

# High $p_T$ Jets and Photons at DØ

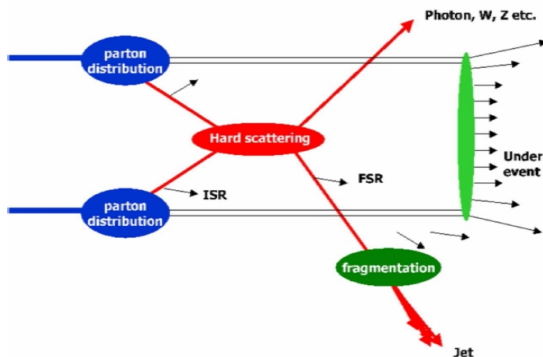
Zdeněk Hubáček

FJFI ČVUT

**Top Meeting Praha-Bratislava-Košice, 30.1-1.2.2008**



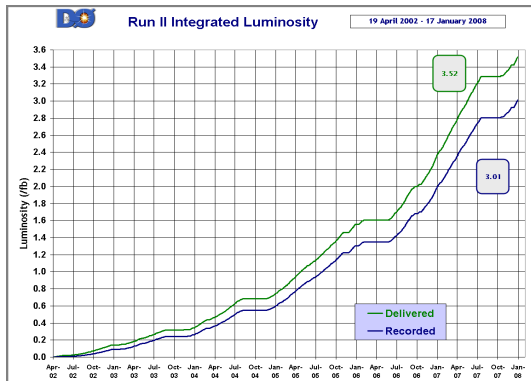
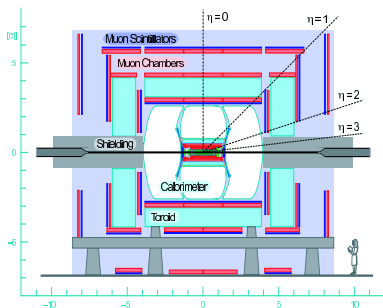
# QCD & Proton Structure



Measurements of various jet cross sections give us hints about the proton structure, in particular about

- Parton distribution functions
- QCD matrix elements
- Strong coupling constant  $\alpha_s$

# DØ Experiment

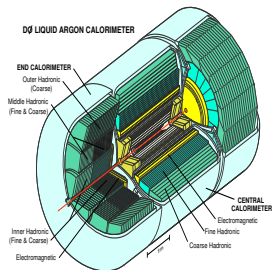


Tevatron  $p\bar{p}$  accelerator:

- $\sqrt{s} = 1.96\text{TeV}$
- Integrated luminosity  $> 3\text{fb}^{-1}$

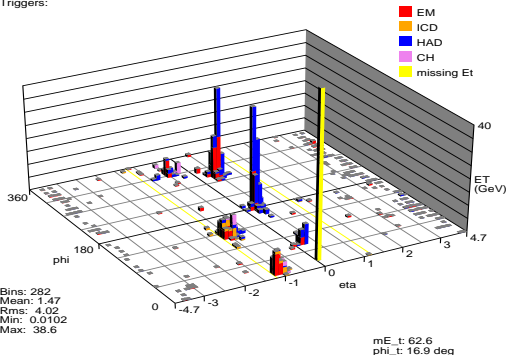
# Jets in the DØ Detector

Most of the events contain clusters of hadrons (**jets**)



Run 204001 Evt 11826034

Triggers:

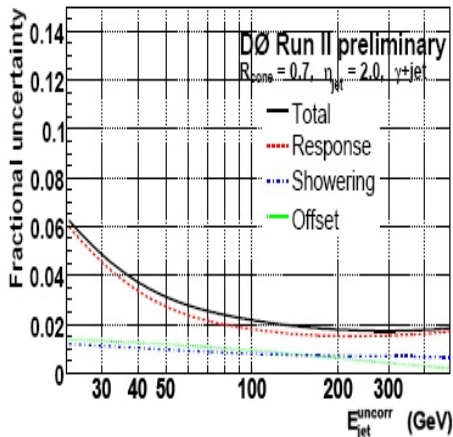
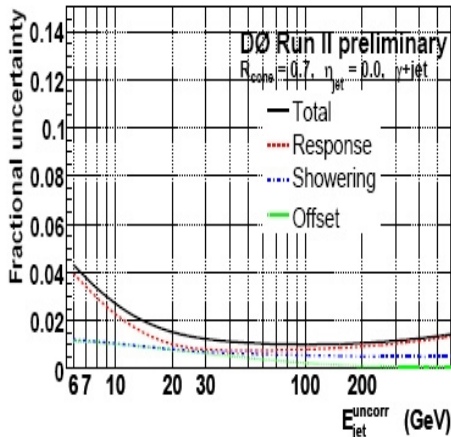


