Inclusive Higgs Production Via Double Pomeron Exchange

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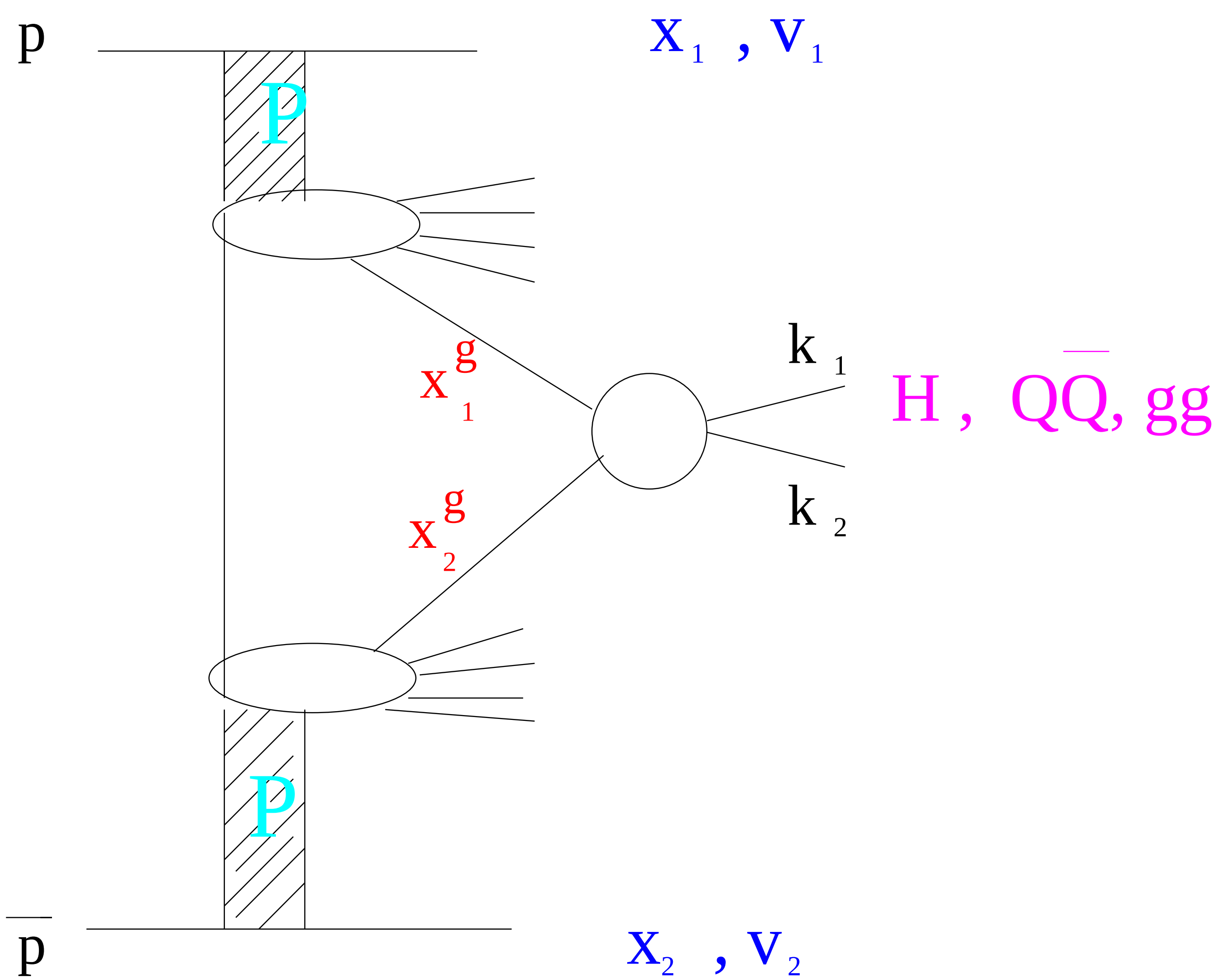
Formalism: Inclusive cross sections



- Idea: convolute exclusive cross section ($partons \rightarrow Higgs$ and $partons \rightarrow dijets$) with the probability of finding these partons in the pomeron

