Proposition pour nouvelle expérience "NA48/3"

But: Recherche d'un mode de desintégation rare de $K^+ \to \pi^+ \nu\nu$

$$BR(K^+ \to \pi^+ \nu\bar{\nu}) = (8.0 \pm 1.1) \times 10^{-11}$$ (latest CKM workshop)

i.e. : $K^+ \to \pi^+$ + rien du tout

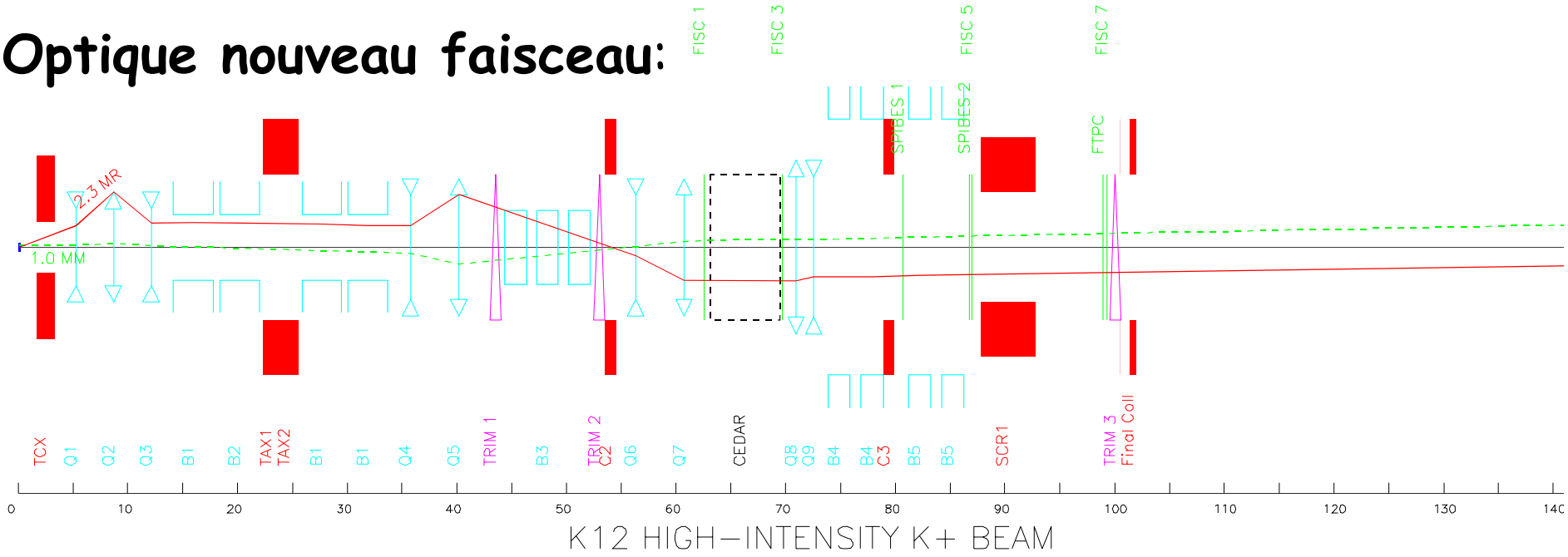
L'expérience devrait collectionner ≈ 100 événements de ce type 2 ans à partir de 4 10^{12} desintégrations de K^+ / année SPS.

Pour arriver à ce but, il faut:

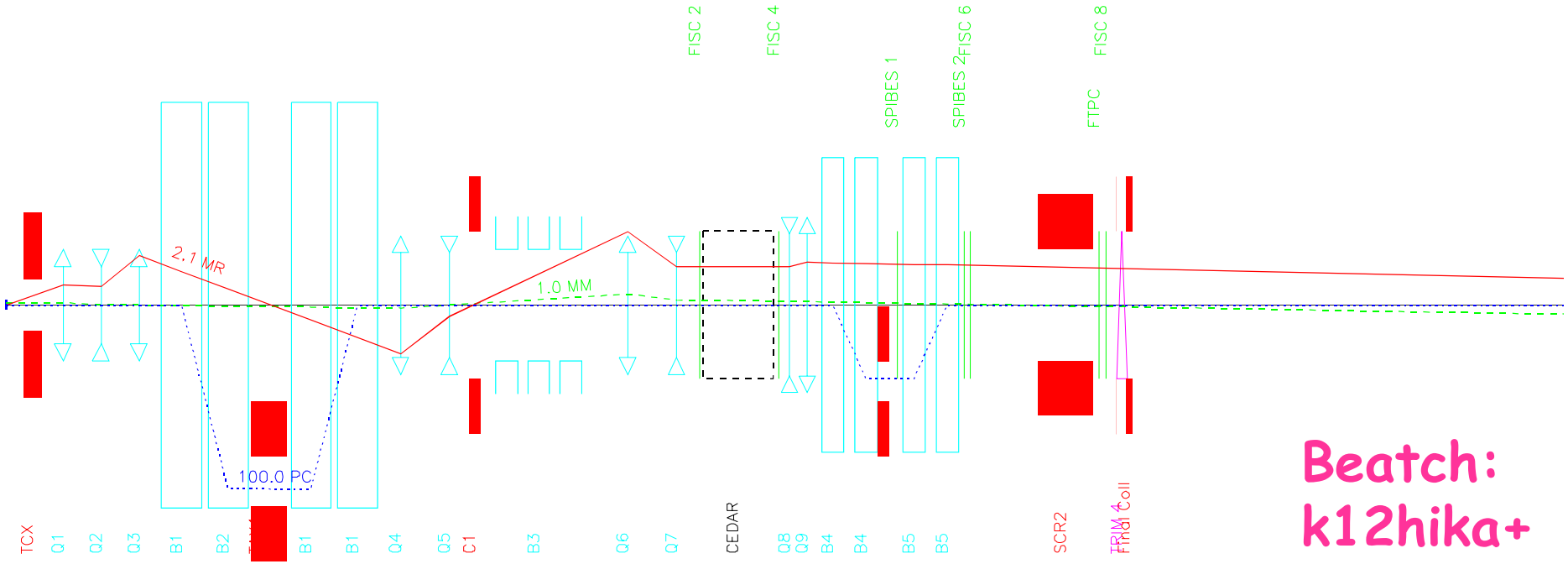
1. Beaucoup de temps de faisceau
2. Une grande acceptance et effacité de l'expérience
3. Un excellent "VETO" pour assurer le "rien"

