

# Determination of parton density functions from pp - and ep measurements

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17.9.2007

What is a parton density function (PDF)?

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- in the improved parton-model protons consist of  
gluons and quarks



partons

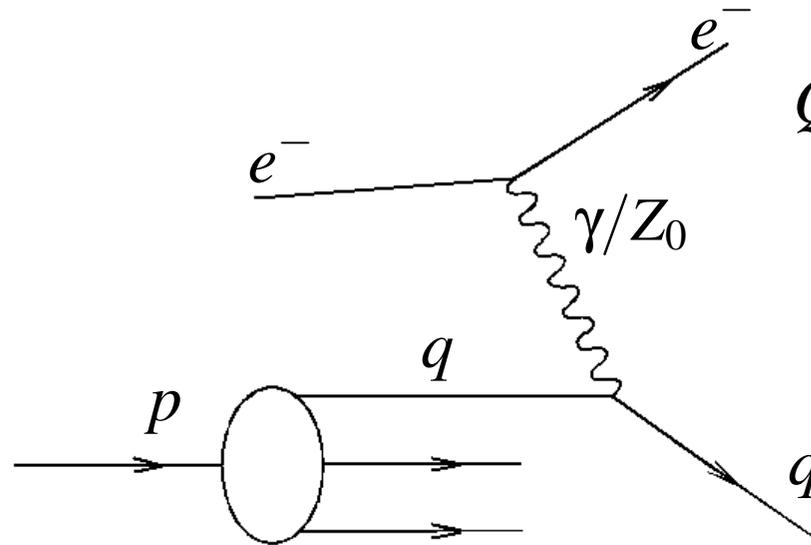
$x$ : fraction of the protons momentum for parton  
 $Q^2$ : energy scale

- in a measurement with a certain  $Q^2$  a PDF  $f(x, Q^2)$   
gives the number of partons with a certain  $x$

## What is a parton density function (PDF)?

- e.g. ep-collisions

$$eq \rightarrow eq$$



$$Q^2 = -(p_e - p_e')^2$$

- x-section is proportional to PDF  $f(x, Q^2)$

$$\frac{d\sigma}{dx dQ^2} \propto \sum_i e_i^2 x f_i(x)$$

## How to determine PDFs ?

- parametrize PDF
  - e.g. gluon density is proportional to

normalization constant  $\times$  power of  $x$

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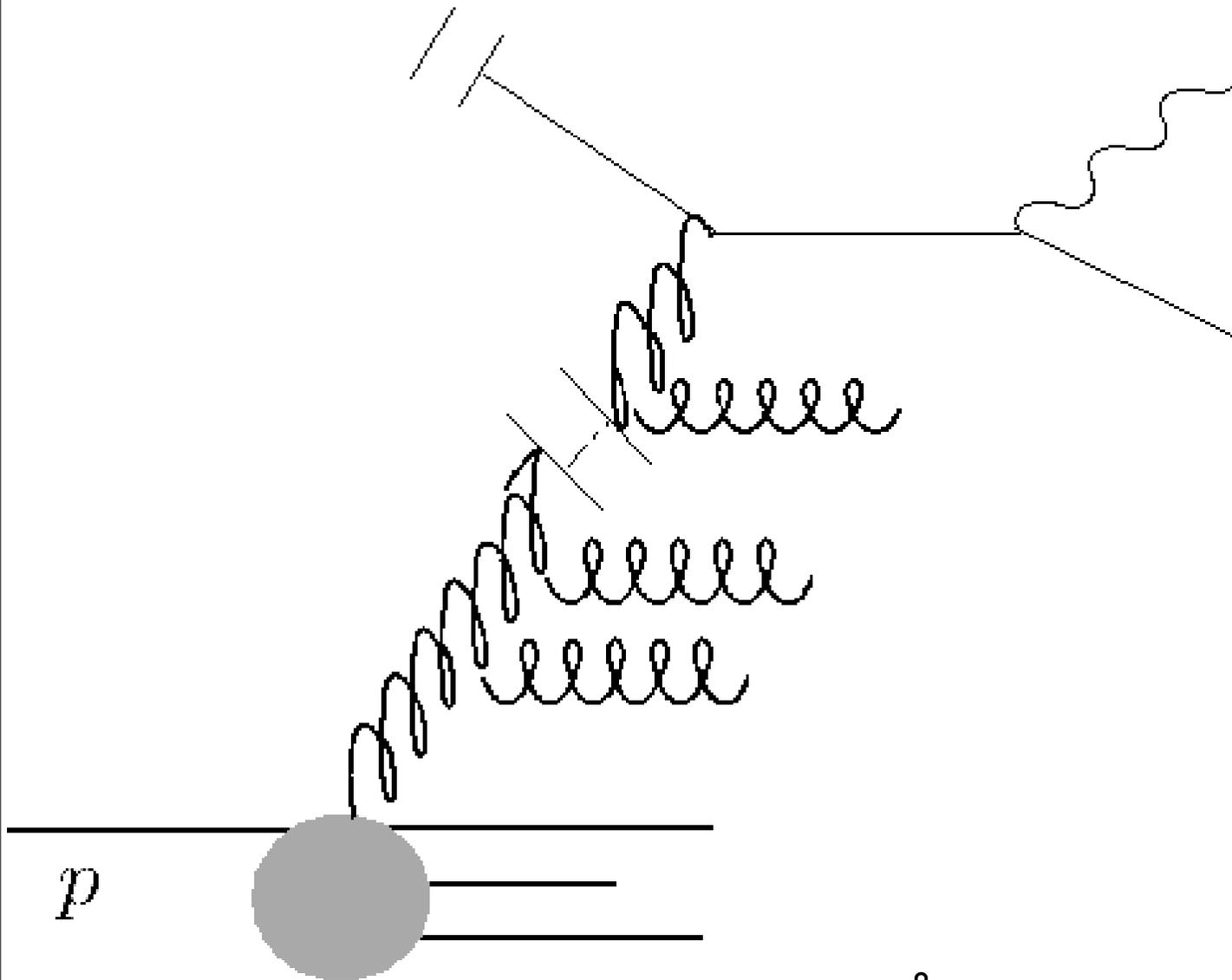
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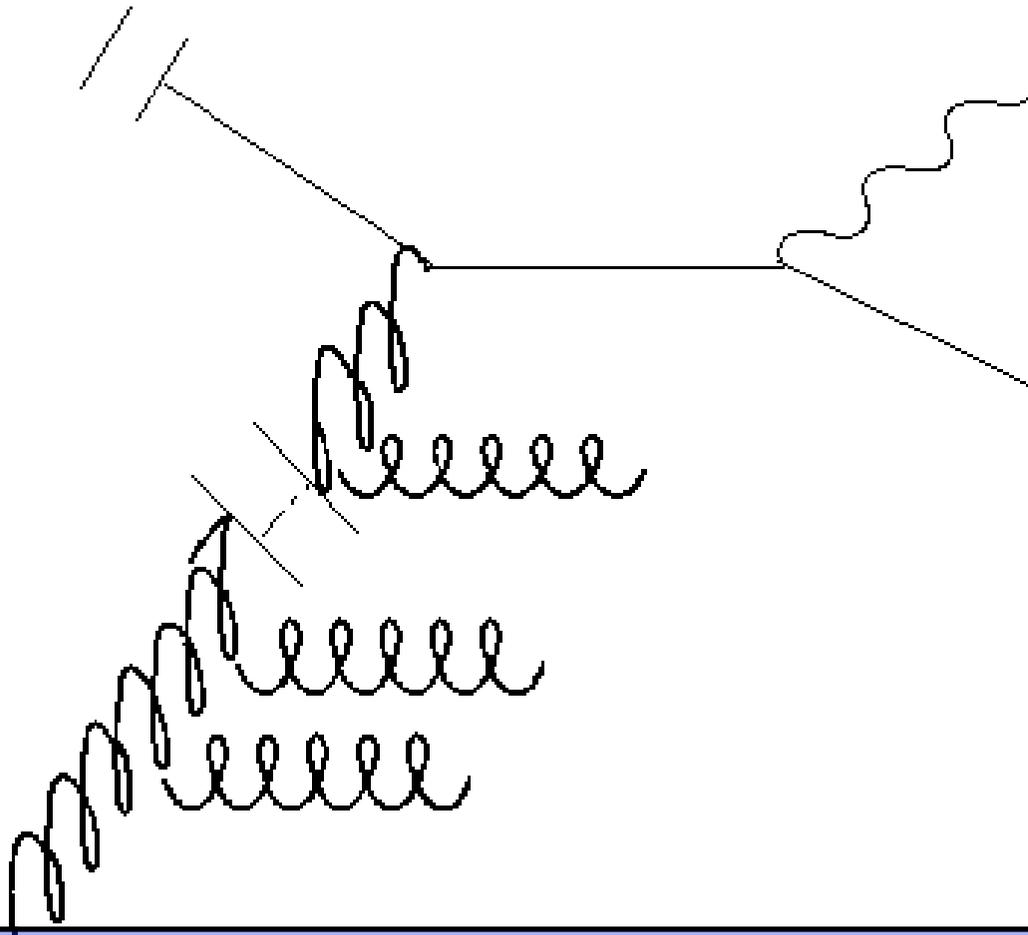
- include it in a MC simulation (PYTHIA, Cascade)
- change parameters until MC data fit to detector data  
→ fitting

