IR issues

to recruit you in IR study.

General meeting of theACFA -LC working group
KEK, Japan
T. Tauchi (KEK), March 17, 1999

Contents

1. Introduction to interaction region (IR)
2. Recent activities
   - muon background with muon attenuators
   - masking system for pairs
   - pair monitor (beam profile monitor)
   - support tube   etc.

6. Summary
   IR issues to be studied for CDR.

ACFA Joint Linear Collider
Physics and Detector Working Group

IR subgroup

(Under construction. Comments are welcome)

What's New ?

- 12-March-1999 Proceeding paper of "Detector Overview __ focused on interaction region" is added in Talks related to the interaction region.
- 25-February-1999 A page of talks related to the ineteraction region is added in Libraries, where a pdf file of "Detector Overview" given at 1st ACFA workshop can be seen.
- 3-February-1999 One e-mail was distributed, which calls contributions for 1999 Sitges LC-Workshop.
- 3-February-1999 The page is created.

Introduction

- This group consists of these people at present, and calling for new commers.
- Interaction region is a place where a good communication between experimentalists and accelerator physicists is very important. The field is large from the exit of the main linac to the beam dump. The major issues are backgrounds related beams and stability of the beams for high luminosity.
- Activities
  - Background calculation/simulation (synchrotron radiations, e+e- pairs, muons, neutrons, hadrons...)
  - Masking system around an interaction point (IP).
  - Collimation system at the exit of the main linac.
  - Final focus system.
  - Dump line including beam polarization/energy measurement system.
  - Instrumentation (beam position/profile monitor, fast feedback,....)
- IR issues

Getting Started

- If you are not registered to ACFA working group, please join. If you are ACFA working group member, but not in the acfa-ir subgroup, please ask webmaster@acfahep.kek.jp to do so. The acfa-ir mailing list is delivered to these addresses.
- Submit to acfa-ir@acfahep.kek.jp
- Mail archive

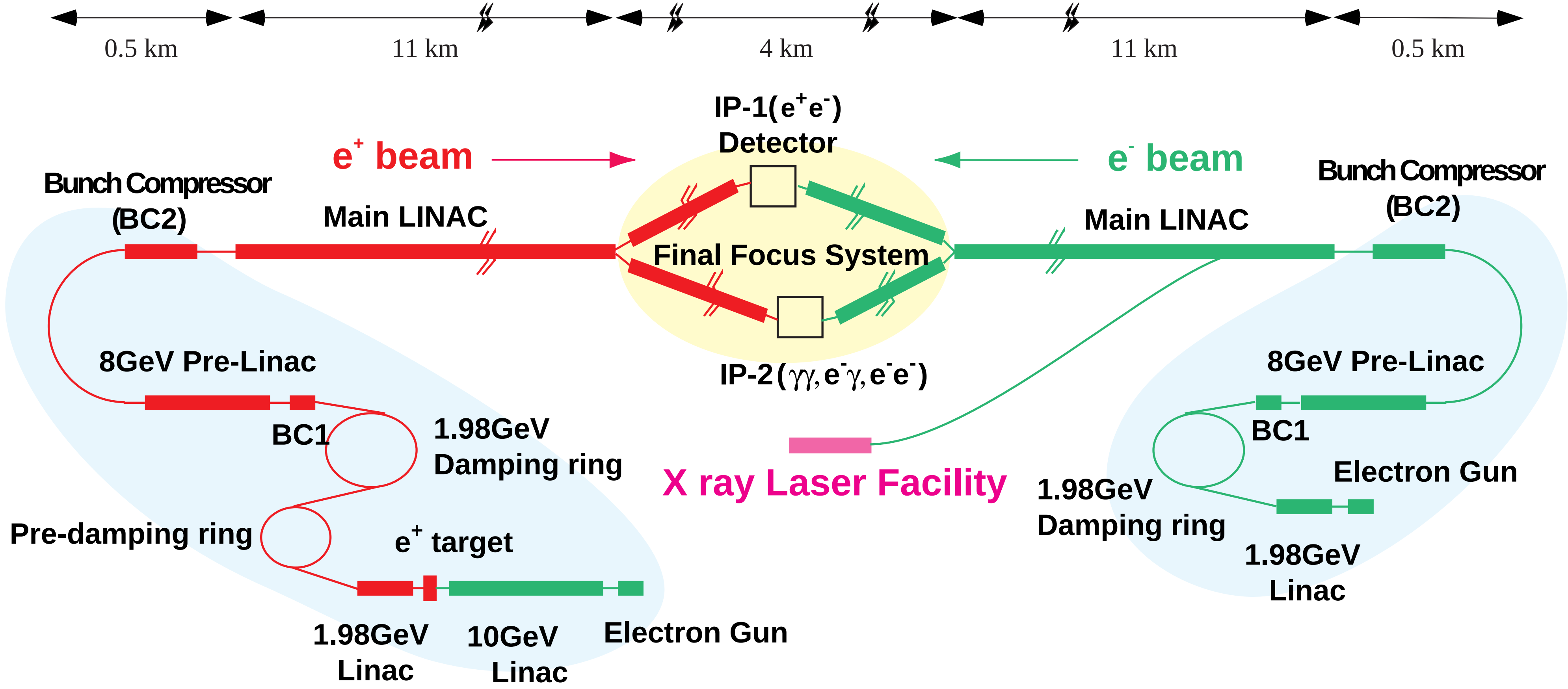
Calendar

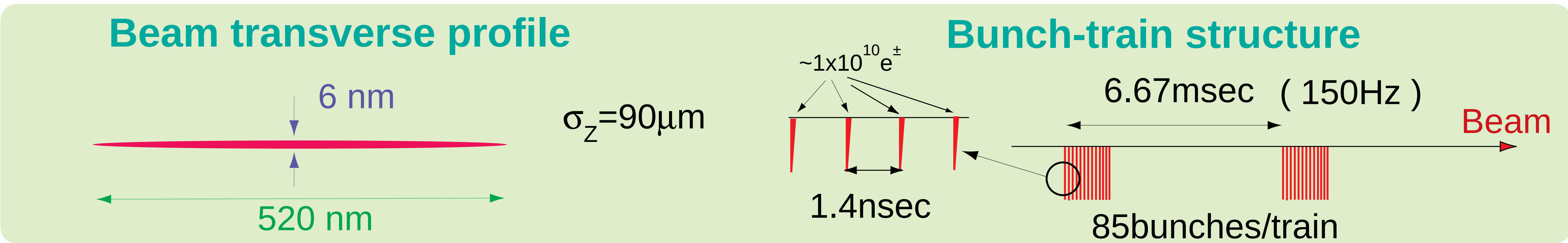
- 28 April - 5 May 1999 : LCWS99, Sitges (Spain).
- 17&18 March 1999 : Working group get together at KEK, Japan

Libraries

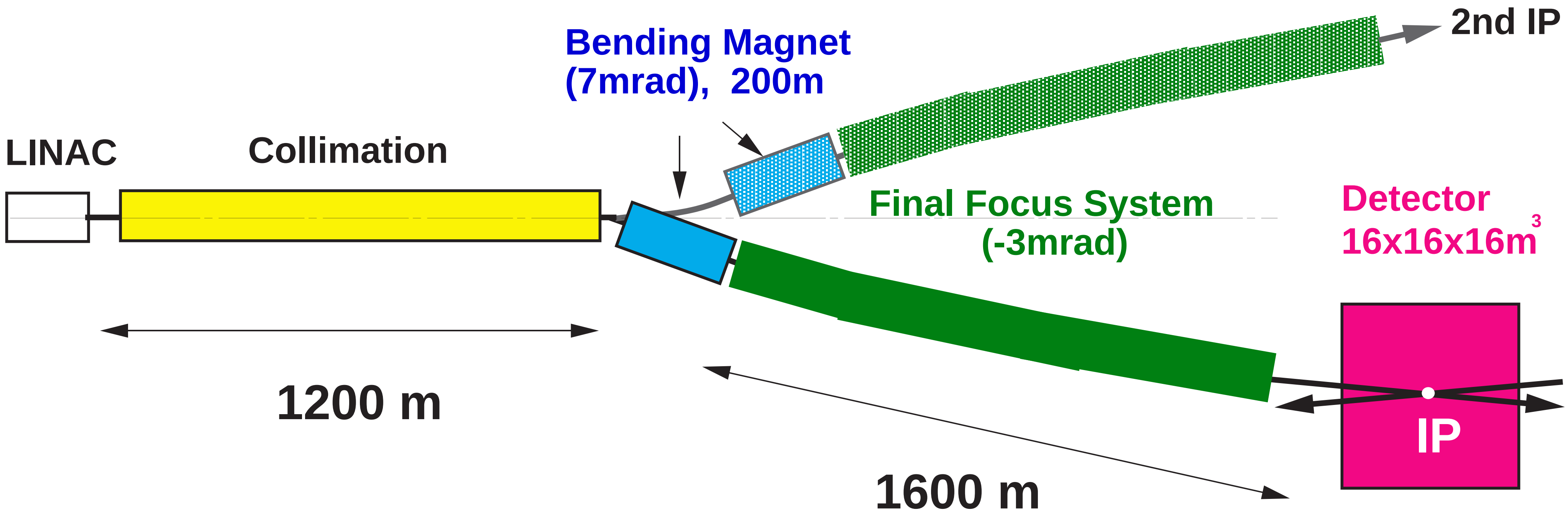
- Talks related to the interaction region.
- Available programs (beam-beam effect etc.)

