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CERN/2/11/2000

Considerations on DETECTOR LAYOUT

- Geometrical CLUSTER SIZE
  due to the CHAMBER THICKNESS

- Chamber positioning along X

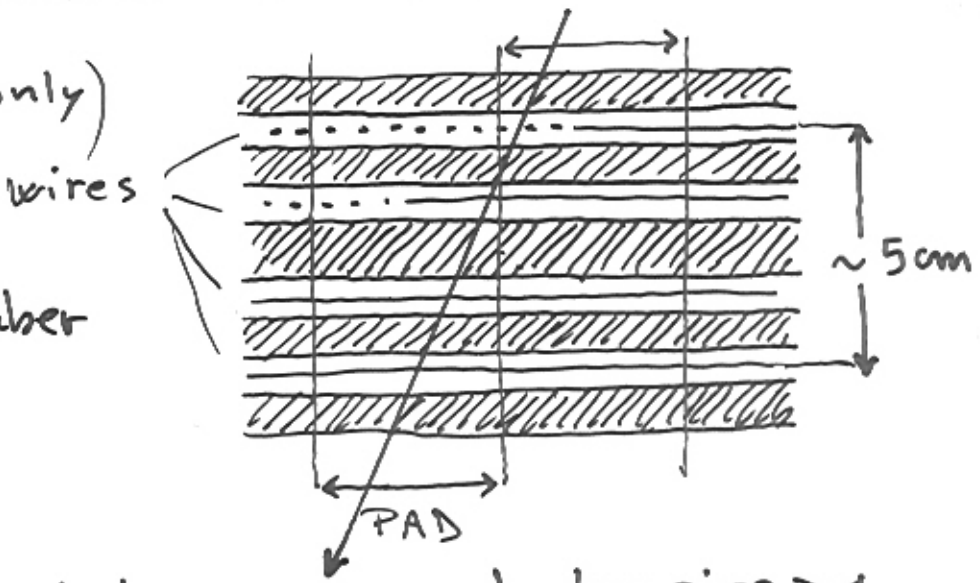
→ effects of lack of projectivity on
  P_T TRIGGER / $\mu^+\mu^-$ acceptance

- – base line configuration(s)
  – configurations to be studied/tuned

- TOOLS / EVENT SAMPLES needed

GEOMETRICAL CLUSTER SIZE

(-x coordinate only is relevant)



inclined tracks ⇒ cluster size > 1

ϑ_x $\mu^+\mu^-$ tracks = $\vartheta_{x\,proj.} \pm \Delta\vartheta_x$

in most of the area (where clust. size is relevant)

$\Delta\vartheta \ll \vartheta_{proj}$ (Transp)

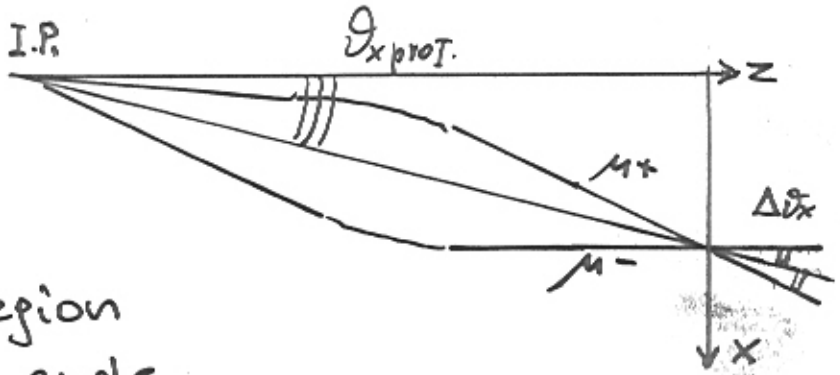
Assume $\vartheta_x = \vartheta_{x\,proj.}$

the cluster size measured in unity of PADs is <u>maximum</u> in <u>M2</u> and in the <u>external edge X of the 4 Regions</u>

c.s. = 1.32 (assuming 5 cm distance from the first and last wire layer)

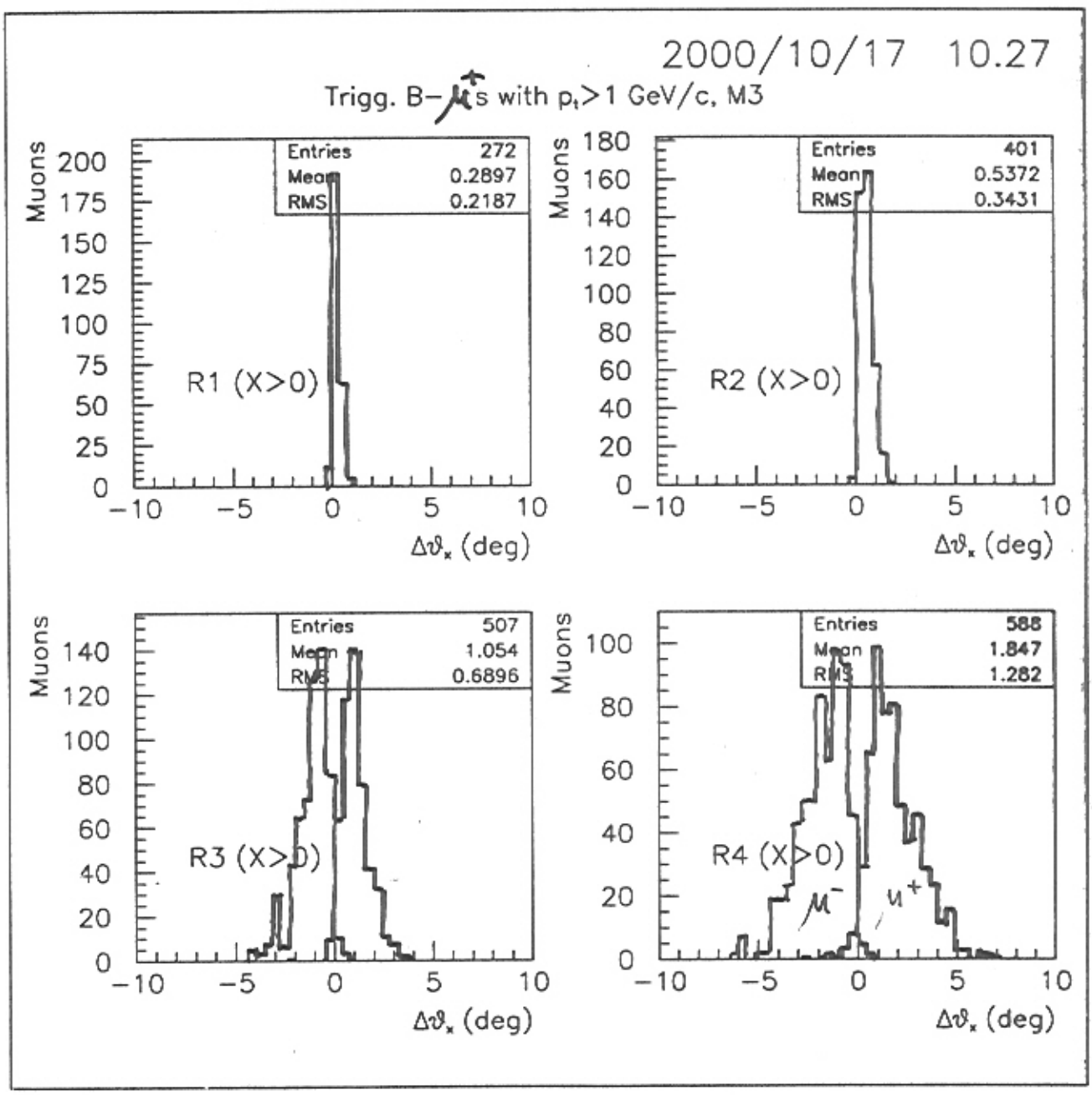
$\pm \approx .05$ (for $\mu^+\mu^-$ bending)

Cluster size has important effects on tripper performance (transp)

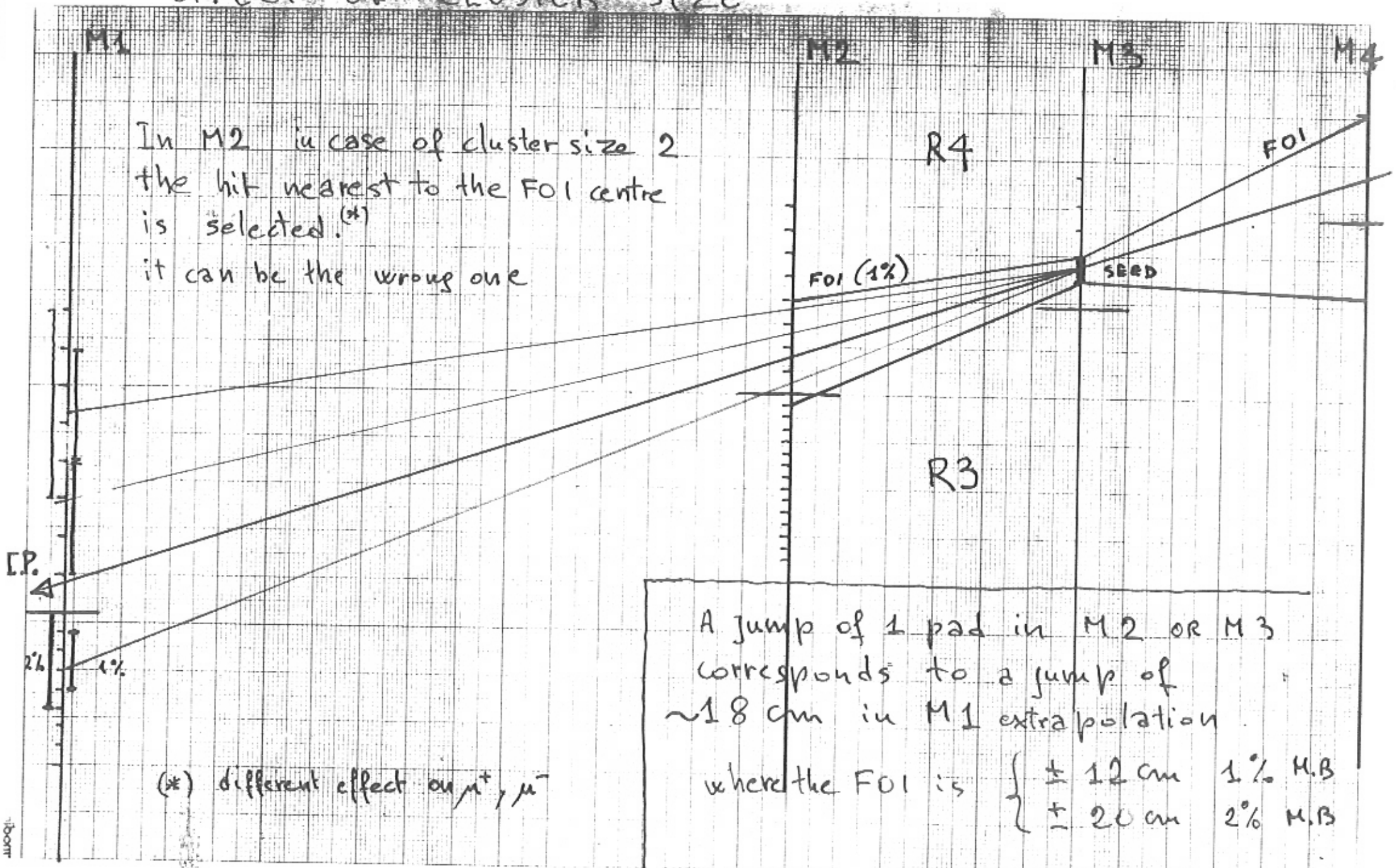


Angular spread per Region

ϑ = projective angle



EFFECT OF CLUSTER SIZE



In M2 in case of cluster size 2
the hit nearest to the FOI centre
is selected.(*)
it can be the wrong one