Nouveau faisceau, nouvelle expérience
(gardant le LKr, mais pas beaucoup du reste)

Optique nouveau faisceau:



K12 HIGH−INTENSITY K+ BEAM

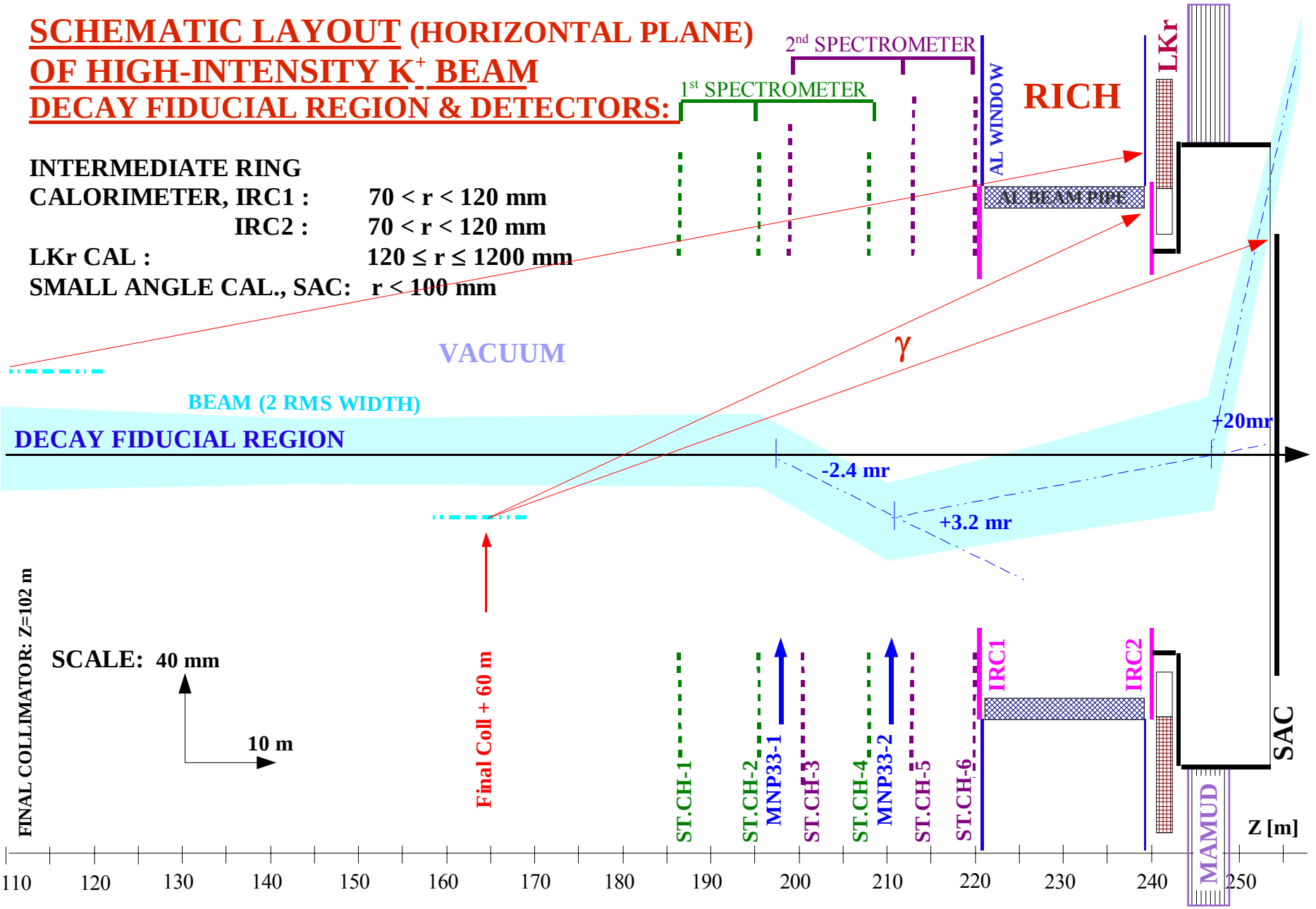


Beatch: k12hika+

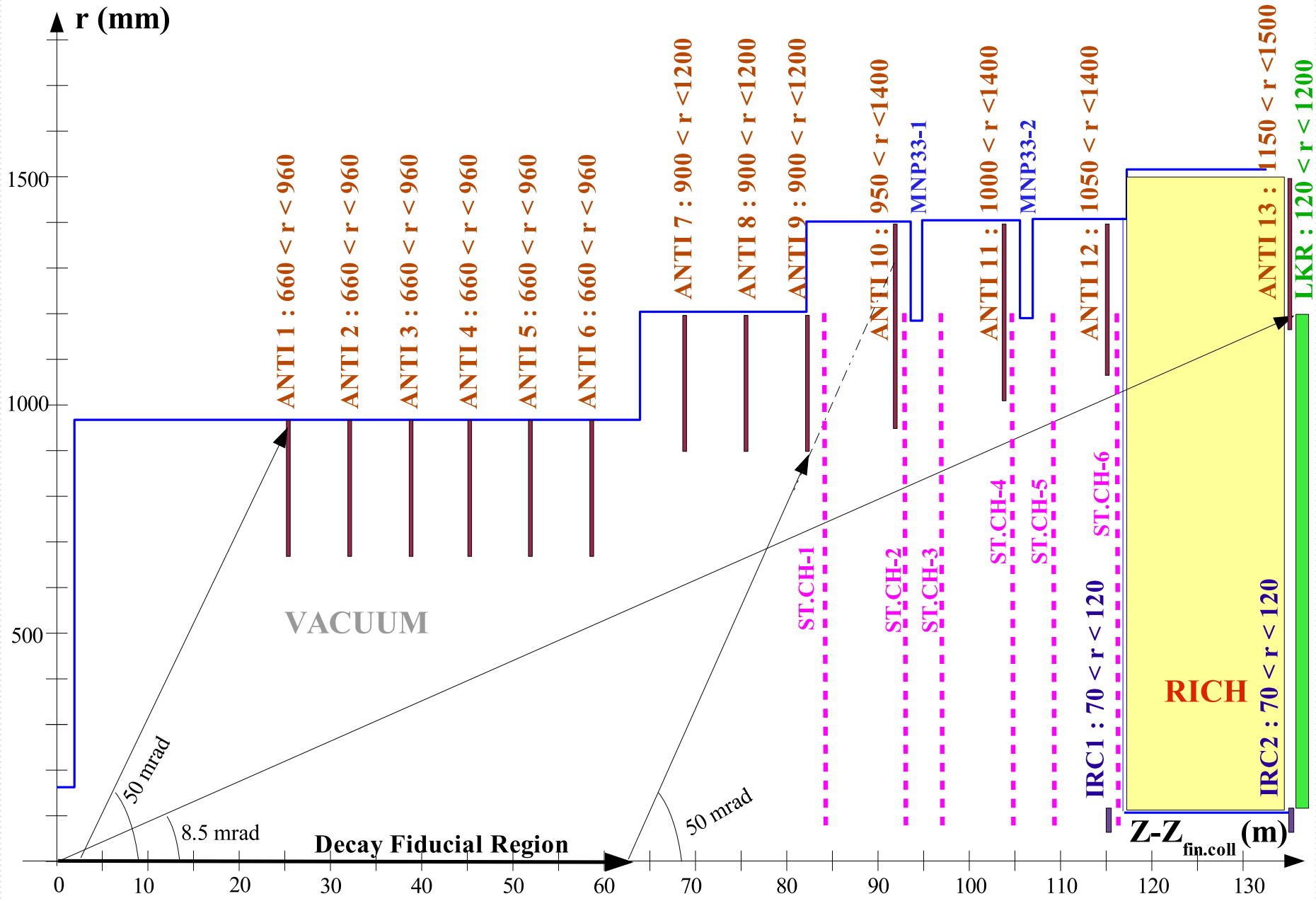
SCHEMATIC LAYOUT (HORIZONTAL PLANE) OF HIGH-INTENSITY K^+ BEAM

DECAY FIDUCIAL REGION & DETECTORS:

INTERMEDIATE RING
CALORIMETER, IRC1 : 70 < r < 120 mm
IRC2 : 70 < r < 120 mm
LKr CAL : 120 ≤ r ≤ 1200 mm
SMALL ANGLE CAL., SAC: r < 100 mm



Compteurs Veto:



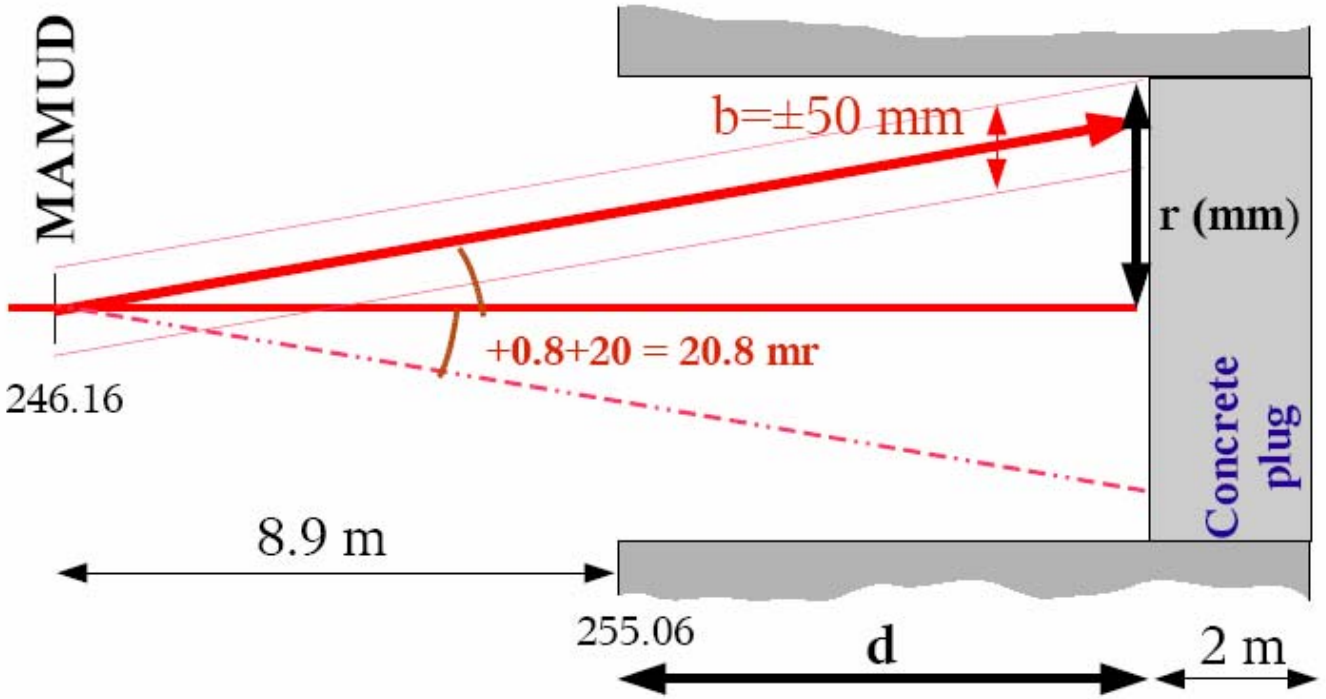
Beam parameters

Beam:	*Present K12 (NA48/2)*	*New HI K+*	*Factor gain wrt 2004* [5)]
SPS protons per pulse	1×10^{12}	3×10^{12}	3
Duty cycle (s./s.)	4.8 / 16.8	→	1
Beam acceptance (H, V (mrad)	± 0.36	± 2.3, ± 2.1	
Solid angle (μsterad)	≈ 0.40	≈ 16	40
Av. K^+ momentum $<p_K>$ (GeV/c)	60	75	K^+: 1.50 π^+ : 1.35 Total : 1.35
Momentum band Δp_K (GeV/c) **Eff.: (Δp/p in %)** **RMS: (Δp/p in %)**	57 – 63 = 6 ± 5 ≈ 4	73.5– 76.5=3.0 ± 2.0 ≈ 1.0	≈ 0. 5 ≈ 0.4 ≈ 0.25
Beam size (cm) **Area at SPIBES (cm^2)**	r = 1.5 ≈ 7.0	± 1.6, ± 2.2 ≈14	 ≈ 2
Divergence: RMS (mrad)	≈ 0.05	≈ 0.10	≈ 2

