

# Higgs Production at LHeC

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# Methodology

- Madgraph : tree level calculations of various processes  
~ $\alpha_s$ ,  $\alpha_s^2$  and  $\alpha_s^3$
- Code generated according to request via web interface  
(you have to know what are you doing...)
- SM parameters can be steered via SM parameter calculator (param\_card.dat)-> e.g. allows to study a variation of MH
- Beam energy, phase space cuts, PDF, scales etc. via steering card (run\_card.dat)
- No specific higgs decay modes considered.
- Madgraph produced all diagrams shown in this talk.

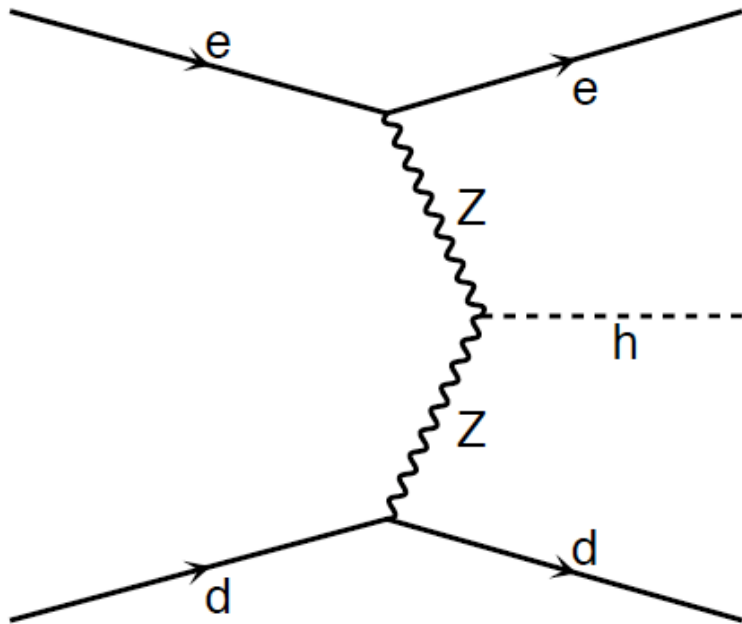
# Used Settings

- PDF : CTEQ6I1 (LO PDF and LO  $\alpha_s=0.13$ )
- Factorization and renormalizations scales set to partonic c.m.s.
- Usually no phase space cuts except stated otherwise -> total cross sections
- Higgs mass 120 GeV except stated otherwise, all other parameters according to tree level calculations (e.g. Z and W widths)
- Proton beam energy fixed to 7000 GeV
- Electron and positron beam energies set to 70 and 140 GeV
- 10 k events per point

# NC : LO SM Higgs Production

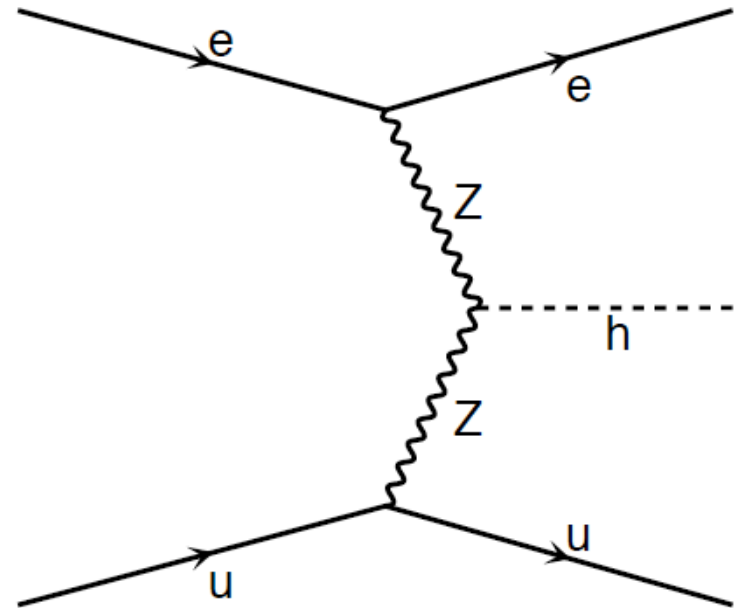
e-p (swap charges for e+p)