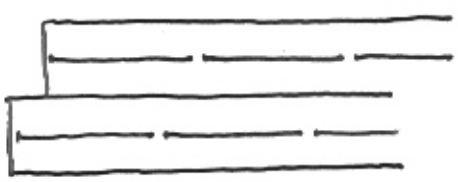
(*) different effect on μ^+, μ^-

A jump of 1 pad in M2 OR M3
corresponds to a jump of
~18 cm in M1 extrapolation

where the FOI is $\begin{cases} \pm 12\text{ cm} & 1\%\ \text{M.B} \\ \pm 20\text{ cm} & 2\%\ \text{M.B} \end{cases}$

Cluster size could be significantly reduced building a 4-Gap chamber with a small shift of PADs

or by conveniently assembling two layers of 2-Gap each



BUT:

Different standards in the design and in the assembling of a 4-Gap chamber

NIGHTMARE ?

the effect of cluster size is sizable but we don't know if it is relevant for the S/N ratio (the effect cannot exced few %)

→ check as soon as the new M.C. is ready

ASSUME AS BASE-LINE

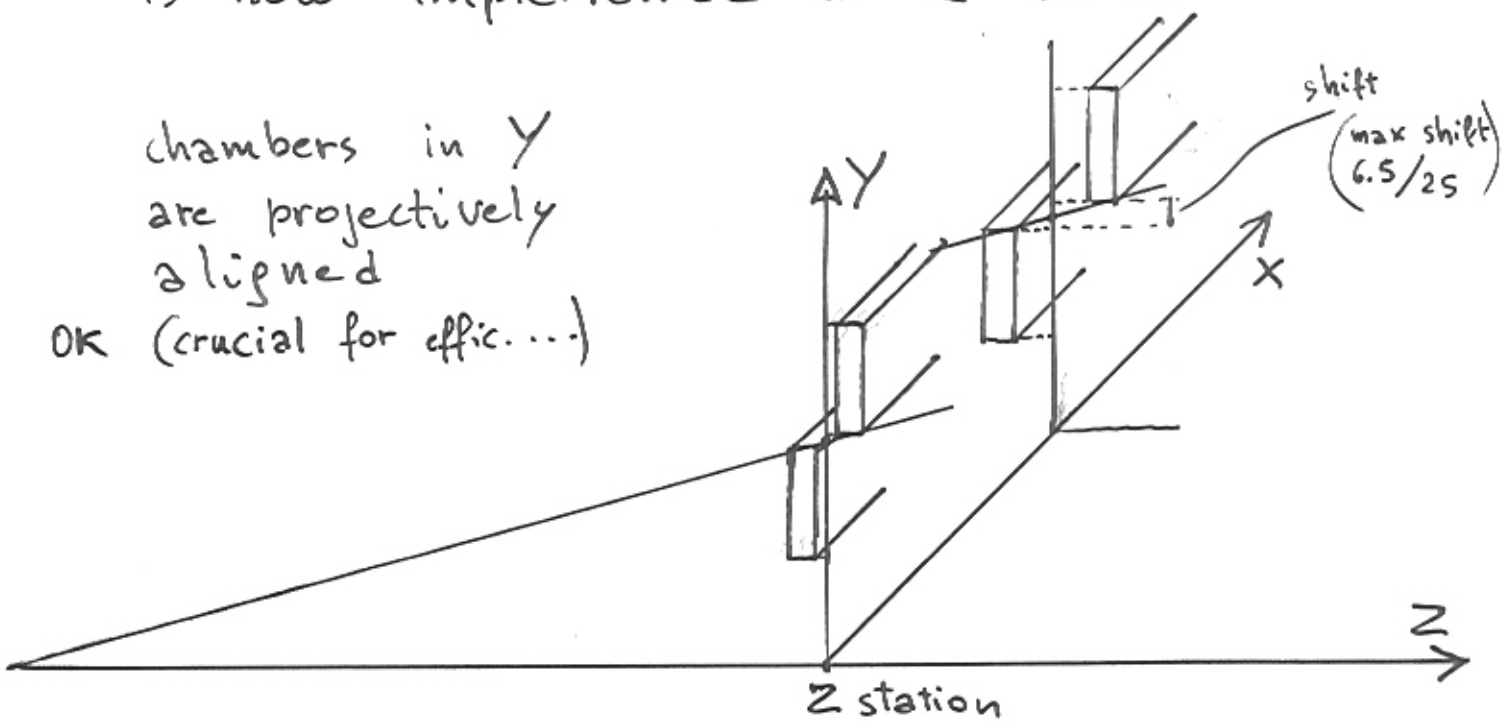
NO PROJECTIVE SHIFT inside each chamber

(this is assumed in the following considerations)

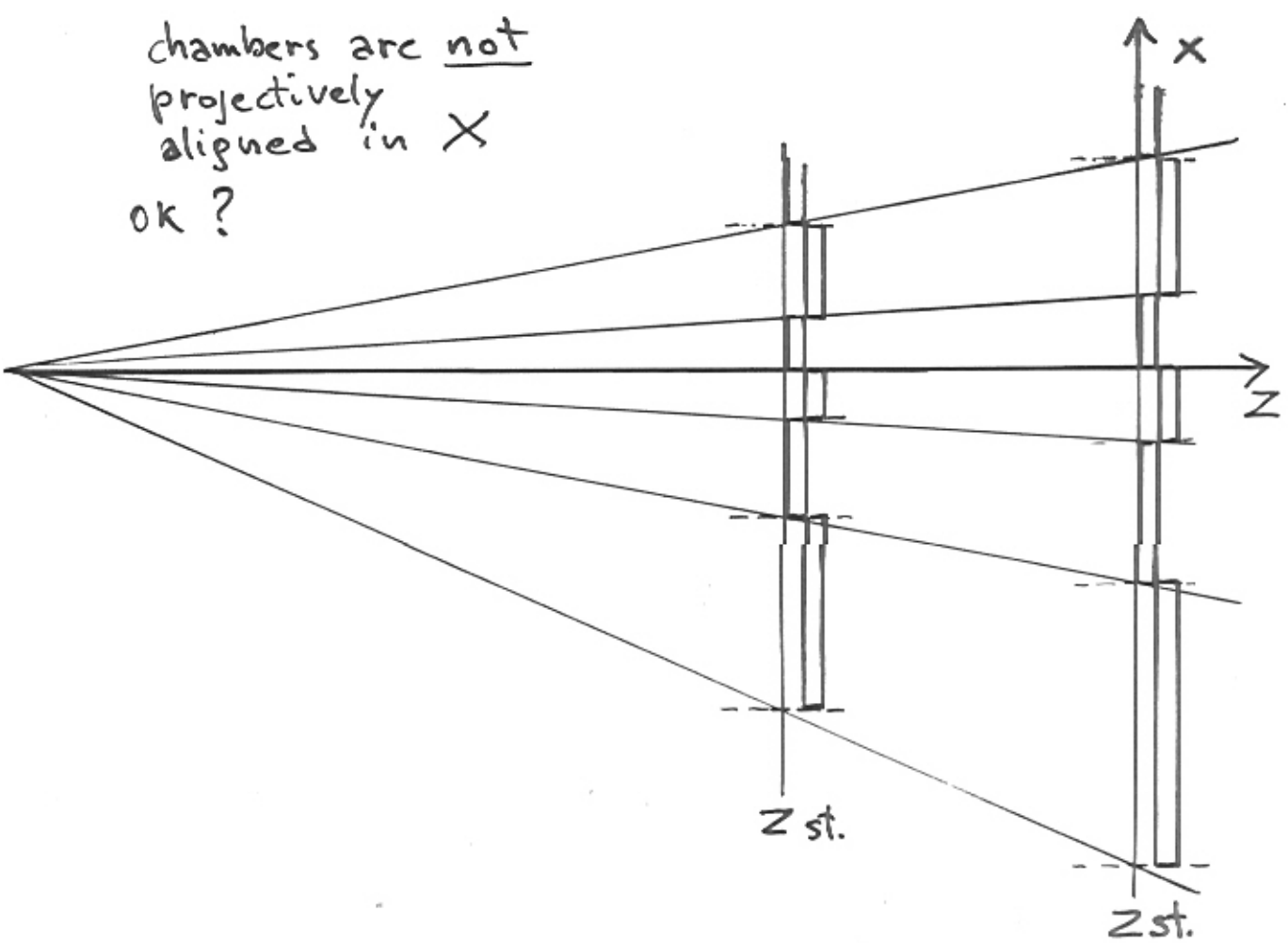
EFFECT OF CHAMBER POSITIONING
(PROJECTIVITY - NON PROJECTIVITY)

let's refer to the layout that is now implemented in te M.C.

chambers in Y are projectively aligned
OK (crucial for effic....)



chambers are not projectively aligned in X
OK ?



chambers are much longer in X
(inefficiencies due to misalignements are small)

in X $\mu^+\mu^-$ bending spoils projectivity

ABOUT TRIGGER PERFORMANCE :

The distance in Z between corresponding chambers in the various stations is the same