Beam parameters (2)

Beam:	*Present K12 (NA48/2)*	*New HI K+*	*Factor gain wrt 2004* [5)]
Decay fid. Length (m)	50	60	
(τ_K^+)	0.111	0.107	0.96
Beam flux/pulse: p (x 10^7)	0.86	49	
K^+	**0.31**	15	50 (≈30)
π^+	3.32	150	45 (≈27)
e^+	0.95	35	
Total per pulse (x 10^7)	5.5	**250**	≈45 (≈27)
per Effective spill length (/s)	1.8	80	≈45 (≈27)
MEAN/cm^2 (SPIBES) / s	0.25	≈6 (max 15)	≈25 (≈15)
Eff. Running time / year (days)	120	100	
Overall efficiency	0.5	0.6	
Effective number of pulses	3 * 10^5	3 * 10^5	1.0
K^+ decays per year	**1.0 10^{11}**	**4.8 10^{12}**	**≈ 48**
in fiducial length			

Plus grand trou dans le mur du fond…



d = 8 m

r = 40 cm

Evaluation en cours par Allain Gonidec

G.Collazuol, FLUKA + Toy MC

Vacuum requirements

Pressure needed:

1) nucl. density $n_{[nucl./cm3]} = 5\ 10^{19} \times P_{[mbar]}$ (for O_2 at T=300K)

2) hadr. fluxes/pulse x pulses/year : ϕ = 150 10^7 x 3 10^5 π
50 10^7 x 3 10^5 p
15 10^7 x 3 10^5 K

It is found:

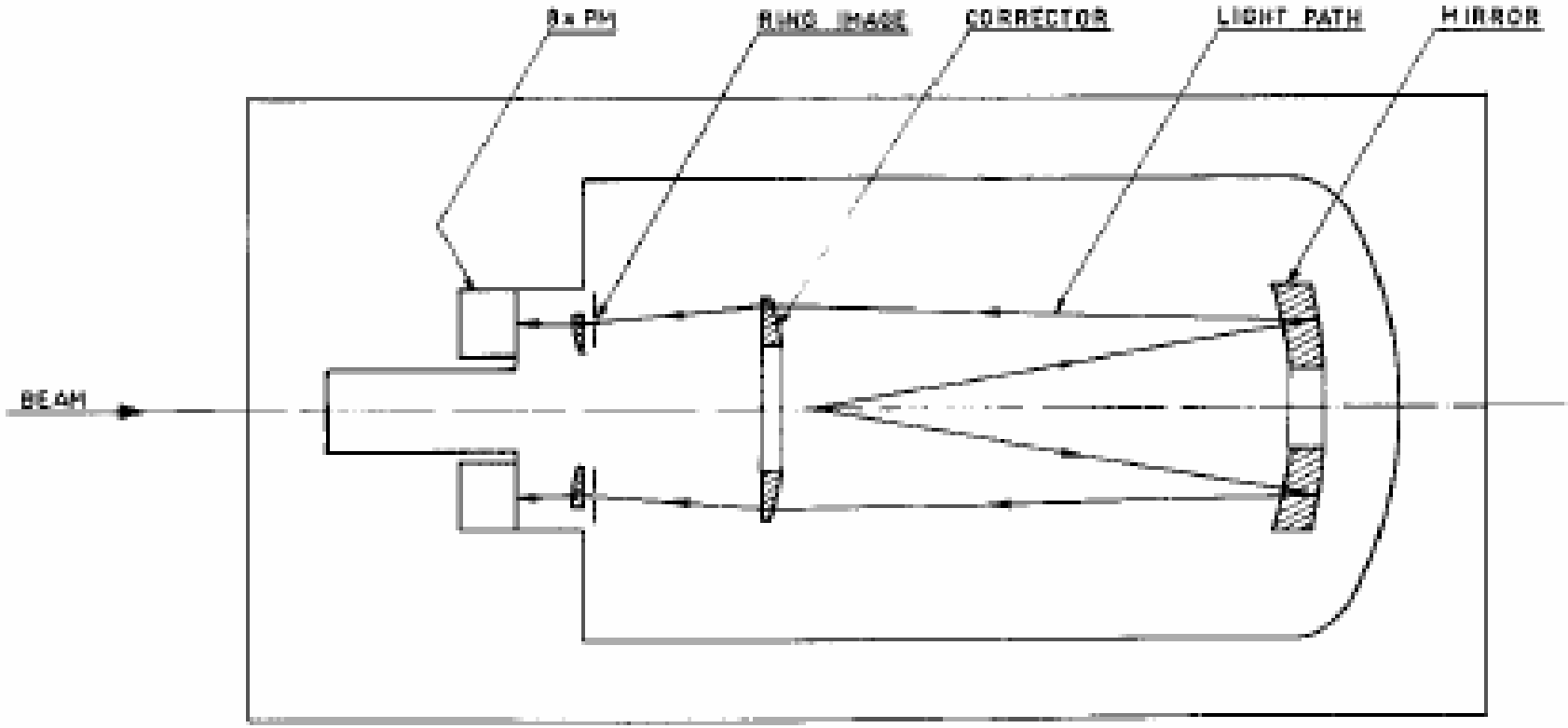
fake signal/year = $n \times \sigma \times L_{[fid\ vol]} \times \phi \times Prob_{fake} = 1.6 \times 10^7\ P_{[mbar]}$

ie with a pressure of P ~ 0.6×10^{-7} mbar
~ 1 fake signal /year is (rougthly) expected

