Charm studies using the Breit frame

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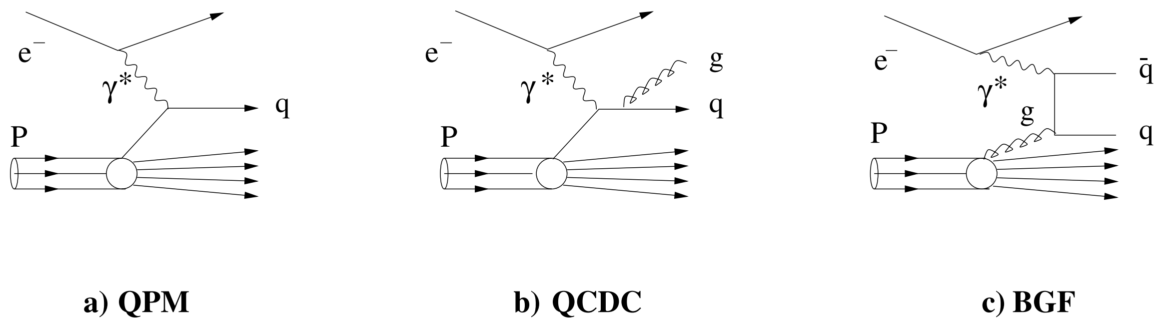
Presented at DESY workshop
"Monte Carlo Generators for HERA Physics"

(February, 1999).



Perturbative charm production

- Sea charm density method

  Adopted by MRS/CTEQ groups

  Input for DGLAP at $Q^2 = 2 - 4$ GeV^2

  Realized through QPM and QCDC

  MC: LEPTO (- BGF option)

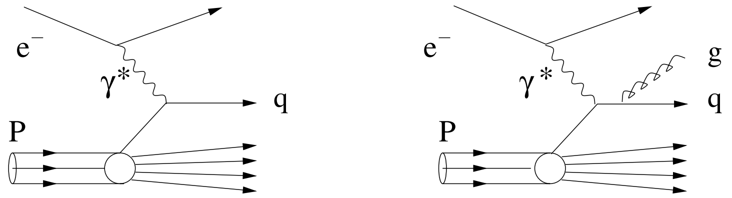
- Boson-Gluon Fusion (BGF) $\gamma^* g \to c\bar{c}$

  Adopted by GRV group

  $W^2 = Q^2(1-x)/x >> 4m_c$

  Realized through BGF only

  MC: AROMA



a) QPM b) QCDC

Non-perturbative charm production

- Intrinsic charm

  $| \, p\rangle = \alpha \, | \, uud\rangle + \beta \, | \, uud \, \bar{c}c\rangle$

  Realized through QPM and QCDC only

  Low production rate $< 1\%$

  MC: an option in LEPTO

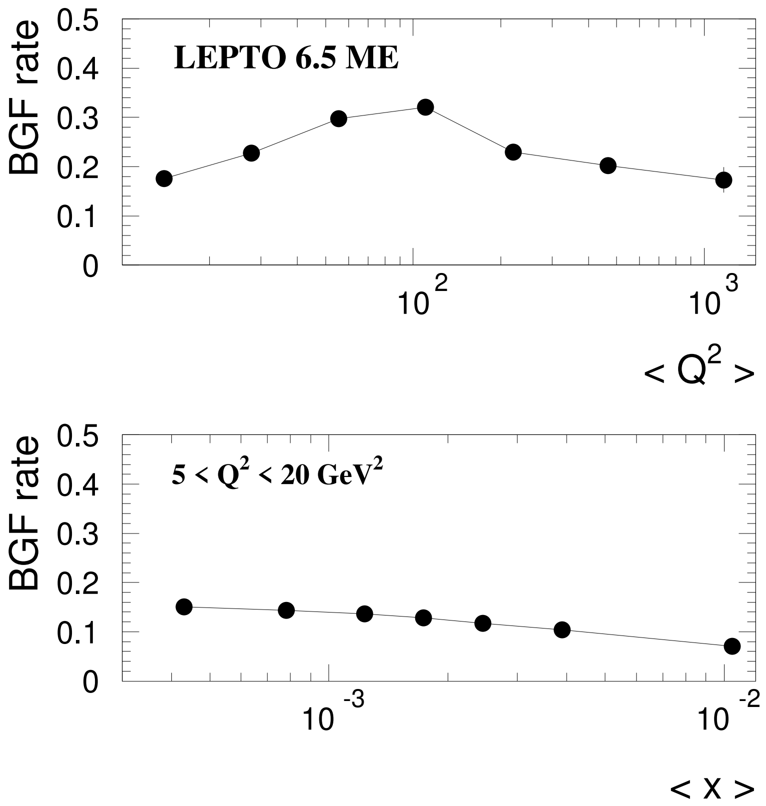
- Fragmentation

  Known from LEP to be small.