Need a tool which finds jets = **jet algorithm**

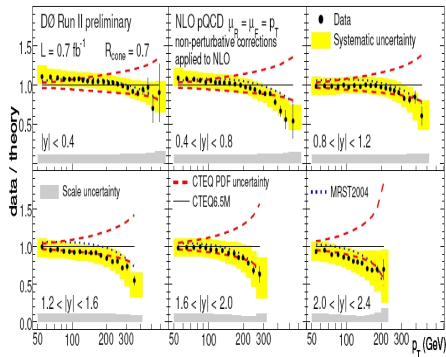
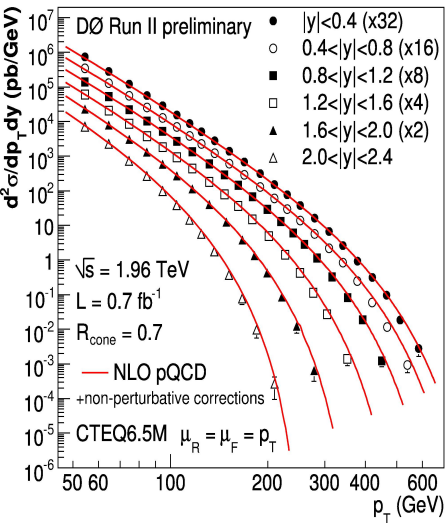
DØ uses RunII Cone Midpoint Algorithm with  $R_{\text{cone}} = 0.5$  or  $0.7$

# Jet Energy Calibration

$$E_{\text{jet}}^{\text{corrected}} = \frac{E_{\text{jet}}^{\text{calorimeter}} - \text{Offset}}{\text{Response} \cdot \text{Showering}}$$



# Inclusive Jet Cross Section $\frac{d^2\sigma}{dp_T dy}(p\bar{p} \rightarrow \text{jet} + X)$

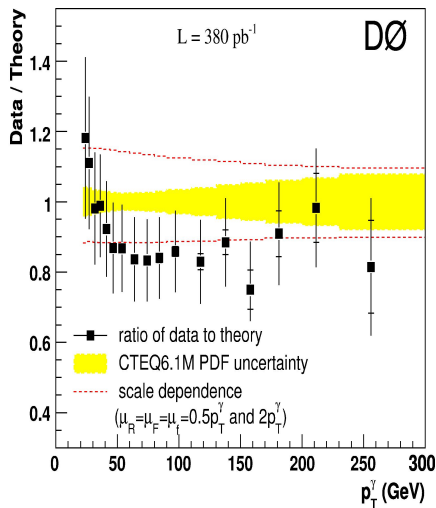
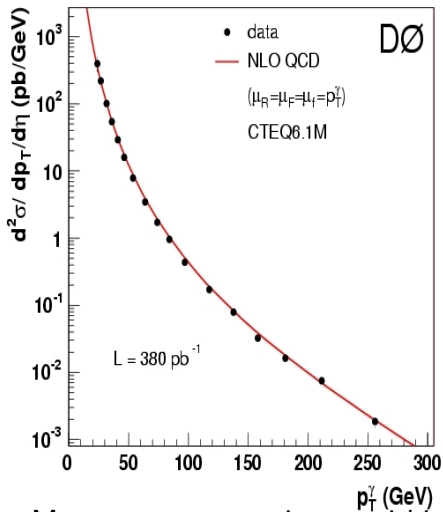


# Direct Photons Produced in Hard Scattering



- $\gamma$  is directly produced in the hard scattering process + no hadronization  $\rightarrow$  direct probe of QCD + sensitivity to gluon PDF at LO.
- Cross section for photons is lower by a few orders of magnitude than for jets
- Problem of photon purity - need to separate from photons from particle decays