- Higgs inclusive cross section:

$$
\begin{aligned}
d\sigma_H^{incl} &= G_P(x_1^g,\mu)G_P(x_2^g,\mu)\ \frac{dx_1^g}{x_1^g}\ \frac{dx_2^g}{x_2^g} \\
& d\sigma_H^{excl}(s \rightarrow x_1^g x_2^g\ s),
\end{aligned}
$$

- Same idea for dijet cross section

Formalism: Exclusive cross sections

- Starting point: double pomeron exchange: Bialas-Landshoff for Higgs cross section, and Bialas-Szeremeta-Janik for dijet production: $p\bar{p} \rightarrow p\bar{p}H$ and $p\bar{p} \rightarrow p\bar{p}q\bar{q}$

- Higgs:

$$\sigma_H \sim \left(\frac{s}{M_H^2}\right)^{2\epsilon} \frac{1}{x_1}\frac{1}{x_2}\,\delta\left((1-x_1)(1-x_2) - \frac{M^2}{s}\right)$$
$$(1-x_1)^{\alpha' v_1^2}(1-x_2)^{\alpha' v_2^2} \exp\left(-2\lambda(v_1^2+v_2^2)\right)$$

where:

$\alpha(t) = 1.08 + 0.25t$ (α'=0.25)

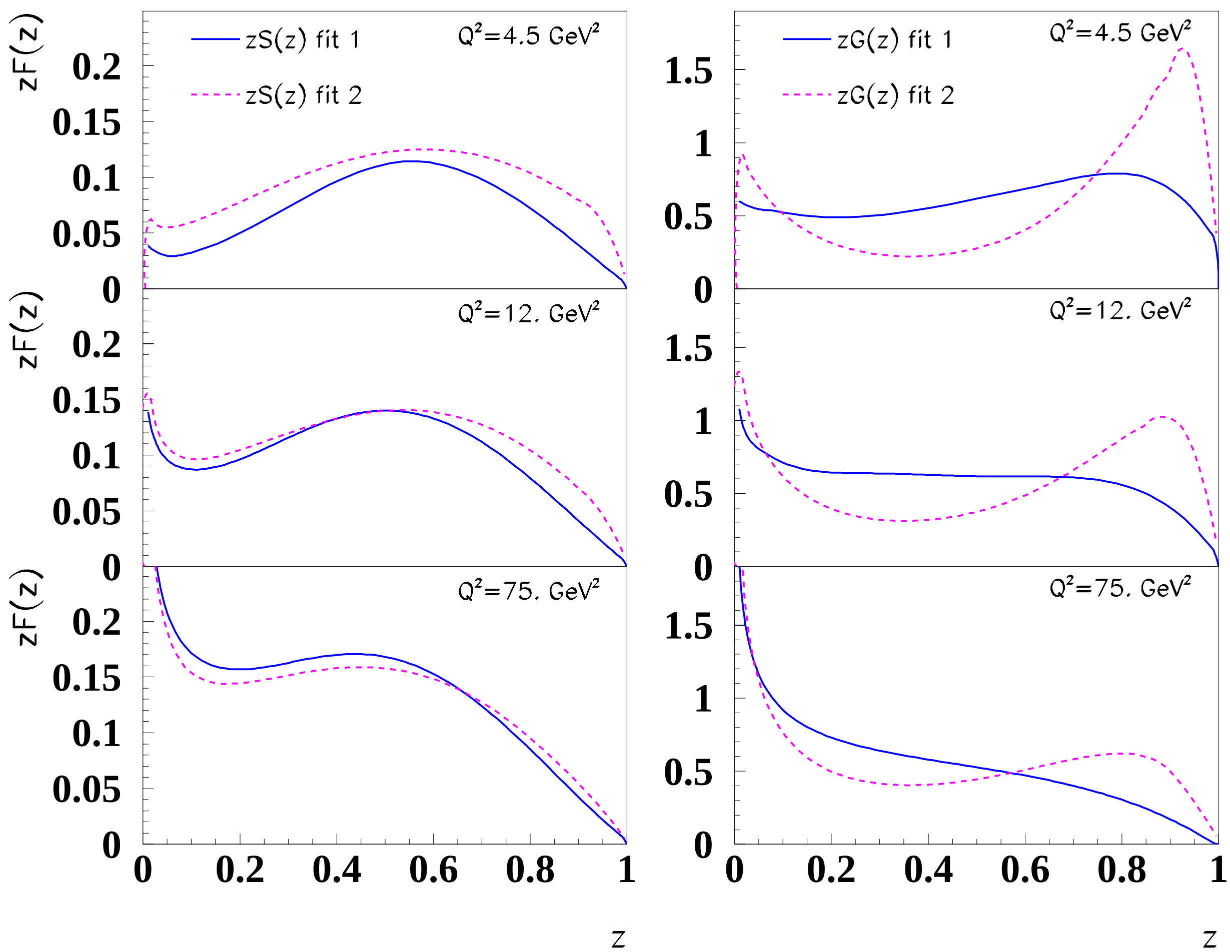
x_i is the momentum fraction of the proton