H1 has set a limit of 5% on charm from non-BGF

... but QCDC from sea was not included

... too low statistics



Can BGF process be filter out ?

- Phase space with suppressed BGF rate:

  ME LO calculation with GRV94 HO gives:

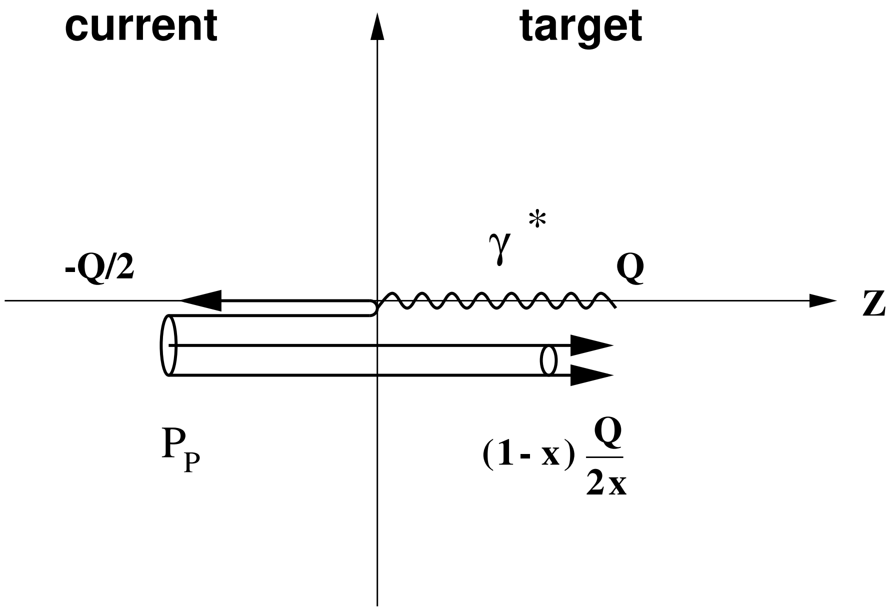
  $5 < Q^2 < 20$

  $x > 0.002$

  ...acceptable for DIS studies.

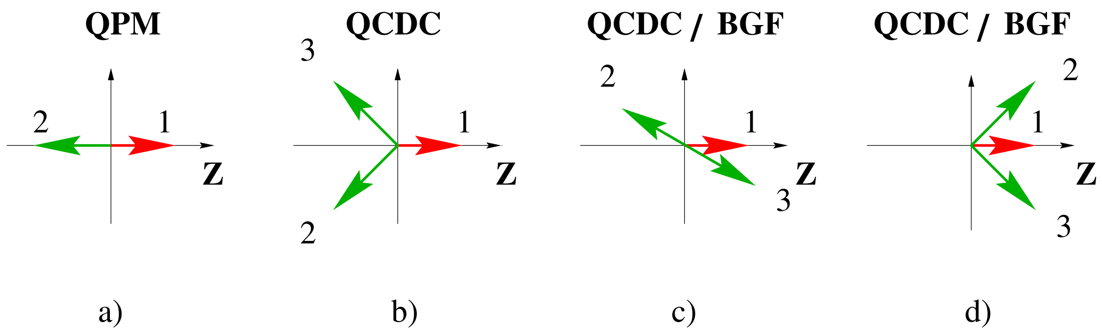
- A tool to further reduce BGF processes

  Use the Breit frame !



Breit Frame

Jet configurations at LO



BGF can be reduced requiring

- More than one jet in the current region
- Large multiplicity in the current region
- p_T event imbalance is low

Conclusions (for LO MC so far)

- Look at $Q^2 < 20$ ($x > 0.001$) where pQCD processes are suppressed.

