Studying the Higgs-charm coupling with the CMS detector

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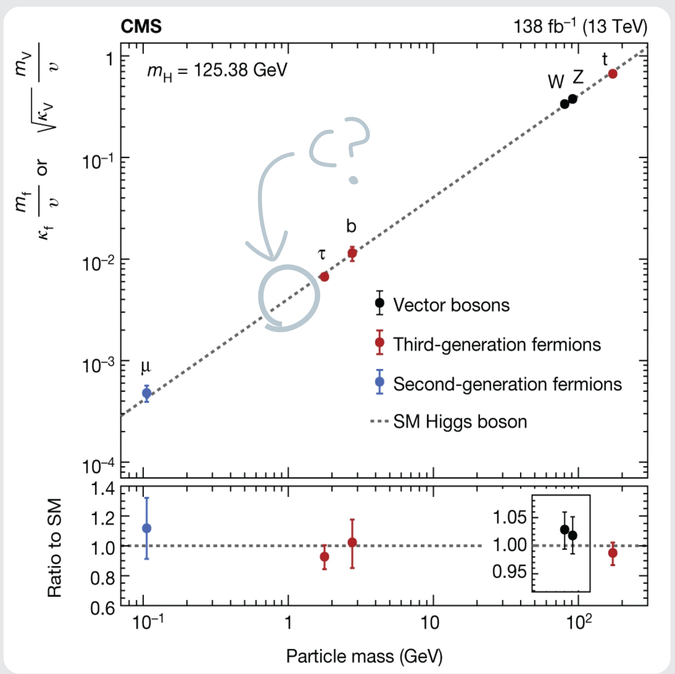
Why?

Investigate consistency of known charm-quark mass with SM Higgs-charm coupling strength κ_c!

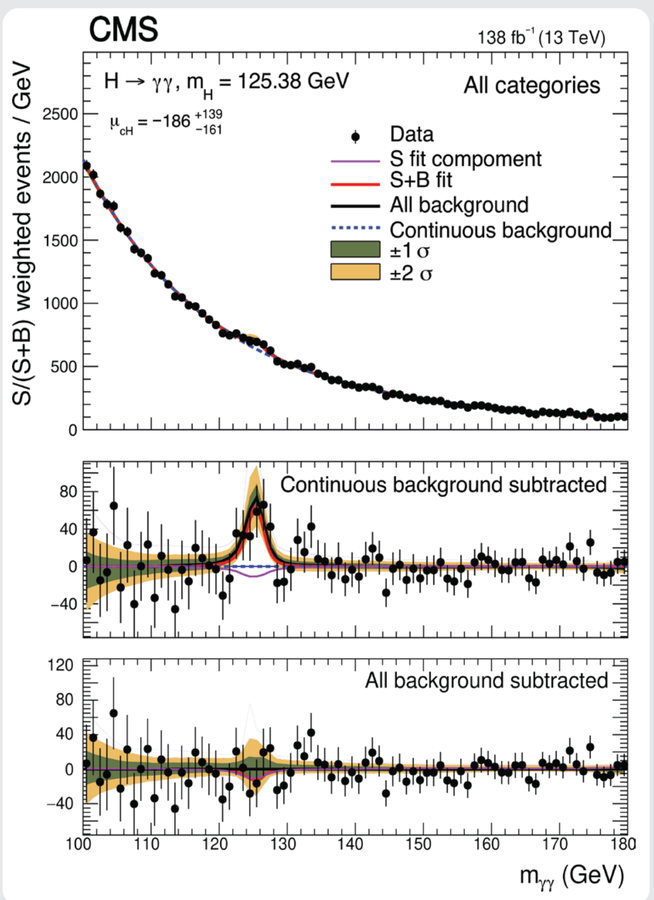
- Existing coupling strength κ_i measurements of other fermions remain consistent with SM
- Inconsistencies → new physics?



How?