MOREOVER

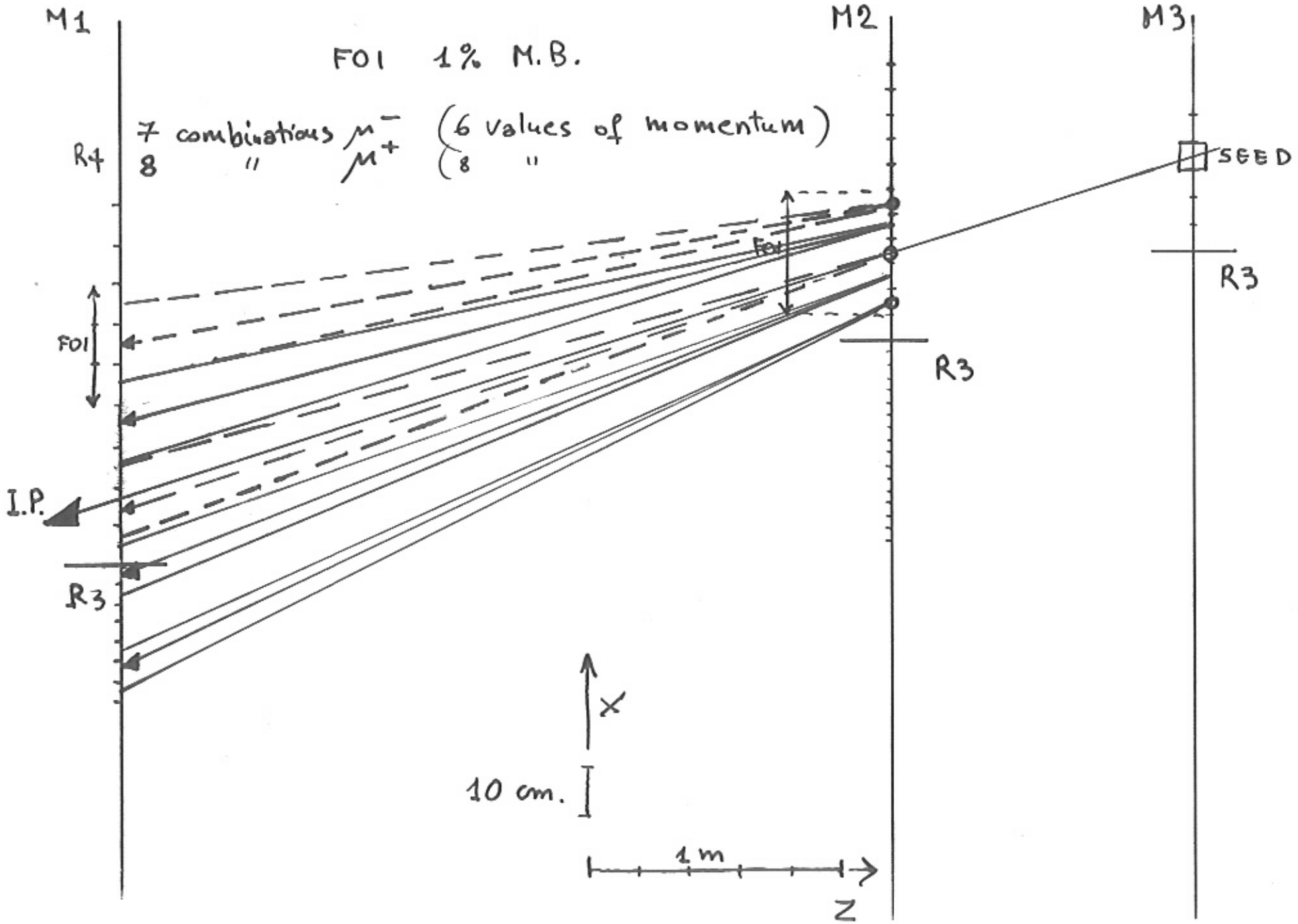
P_T calculation in the TRIGGER can be done considering the right z position of the chambers (look-up table)

$\Rightarrow$ at the first look one would think that the effect of non projectivity is negligible

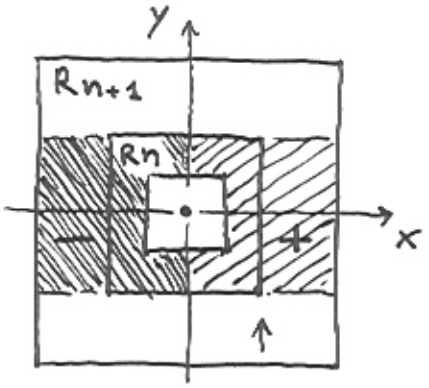
BUT:

- what about local angular acceptance for $\mu^+\mu^-$?
- SECTORS hardwired in the FIP
- FOI are opened assuming nominal Z position

$\rightarrow$ let see in more detail

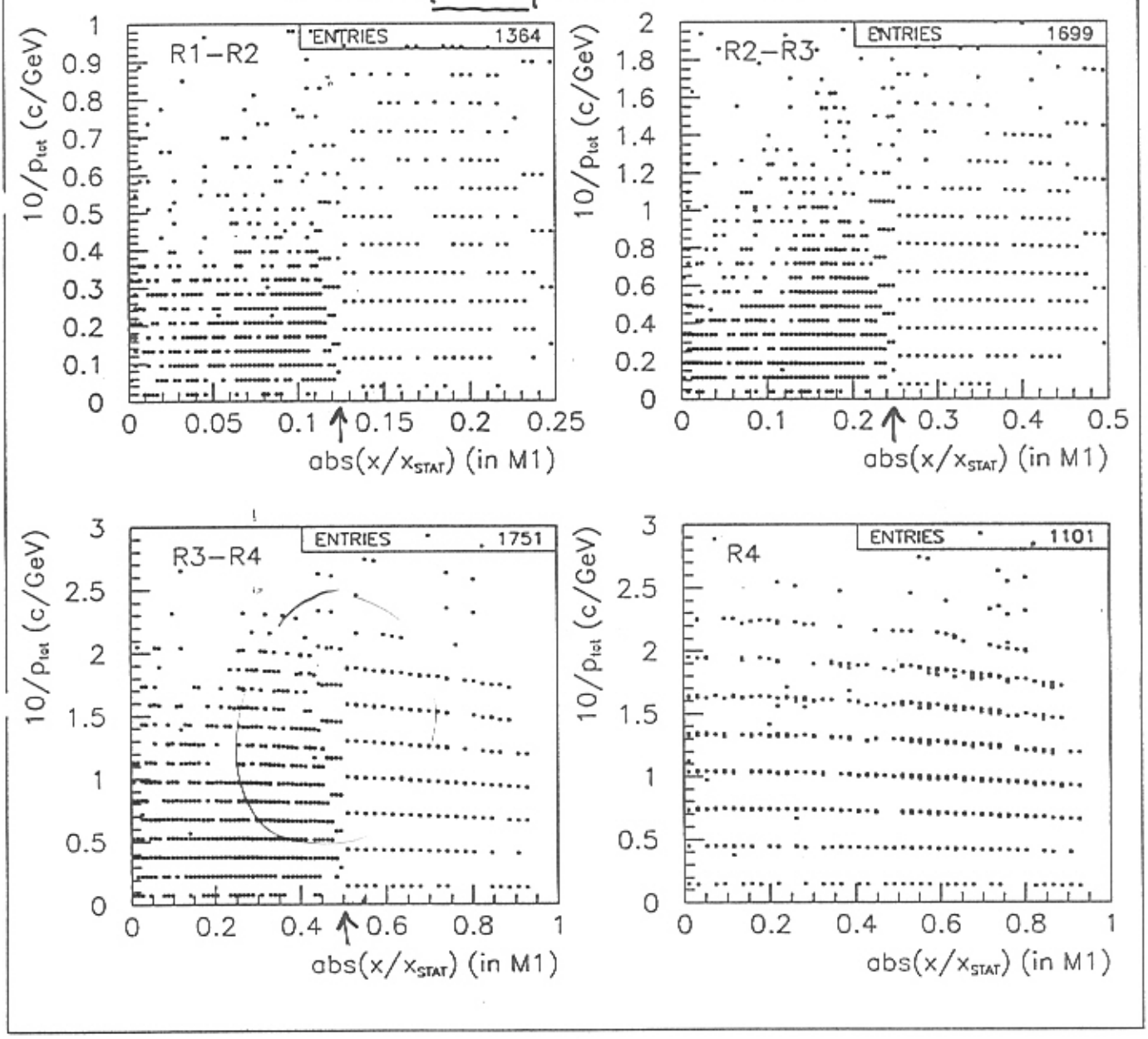

M1
M2
M3
FOI 1% M.B.
7 combinations μ⁻ (6 values of momentum)
8 " μ⁺ (8 " "
R4
SEED
R3
FOI
FOI
R3
I.P.
R3
X
10 cm.
1 m
Z