  $\Longrightarrow$ $7 - 15\%$ BGF events (depending on x)

- Event sample can be reduced using the Breit frame:

  $\Longrightarrow$ by factor ~ 4 for charm from sea (QPM+QCDC)

  $\Longrightarrow$ by factor $\sim 20 - 30$ for charm from BGF

- If BGF is the only charm source, after cut we should expect

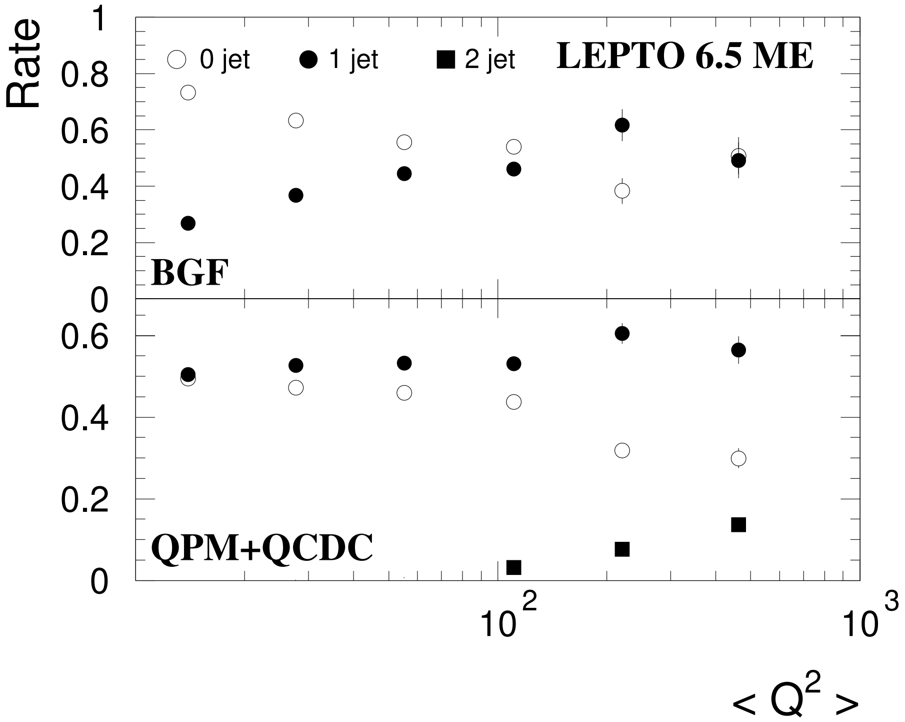
  $\Longrightarrow$ $1 - 2\%$ charmed events

