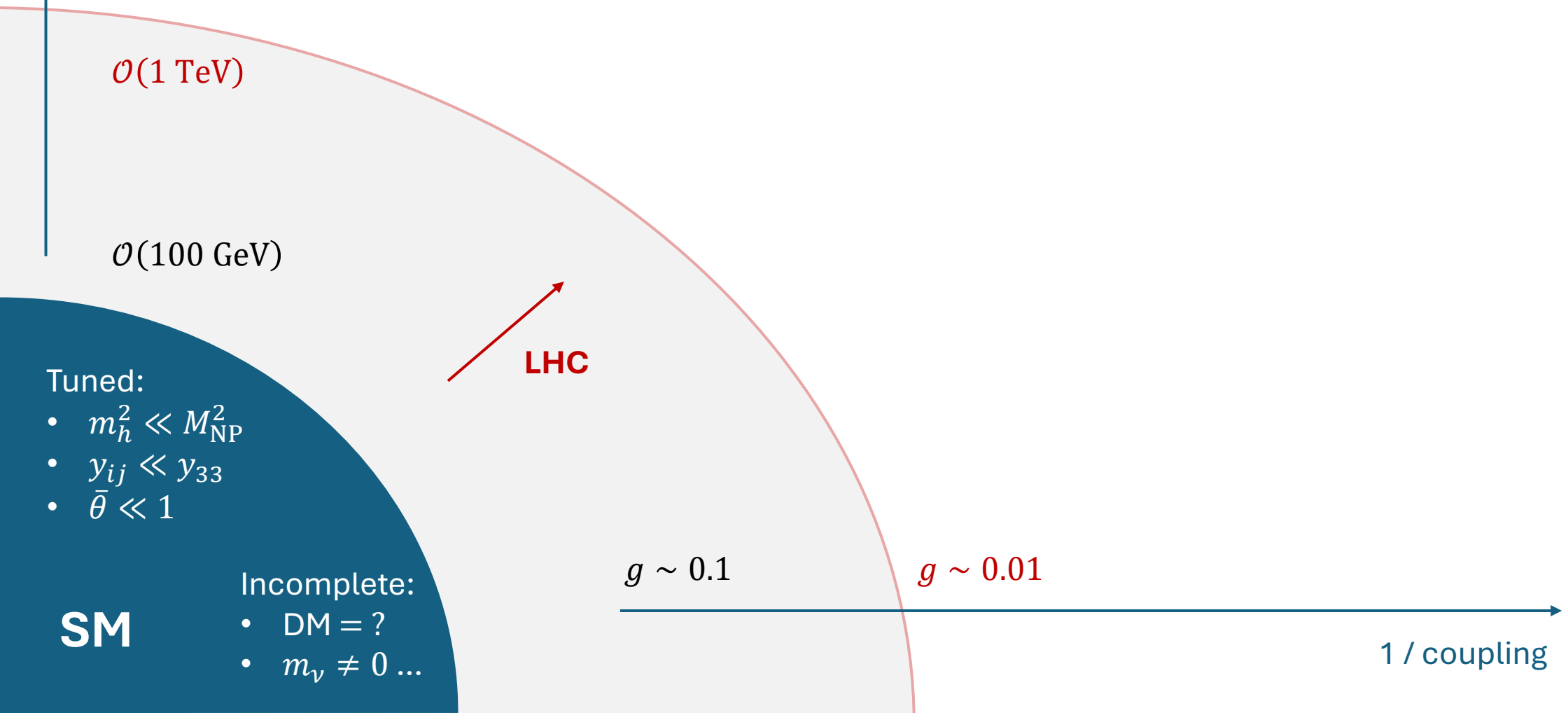
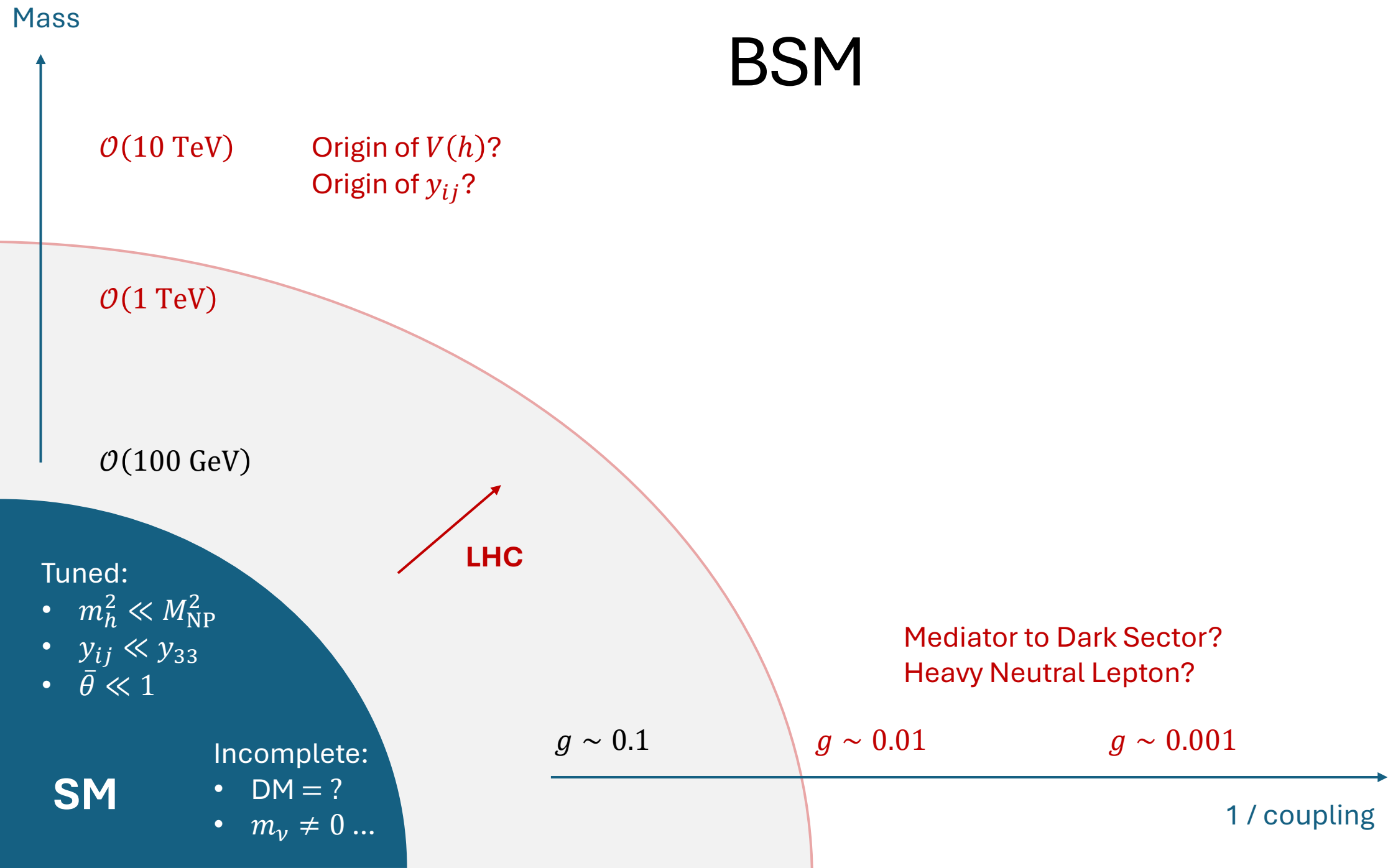