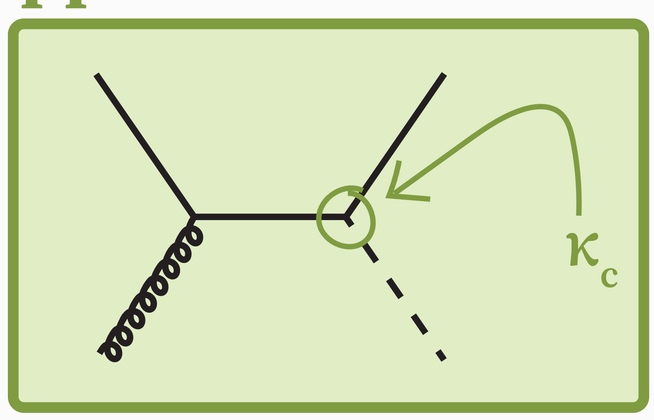
Signatures sensitive to κ_c are numerous and can be experimentally challenging
→ **many different final states** to target with many types of particles

Analysis & results



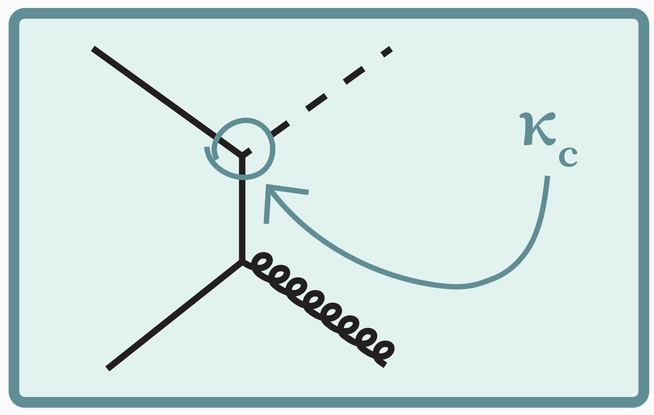
HIG-23-010

$pp \rightarrow H + c$



HIG-23-011

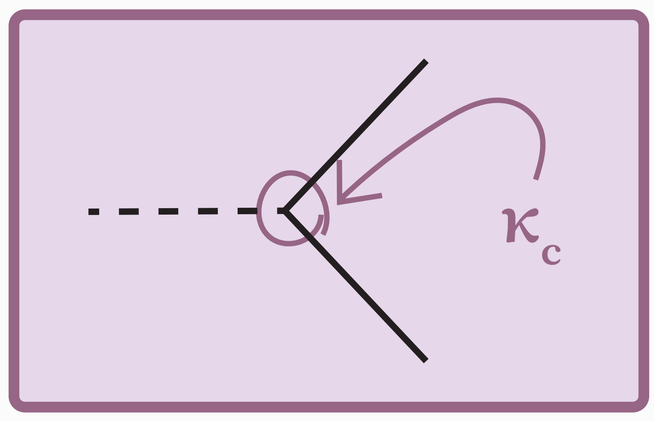
$pp \rightarrow H + X$



HIG-23-011

Sensitive to κ_c in production of Higgs

$pp \rightarrow XH(c\bar{c})$



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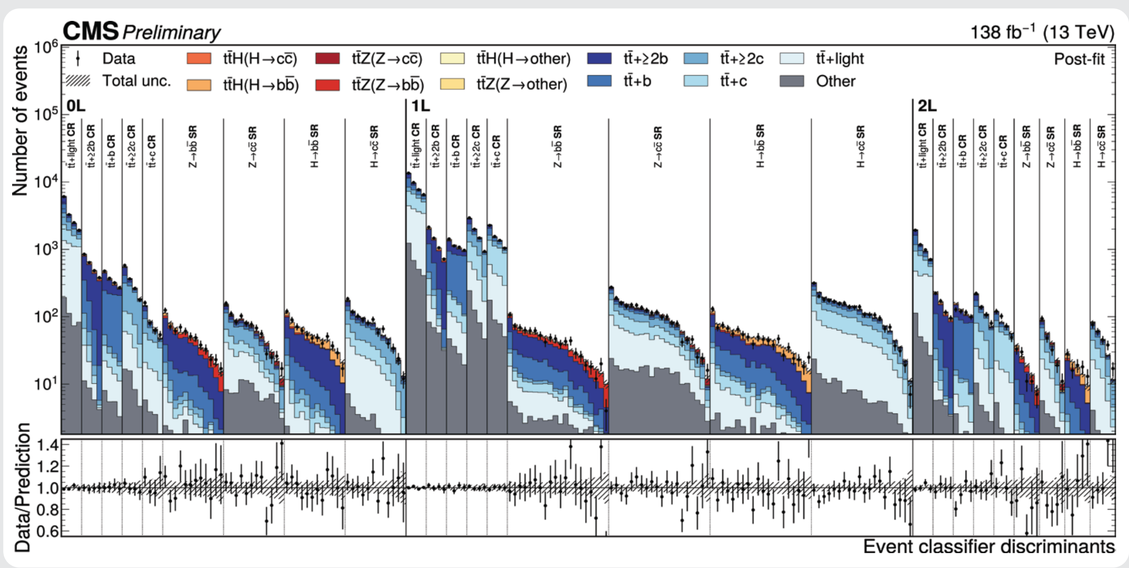
Sensitive to κ_c in decay of Higgs

- **Two-fold background rejection:**
  - reducible non-Higgs backgrounds
  - non-reducible Higgs backgrounds
- **Large degeneracy betwwen κ_b and κ_c.** Possible to measure both simultaneously or set $\kappa_b = 1$ to measure κ_c