Schematics of JLC accelerator complex





JLC : Beam Delivery System for $\sqrt{s}$ = 0.3 - 1.5 TeV



Muon

collimate beam-tail

$6\sigma_x \times 40\sigma_y$

Synchrotron Light

from collimated beam

$$\sigma_{\theta x(y)} = \sqrt{\varepsilon_{x(y)}/\beta_{x(y)}}$$

$$\sigma_{x(y)} = \sqrt{\varepsilon_{x(y)} \cdot \beta_{x(y)}}$$

e^+e^- pairs

Minijets

$\theta_c = 8$ mrad

P81. KEK proceedings. 97-2
T. Hirose, 6th Workshop
on JLC, 12/4-5, 1996

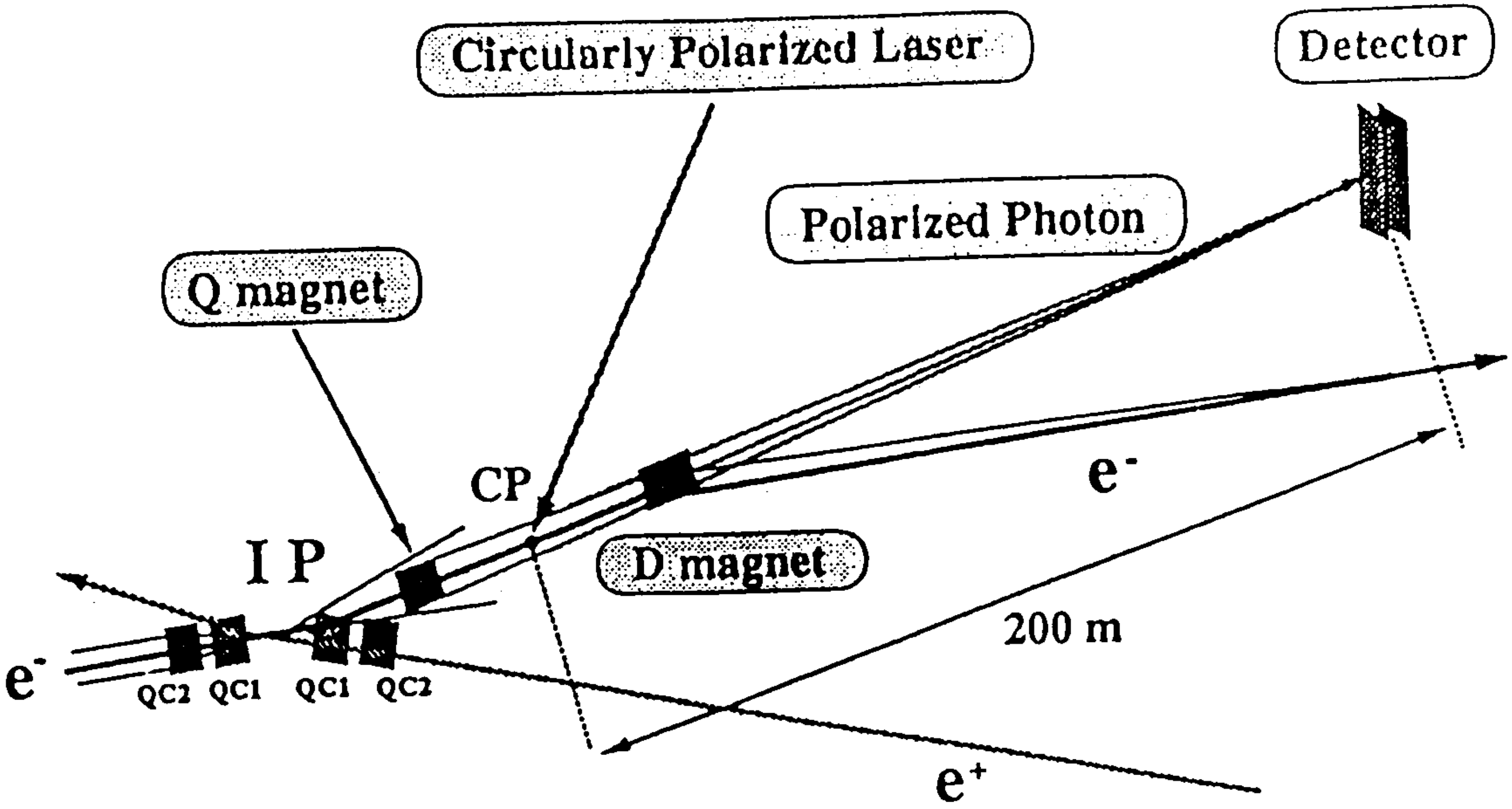


Figure 14: Proposed layout of the polarimeter for JLC

point with a distance L from the CP. Accordingly, we locate other quadrupole magnets at a downstream position from QC1, as shown in Fig 14. Assuming that L is set to be 200 m, the e^- beam projected on the detector is able to focus down to 20 μm, which is ... (20 μm) of the $e^{\pm}$ beams.