# How is the data simulated?



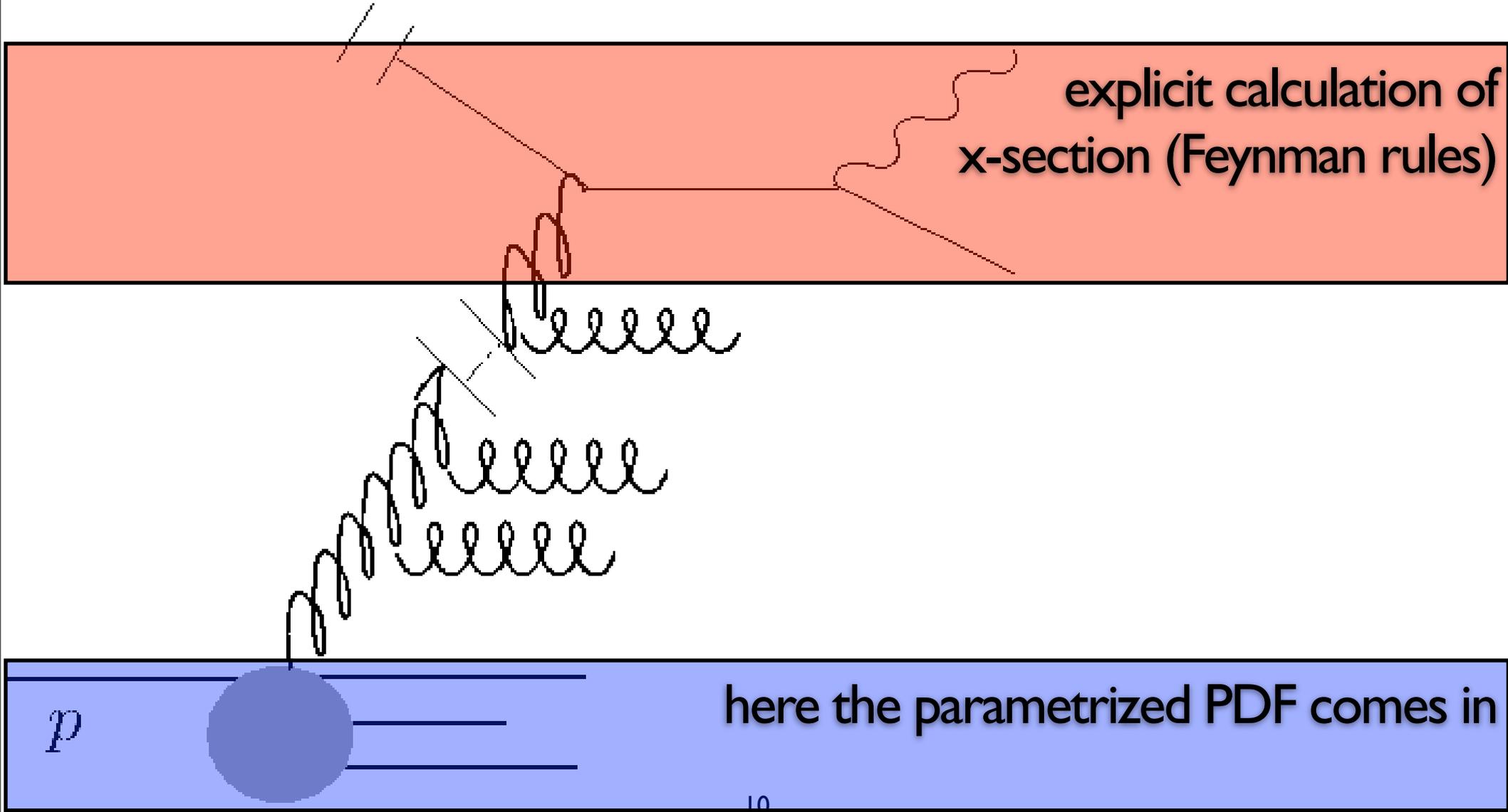


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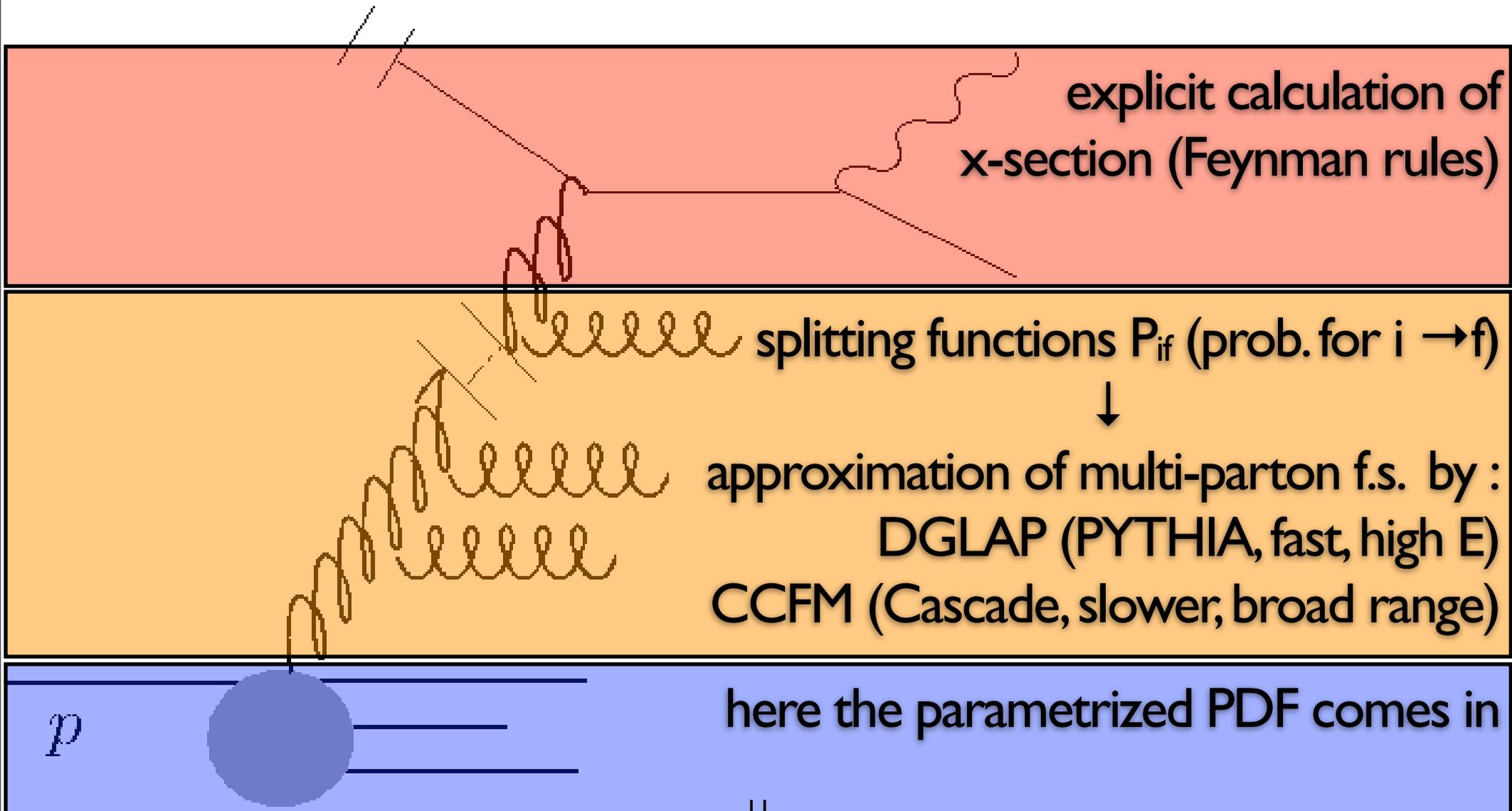


here the parametrized PDF comes in

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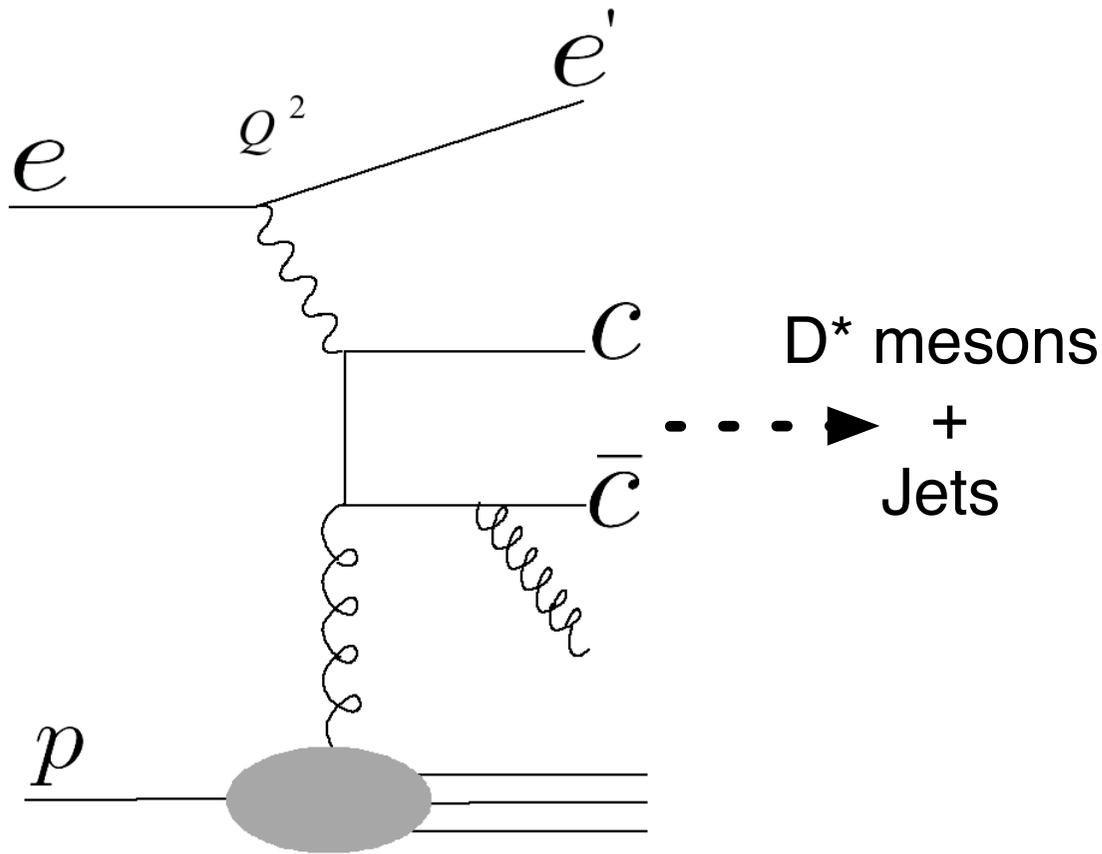