- If more charmed events are observed, this is due

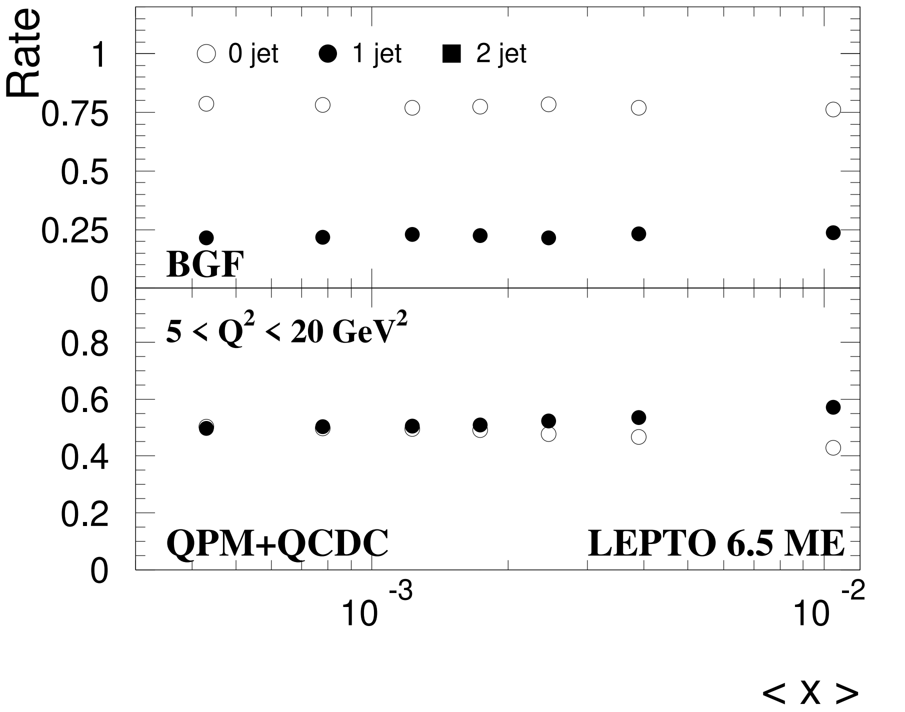
  $\Longrightarrow$ Sea charm

  $\Longrightarrow$ Intrinsic charm

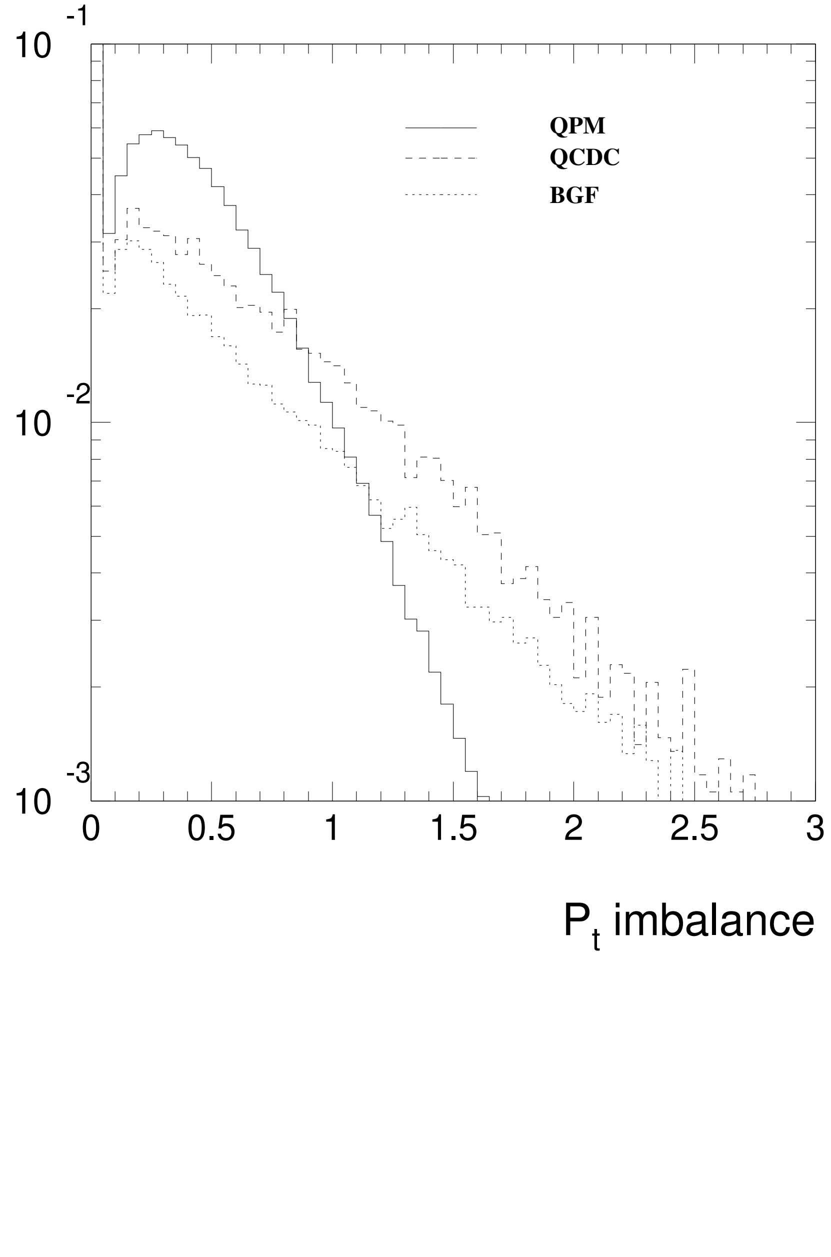
  $\Longrightarrow$ Diffractive excitation