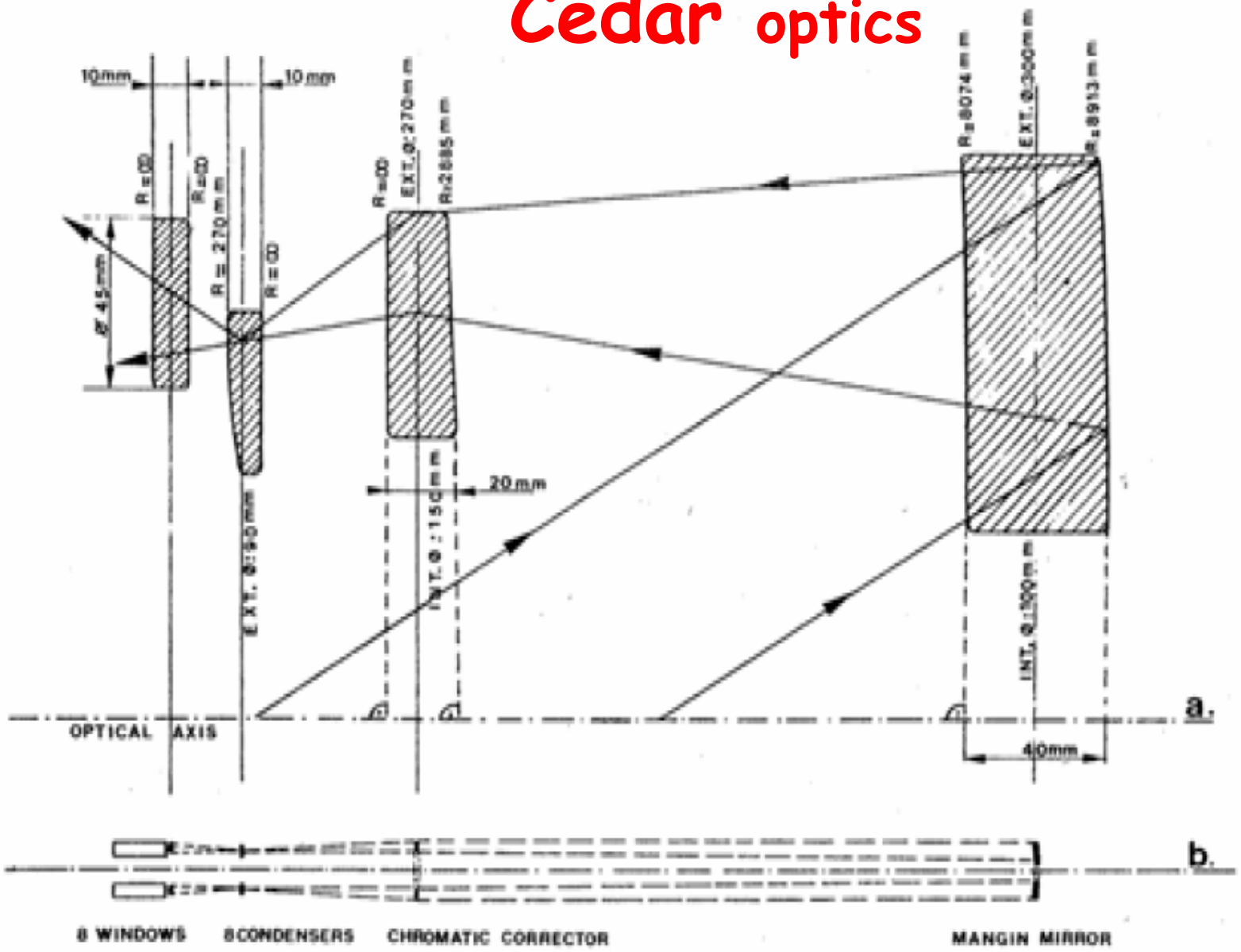
Without Cedar,
$\approx 10^{-6}$ with Cedar

Suggestion: design vacuum for 3 10^{-7} mbar

CEDAR Schematic view



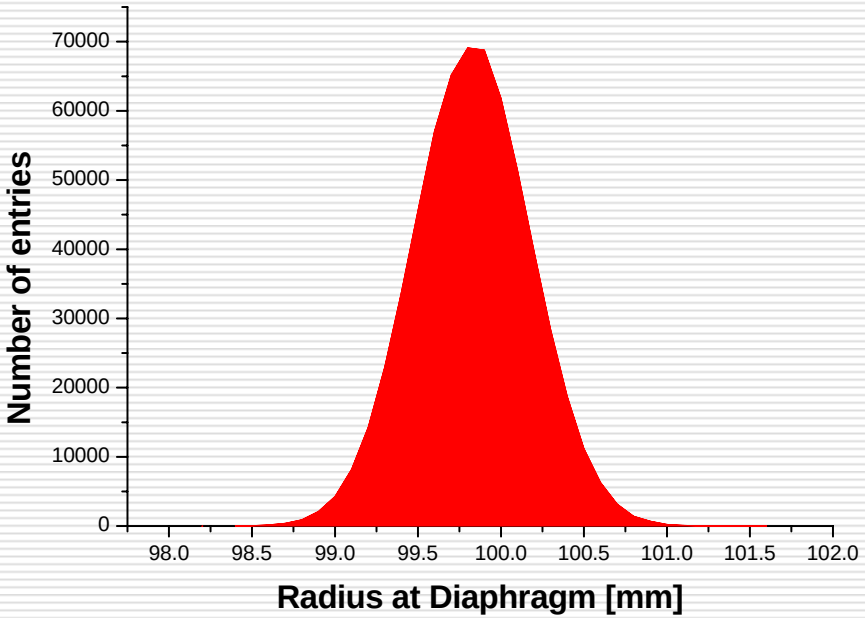
Cedar optics



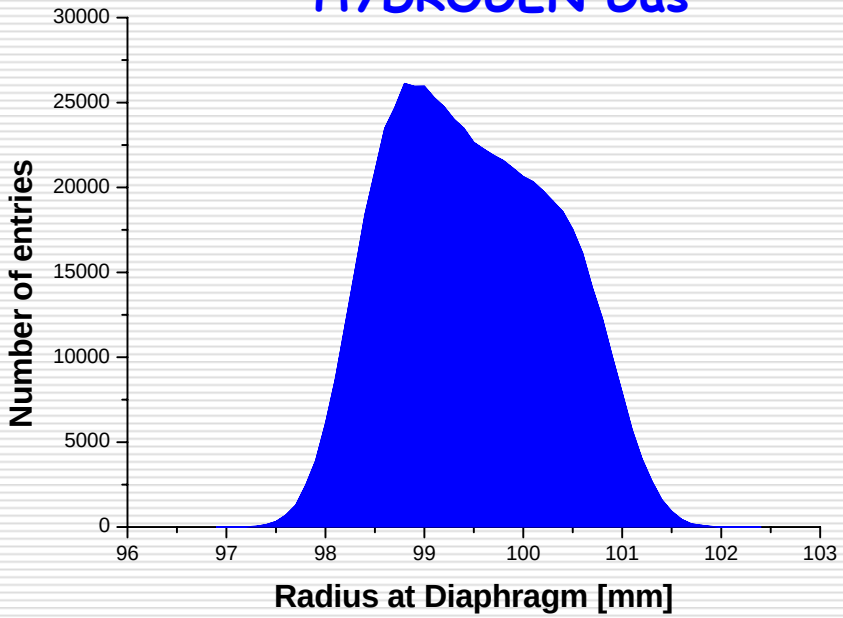
Cedar-North

Moins de matière, 3 bar (pas 11) !

