Double Diffractive Higgs Boson Production

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- HOPE and FACTS: Higgs *vs.* Dijets
- PROSPECTS: The Models
- TESTS: Models *vs.* Tevatron (Run II)

Two questions in our minds: Is $\sigma_{Diff}(Higgs)$ high enough?
What do we gain compared to standard production?

[a] With a contribution by Rikard Enberg on SCI model

Interest in Double Diffraction?

- General Motivation: Quite obvious from the LEP candidates and/or SUSY Higgses.

  Very important to look for Higgses in the 115-120 GeV region; Need to have different ways to see the Higgs since this search will be hard...

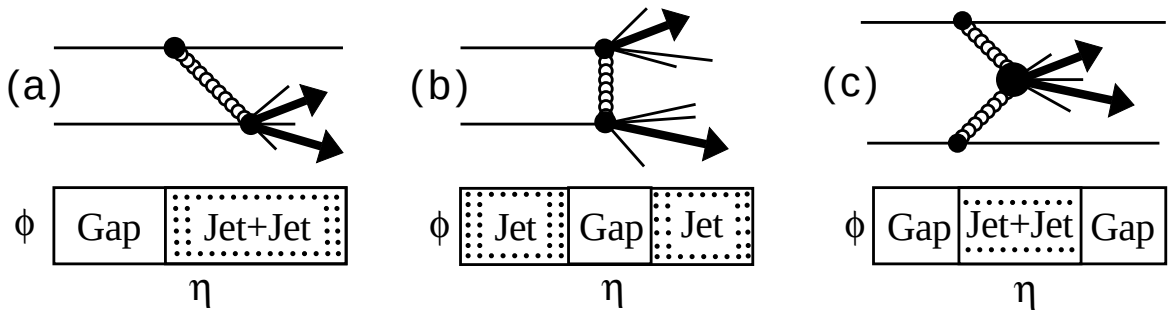
- LHC: Clearly, the golden accelerator to see the Higgs, but more difficult in the low mass region ($\gamma\gamma$ region).

  The mass measurement using diffractive events may be very important using the resolution coming from proton tagging.

- Standard *vs.* Diffractive Higgs production: Evaluation of the cross-sections is crucial (and difficult!):

  The main point: "Calibration" to the High mass double diffractive production modes to be measured at Tevatron (Run II)

FACTS: Diffractive Dijets at Tev. (Run.I)

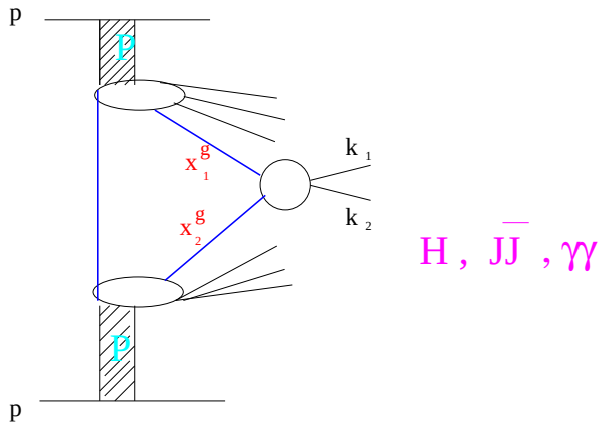


NB: In the following, only diagram (c) considered

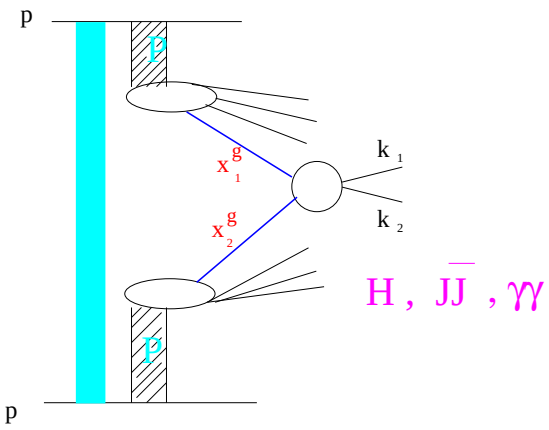
Kinematic variables

- $\xi_1(\xi_2)$: $p(\bar{p})$ **fractional momentum loss** ($\Delta\eta_i \sim \log 1/\xi_i$: **rapidity gaps**)
- $M^2 = s\xi_1\xi_2$: **Diffractive mass produced**
- M^2_{JJ}: **Dijet mass**
- $M^2_{JJ}/s\xi_1\xi_2$: **Dijet mass fraction** < 1

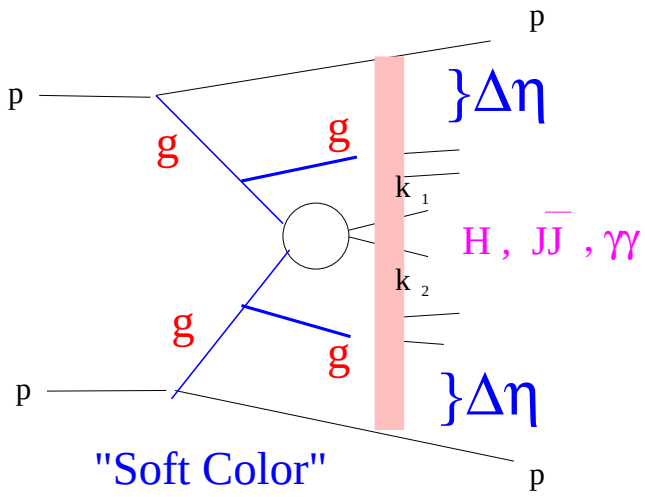
The models in Friendly Competition



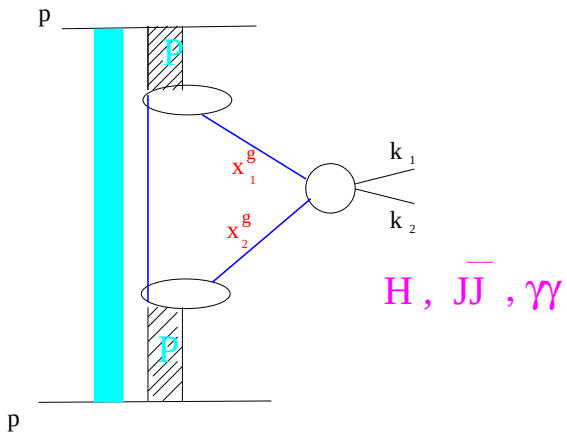
"Inclusive, Non fact. POM."



