Tagging of Pb-ions in ALICE

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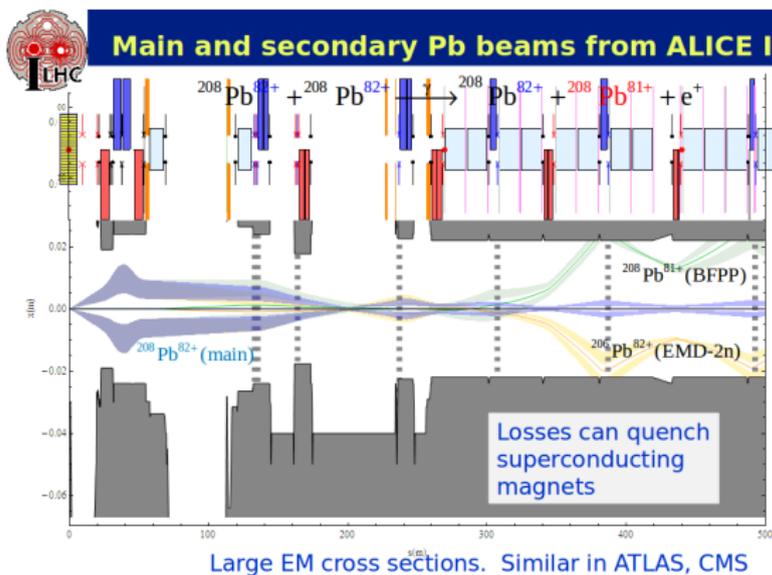
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Secondary lead beams at IP2

Trigger on electromagnetic processes

Two detector concepts for the dispersion collimators

Secondary Pb-beams at IP2

Main and secondary Pb beams from ALICE IP

$^{208}Pb^{81+} + ^{208}Pb^{82+} \rightarrow ^{208}Pb^{82+} + ^{208}Pb^{81+} + e^+$

$^{208}Pb^{81+}$ (BFPP)

$^{208}Pb^{82+}$ (main)

$^{206}Pb^{82+}$ (EMD-2n)

Losses can quench superconducting magnets

Large EM cross sections. Similar in ATLAS, CMS

J.M. Jowett, ALICE Forum, 20/7/2011

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Upgrade of Pb-beam intensity requires DS (Dispersion Suppression) collimators in cold section of LHC dipole magnets, 380 m from IP2

Possibility of active collimators ?

Tagging of secondary Pb-ions

particle transport according to magnetic rigidity $B\rho = \frac{Z}{A}\frac{p}{q}$

for secondary Pb-beams $\frac{Z}{A} \neq \frac{82}{208}$

- $\frac{Z}{A} = \frac{82}{207}, \frac{82}{206}$: GDR 1n, 2n decay
- $\frac{Z}{A} = \frac{81}{208}, \frac{80}{208}$: single and double bound-free pair production
  - ▶ bound-free pair production is an electromagnetic process
  - ▶ possibility of trigger on purely electromagnetic processes
  - ▶ the physics of strong electromagnetic fields
- search for hybrids Pb_{207}^{80+} (2 b.-free, 1 n), Pb_{206}^{81+} (1 b.-free, 2 n)
- $\frac{Z}{A} \neq \frac{82}{208}$: activity in central barrel,ZDC: fragmentation studies
  - ▶ additional information for study of very peripheral reactions
  - ▶ correlation studies of forward fragments with particle multiplicity at midrapidity

measure position (magn. rigidity) and a signal $\propto$ Z
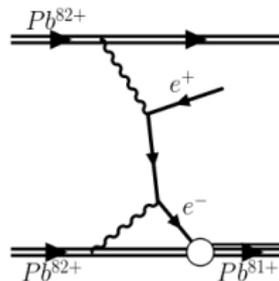time-of-flight for pile-up rejection and vertex constraint

