R.T. Jones
UConn
Hall D Wsite
R.P.I. 3.

Summary of

Photon Beam and Tagger Working Group

1. Design Report Issues

A. tagging accidentals rate
B. inconsistencies
C. beam current

2. The Next Steps

A. beam transport design
B. determine geographic limits
c. involve personnel at Jlab in design
★ point-person for Hall D at Jlab

3. R + D

A. source for large, high quality diamonds, cheap.
B. investigate crystals of Be as alternative to diamond

1. Design Report Issues

A. tagging accidentals rates

CDR p. 116 : $A_0 = S \, \Delta T \, \Phi$

level 0 trigger rate — start counter rate — time window — "OR" rate

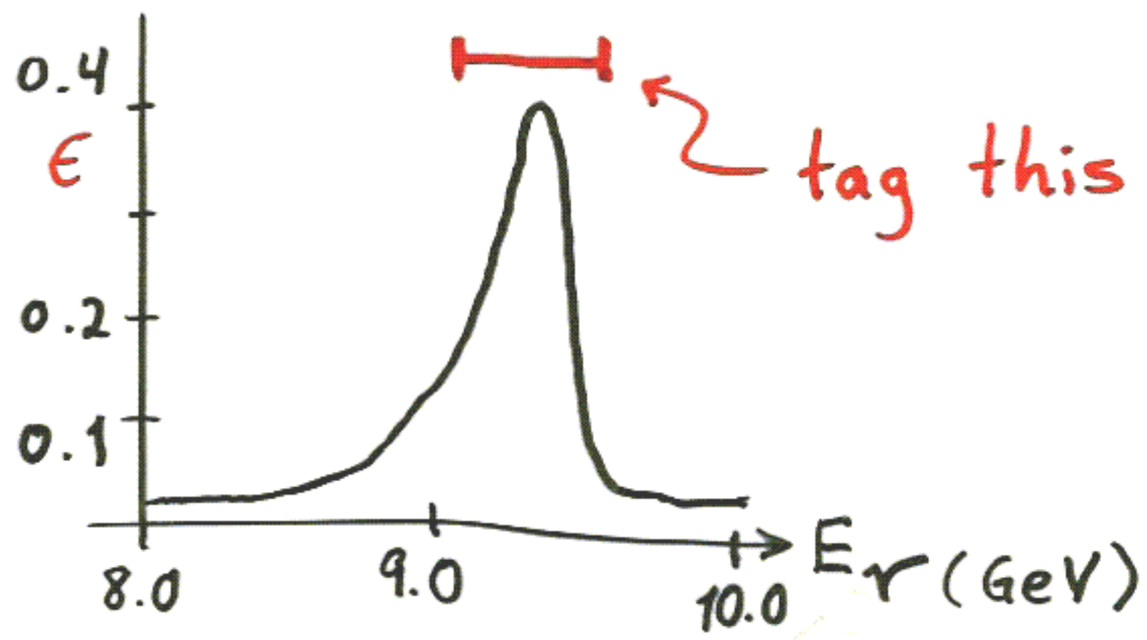
$= \emptyset.46 \, \phi$

"Ø.Ø7 for CLAS"

But: ϕ = photons in tagging range on target /s
($10^7 s^{-1}$ for CDR)

Φ = photons in tagging range at radiator /s

$= \frac{1}{\epsilon} \phi$ (ϵ is "tagging efficiency")



Φ = 250 MHz / GeV ! (CDR p

* different from CLAS
* only affordable to tag around peak
(see discussion in CDR)

B. Inconsistencies

★ horizontal vs. vertical beam dump
- environment
- physics
- tagger engineering

(see fig 4.5 vs front cover)

★ distance radiator - collimator
(50 m vs 80 m)

★ beam optics

C. Beam Current

★ 3μA on 20μm diamond radiator,
2mm collimator @ 80 m, peak @ 9 GeV
10^8 γ/s

★ ~ ½ at E_γ = 10 GeV peak position

★ requesting <u>10μA</u> (CDR p.57)

★ hadron beams at 24 GeV, 10μA
~ 1000 $k^\pm$ /s
~ 60,000 $\pi^\pm$ /s

12 - 24 GeV/c HALL D BEAM LINE

C. Yan and R. Carlini
Physics Division, TJNAF

Abstract

The report presents a preliminary optics design of the major part of Hall D beam line - the chicane achromat. It consists of 6 quadrupoles and 10 dipole magnets. The chicane bends the 24 GeV/c beam up and down by 11.64 degree. The vertical translation by chicane brings the beam from underground up to the surface level. Beam is achromatically double-focused on the radiator. The CEBAF existing designs of the BZ dipole and QA quadrupole can be used as basic elements without modification.