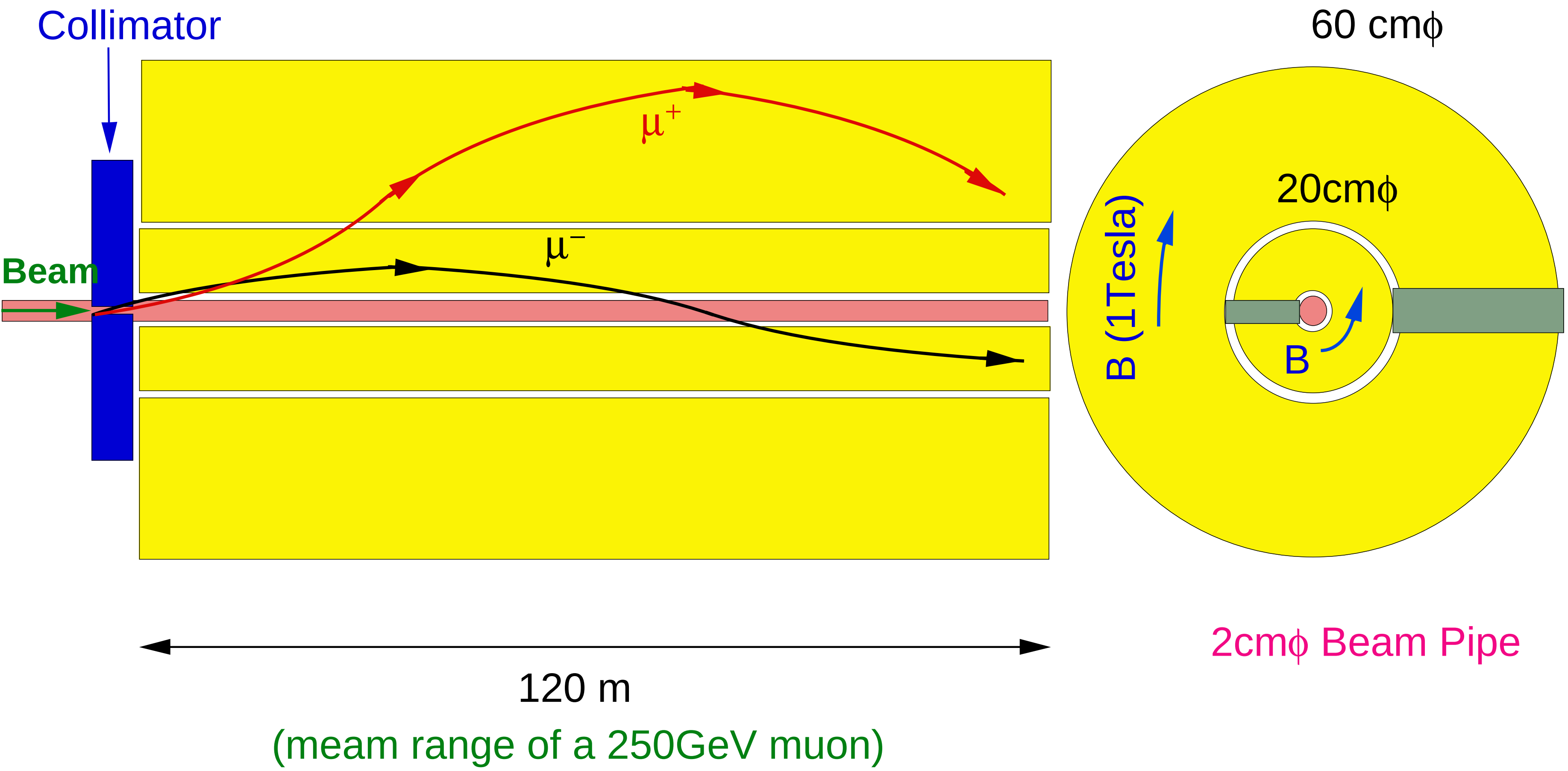
FFIR ISSUES TO BE STUDIED

FFIR group

Toshiaki Tauchi
Thu Nov 12 16:41:22 JST 1998

Muon Attenuator

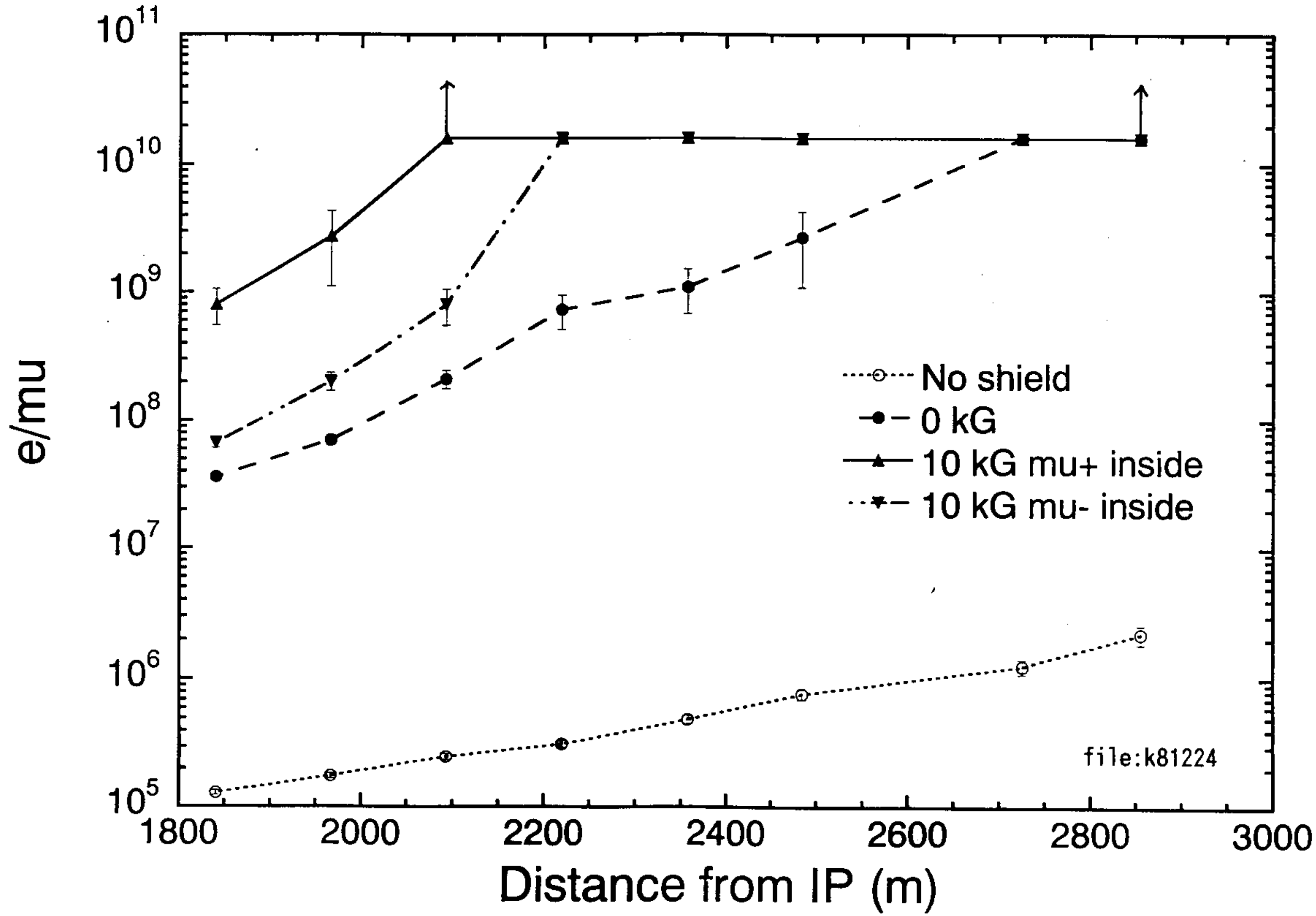
E.A.Kushnirenko, LC92



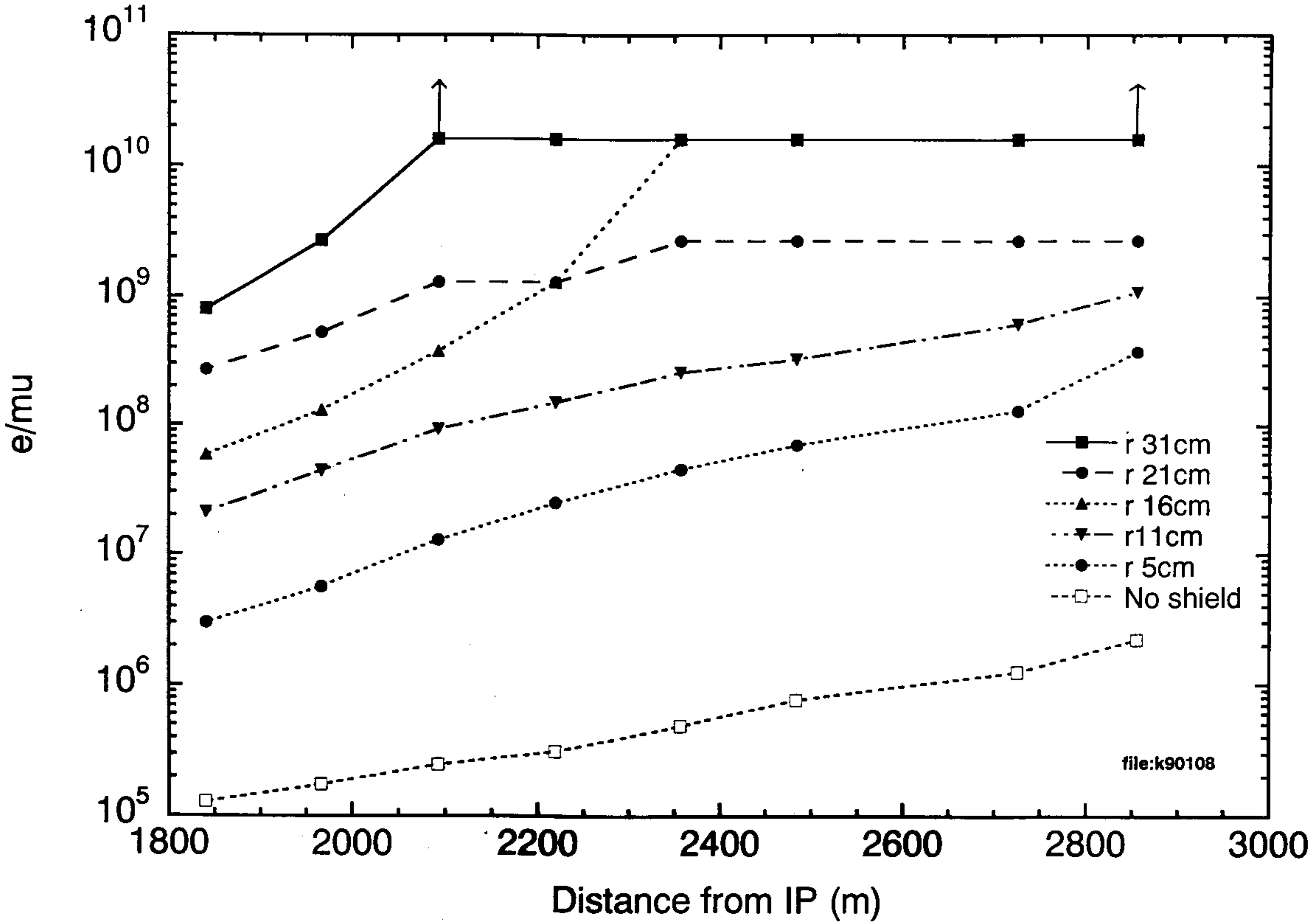
1 Best case: muon attenuator at 1510-2856 m

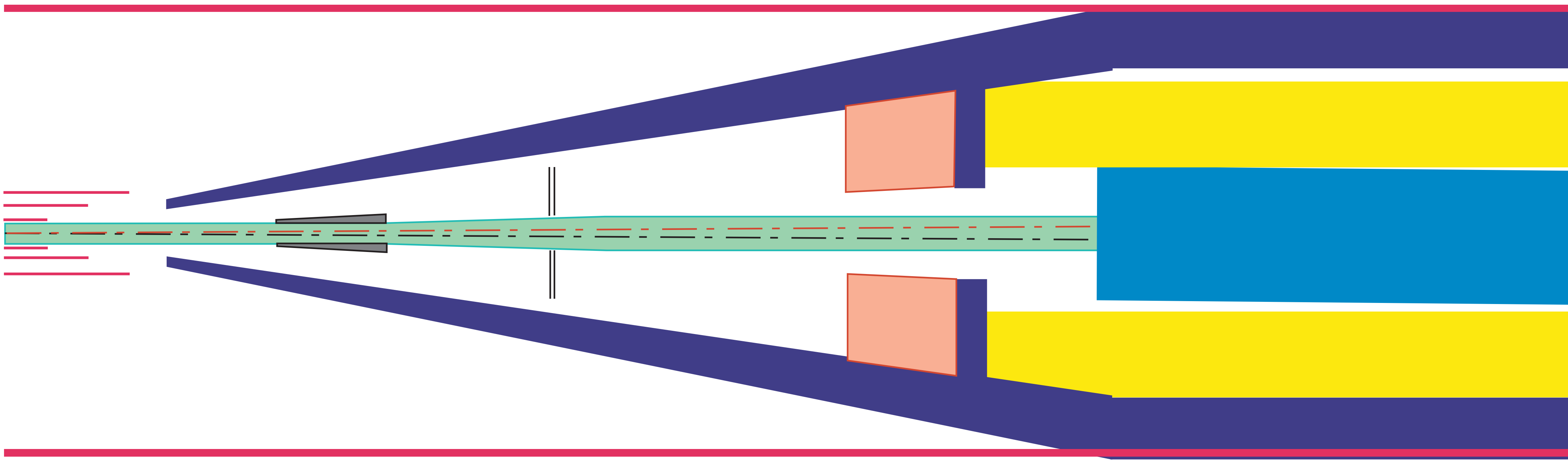
2 Muon attenuator at 1510-2856 m, into the tunnel