Single and multiple pair production
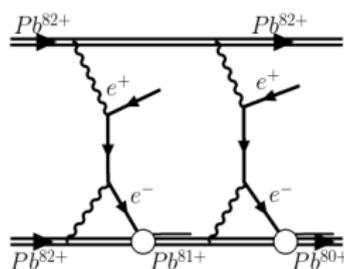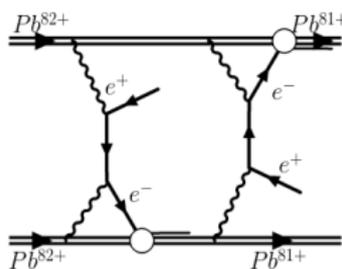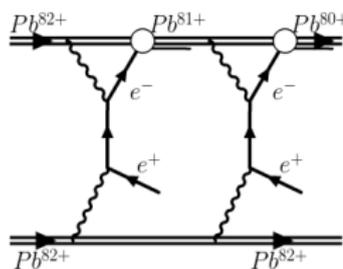
single pair production: free e^+e^- bound-free e^+e^-
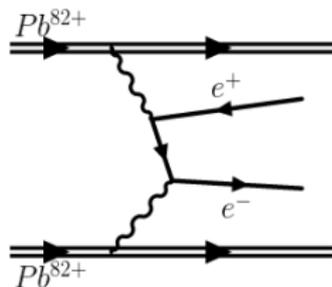
$\sigma_{Born}(e^+e^-,PbPb,LHC) \sim 200$ kb

$\sigma_{BFPP}(PbPb,LHC) \sim 270$ b per beam

double bound-free pair production

$\sigma_{2xBFPP}(PbPb,LHC) > 6$ mb (priv. comm. V.Serbo)

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Multiple pair production

production of bound-free pair with a free pair
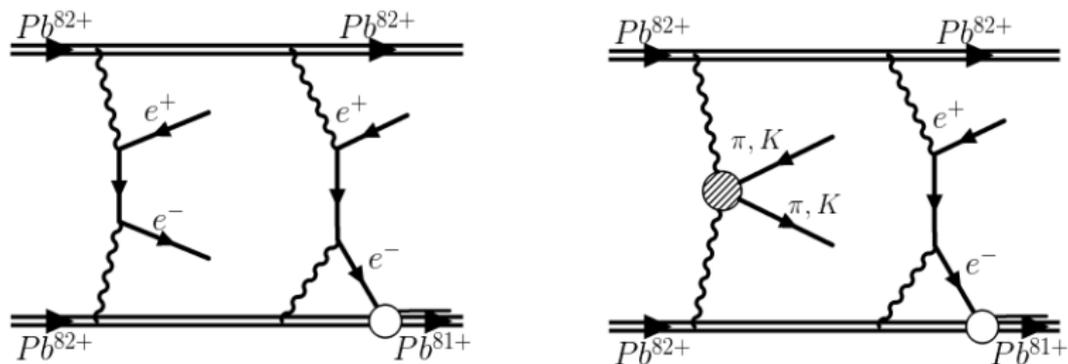
Trigger on electromagnetic processes
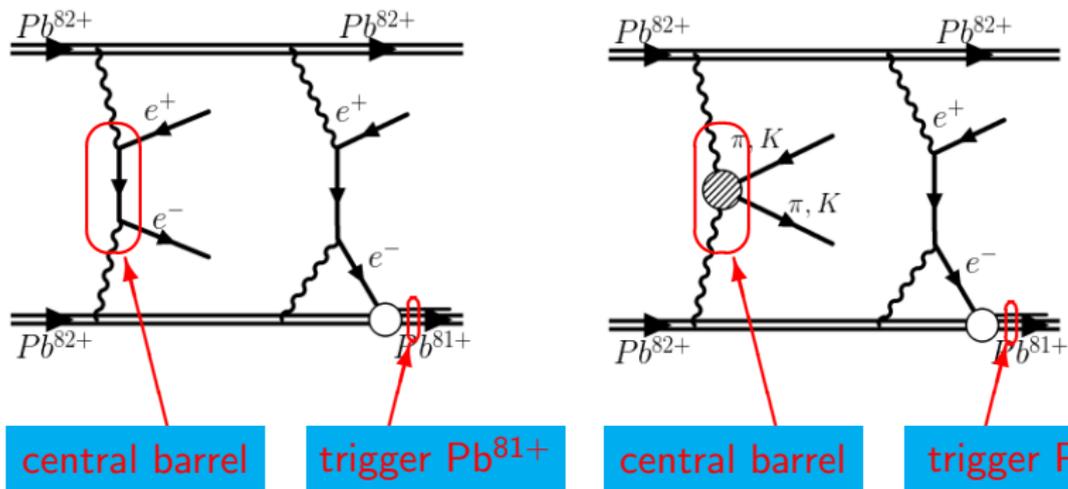
Forward trigger on Pb^{81+}, measure in central barrel