$\begin{cases} \mu^+ , & x > 0 \\ \mu^- , & x < 0 \end{cases}$

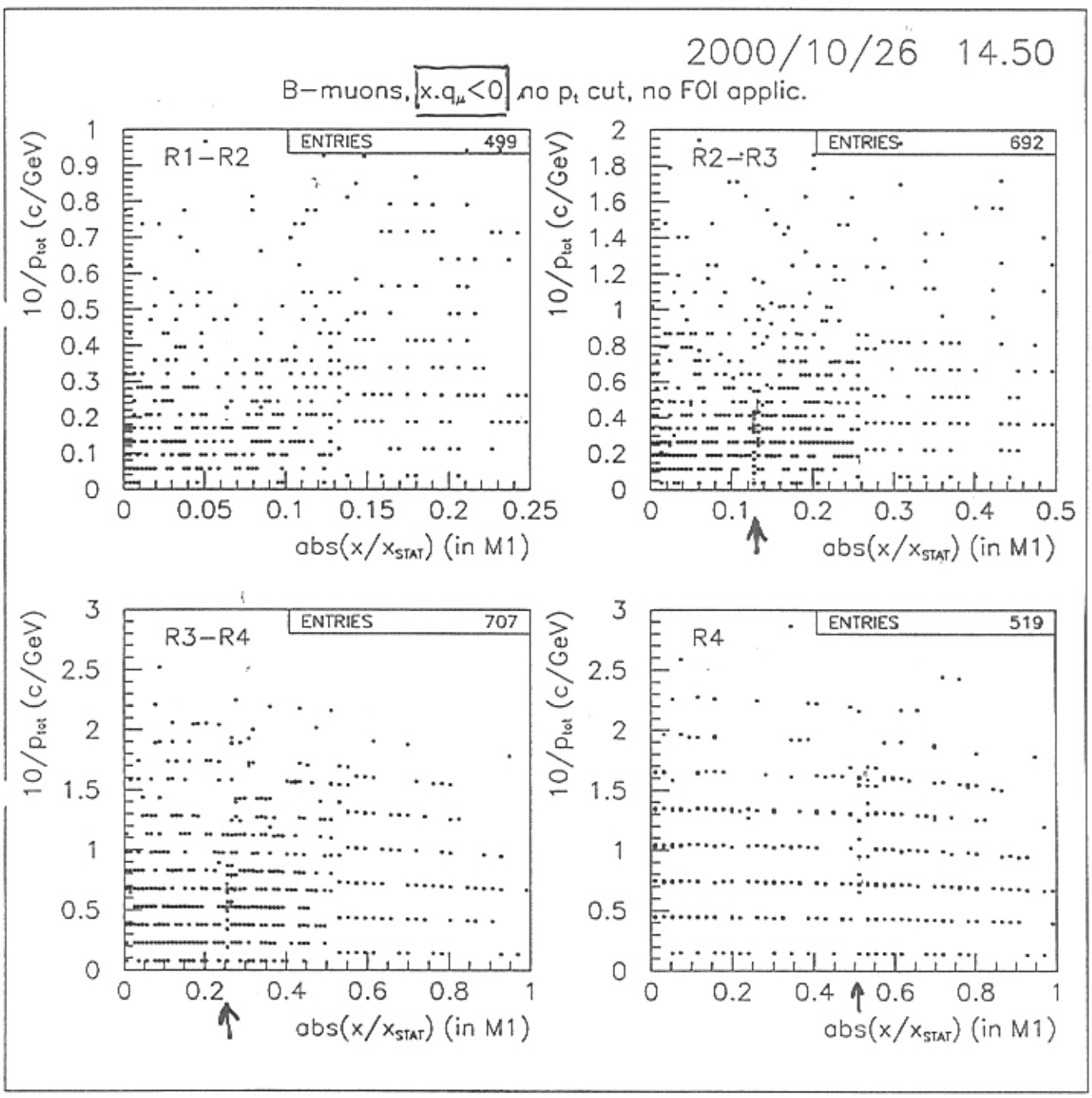


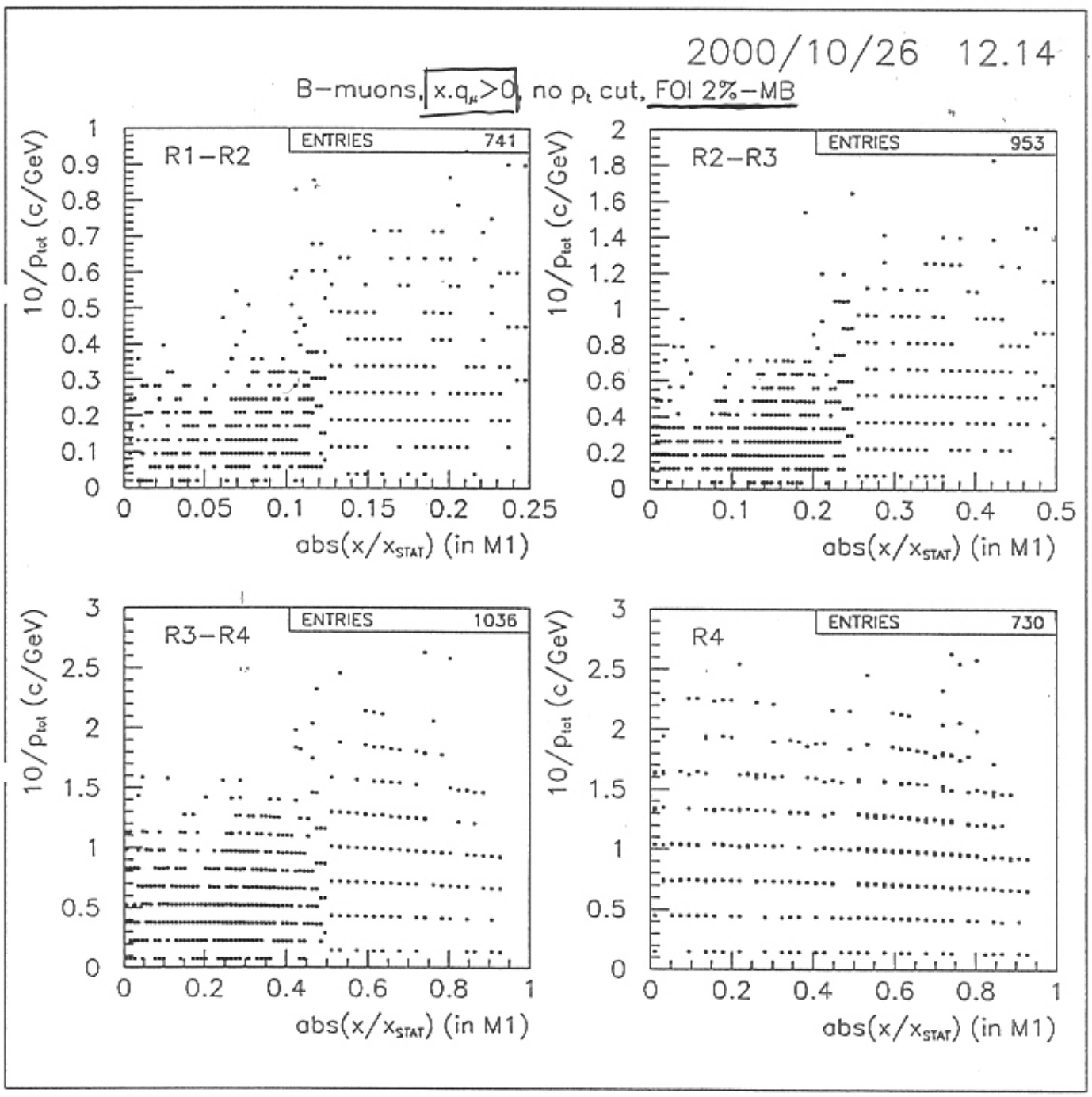
2000/10/26 12.12

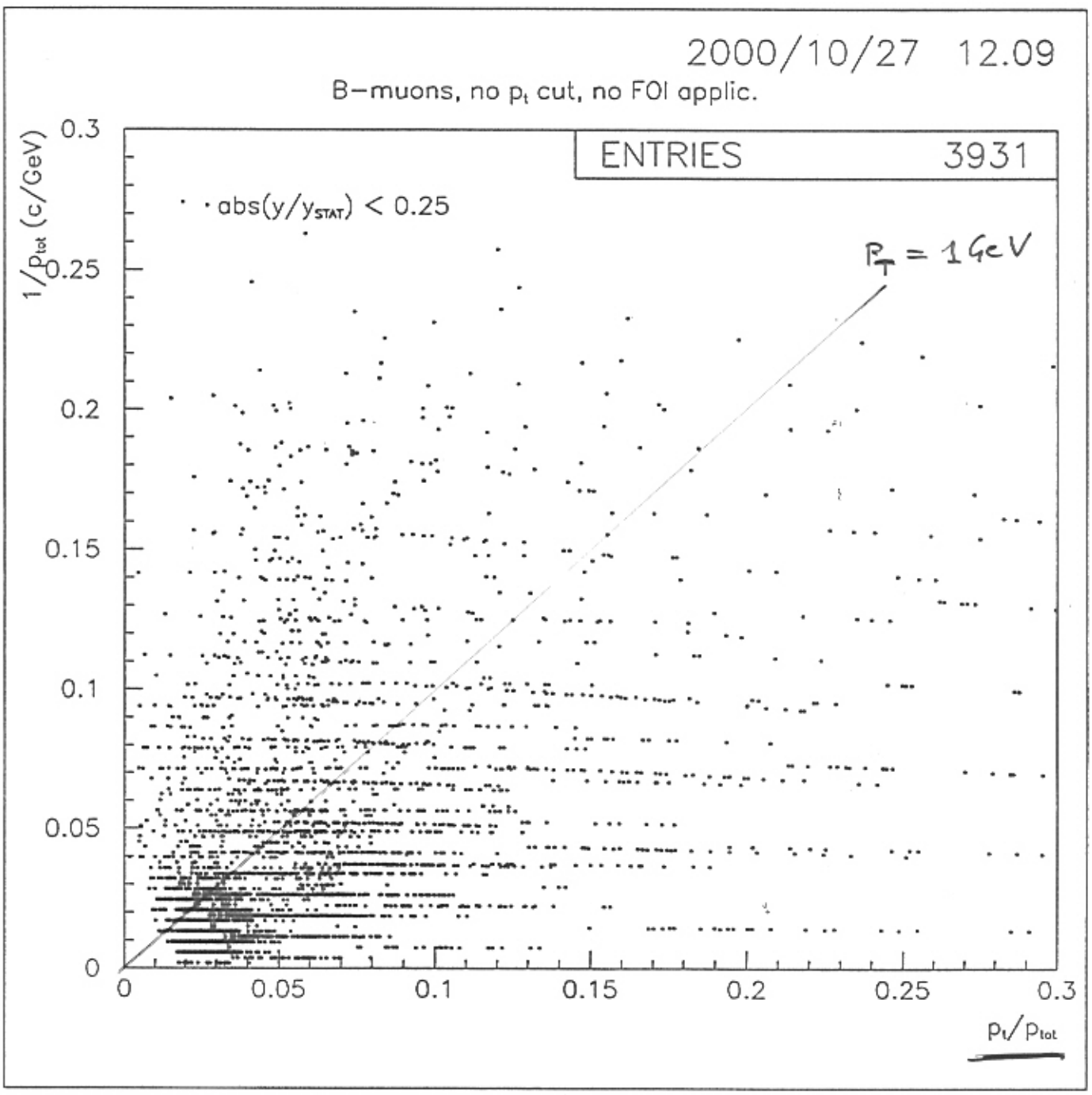
B−muons, $x.q_\mu > 0$, no p_t cut, no FOI applic.