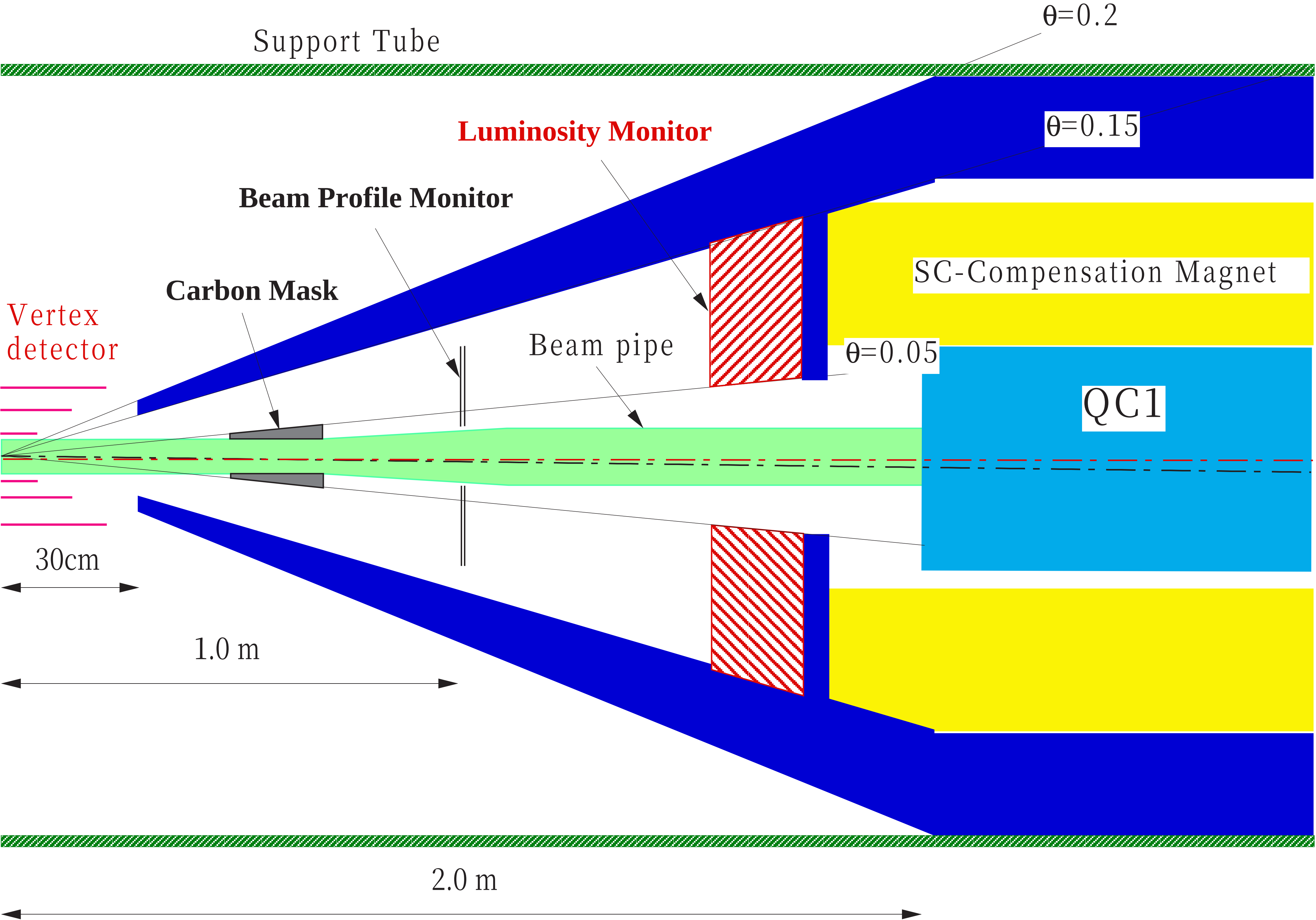
[redacted] Y. Namito

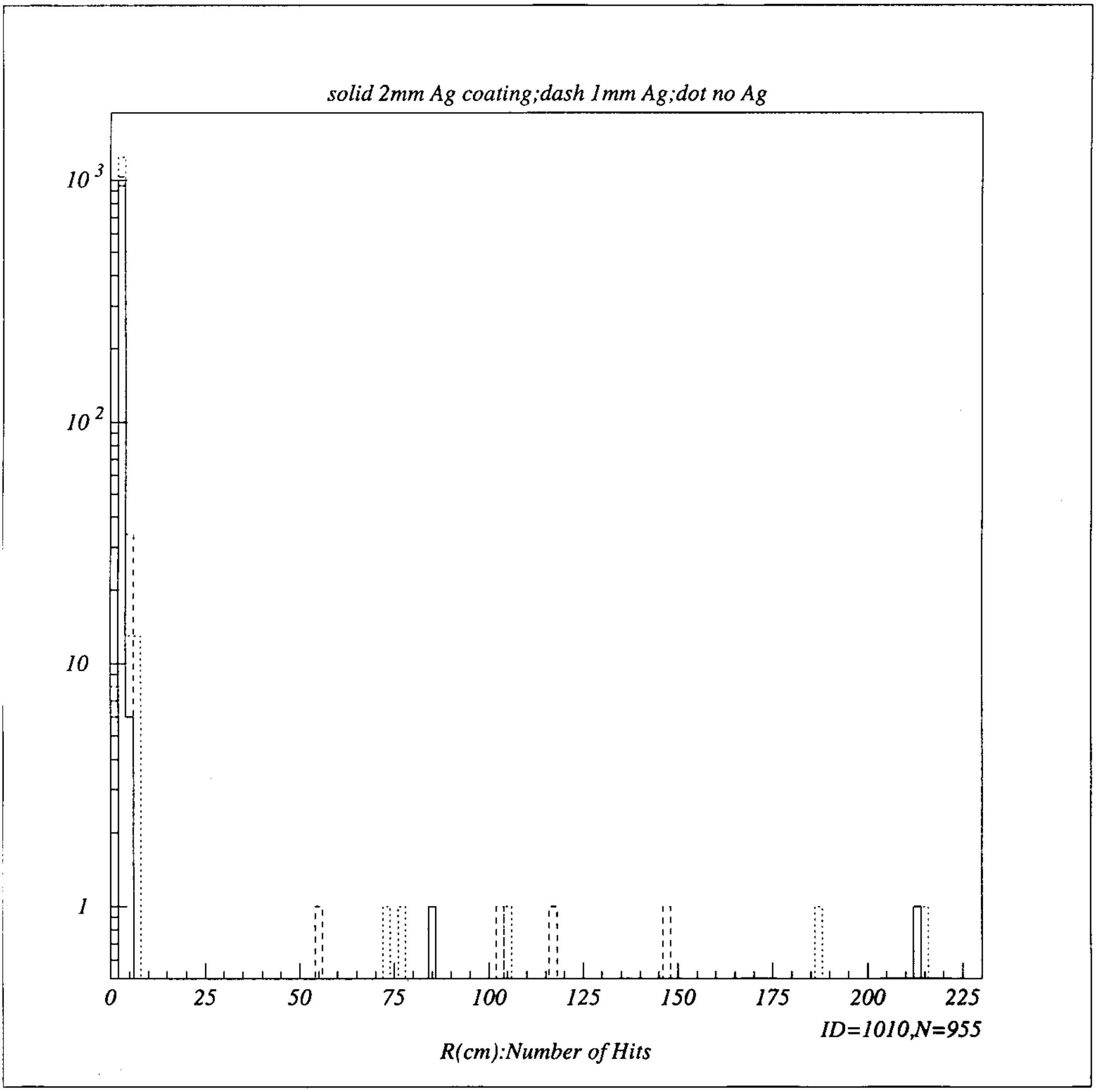


5 Case study: muon attenuator at 1510-2856 m, various radius





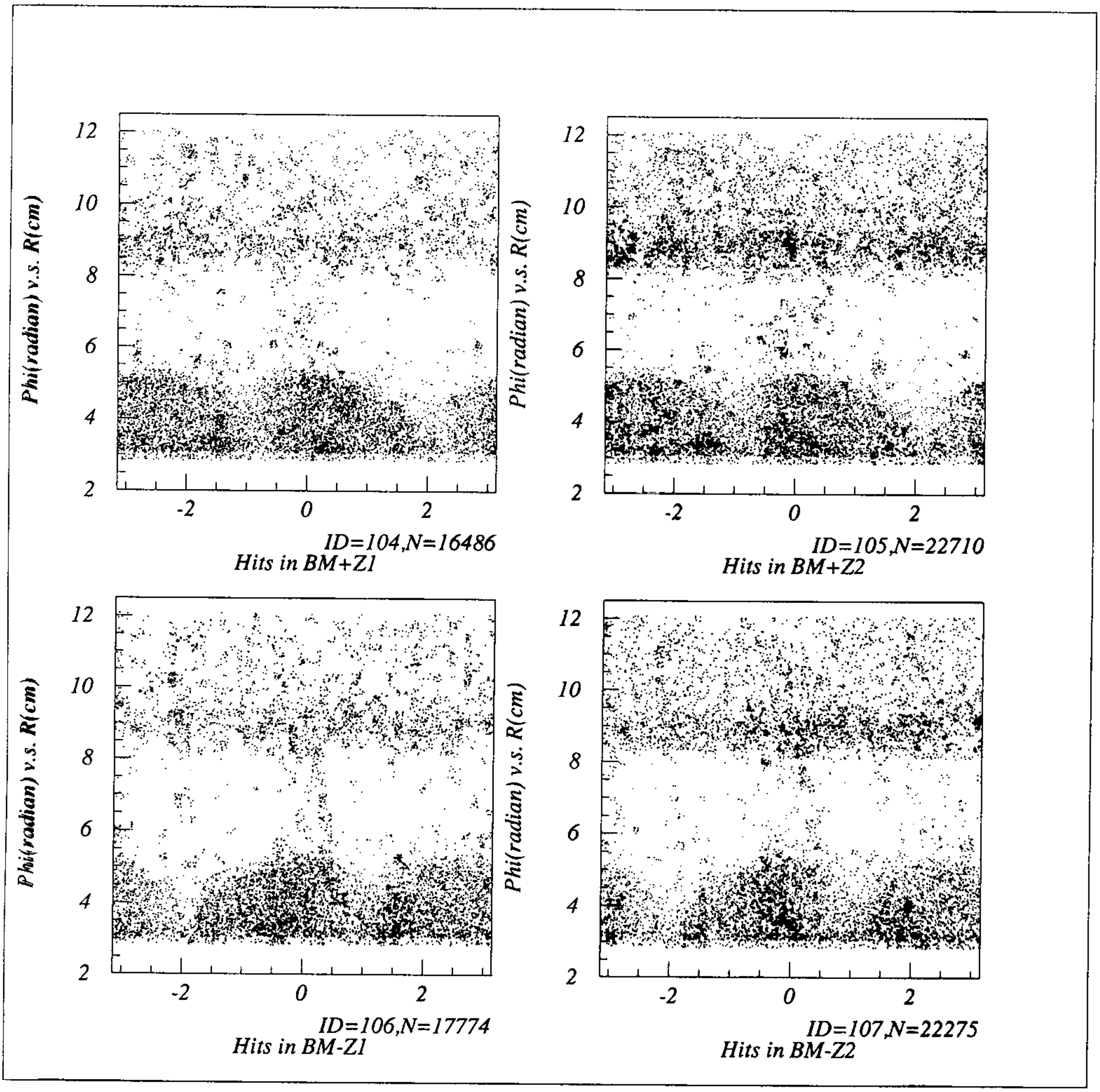

θ=0.2
Support Tube
θ=0.15
Luminosity Monitor
Beam Profile Monitor
