Diffractive Higgs production at LHC

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40th PNPI Winter School
Repino, February 25, 2006

Outline:

Why Diffrractive Higgs?

Hard Diffraction: dijets

Double-Pomeron-Exchange (DPE)

Higgs via single-Pomeron exchange

Summary

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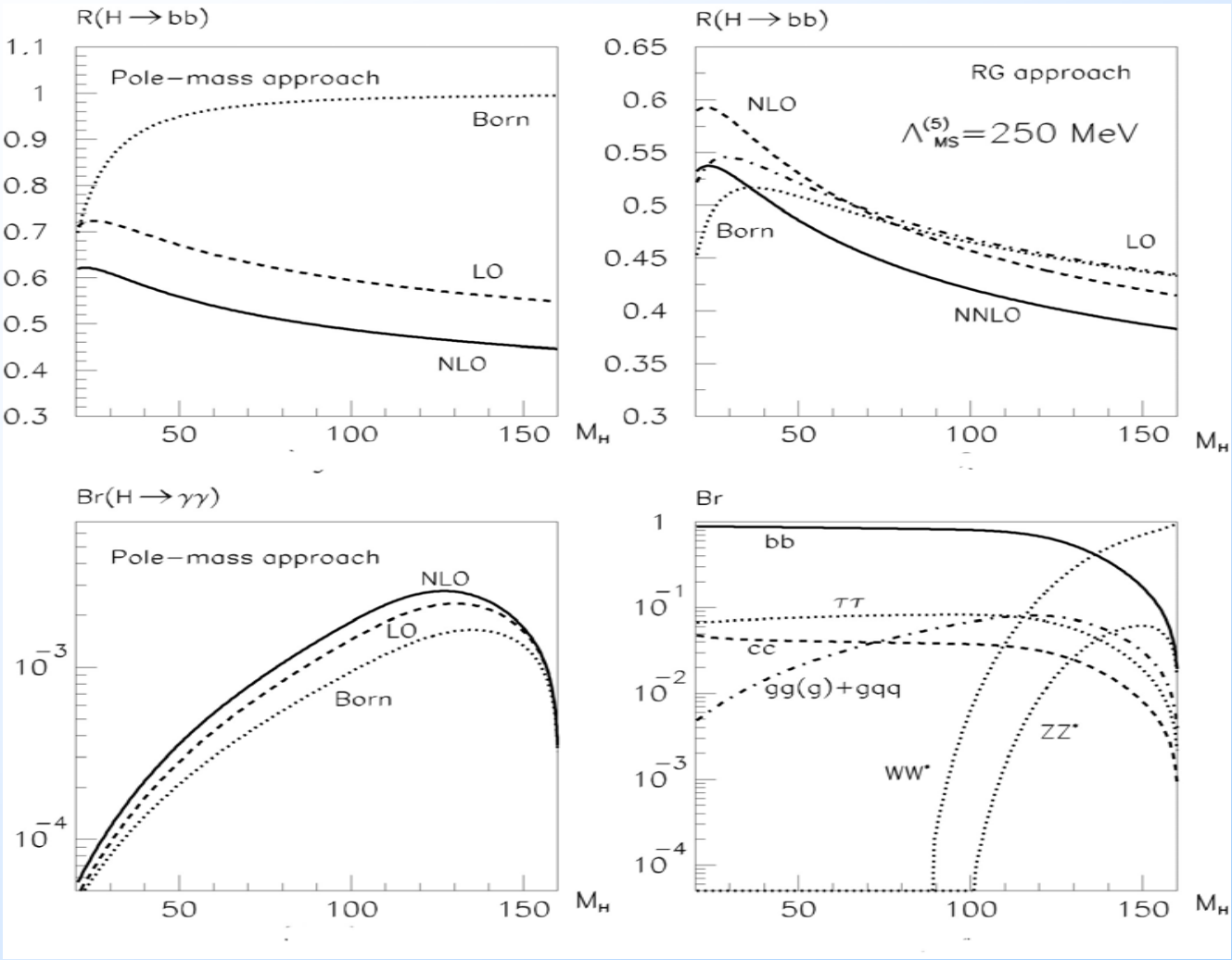
NLO S.Gorishny et al. 91
A.Kataev & VK 93



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Light Higgs at LHC

$120 < m_H < 140$ GeV $L = 30 Fb^{-1}$

	#events	Significance
• H -> γγ	300	3-4 σ ?
• H-> jbbj	300	5-6 σ ?
Diffractive Higgs		
• pp->pHp->pbbp	10	4σ

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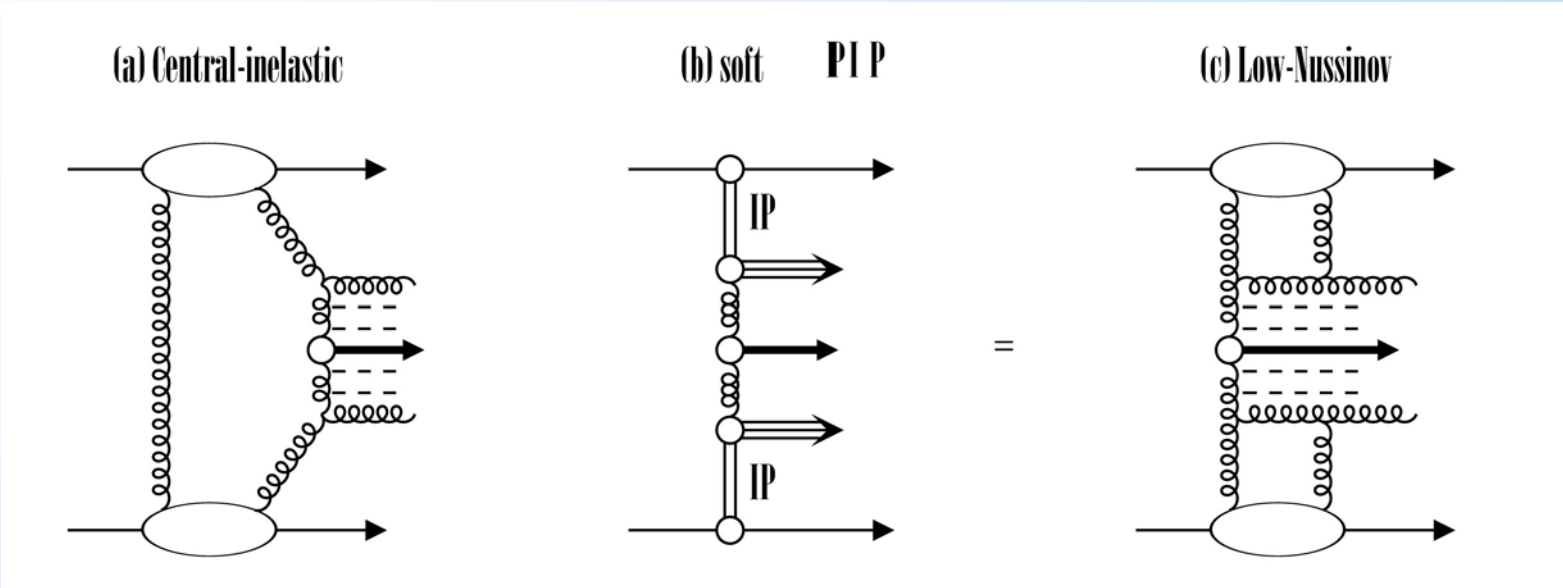
Double-Pomeron Exchange (DPE)