$e^- d \rightarrow e^- h d$



around 1/3

$e^- u \rightarrow e^- h u$

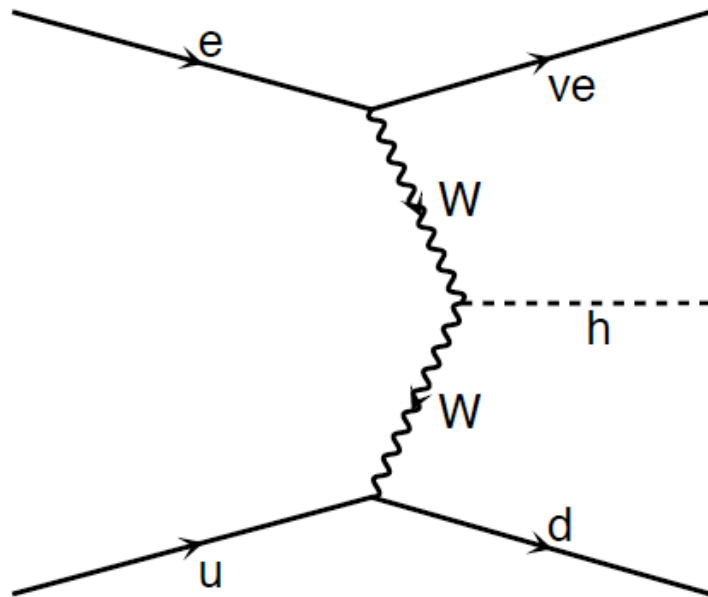


around 1/3

# CC : LO SM Higgs Production

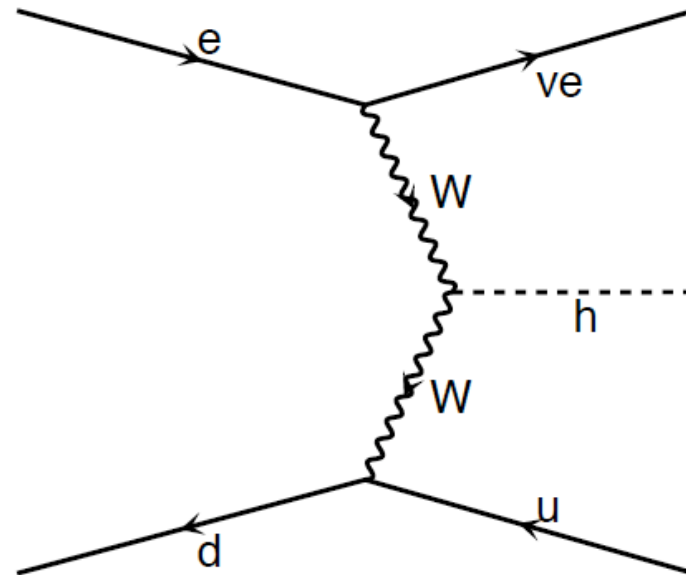
e-p (swap charges for e+p)