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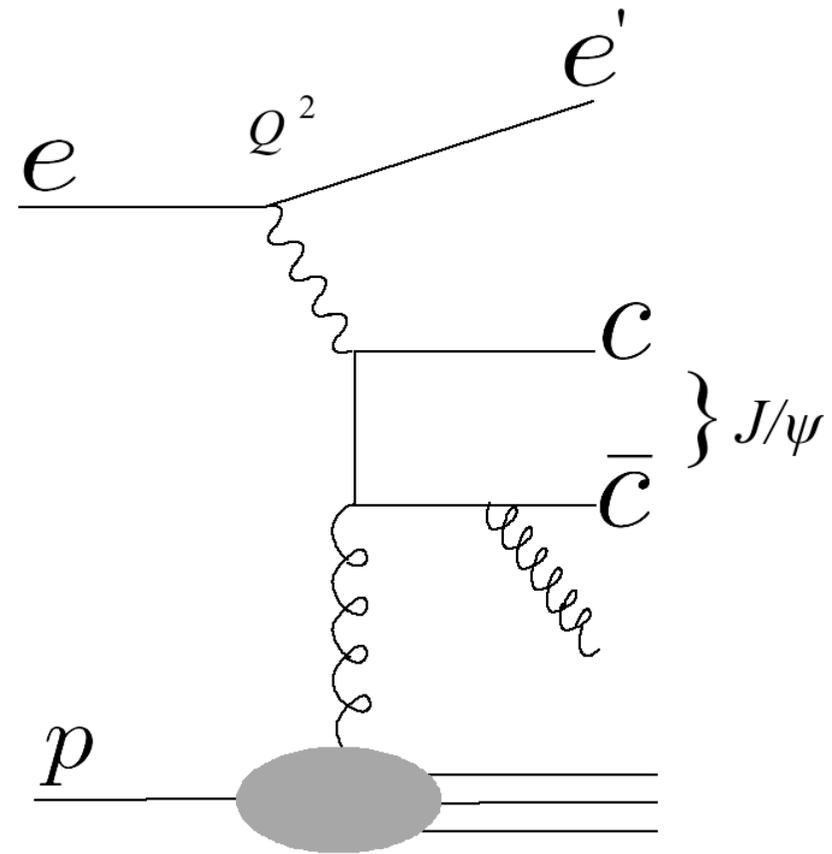


# The Cascade/HERA team: Tom and Plamen

## D\* production (Tom)

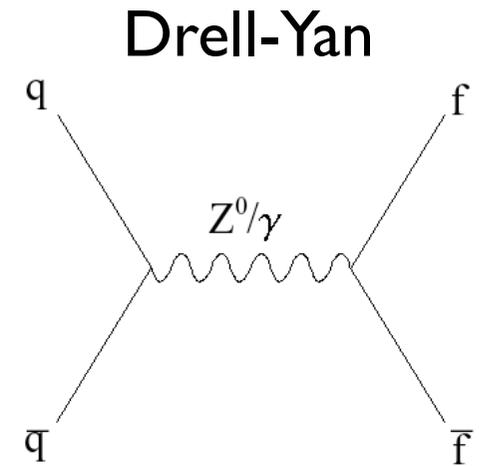
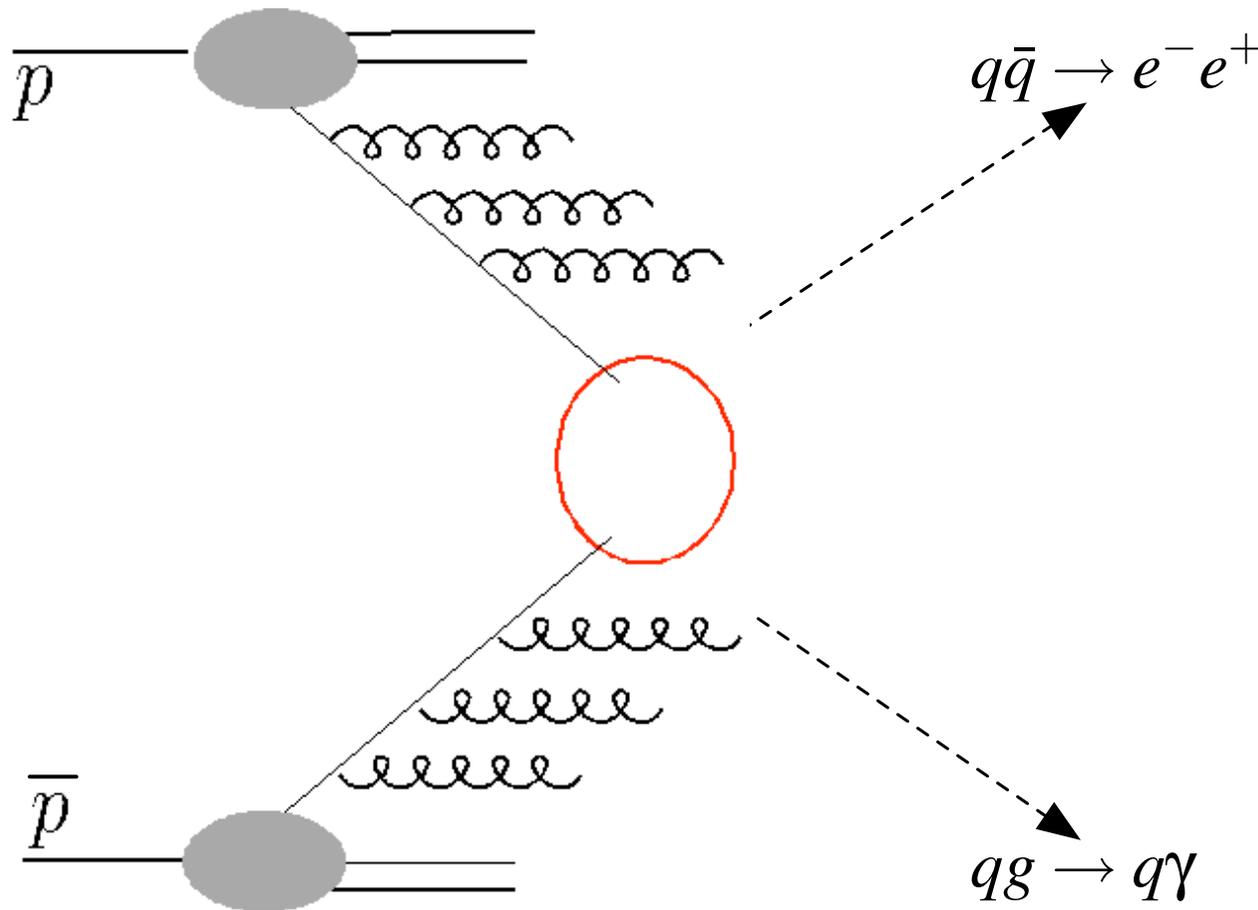