BSM / Flavour at FCC: Theory Intro

BSM



BSM

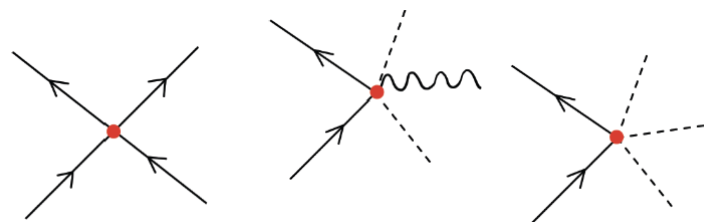


Mass

BSM @ FCC-ee

Indirect tests for heavy NP

- Models, SMEFT
- EW, Flavour, Higgs couplings



$\mathcal{O}(100 \text{ GeV})$

FCC

LHC

Tuned:

- $m_h^2 \ll M_{\text{NP}}^2$
- $y_{ij} \ll y_{33}$
- $\bar{\theta} \ll 1$

SM

Incomplete:

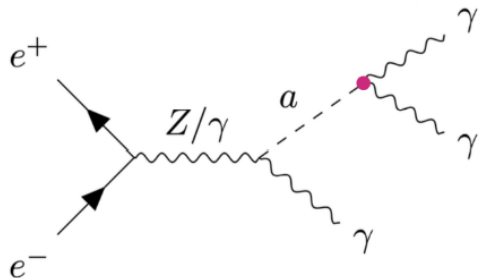
- $\text{DM} = ?$
- $m_\nu \neq 0 \dots$

$g \sim 0.1$

$g \sim 0.01$

Direct searches for light NP

- HNLs, ALPs, LLPs

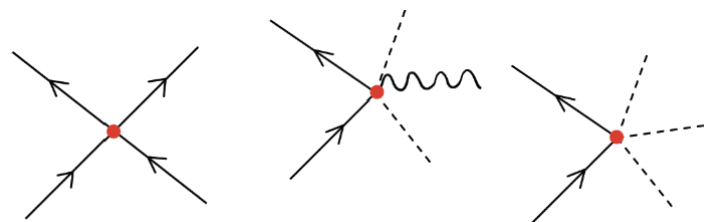


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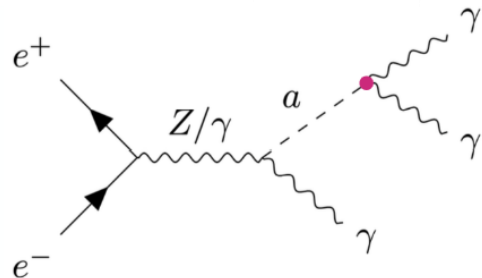
$g \sim 0.01$

Of course, not binary!