"Inclusive, fact. POM"



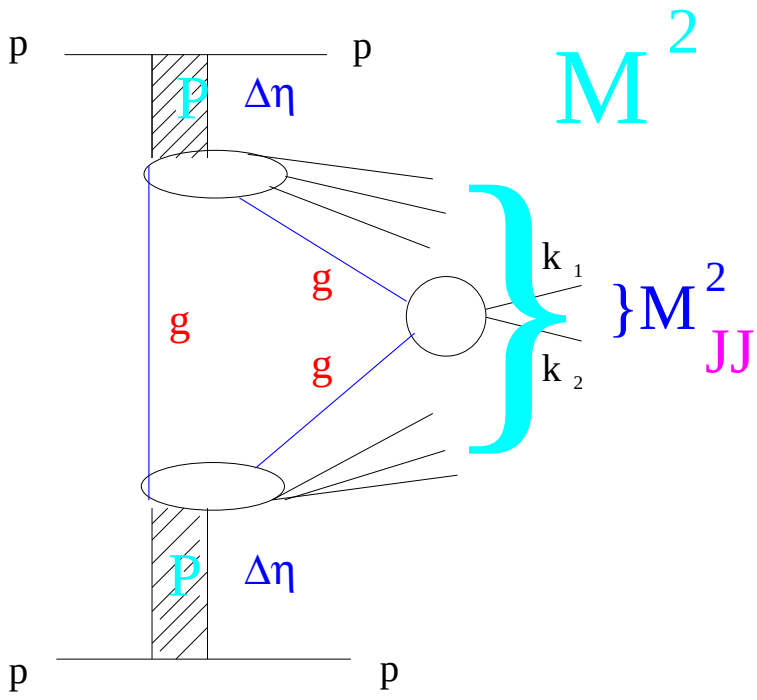
"Soft Color"



"Exclusive "

Two or Three Things I know about it[a]

M.Boonekamp, R.P., C.Royon,
hep-ph/0107113,0205332[b],0301244

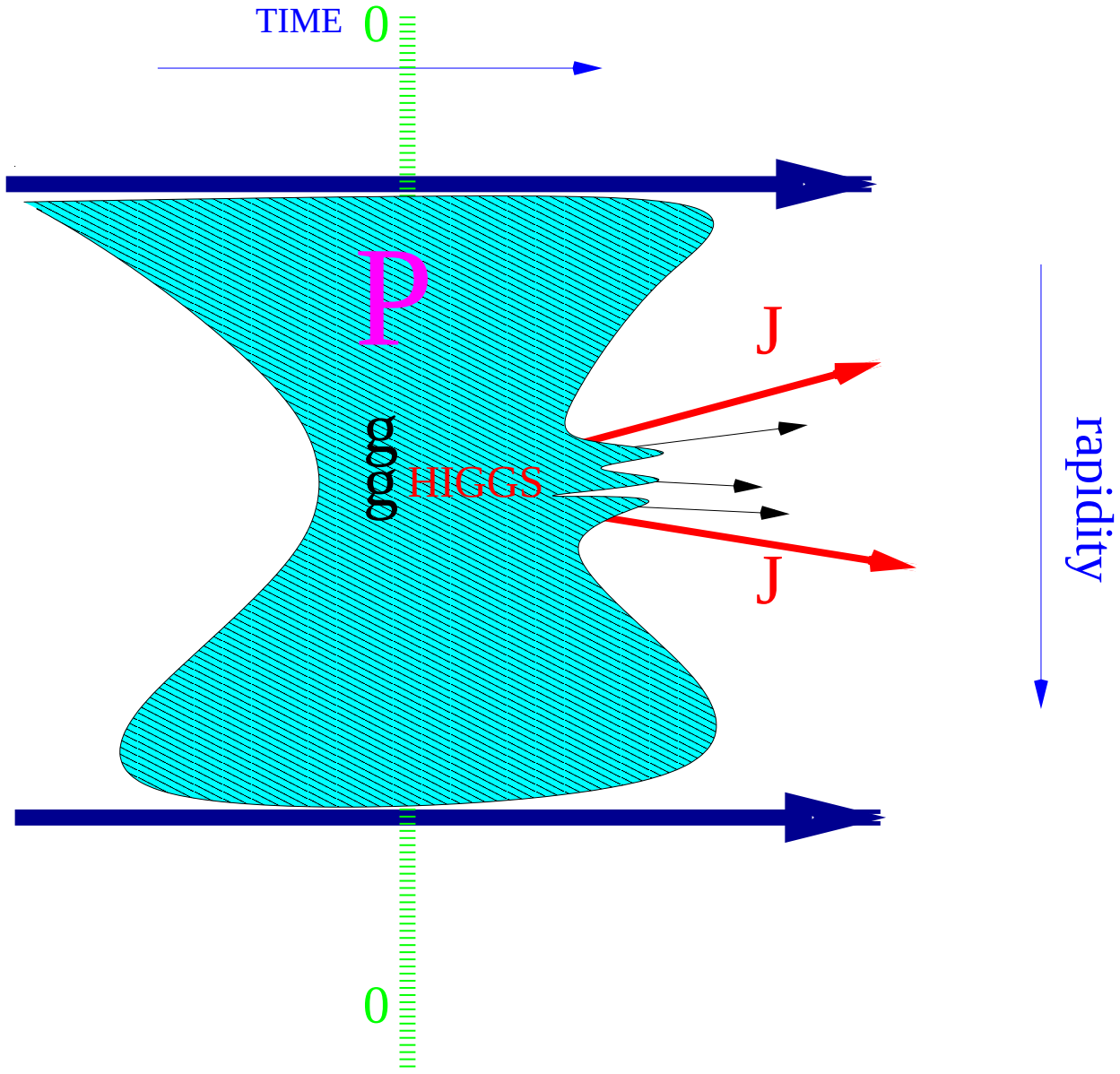


The idea of the model: Take the usual hadron-hadron cross section to produce the hard scattering (Higgs, dijets, $\gamma\gamma$) and convolute it with $G_{\mathcal{P}omeron}$ at HERA

