THE STATUS OF DAΦNE

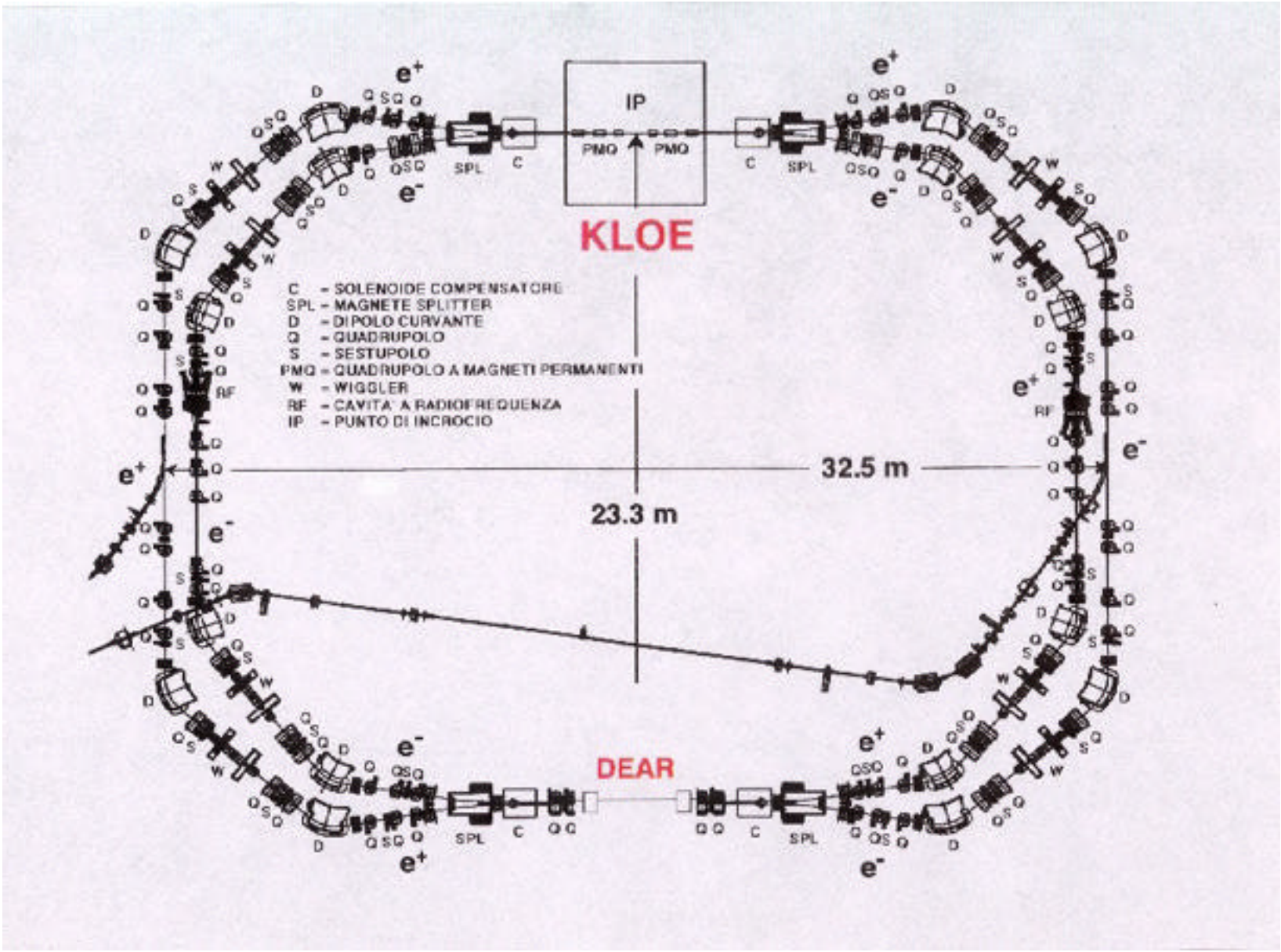
C. Biscari

DAΦNE Team

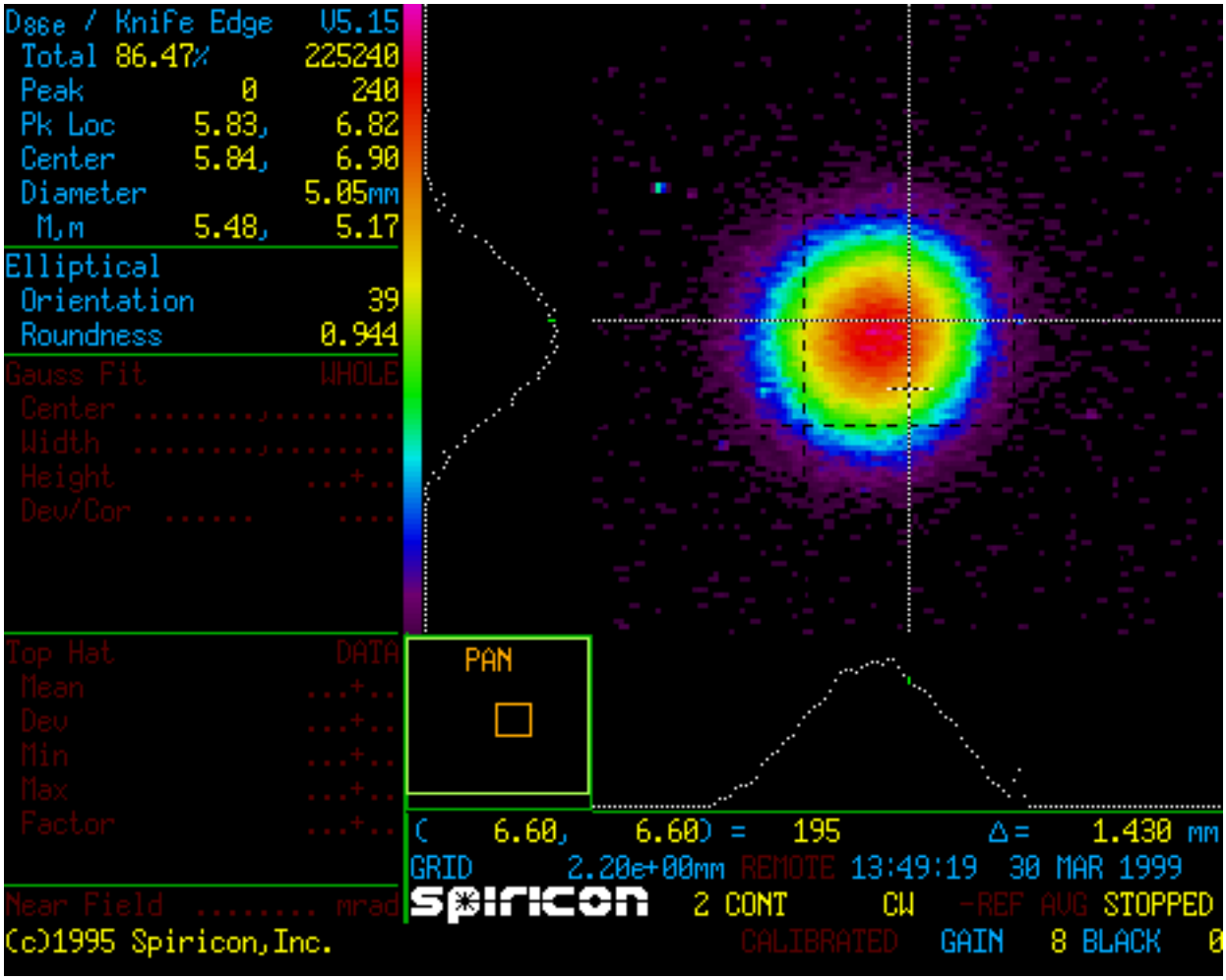
D. Alesini
A. Argan
C. Biscari
R. Boni
M. Boscolo
A. Clozza
G. Delle Monache
G. Di Pirro
A. Drago
A. Gallo
A. Ghigo
S. Guiducci
F. Marcellini
G. Mazzitelli
C. Milardi
L. Pellegrino
M.A. Preger
R. Ricci
C. Sanelli
F. Sannibale
M. Serio
F. Sgamma
A. Stecchi
A. Stella
C. Vaccarezza
M. Vescovi
G. Vignola
M. Zobov

TALK OUTLINE

- Single ring
- Single bunch luminosity
- Operation for KLOE


IP
PMQ
PMQ
KLOE
C - SOLENOIDE COMPENSATORE
SPL - MAGNETE SPLITTER
D - DIPOLO CURVANTE
Q - QUADRUPOLO
S - SESTUPOLO
PMQ - QUADRUPOLO A MAGNETI PERMANENTI
W - WIGGLER
RF - CAVITA' A RADIOFREQUENZA
IP - PUNTO DI INCROCIO
32.5 m
23.3 m
DEAR
e+
e-
SPL
C
RF