Example: light particles (LLPs) from SUSY e.g. with compressed spectrum

Direct searches for light NP

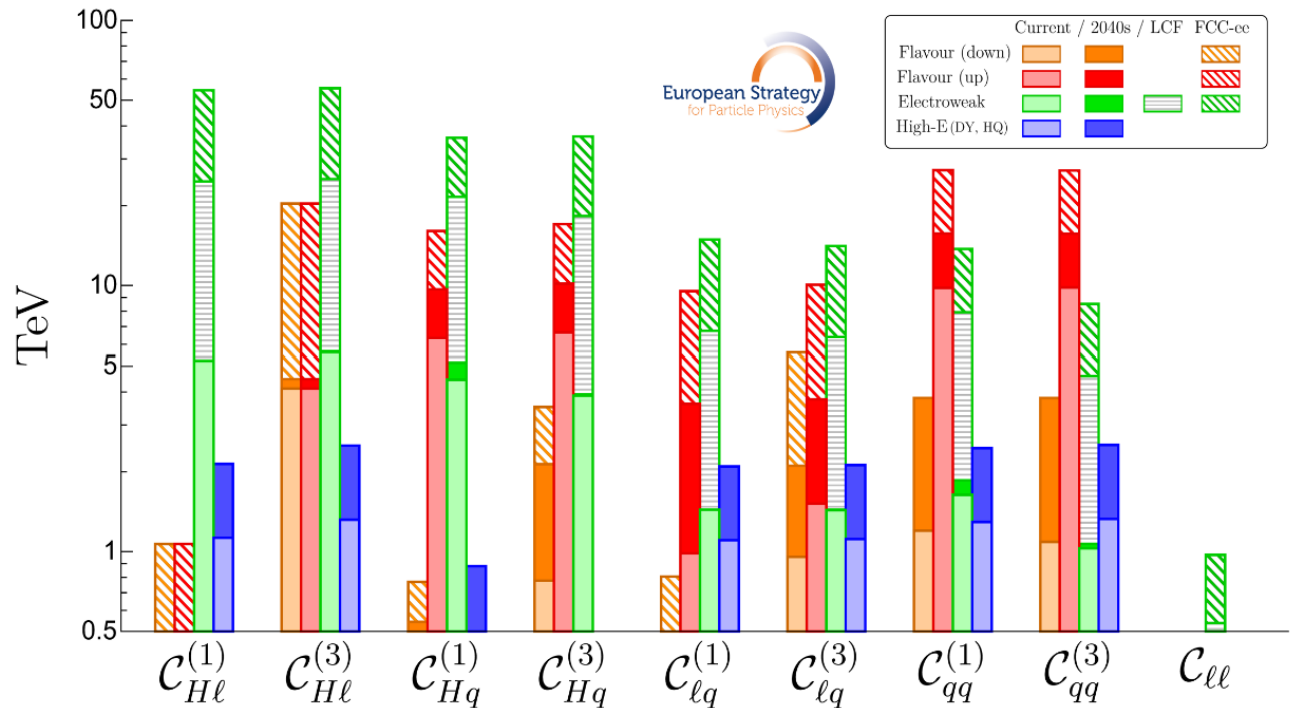
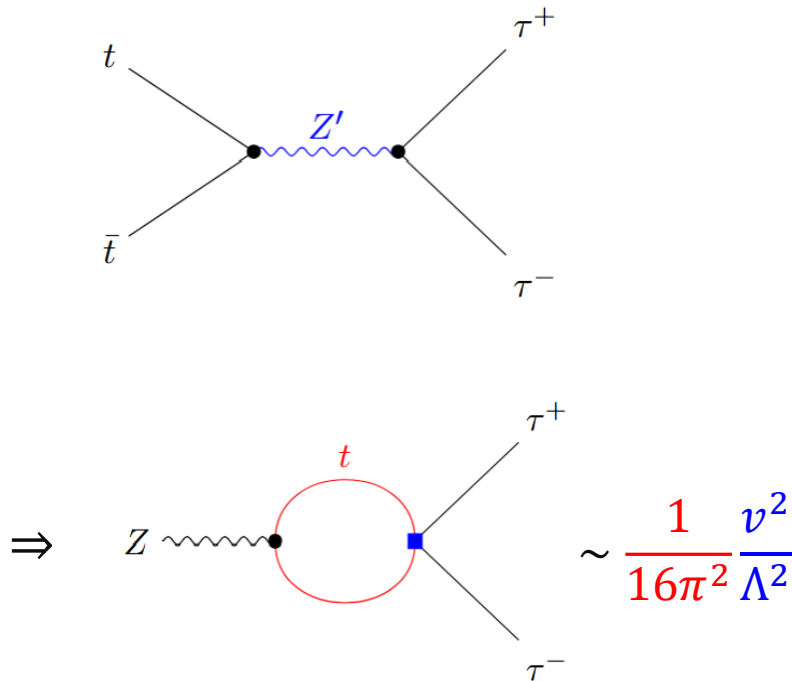
- HNLs, ALPs, LLPs



Indirect Exploration: EWPOs

Electroweak precision (Z pole + W mass +...)

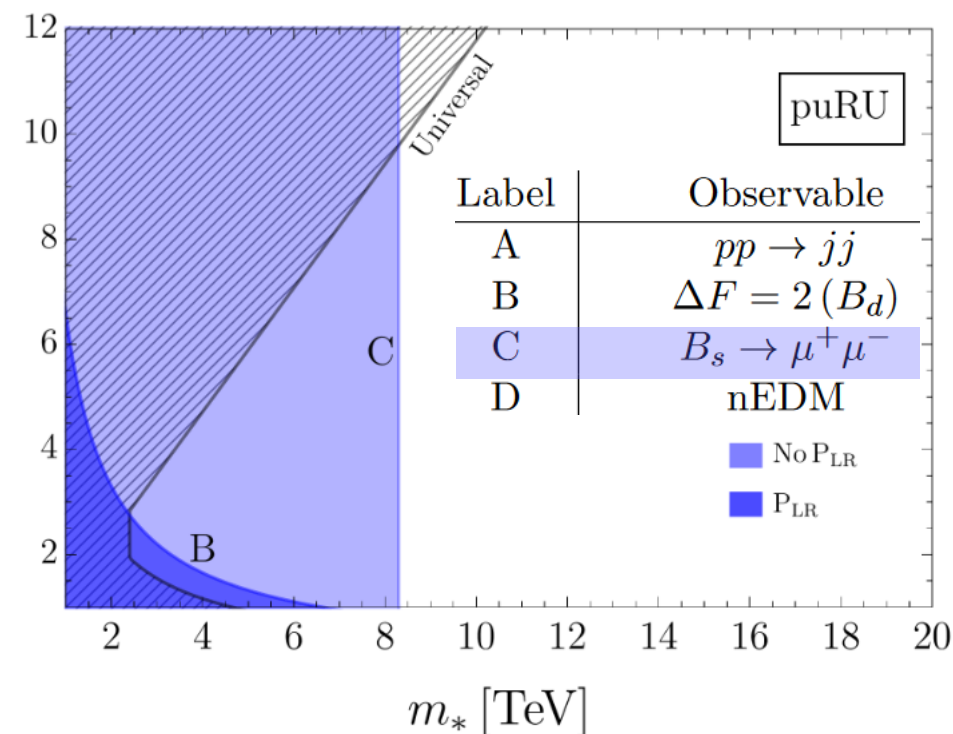
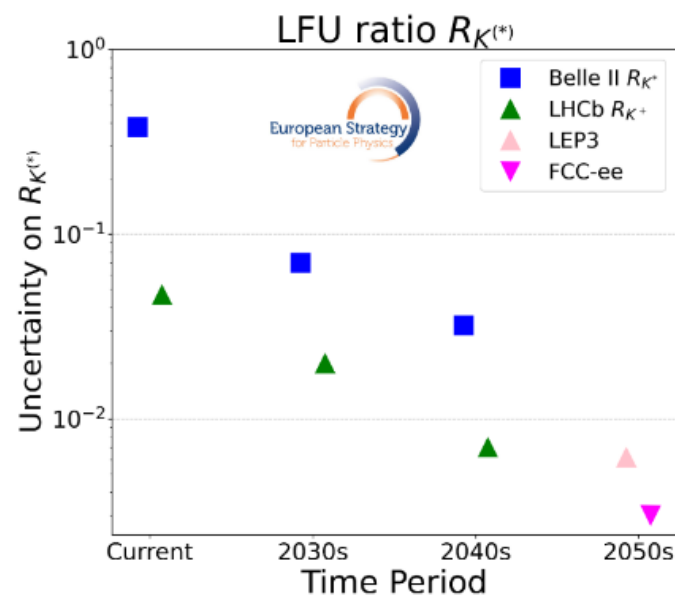
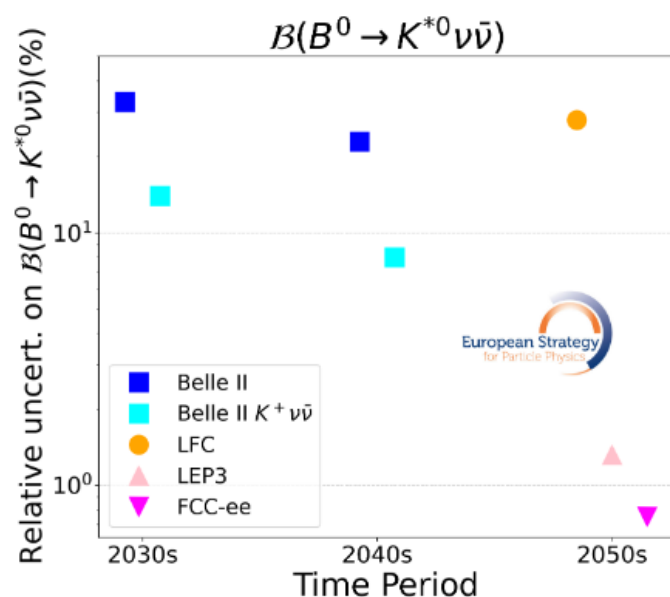
- $\delta O/O \lesssim 10^{-(3\div 4)} \Rightarrow$ broad sensitivity to **TeV, even if loop-suppressed**
- Extremely sensitive tests of solutions to hierarchy problem, flavour puzzle