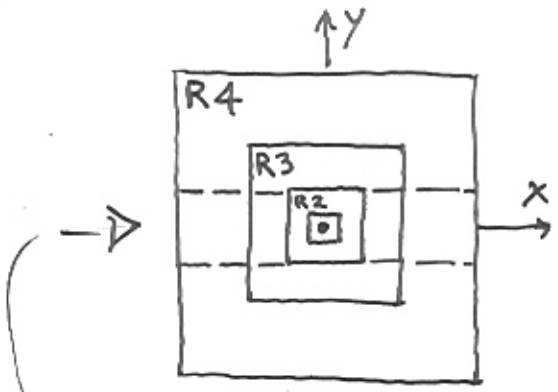
$\begin{cases} \mu^+, x < 0 \\ \mu^-, x > 0 \end{cases}$




2000/10/26 12.14
B−muons, x.q$_\mu$>0, no p$_t$ cut, FOI 2%−MB
R1−R2
ENTRIES 741
R2−R3
ENTRIES 953
R3−R4
ENTRIES 1036
R4
ENTRIES 730
10/p$_{tot}$ (c/GeV)
abs(x/x$_{STAT}$) (in M1)



$\sin\delta$ (calculated) at the I.P.



2000/10/26 12.13

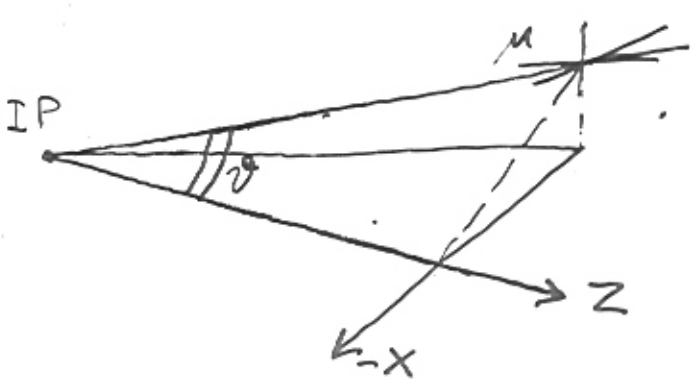
B−muons, $x.q_\mu>0$, no p_t cut, no FOI applic.

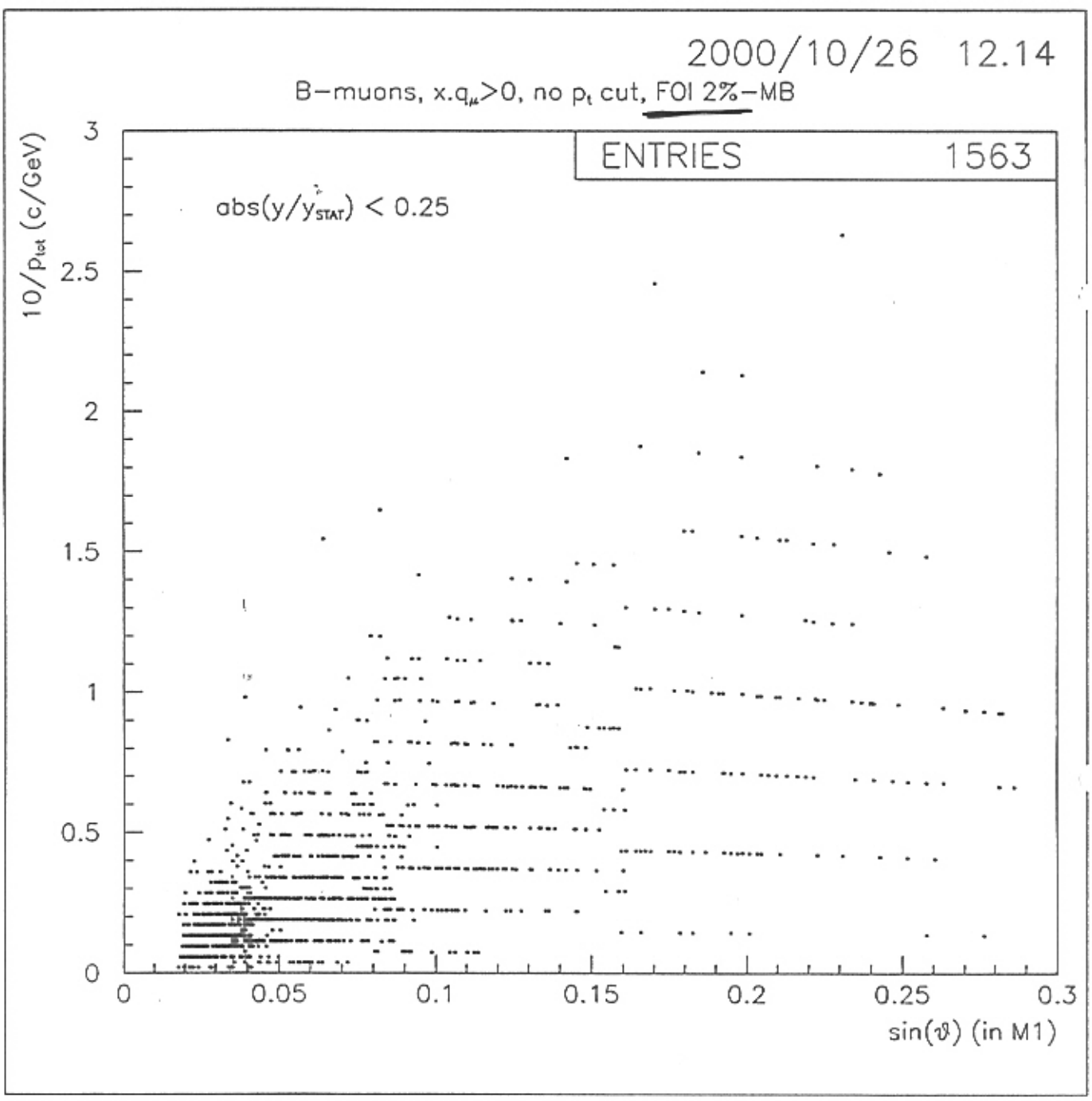
ENTRIES 2815

abs(y/y_{STAT}) < 0.25

$10/p_{tot}$ (c/GeV)

sin(ϑ) (in M1)

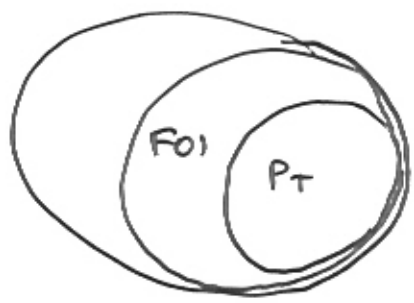


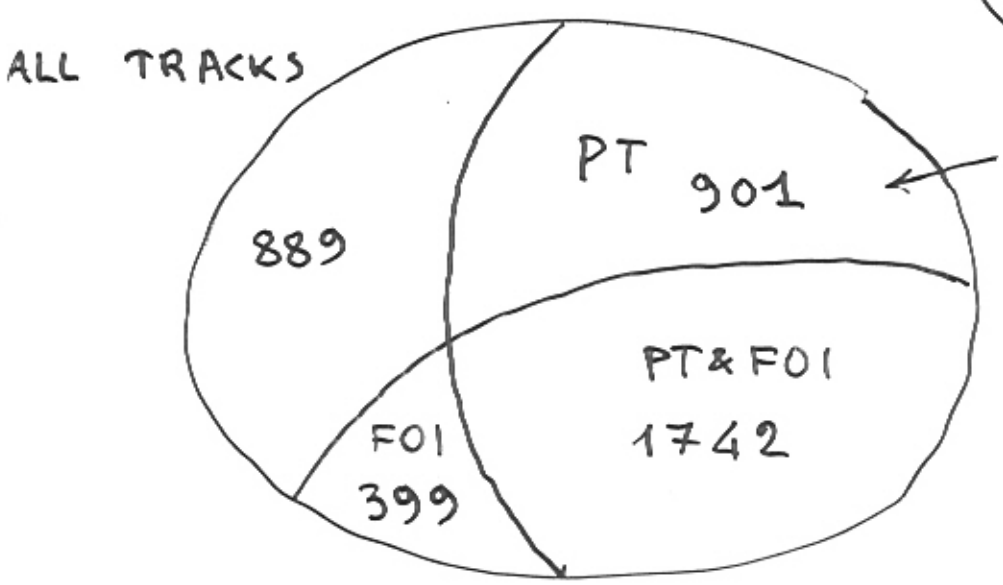

2000/10/26 12.14
B−muons, x.q$_\mu$>0, no p$_t$ cut, FOI 2%−MB
ENTRIES 1563
abs(y/y$_{STAT}$) < 0.25
10/p$_{tot}$ (c/GeV)
sin(ϑ) (in M1)
0
0.5
1
1.5
2
2.5
3
0.05
0.1
0.15
0.2
0.25
0.3

$B \to \mu X$ events

(only hits of μ from B considered)