1. Basic function

- Match the output beam from 5 ½ pass to Hall D transportation line
- Vertically translate beam from underground tunnel to the surface level
- Provide approximately achromatic and double focusing beam on the radiator
- Leave enough flexibility for the final geometric adjustment of civil engineering design

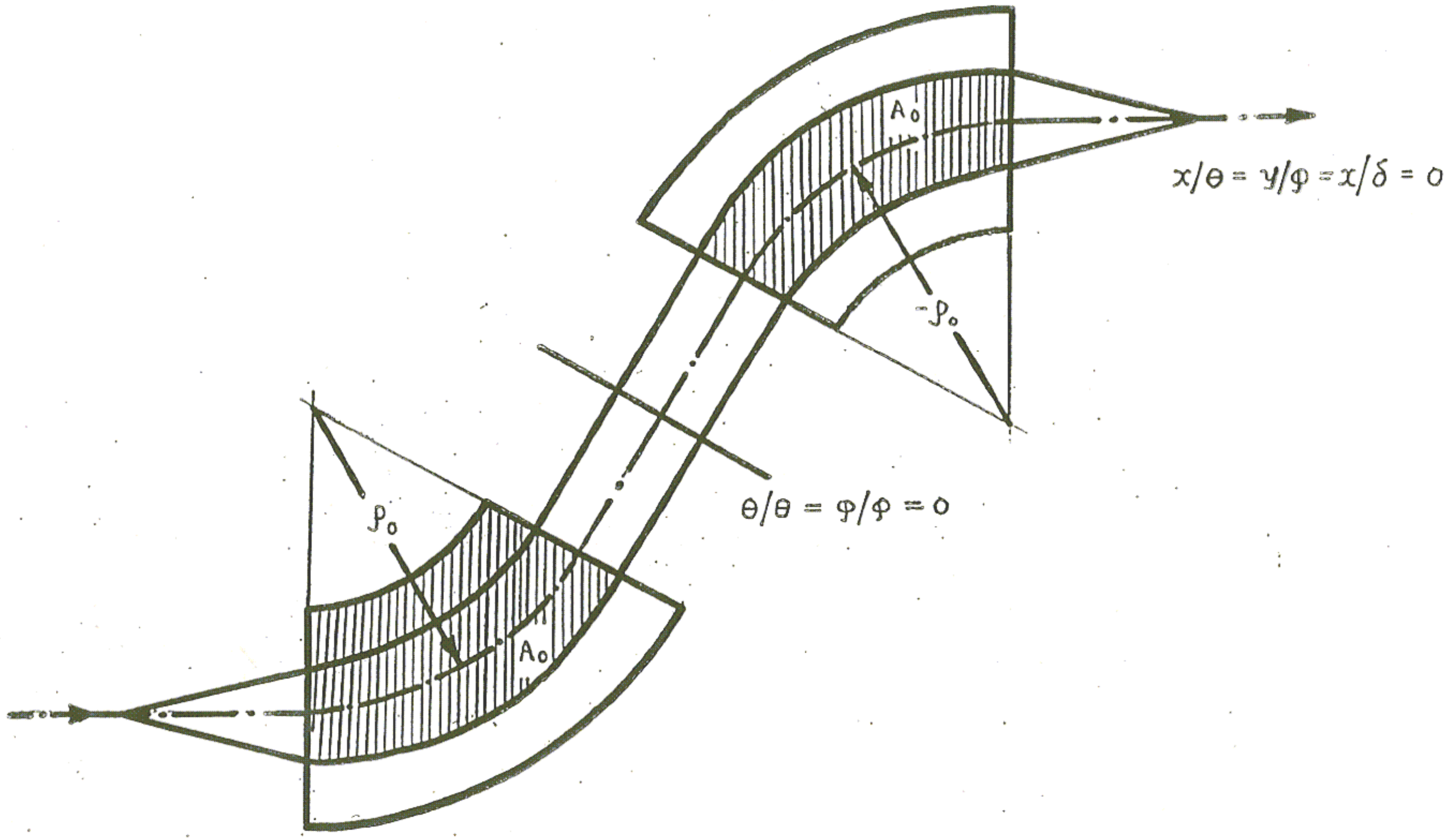

A_o
$-\rho_o$
$x/\theta = y/\varphi = x/\delta = o$
$\theta/\theta = \varphi/\varphi = o$
ρ_o
A_o