v_i their transverse momentum

k_i the outgoing jet momentum

$\lambda \sim 4$ GeV^2, the slope of the pomeron-proton coupling

Gluon density in the pomeron



C. Royon (UTA, Saclay), L. Schoeffel (Saclay), J.Bartels (Hamburg-DESY), H.Jung (Lund), R.Peschanski (Saclay), Phys. Rev. D 63 (2001) 074004.

Detector simulation and acceptance

- Fast simulation (shw) of the CDF and D0 central detector

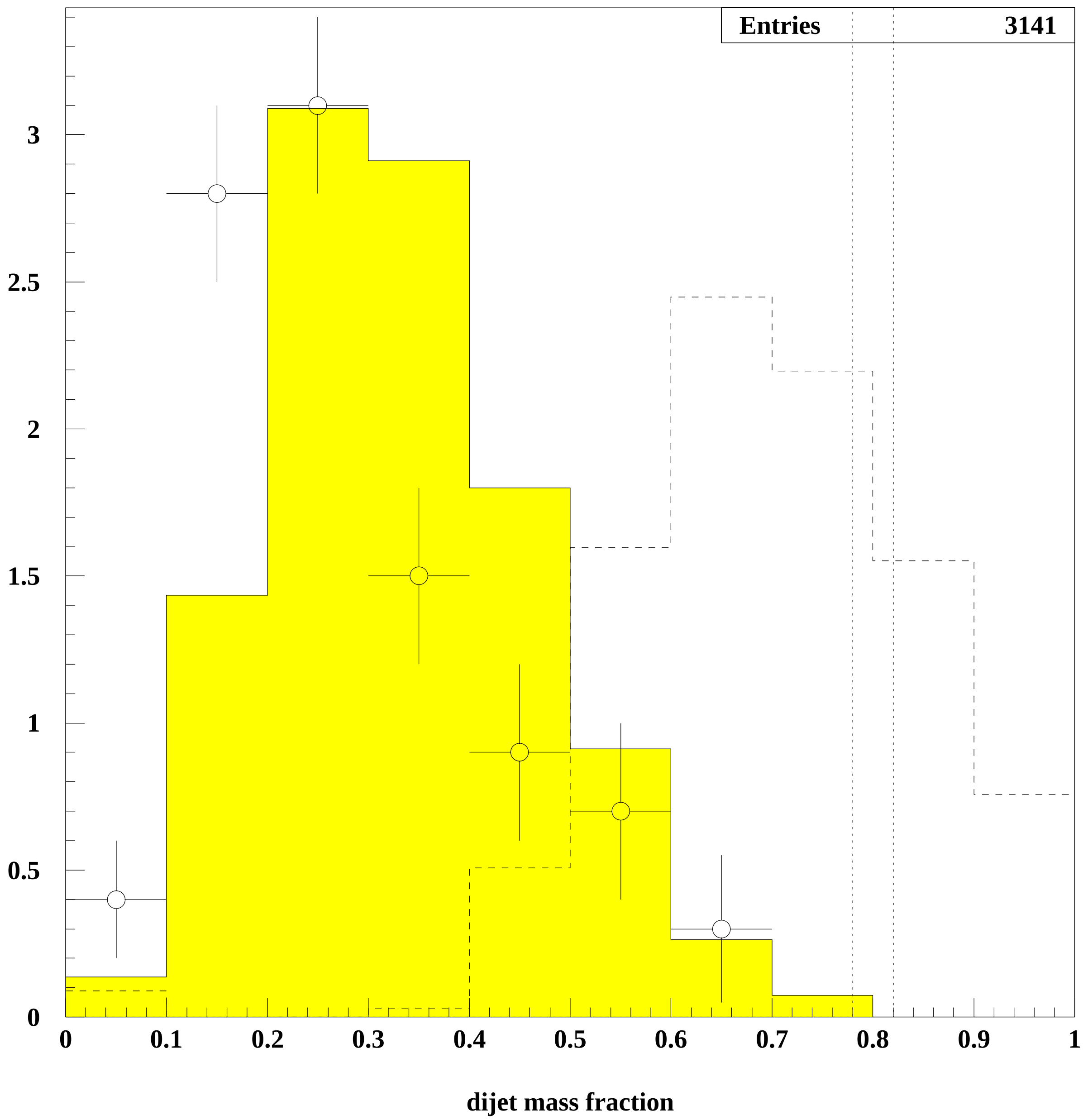
- For dijet CDF measurements: $\bar{p}$ tagged, $0.035 \leq \xi_{\bar{P}} \leq 0.095$, $|t| < 1$ GeV^2, $0.01 \leq \xi_P \leq 0.03$ total cross section: $\sigma \sim 14.4$ nb, CDF: 43.6 nb, we scale our cross section to the CDF measured one.