# Isolated Photon Cross Section

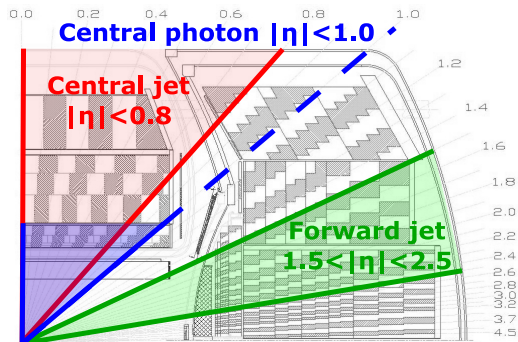


Measurement consistent within errors with NLO QCD, but some shape is present

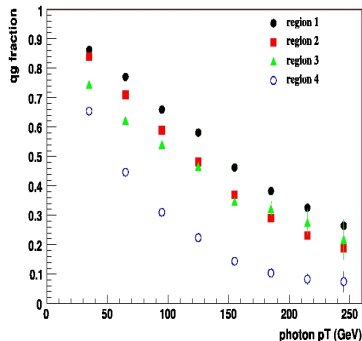


# Tripple Differential Photon+Jets Cross Section $\frac{d^3\sigma}{dp_T^\gamma d\eta^\gamma d\eta^{\text{jet}}}$

Extended the photon measurement to include also additional jets -



Quark-gluon fraction:



**Region 1** - central jet and SS  $\gamma$

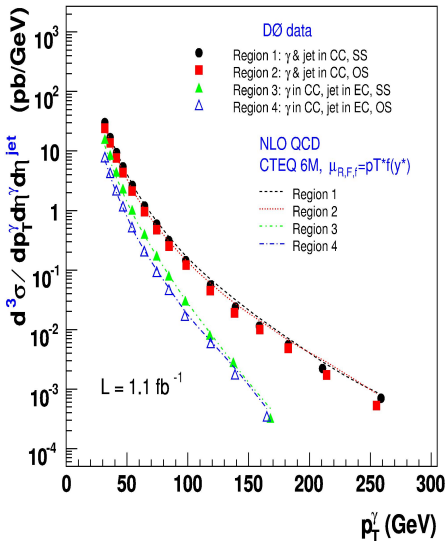
**Region 2** - central jet and OS  $\gamma$

**Region 3** - forward jet and SS  $\gamma$

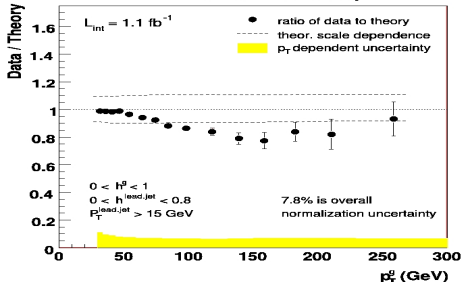
**Region 4** - forward jet and OS  $\gamma$

# Photon+Jets Cross Section

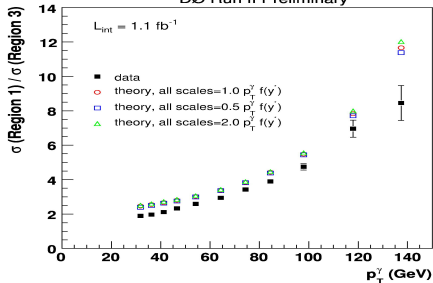
DØ RunII Preliminary



DØ Run II Preliminary



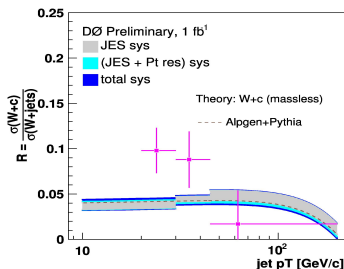
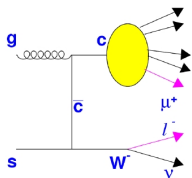
DØ Run II Preliminary



# Other PDF - Strange Quark Distribution

## Measurement of $W + c$ -jet to $W + \text{jet}(s)$ ratio

- Dominant contribution from  $sg \rightarrow W^- c$  or  $\bar{s}g \rightarrow W^+ \bar{c}$  process while  $dg \rightarrow W^- c$ ,  $\bar{d}g \rightarrow W^+ \bar{c}$  are suppressed because of  $|V_{cd}|^2$
- First test of QCD evolution for  $s$  quark PDF
- Important background to top, stop or Higgs physics



## Conclusions:

- Inclusive jet cross section measurement with the new energy calibration has largely reduced the experimental errors and can be used for further constraints of PDFs
- Photon cross sections described only fairly by the current theory
- $W + c$  allows tests of evolution of  $s$  quark PDF important for Higgs searches at the LHC