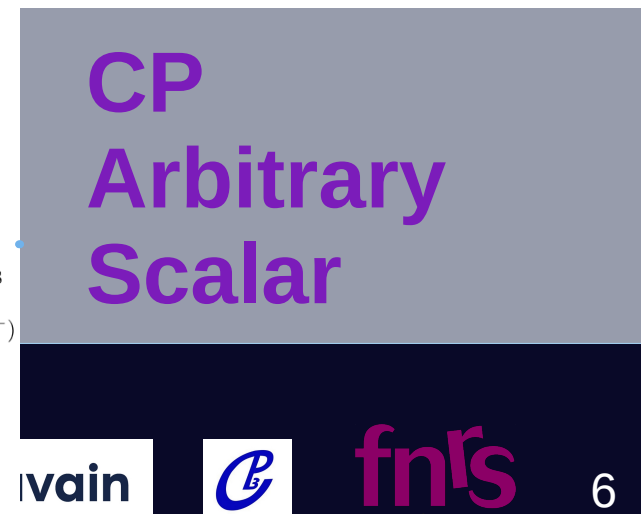
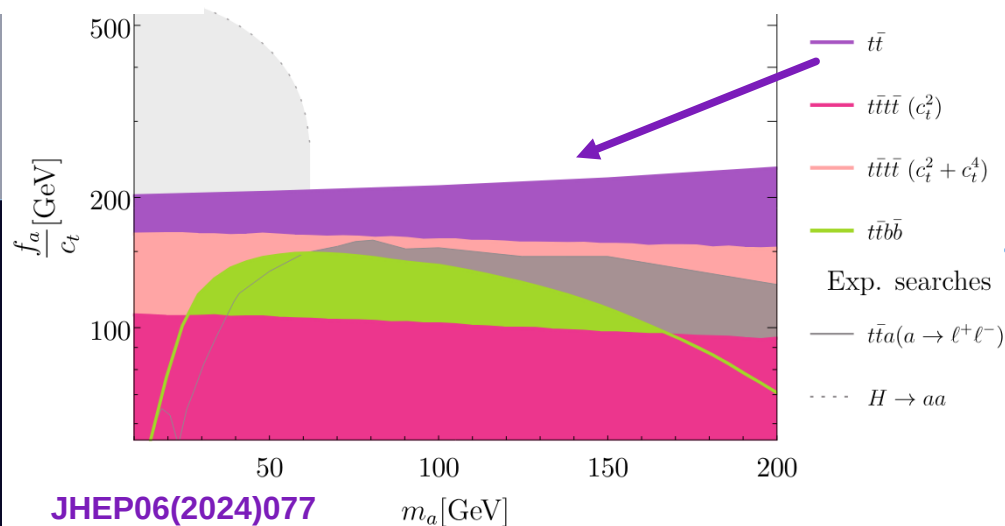
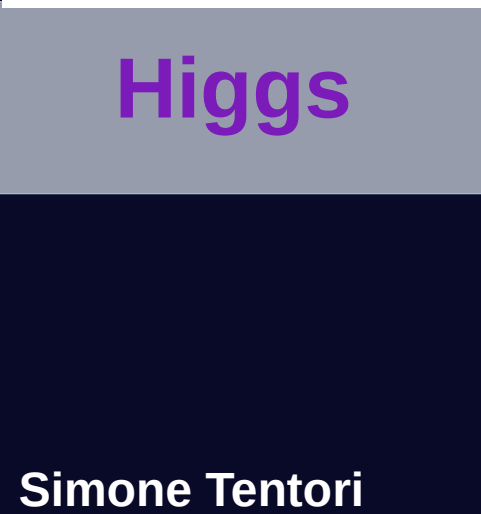