[a] about her *cf. Jean-Luc Godard, 1966*

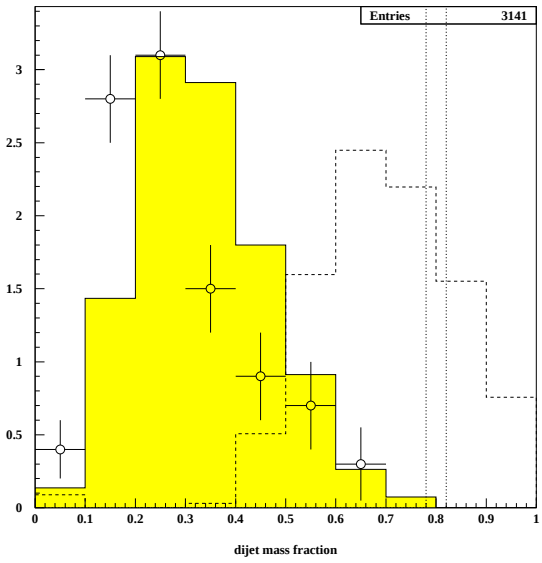
[b] + A.de Roeck

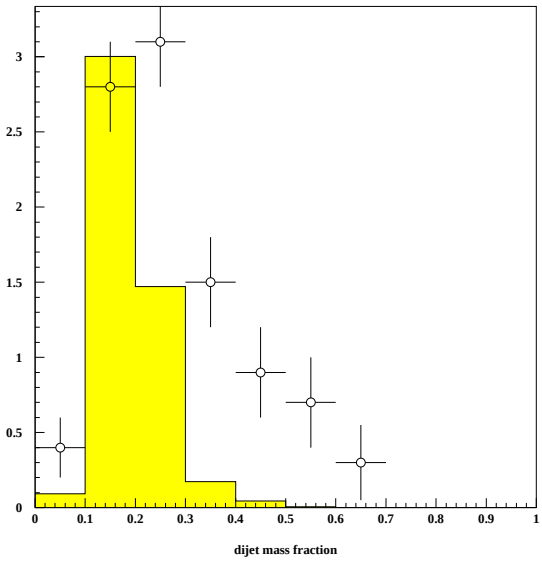
My View of Double Diffractive Higgs...



Time evolution $\Rightarrow$ hard QCD factorized but soft Pomeron not factorized

CDF dijet mass fraction

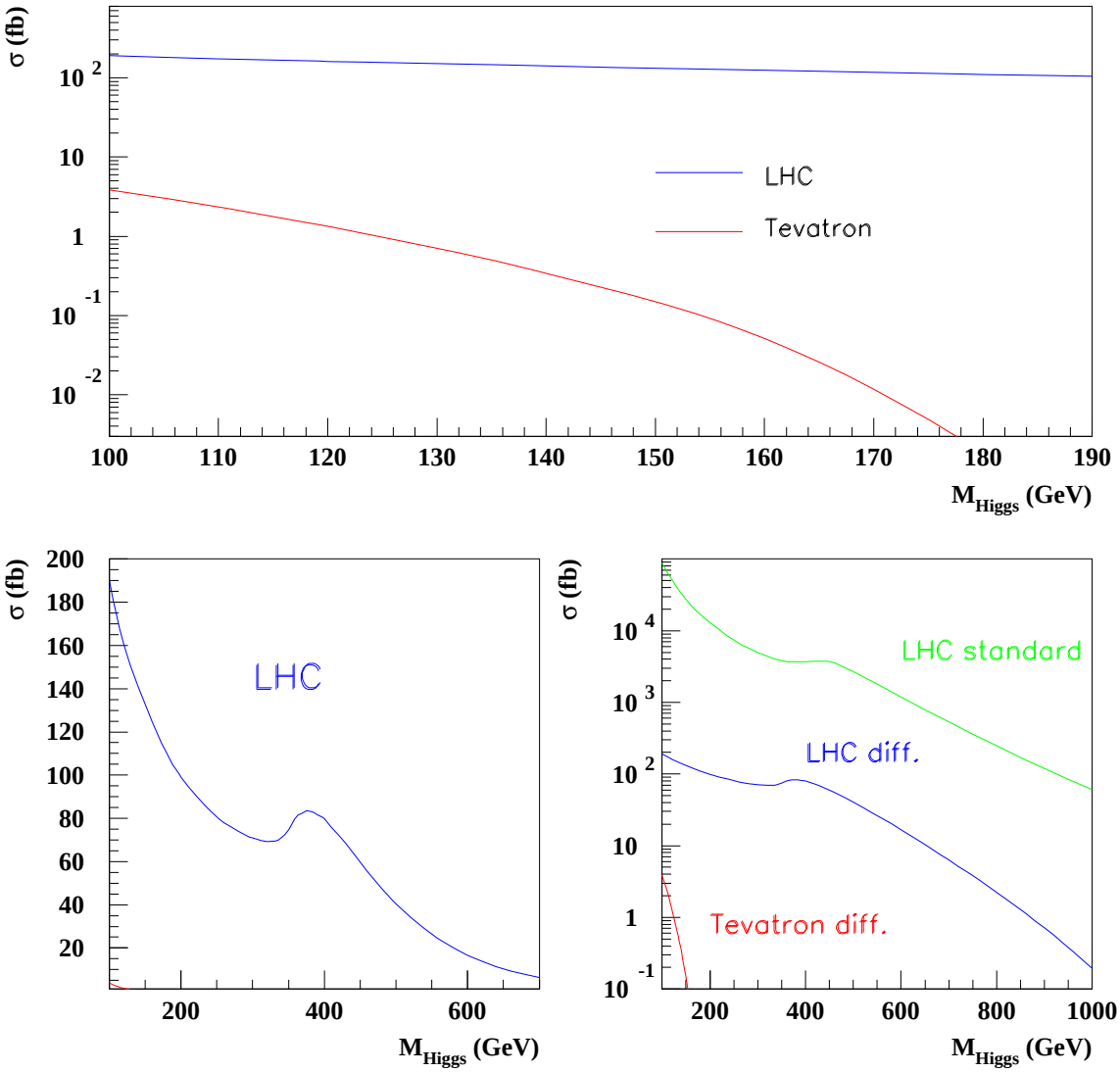




CDF Coll.,Phys.Rev.Lett. 84 5043 (2000)