$e^- u \rightarrow \nu_e h d$



around 90-80%

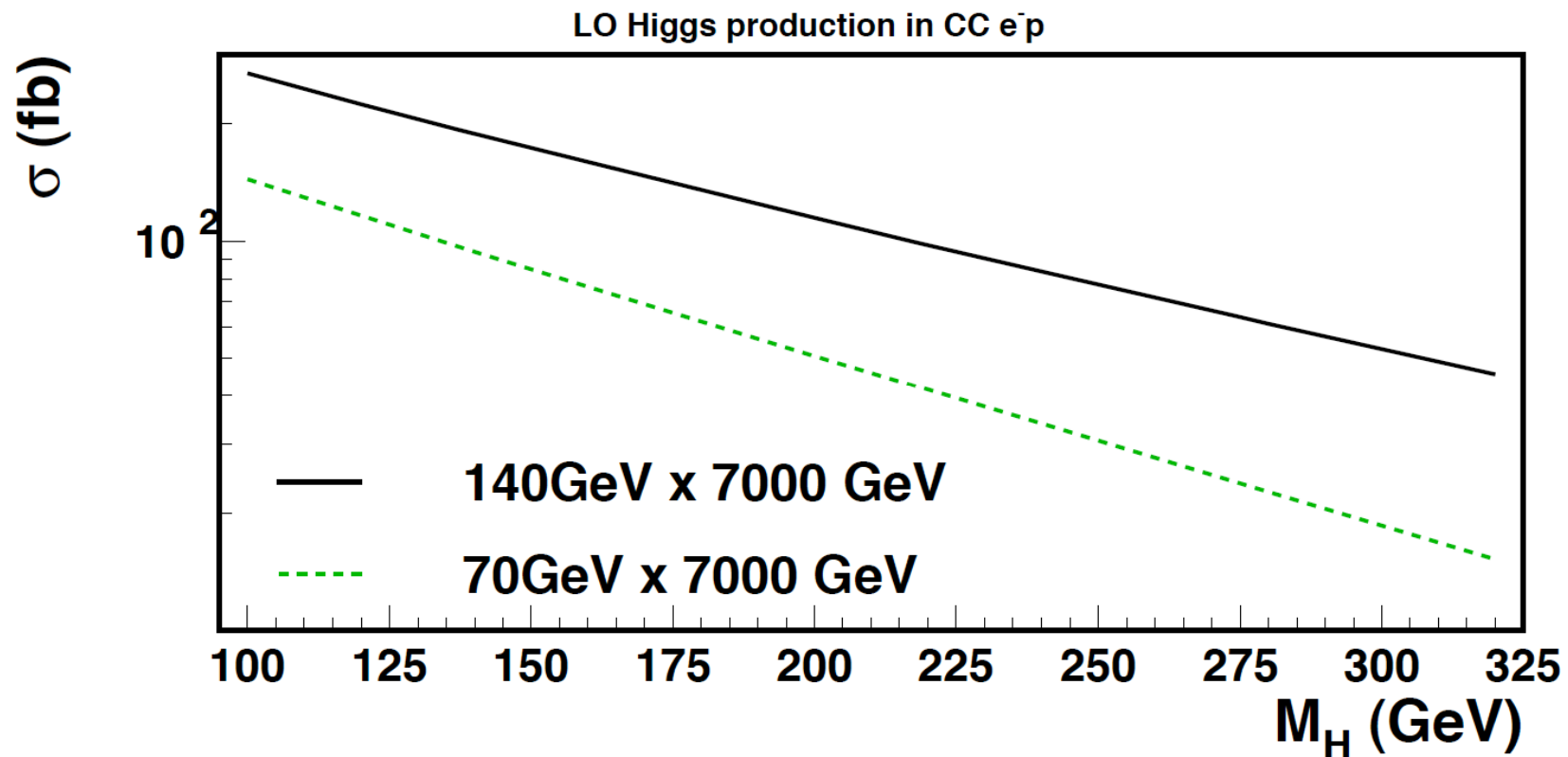
$e^- d \rightarrow \nu_e h u$



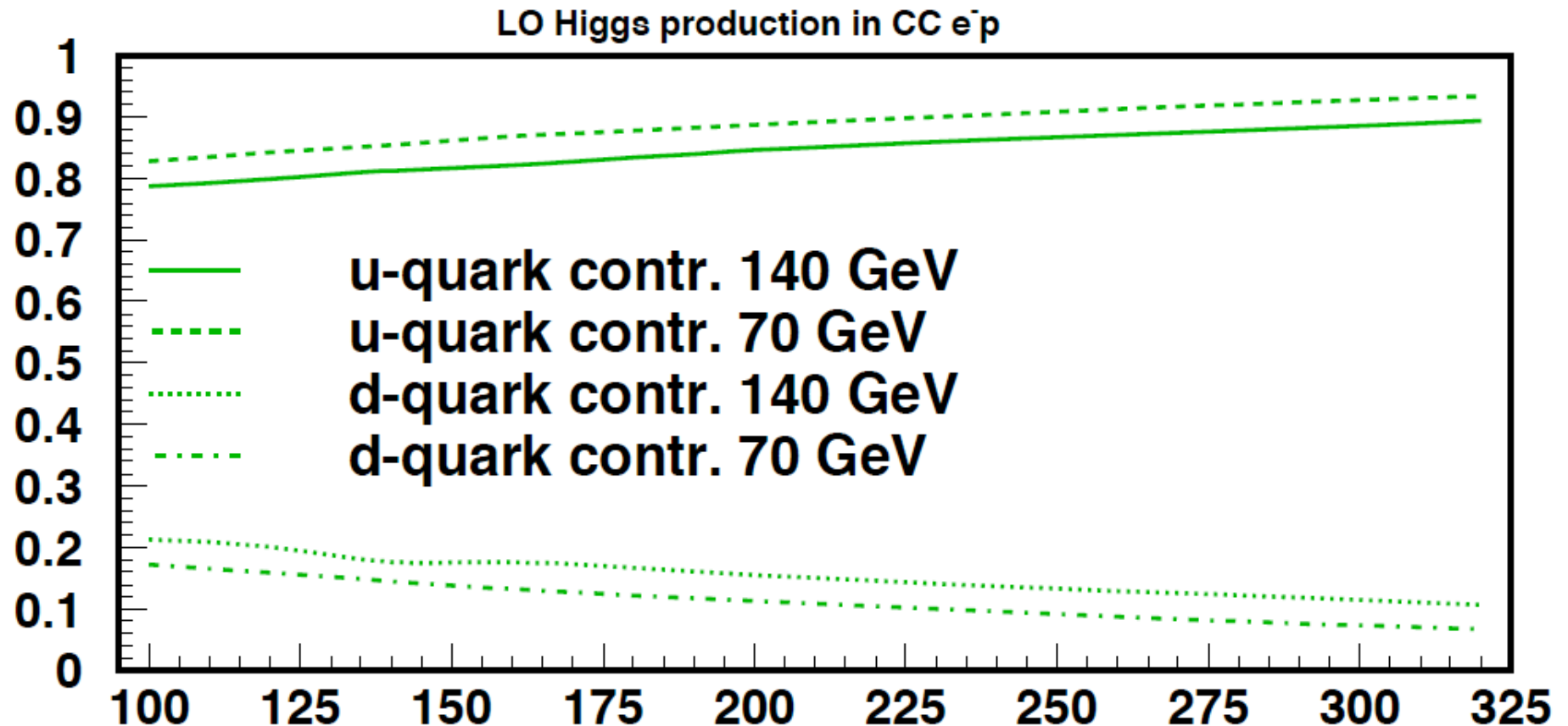
around 10-20%

# CC e-p : Total Cross Sections

- 140 GeV e- : SM Higgs cross sections are around 250 - 40 fb for  $M_H$  range of 100-300 GeV
- 70 GeV e- : reduced to around 1/2