SC-Compensation Magnet
Carbon Mask
Vertex
detector
Beam pipe
θ=0.05
QC1
30cm
1.0 m
2.0 m



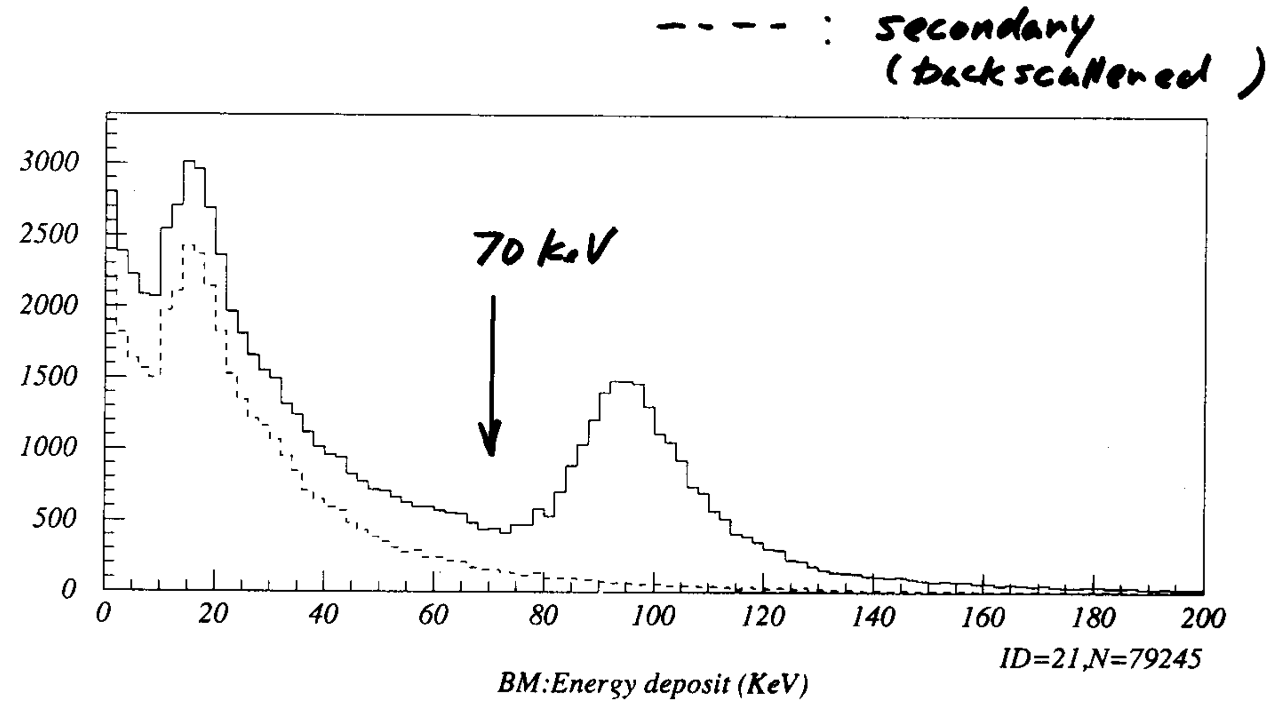
solid 2mm Ag coating;dash 1mm Ag;dot no Ag
10^3
10^2
10
1
0
25
50
75
100
125
150
175
200
225
ID=1010,N=955
R(cm):Number of Hits