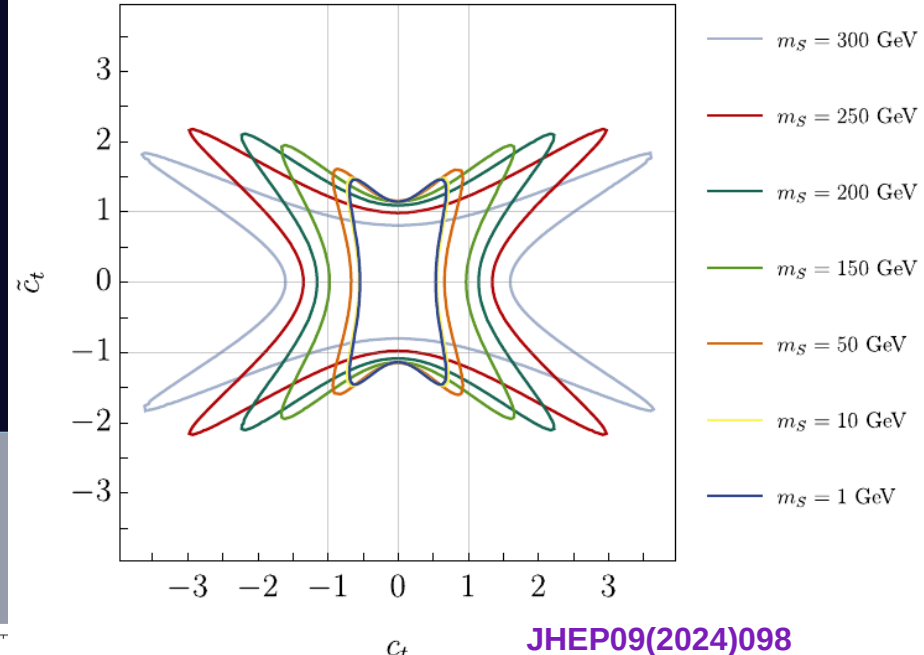
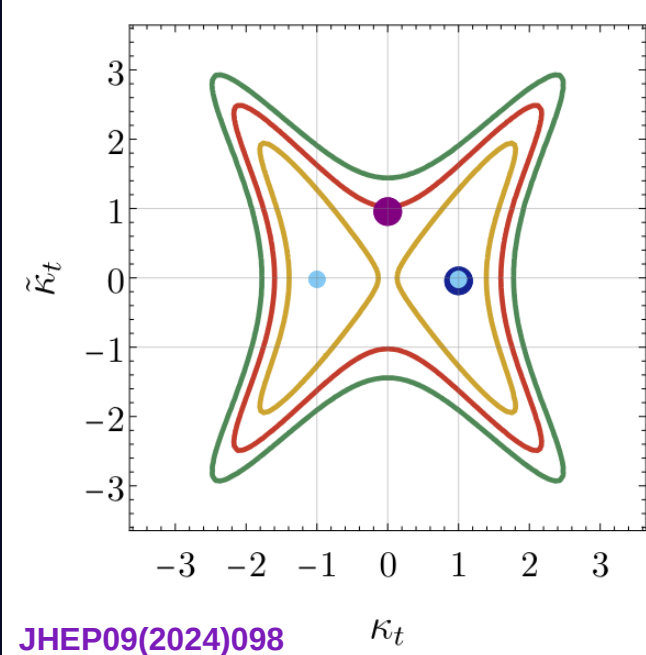
$E = 470 \text{ GeV} < E \text{ (FCCee)}$