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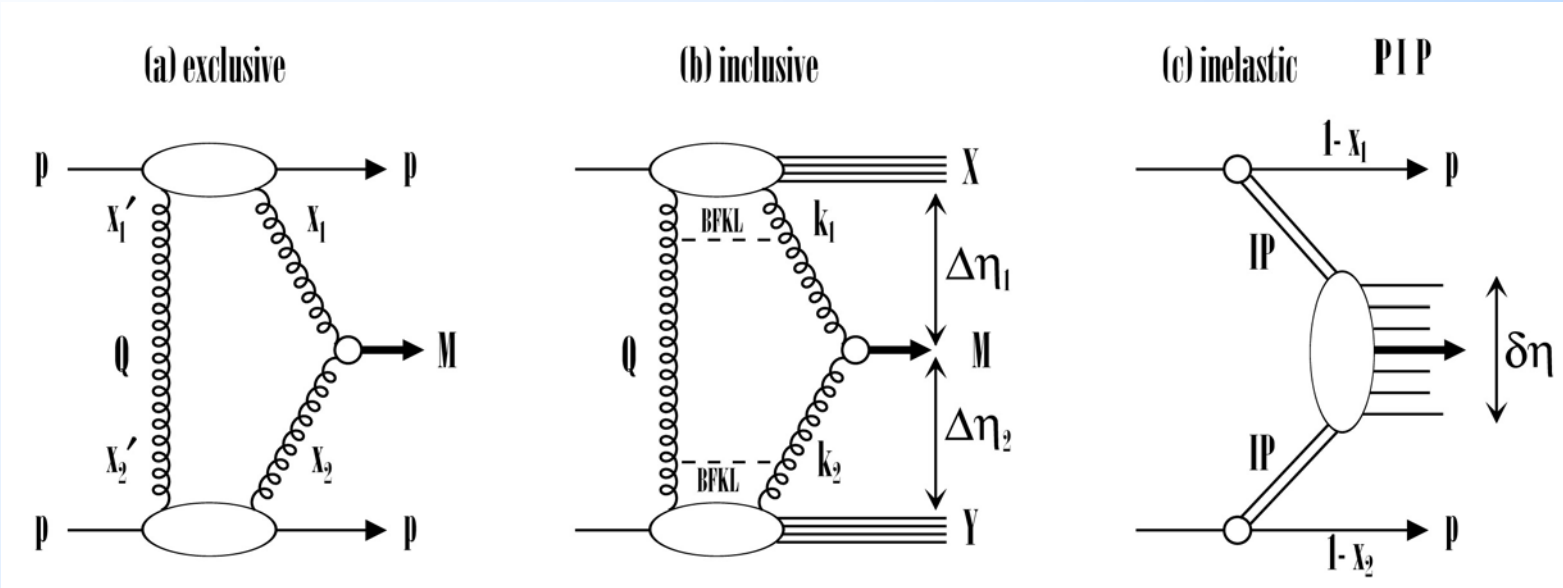
Durham-Gatchina model (Khoze, Martin & Ruskin)



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Hard diffraction

- Ingelman & Schlein (85)
- UA8 (88): diffractive high-pT dijets !

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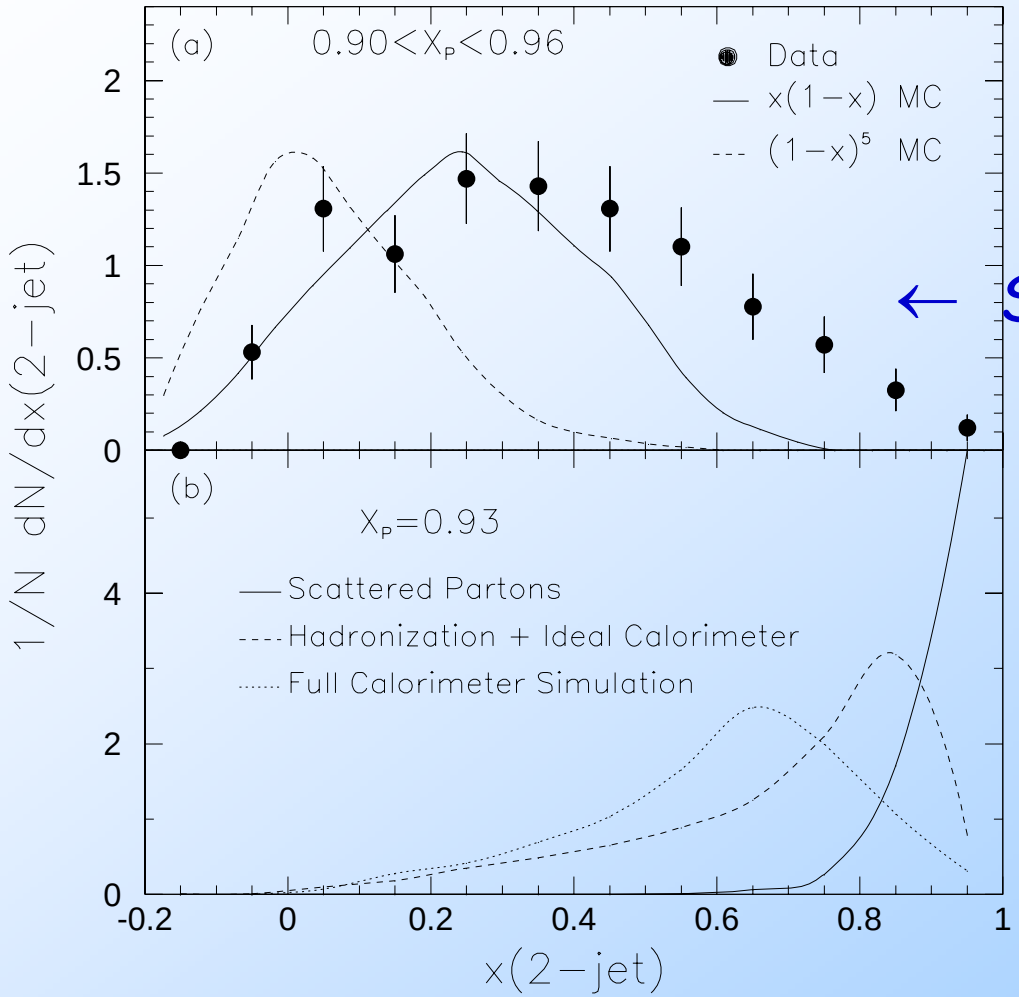
UA8 data from SppS (630 GeV)