Indirect Exploration: Flavour Factory

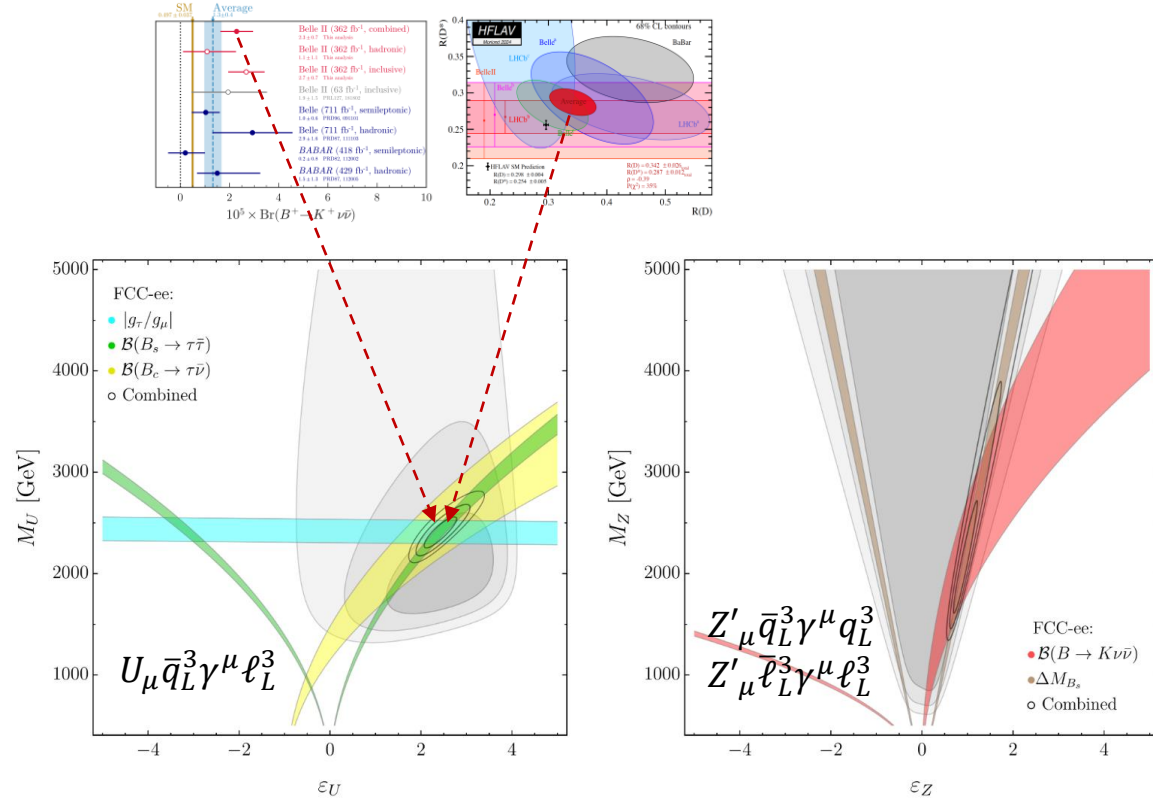
High Stats + Boost (w.r.t. B factory) + Clean environment (w.r.t. LHC)

- New frontiers e.g. **$b \rightarrow s\tau\tau$ transitions** (expect 10^3 improved sensitivity w.r.t. LHCb / Belle II)
- Not just tests for flavour models, but leading probes of e.g. composite Higgs!



