EF08: Model Specific Explorations

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EF08: Model Specific Explorations

- **Goal:**
  - Search studies + summaries, including results from other groups, interpreting them in a model context.
- **Model list to include:**
  - Eg: SUSY, Compositeness/Extra Dimensions, Leptoquarks (Others?)
- **Work will include**
  - Search sensitivity estimates,
  - Reinterpretations of sensitivity estimates from other groups (e.g. long-lived particle as Higgsino), and
  - Model parameter scans and comparisons with precision measurements (for example pMSSM scans).

Deliverables

- **Need to start thinking about our "deliverables"**
  - The EF08 section of the Snowmass report will be 20-50 pages (check???)
  - Allows for a fair number of plots, but to make an impact they will be need to be effect comparisons and quantification of sensitivity
    - … if they are they will be in the EF summary report and will be shown a lot
  - We need them to be good, complete, and well vetted by our broad community
  - Need to start with a coherent set of assumptions
- **We need people to commit to making some of these deliverables**
  - Would like to see presentations on first draft results on January, enough time to address issues.
- **The following slides have lots of questions, please comment here or email us your thoughts**

Colliders

Snowmass 2021 Energy Frontier Collider Study Scenarios

Collider	Type	$\sqrt{s}$	P [%] e$^-$/e$^+$	L_{int} ab^{-1}
HL-LHC	pp	14 TeV		6
ILC	ee	250 GeV	±80/±30	2
		350 GeV	±80/±30	0.2
		500 GeV	±80/±30	4
		1 TeV	±80/±20	8
CLIC	ee	380 GeV	±80/0	1
		1.5 TeV	±80/0	2.5
		3.0 TeV	±80/0	5
CEPC	ee	M_Z		16
		$2M_W$		2.6
		240 GeV		5.6
FCC-ee	ee	M_Z		150
		$2M_W$		10
		240 GeV		5
		$2\,M_{top}$		1.5

Snowmass 2021 Energy Frontier Collider Study Scenarios

| Collider	Type	$\sqrt{s}$	P [%] e$^-$/e$^+$	L_{int} ab^{-1}
FCC-hh	pp	100 TeV		30
LHeC	ep	1.3 TeV		1
FCC-eh	ep	3.5 TeV		2
muon-collider (higgs)	$\mu\mu$	125 GeV		0.02
High energy muon-collider	$\mu\mu$	3 TeV		1
		10 TeV		10
		14 TeV		20
		30 TeV		90

Note for muon-collider: It is important to note that the plan is not to run subsequently at the various c.o.m etc. These are reference points to explore and assess the physics potential and technology. The luminosity can be varied to determine how best to exploit the physics potential.

Other options to explore:

o   Muon collider at a very high energy (>30 TeV?)
o   FCC pp >150 TeV? and ~75 TeV documenting sensitivity loss
o   Very high energy e+e- collider
o   Other emerging ideas:, e.g. γ-γ collider, and the C^3 e$^+$e$^-$ collider
    [C^3=Cool Copper Collider]

- **One key goal is to represent these collider options in all the main model plots**

