Discussion Session: Diffraction at the LHC and exclusive Higgs production

(If you are still here, you may be interested in the annual Manchester Forward Physics meeting, this year on the 13^{th}-15^{th} December – contact Andy Pilkington, Valery Khoze, Brian Cox or Steve Watts for details)

Possible discussion topics

- What is the uncertainty in the exclusive Higgs cross section calculation
  - due to enhanced survival probability (S_{enh})? (Differences between KMR, GLM, Strikman)
  - due to other uncertainties? (PDFs, Sudakov).

- Can the early data at √s = 7, 10, 14 TeV be used to constrain model uncertainties?

- Urgency of exclusive Higgs detection? What is the necessary timescale for detector upgrades?
  - AFP and HPS (FP420)
  - Forward shower counters at CMS/ATLAS/ALICE/LHCb

- Does exclusive production complement 'traditional' LHC strategy for Higgs measurements?

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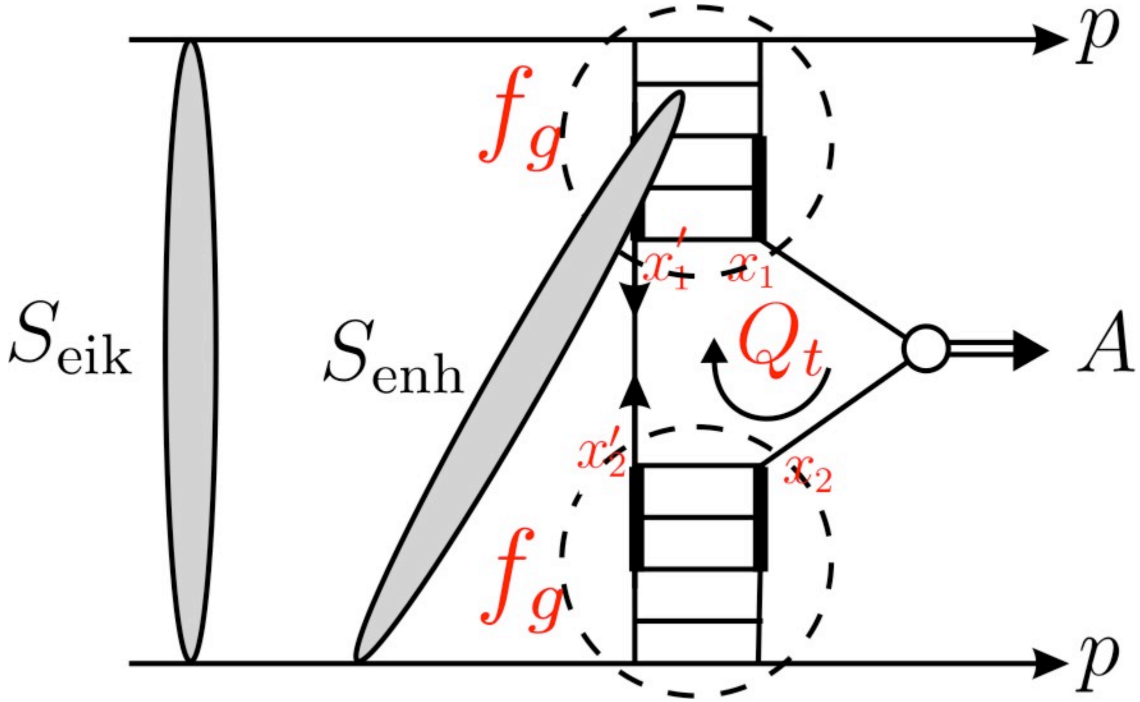
Exclusive Higgs uncertainty (I) – enhanced survival effects

"Enhanced" absorptive effects

(break soft-hard factorization)

rescattering on an intermediate parton:



- KMR estimate S_{enh} gives extra suppression of about 30%
- GLM (2008) estimate suppression factor of 0.063
- Strikman et al estimate suppression factor of (<) 0.1

KMR comments on GLM(2008)