← Super-hard structure

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Pomeron parton distributions

Soft: $\beta\, G_{IP}(\beta,Q_0^2) = 6(1-\beta)^5$

Hard: $\beta G_{IP}(\beta,Q_0^2) = 6\,\beta(1-\beta)^1$

Super-Hard:

$\beta\, G_{IP}(\beta,Q_0^2) = 0.6\; 6(1-\beta)^1$

$+0.4\;\delta(1-\beta)$

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SPE MC generator: Hardping

- Pythia -> Pompyt -> Hardping

At present:

- Only SPE
- Only light jets

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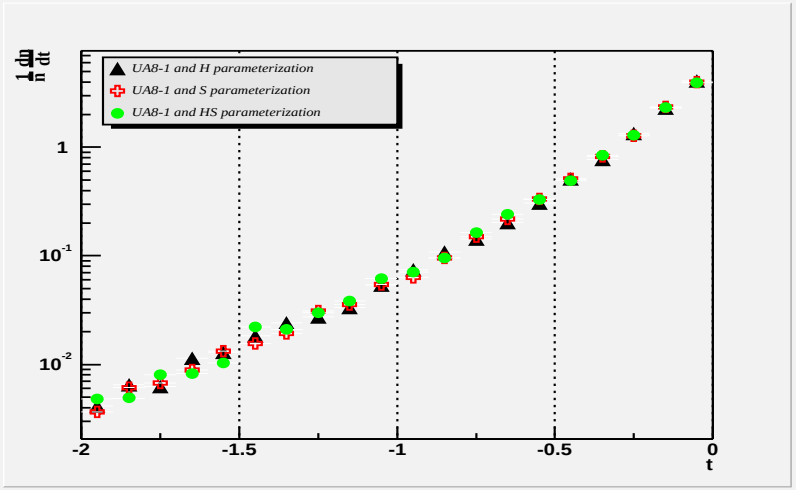
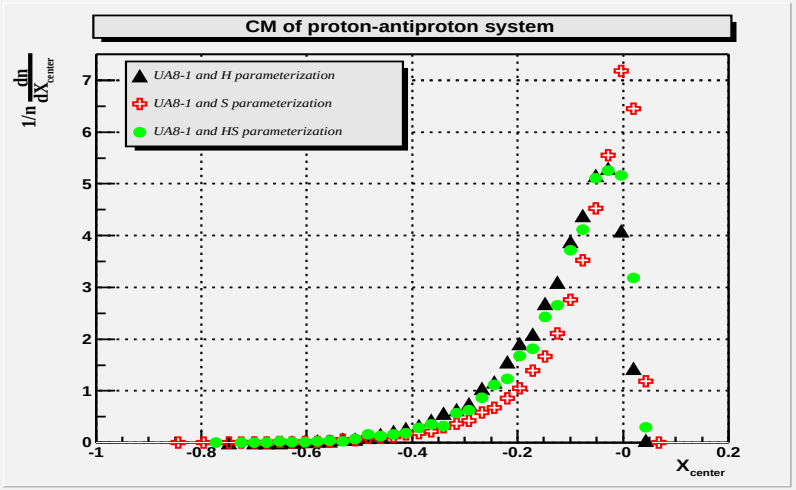
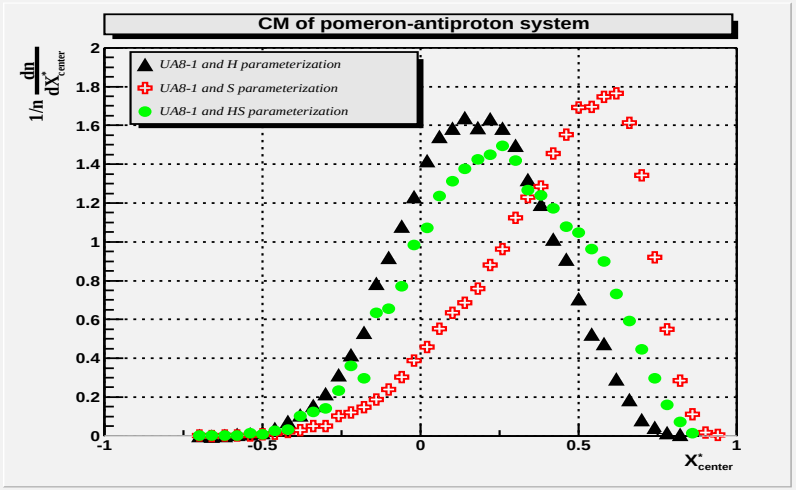
Hardping: 630 GeV (Anufriev & VK)

HARDPING
Flux factor UA8-1
Hard (H) parameterization : zg(z)=6z(1-z)
Soft (S) parameterization : zg(z)=Nz^{a}(1-z)^{b}, a=8, b=0.3
HS parameterization : 0.6H+0.4S
CM Energy 630 GeV
0.925<X_F<0.935
hadron level