- Resolution and acceptance for Higgs predictions:
  ξ resolution: 0.2 %
  t resolution: $0.1\sqrt{t}$
  ξ acceptance: 100% if $\xi > 0.04$, 0% if $\xi < 0.01$, linear between 0 and 100% if $0.01 < \xi < 0.04$
  t acceptance: $|t| \leq 0.5$ GeV^2

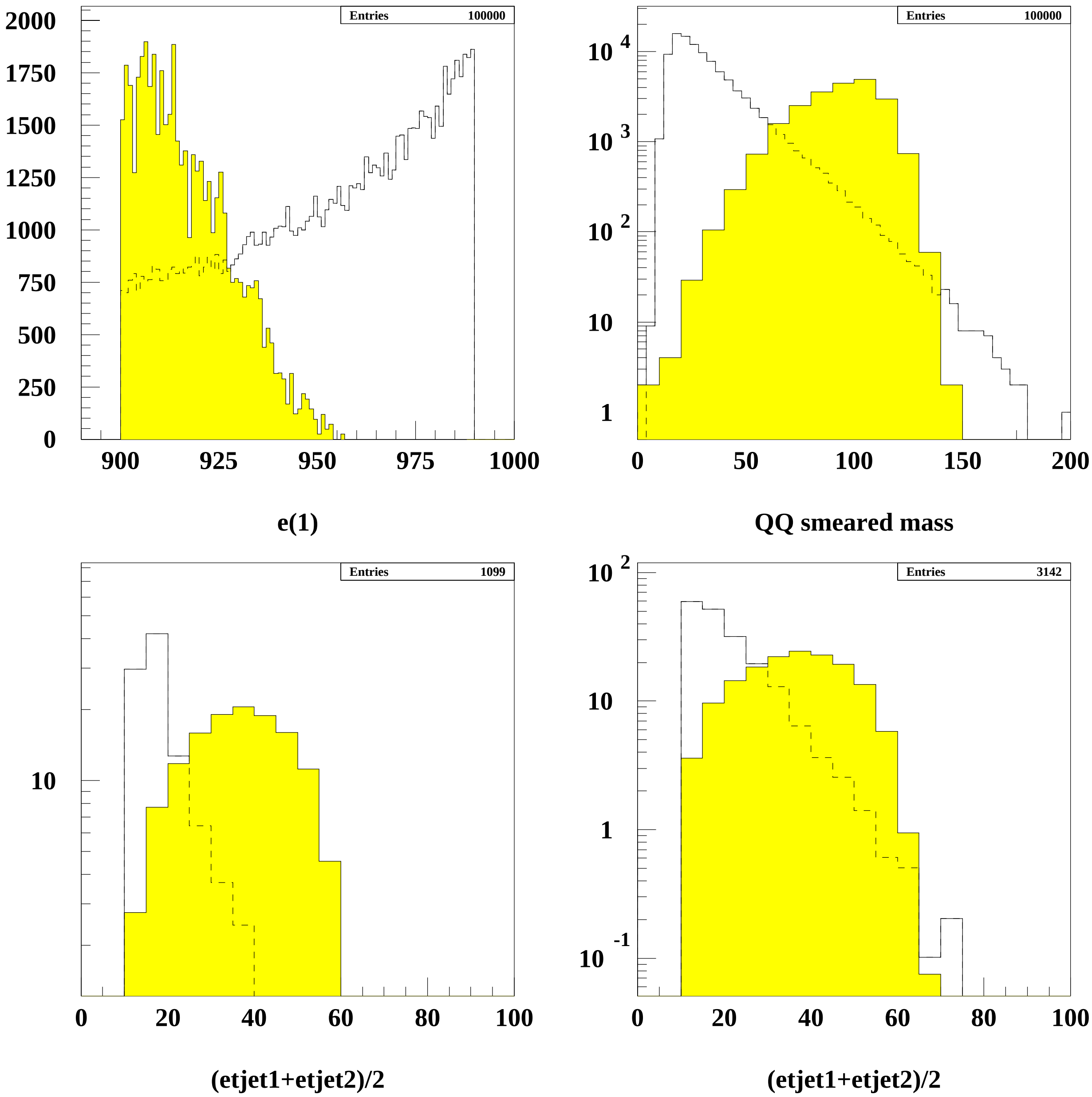
CDF dijet mass fraction

- Yellow: xG + diquarks with radiation (fully simulated)
- Dashed line: xG + diquarks without radiation (fully simulated)
- Dotted line: xG + diquarks without radiation (generator level)
- Conclusion: Radiation needed..., good description of CDF data