GLM include some 3P effects, but get $\langle S_{enh}^2 \rangle = 0.063$

$$\langle S_{tot}^2 \rangle = 0.0235 \times 0.063 = 0.0015$$

Calculation should be extended to obtain reliable S_{enh}

1. Need to calc. b, k_t dep., S_{enh} comes mainly from periphery (after S_{eik} suppression) where parton density is small.
   So S_{enh} (GLM) is much too small.
2. First 3P diagram is missing, so σ_{SD} much too small.
3. Four or more multi-Pomeron vertices neglected, so σ_{tot} asymptotically decreases (but GLM have σ_{tot} asym. const.).
   Model should specify energy interval where it is valid.
4. Need to consider threshold suppression.
5. Should compare predictions with observed CDF data.

KMR comments on Strikman et al.

also predict a v.small S_{enh} !

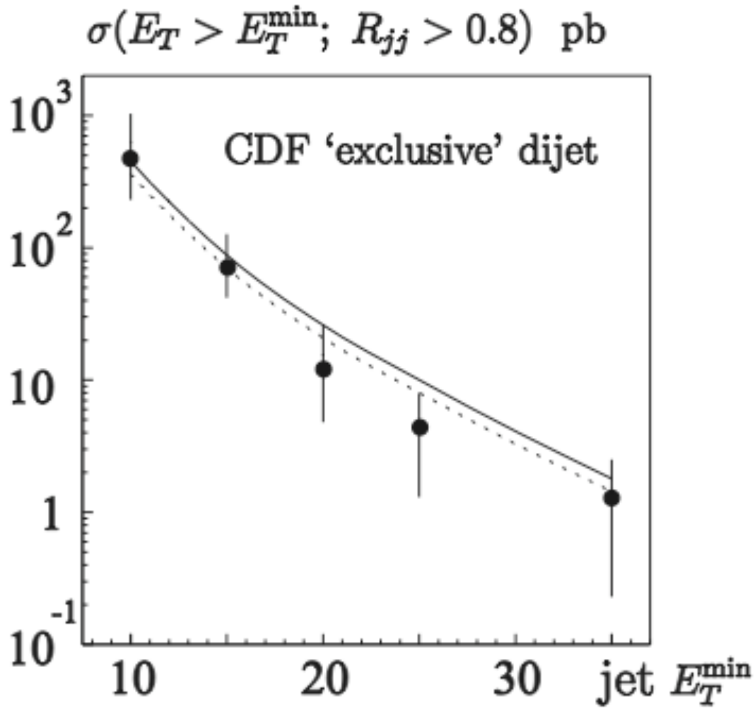
They use LO gluon with steep 1/x behaviour.

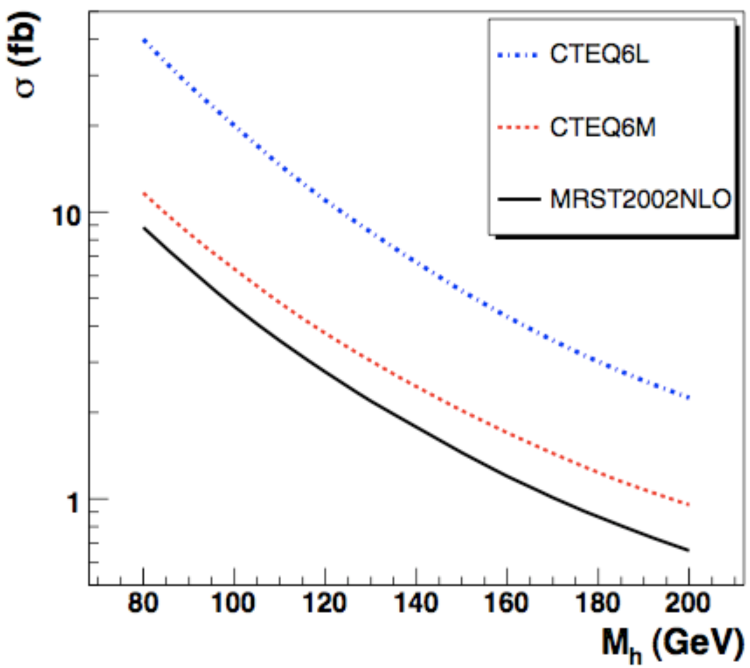
Obtain black disc regime at LHC energy, with low x gluon so large that only on the periphery of the proton will gap have chance to survive.