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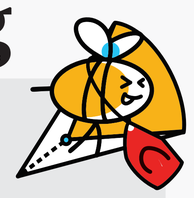
Flavour tagging



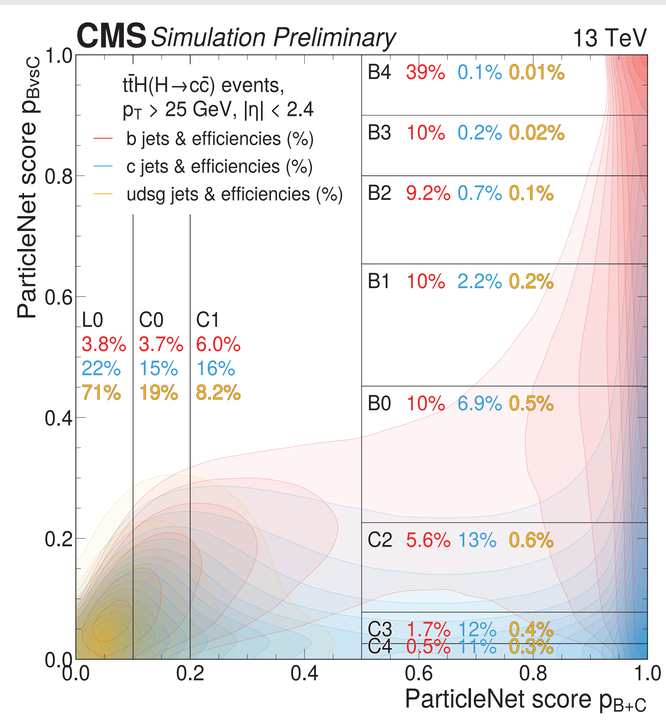
In signatures with final state c-quarks, we require flavour tagging algorithm(s) to **distinguish c-jets from other flavour jets**

Typically, c-tagging is a two pronged task:

- Discrimination of heavy flavour (b/c) vs light flavour (udsg) jets
- Discrimination between b and c-jets

Utilise **machine-learning** algorithms to perform multivariate jet-flavour discrimination task. Leverages information from:

- Secondary vertices
- Jet constituent particles
- Tracks



HIG 24-018

Strong constraints on κ_c at 95% CL!

H(γγ)+c	$\kappa_c < 31.8$
H(4ℓ)+X	$\kappa_c < 3.4$ $\kappa_c > -4.0$
$t\bar{t}H(c\bar{c})$ + VH(cc̄)	$\kappa_c < 3.5$

Measurement **uncertainties** driven by:

- Statistics
- Theory
- Jet flavour tagging