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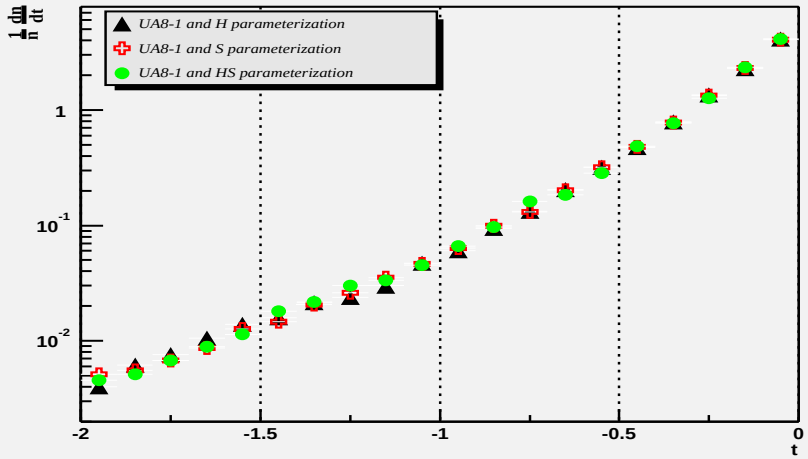
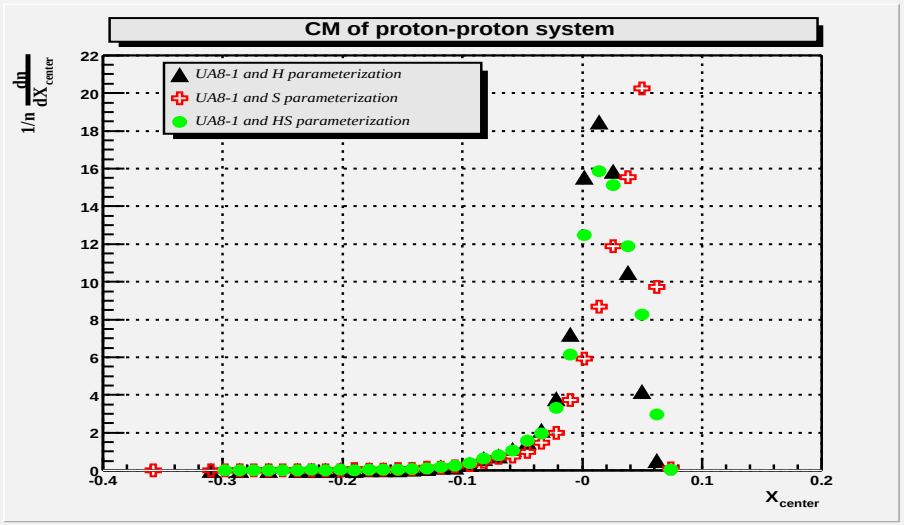
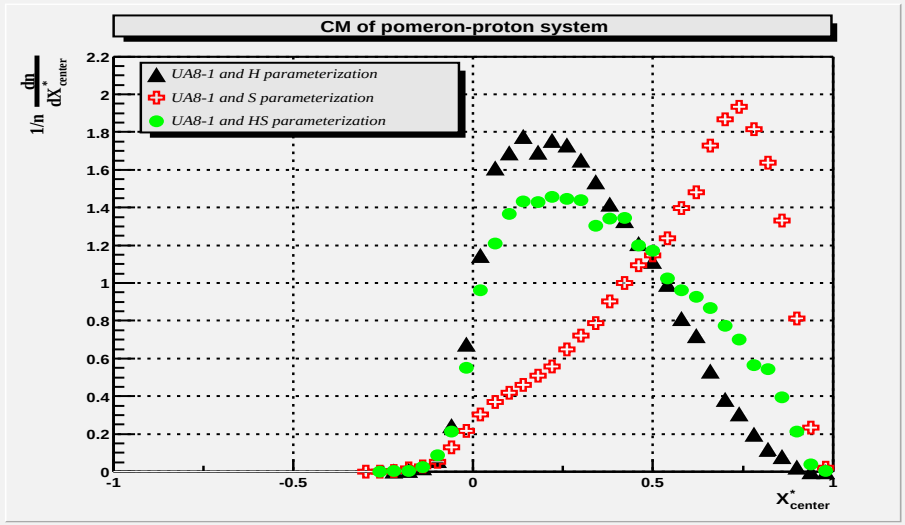
Hardping for LHC (Anufriev & VK)

HARDPING
Flux factor : UA8-1
Hard (H) parameterization : zg(z)=6z(1-z)
Soft (S) parameterization : $zg(z)=Nz^{a}(1-z)^{b}$, a=8, b=0,3
HS parameterization : 0.6H+0.4S
CM Energy 14 TeV
$0.925<X_F<0.935$
hadron level







Higgs production via double-Pomeron exchange

Khoze,Martin & Ryskin
De Roeck,Peschanski & Royon
Levin et al
Cudell et al
Ingelman et al
Petrov et al
Erhan, VK & Schlein

Exclusive channel

Small x-section: < 10 Fb ?

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Higgs production in Pomeron-p collisions

$x_H = \beta - \xi = \beta - \tau/\beta \qquad \tau = M_H^2/M_X^2$

$$d\sigma(Pp \to H)/dx_H = \sigma_{LO} G_N(\tau/\beta, M_H^2)\, G_{IP}(\beta, M_H^2)\, 2\tau/\sqrt{(x_H^2 + 4\tau^2)}$$