## J/ $\Psi$ production (Paco)

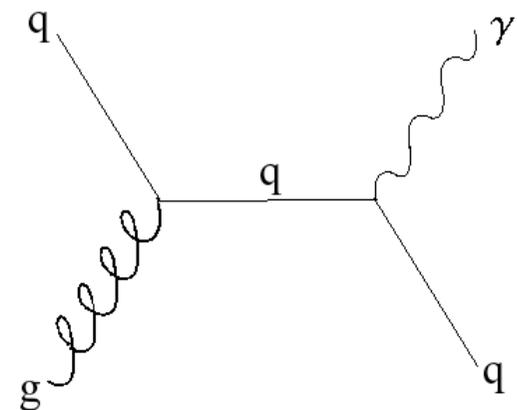


# The Pythia/Tevatron „team“: me

- Data from D0 and CDF at Tevatron, Fermilab

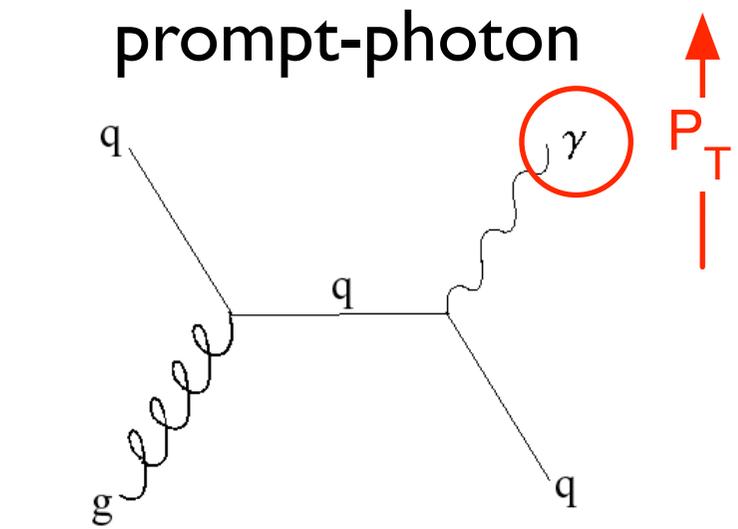
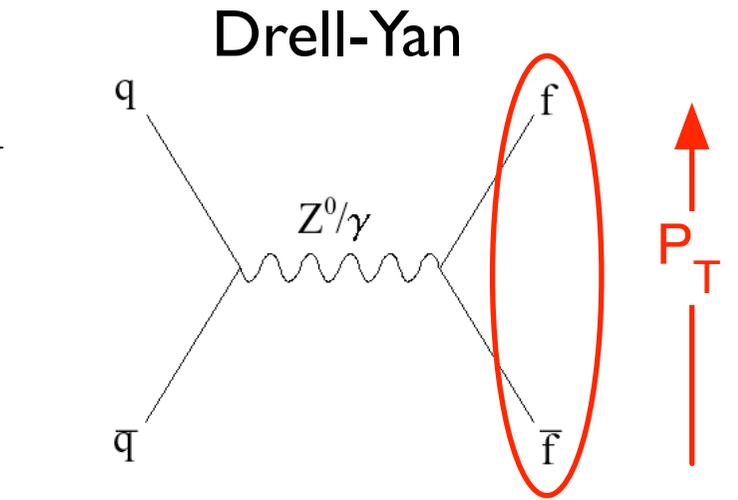
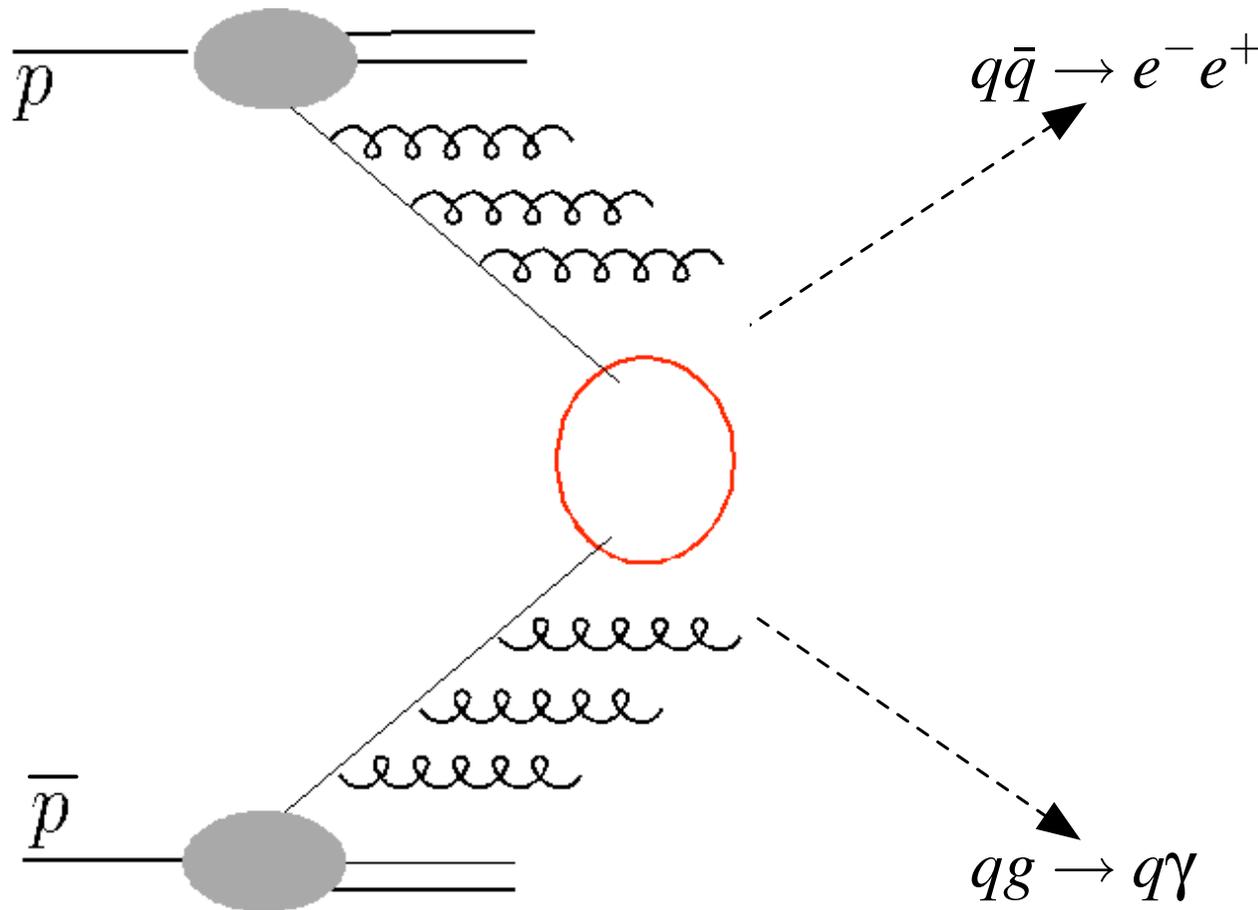