FIRST POSITRON BEAM WITH KLOE



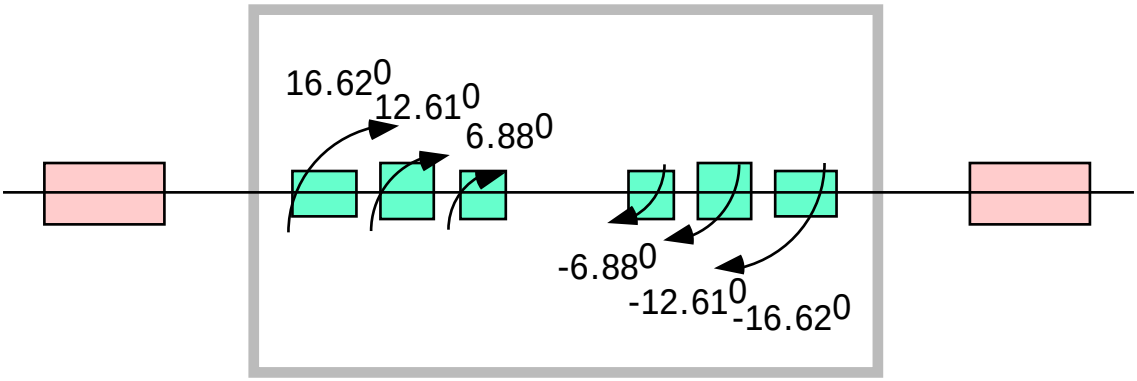
KLOE Compensation

$$B_0 = .6 \ \ T$$

$$\int Bds = 2.4 \ \ Tm$$

$$B\rho = 1.7 \ \ Tm \qquad E = 510 \ \ MeV$$

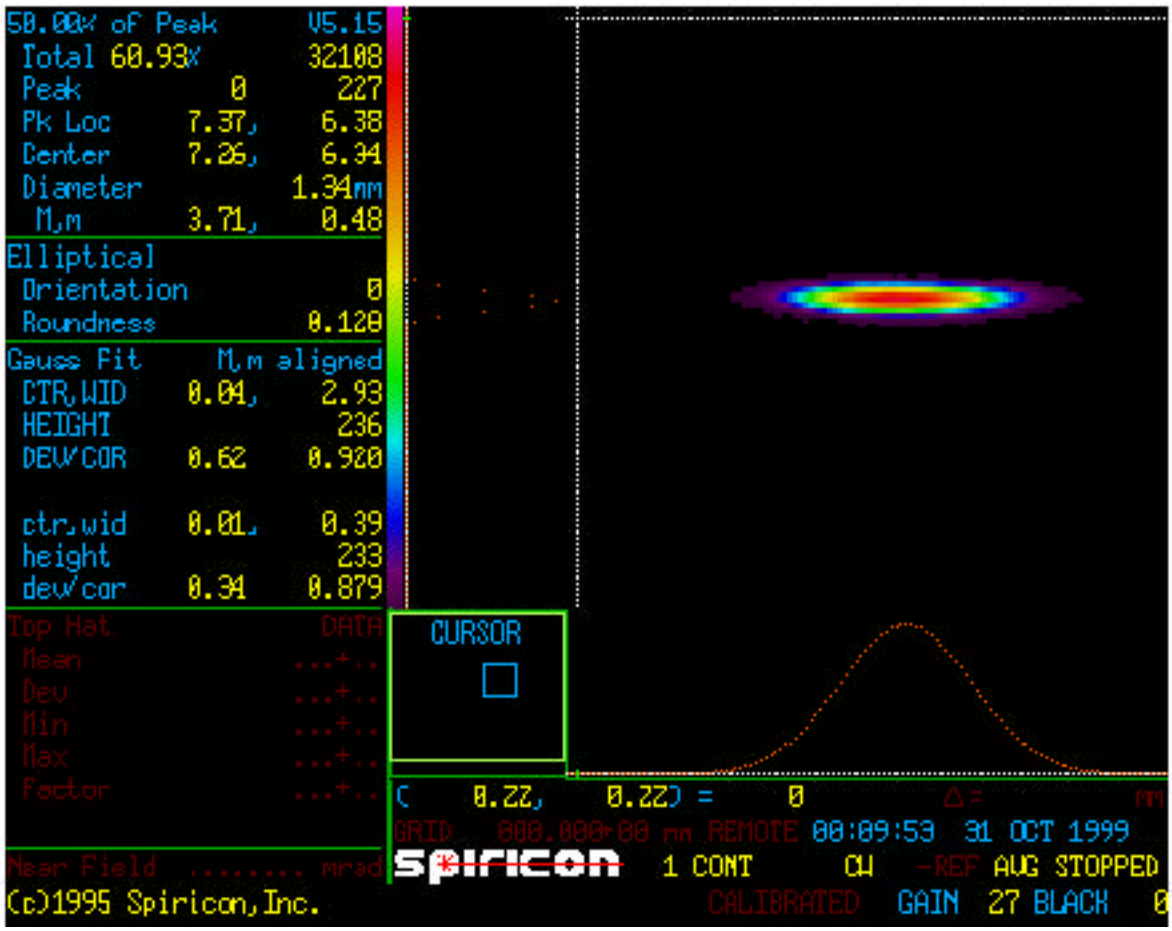
$$\frac{1}{2}\frac{\int Bds}{B\rho} = 40^0$$



