LOI : HI chapter

1 page ?
or less ?

Introduction

Physical aspects

Technical aspects

Conclusion

Introduction

- a very attractive physics ...
- where the A-E experiment is complementary of the dedicated HI experiment

• Physics ? 2 main physical goals

1st : To create, then to observe an ideal QGP in a selected Δy window with the conditions of a "mini big. bang"

proposition : $\Delta y \simeq \pm 1.5$ "mid-rapidity"

↳ only the barrel without the ending cracks

measurements : 2 kinds

* global observables

⟷ conditions of creation of QGP

$\mathcal{E}$: energy density

b : impact parameter] ⇒ geometry or number of participants

M : multiplicity

* specific observables

the behaviour of high mass dileptons

(mainly Υ states)

2nd : To study distributions of multiplicities, at least in a 2D-space $(\Delta\eta, \Delta\phi)$ for the same $\Delta\eta \simeq \pm 1.5$ window

measurements:
factorial moments and factorial correlators
⇒ behaviour of Levy index to search a phase transition

+ both signatures as combined tools to search QGP

- A-E apparatus ?
to obtain good statistics for rare processes left-out by the dedicated HI experiment
← performances of Muon system, calorimetry and Tracking

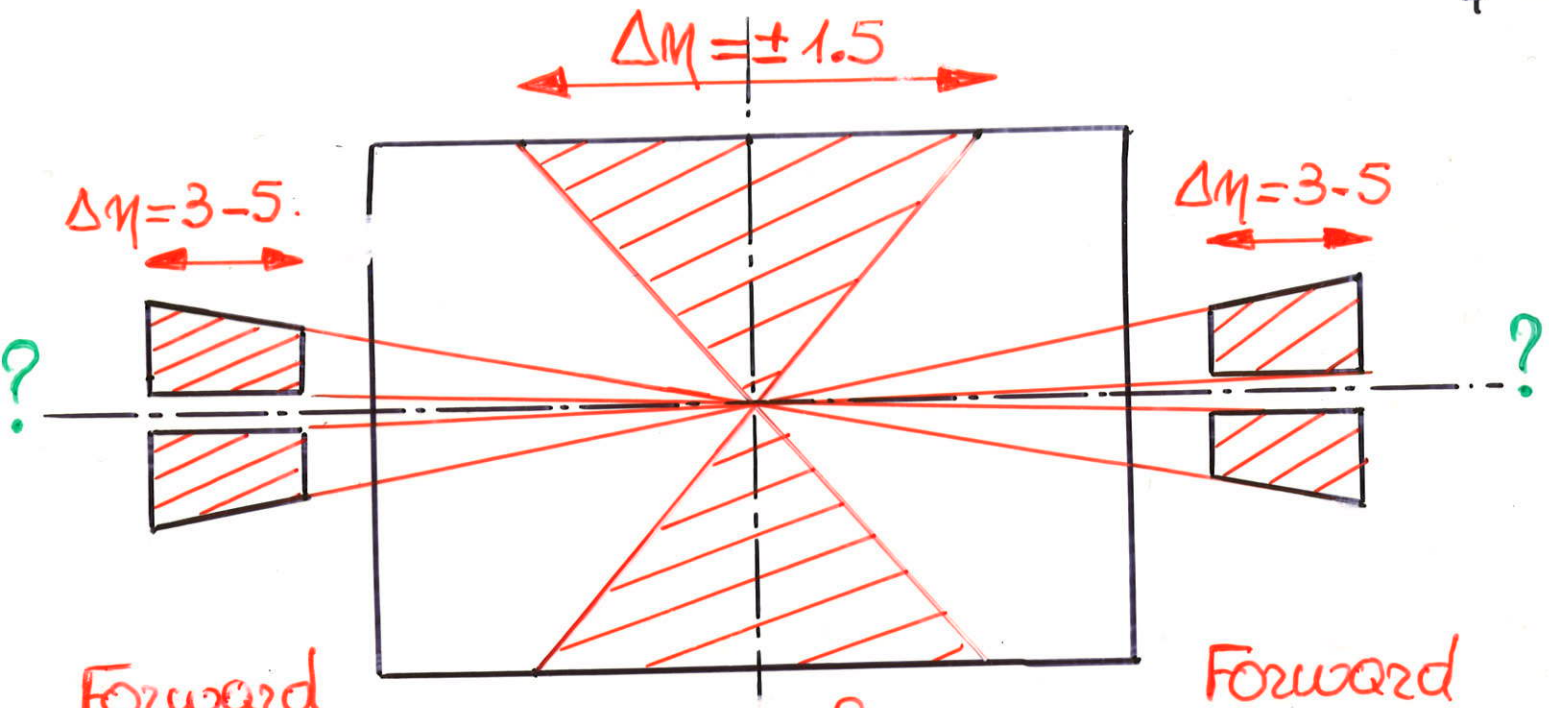
with few modifications:
- to use a limited number of subdetectors (or a part of them)
- the adjustment of electronics and triggers (bunch spacing = 105 ns)