### prompt-photon



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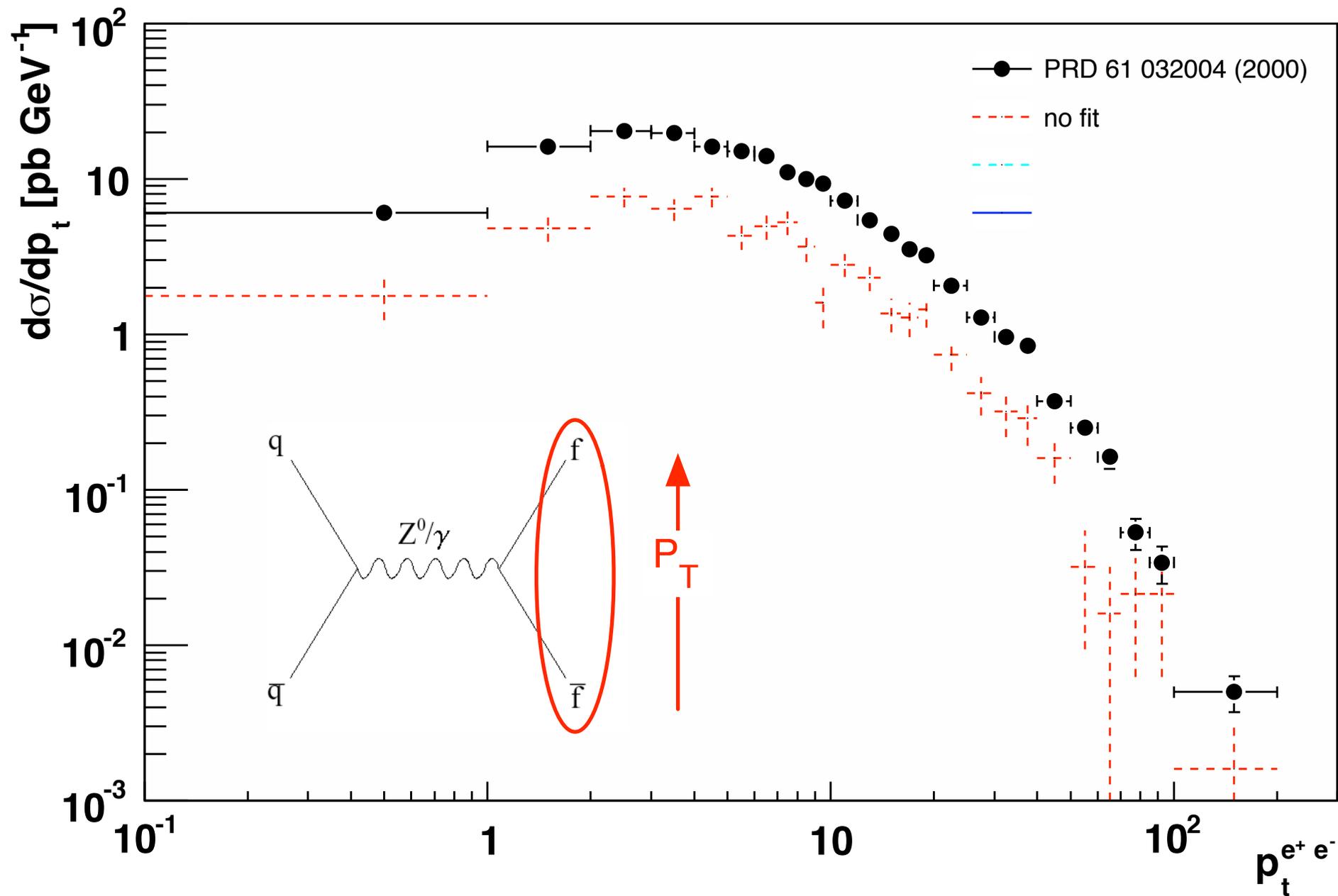
## Procedure

- implementation of data:
  - copy detector data into a routine
- event simulation and cuts  
cut ↔ data selection
  - e.g. : if (invariant mass > 60 GeV) then accept data  
else discard it
- fitting of parameters of PDF (by minimizing  $\chi^2$  )

