

Some Comments on SP(750)

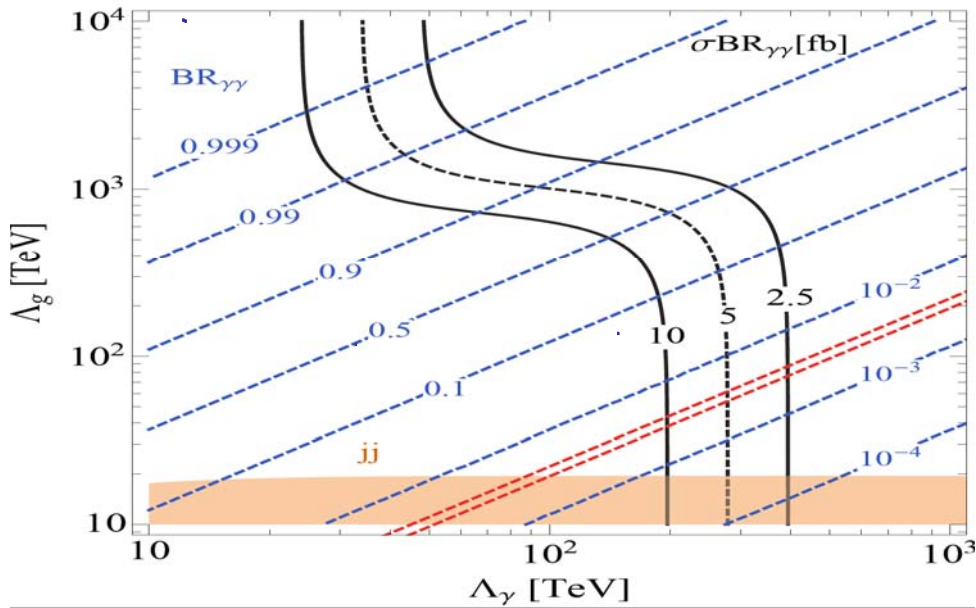
[Discussions w/ R. D'Agno, D. Pinner, J. Ruderman]

* Definitely most interesting + likely
LHC anomaly - Exciting!

[* Run 1 vs Run 2 tension, "other channels look elsewhere",
width issue; also big coincidence that S/B ~ few
with QCD events (but just where sig./background fluct. hurt!)]

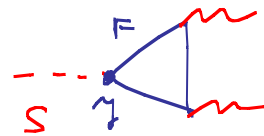
* I give it a ~ 10% chance of being real (= betting odds)

$$\frac{\phi}{\Lambda_g} G_{\mu\nu,a} G^{\mu\nu,a} + \frac{\phi}{\Lambda_\gamma} F_{\mu\nu} F^{\mu\nu}$$



* Very weak coupling to SM!

* Trivial to UV complete



$$\frac{1}{\Lambda} \sim \frac{\alpha}{4\pi} \frac{g}{M_F}$$

M_F from 10^5 GeV
 $\rightarrow 10$ TeV OK

If reasonably weakly coupled,
 $M_F \lesssim \text{TeV} + \text{must produce } F$



* If S is a scalar, why is it light?

[Radiative naturalness can be postponed to 10TeV !]

* S is composite/strongly coupled @ m_S
(related to h compositeness? But why no $S \rightarrow hh, \tau\tau$?)

* S is a PGB

* SUSY [S, iS_2, ψ_S] w/ chiral symmetry on ψ_S

* Could it be connected with other anomalies?

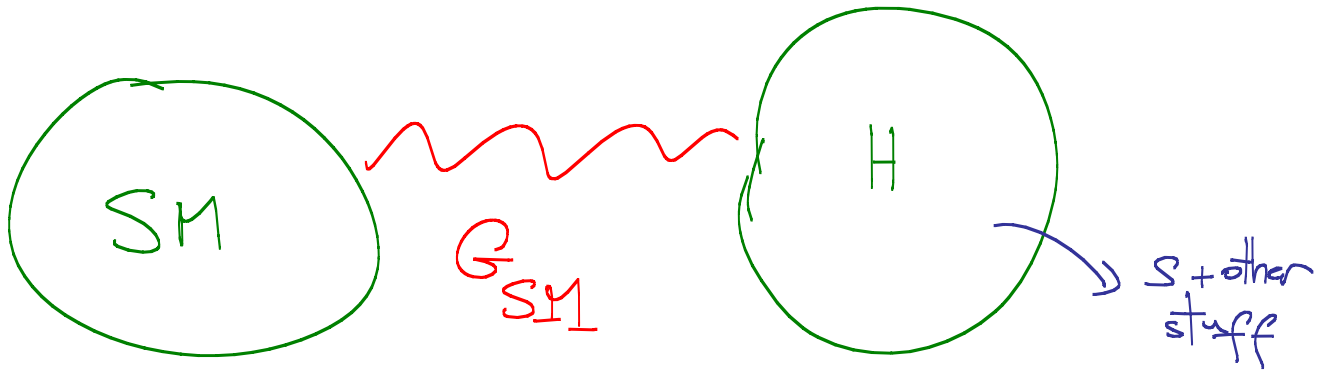
e.g. (D^c, D) vector-like state $\longleftrightarrow \lambda g_3 \ell_3 D^c$
 $\rightarrow B \rightarrow D \tau \nu$ anomaly [$\lambda \sim 1, m_D^c \sim 500\text{GeV}$]

* S could be real + still physics generating $\frac{S F^2}{\wedge}$ inaccessible.

* Of course a million models can contain S -
absent more information enumerating them isn't
particularly illuminating


* For now, most interesting to think of simple,
predictive models that might also connect to
bigger pictures, + sharply suggest new states/signals

"Horizontal" New Physics



(dom couplings $\rightarrow 0$ as $g_{SM} \rightarrow 0$)

