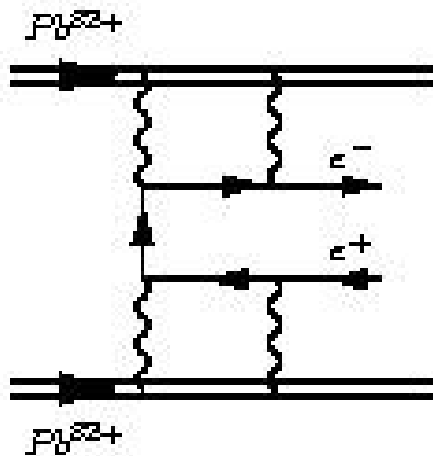


Prospects of bound-free pair production measurements at LHC energies

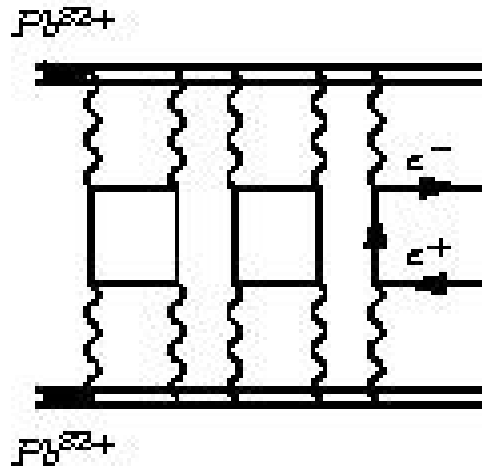
- QED in a strong coupling regime: $Z\alpha \sim 0.6$
- Multiple pair production
- Pion/kaon pair photoproduction
- $\gamma\gamma \rightarrow$ low mass resonances
- Total $\gamma\gamma$ hadronic cross section

QED in strong coupling

- free pair production cross section in Born approximation:
Landau, Lifshitz(1934), for Pb-Pb (LHC): $\sigma_{\text{Born}}(e^+e^-) \sim 2 \times 10^5 \text{ b}$
- One pair cross section $\sigma_1 = \sigma_{\text{Born}} + \sigma_{\text{Coul}} + \sigma_{\text{unit}}$



Coulomb corrections



Unitarity corrections

e^+e^- -pairs(Pb-Pb,LHC):

$$\sigma_{\text{Coul}} \sim -0.14 \sigma_{\text{Born}}$$

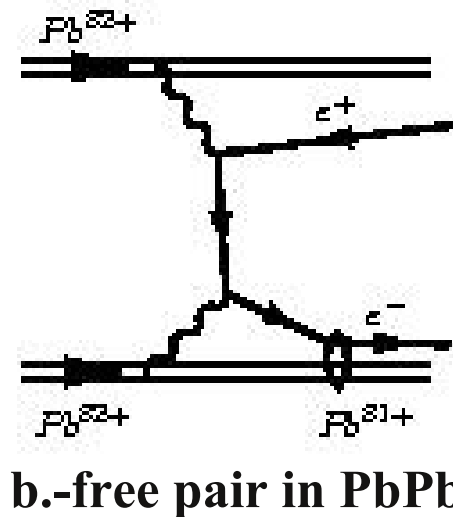
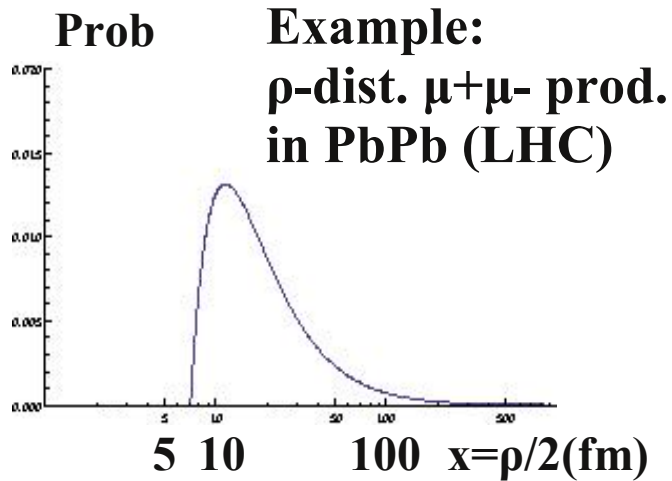
$$\sigma_{\text{Unit}} \sim -0.033 \sigma_{\text{Born}}$$

Bound-free pair production

- bound-free e^+e^- pair production in equivalent photon approx.:

$$\sigma_{Z_1+Z_2 \rightarrow Z_1+e^+ + (Z_2+e^-)} = \int P_{\text{bfpp}}(\rho) d^2\rho = \int dn_\gamma(\omega) \sigma_{\gamma Z_2 \rightarrow e^+ + (Z_2+e^-)}(\omega)$$

- $dn_\gamma(\omega) = Z_1^2 \frac{\alpha}{\pi^2} \times d\omega/\omega \times d^2\rho/\rho^2$



σ_{BFPP} (PbPb, LHC)
 ~ 270 b (per beam)