$$\chi^2 = \sum_i \frac{(MC_i - data_i)^2}{(standard\ deviation)^2}$$

# Drell-Yan

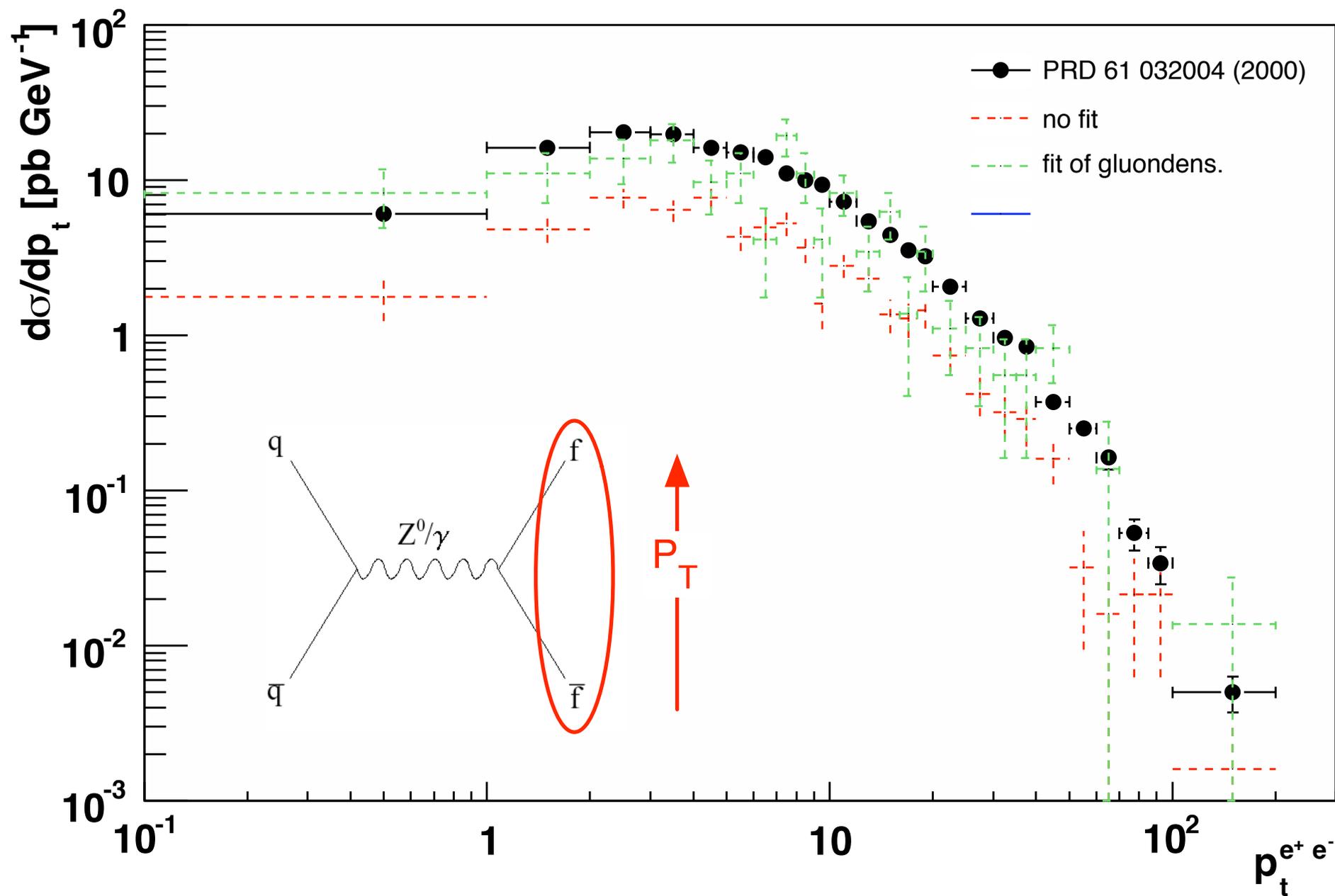
$$q\bar{q} \rightarrow e^-e^+$$





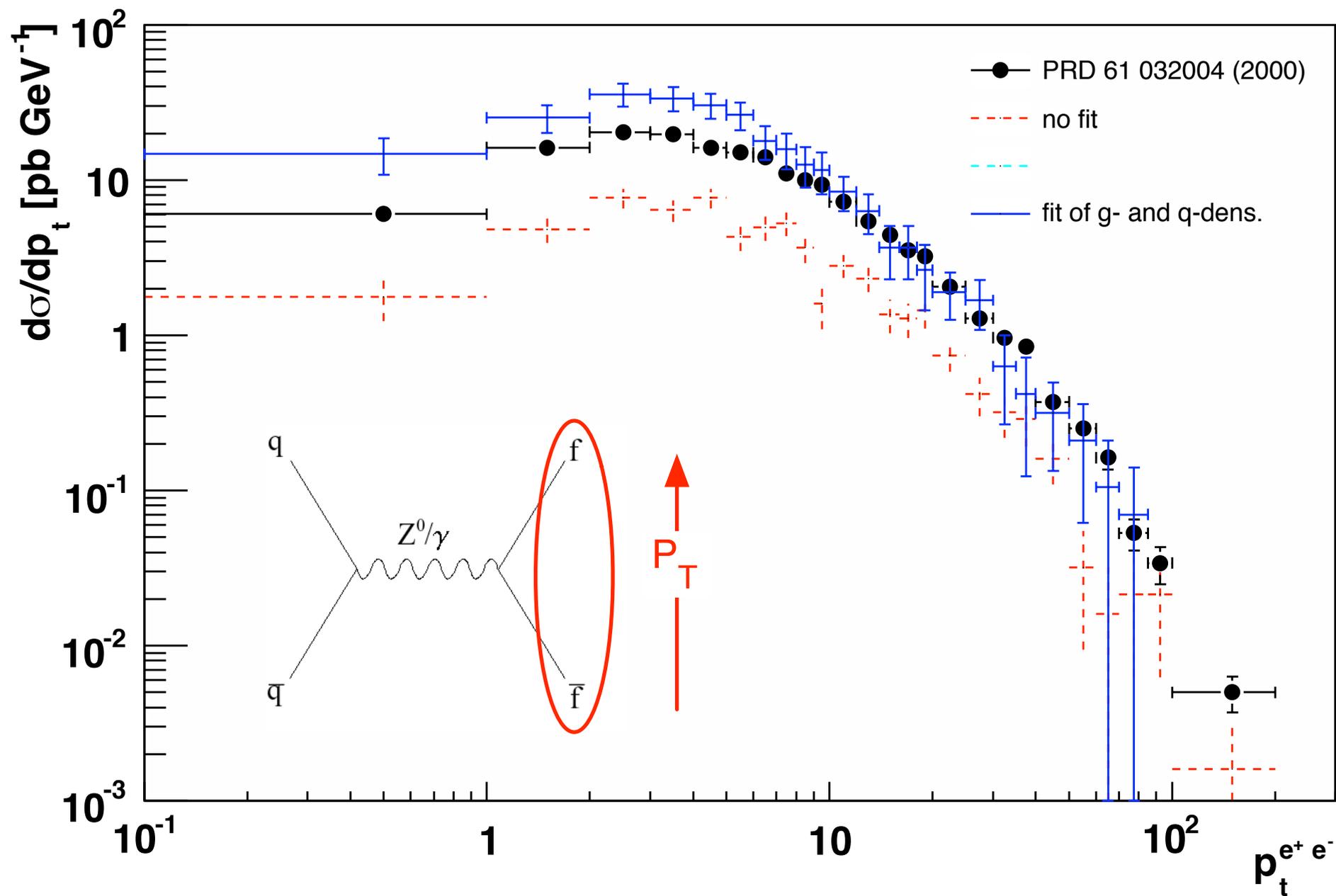
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