

Higgs Portal

Higgs portal:
$$\mathcal{L} = \mathcal{L}_{SM} - \frac{1}{2}\partial_\mu\phi\partial^\mu\phi - \frac{1}{2}M^2\phi^2 - c_\phi|H|^2\phi^2$$
$$+ A_H\phi|H|^2 + \mu_\phi\phi + A_\phi\phi^3$$

Well-motivated extension of SM...

- Renormalizable coupling to hidden sectors
- Connections to Dark Matter, Hierarchy Problem, Matter-Antimatter Asymmetry

\mathbb{Z}_2 -symmetric case:

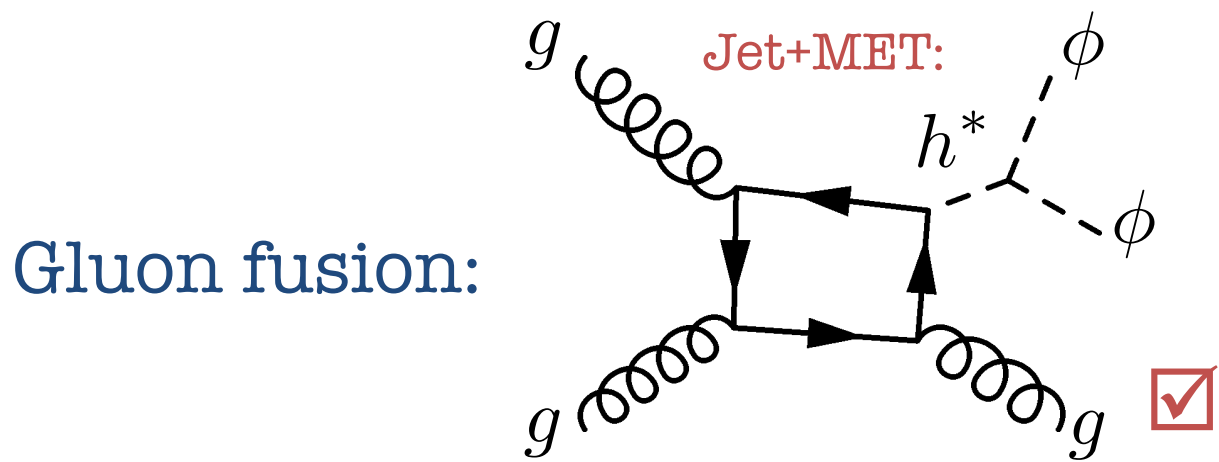
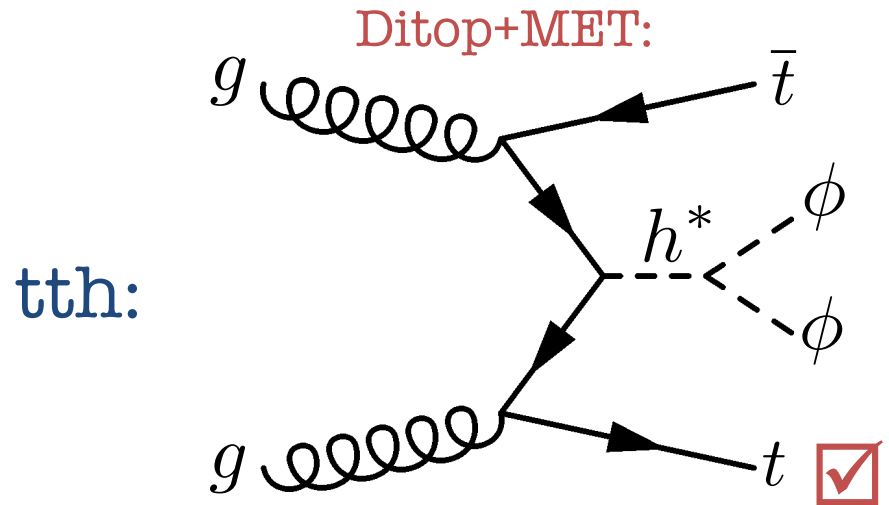
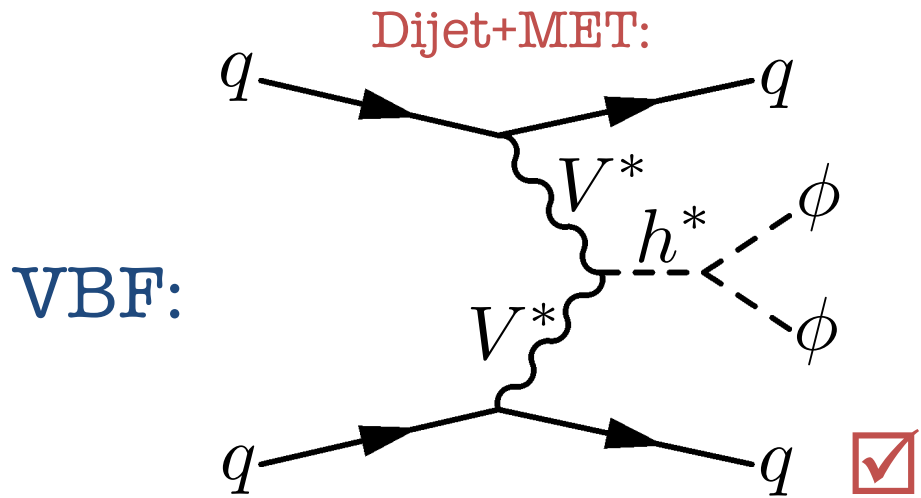
Usual limits on-shell: $h \rightarrow \phi\phi \Rightarrow \Gamma_{h \rightarrow \text{inv}} \neq 0$