	Nevs
ALL TRACKS	3931
P_T cut 1 GeV	2643
FO1 (2% M.B.)	2141





- strong correlation

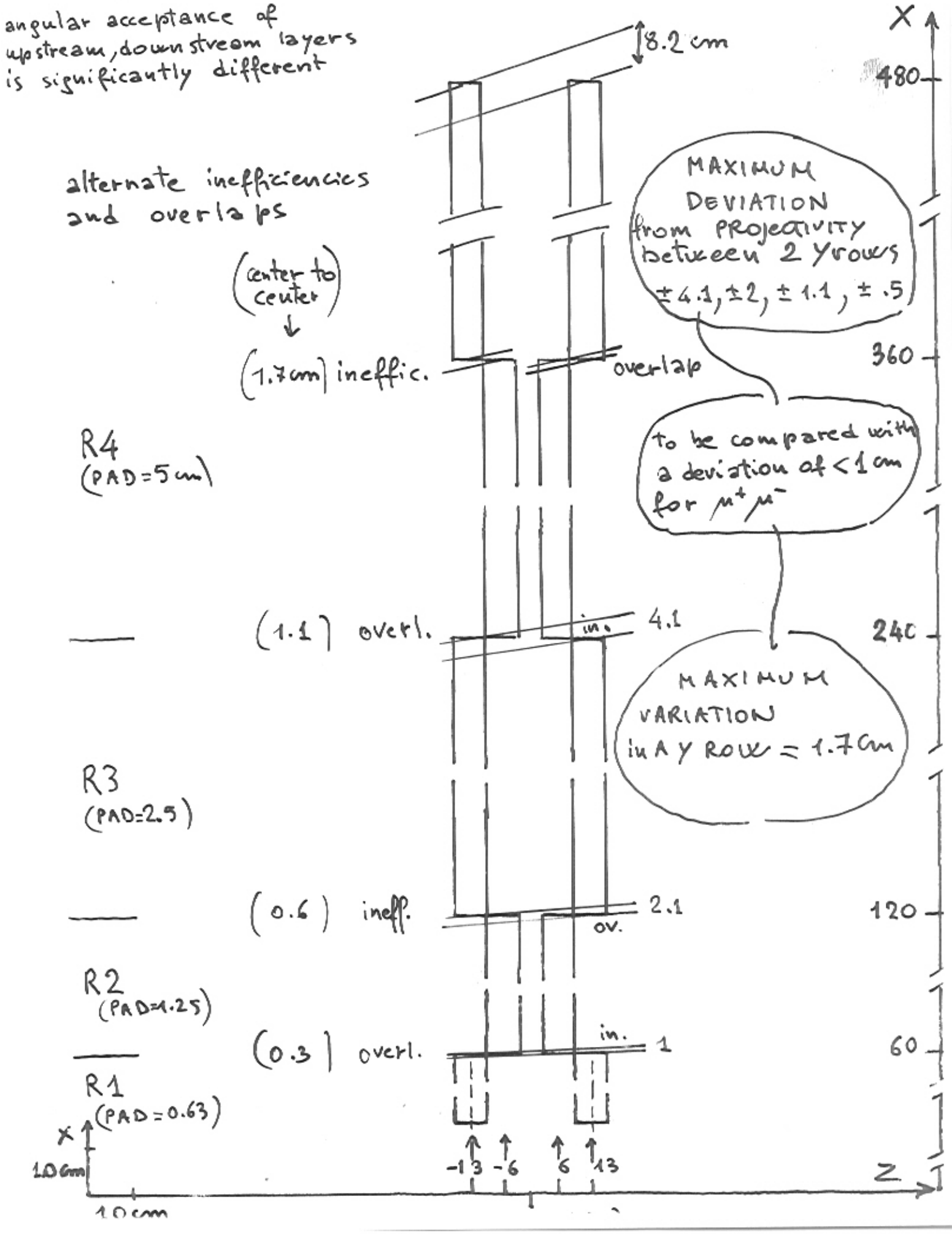
→ large number of high P_T tracks rejected by FO1

⇒ Even if the P_T is correctly calculated (by the trigger algorithm) any FO1 distortion / asymmetry between $\mu^+ \mu^-$

⇒ BIAS

STATION M2 (2 ADJACENT Y ROWS CROSSING R1)