Pomeron *vs.* Proton Source of Gluons

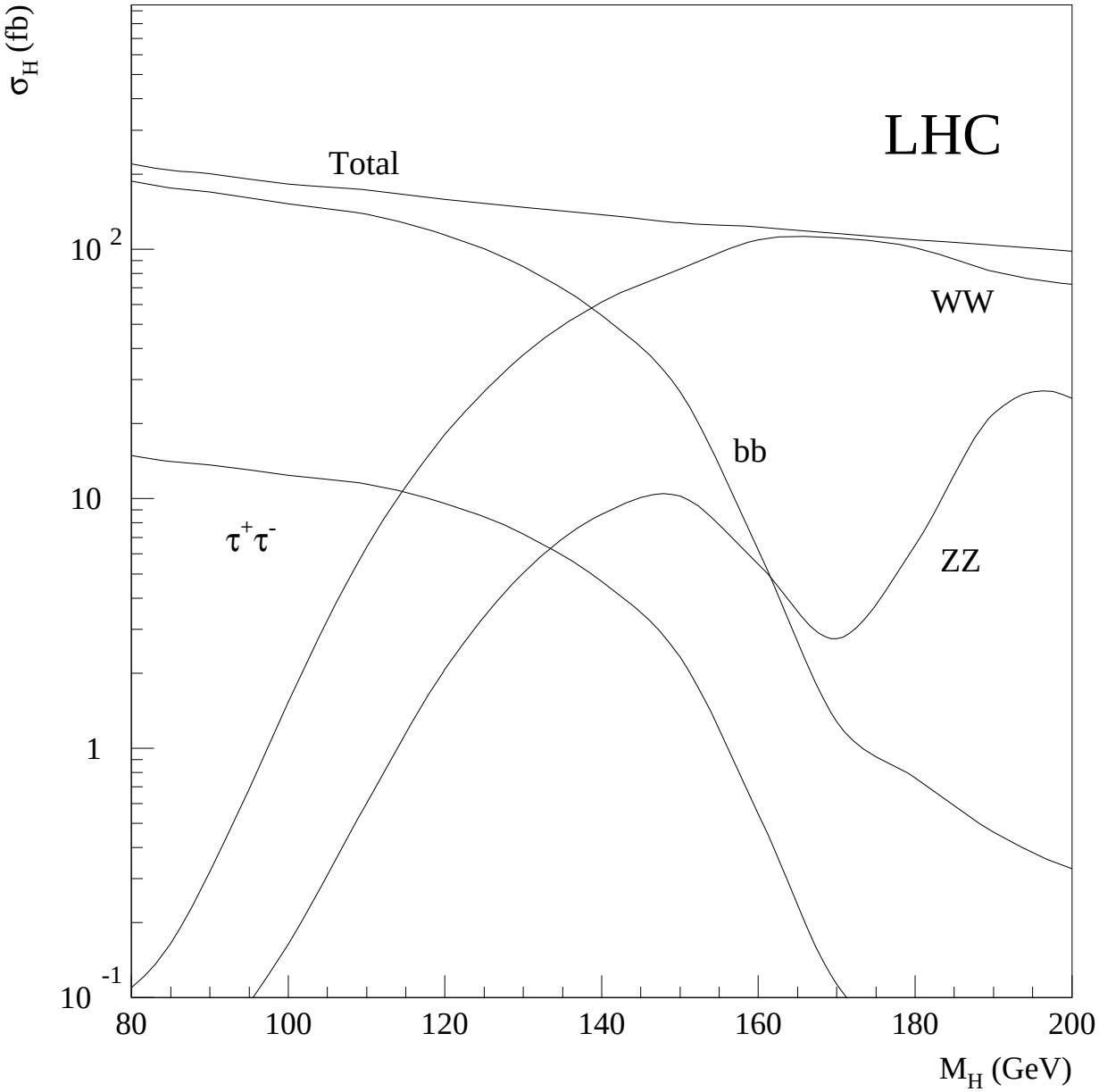
PROSPECTS: Tevatron and LHC cross sections