However, empricially the low x, low Q^2 gluon is flat – the steep 1/x LO behaviour is an artefact of the neglect of large NLO corrections.

Again should compare to CDF exclusive data.

Exclusive Higgs uncertainty (II)





- Good description of CDF data from KMR model (with Sudakov, soft-survival etc)
- Extrapolating to LHC:
  - KMR predict factor of three uncertainty (example PDF uncertainty shown above)
  - Dechambre/Ivanov et. al. predict larger (?) uncertainty.

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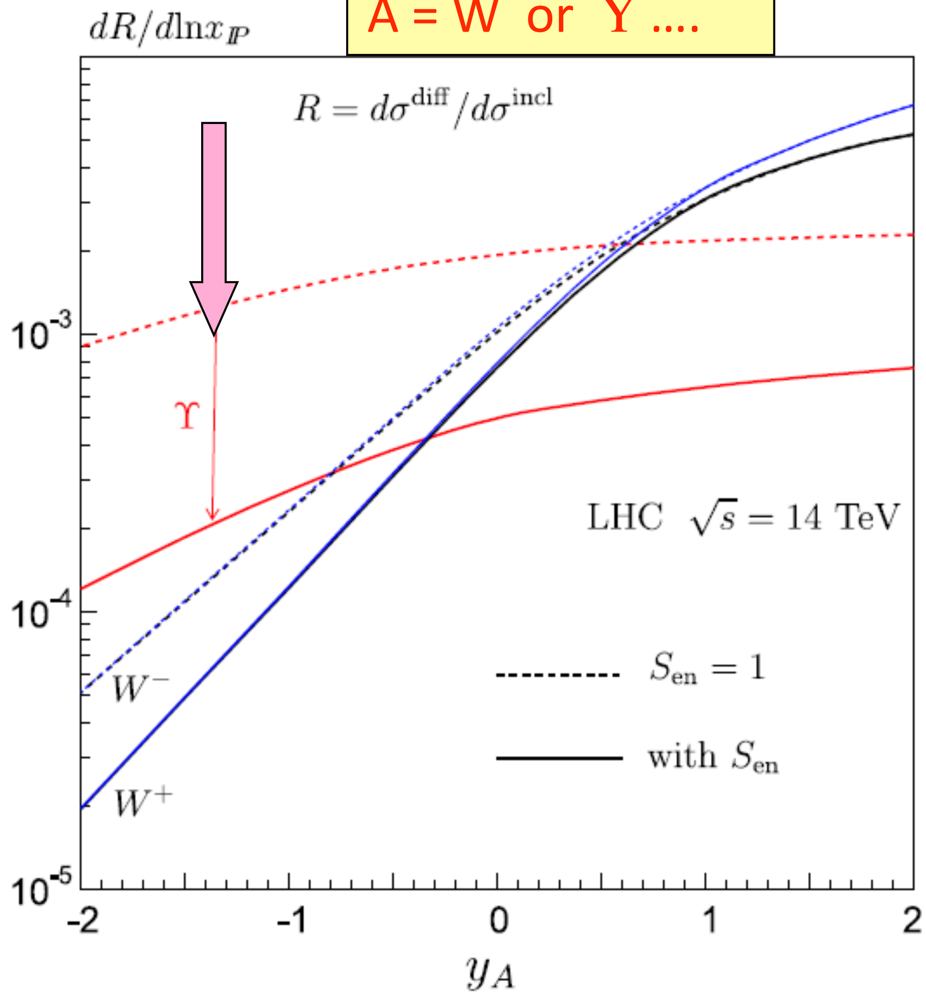
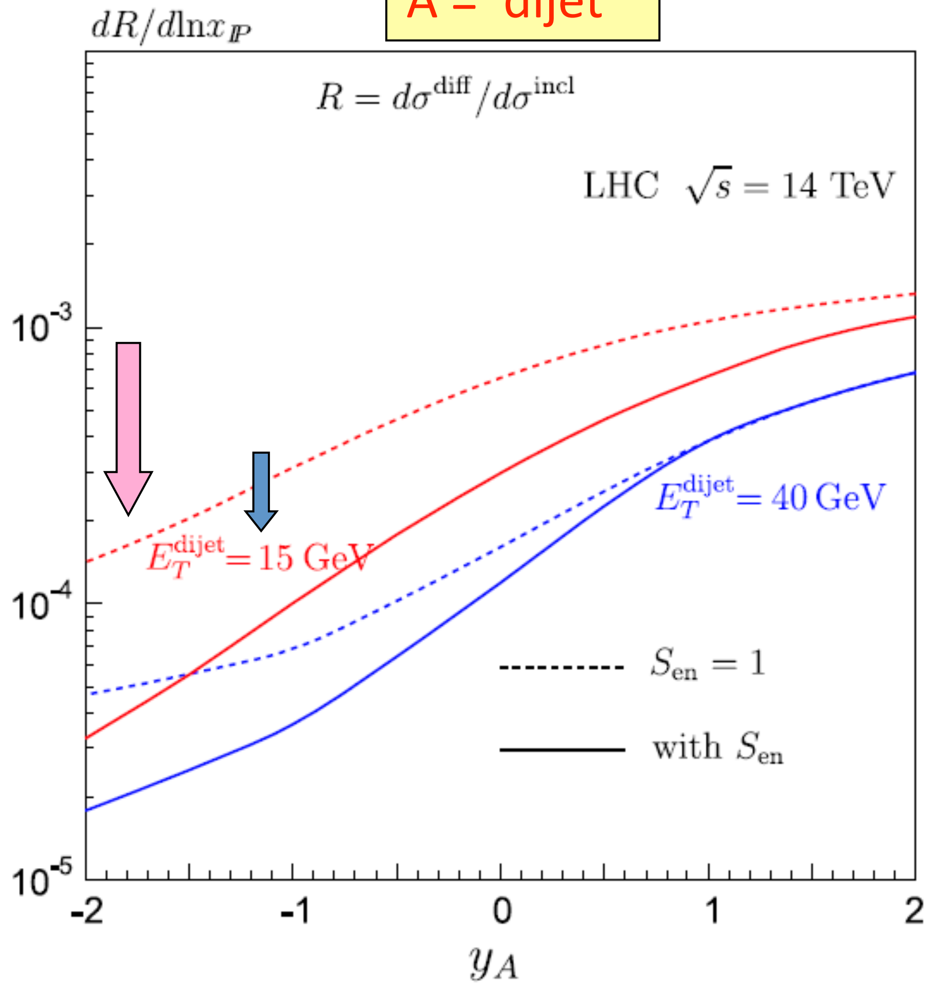
Fixed √s predictions:

A = W or Υ ....

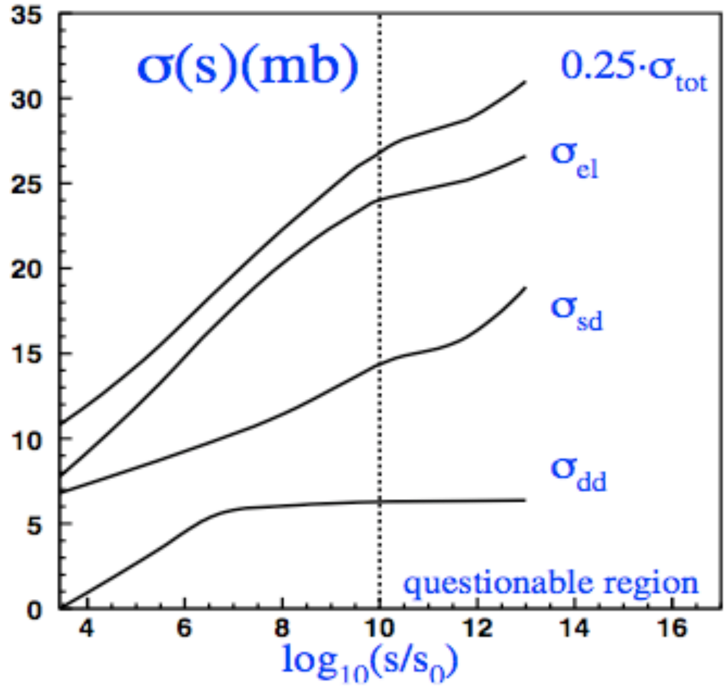


A = dijet

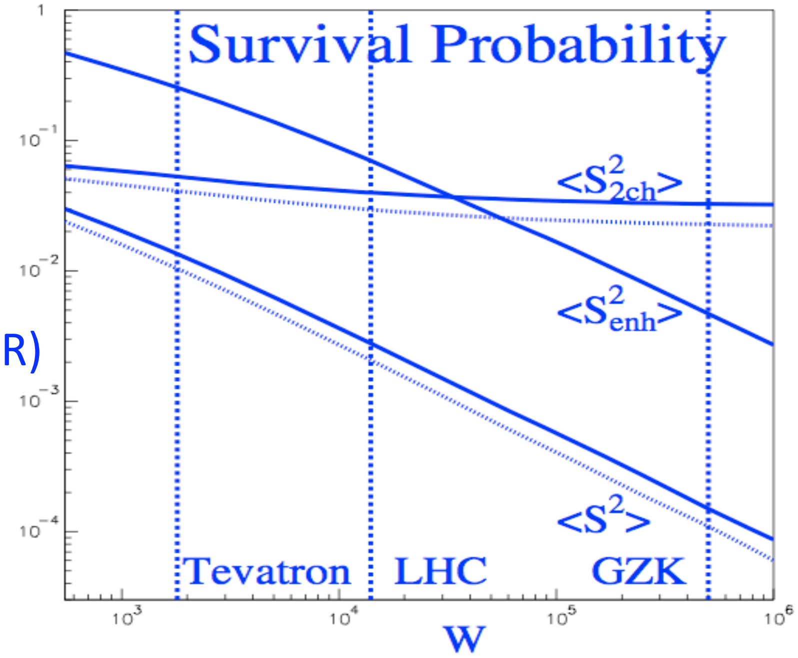


KMR rough estimates of enhanced absorption S^2_{en}

Early diffractive measurements at LHC



GLM predictions (different from KMR)



- We should repeat our diffractive measurements at √s=7,10,14 TeV if possible.
  - If all models fit CDF data (at 2TeV), but have large differences at 14TeV, then √s dependence could become apparent.
  - Will the luminosity be determined well enough?

- Unitarity/saturation effects are stronger in inelastic diffraction.

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Higgs coupling structure determination?

[C. Ruwiedel, M. Schumacher, N. Wermes '07]

$\Rightarrow$ explore $HW_\mu W^\mu$ coupling via $WW \to H \to \tau^+\tau^-$

$\Rightarrow$ $2\,\sigma$ effect for $M_H = 120$ GeV

Problem in MSSM:

$$g_{hVV} = g_{HVV}^{\text{SM}} \times \sin(\beta - \alpha)$$
$$g_{HVV} = g_{HVV}^{\text{SM}} \times \cos(\beta - \alpha)$$
$$g_{AVV} = 0 \qquad \text{at tree-level}$$

$M_H \approx M_A \gtrsim 150$ GeV $\Rightarrow$ h has substantial VV coupling but no (sufficient) $h \to \tau^+\tau^-$ enhancement

$M_H \approx M_A \lesssim 130$ GeV $\Rightarrow$ H has substantial VV coupling but no (sufficient) $H \to \tau^+\tau^-$ enhancement

- Slide taken from Sven Heinemeyer et. al. at EDS 2009.
- BSM Higgs sectors typically have a SM-like Higgs and another Higgs that decouples from the vector bosons.
- AFP/HPS help get spin-parity information on the ones that decouple from the W/Z's

Other topics