$$\beta = 2\tau/(x_H + \sqrt{(x_H^2 + 4\tau^2)})$$

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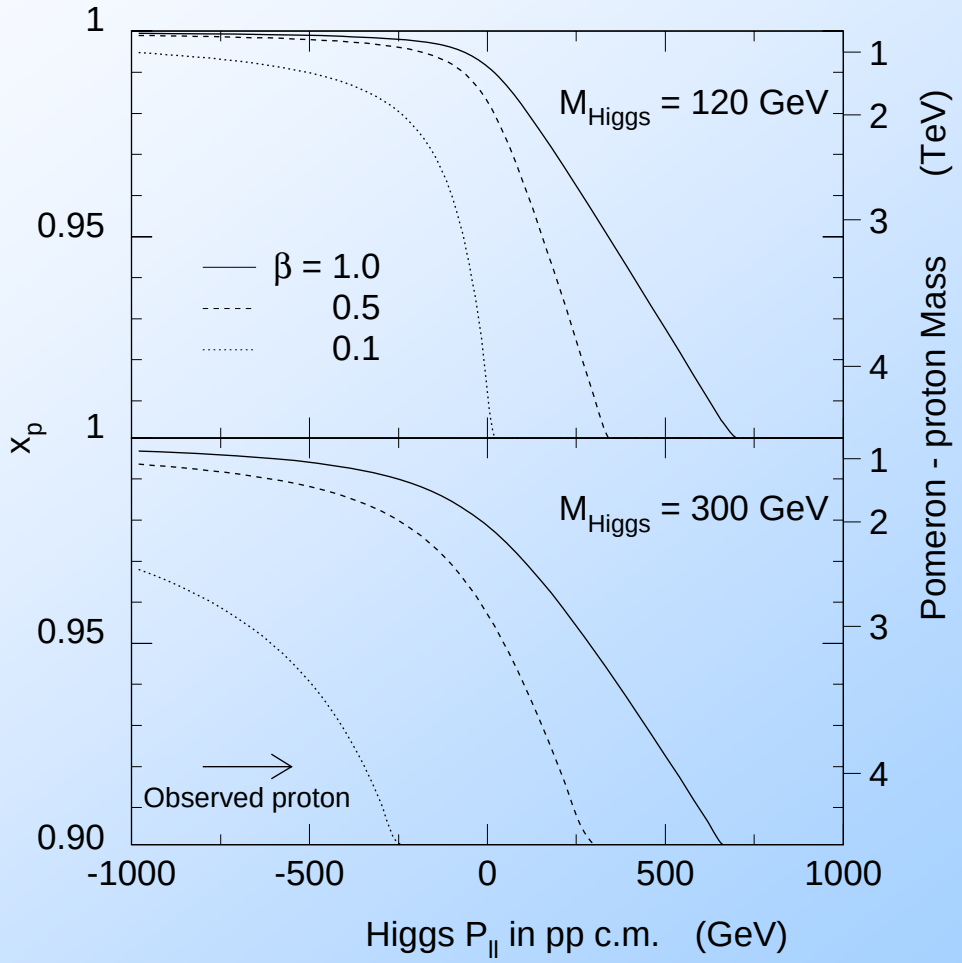
Kinematics of Higgs production via single-Pomeron exchange



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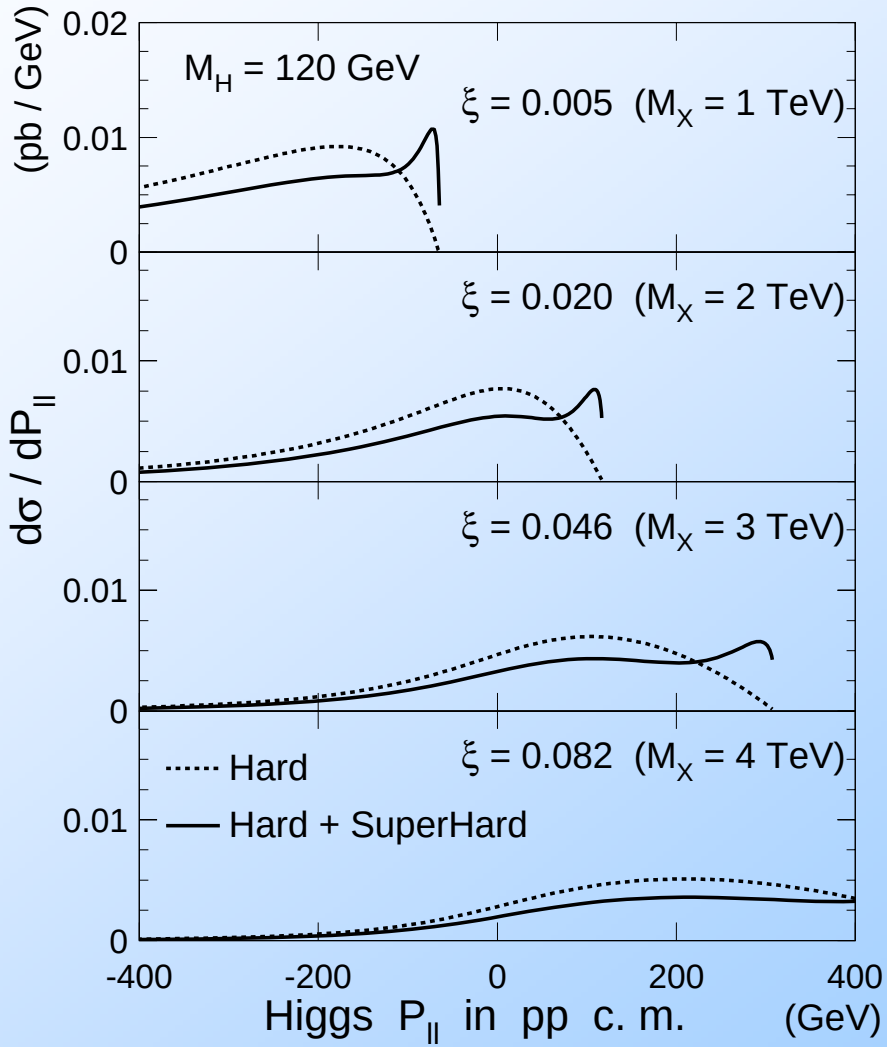
pp c.m. system at fixed M_X (ξ)



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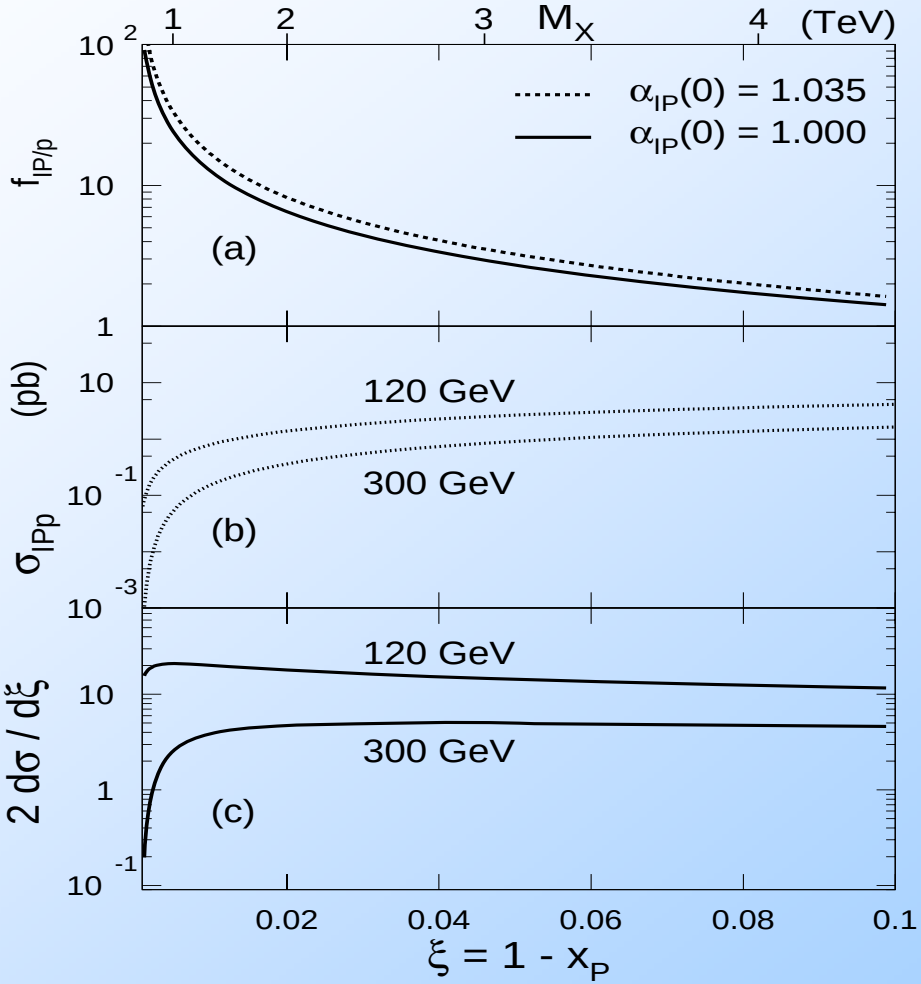
Higgs x-section in P-p collisions