Off-shell contributions



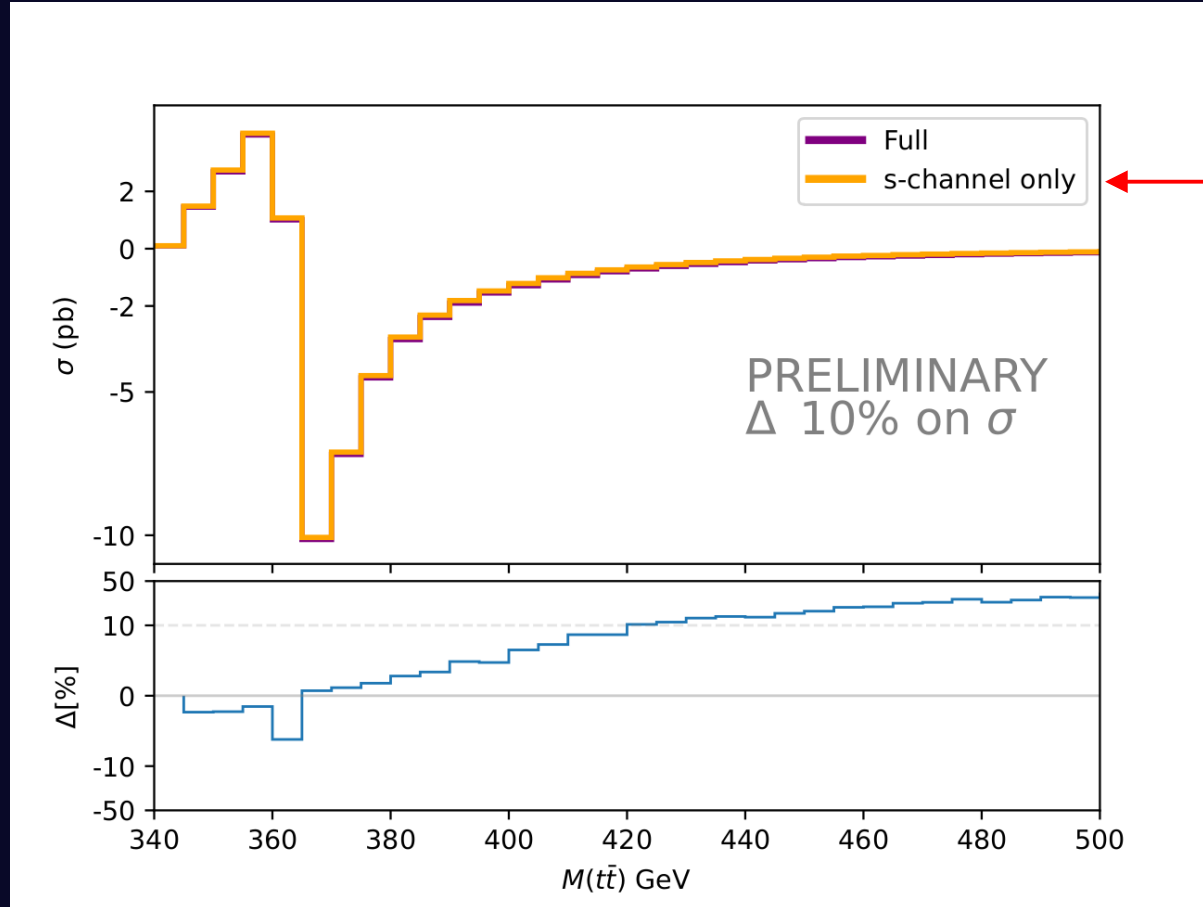
Off-shell contributions





BackUp

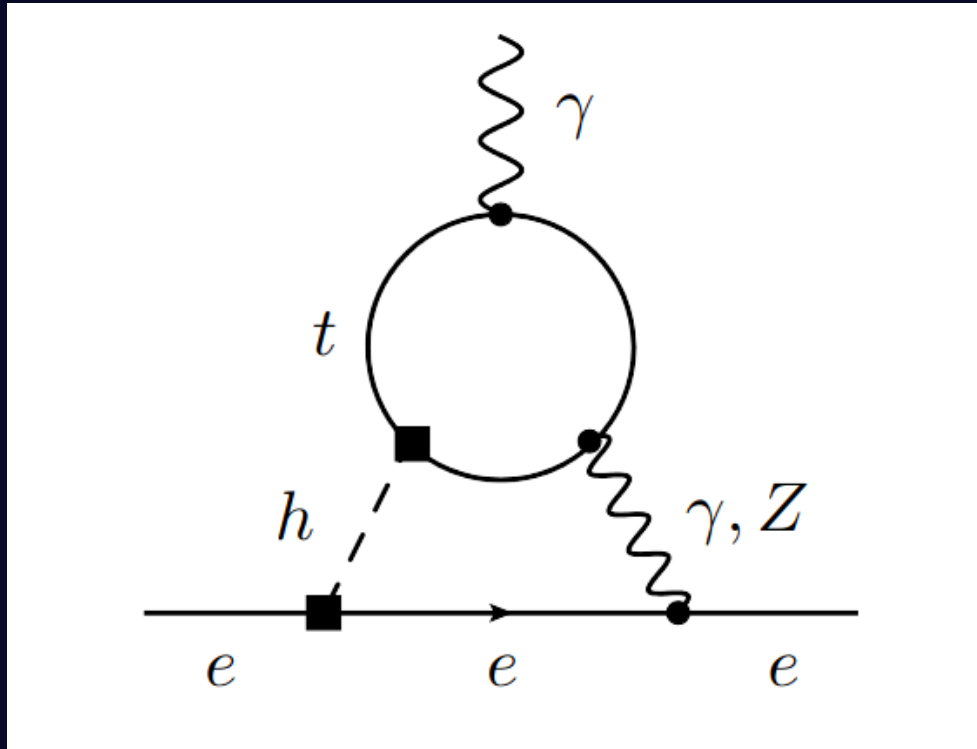
Pseudoscalar full virtual corrections



CMS PAS HIG-22-013

Full virtual corrections
could help disentangle
toponium VS pseudoscalar?

Indirect Searches: electron EDM



Brod, Haisch, Zupan: [1310.1385]