HELIUM Gas



HYDROGEN Gas



Mean=100.0 mm
RMS = 0.15 mm

Monochromatic pencil beam
75 GeV/c, $\Delta p/p=0, \sigma_x=0, \sigma_{x'}=0$

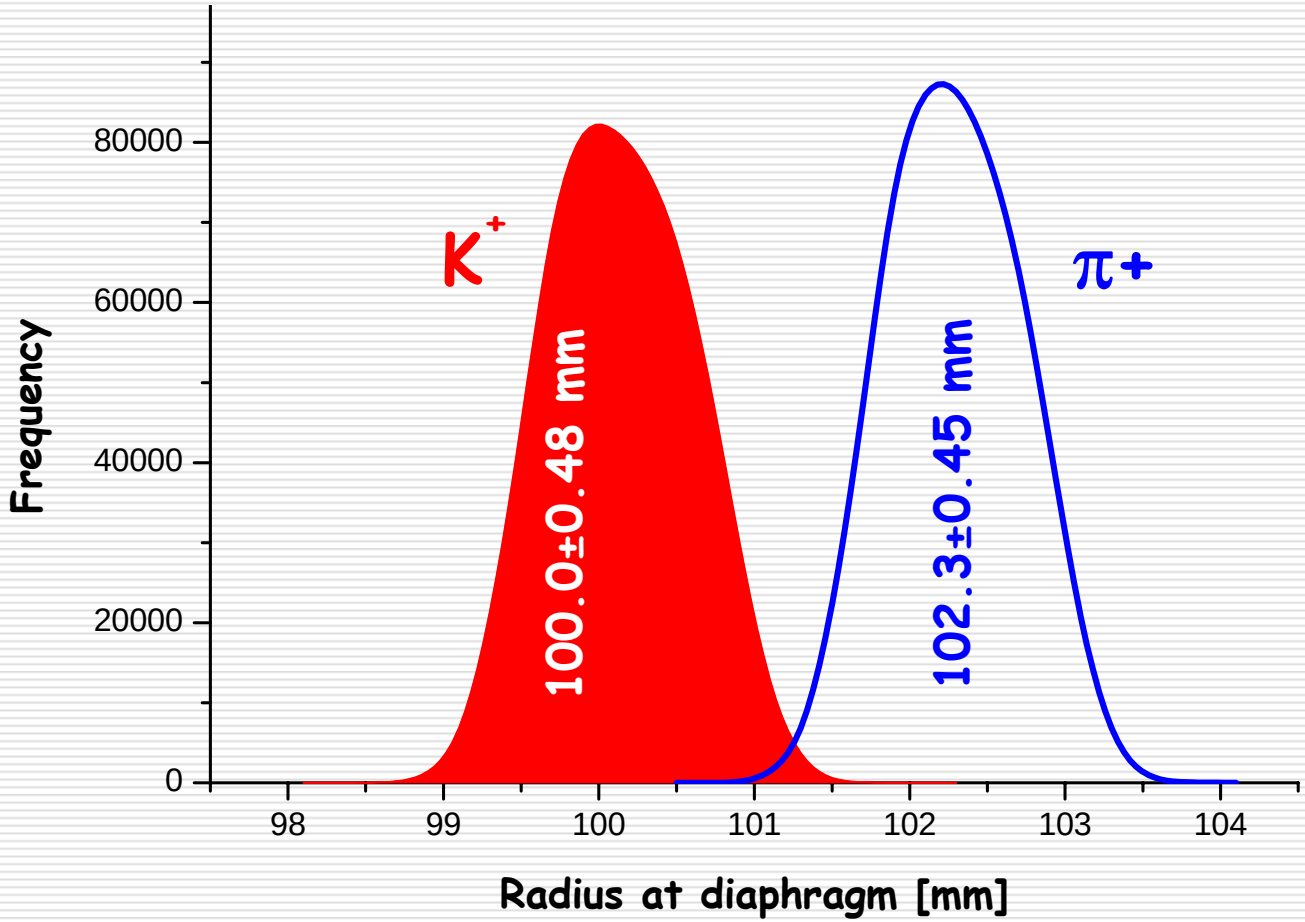
Mean=100.0 mm
RMS = 0.78 mm

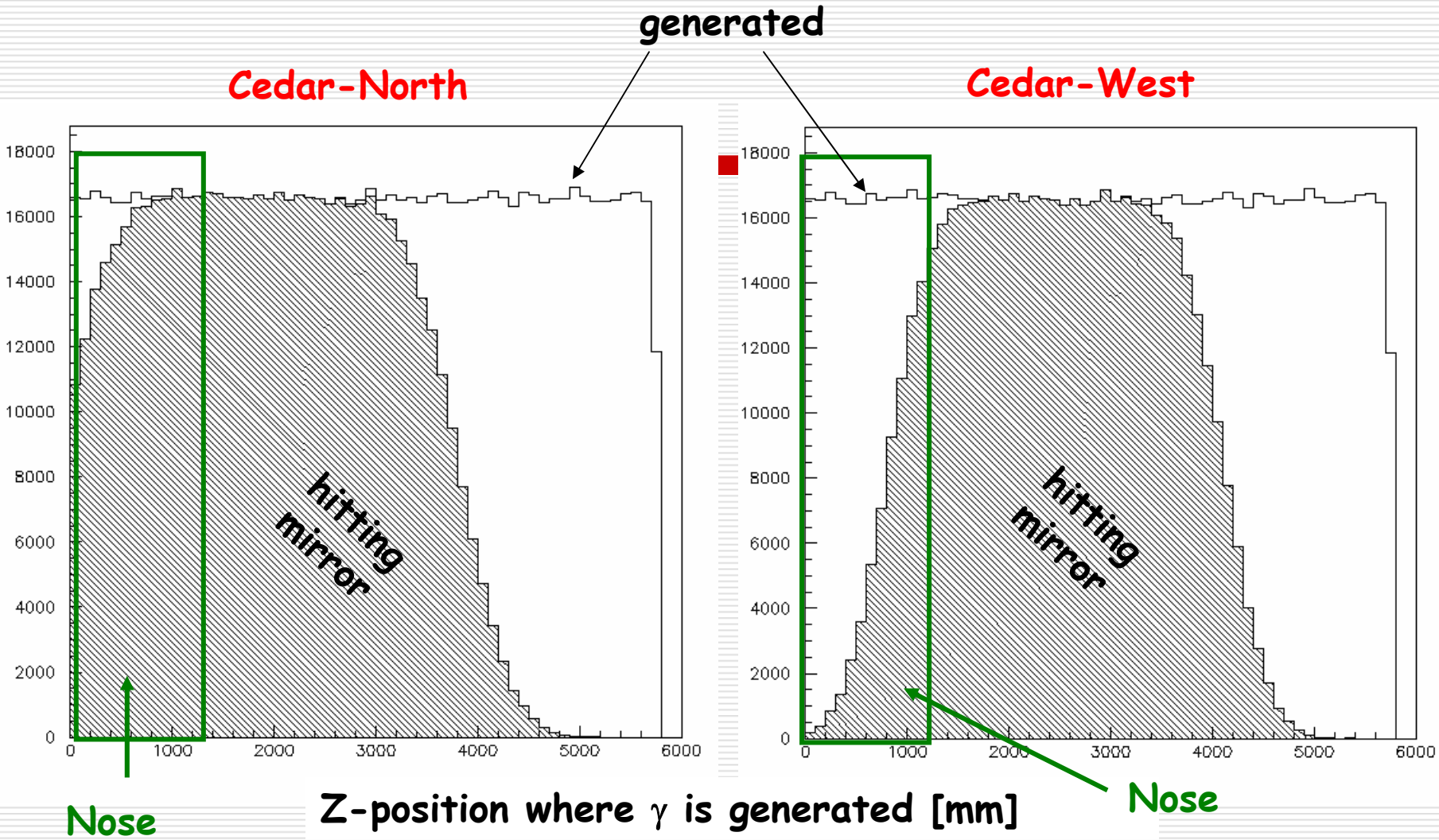
Mean = 99.9 mm
RMS = 0.36 mm

Realistic beam (plotted), 75 GeV/c,
$\Delta p/p=1\%, \sigma_X=1$ cm, $s_{X'}= 80$ μrad

Mean = 99.5 mm
RMS = 0.84 mm

Cedar-West (H_2 filled)

