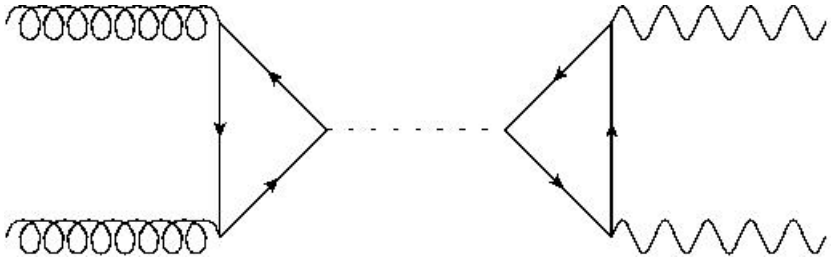
Glue to light signal of a new particle

Tae Hyun Jung

Seoul National University

with Dongjin Chway, Radovan Dermisek and Hyung Do Kim,
arXiv:1512.08221, replaced version on May 1 (threshold resummation)



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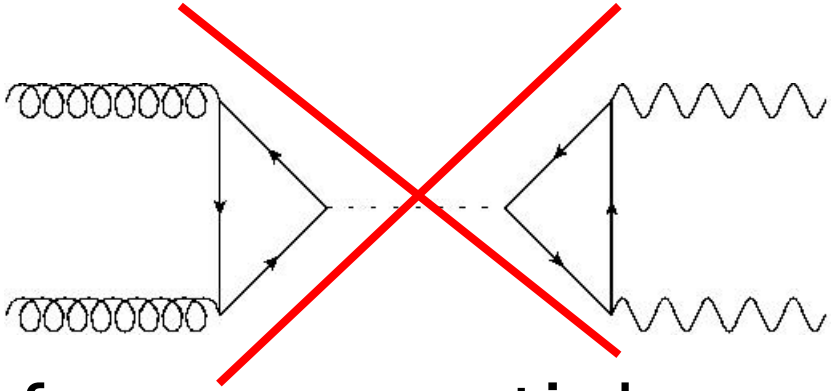

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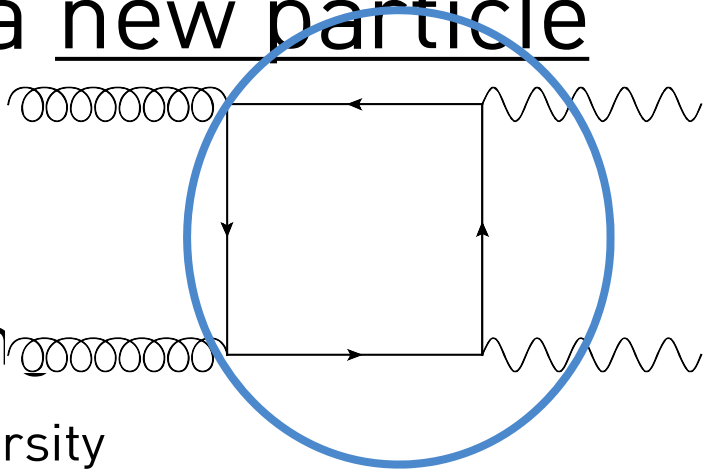

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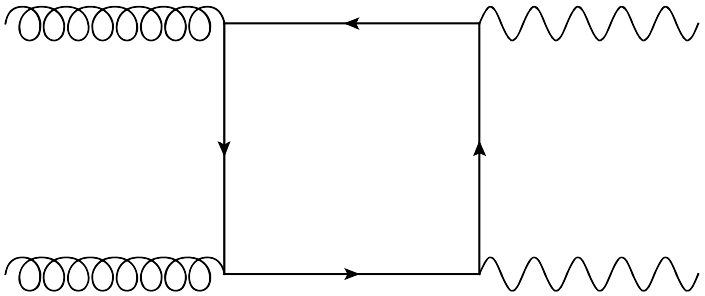

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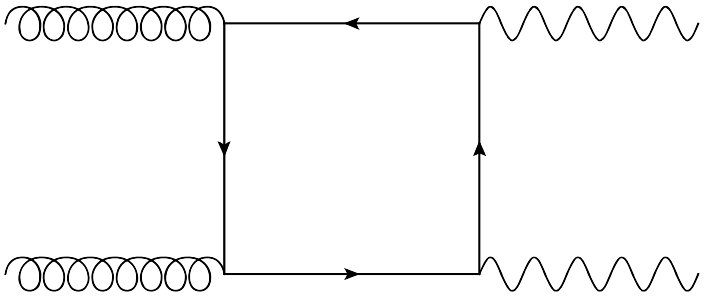

Drastic enhancement near $m_{\gamma\gamma} = 2m_X$

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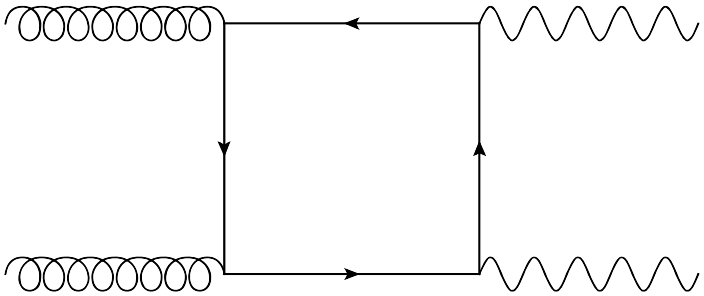

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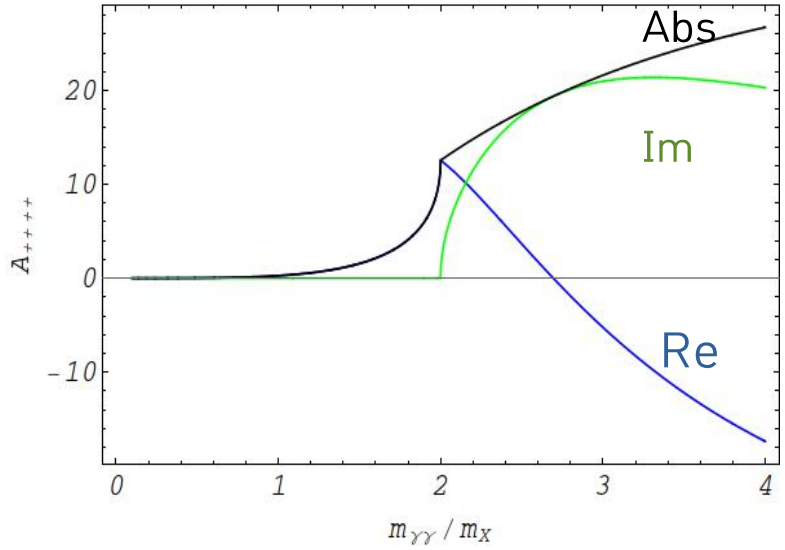

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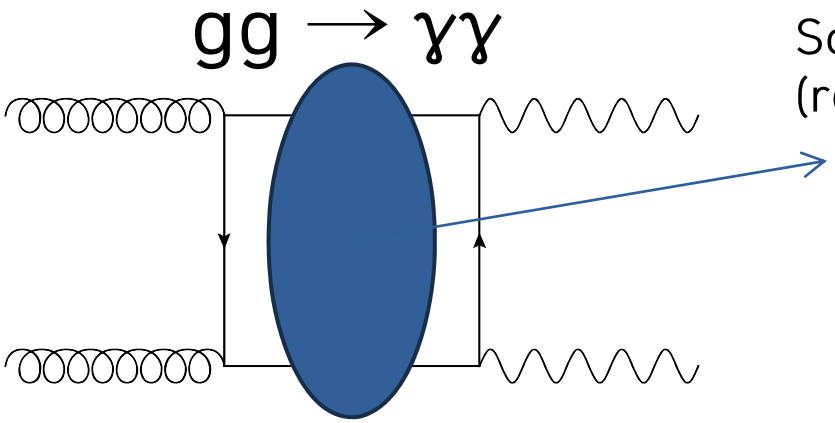
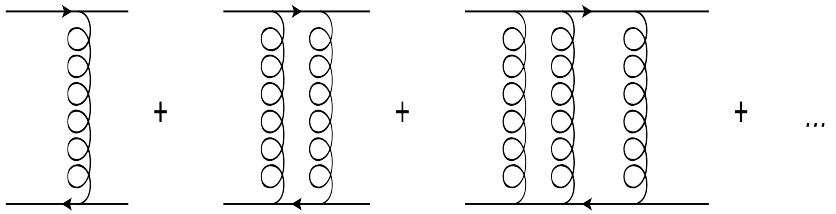


Sommerfeld enhancement near $m_{\gamma\gamma} = 2m_X$
(resummation of ladder diagrams)



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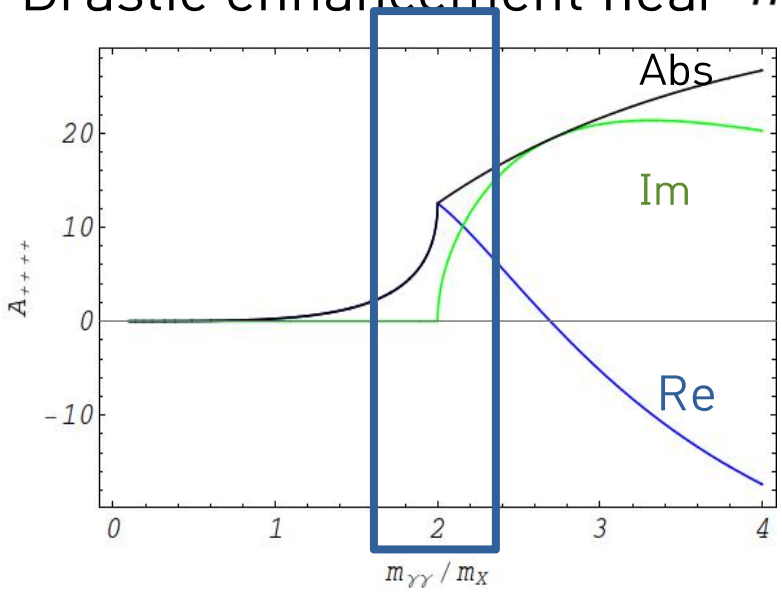

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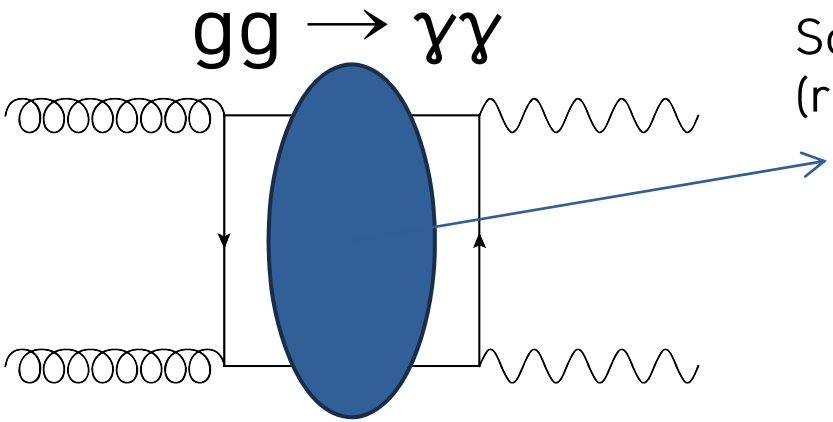

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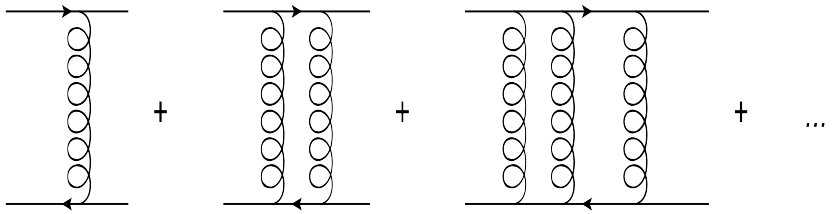

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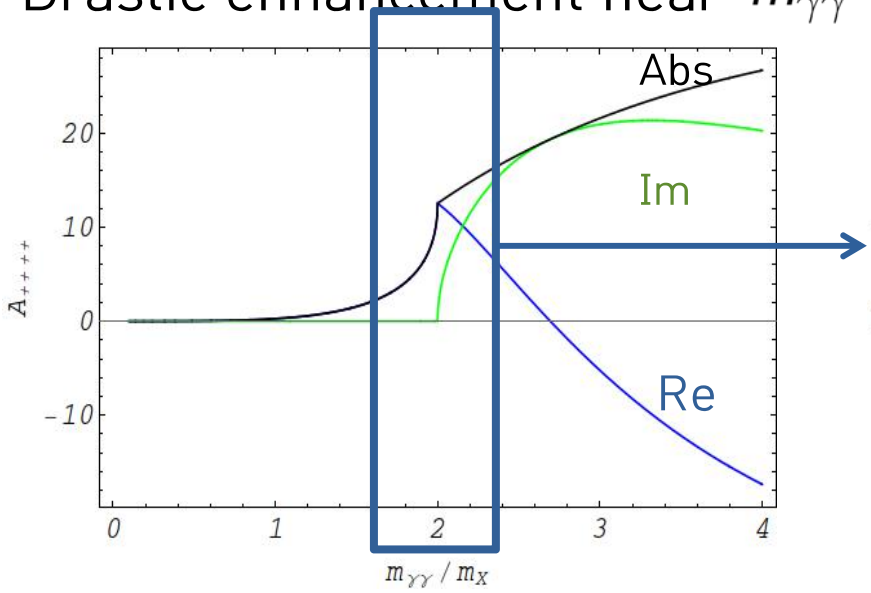
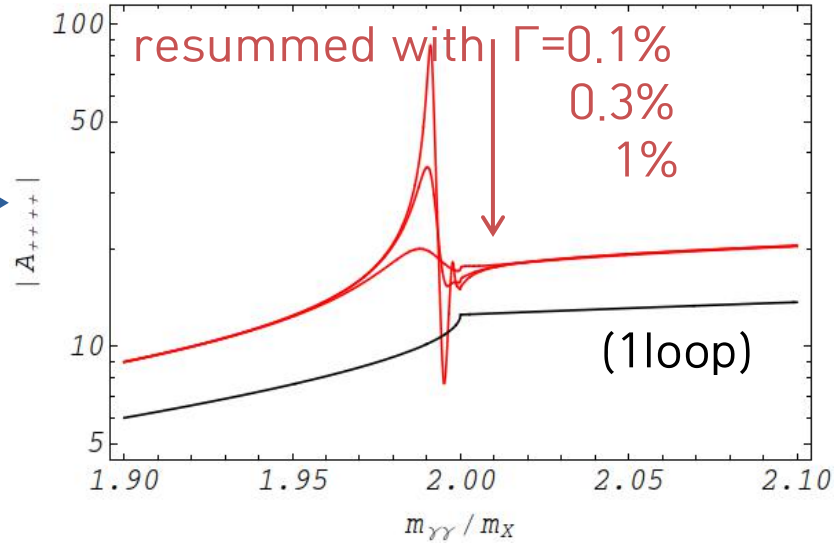
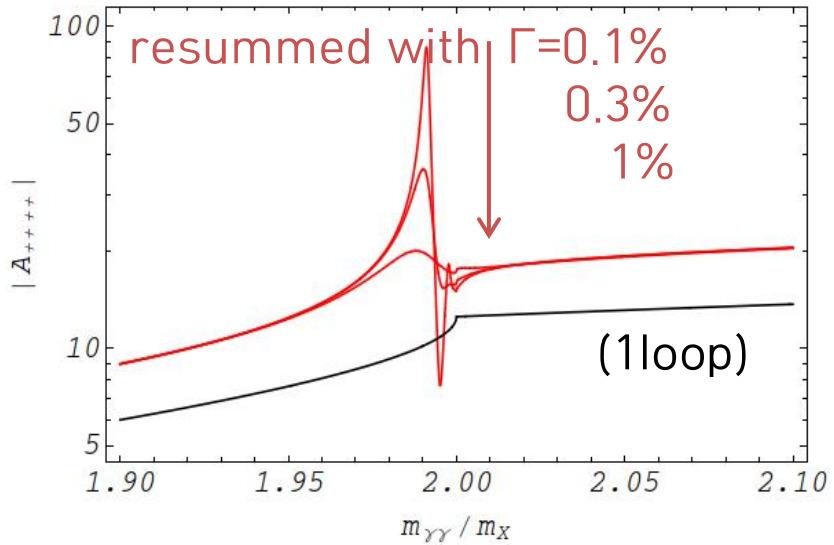


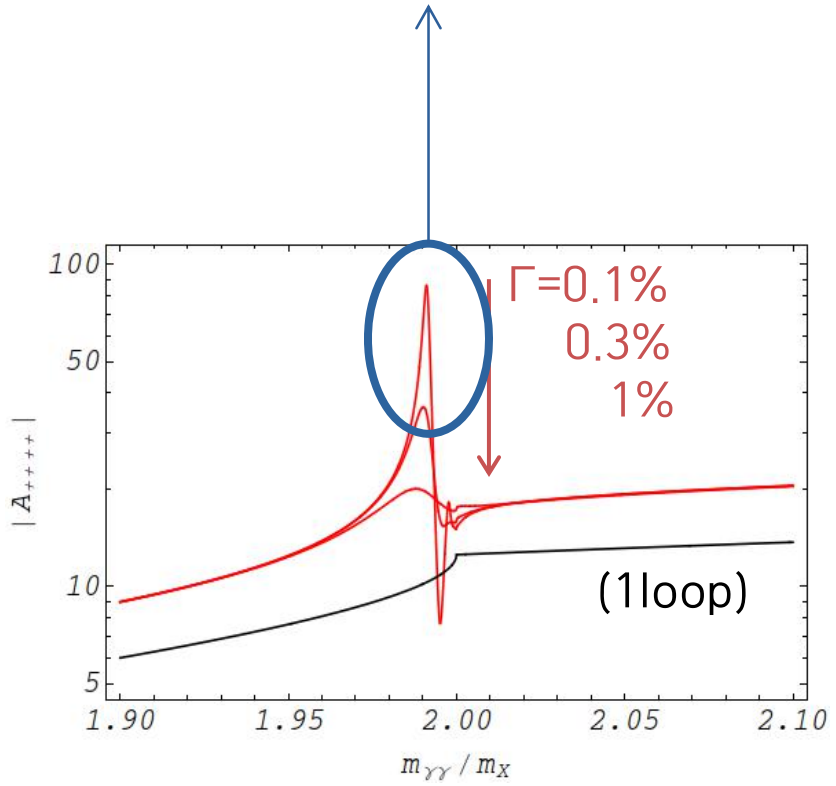


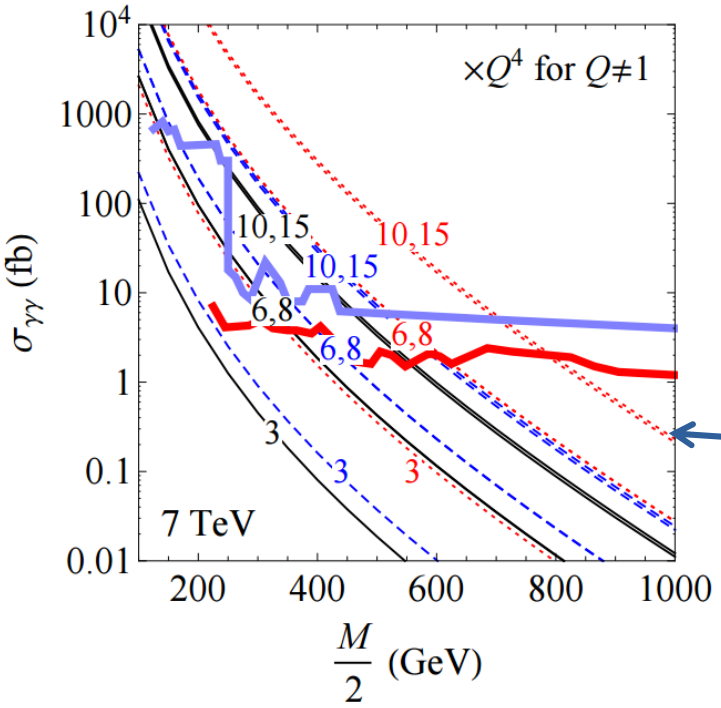

resummed with Γ=0.1%
0.3%
1%
(1loop)
100
50
10
5
1.90
1.95
2.00
2.05
2.10
$|A_{++++}|$
$m_{\gamma\gamma}/m_X$

Bound state search

e.g.:quarkonium, stoponium, gluinonium ...

($\Gamma/m \ll 0.7\%$)





Y. Kats and M. J. Strassler, JHEP **1211**, 097 (2012)

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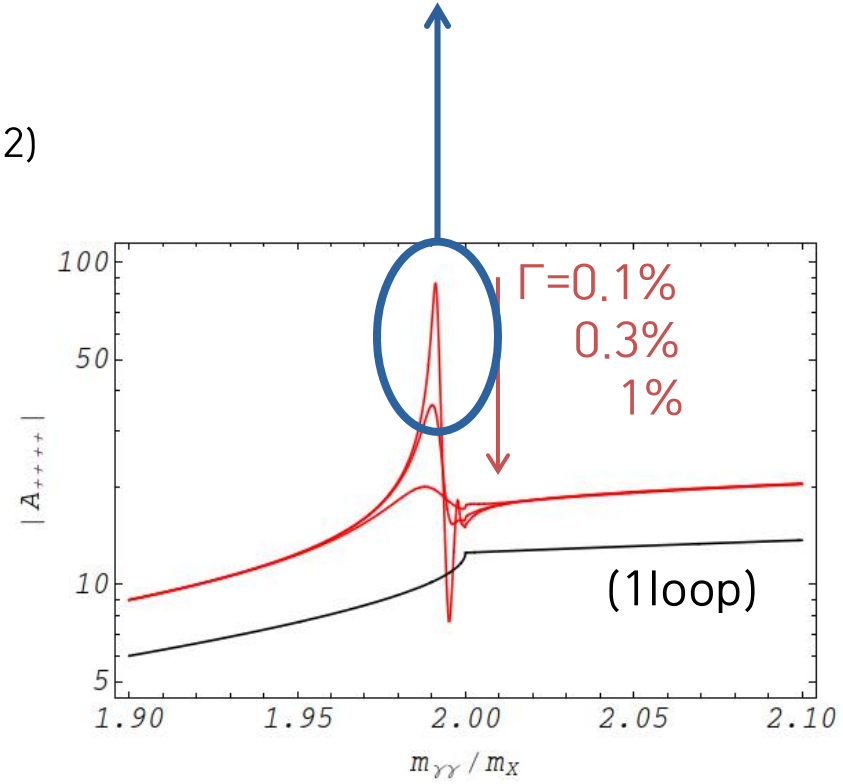

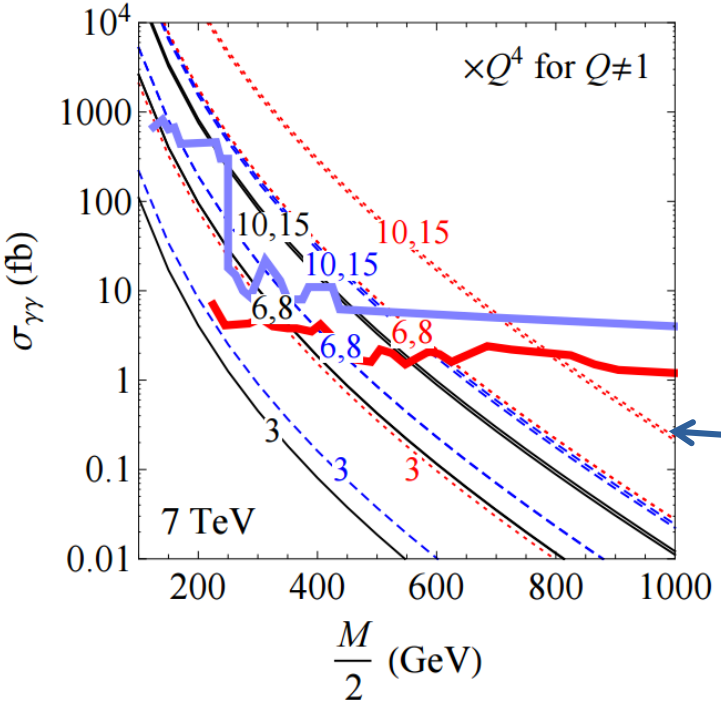

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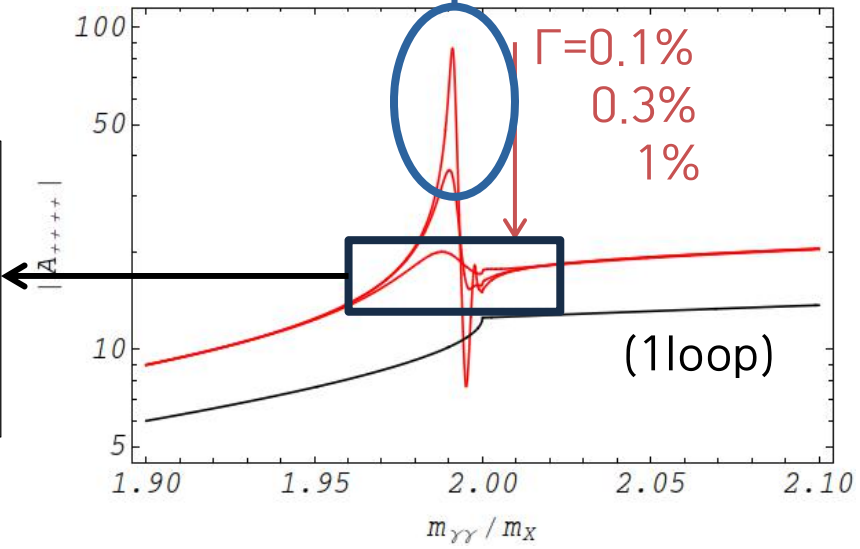
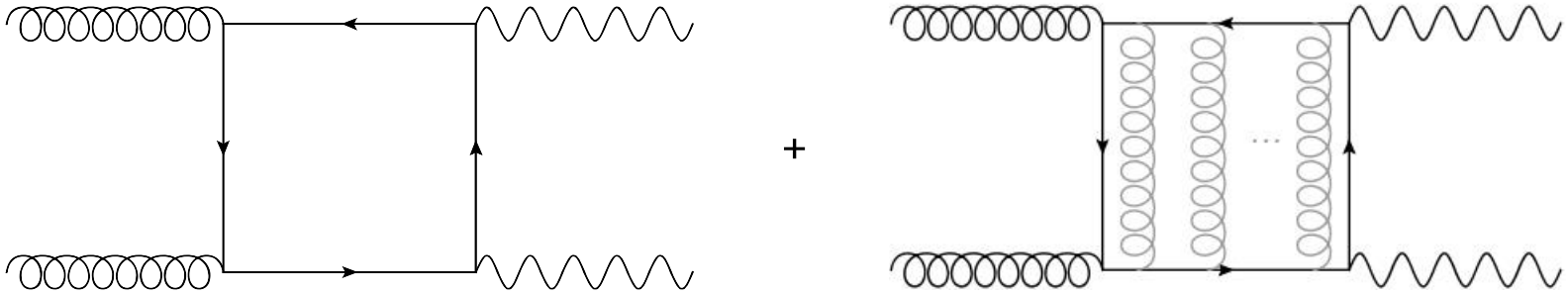


My interest

We also can see this unfortune parameter space ($\Gamma/m>0.7\%$)
e.g.: top quark $\Gamma/m\sim0.8\%$

Background Amplitude



light quarks(u, d, s, ...)

new particle

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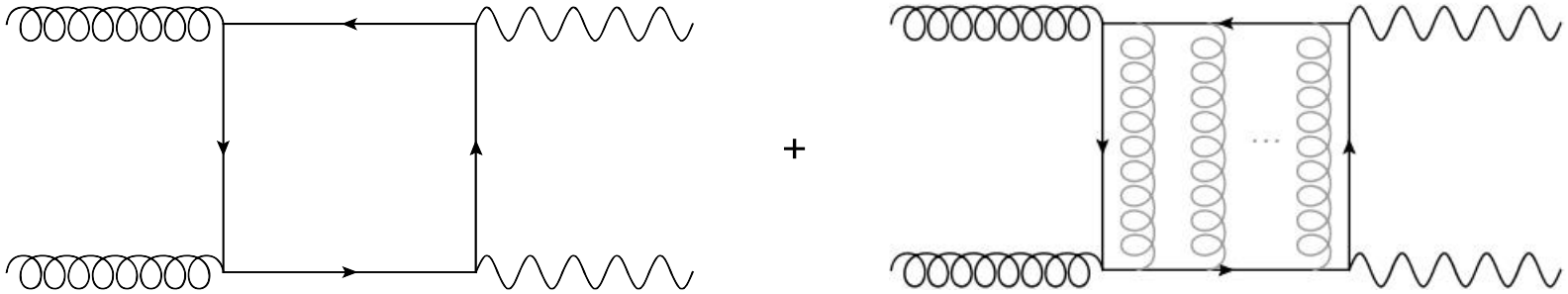

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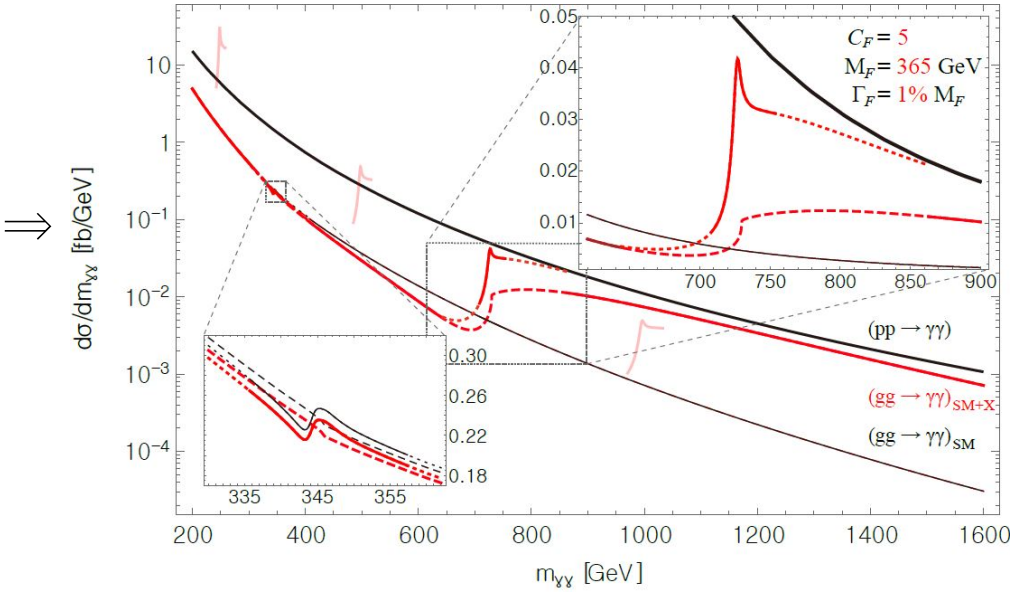


$$C_X = N_X S_2 Q^2$$

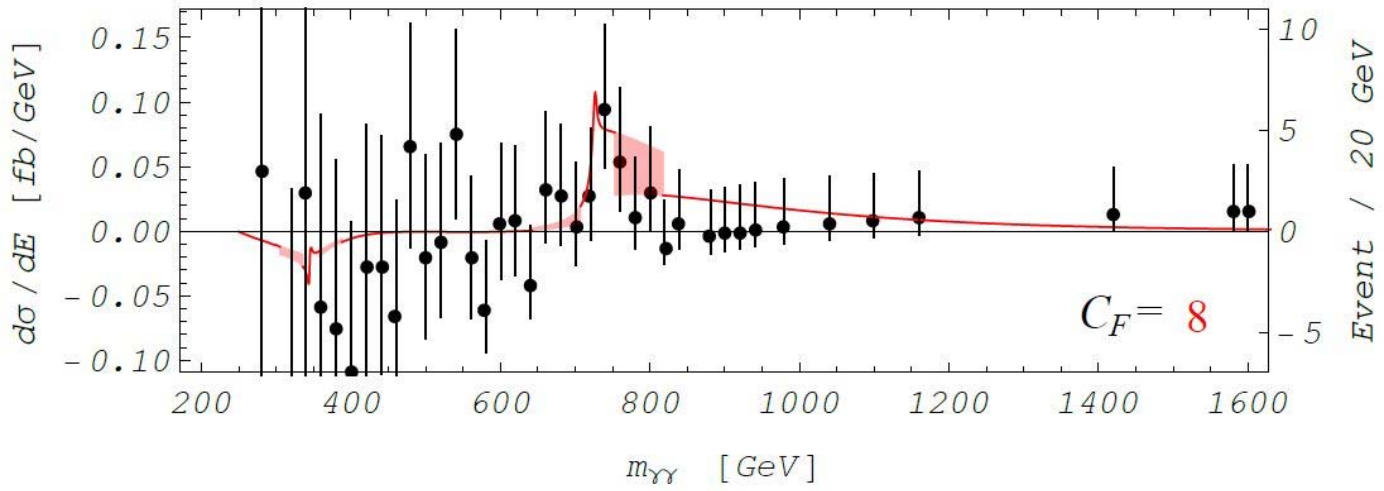
# of ptc Dynkin index electric charge

5 =10 *(1/2)* (1)^2

= 2 *(1/2)* (2.2)^2

750 GeV excess as an example

fermion



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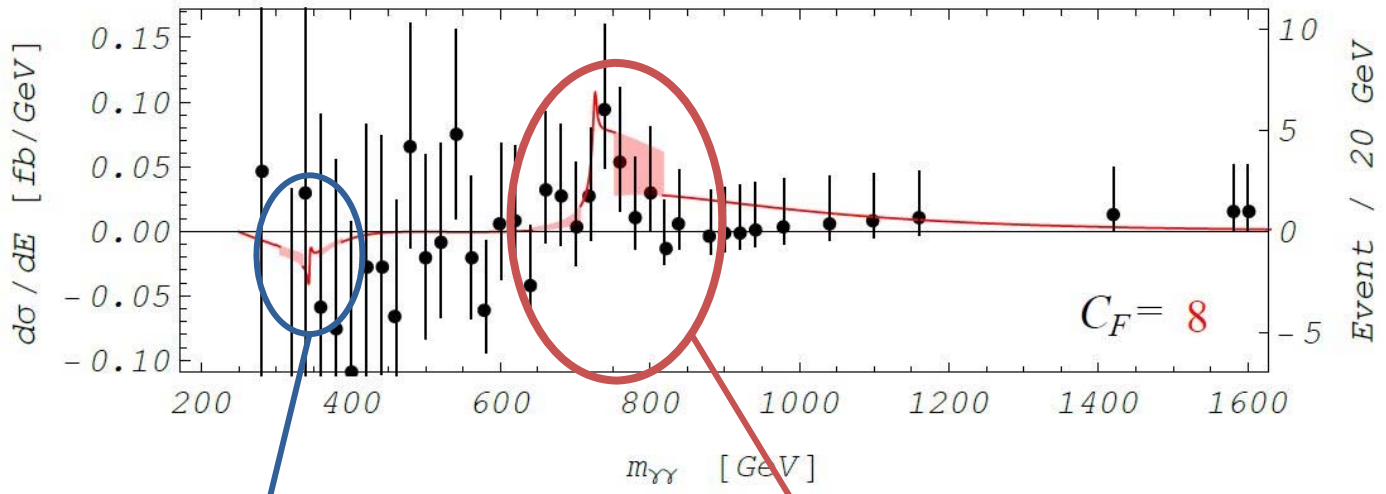

$N_X S_2 Q^2 = 8$ with $M_X = 365$, $\Gamma/M_X = 1\%$

Top threshold interference dip due to SM 5 light quark diagrams

(2~3 fb : expected to be observed at the end of runII)

Prefered large width seems to be well-fitted without any perturbativity problem

$$C_X = N_X S_2 Q^2$$

# of ptc

Dynkin index

electric charge

750 GeV excess as an example

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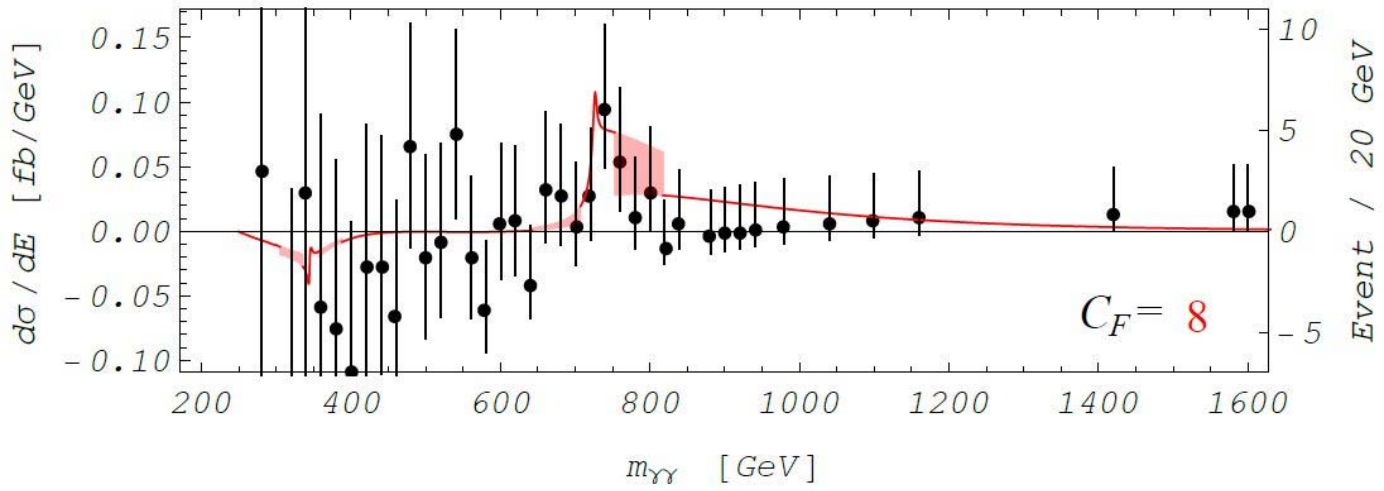

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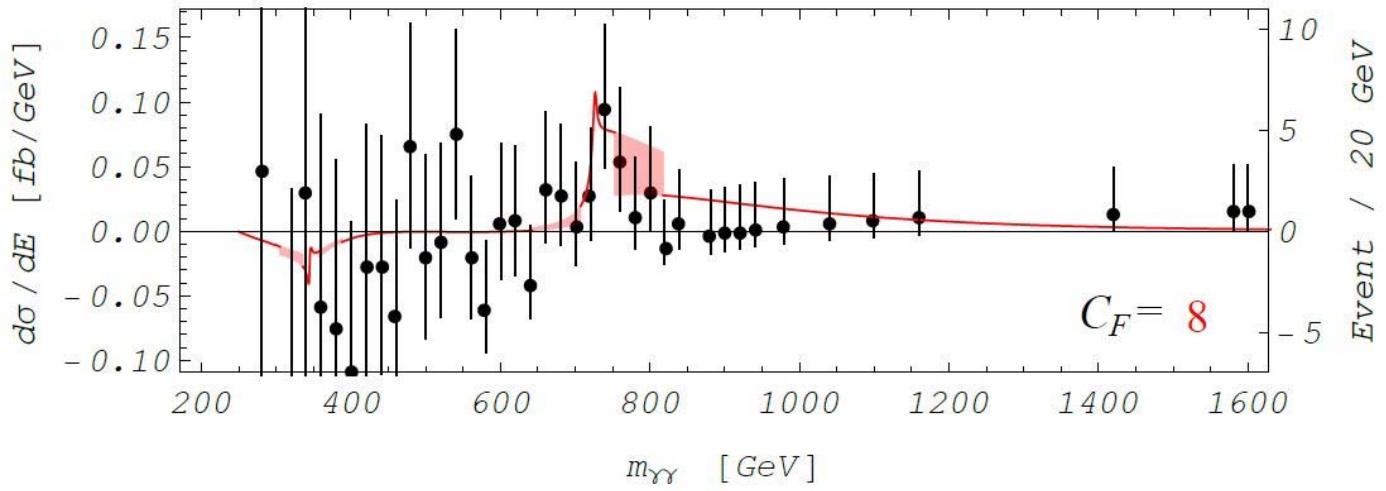
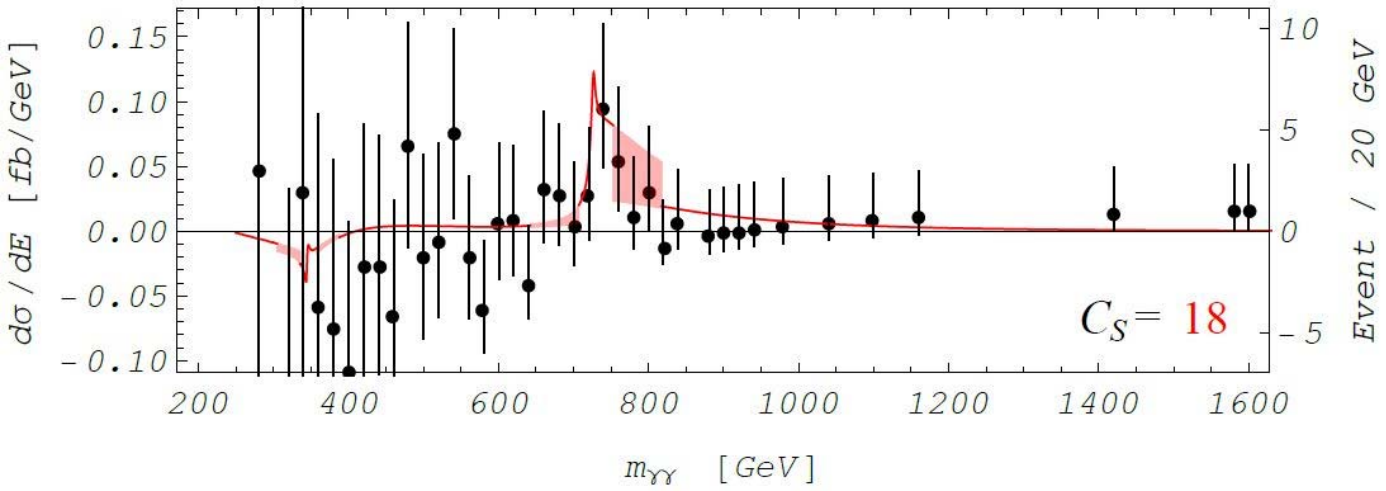
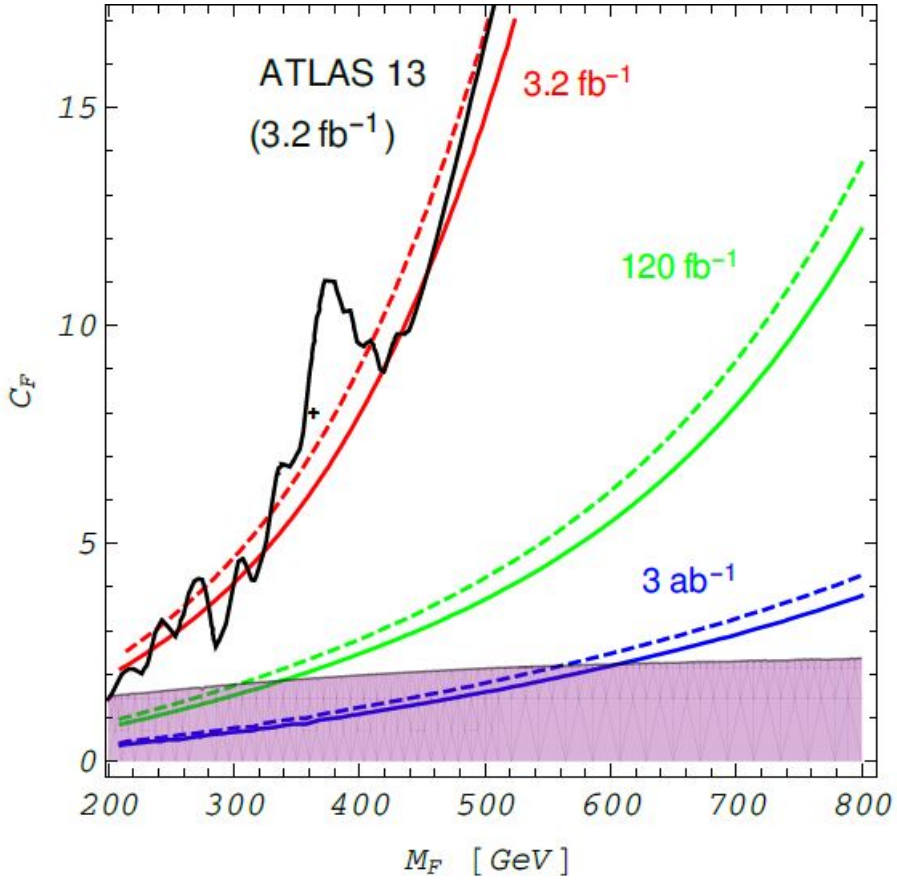
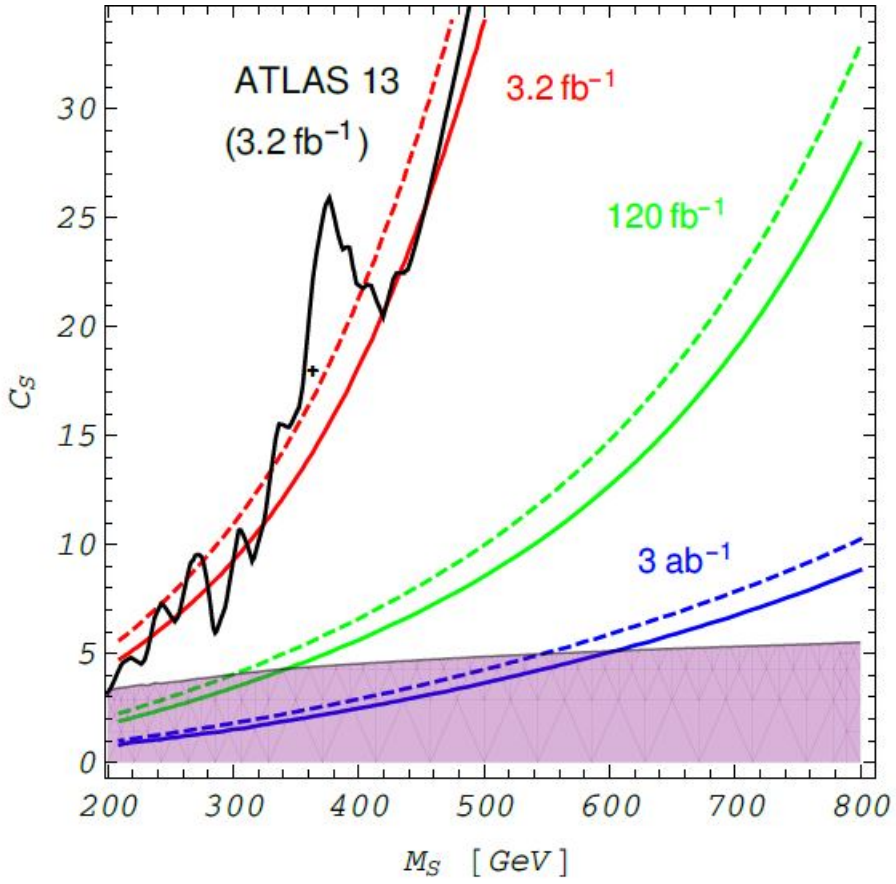


scalar



Exclusion Plot (without interference)





y axis : $C_X = N_X S_2 Q^2$

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There is no more possibility of colored and charged particle which is excluded by this plot.