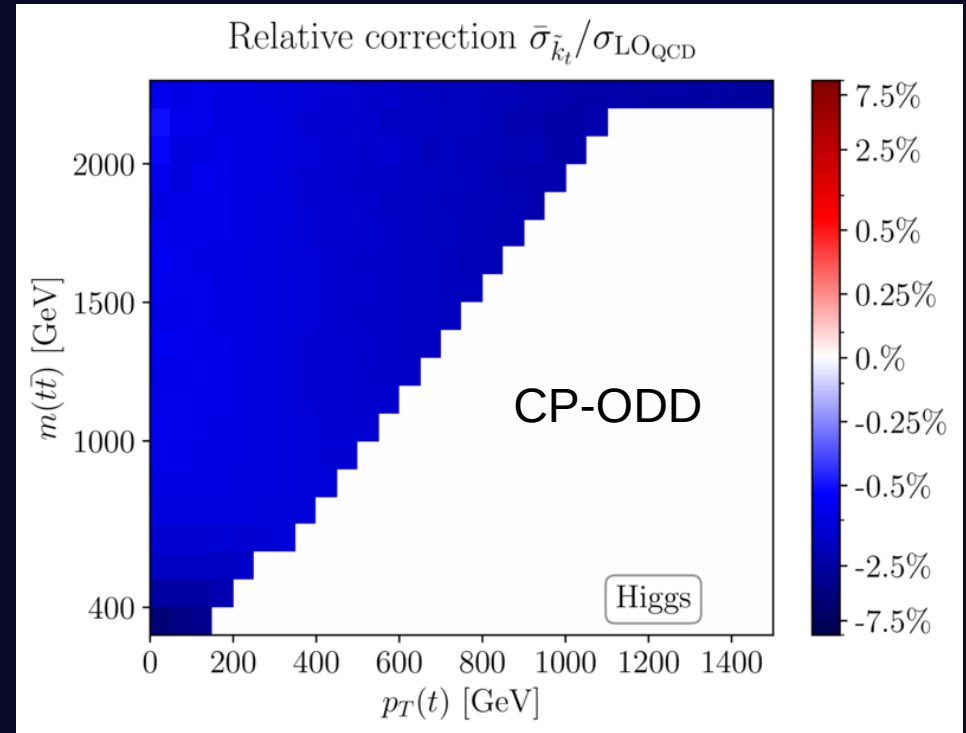
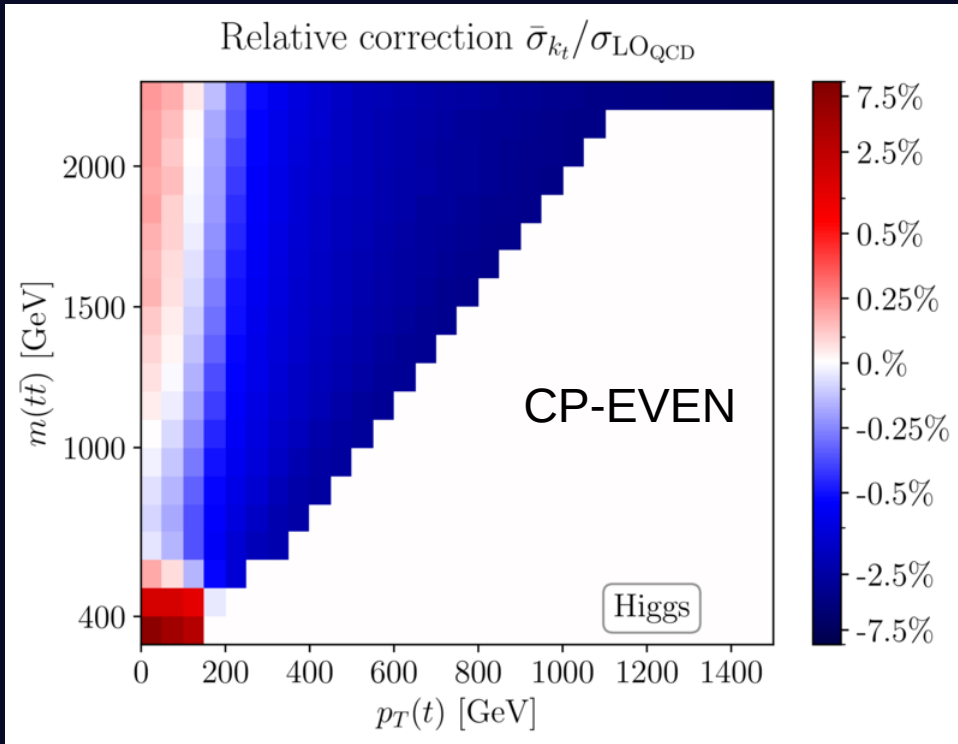
Extremely precise measurement:

- $|\tilde{k}_t| < 0.01$

Additional assumption:

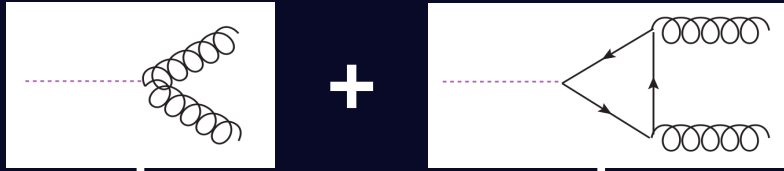
- Higgs couples to SM electron
- $|\tilde{k}_e| = 0, |k_e| = 1$
- Possible One Loop NP effects