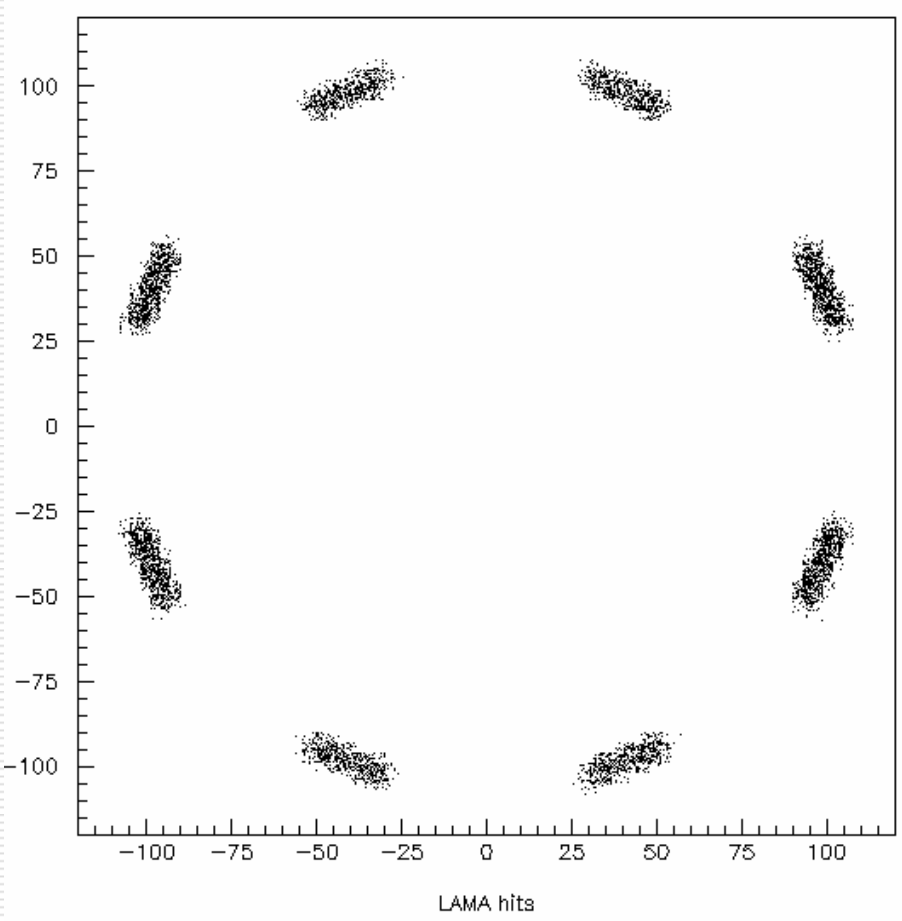


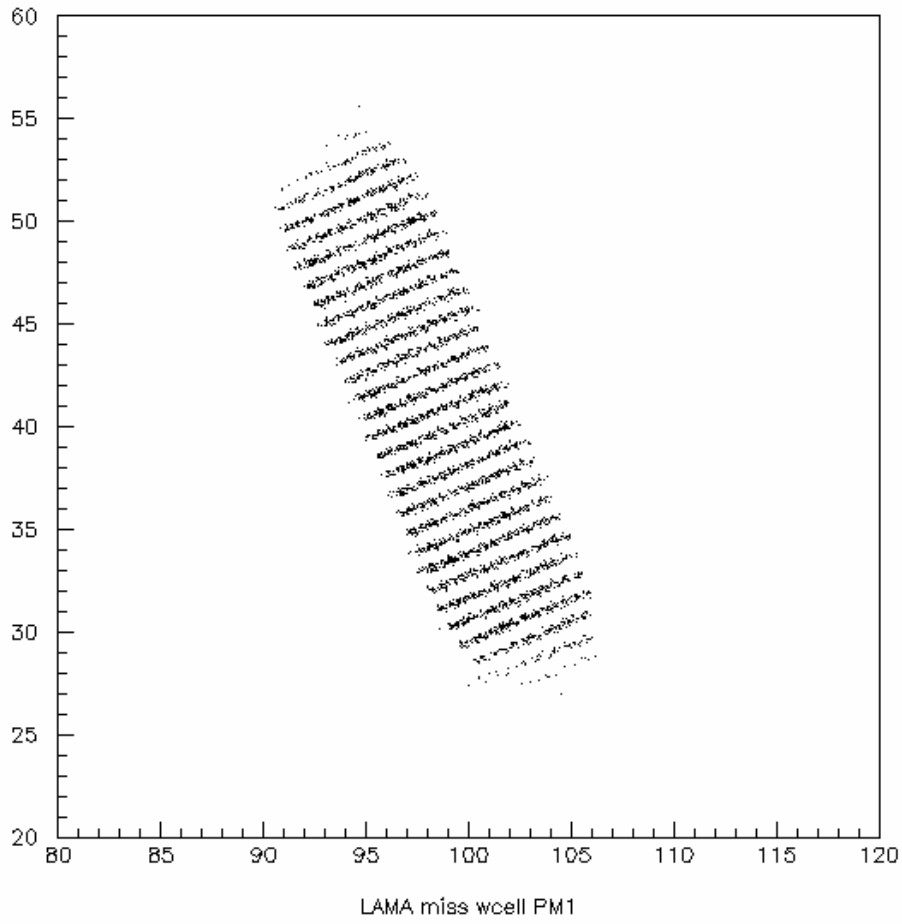


'Nose' not so useful for Cedar-West

(Efficiency curve almost identical with and without nose)

Cedar-West, Hydrogen filled





Position of photons hitting LAMA cells

Zoom onto unit #1

A.Placci:

HAMAMATSU

LINEAR ARRAY MULTIANODE PMT AND ASSEMBLY
R5900U-L16 SERIES, H7260 SERIES

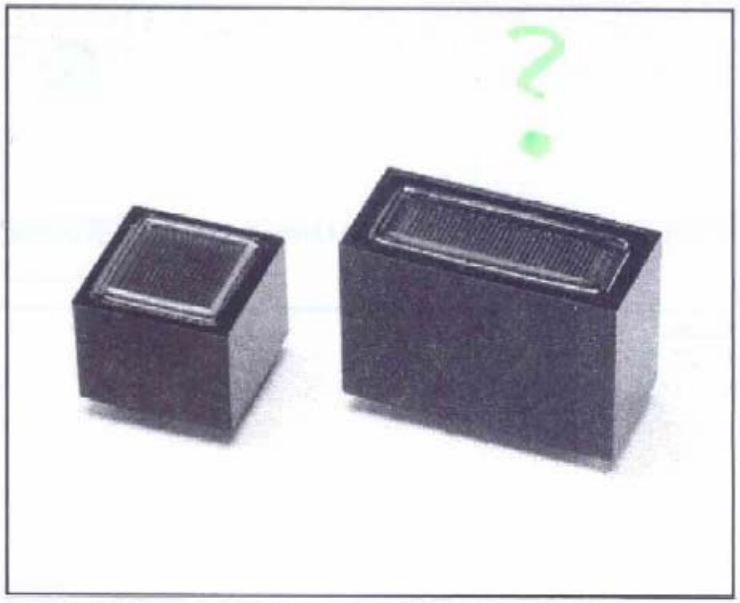
Multianode 16 Channel Linear Array (R5900U-L16: PMT)
Multianode 32 Channel Linear Array (H7260: PMT ASSEMBLY)

FEATURES

- High Cathode Sensitivity
  - Luminous 250 μA/lm Typ. (-01 Type)
  - Luminous 500 μA/lm Typ. (-20 Type)
- Anode Structure
  - 1 mm Channel Pitch
  - R5900U-L16 Series..... 0.8 mm × 16 Anodes
  - H7260 Series..... 0.8 mm × 32 Anodes
- High Speed Response: Rise Time 0.6 ns Typ.

APPLICATIONS

- Biomedical Fluorescence Detection
- Laser Scanning Detection
- Spectroscopy
- Environmental Monitoring



LEFT: R5900U-L16 SERIES RIGHT: H7260 SERIES

Anode, Cathode current: **Lab tests of several photon detectors planned**

Cost of Beam line itself

Item		Cost (kCHF)	Comments
TAX	2 Copper blocks	75	Inc. machining 6.3k
	6 Iron blocks	70	Inc. machining 19 k
	Tungsten inserts	18.5	
	Various small items (grids, switches,..)	15	
XCSV&H	Pole faces (W)	13	
MBPLV	Support structures VP + chandelles	12	FSU study+fabr 120h Modify 'capots' 40h