Fig. 2

Table 1. Beam transportation matrix at the mid-point of chicane

$$\begin{pmatrix} x \\ \theta \\ y \\ \phi \\ z \\ \delta \end{pmatrix}_{mid} = \begin{pmatrix} 0.44159 & 2.10313 & 0.00000 & 0.00000 & 0.00000 & 1.71763 \\ -0.47548 & 0.00000 & 0.00000 & 0.00000 & 0.00000 & 2.01443 \\ 0.00000 & 0.00000 & -1.33833 & 1.27193 & 0.00000 & 0.00000 \\ 0.00000 & 0.00000 & -0.78621 & 0.00000 & 0.00000 & 0.00000 \\ -0.17063 & -0.42366 & 0.00000 & 0.00000 & 1.00000 & -0.08509 \\ 0.00000 & 0.00000 & 0.00000 & 0.00000 & 0.00000 & 1.00000 \end{pmatrix} \begin{pmatrix} x \\ \theta \\ y \\ \phi \\ z \\ \delta \end{pmatrix}_{in}$$

point-to-parallel

Table 2. Beam transportation matrix at the radiator

$$\begin{pmatrix} x \\ \theta \\ y \\ \phi \\ z \\ \delta \end{pmatrix}_{out} = \begin{pmatrix} -0.35629 & 0.00000 & 0.00000 & 0.00000 & 0.00000 & 0.00000 \\ 0.46643 & -2.80668 & 0.00000 & 0.00000 & 0.00000 & -4.58445 \\ 0.00000 & 0.00000 & -1.48126 & 0.00000 & 0.00000 & 0.00000 \\ 0.00000 & 0.00000 & 0.28038 & -0.67510 & 0.00000 & 0.00000 \\ -0.16334 & 0.00000 & 0.00000 & 0.00000 & 1.00000 & 0.52182 \\ 0.00000 & 0.00000 & 0.00000 & 0.00000 & 0.00000 & 1.00000 \end{pmatrix} \begin{pmatrix} x \\ \theta \\ y \\ \phi \\ z \\ \delta \end{pmatrix}_{in}$$

focus at radiator

achromatic transport

6. Major performance of chicane translator at 24 GeV/c

Bending Power of individual (degree)	2.327
Total bending power (degree)	11.64
Number of BZ's (5 up + 5 down)	10
Number of quads	6
Space for dipole magnets (m)	20
Spare space for other elements (m)	36
Beam energy range (GeV)	12 – 24
Maximum total Bdl (kG m)	32.53
Maximum PS current (A)	550
Maximum PS voltage (V)	450
Total power dissipation (kW)	239
Maximum quad gradient (kG/cm)	4.27
Maximum quad current (A)	17