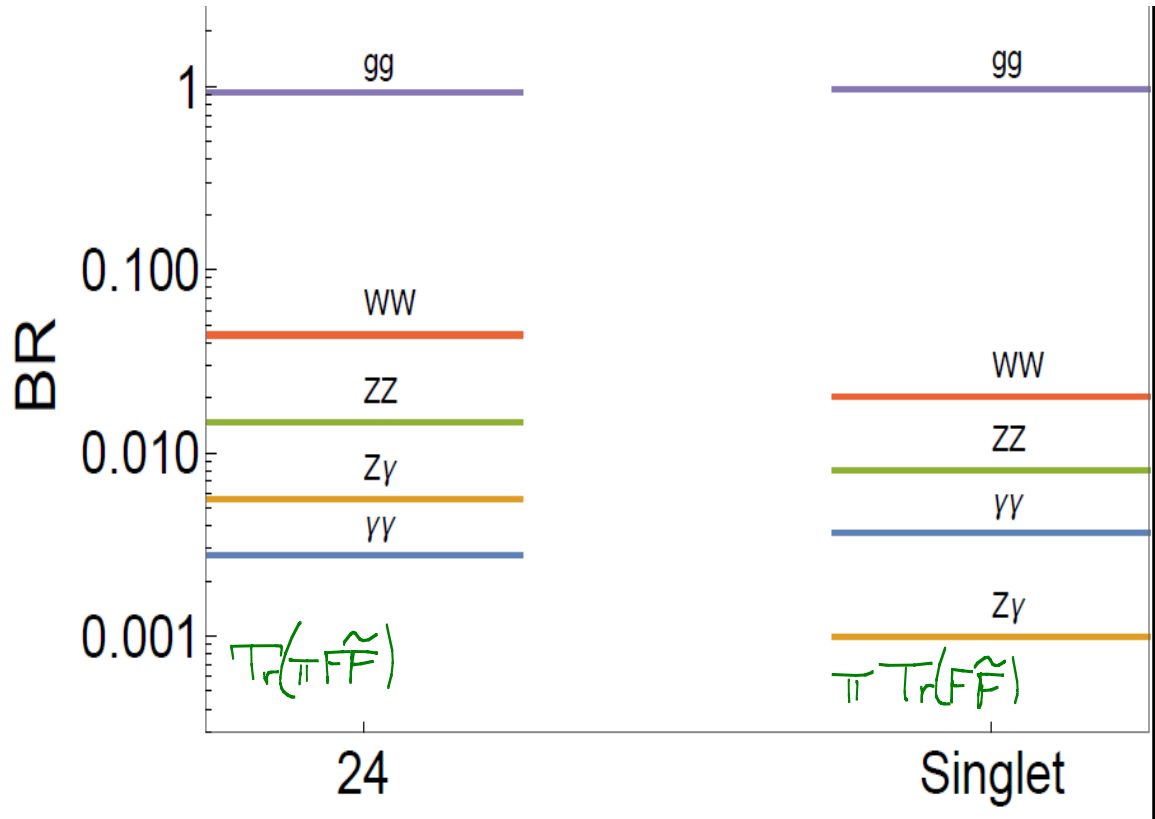
Unification + Pseudos



* If S is a PNCB — an opportunity:
does H care about unification?

If so new states should come in multiplets
of $SU(5)/SO(10)$, so

$S \in 1$ or $24 \dots$ of $SU(5)$
[1 or 45 or $54 \dots$ of $SO(10)$]



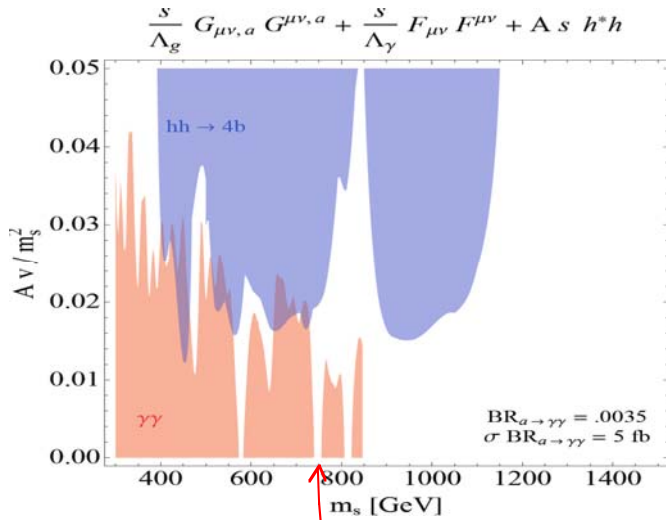
S + SUSY



Look for $(S_1 + i S_2) + \text{singlino}$

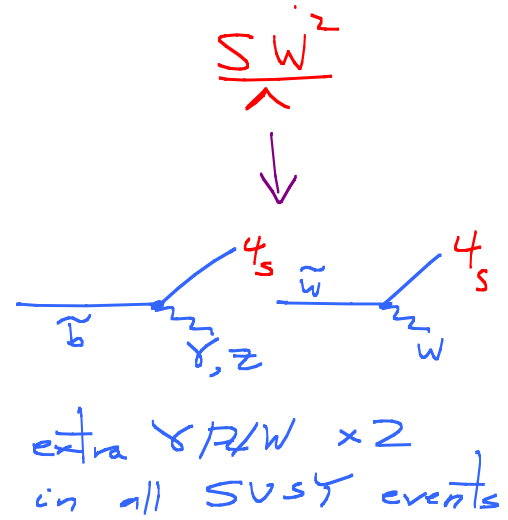
↓
In $\mathcal{N} = 1$ + higgs higgs

↓
Can change all
SUSY cascades
if light

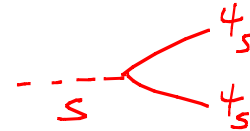


$S_{1,2}$ nearly deg.

Note: SUSY only symmetry that can relate $(S_1 FF, S_2 FF)$!



Also $W \supset 2 S^3$ couplings



* HIGHER SPIN?

* NOT RESONANCE?