Multiple pair production

- Two pair production (one free, one bound-free) :
- $\sigma(\text{free, b.free}) = \int P_{ee}(\rho) P_{\text{bfpp}}(\rho) d^2\rho$
- Differential cross sections $d\sigma/d(pT)$



free and b.-free pairs in PbPb



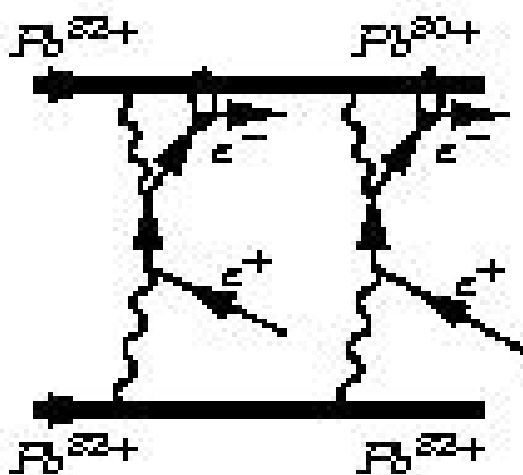
b.free e^+e^- plus $\pi^+\pi^-$ (K^+K^-) pair

→ next talk by N.Kaiser

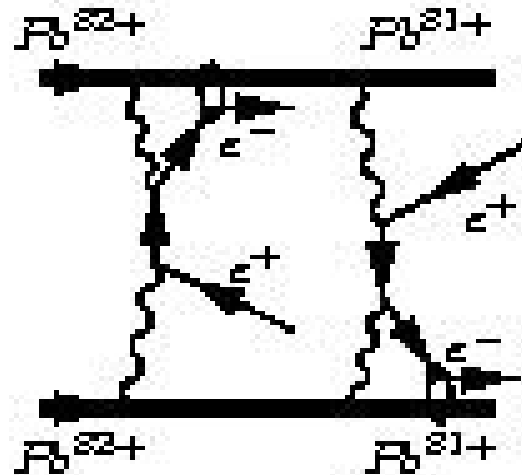
Trento, feb 27, 2012

Multiple bound-free pair production

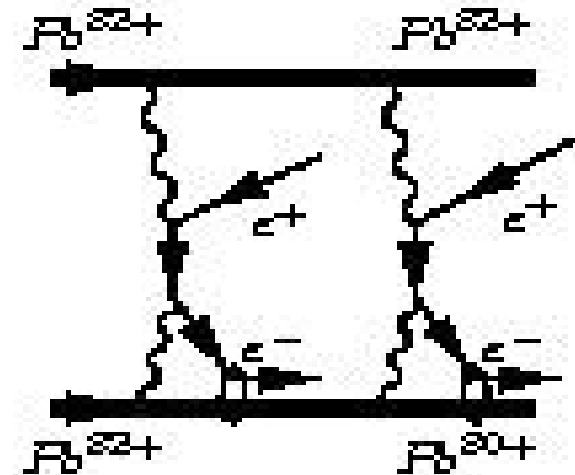
- production of two bound-free pairs



Pb(80+)Pb(82+)



Pb(81+)Pb(81+)



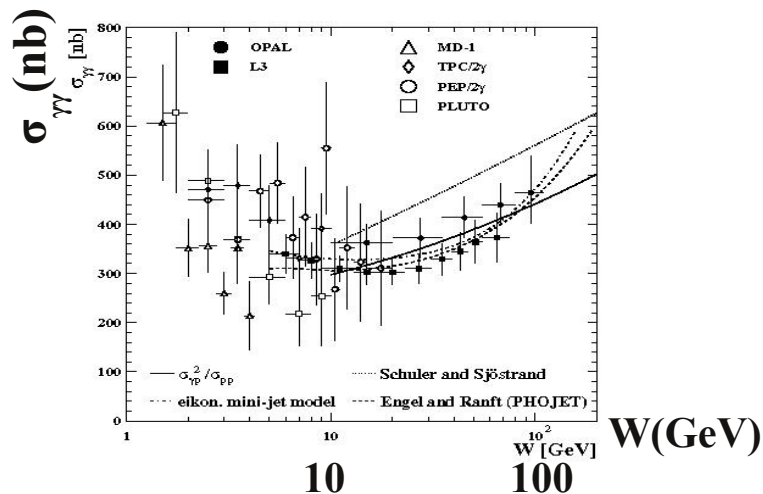
Pb(82+)Pb(80+)

$\sigma_{\text{Born}}(80+,82+) > 6 \text{ mb}$
(comm. V. Serbo)

$$\sigma_{2\text{BFPP}} = \sigma_{\text{Born}} + \sigma_{\text{Coul}} + \sigma_{\text{uni}}$$

Total $\gamma\gamma$ hadronic cross section

- Does the $\gamma\gamma$ hadronic cross section have the same energy dependence as the proton-proton cross section ?
- Measurements by PLUTO, TPC/2, PEP/2, MD1, L3 and OPAL



$\gamma\gamma \rightarrow$ hadrons

**For PbPb at LHC:
 $W(\gamma\gamma) < 200$ GeV for Z^4 enhancement**

→ rates need to be evaluated

Summary

- QED measurements in the strong coupling regime: $Z\alpha \sim 0.6$
 - Multiple pair production: (bound-free, free-free)
 - Multiple pair production (bound-free, bound-free)
- Pion/kaon pair photoproduction
- Hadron spectroscopy: $\gamma\gamma \rightarrow$ low mass resonances
- Total $\gamma\gamma$ hadronic cross section