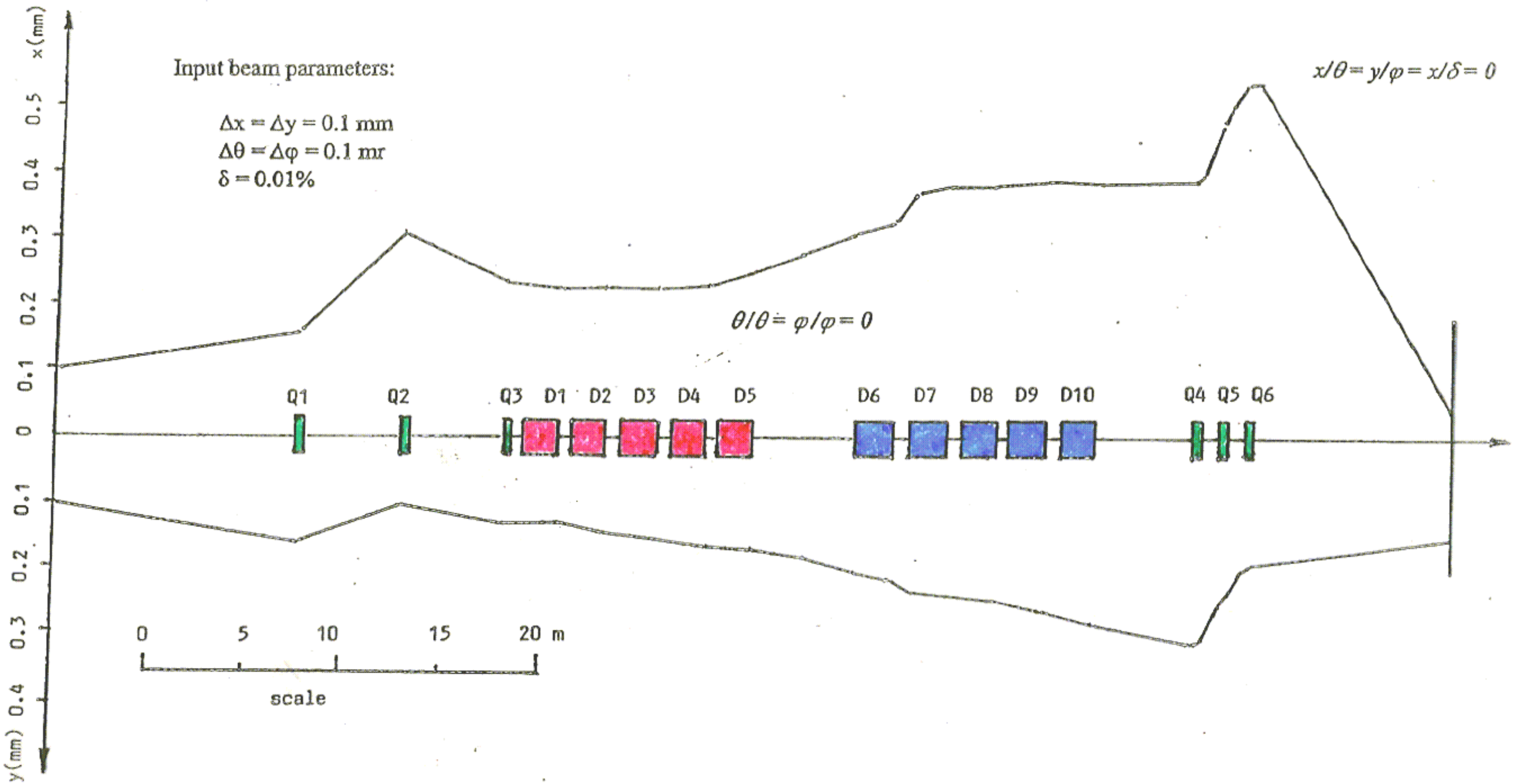
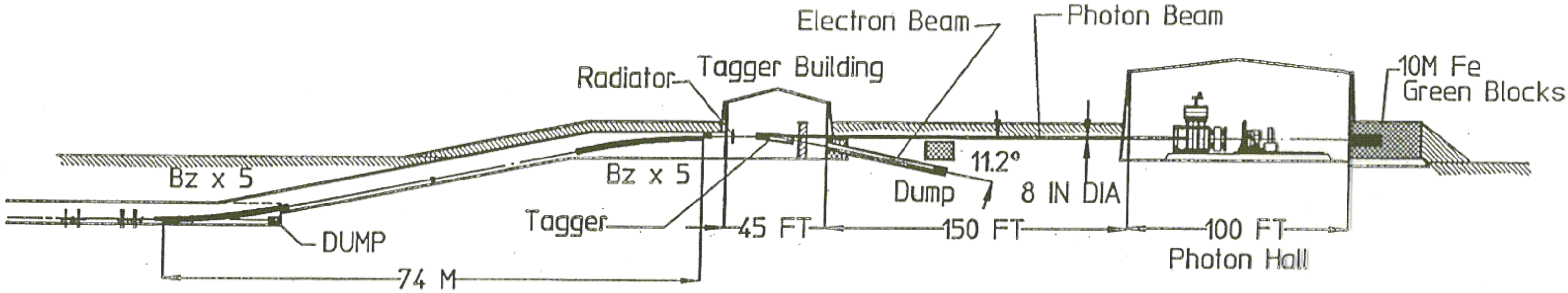