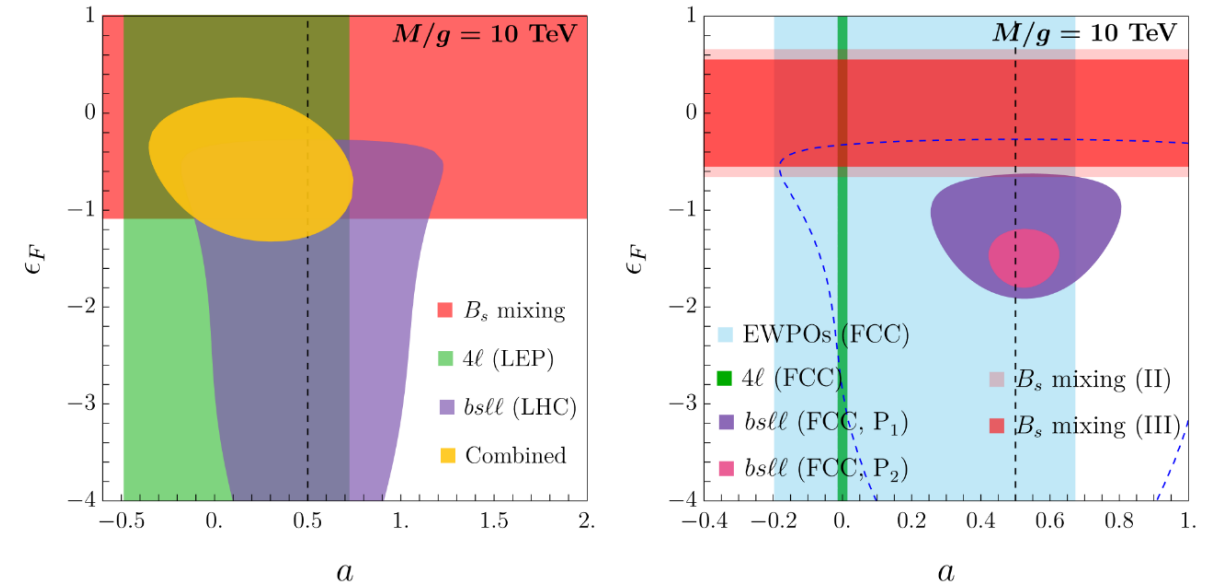
Any real BSM model predict correlations*

*between different indirect observables, but also possibly with direct searches



Flavour Model: deconstructed $SU(4)$

Allwicher, Isidori, Pesut, [2503.17019](#)

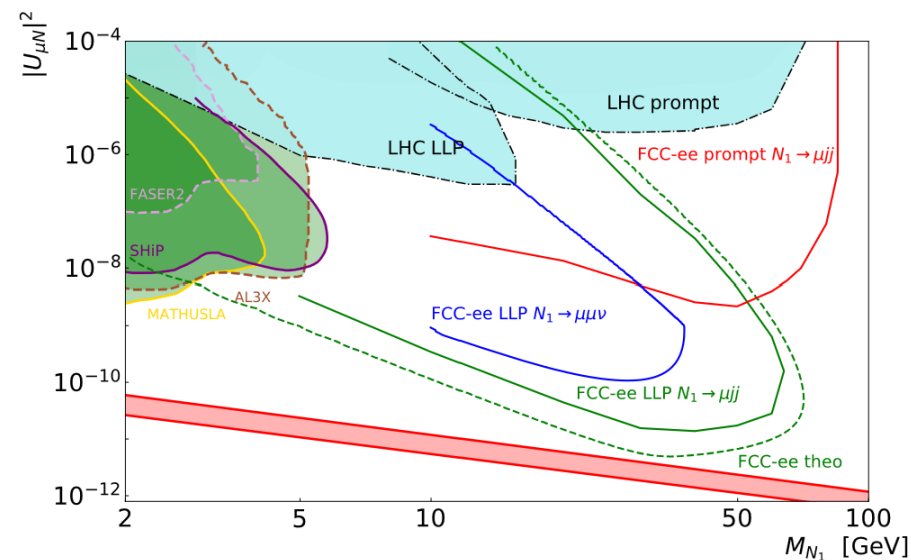
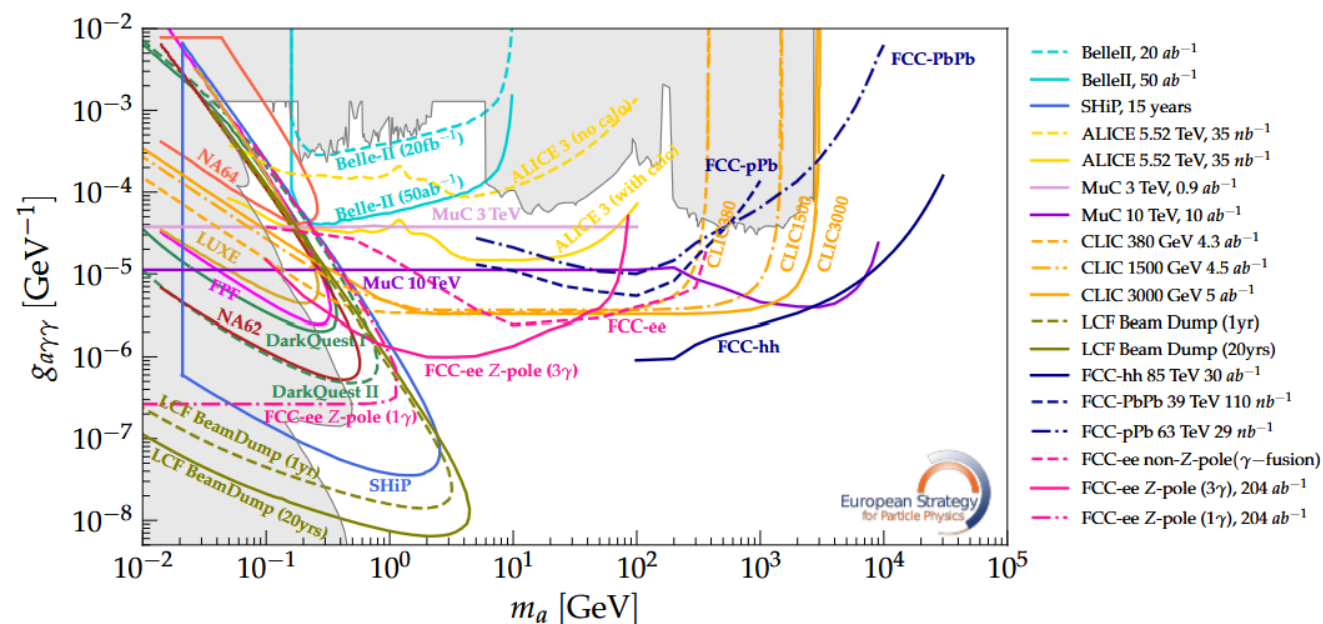