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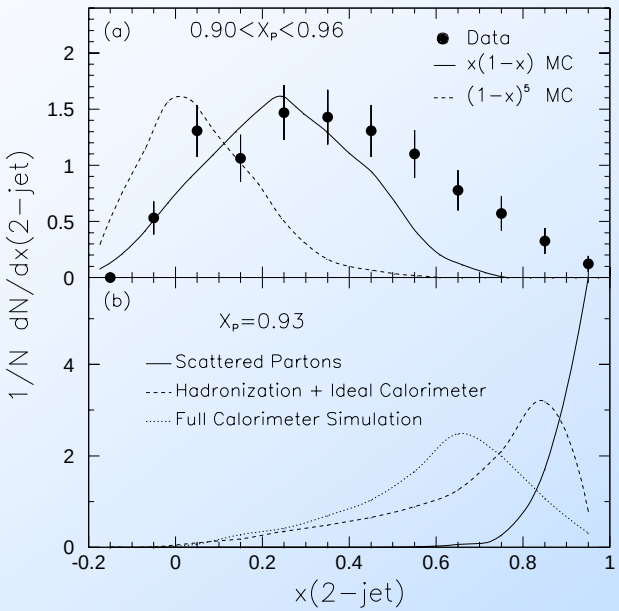
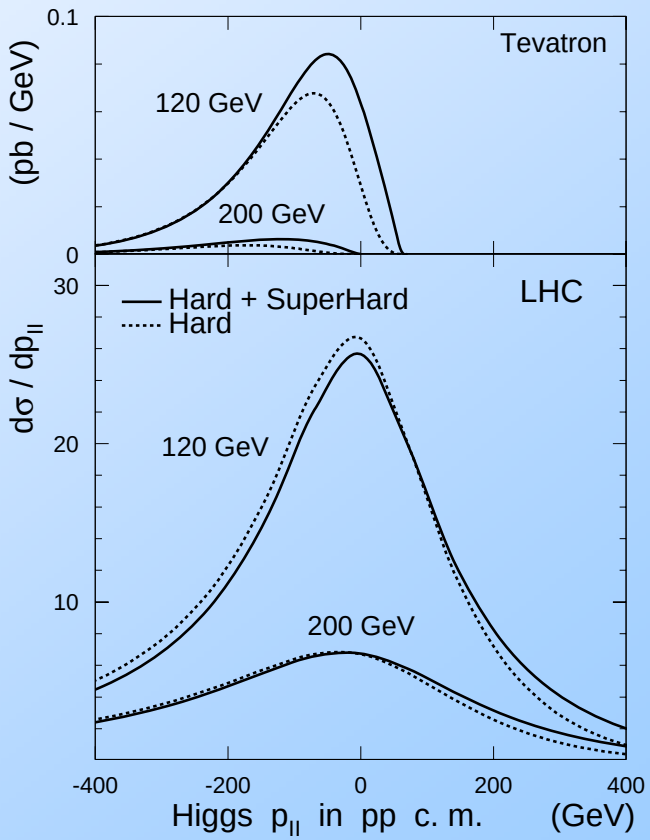
Single-Pomeron Exchange

SPE (Soft and Hard): non-central

Hard SPE: central !





Pomeron-proton c.m.s.

UA8 Collaboration

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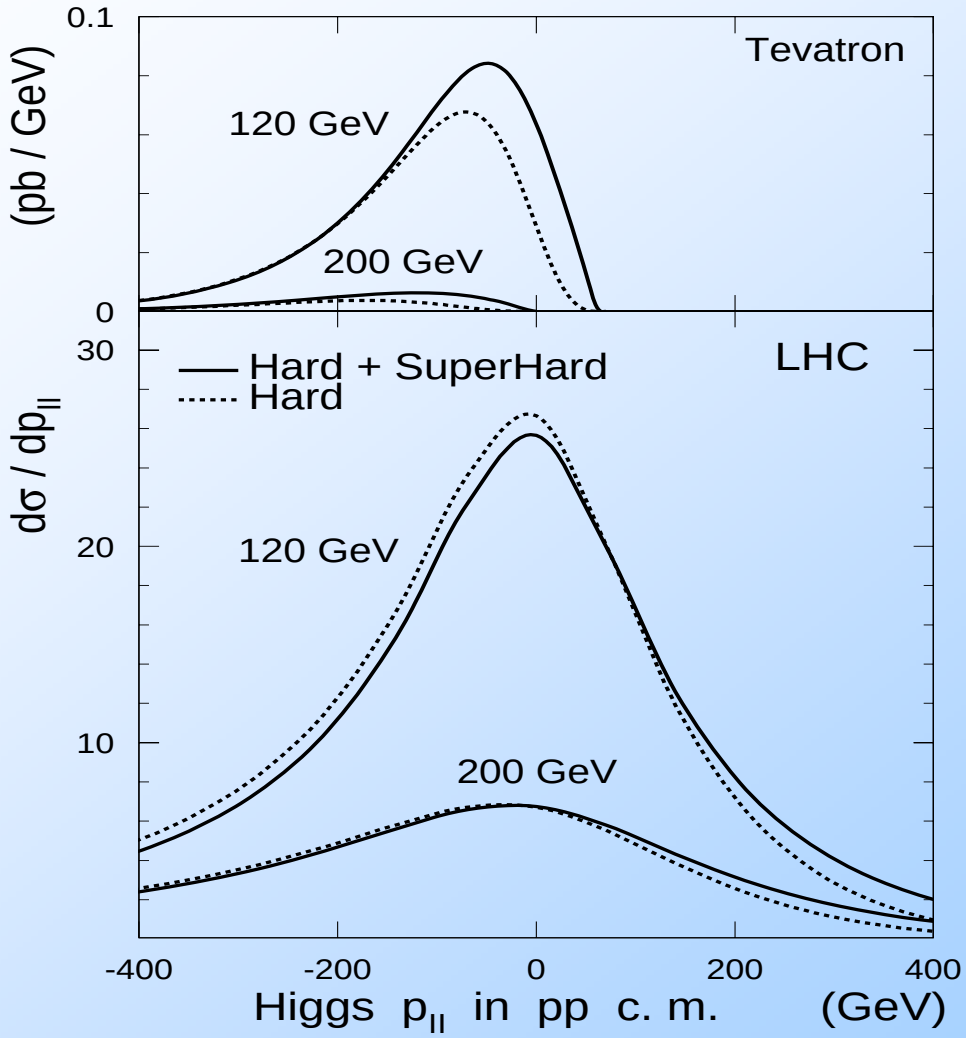
pp c.m. system