50 x 50 μm^2 pixel device 300 μm^t Si

Beam Profile Monitor
Hits : Φ v.s. r

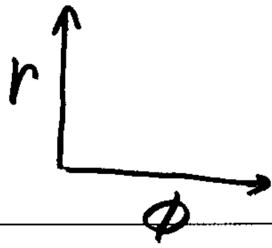


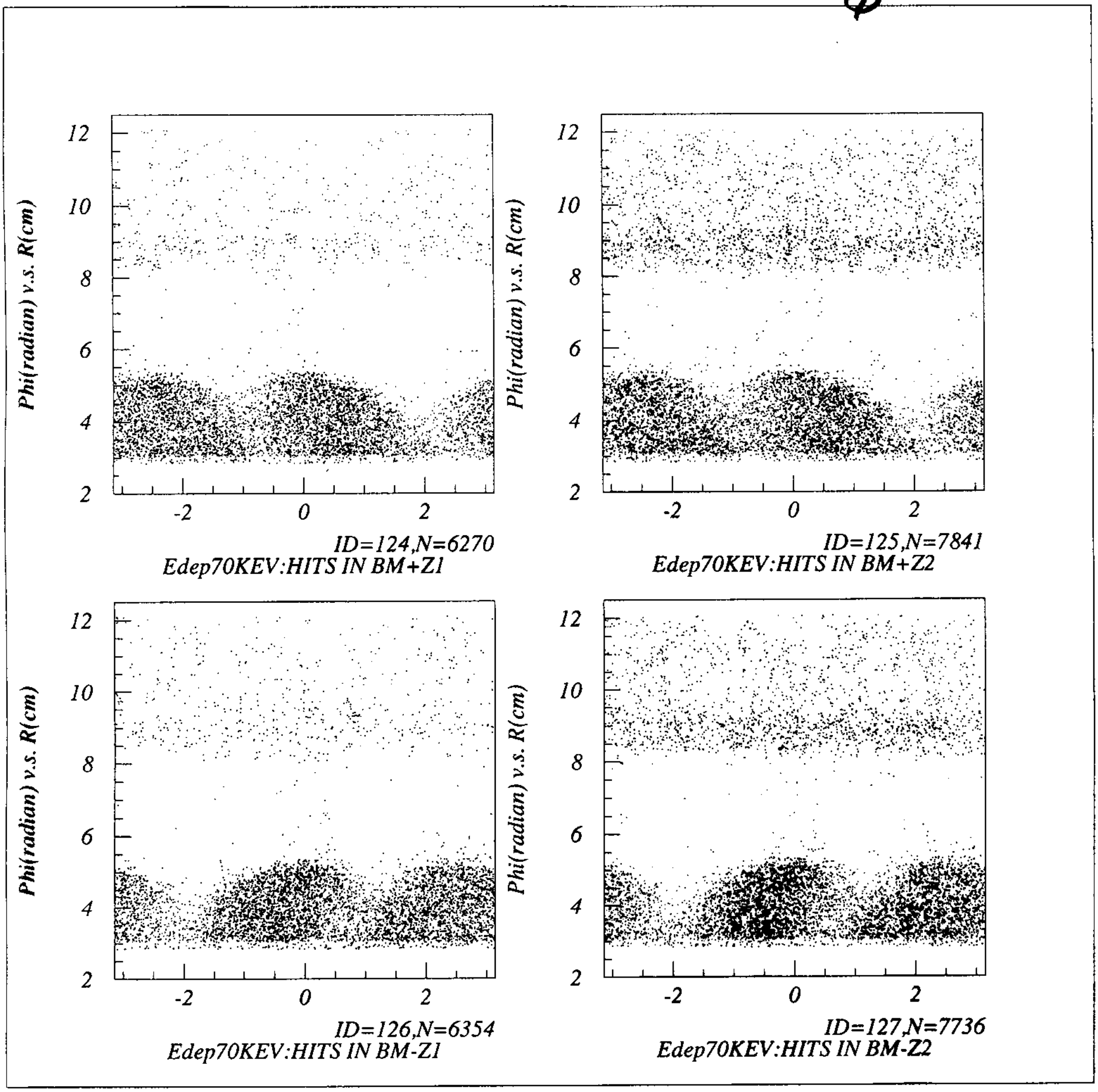
Energy Deposits at the Monitor



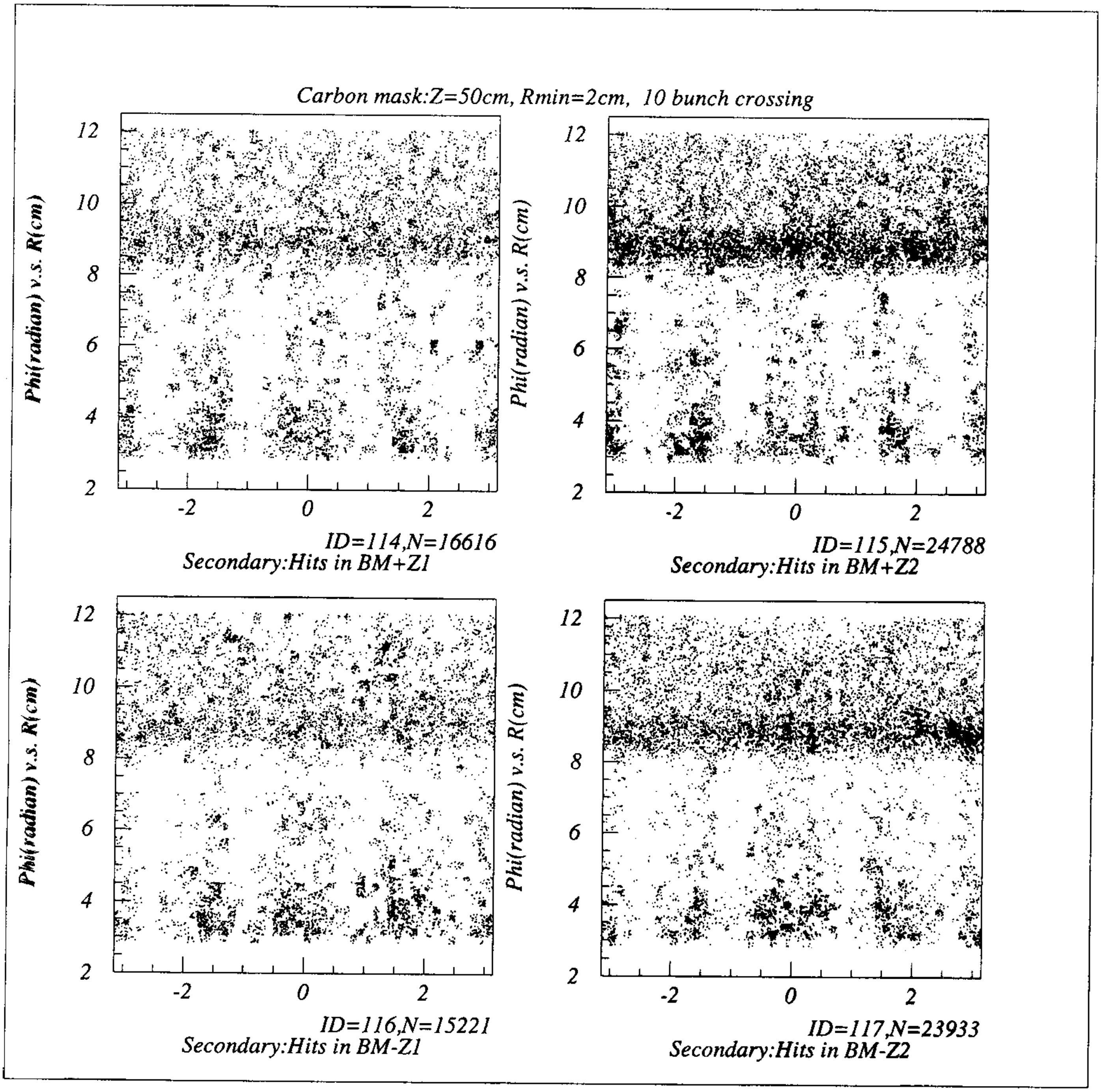
Pair monitor

> 70 keV

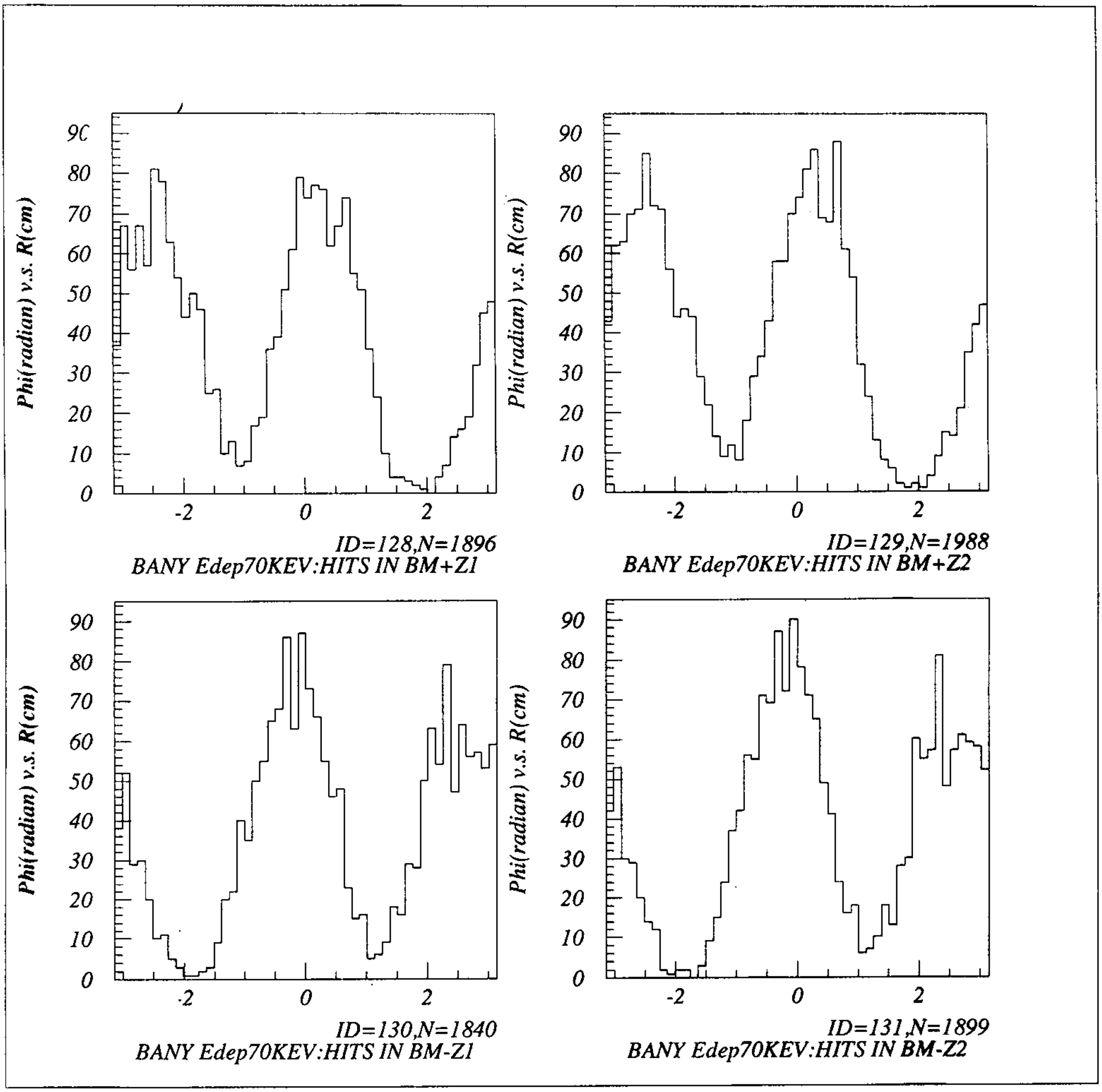




< 70 keV



Carbon mask:Z=50cm, Rmin=2cm, 10 bunch crossing
Phi(radian) v.s. R(cm)
ID=114,N=16616
Secondary:Hits in BM+Z1
ID=115,N=24788
Secondary:Hits in BM+Z2
ID=116,N=15221
Secondary:Hits in BM-Z1
ID=117,N=23933
Secondary:Hits in BM-Z2