Relevant if we have: $m_\phi < m_h/2 < 62 \text{ GeV}$

But this is a small portion of parameter space!

Higgs Portal

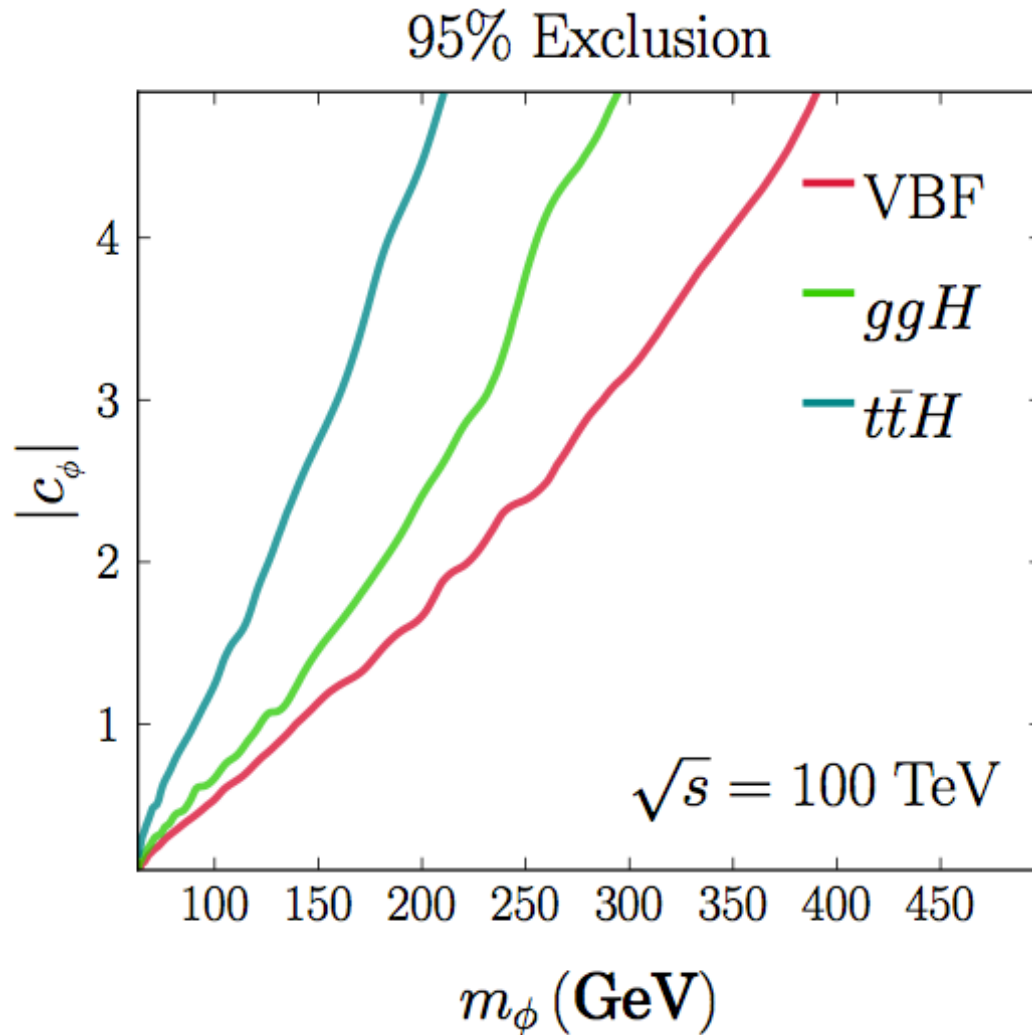
Want more coverage! For $m_\phi > m_h/2$ must go off-shell...