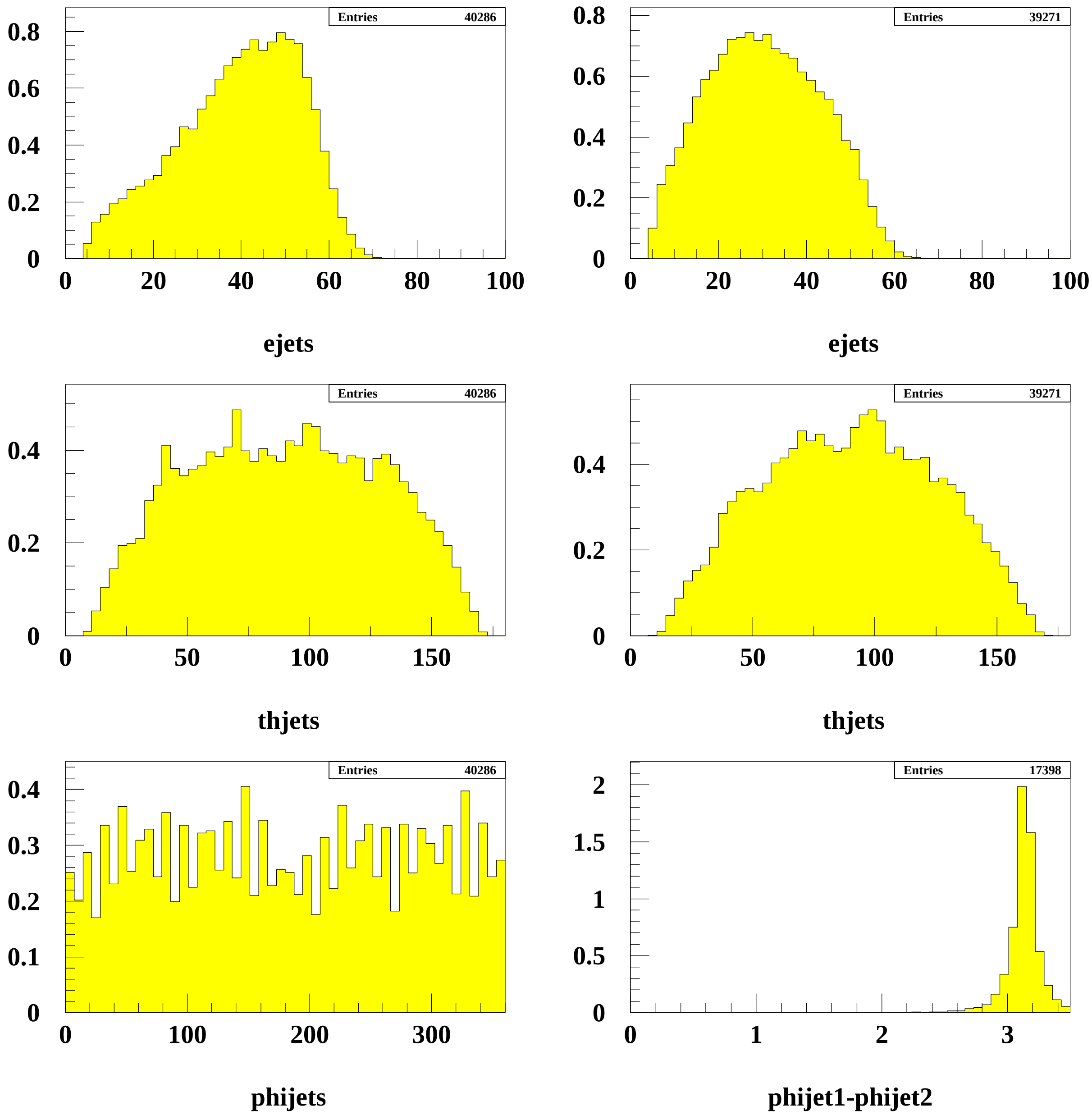
CDF dijet mass fraction



Higgs and $b\bar{b}$ distributions