Z' Model: Gauged $B_3 - aL_1 - (1 - a)L_2$

Allanach, Mullin, [2306.08669](#); Bordone, Cornella, Davighi, [2503.22635](#)

Direct Exploration: Light Particles

- Axion Like Particles (ALPs)
- Heavy Neutral Leptons
- Dark Photons
- Dark Scalars (Higgs Portal)



Brainstorming

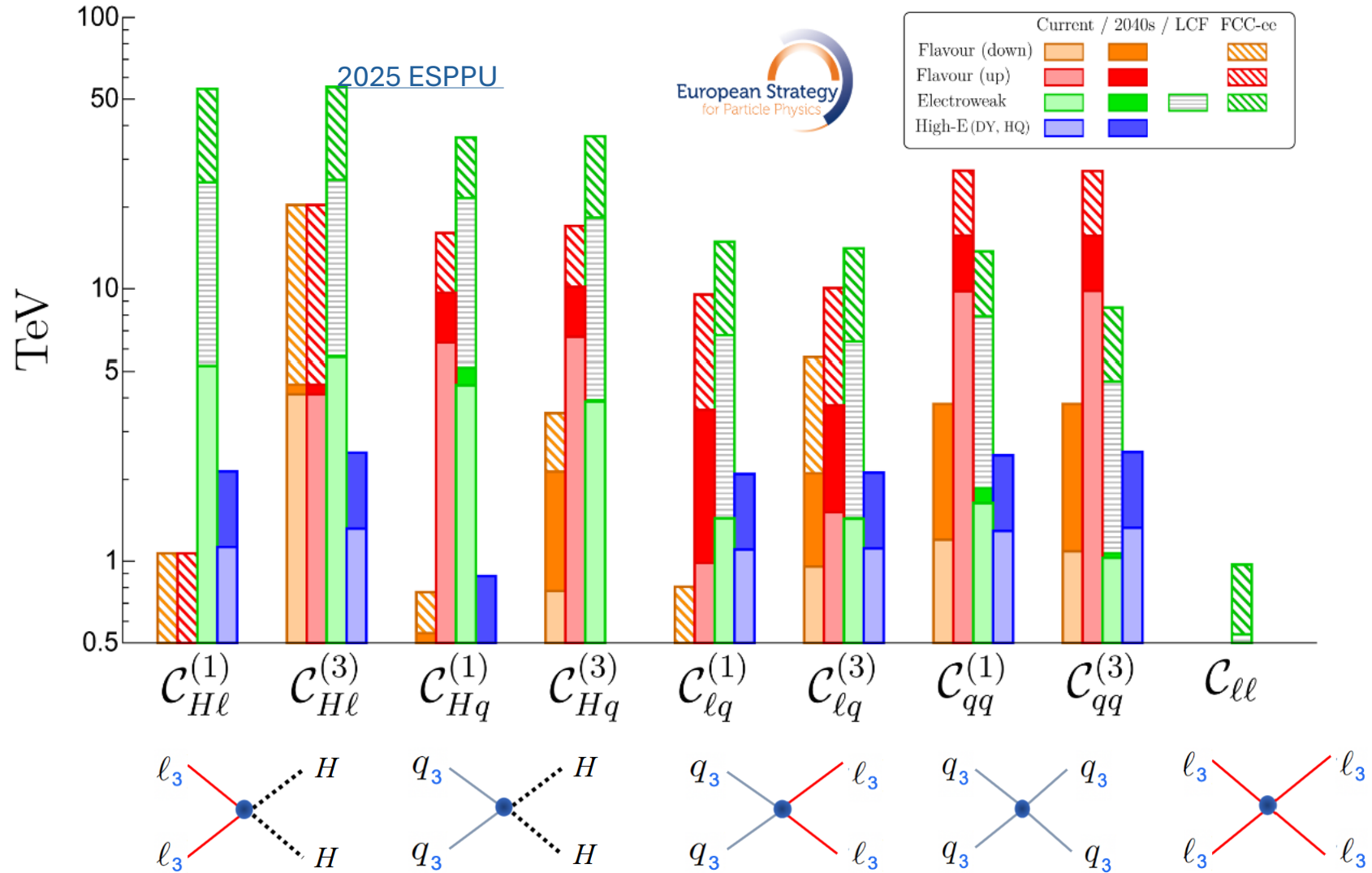
1. Light NP in B decays (Sophie Renner). E.g. Light DM with non-trivial flavour structure?
2. Light gauge bosons e.g. related to flavour puzzle – joint sensitivity from EWPO, flavour measurements, and direct searches?
3. Start from experimental possibilities: identify new flavour observables / processes e.g. $B_s \rightarrow n$ photons, new things with taus, soft b-jets.
 - Theorist asks: what are the interesting models?
4. New physics in $ee \rightarrow Zh, \bar{t}t$ runs? Underexplored (beyond SMEFT)
5. Broad study of new physics in $b \rightarrow see$ (JD, Marzia Bordone, Stephane Monteil)

Extra

Indirect Exploration: Effective Interactions

Example:

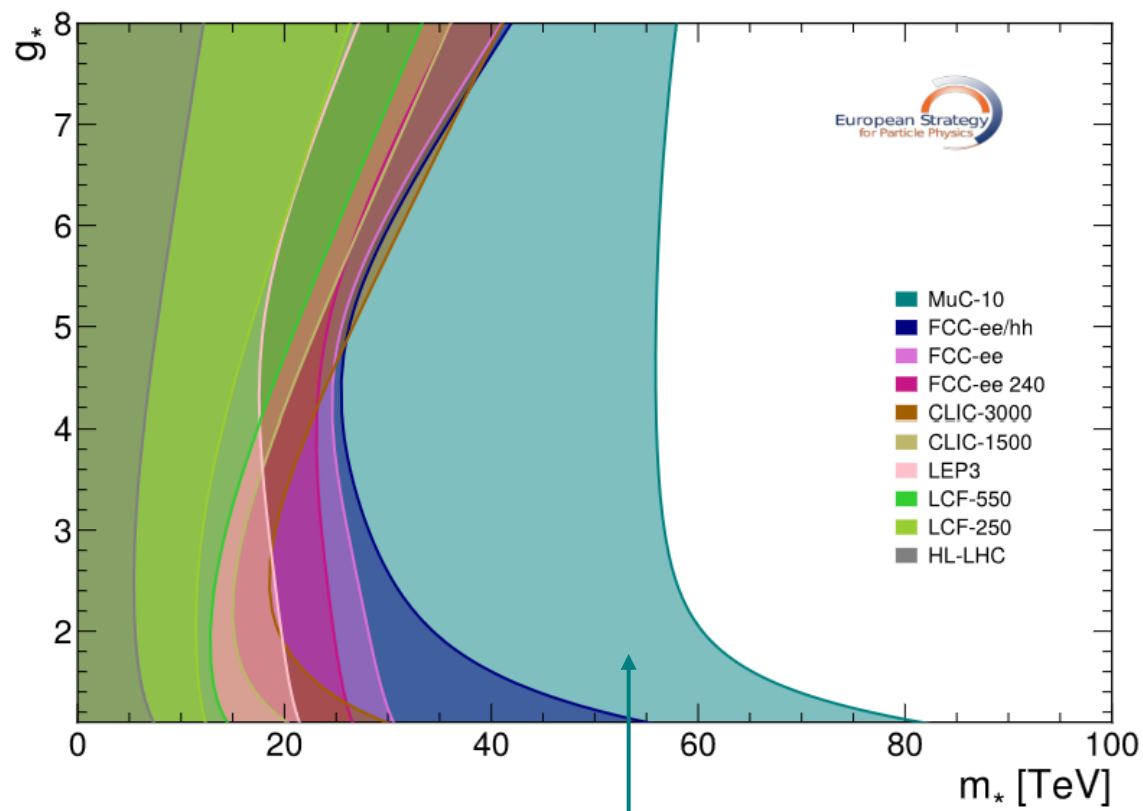
Tree-level NP
coupled only to
3rd generation



Indirect + Direct (at hh): Composite Higgs

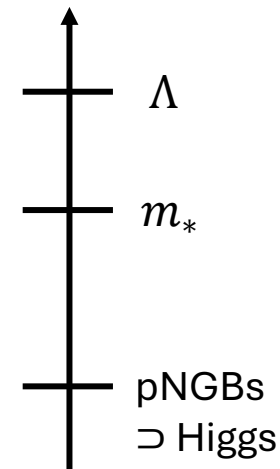
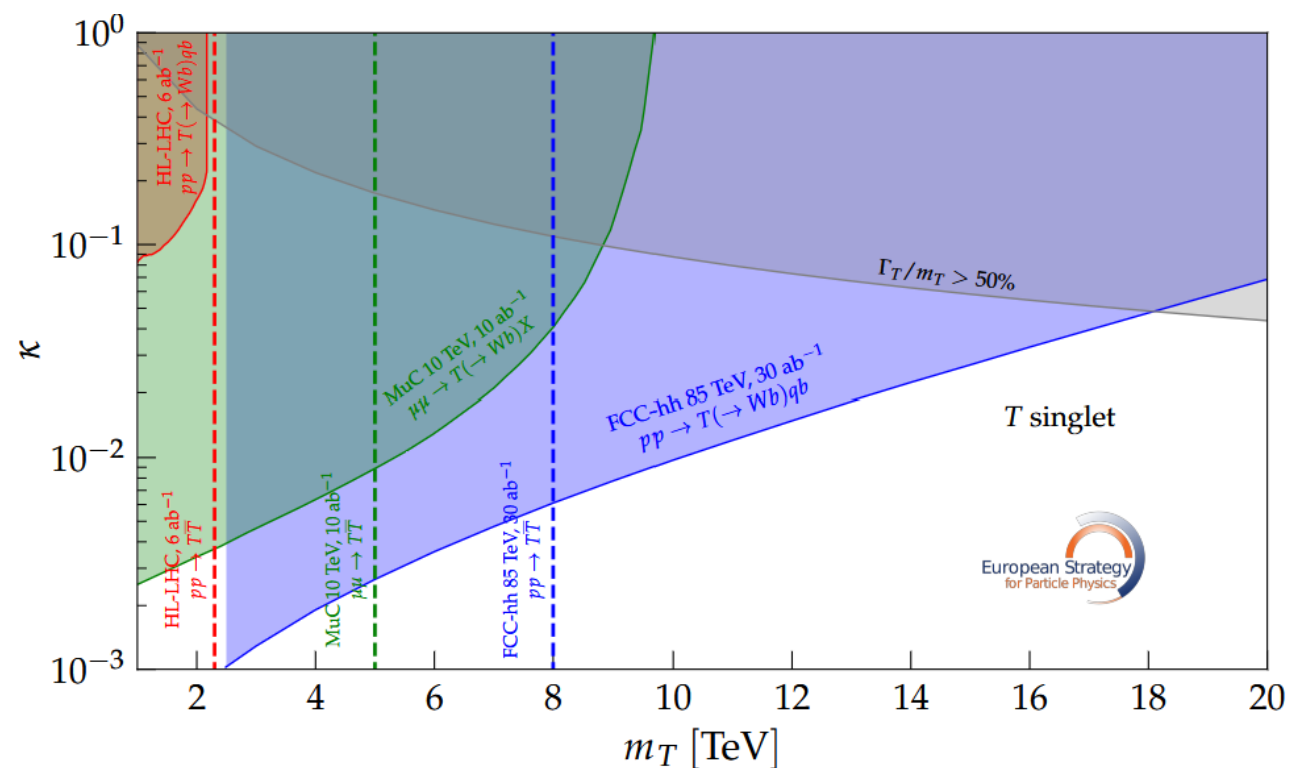
One mass m_* , one coupling $g_* > g_{\text{SM}}$