Note: Higgs EFT overestimates rate so full loop necessary.

Higgs Portal

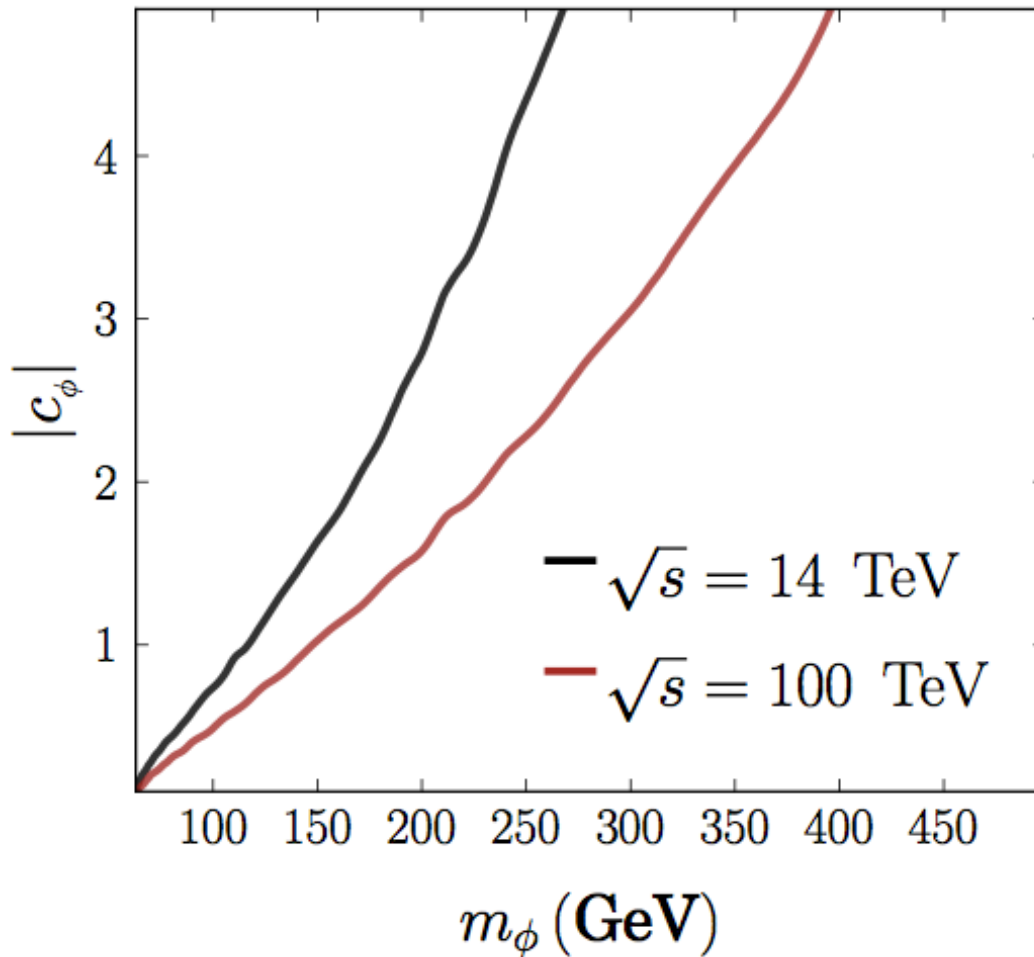
Different channels:



Higgs Portal

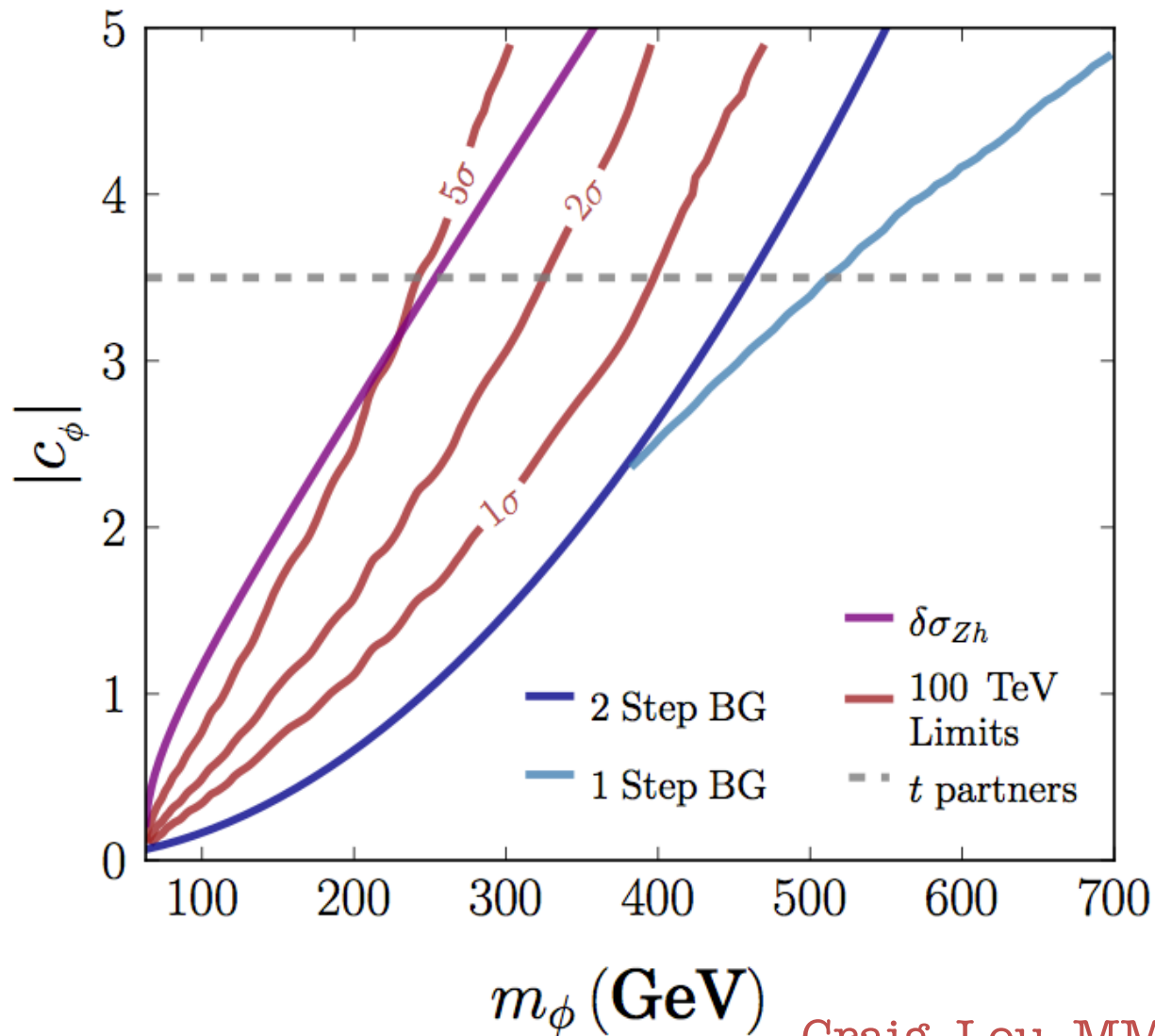
Different colliders:

95% Combined Exclusion



Higgs Portal

BSM Implications, Naturalness, Baryogenesis:



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BSM Implications, Dark Matter:

