Bounding the Higgs width using H=>VV

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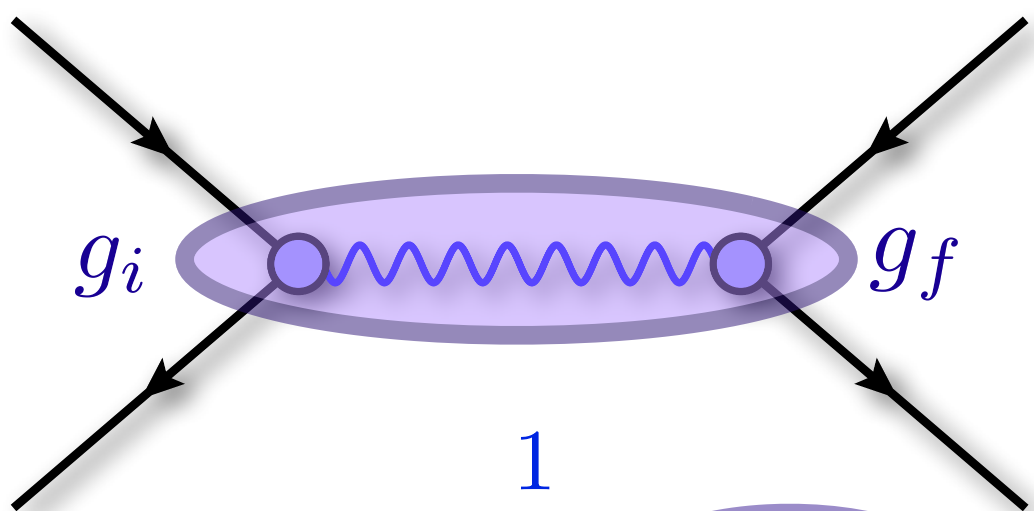
With John Campbell and Keith Ellis

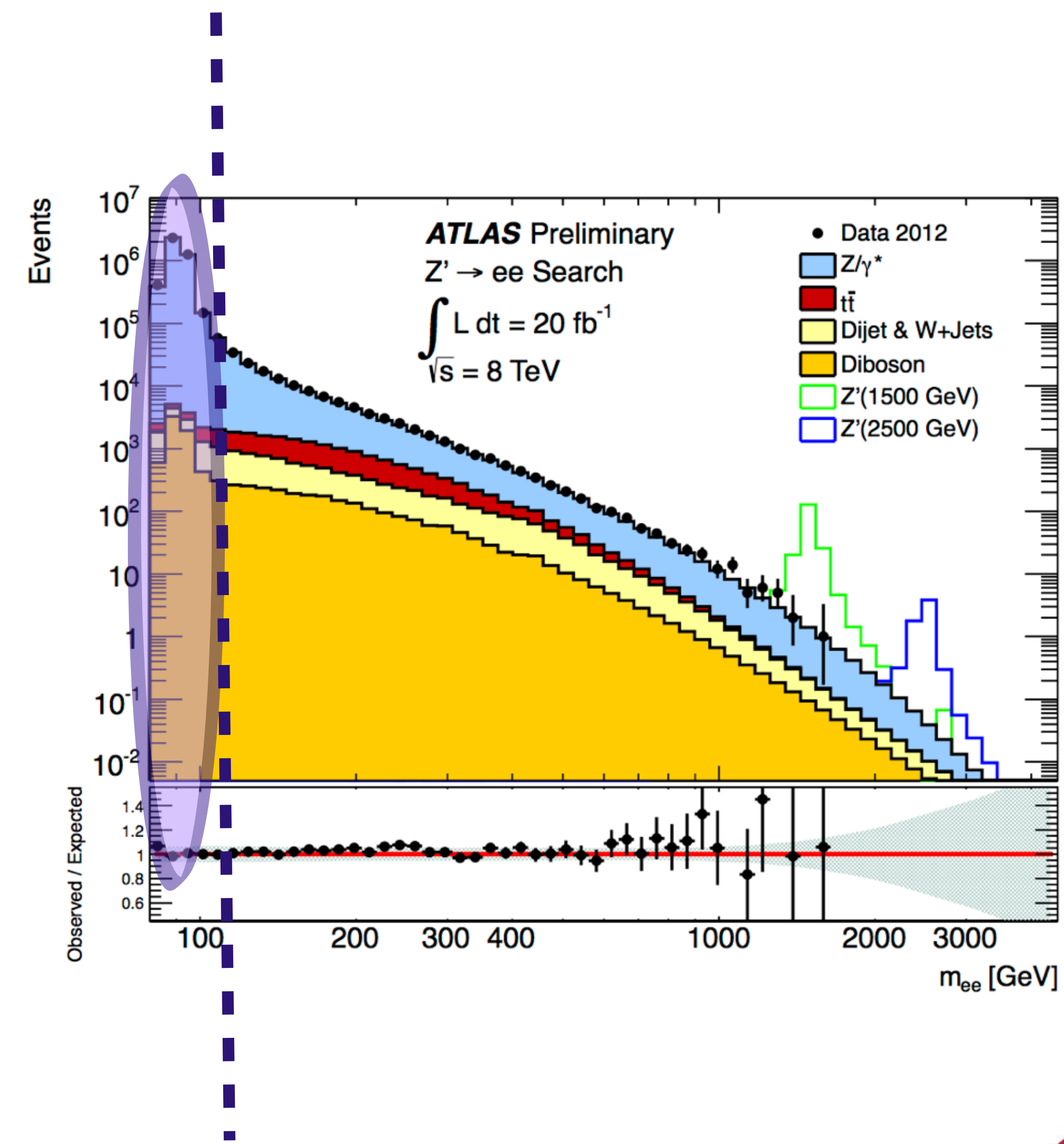
(1311.3589 and 1312.1628)

Bounding the Width Using the Off-shell Cross Section

(CW, Campbell, Ellis 11)
(Kauer, Passarino 12)
(Caola, Melinikov 13)
(CW, Campbell, Ellis 13)



$$\frac{1}{(s - M_X^2) + i\Gamma_X M_X}$$



In the resonance region the "on-shell" cross section is dominated by the width.

$$\sigma^{on}_{i\to X\to f} \sim \frac{g_i^2 g_f^2}{\Gamma_X}$$

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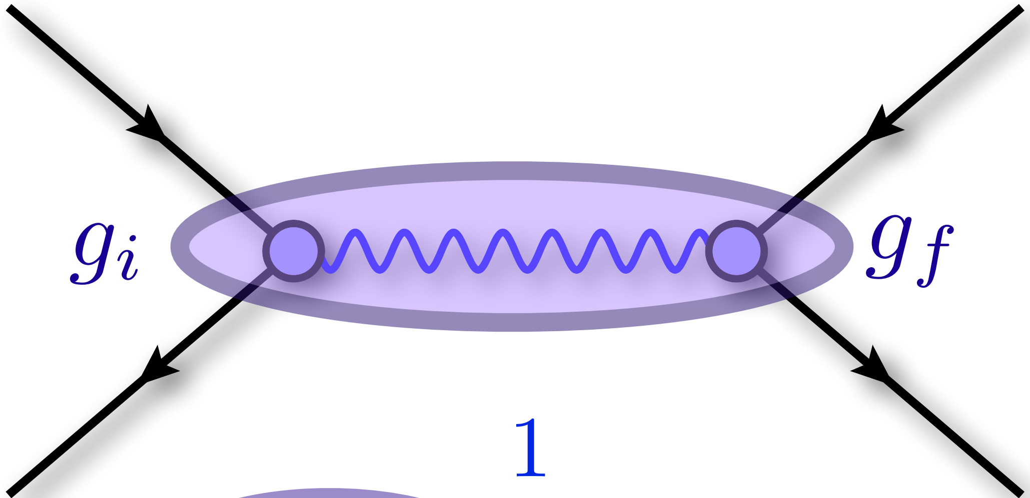
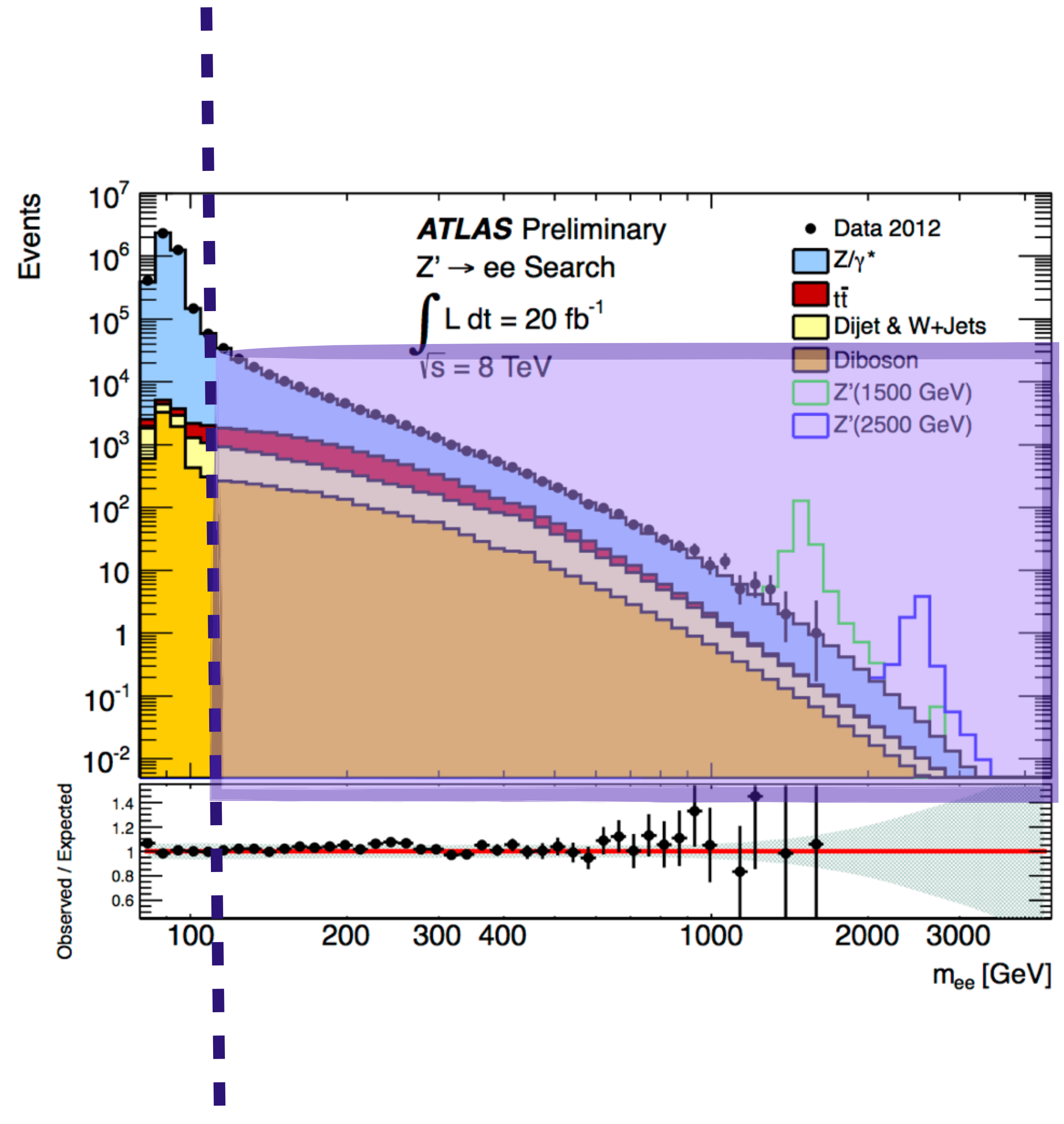


$$\frac{1}{(s - M_X^2) + i\Gamma_X M_X}$$

Away from the resonance region, the "off-shell" cross section does not depend on the width.

$$\sigma^{off}_{i\to X\to f} \sim g_i^2 g_f^2$$



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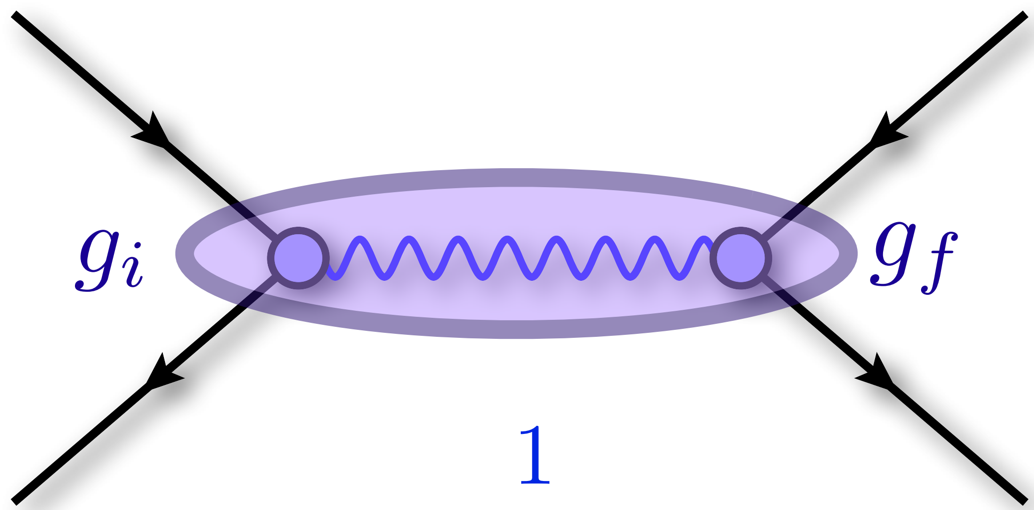
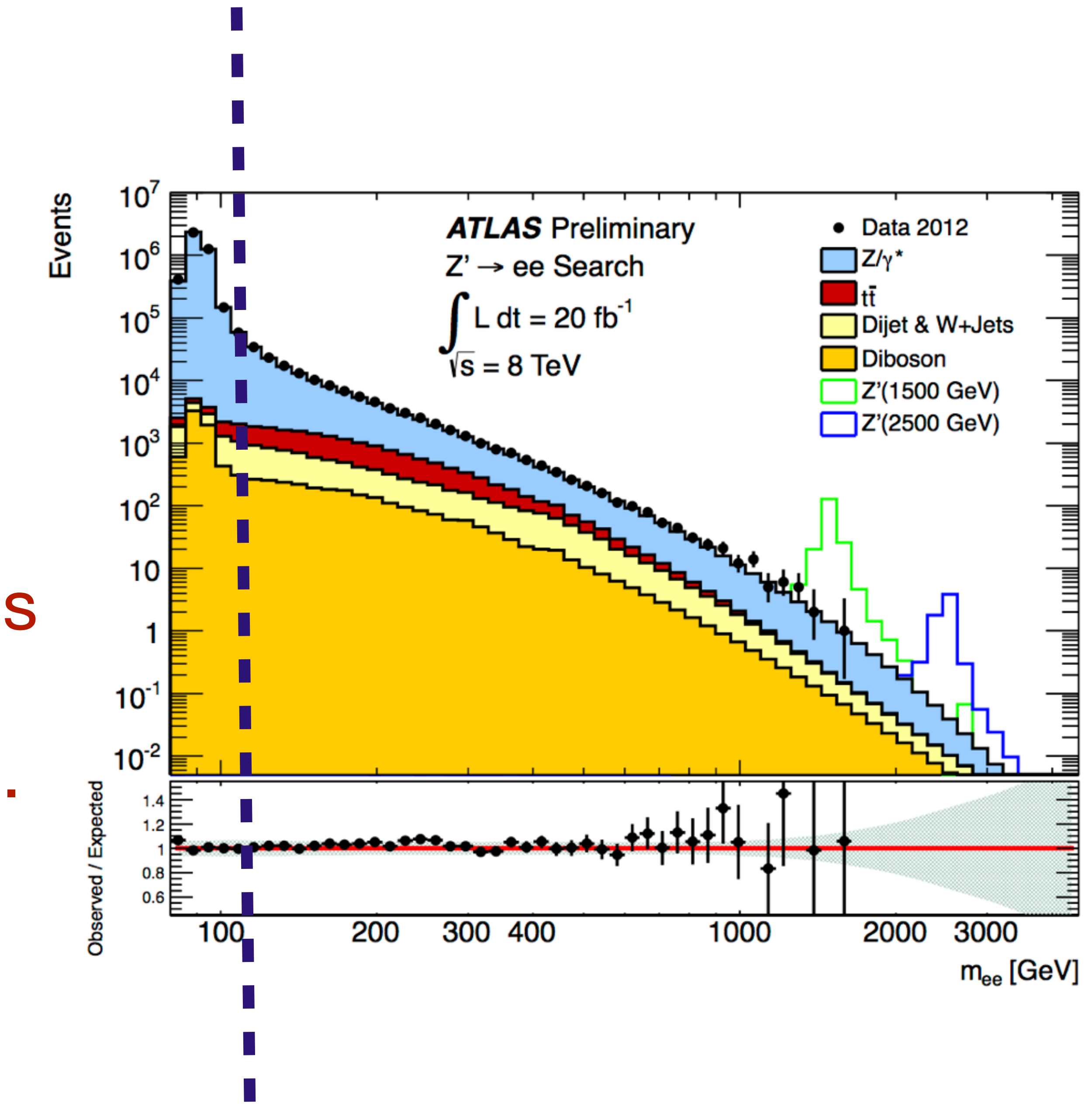


$$\frac{1}{(s - M_X^2) + i\Gamma_X M_X}$$

The ratio of these cross sections is therefore dependent on the width and *independent* of the couplings.

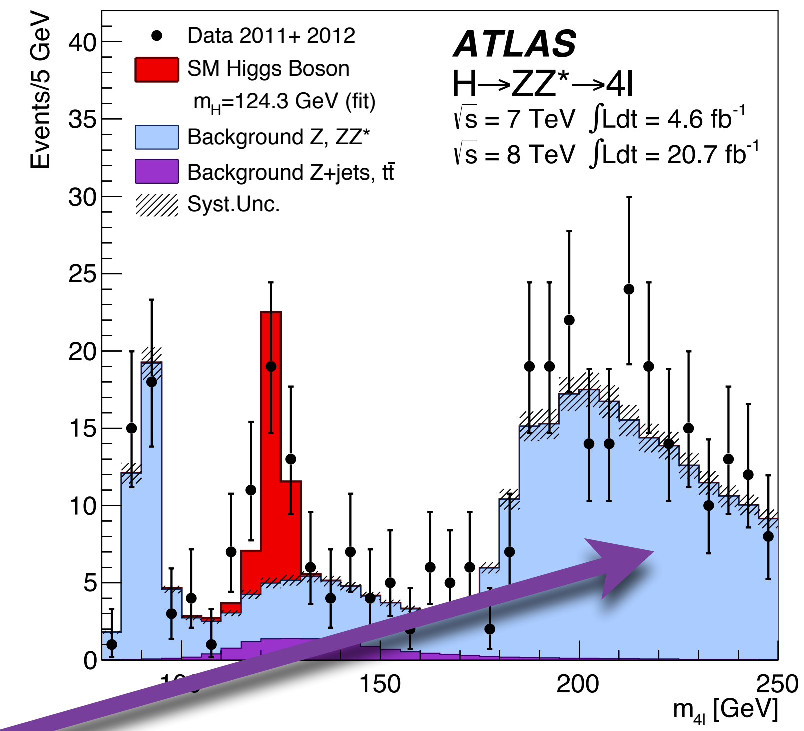
$$\frac{\left(\frac{\sigma_{off}}{\sigma_{on}}\right)_{exp}}{\left(\frac{\sigma_{off}}{\sigma_{on}}\right)_{SM}} \propto \frac{\Gamma_X}{\Gamma_X^{SM}}$$

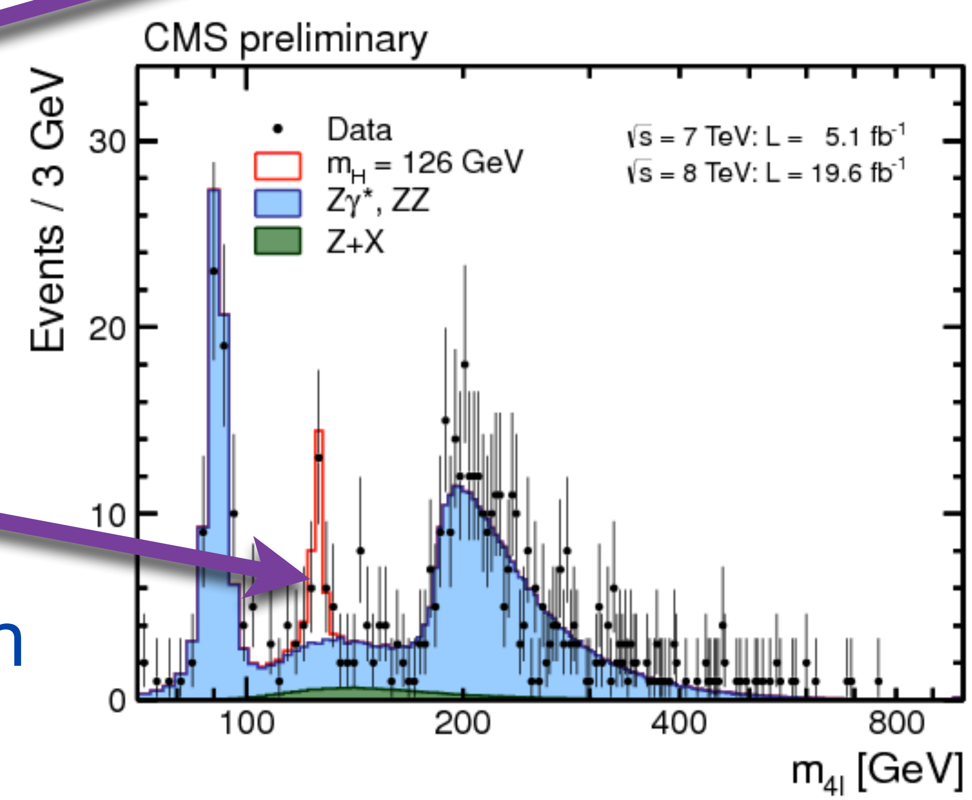


Applications to the Higgs

- Off-shell we know only at LO (incl intf)

$$\frac{\left(\frac{\sigma_{off}}{\sigma_{on}}\right)_{exp}}{\left(\frac{\sigma_{off}}{\sigma_{on}}\right)_{SM}} \propto \frac{\Gamma_X}{\Gamma_X^{SM}}$$





- We know the on-shell cross section very well, can use NNLO rate etc.

What about K-factors ?

Personally, I think that a central (dynamic) scale should be chosen such that,

$$\sigma_{LO}^{on}(\mu_{NNLO}) \sim \sigma_{NNLO}^{on}(\mu_{NNLO})$$

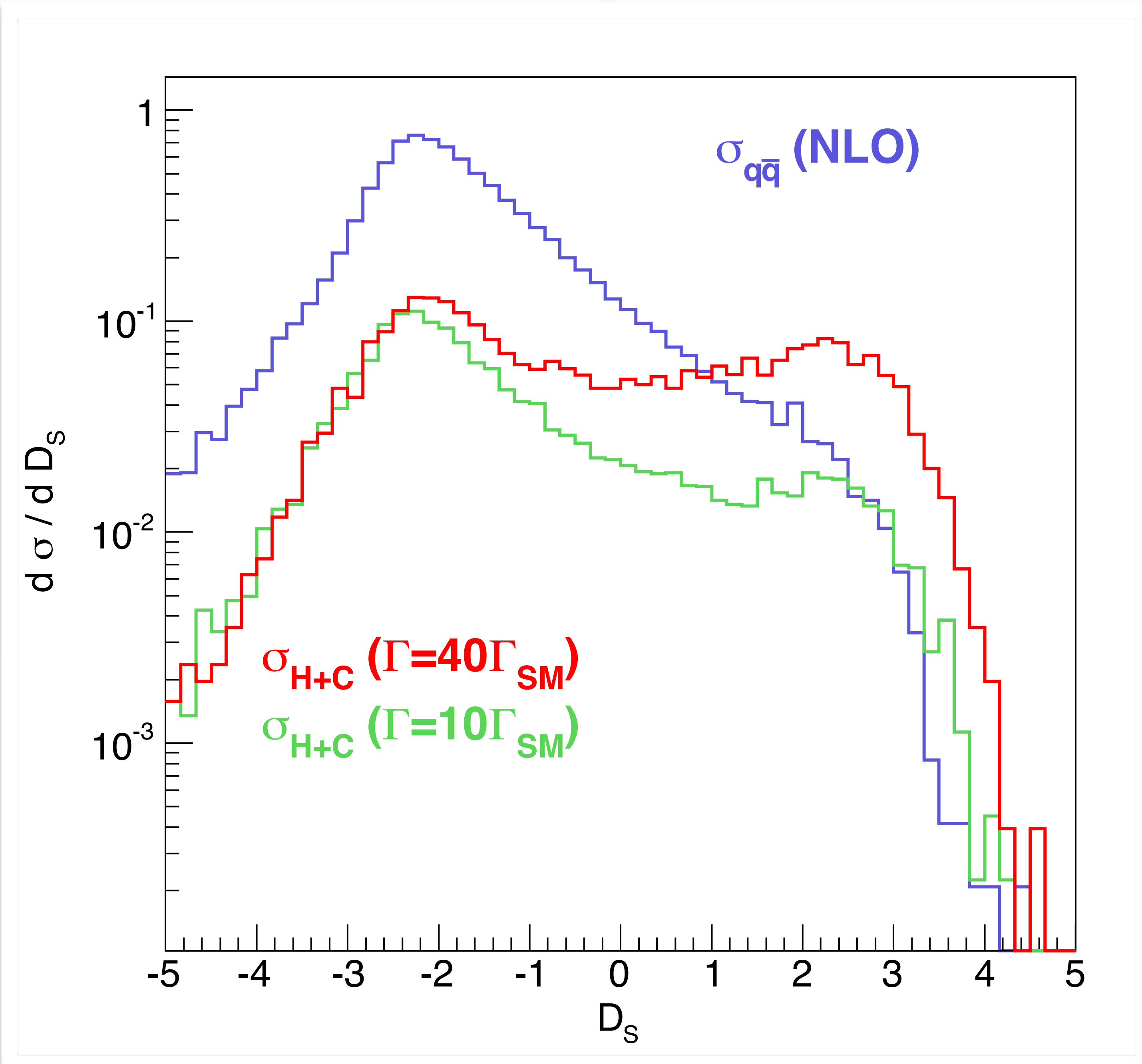
This is in some ways equivalent to including a NNLO K-factor (at least in the on-shell regime).

Then in the off-shell region we use the same form of scale, i.e.

$$\sigma_{LO}^{off}(\mu_{NNLO})$$

But use the usual LO scale variation as an indicator of uncertainty (i.e an envelope of {1/2, 2})

Systematics of the MEM



MEM discriminant

$$D_S = \log\left(\frac{P_H}{P_{gg} + P_{q\bar{q}}}\right)$$

Is not sensitive to scale since

$$P_X \sim \frac{|\mathcal{M}_X|^2}{\sigma_X}$$

In fact for fixed scale choice dependence on α_S drops out.

Therefore systematics are the same as the usual analysis, i.e. normalization of gluon induced samples versus qqb.