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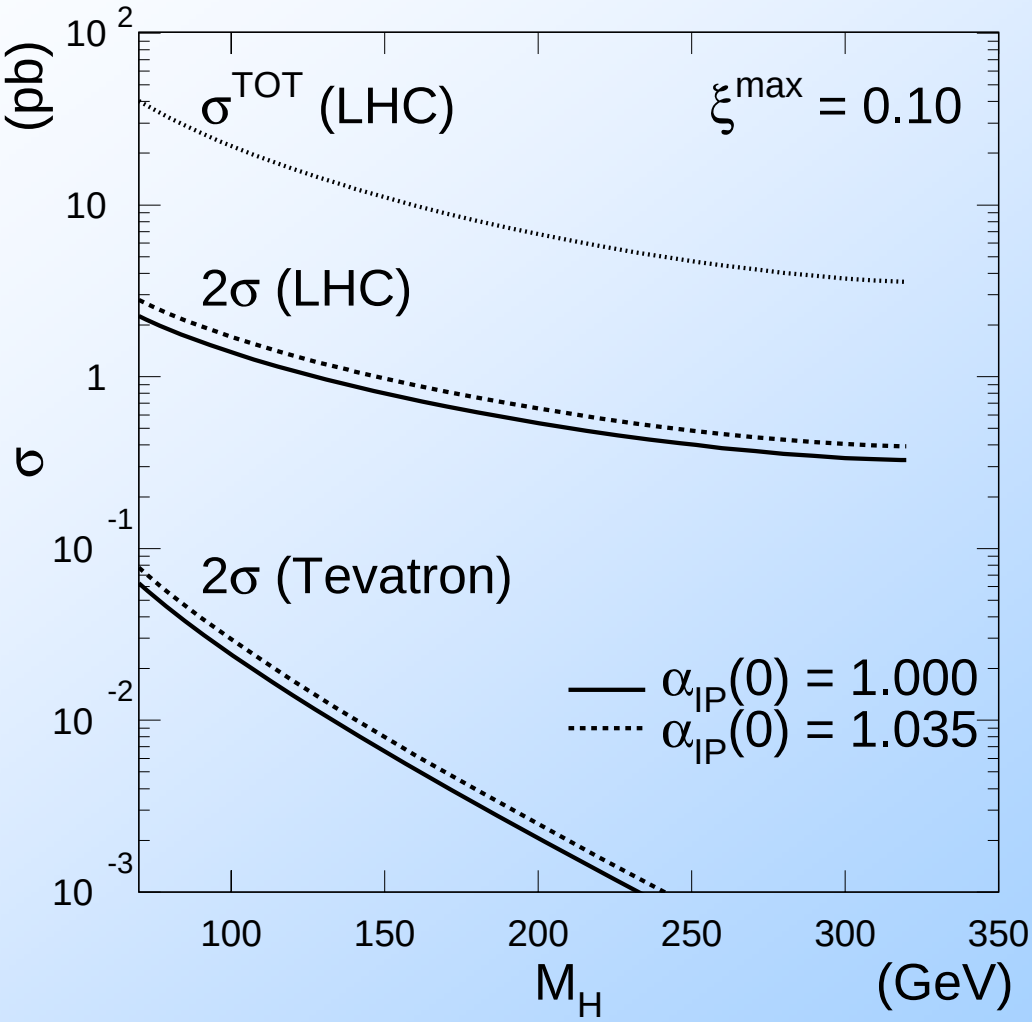
Total x-sections



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Higgs via ingle-Pomeron exchange

- Inclusive SPE: $\sigma = 1$ pb
- Exclusve: quasielastic SPE Higgs ?

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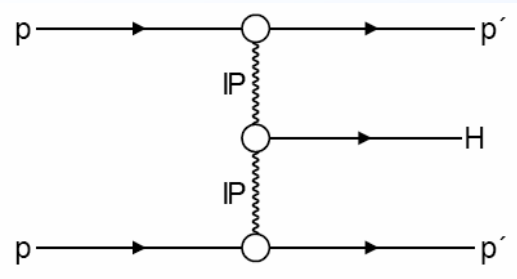
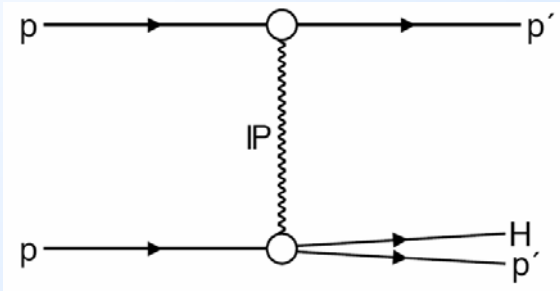
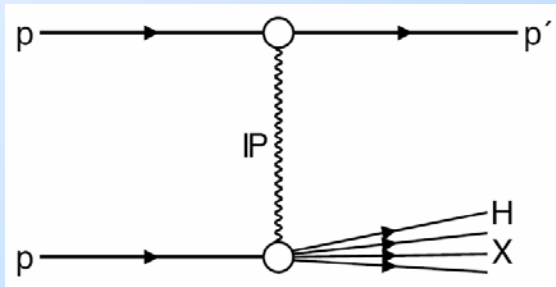
Higgs: SPE vs DPE