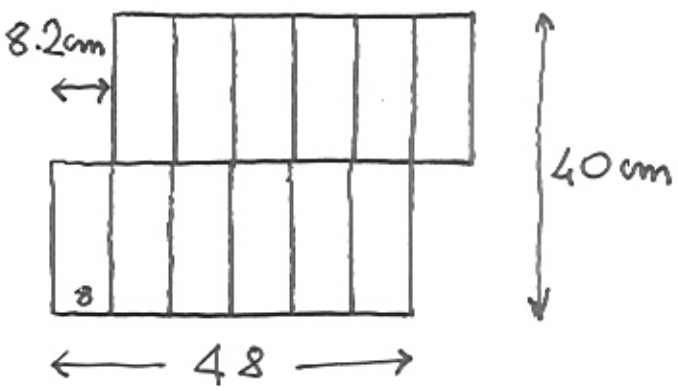
LAYOUT NON PROJECTIVE IN X



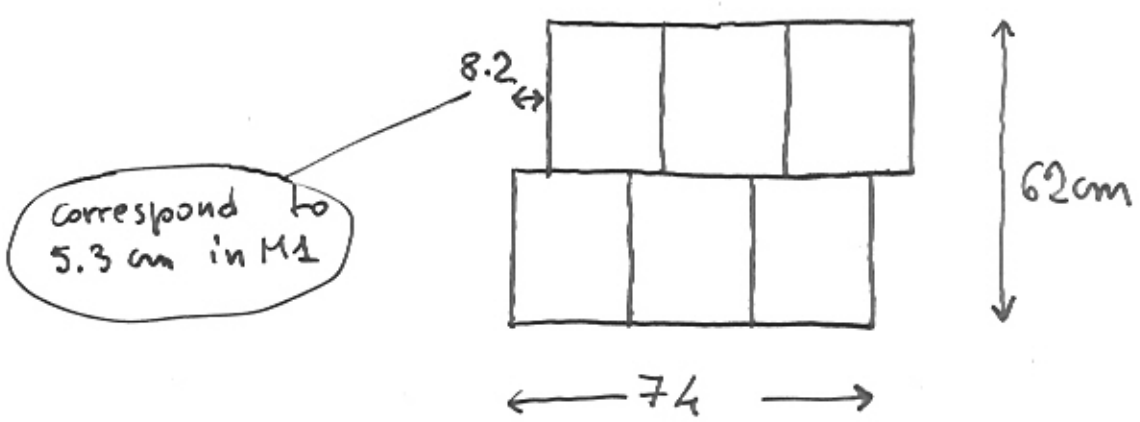
SHAPE OF SECTORS
DUE TO THE LACK OF X PROJECTIVITY

X Edge of Region R4

M1



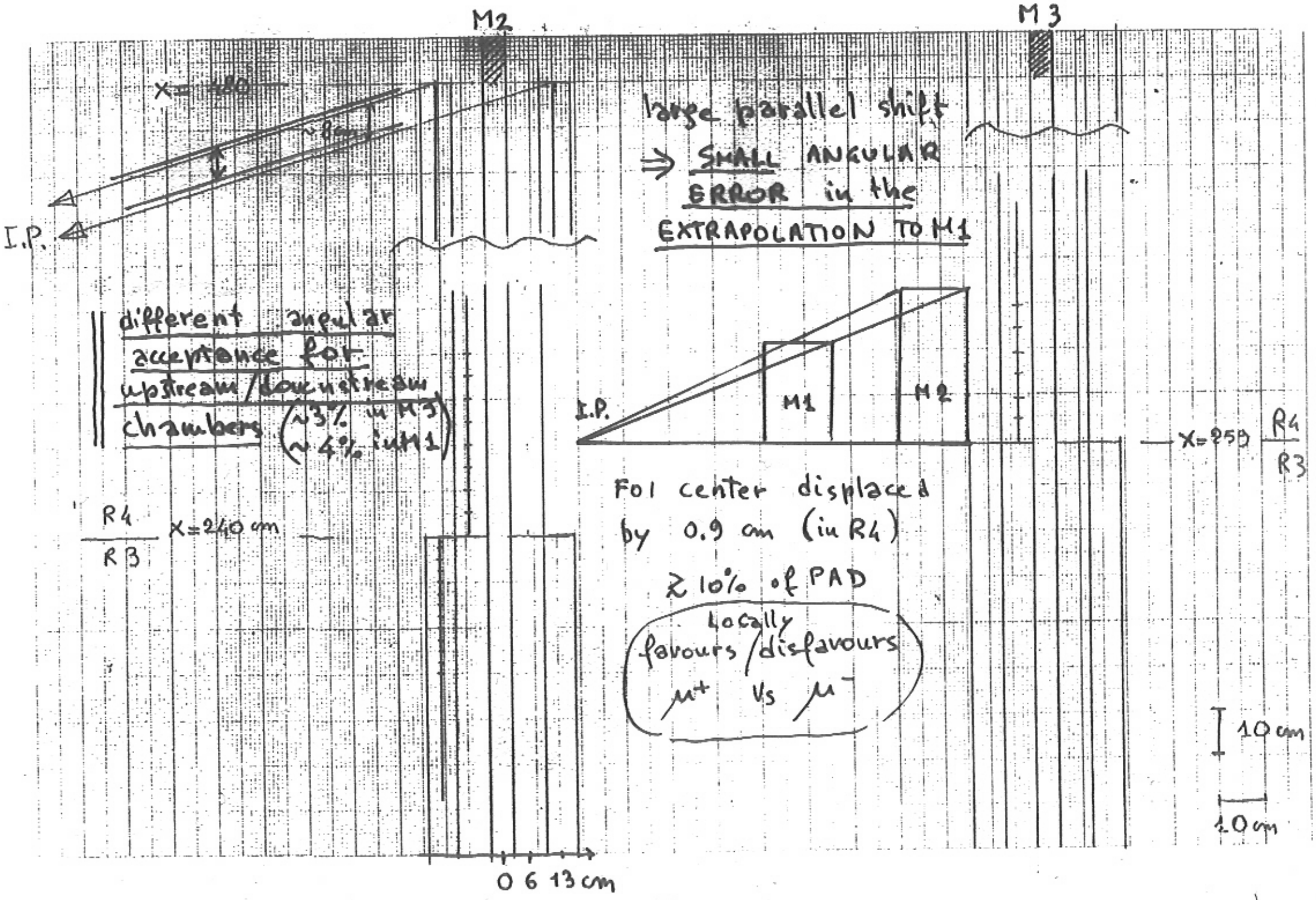
M5

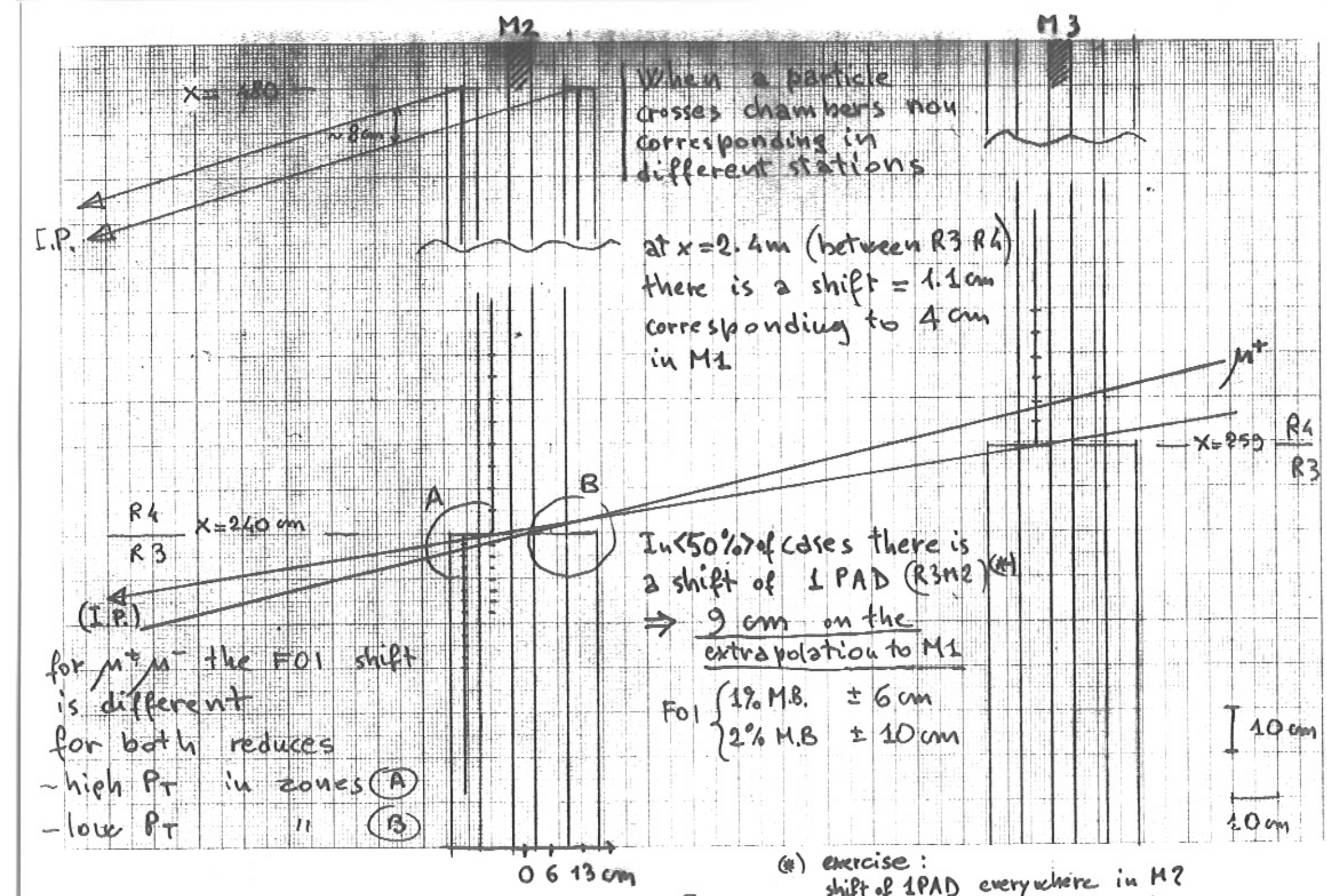


the two sectors do not overlap projectively

$\Rightarrow$ holes / overlaps

on 2.9 cm / 48 cm


M2
M3
x=-80
~8cm
I.P.
large parallel shift
⇒ SMALL ANGULAR ERROR in the EXTRAPOLATION TO M1
different angular acceptance for upstream/downstream chambers (~3% in R3, ~4% in M1)
I.P.
M1
M2
x=250
R4/R3
R4/R3
x=240 cm
For center displaced by 0.9 cm (in R4)
≳ 10% of PAD
locally favours/disfavours μ+ vs μ−
10 cm
10 cm
0 6 13 cm



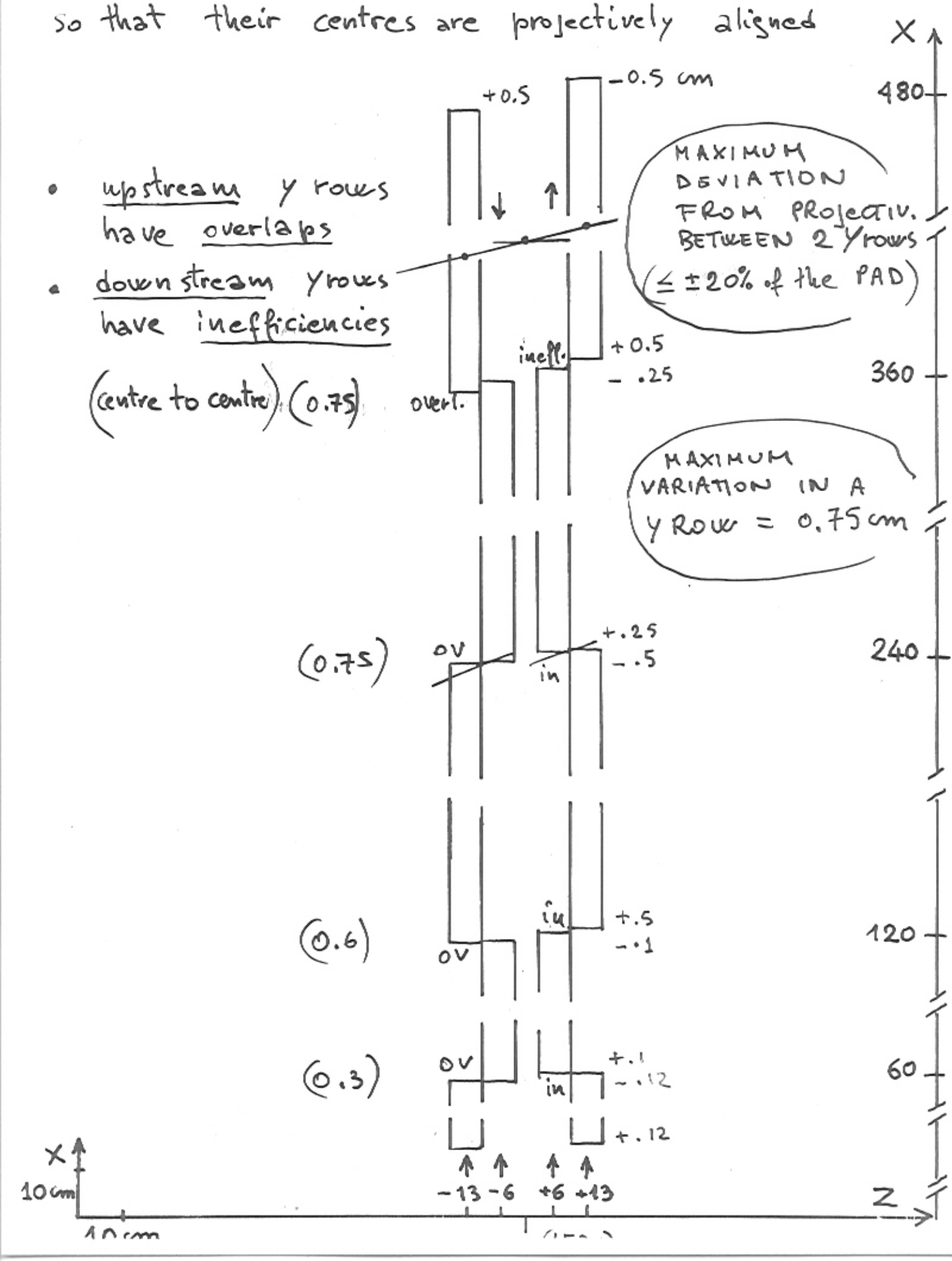
(#) exercise :
shift of 1PAD everywhere in M2?
⇒ B acceptance → 60%

LAYOUT PROJECTIVE IN X

chambers are shifted symmetrically up down so that their centres are projectively aligned

- upstream y rows have overlaps
- downstream yrows have inefficiencies

(centre to centre) (0.75)



The situation is improved
(but not fully cured)

- effects of FOI misalignement significantly reduced (by a factor ~2 – 4)
- overall angular acceptance of the upstream downstream layers much more similar

but systematic – overlaps (upstream l.)
– inefficiencies (downstream l.)

→ inefficiency can be reduced increasing overlap
OPTIMUM ? (– S/N ratio
– $\mu^+\mu^-$ accept.)

BASE LINE CONFIGURATION

- (4-Gap) CHAMBERS WITHOUT INTERNAL PAD SHIFT
- Y as now ("projective", no overlap)
- X chamber centres aligned projectively

⇒ <u>check the effect of cluster size</u> reduction with a pad shift inside chambers

⇒ <u>tune overlaps</u>

but ...

If we want to make $\mu^+\mu^-$ TAG

at the level of % we must control

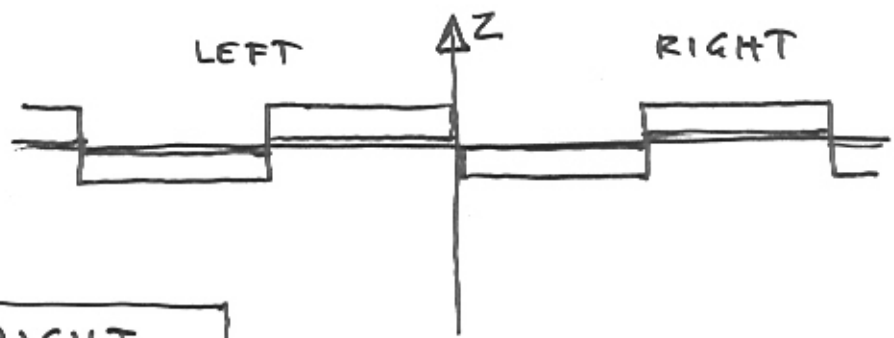
much better the detector systematics

concerning left-right / $\mu^+\mu^-$ symmetry

with the present layout the symmetry

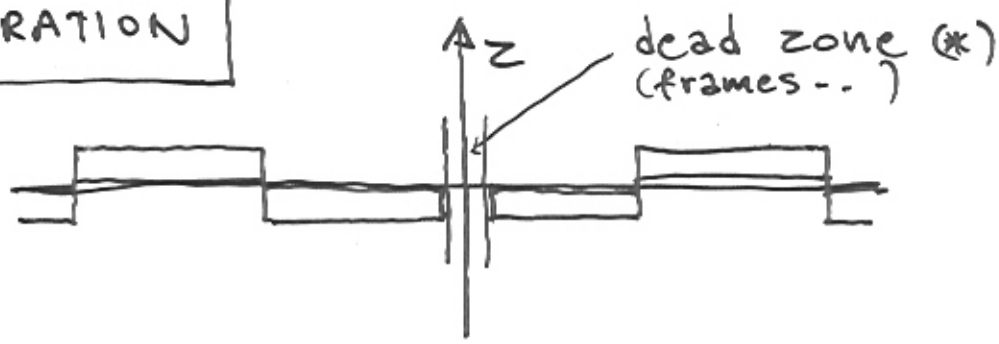
is obtained integrating the full area

(and assuming symmetric background up/down)



TRY

LEFT - RIGHT
SYMMETRIC
CONFIGURATION



- X projectivity

→ tune chamber position
(overlaps)

(*) affects chamber positioning ....

MY PREFERRED CONFIGURATION

TOOLS NEEDED

OPTIMIZATION must be performed
- not only on the basis of S/N ratio
- particular care on $\mu^+\mu^-$ spectra / accept. / edge effects

- We need high statistics of B events

$\gtrsim 10^5$ M.B.