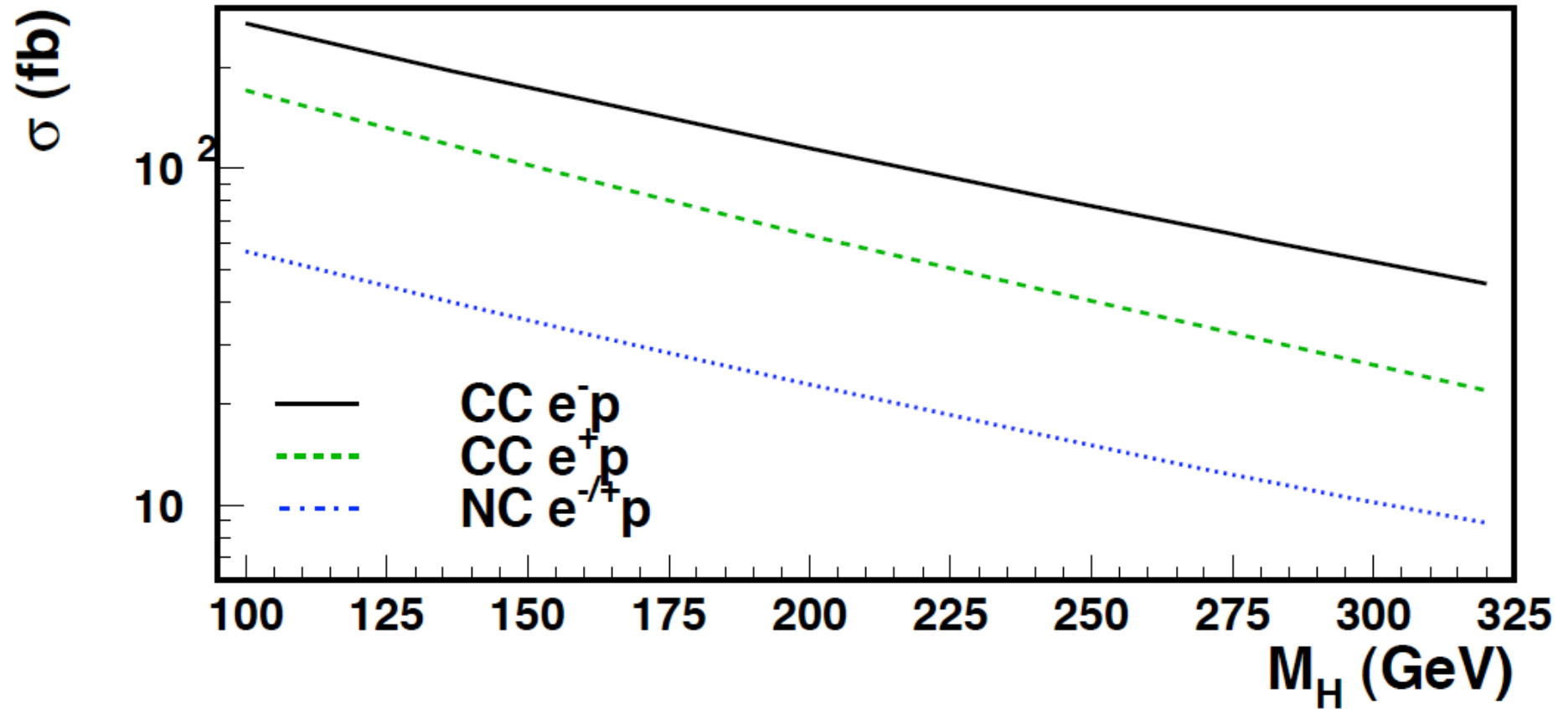


# Side Remark : u and d-quark type Contributions



- Reflecting the different mean  $x$  probed.