- free e$^+$e$^-$-pairs
- π^+-π^- and K$^+$-K$^-$-pairs
- pure electromagnetic processes

Physics topics in tagging secondary lead beams

- Fragmentation studies, study of very peripheral reactions
- Giant dipole neutron decays, bound-free pair production, hybrids
- The physics of strong electromagnetic fields
  - ▶ QED in a strong coupling regime: $Z\alpha \sim 0.6$
  - ▶ Coulomb and unitarity corrections to Born level diagrams of double bound-free pairs
  - ▶ Multiple lepton pair production
  - ▶ Pion/Kaon pair photoproduction
  - ▶ $\gamma\gamma \to$ low mass resonances
  - ▶ Total $\gamma\gamma$-hadronic cross section
  - ▶ Chiral magnetic effect in pure electromagnetic interactions ?
    - • reaction plane not known, particle dipole pattern at midrapidity ?
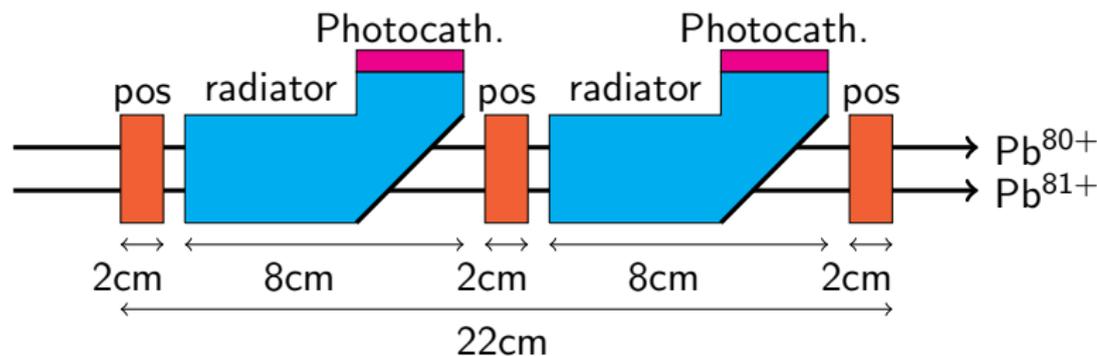   - • comparison to very peripheral hadronic reactions

Concept of a detector at dispersion collimator location

concept of a detector, NOT a technical drawing !

pos: 2-d position and time of flight

radiator: Cerenkov radiator

Photocath: readout Cerenkov photons, 2-dim

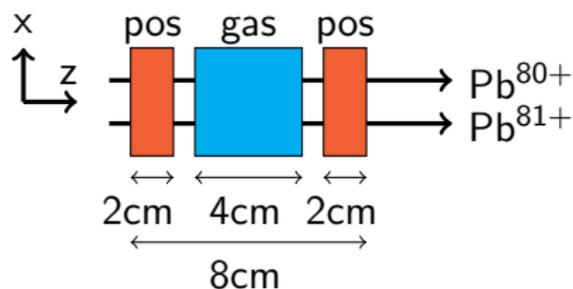clearance 1 cm at front and end, 0.5 cm between elements

total length $\sim$ 20-25 cm

Concept of a gas detector at dispersion collimator location

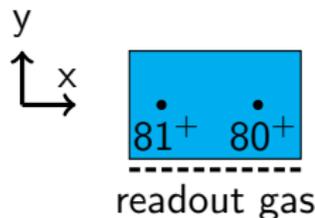concept of a detector, NOT a technical drawing !

pos: 2-d position and time of flight

gas detector volume, segmented readout in z and x

clearance 1 cm at front and end
0.5 cm between elements

total length z-dir. $\sim$ 8-12 cm

x-direction dispersive
y-direction vertical
z-direction beam