σ(excl. DPE) < σ(excl. SPE) < σ(inel. SPE)

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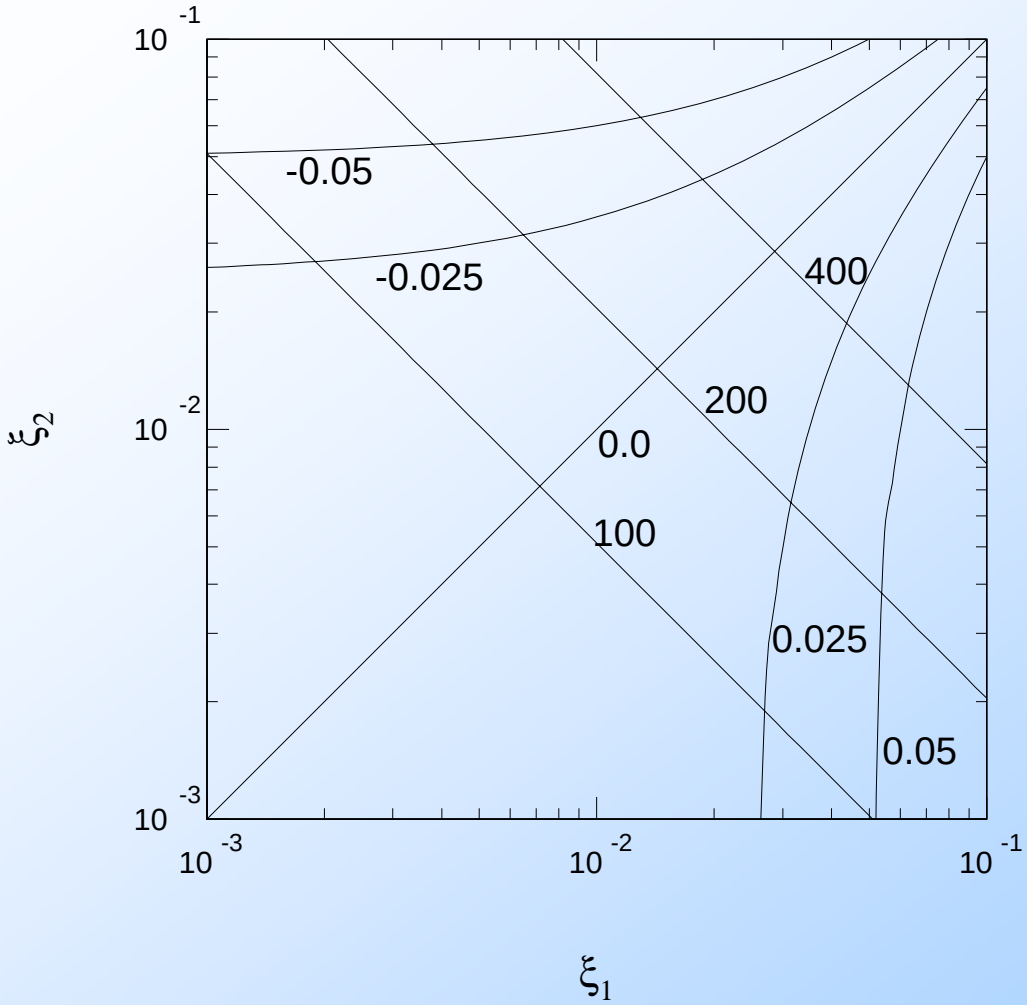
Exclusive Higgs SPE kinematics



$$\xi_1 \xi_2 s = M_H^2$$

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Higgs via SPE: signal/background

- Inelastic SPE: S/B as in inelastic
- ExclusveSPE Higgs: pp->pHp

- Selection rule for exclusive DPE Higgs ->bbar factor 1/3000 -> S/B ≈ 0.5 – 3.0
- Khoze, Martin & Ryskin (01)
- De Roeck Khoze, Martin & Ryskin (02)
- Boonekamp,Royon & Peshanski (04)

- Selection rule depends only from final state ! (does not depend on production mechanism)

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Exclusive SPE x-section

Effective Higgs-nucleon interaction (via triangle anomaly):

$$L=\sqrt{(2G_F)}(2/3)(m_N/b)\,\psi\psi$$

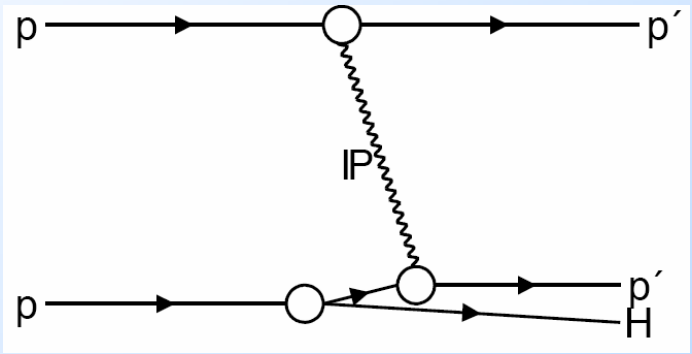
Shifman, Vainshtein & Zakharov (78)

$$\alpha_{HNN}/2\pi \approx 10^{-9}$$

σ(excl. SPE) -> up to 0.1 σ(inel. SPE)

-> up to 30 σ(excl. DPE)

-> up to 100 Fb



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Light Higgs at LHC

$120 < m_H < 140$ GeV $L = 30 Fb^{-1}$

	#events	Significance
• H -> γγ	300	3-4 σ
• H-> jbbj	300	5-6 σ
Diffractive Higgs		
• pp->pHp->pbbp	10	3σ
• pp->pHX-pbbX	10^4	10^{-1}σ ?
• pp->pHp->pbbp	10-300	3-? σ

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Summary

- Inelastic Higgs production via Single-Pomeron Exchange (~ 1 pb):
  larger than DPE x-section
  central region !
- Exclusive Higgs via SPE (b-bbar channel):
  signal/bkgd as good as in exclusive DPE !

Exclusive Higgs via SPE:
a promising channel at LHC !

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