Squarks and Gluino Deliverables from European Strategy
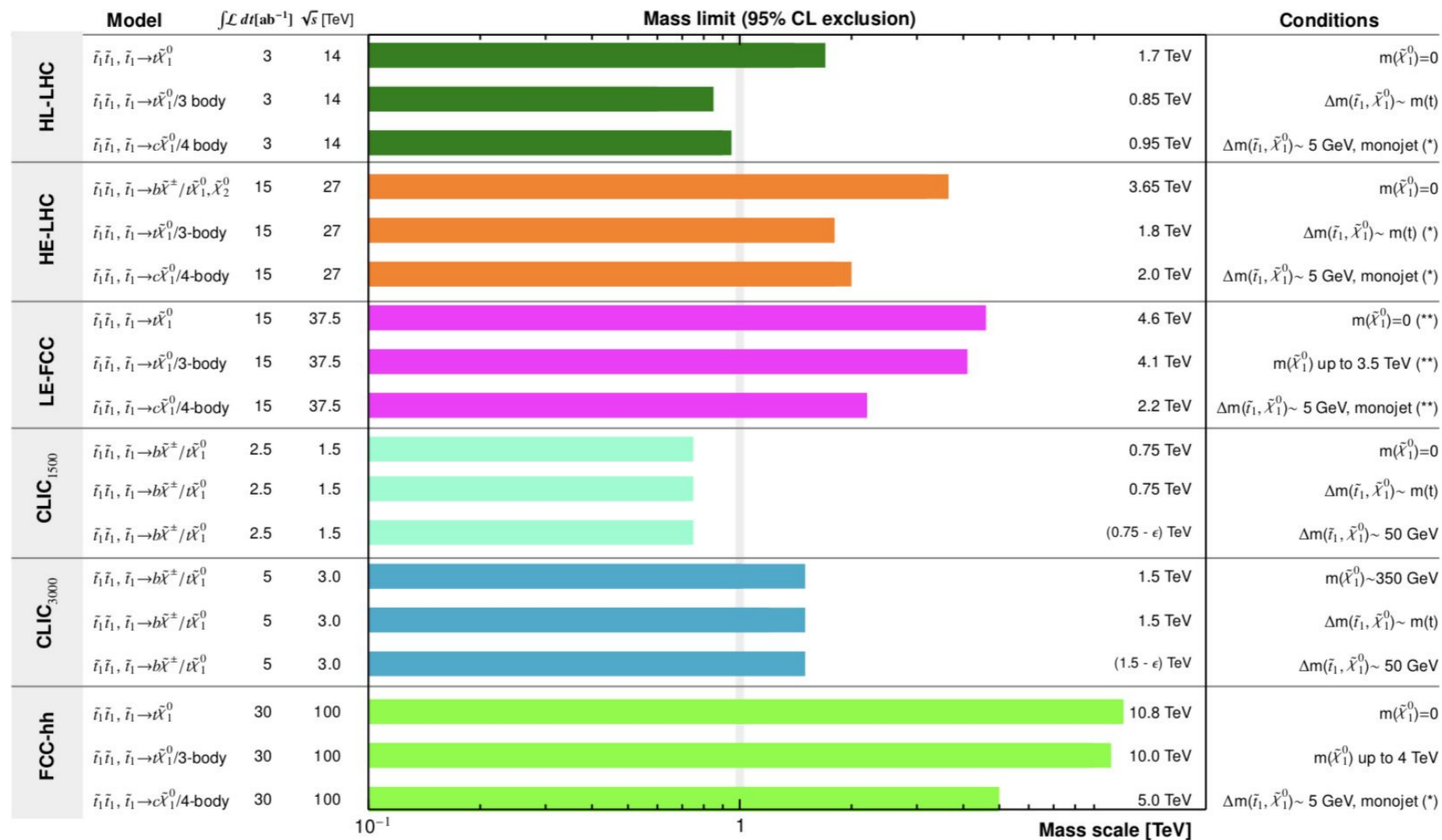
- **Are we happy with the bar chart or do we want a 2-d plot?**
- **Remove HE-LHC and LE-FCC**