Double differential



TOP-ALP vs Pseudoscalar

$$a \rightarrow gg(\gamma\gamma)$$



+

$$\Gamma \propto [1 + 2m_t^2 C(p, q, m_t)]^2$$

Only contact
interaction

Only Pseudoscalar

$2m_t > m_a$

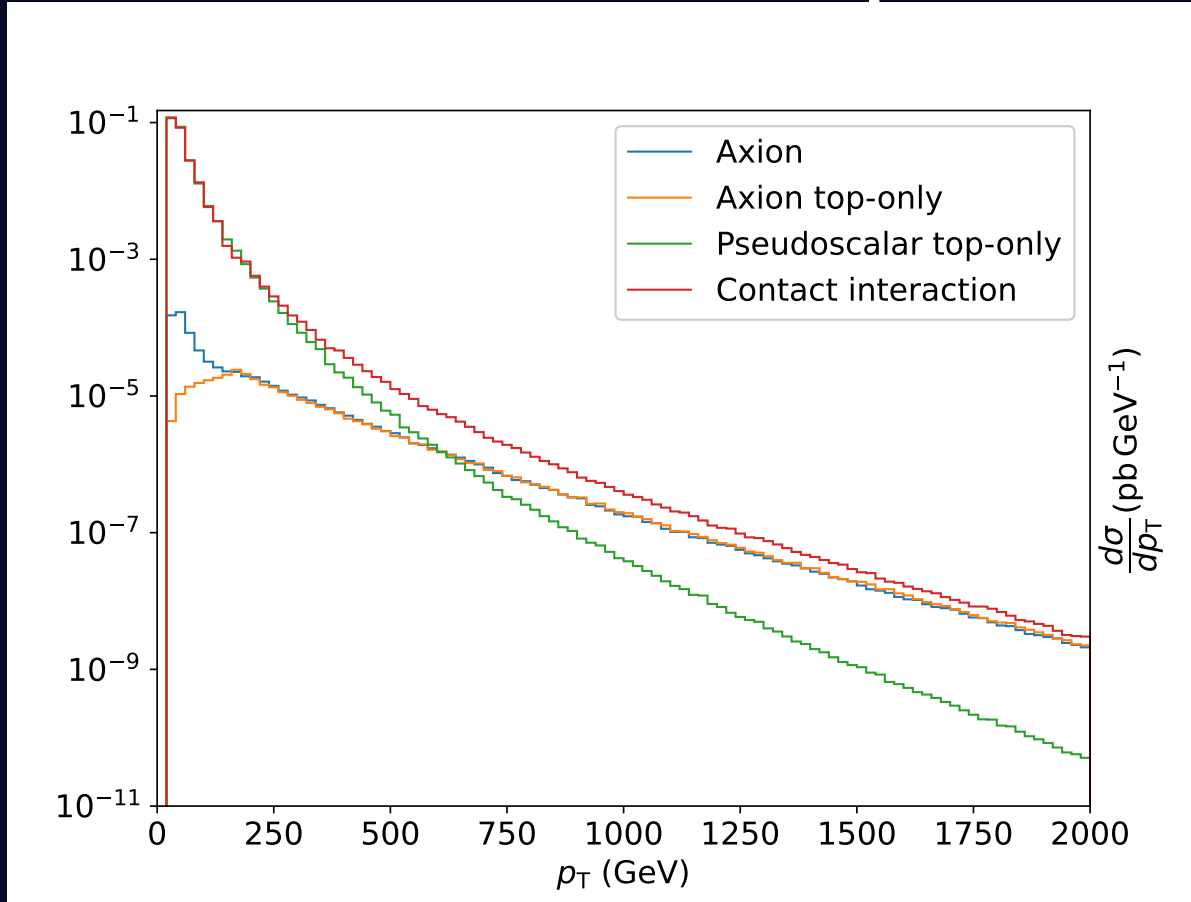
$$\Gamma \propto \left[1 + 2m_t^2 \left(-\frac{1}{2m_t^2} - \frac{m_a^2}{24m_t^4} \right) \right]^2$$

Cancellation between contact
interaction and pseudoscalar!