⇒ Universal bounds from EWPOs, Higgs couplings

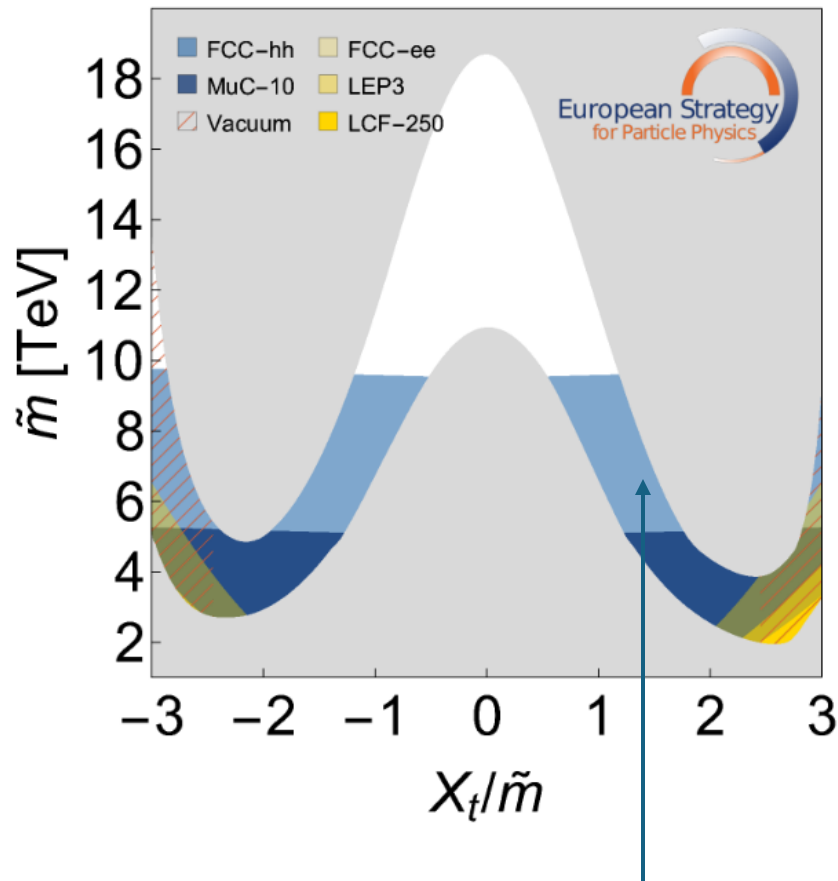


$WW \rightarrow h$ fusion, grows with energy

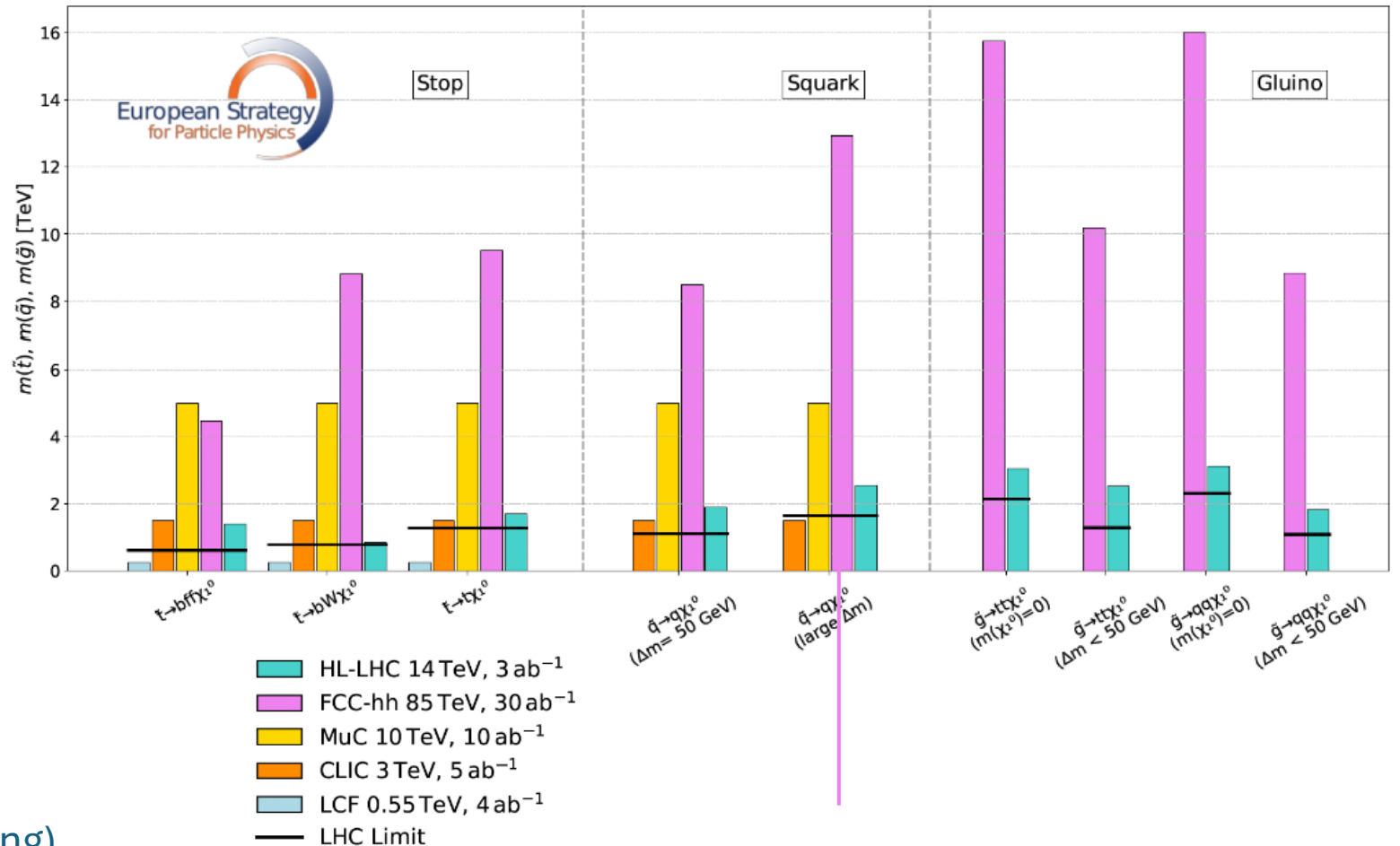
A realistic composite Higgs also **needs a coloured state** (top partner) to explain $y_t \approx 1$



SUSY at the Mass Frontier: FCC-hh



MSSM region (stop mass & mixing)
compatible with $m_h = 125$ GeV



FCC-hh: ultimate reach for coloured states