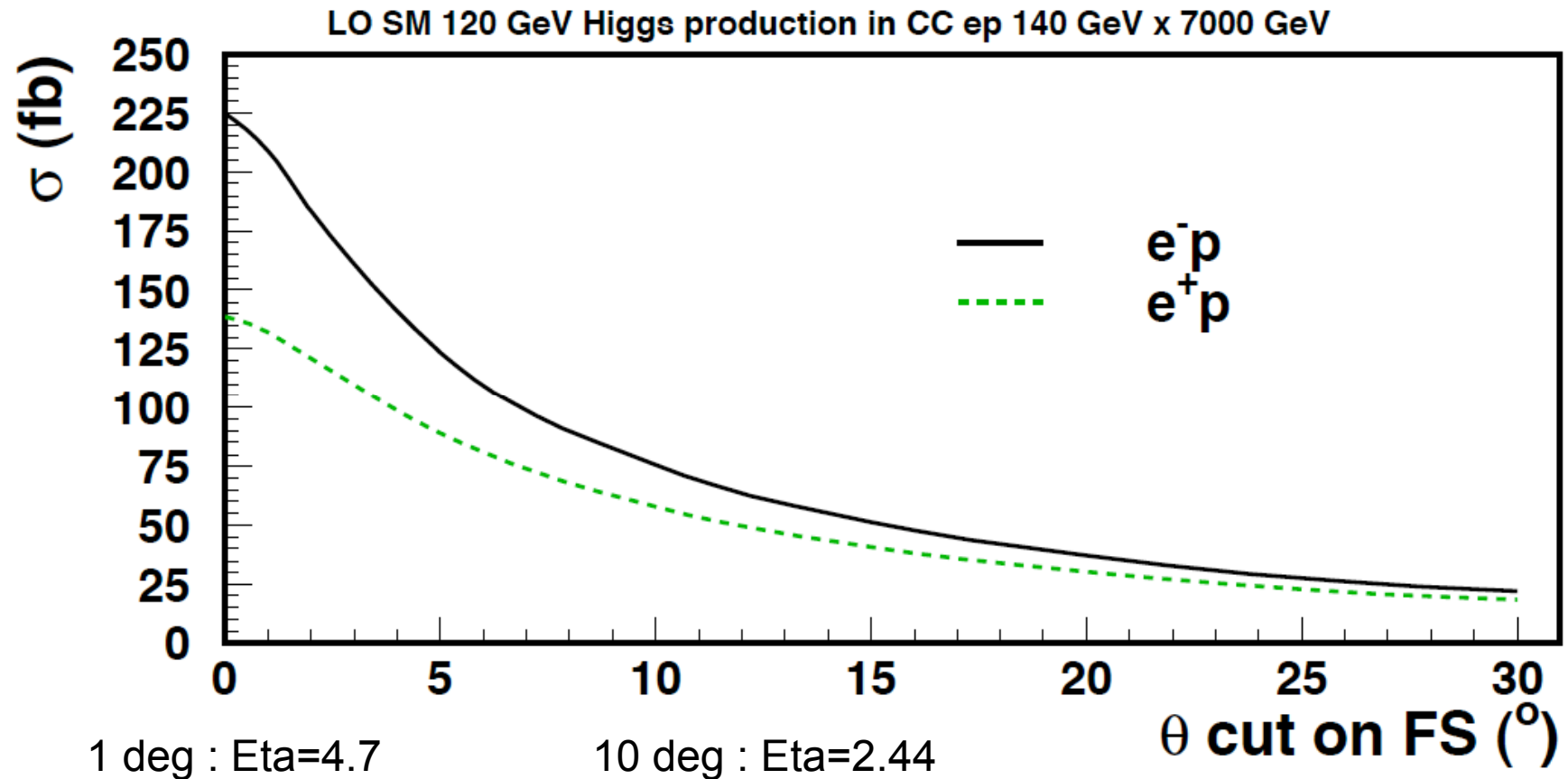
# 140 GeV x 7000 GeV



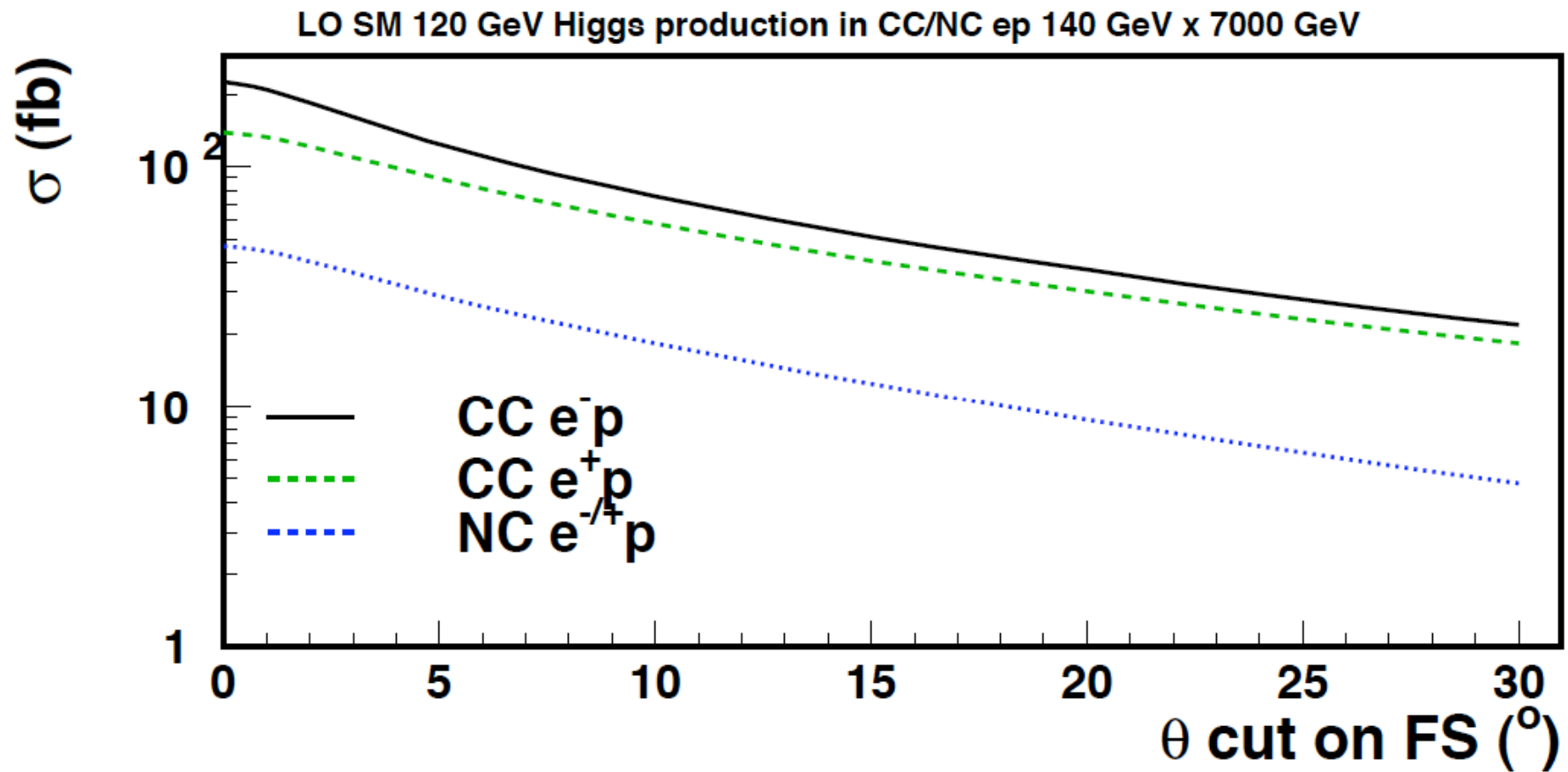


# Effect of Detector Acceptance

- Apply eta cuts on ALL final states

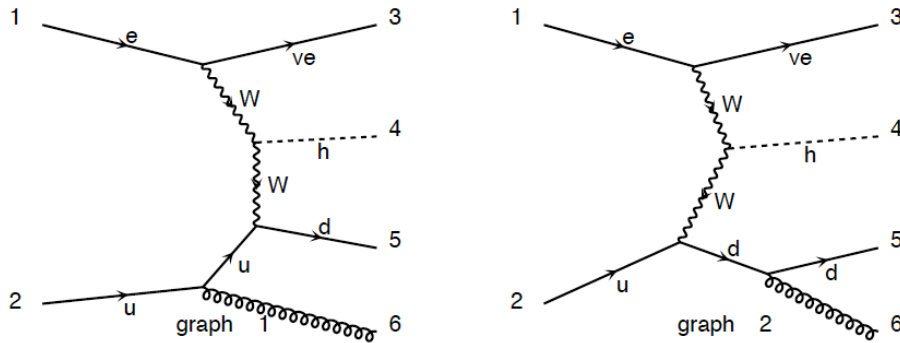


# Effect of Detector Acceptance

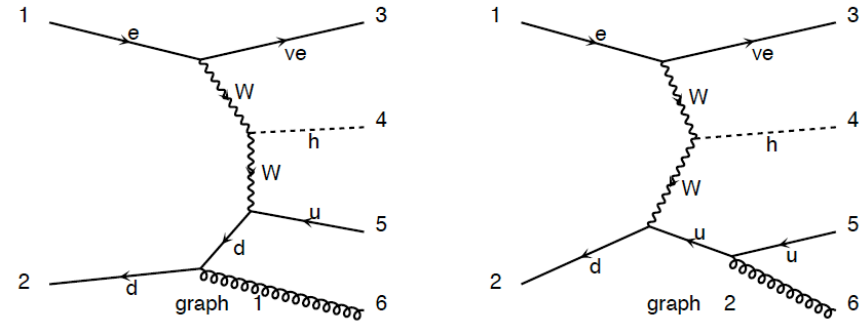


# What about HO Contributions?

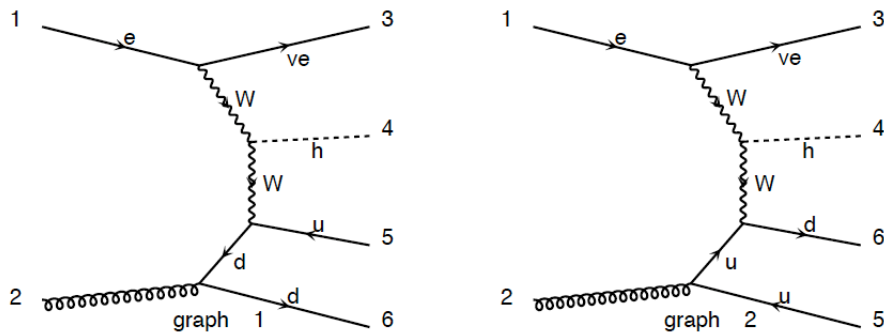
Diagrams by MadGraph e- u -> ve h d g