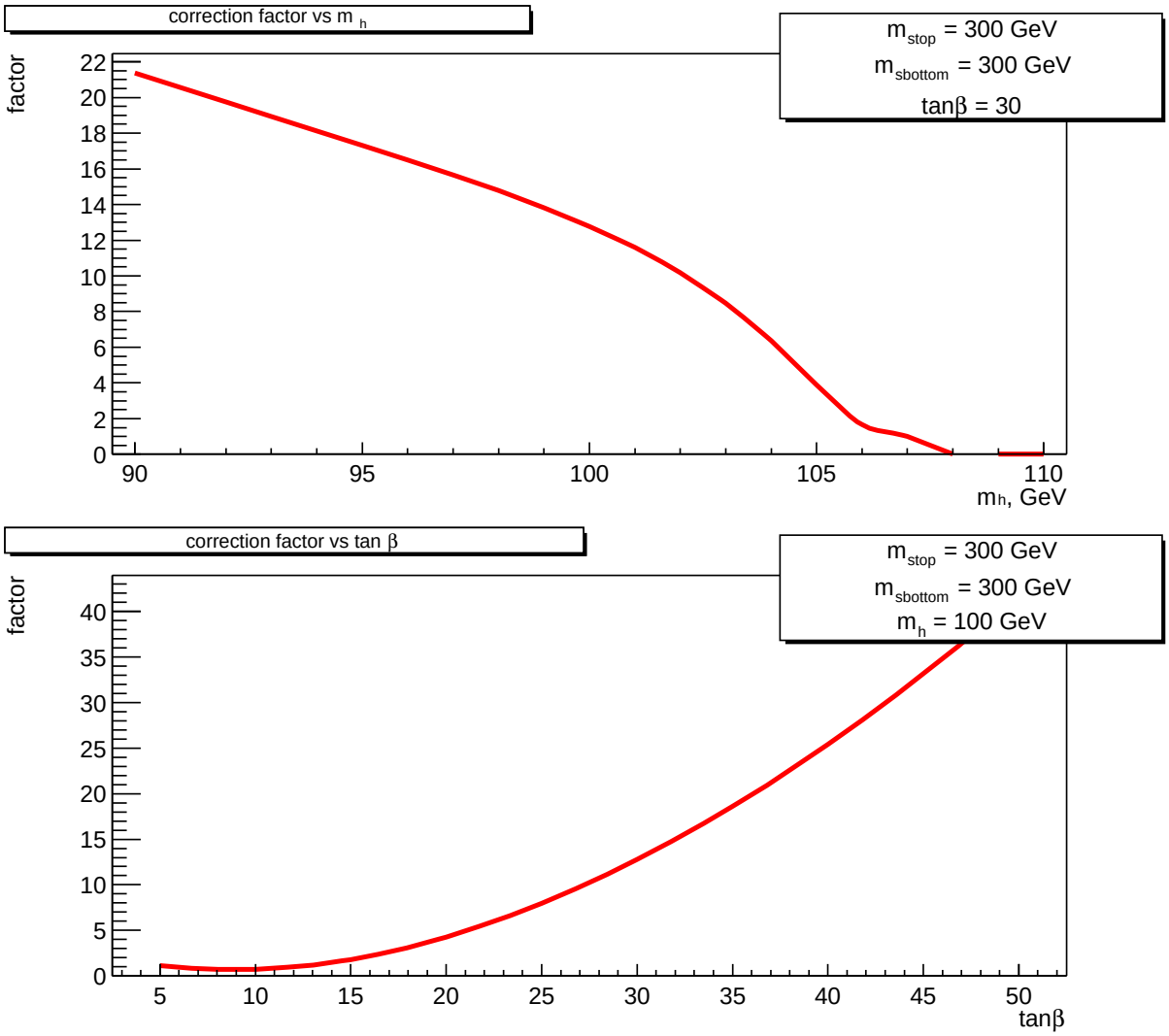
Non Fact. POM. M.Boonekamp, A. De Roeck, R.P., C.Royon, hep-ph/0205332

PROSPECTS: LHC cross sections

Various decay channels

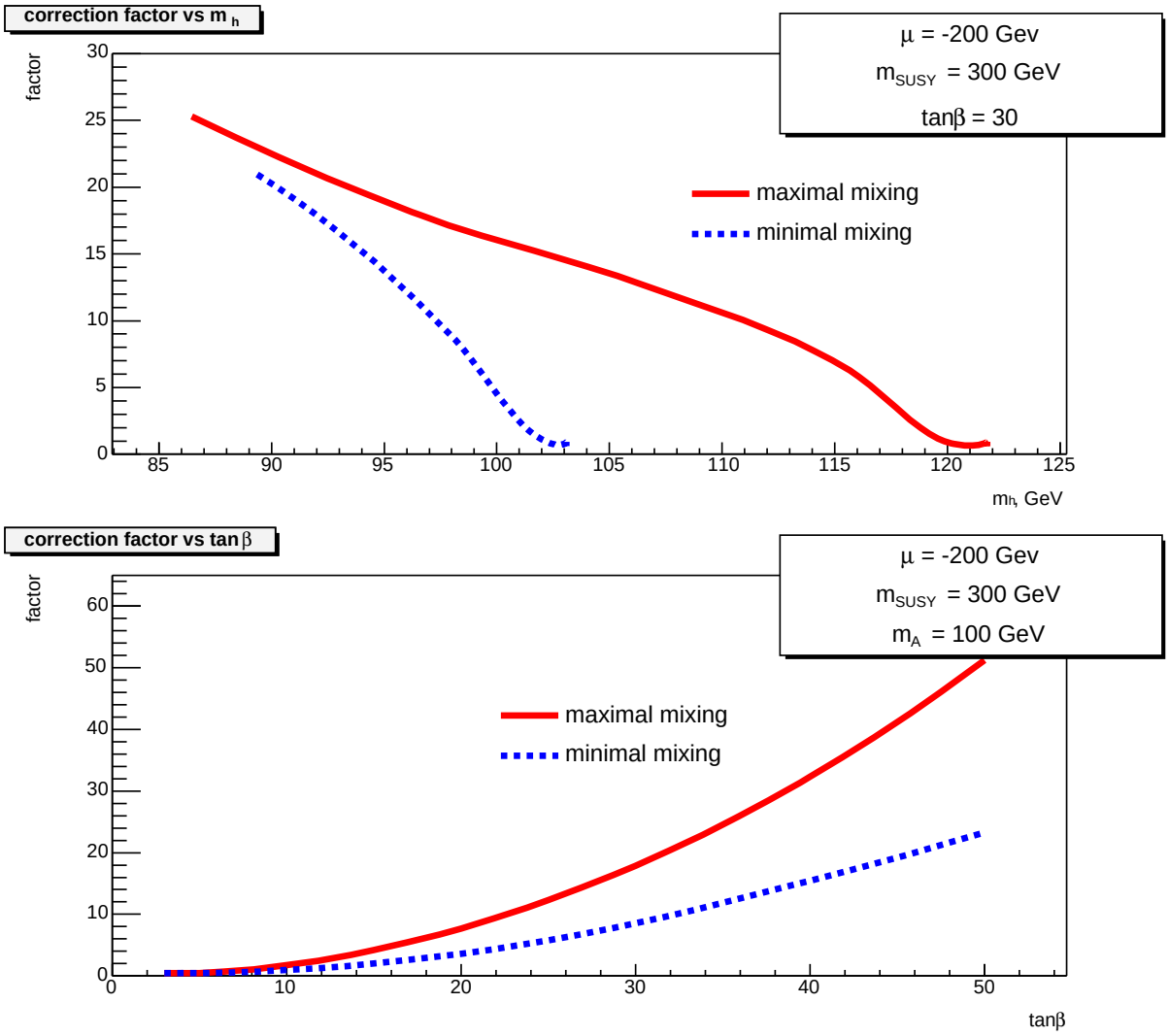


PROSPECTS: SUSY factors (Tree level)