Phi(radian) v.s. R(cm)
ID=128,N=1896
BANY Edep70KEV:HITS IN BM+Z1
ID=129,N=1988
BANY Edep70KEV:HITS IN BM+Z2
ID=130,N=1840
BANY Edep70KEV:HITS IN BM-Z1
ID=131,N=1899
BANY Edep70KEV:HITS IN BM-Z2

Support tube

LCWS 93, Hawaii
S. Kanda

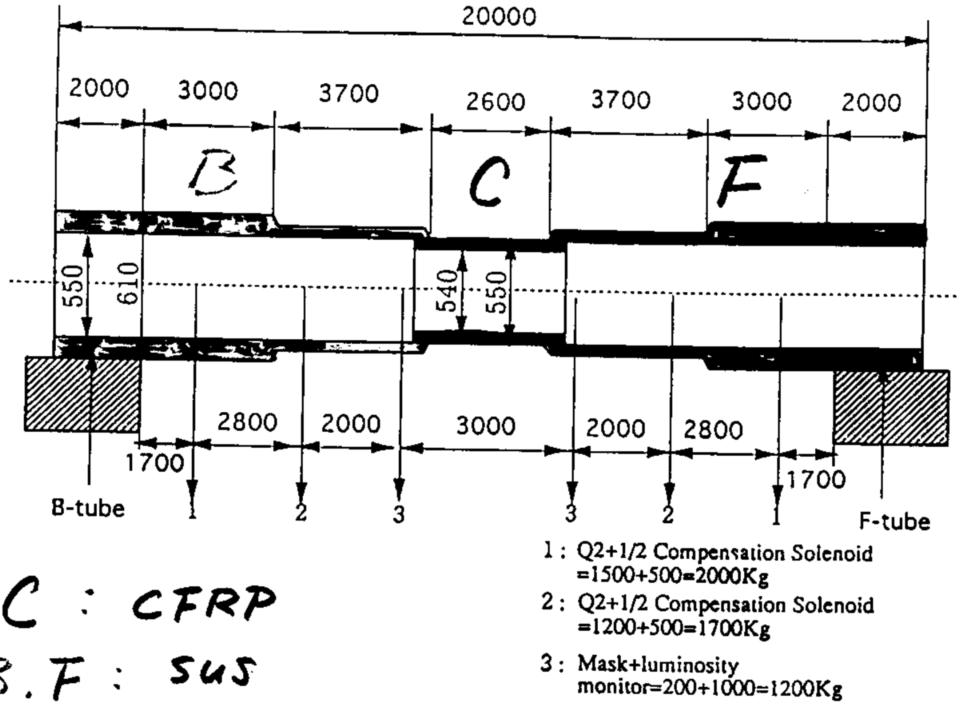


Fig. 1. Schematic view of the support tube.

Relative displacement due to ground motion

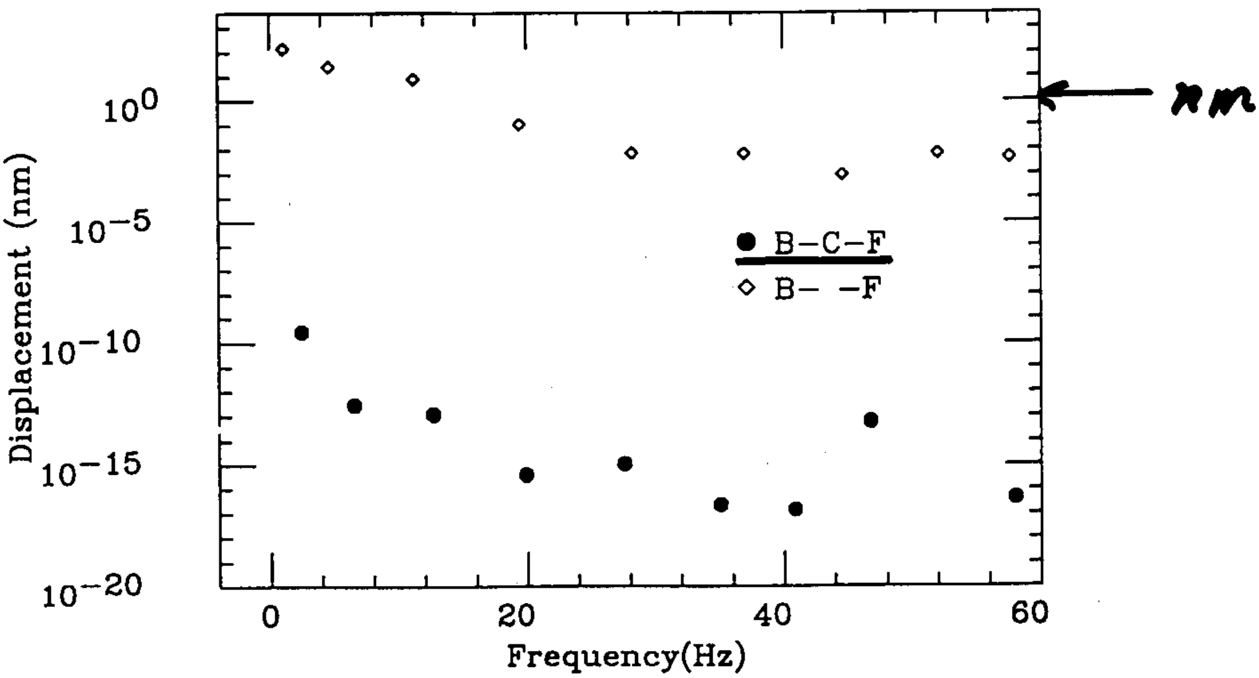
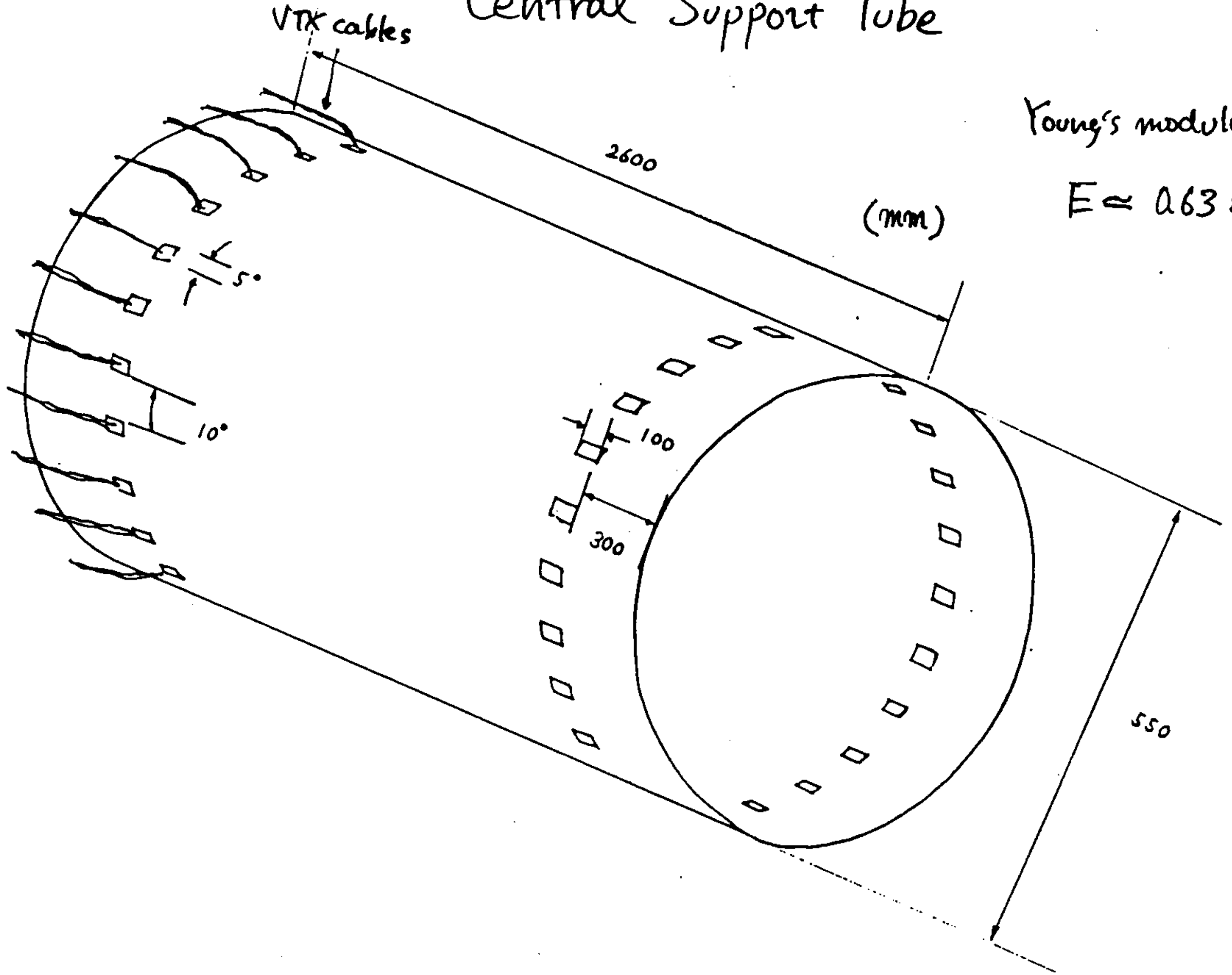