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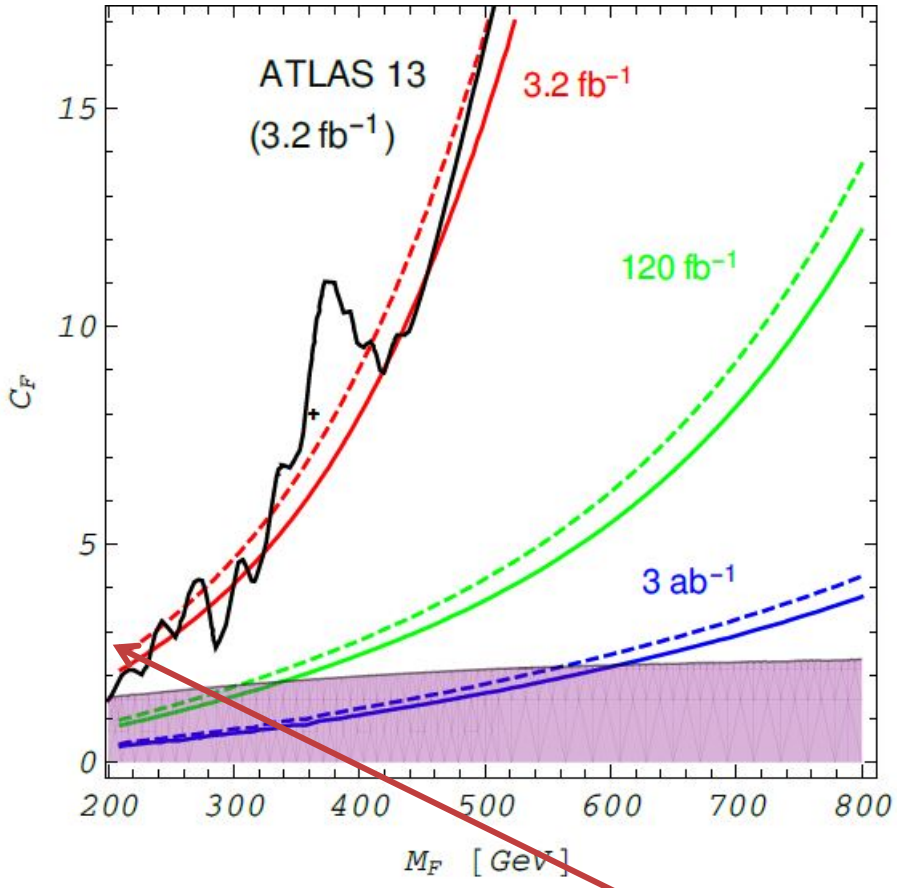

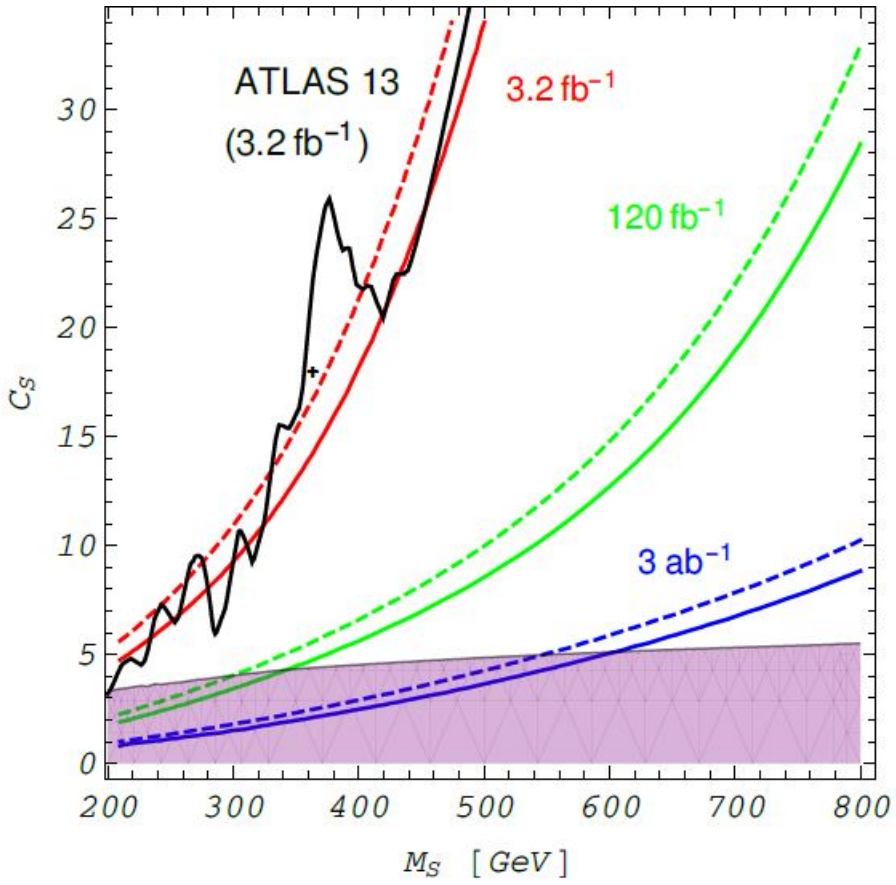

y axis : $C_X = N_X S_2 Q^2$

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e.g) 200 GeV vector-like quark with charge 5/3

Summary

- Without any hint of detail of BSM in the nature, $gg \rightarrow \gamma\gamma$ channel gives the most conservative exclusion for color charged and electric charged particles.

- For large $C_X = N_X S_2 Q^2$, the spectrum shape seems like a bump at the threshold with broad width.

  (If the large width of 750 GeV excess is confirmed, then this scenario should be considered seriously)

- For small $C_X = N_X S_2 Q^2$, the interference effect becomes important and the spectrum shape seems like a dip (e.g.top threshold; expected to be observed at the end of runII).