- **NEED Muon colliders, … any other relevant?**
- **Need to review source of results line by line**
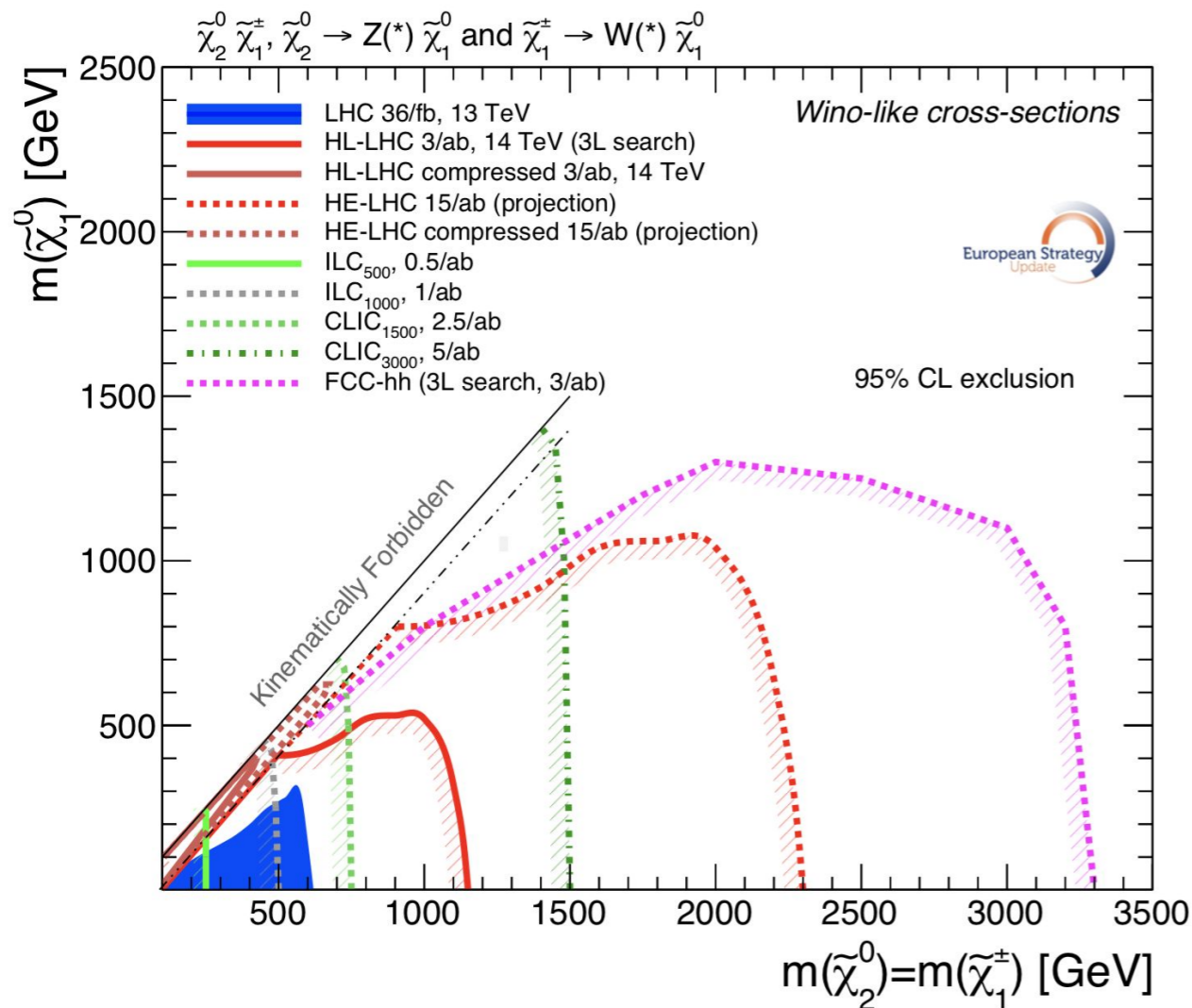- **Same is needed for squarks and gluinos**