C.Royon, hep-ph/0308283,
Mod.Phys.Lett.A18:2169,2003

PROSPECTS: SUSY factors (2-loop level)



P.Demine,S.Lavignac,R.P.,C.Royon, to appear

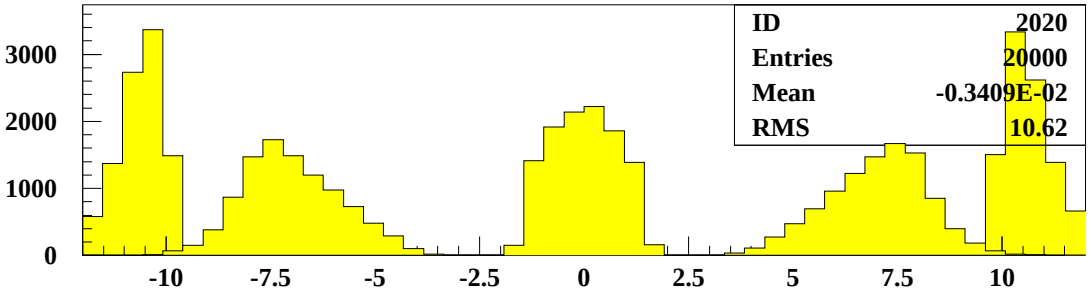
PROSPECTS: Higgs $\sigma_{Prod.}(fb)$

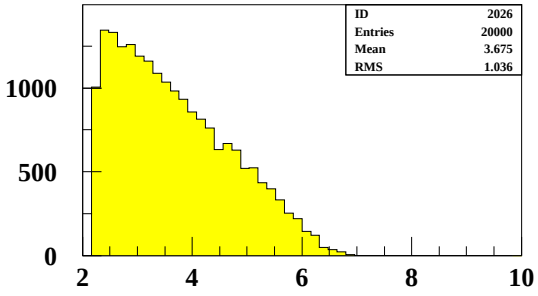
	(1)	(2)	(3)	(4)
H∼115 GeV, TeV.	1.7	0.029	.03	10^{-4}
Tev: $\mathcal{L} \sim 1 fb^{-1}$		0.09		
H ∼115 GeV, LHC	169	379×	1.4	0.19
$\times = GSP \sim (.1 \to .03)$		486×		
H ∼160 GeV, LHC	123	145×	.55	-

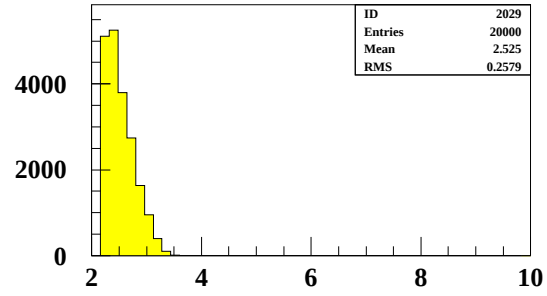
- **(1) Non Fact. POM.** M.Boonekamp, R.P., C.Royon, ph/0107113
- **(2) Fact. POM.** B. Cox, J. Forshaw, B. Heinemann, ph/0110173
- **(3) Exclusive** V. Khoze, A. Martin, M. Ryskin, ph/020130 and Refs.
- **(4) Soft Color** R. Enberg, G. Ingelman, A. Kissavos, N. Timneanu, ph/0203267