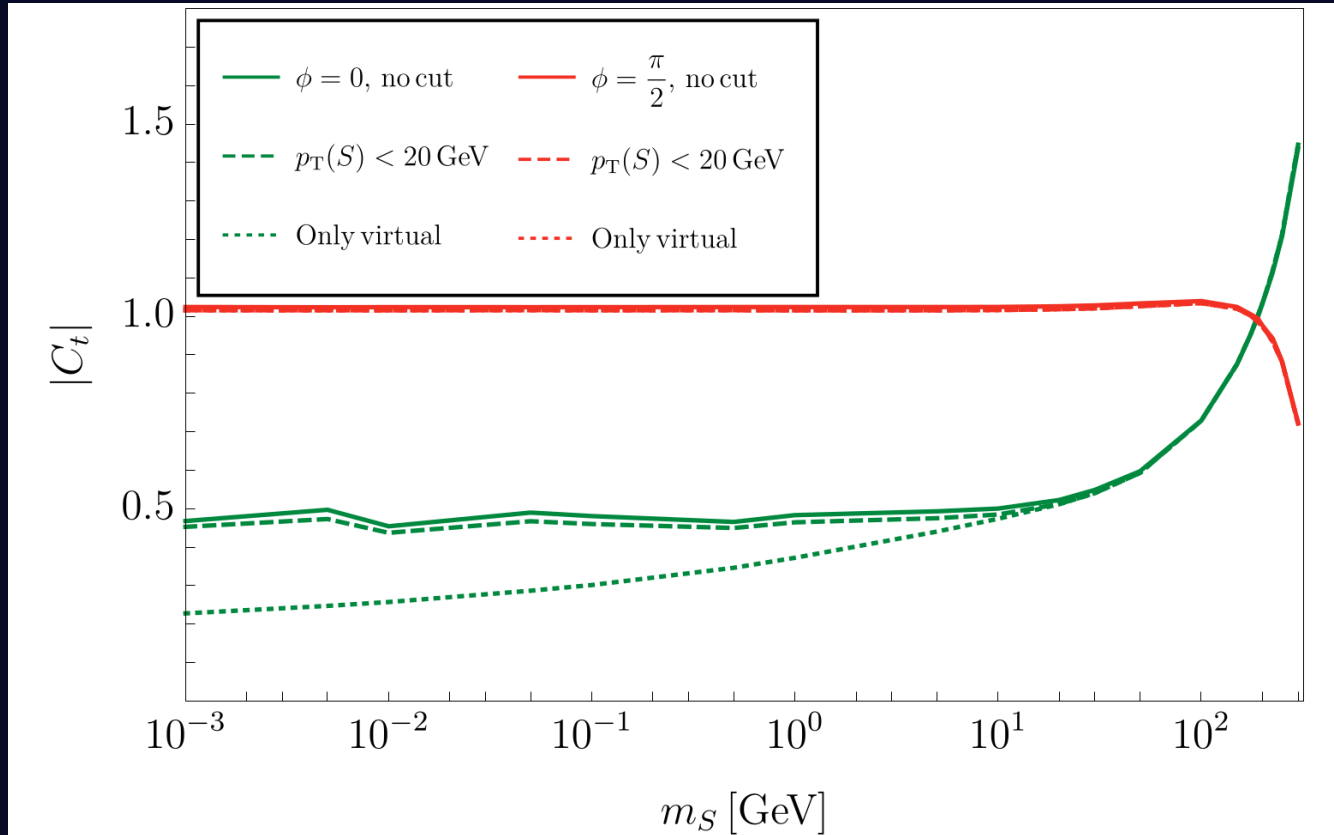
$$\Gamma \propto \frac{m_a^4}{144m_t^4}$$

Super-suppressed
w.r.t. single terms

ALP: PT Comparison



Transverse momentum sensitivity



$$|C_t| = \sqrt{c_t^2 + \tilde{c}_t^2}$$

$$\phi = \arctan \frac{\tilde{c}_t}{c_t}$$