Physical aspects

- Recalls about the thermodynamical conditions to create QGP at LHC
- The interest of heavy quarkonium states
  - $c\bar{c}$ and $b\bar{b}$ produced by prethermal interactions at an early stage
    $\neq$ $q\bar{q}$ ordinary ... at a late stage
  - 2 scenari for point-like pair evolving in a very dense medium:
    - QGP: global effect of a deconfining medium
    - Absorption: local dissociations
  - the interest of bottomium states rather than charmonium states + the foreseen dependences of Υ Υ' Υ'' states versus $p_T, E_T, \mathcal{E}$ ... for the various scenari
- The Levy index for an universal law of ordinary matter
  ... and a discrepancy for a phase transition

Technical aspects

which are the convenient subdetectors?



E_T

M

$\mu^+\mu^-$

e^+e^-

Subdetectors:

Hadronic Very Forward calo. ⇒ E_0

H+EM Barrel calo. ⇒ E_T

... + Tracking ⇒ e^+e^-

Full Muon System: Toroide + Solenoide + Tracking + Had. Barrel calo.

⇒ $\mu^+\mu^-$

Sampling of INNER Tracking: Pixels?

⇒ M

Remark: E_0 and E_T ~ energy flow

2 different Δy windows:

- Midrapidity : $\Delta y = \pm 1.5$
  for all observables,
  but for Very Forward Energy
- Large rapidity : $\Delta y \gtrless 3-5$?

Global variables :

- $\mathcal{E} = f(E_T, A\text{-}A)$ $A = p, S, Pb$
  slow variation with $E_T^0 \Rightarrow$ to vary A
- "b" $= f(E_0)$ or geometry
- M (Total) "Total" in the retained window

Specific observables

- $M_{e^+e^-} \leqslant 11$ GeV/c^2 $\sigma_{Mee}/M_{ee} \sim 1\%$
  $P_{Te^+e^-} \sim 0$ - 30 GeV/c $\sigma_{Pe}/P_e \leqslant 2\%$

  $P_\mu \sim 4$ - 40 GeV/c $\sim 10\lambda$
  $P_e \sim 1$ - 40 GeV/c

	$\mu^+\mu^-$	e^+e^-
Trigger	Better	
Background	Better	
σ_M / M		Better
σ_{P_T}/P_T	$\sim$	$\sim$

- M (δM, $\delta\phi$)

Rough estimations

- Mass resolution

$\mu\mu$: $\sigma_M/M \sim 1\%$ as expected

Full magnetic system:
air core toroid + solenoid + inner tracking

but only $\sim 3.5\%$ air-core toroid alone

e-e: $M_{ion\text{-}ion} \sim 10\ M_{p\text{-}p}$ (high $\mathcal{L}$)

⇒ an upgrade of the inner tracking

- Triggers
  - $p_T^e > 5$ GeV/c EM calo.
  - p_T^μ $\begin{cases} > 6 \text{ GeV/c} & \text{air-core option} \\ > 12 \text{ GeV/c} & \text{iron core option} \end{cases}$

- Barrel E_T EM + Had
- Very Forward ? New Had. Calo.

Conclusion

- Recall of the feasability ...
- Full simulations needed : + scaling laws
  physical generators + detectors

  Background : VENUS , ...
  Vector Mesons : $(J/\psi, \psi')$, $\Upsilon, \Upsilon', \Upsilon''$
  Drell-Yan process (4 - 7 GeV/c²)

  → Rates, Triggers, Cuts ...

- Do not forget experiences → results ?
  before LHC :

  SPS (1994-1998?):
  Pb beam 160 GeV/A on fixed target
  $\sqrt{s} \simeq 20$ GeV/A
  particularly NA50 (ex NA38)

  RHIC (1998 ?)
  Au-Au collider Beam 100 GeV/A
  $\sqrt{s} \simeq 150$ GeV/A

  (LHC $\sqrt{s} \simeq 6300$ GeV/A)

Remark : about the HI working group
- people interested by this physics
+ 1 person (at least) / used subdetector