Rate
0 jet
1 jet
2 jet
LEPTO 6.5 ME
BGF
QPM+QCDC
$< Q^2 >$



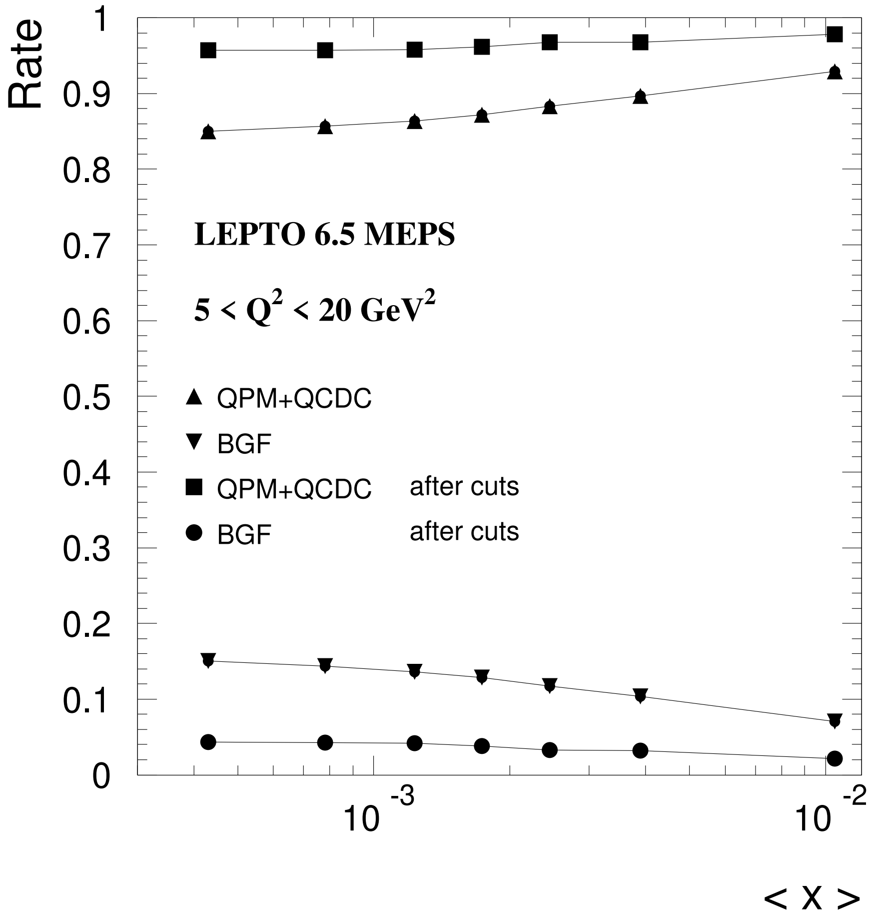
Rate
0 jet
1 jet
2 jet
BGF
$5 < Q^2 < 20$ GeV^2
QPM+QCDC
LEPTO 6.5 ME
$< x >$

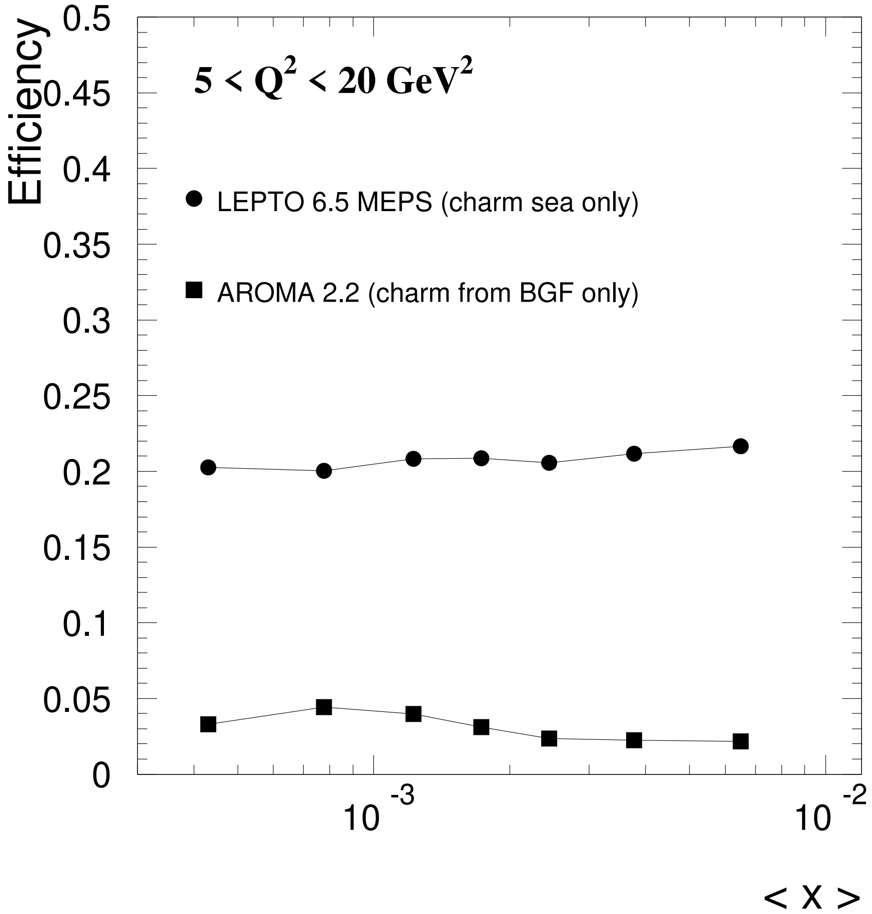


QPM
QCDC
BGF
10^{-1}
10^{-2}
10^{-3}
0
0.5
1
1.5
2
2.5
3
P_t imbalance

Charged particles only
$N > 1$ and $p_T < 0.7$

Selection efficiency $20 - 30\%$





Efficiency
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5 < Q^2 < 20 GeV^2
LEPTO 6.5 MEPS (charm sea only)
AROMA 2.2 (charm from BGF only)
10^-3
10^-2
< x >