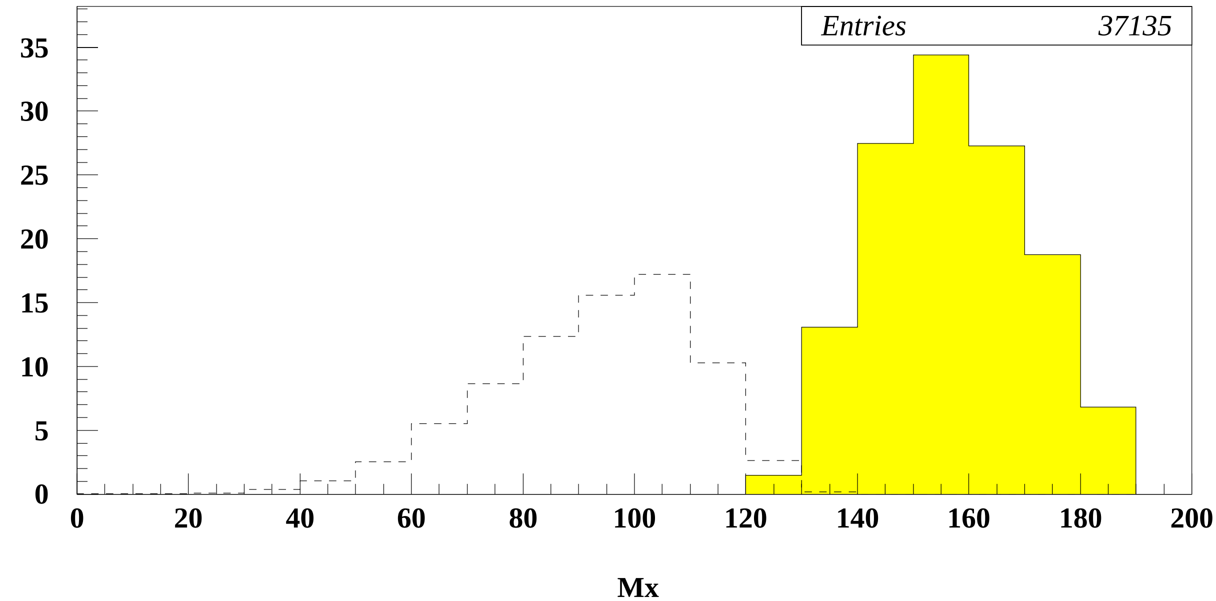
Energy and angle distributions for Higgs