Diagrams by MadGraph e- d~ -> ve h u~ g



Diagrams by MadGraph e- g -> ve h u~ d



Tree level  $\alpha_s \cdot \alpha_s$

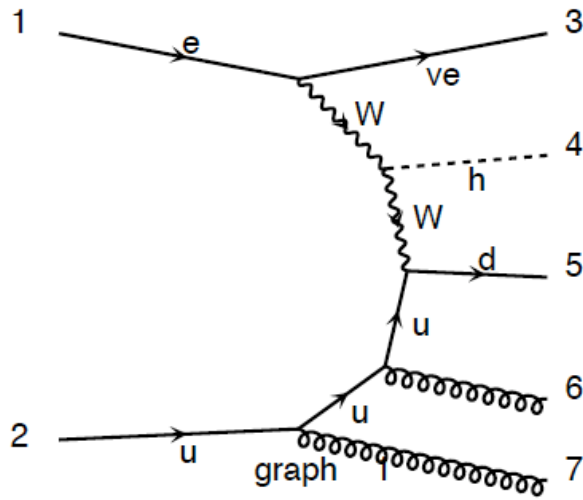
140 GeV / 70 GeV

CC e-p : 175 fb / 83 fb

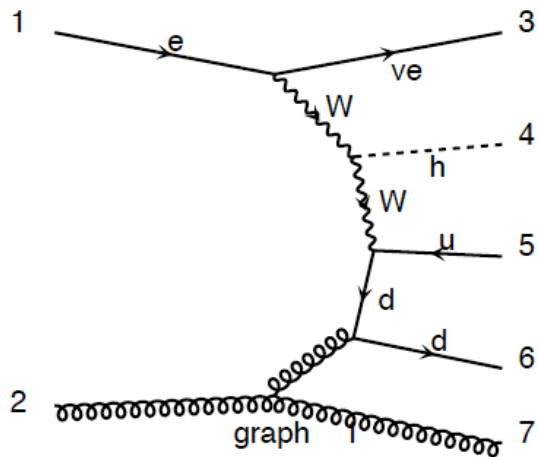
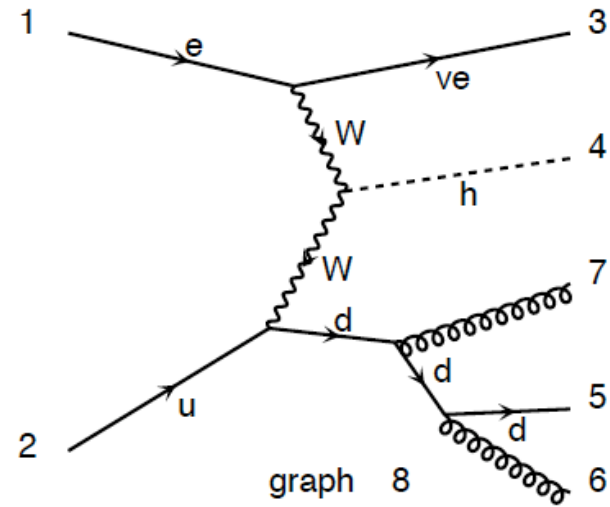
CC e+p : 109 fb / 46 fb

NC ep : 40 fb / 17 fb

# What about 'More' HO Contributions?



41 diagrams  
e.g.



CC e-p : Tree level  
 $\alpha_s \alpha_s \alpha_s$  :

113 fb

# Some Thoughts

- The SM Higgs cross sections are sizeable.
- LHeC may open an unique access to light Higgs via  $b\bar{b}$  via ZZ and WW fusion
- May we profit from e-beam polarization?
- Tag the Higgs via  $b\bar{b}$  (75%)
  - > Check topologies,  $b\bar{b}$  tagging efficiencies...
- HO contributions for signal and background ?
- Background : jets in CC, single top...