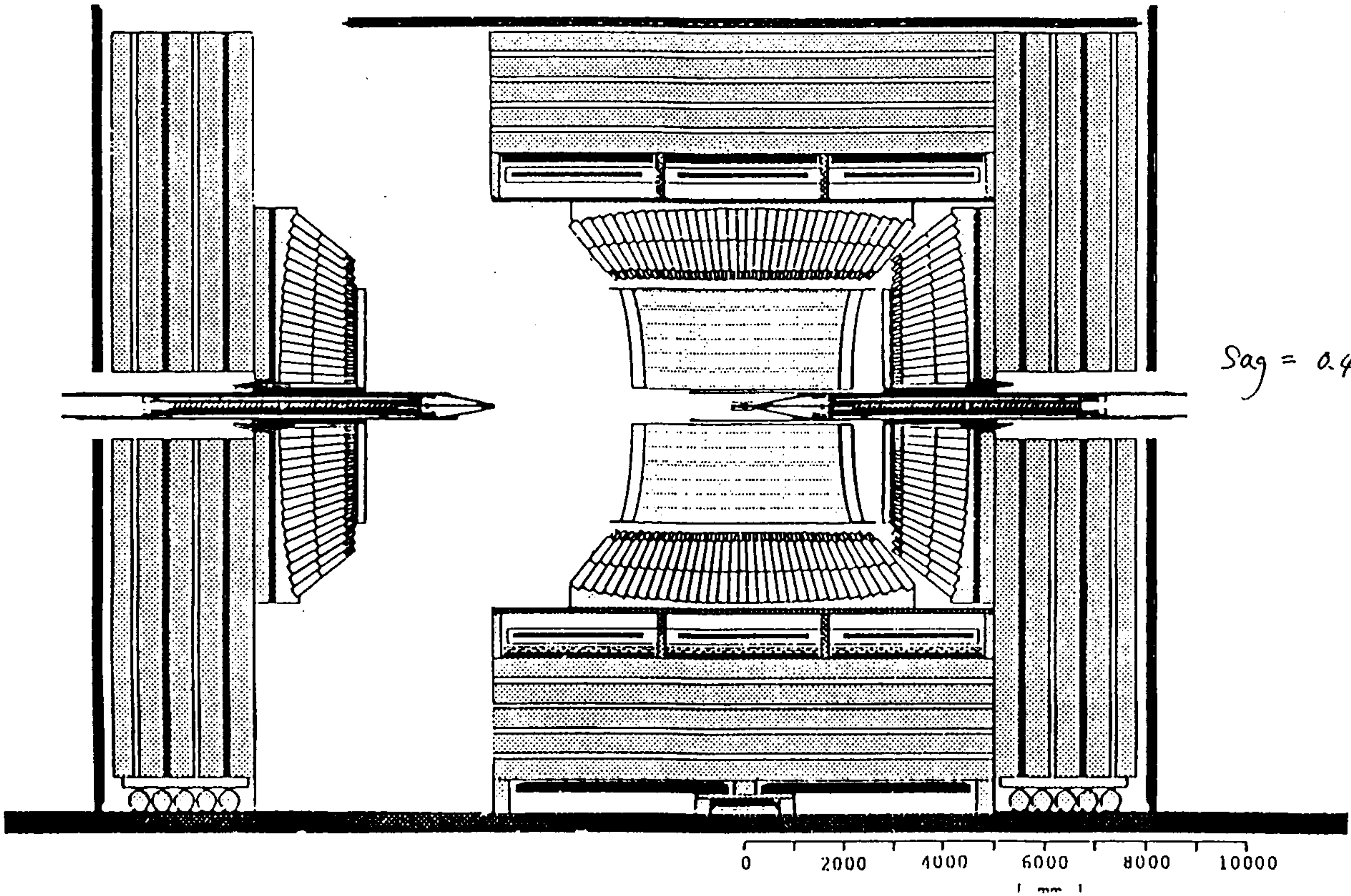
Fig. 3. Results of the modal analysis for case 1): F/B tubes are connected by C-tube, both tube ends are fixed, and case 2): F/B tubes are separated, a single end is free. The input velocity spectrum was measured in the KEK.

Central Support Tube



Young's modulus E

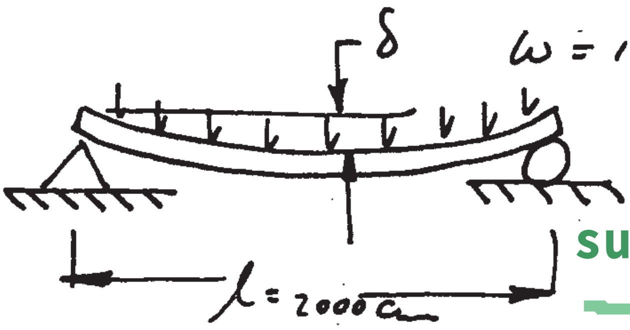
$E \simeq 0.63 \times E_0$ (no hole)



Sag = 0.49 cm

comment by Gordon Bowden (SLAC), Jan.28 1999

STATIC DEFLECTION



$w = 10^4\ Kg / 20\ m = 5\ kg/cm$

support distance 8 m

$E_{CFRP} \simeq 2 \times 10^6\ Kg/cm^2$ → 40 cm

$I = \pi (27.5\ Cm)^3 (0.5\ Cm) = 3.267 \times 10^4\ Cm^4$

$$\delta = -\frac{5 w l^4}{384\ EI} = \frac{5 (5\ Kg/Cm)(2 \times 10^3\ Cm)^4}{384 (2 \times 10^6\ Kg/Cm^2)(3.267 \times 10^4\ Cm^4)}$$

⇒ $\delta = 0.13$ cm

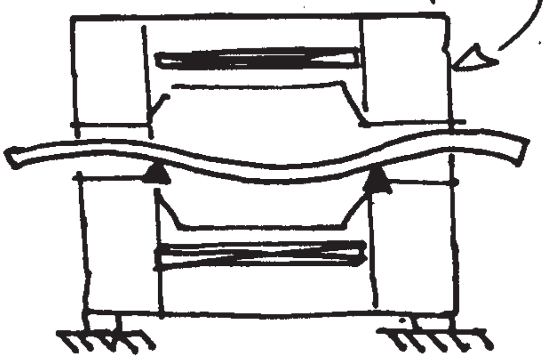
$\boxed{\delta = 15.9\ Cm}$ (ALL CARBON ½ Cm WALL × ϕ .5 METER)

δ = 0.49 cm in the previous figure(S.Kanda)

RESONANT FREQ CORRESPONDING TO 5 mm DEFLECTION CORRESPONDING TO KANDA'S CALCULATIONS

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{9.8\ m/SEC^2}{.005\ m}} = \boxed{7\ Hz}$$

I ASSUME HIS SUPPORT ASSUMPTION WAS "SUPPORT TUBE WITH "FIX THE ENDS OF SUPPORT TUBES TO INSIDE OF THE RETURN YOKE OF DETECTOR MAGNET



WHERE ARE SUPPORTS LOCATED?

see the previous figure

IR issues: to be studied

1. Mask design

JIM simulation based on GEANT3 -> GEANT4
CAIN for pair generation instead of ABEL
cain2bnk.f to convert CAIN output to JIM input
comparison between CAIN and ABEL
neutron background estimation
magnetic field of QC1 and compensation SC must be included.

2. Veto system

Active mask and luminosity monitor
minimum veto angle = 50 mrad -> smaller ?
R&D :
e.g. Si/W sandwich for active mask,
BGO for luminosity monitor

4. Pair monitor

1st feasibility study by JIM and analytic estimations
R&D :
Active pixel sensor (APS) with a fast gate and readout for bunch separation; position and deposit energy measurements

5. Support tube

How to install/support the support tube and how to access inside-detectors ?

stability of two QC1's : < a few nm at freq. > 1Hz

(1st estimtion by S. Kanda; using ANSYS)

or alternative method such as optical anchor....

6. Muon tracking with optical elements

from collimation section to IP

Namito's estimation with muon attenuators :

MUCARLO

More realistic estimation with optics is necessary:

SAD

7. Extraction line (to beam dump)

beam separation and transportation of disrupted beams with good efficiency : CAIN, SAD, JIM

measurements of beam energy, its spread(?), polarization

neutron background from the beam dump.

8. Fast feedback system

bunch by bunch feedback for beam stabilization

very important for high integrated luminosity

R&D:

Beam position monitor (BPM) , pair monitor with fast electronics

note: bunch separation = 1.4 nsec.

9. Superconducting final focus magnet

without compensation magnet -> compact support tube

larger inner radius for finite horizontal crossing

10. Stronger detector solenoid field, B

to reduce backgrounds for shorter radius of the innermost layer, e.g. 2.5 -> 1 cm, of vertex detector.

2 -> 3 Tesla or higher B requires optimization of detectors

beam blow-up ? : SAD