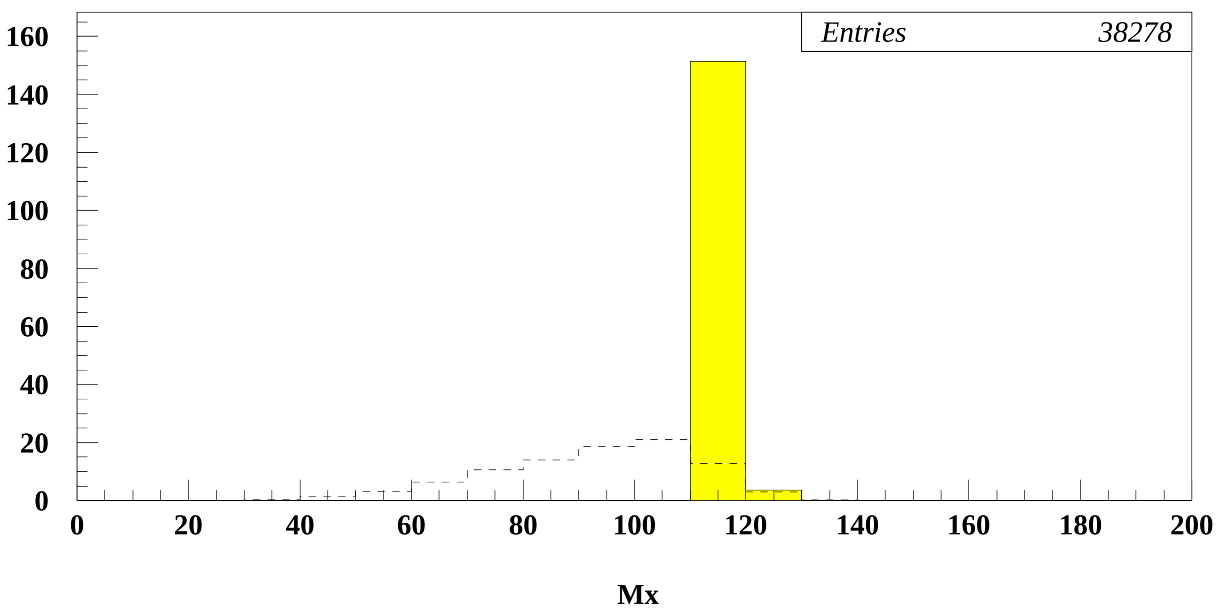


H mass reconstruction (missing mass method)

- Missing mass method: perfect method to reconstruct Higgs mass: $M_H = \sqrt{\xi_p \xi_{\bar{p}} S}$ modified to take into account loss of energy in detectors and radiation $M_H = \sqrt{\xi_p \xi_{\bar{p}} S} . \frac{E_{jet1} + E_{jet2} + E_p + E_{\bar{p}}}{2 . E_{beam}}$
- Mass method with much worse resolution with radiation

H mass reconstruction (missing mass method)





Number of Higgs events for $1 fb^{-1}$ after shw

M_{Higgs}	(1)	(2)	(3)	(4)	(5)
100	26.6	18.5	5.7	1.9	0.2
110	21.6	14.0	5.3	1.3	0.7
120	17.4	9.8	4.8	1.0	1.9
130	13.8	6.1	3.2	0.6	3.3
140	10.6	2.9	1.8	0.3	4.2
150	8.0	1.0	0.8	0.1	5.0
160	5.7	0.2	0.1	0.0	4.5
170	3.7	0.0	0.0	0.0	2.9

- (1): generator level
- (2): detected in roman pots ($b\bar{b}$ channel)
- (3): + at least two jets of 30 GeV p_T
- (4): τ channel
- (5): W^+W^- channel
- $H \to \tau^+\tau^-$ and $H \to W^+W^-$ at high mass with almost no background

Conclusion

- New generator ready to get diffractive events in double pomeron exchange
- Results compared to CDF data in run I: dijet mass fraction in good agreement if one allows radiation (inclusive jet and Higgs production)
- Higgs cross section promising (about 2-5 events per fb^{-1} at Tevatron run II) for a mass between 100 and 140 GeV, very nice and clean process
- Price to pay the high cross sections: missing mass method not working so nicely
- Other promising channels to be studied with this relatively high cross sections: τ and W^+W^- Higgs decays, which are almost background free

Outlook

- Full simulation: needed to get a precise prediction
- Comparison with other models: Our model is based on a non perturbative calculation by Bialas-Landshoff, which works to describe the dijet mass fraction. However, other models lead to much lower cross sections. Needs to be undertood and studied in more detail.
- LHC: Clearly an important topic for LHC as well, with higher cross sections, pot installation studies in CMS in progress