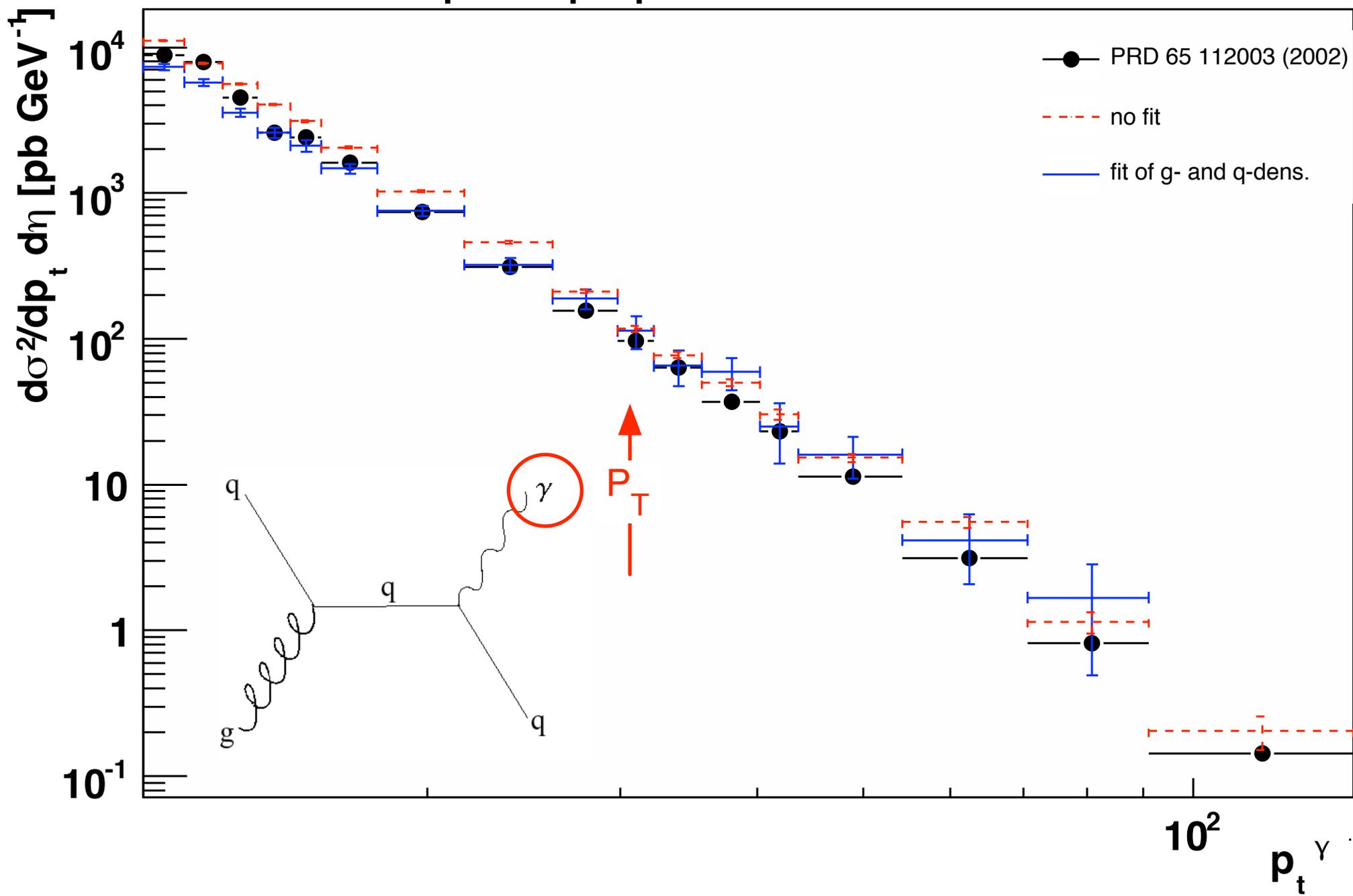
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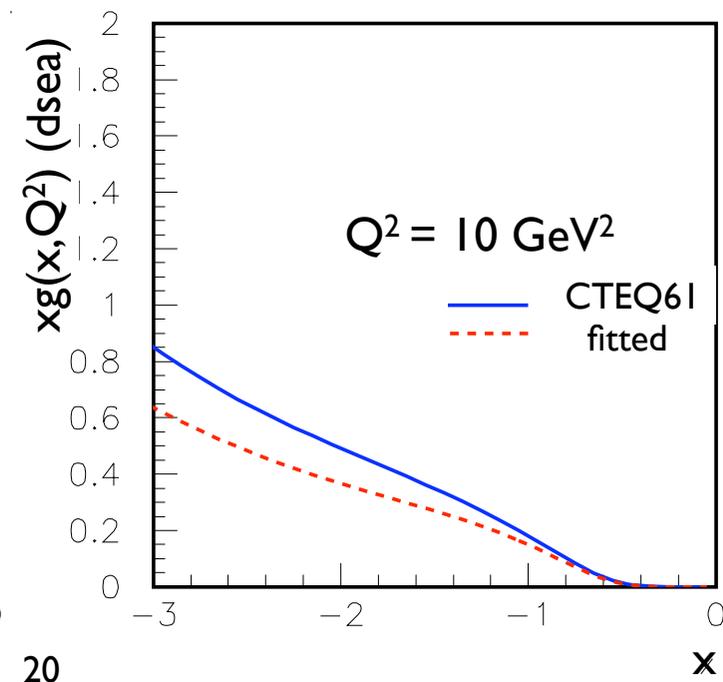
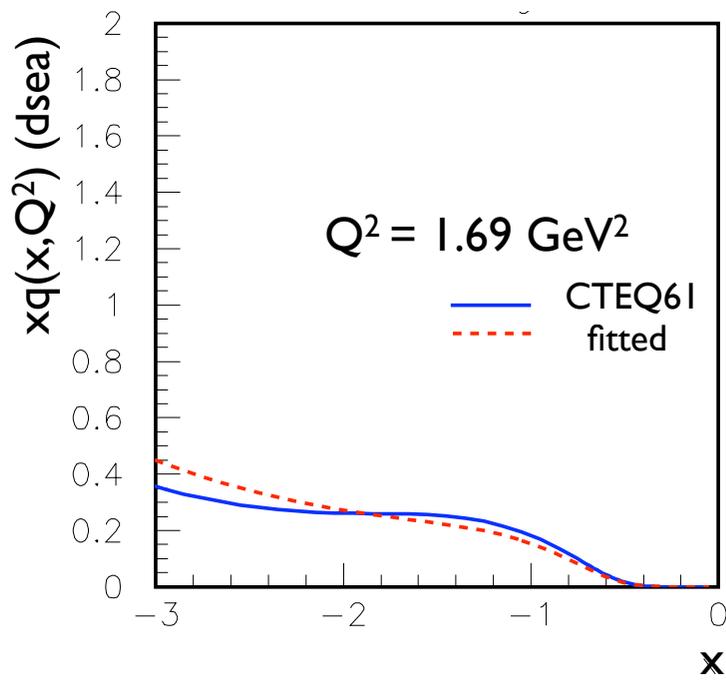
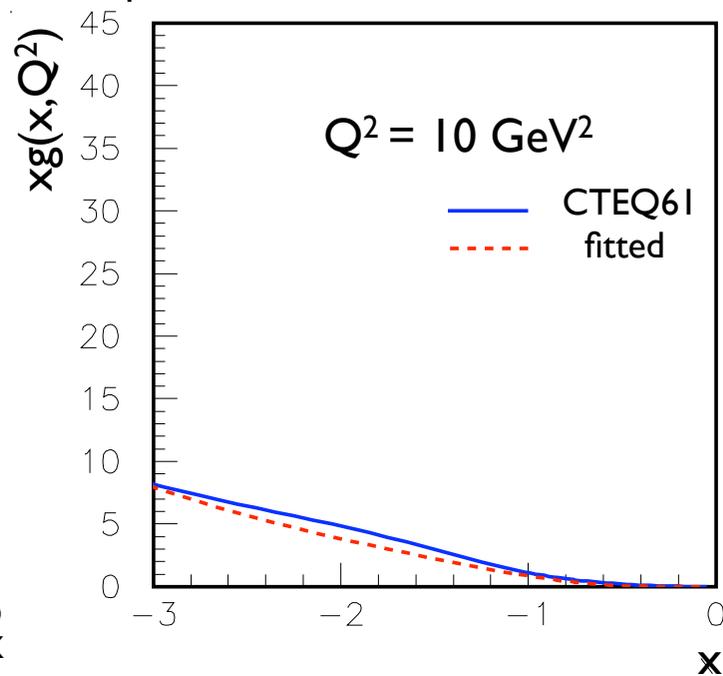
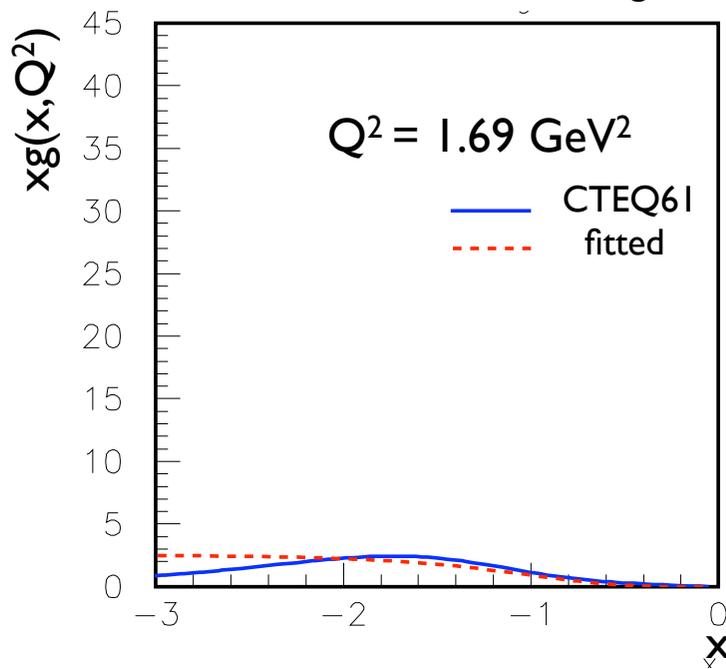


prompt-photon

$qg \rightarrow q\gamma$



gluon + sea quark fits



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## Outlooks

- fitting the data rather than scanning
- compare the PDFs of HERA and Tevatron data (using only Cascade or Pythia)