10^5 $B \to \mu^+$?

10^5 $B \to \mu^-$

(in the present M.C. B is forced $\to \mu^+$)

- We have to test and tune several configur.

ROMA1 proposal for M.C. production

1) Generate with BASE LINE CONFIGURATION
(this will be our reference sample of data)

2) Generate events with a simple
"FLEXIBLE CONFIGURATION"

What is our FLEXIBLE CONFIGURATION

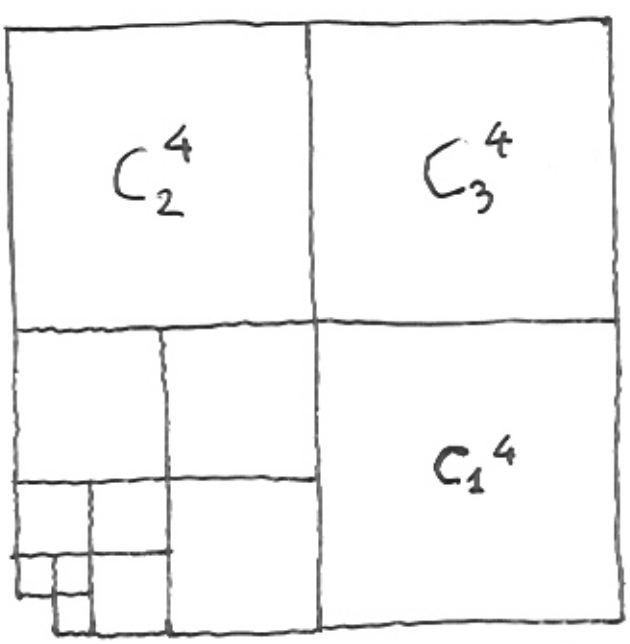
SICB MC

In every quadrant of each region of the 5 stations

3 CHAMBERS : 4-gap for MWC
2-gap for RPC

- SAME MATERIALS & DIMENSIONS along Z
- NO FRAMES

→ the 5 stations are completely covered without any efficiency hole



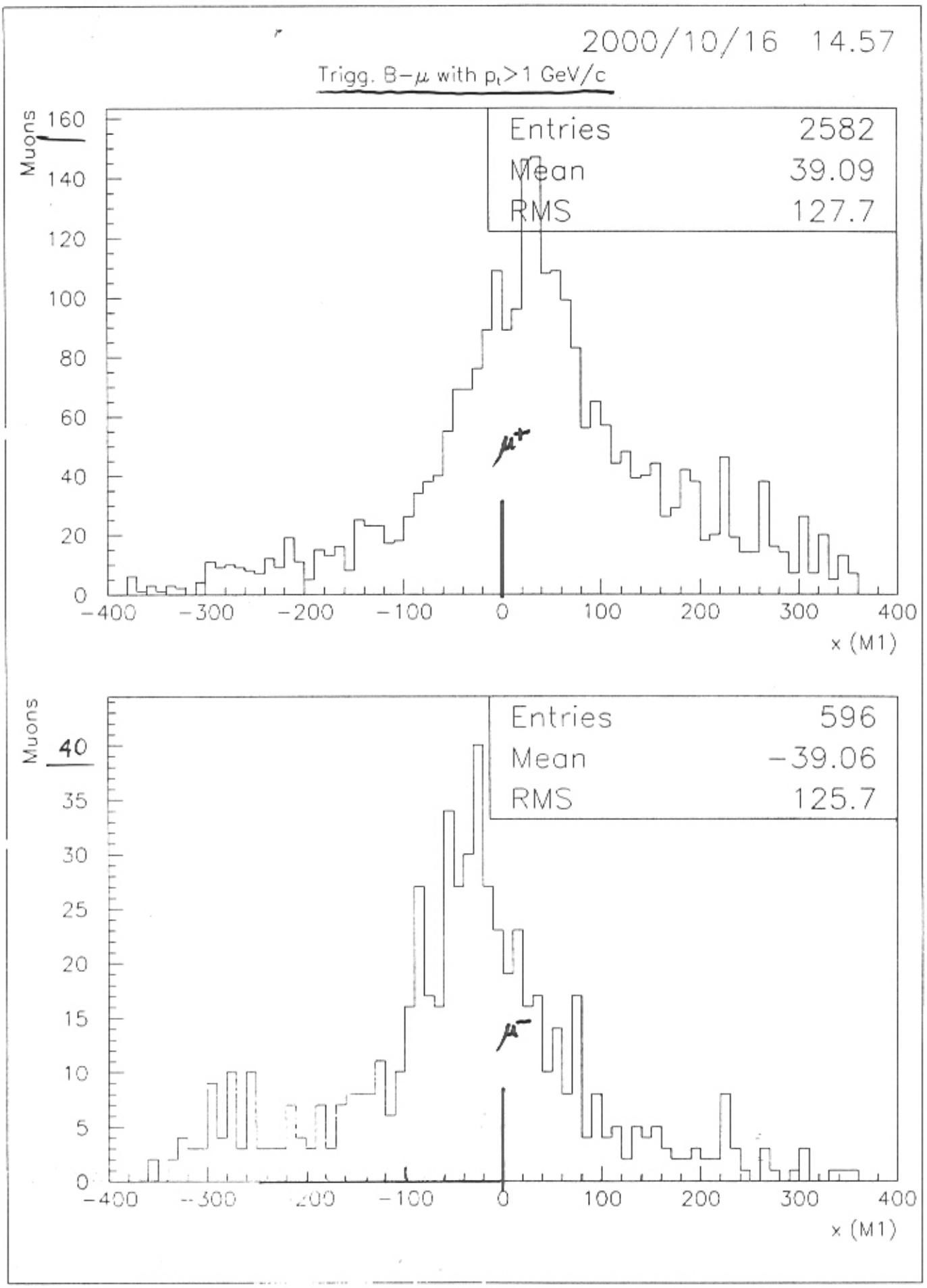
SICB DST

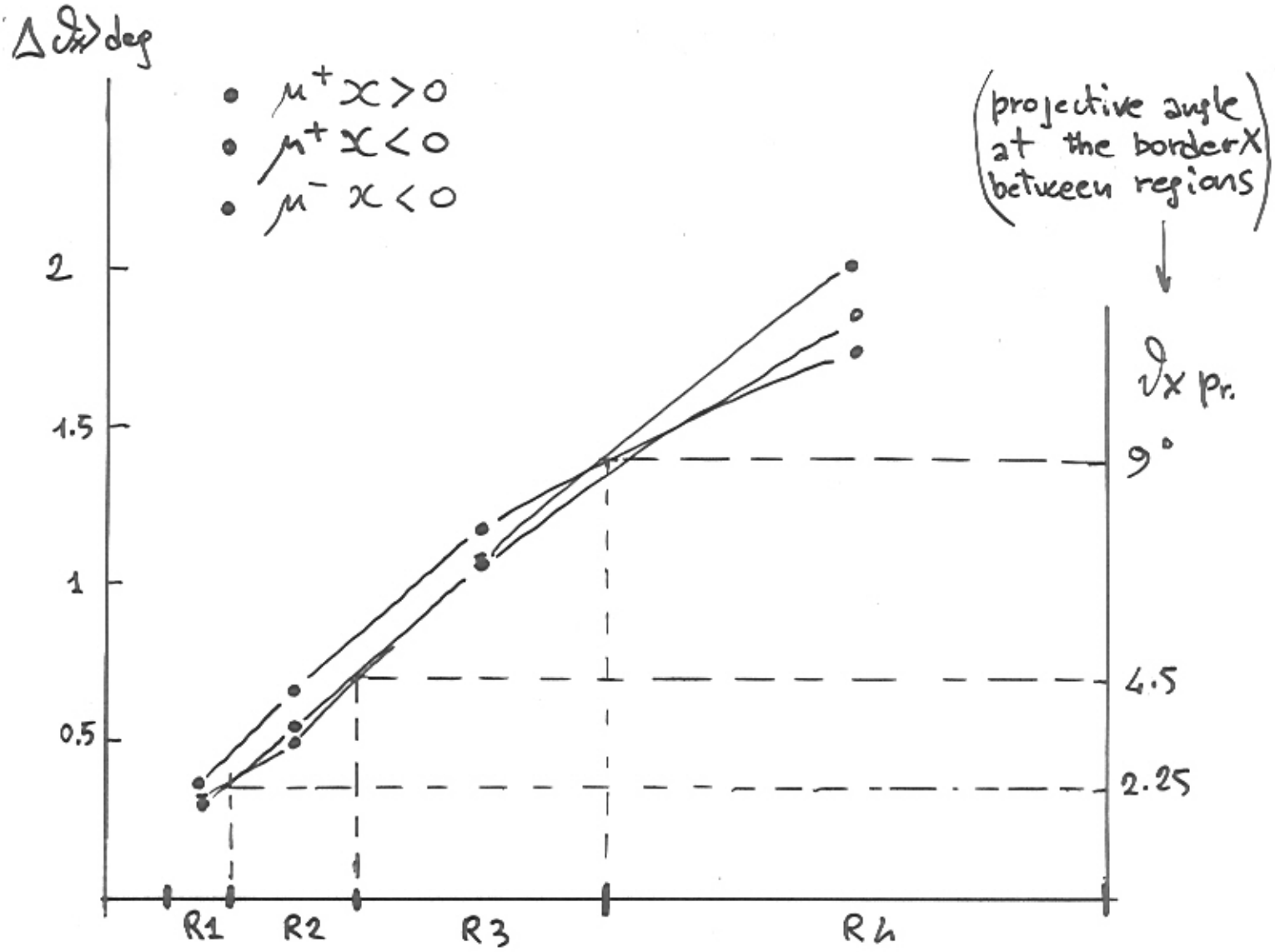
Needs a SOFTWARE INTERFACE (written by ROMA1) to compute the hit positions in the "SANDRA FORMAT" Layout

"FLEXIBLE CONFIGURATION"

- permits to tune any layout working on the same sample of data
- can be compared checked with configuration 1)
- safer from the point of view of defining different geometries (errors can be easily recovered) (geometry in SICBMC is simple)
- Does not introduce a priori inefficiencies (holes between chambers) that cannot be recovered
- Introduces small approximations at the dipitization level

(M.C. with $B \to \mu^+$ forced)





$\Delta\vartheta_x$ = average angular spread (in respect to projectivity with IP) in a region