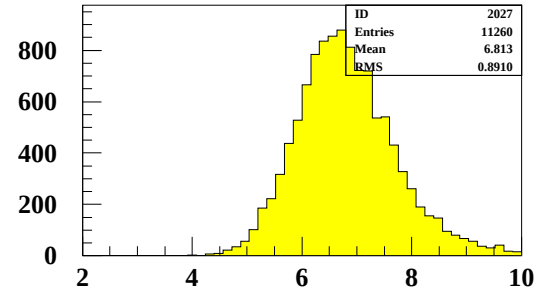
Pomeron remnant tagging possibility

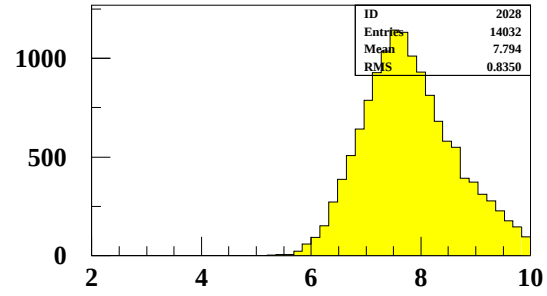
120 GeV Higgs, LHC





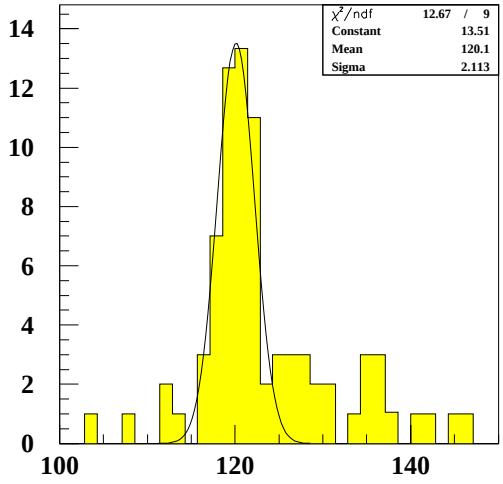




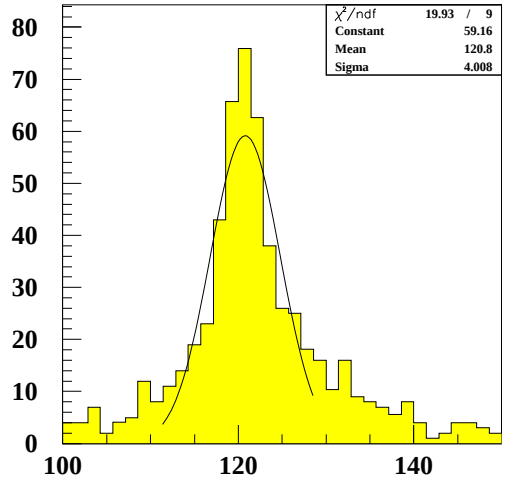


H mass reconstruction

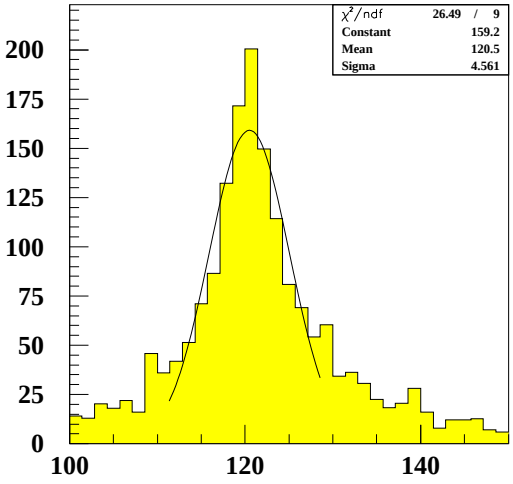
120 GeV Higgs, LHC



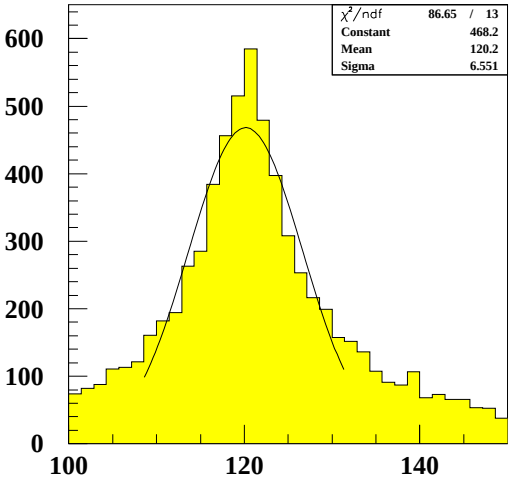
M Higgs - 20 GeV



M Higgs - 50 GeV

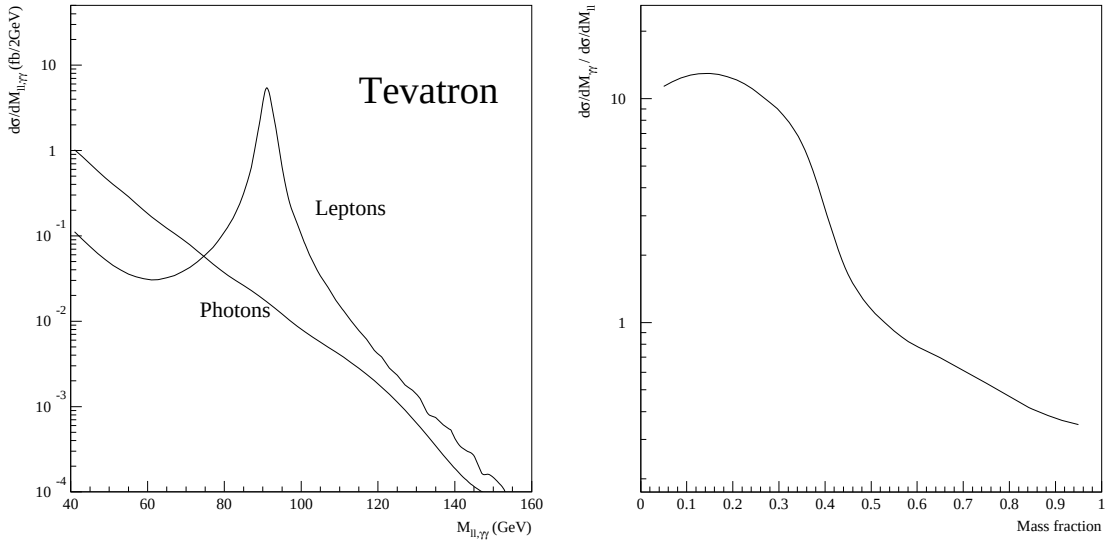


M Higgs - 100 GeV



M Higgs - 500 GeV

TESTS: Exclusive vs. Pomeron at RUNII

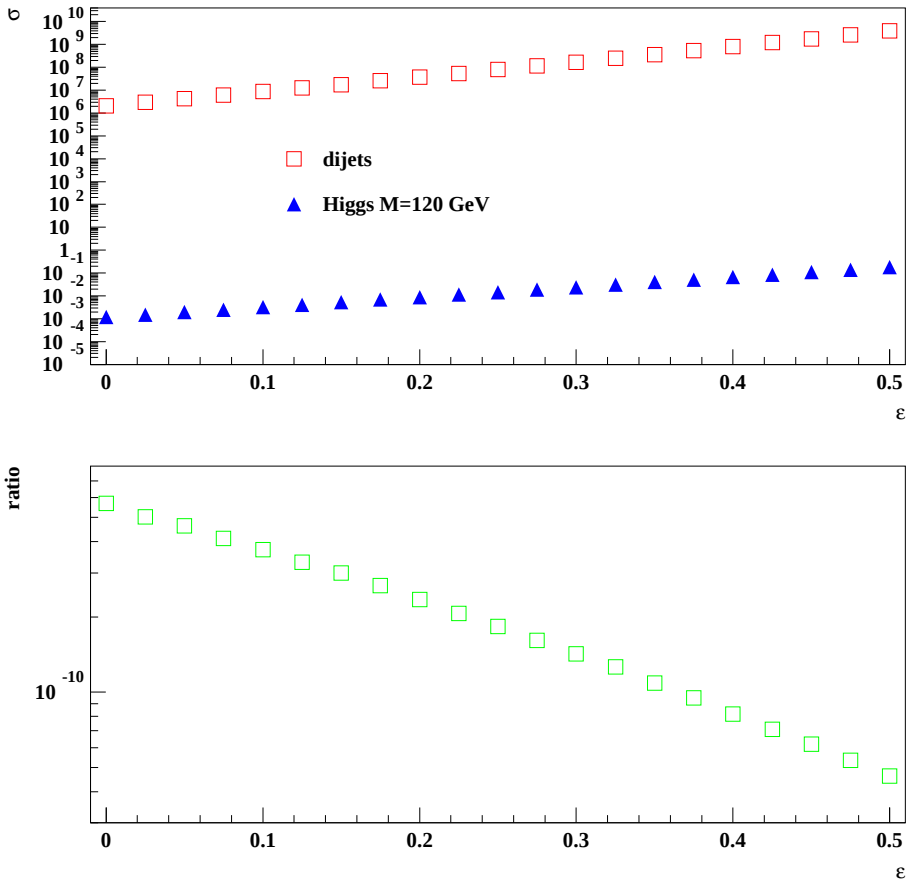


- **Diffractive $\gamma\gamma$, l^+l^- at Tevatron**
- **Their ratio *vs.* Mass Fraction.**

Non Fact. POM. M.Boonekamp, R.P., C.Royon, ph/0301244

Conclusion: Very important to measure diphotons/dileptons!

TESTS: Pomeron models at RUNII

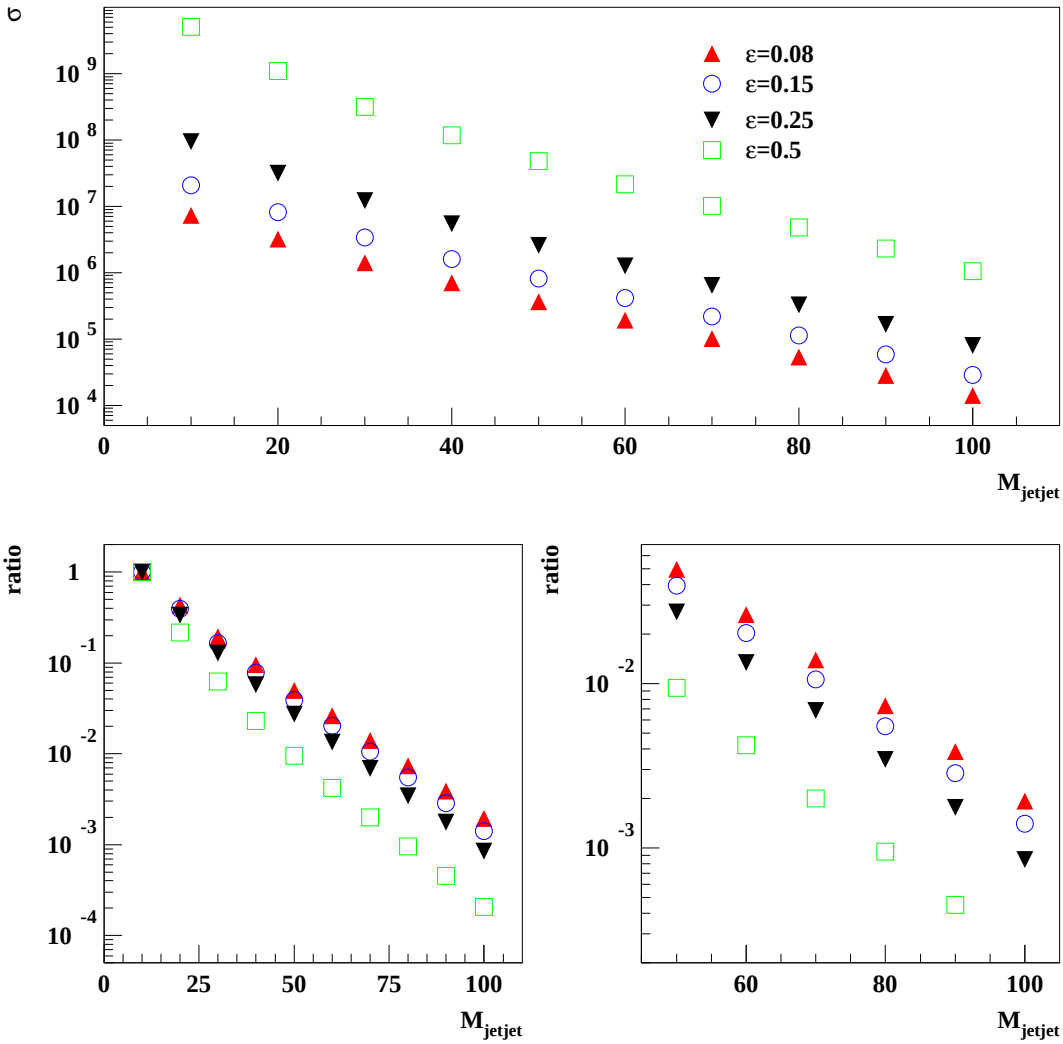


Variation of the dijet *vs.* Higgs cross section (generator level) as a function of the Pomeron intercept ϵ.

Fact.POM: $\epsilon \sim .25$ $\Longleftrightarrow$ **Non Fact.POM:** $\epsilon \sim .08$

Conclusion: Important to measure ϵ!

TESTS: Dependence on the dijet mass



CONCLUSIONS[a]

- **Higgs bosons by DDI : Small X-sections at Tevatron, but large at LHC (except SCI, single diffraction)**
- **Still high uncertainties: Diffractive cuts, jet energy scale, gap survival rate or soft/hard interface**
- **Distinguish between models: Measure diffractive $\gamma-\gamma$ *vs.* l^+l^-, and JJ *mass*, E_T-dependence at run II**
- **Advantages of the diffractive Higgs?: Mass constraint using the roman pot detectors good mass resolution at LHC if measure of Pomeron remnants, low background for WW, $\tau\tau$, also $b\bar{b}$?**

[a] Collaboration now: M.Boonekamp,P.Demine,R.Enberg,T.Kucs, A.Kupko, S.Lavignac, R.P., Ch.Royon