Our planning goal

- **Our planning goal is produce a list of lines in plots and where they will come from, e.g.**

Squark plot curves	Source	Complete?
FCC-HH low Δm	ES strategy (no update need)	yes
FCC-HH high Δm	ES strategy (no update need)	yes
Muon 3 TeV low Δm	XYZ group	no
Muon 3 TeV high Δm	XYZ group	no
...	...	...

- **We will be building and sharing this list so that the contents represent the views of the community … and we actually manage to make the plots**
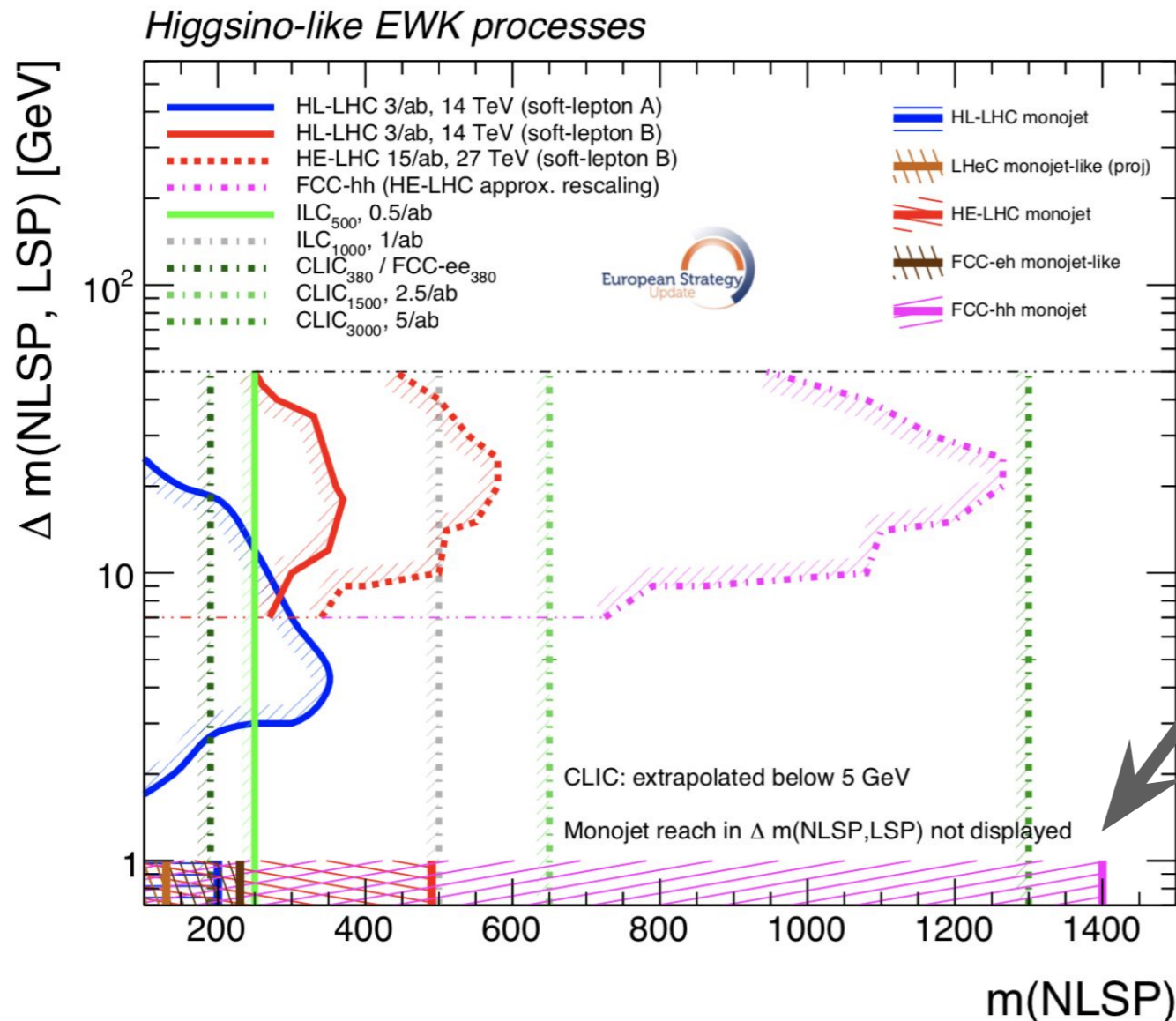
Electroweak Deliverables from European Strategy

$\widetilde{\chi}_2^0 \, \widetilde{\chi}_1^\pm, \, \widetilde{\chi}_2^0 \to Z^{(*)} \widetilde{\chi}_1^0$ and $\widetilde{\chi}_1^\pm \to W^{(*)} \widetilde{\chi}_1^0$

Wino-like cross-sections

- LHC 36/fb, 13 TeV
- HL-LHC 3/ab, 14 TeV (3L search)
- HL-LHC compressed 3/ab, 14 TeV
- HE-LHC 15/ab (projection)
- HE-LHC compressed 15/ab (projection)
- ILC$_{500}$, 0.5/ab
- ILC$_{1000}$, 1/ab
- CLIC$_{1500}$, 2.5/ab
- CLIC$_{3000}$, 5/ab
- FCC-hh (3L search, 3/ab)

95% CL exclusion

Kinematically Forbidden

Axis: $m(\widetilde{\chi}_1^0)$ [GeV], $m(\widetilde{\chi}_2^0) = m(\widetilde{\chi}_1^\pm)$ [GeV]

- **Remove LHC? HE-LHC**
- **NEED Muon colliders, … any other relevant?**
  - **What about other analyses, e.g. the hh results are all 3 lepton-based, but all hadronic might be more sensitive**
- **Need to review source of results line by line**

- **This is not really a realistic model point**
  - **how to include pMSSM scan**
  - **two lines 5% or 95% of pMSSM models excluded**
 - **Need active analyzers on each line to make sure a plot!**

Compressed Deliverables from European Strategy

- **Remove HE-LHC**
- **NEED Muon colliders, … any other relevant?**
- **Low mass threshold fc-hh limits?**
- **Understand Δm coverage of the mono-jet based result (in progress)**