TCX	Steel inserts 3500 kg	45	Incl mounting 40h
MBPL	Steel inserts	46	Incl mounting 80h
Power	Cabling, cooling, connections	36	AT/MEL
	Installation extra rectifiers beam line	2	AB/PO
Beam instrumentation		20	
Vacuum	Cabling + 2 anti-deflagration pumps	45	Incl mounting 130h
Detector integration (supports, special vacuum, etc)		15	
Various	Incl cleaning, safety,..	10	
Manpower (design, installation, etc)		2 FTE	Over many groups
Total	**approximately**	**425**	**Plus 2 FTE**

Cost Cedar modifications

Item		Cost (kCHF)	Comments
Mechanics	Mechanical design nose, windows, etc	24	3 man months
	Construction 1 module + 1 spare	100	
	Vacuum work, special windows	10	
	Hydrogen supply and venting infrastr	50	
	Mounting	16	2 man months
Gas	H2-rated pump	6.5	
	Pressure gauge	20	
Photon detectors + HV supplies		80	
Electronics and cabling		100	*At least*
Standard BDI installation		40	
Total	**approximately**	**450**	**Incl 5 man months**

Preliminary !

Demandes temps faisceau pour 2006

Plusieurs idées ont été lancées :

- Tests Gigatracker pour étudier halo, senseurs différents, …
- MAMUD 'imité' par MBPL? A enlever MUV&HAC??
- CEDAR: tests avec Cedar-W & N2 gaz, nouveaux detectors γ ?
- Etude interactions faisceau avec gaz résiduel dans tank à vide
- Prototype Straw tubes – probablement trop tot
- Tests du calorimètre Krypton Liquide comme veto