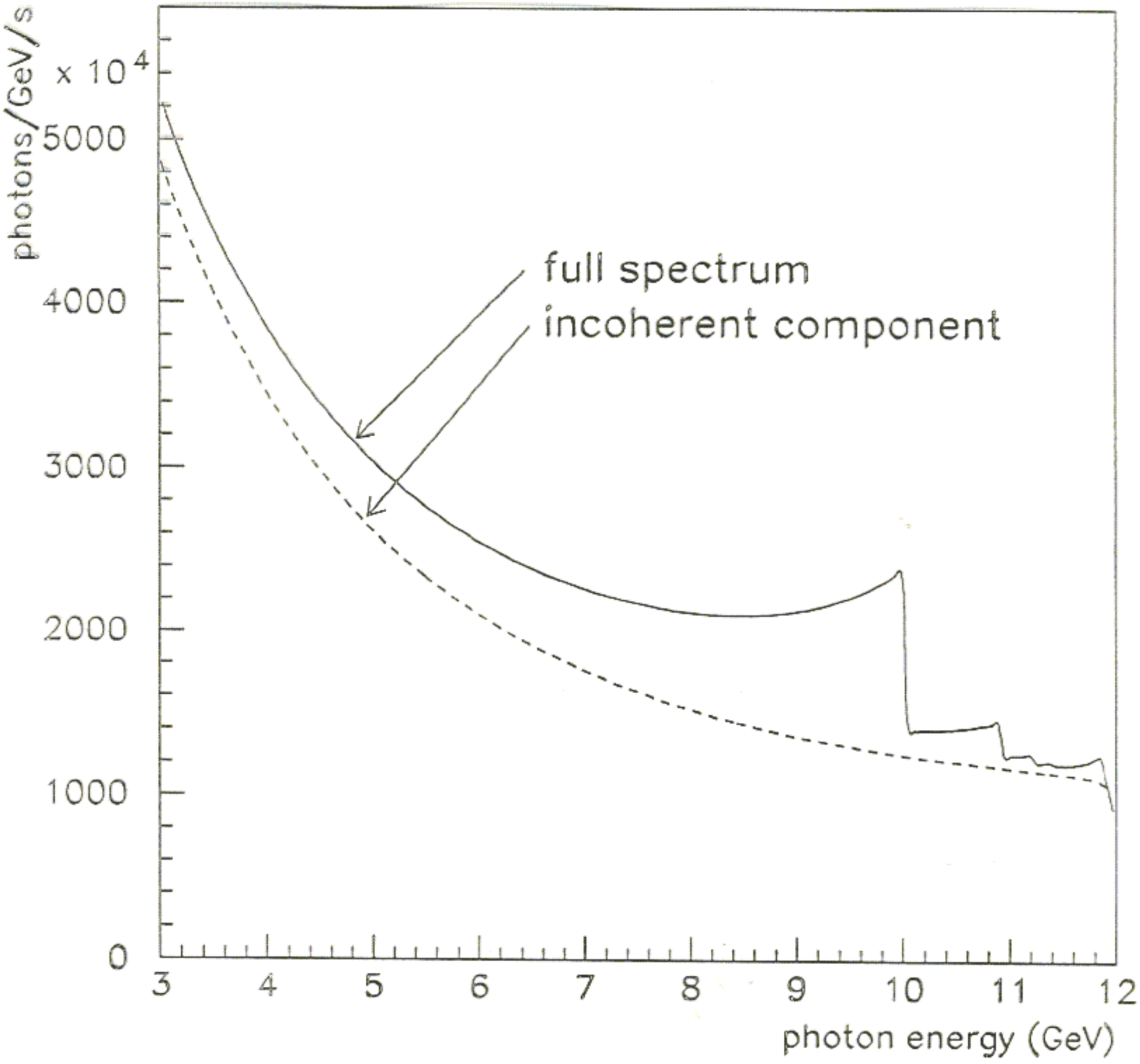
Fig. 3

BEAM ENVELOPE ALONG HALL D BEAM LINE



VERTICAL VIEW OF HALL D BEAM LINE

Fig. 1


photons/GeV/s
x 10 4
5000
4000
3000
2000
1000
0
full spectrum
incoherent component
3
4
5
6
7
8
9
10
11
12
photon energy (GeV)