- **Still need to think about pMSSM scans?**

Composite Deliverables from European Strategy

Composite Higgs, 2σ (left and right panels)
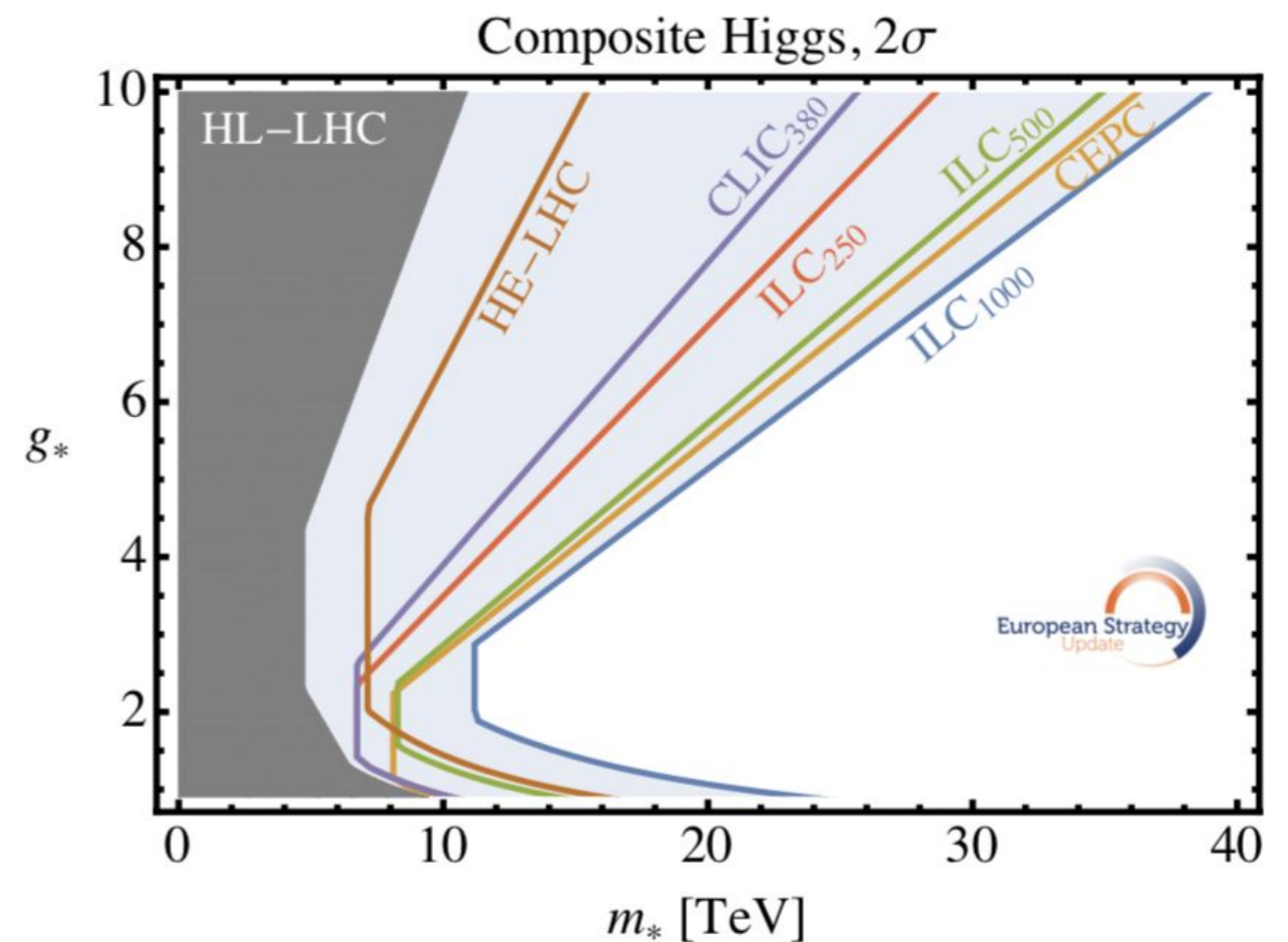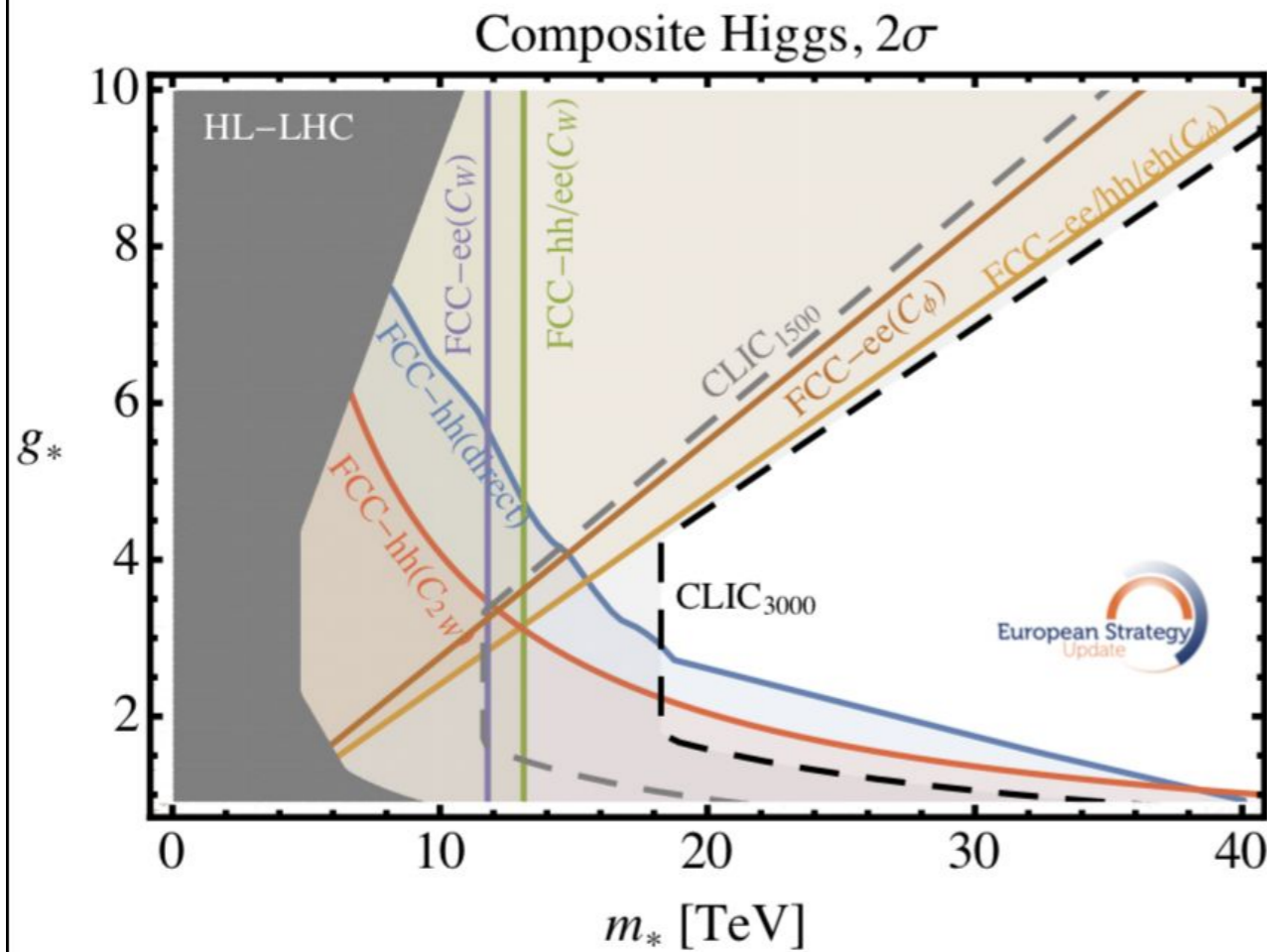
- **Are these the right compositeness plots?**
- **Need to review the source of the lines**
- **Remove HE-LHC add Muon collider**
- **Is there really for EF08 or is it really for "EF04: EW Physics: EW Precision Physics and constraining new physics"**
- **What about new top resonances? Is the comparative reach similar enough to stop squarks to rely on that?**

Other contents

- **Naturalness discussion**
- **g-2 and other anomaly discussion**
- **Uncovered models discussion**
  - Some models may have a specific paragraph without dedicated plots

Summary

- **Give us input on the list of plots**
  - More models? Is there 1-2 RPV plots that makes sense?

- **Let us know which specific lines on the plots are are pursuing**
  - LoI are often not specific enough we want to make this concrete and have consistent assumptions

- **Plan your MC needs**
  - You have to initiate your signal MC and only hh background is generated automatically

- **Please come to the EF08 meetings and give us input!**