Longitudinal Field neutralized by Compensating Solenoids

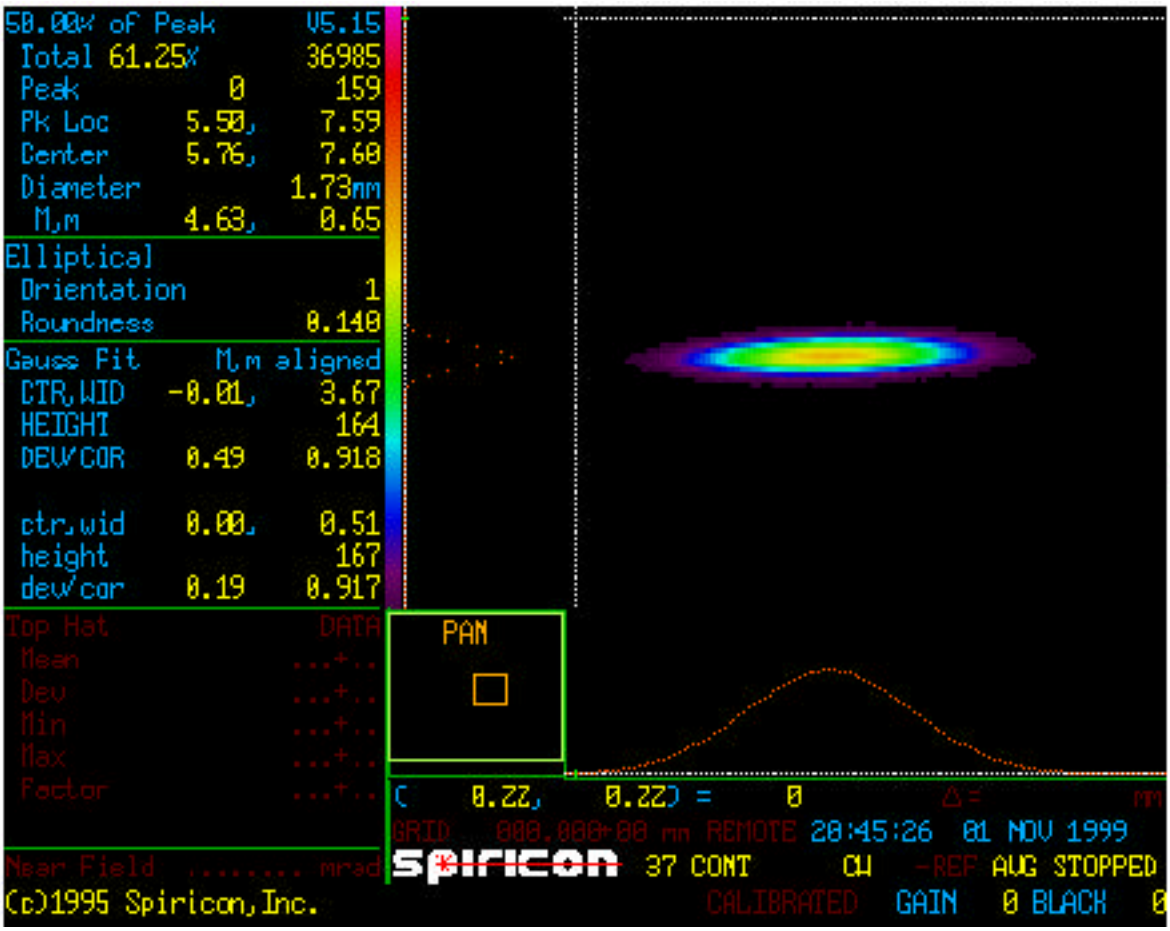
Low-Beta Permanent Quadrupoles are rotated for coupling correction

Correction of coupling with KLOE



e^+

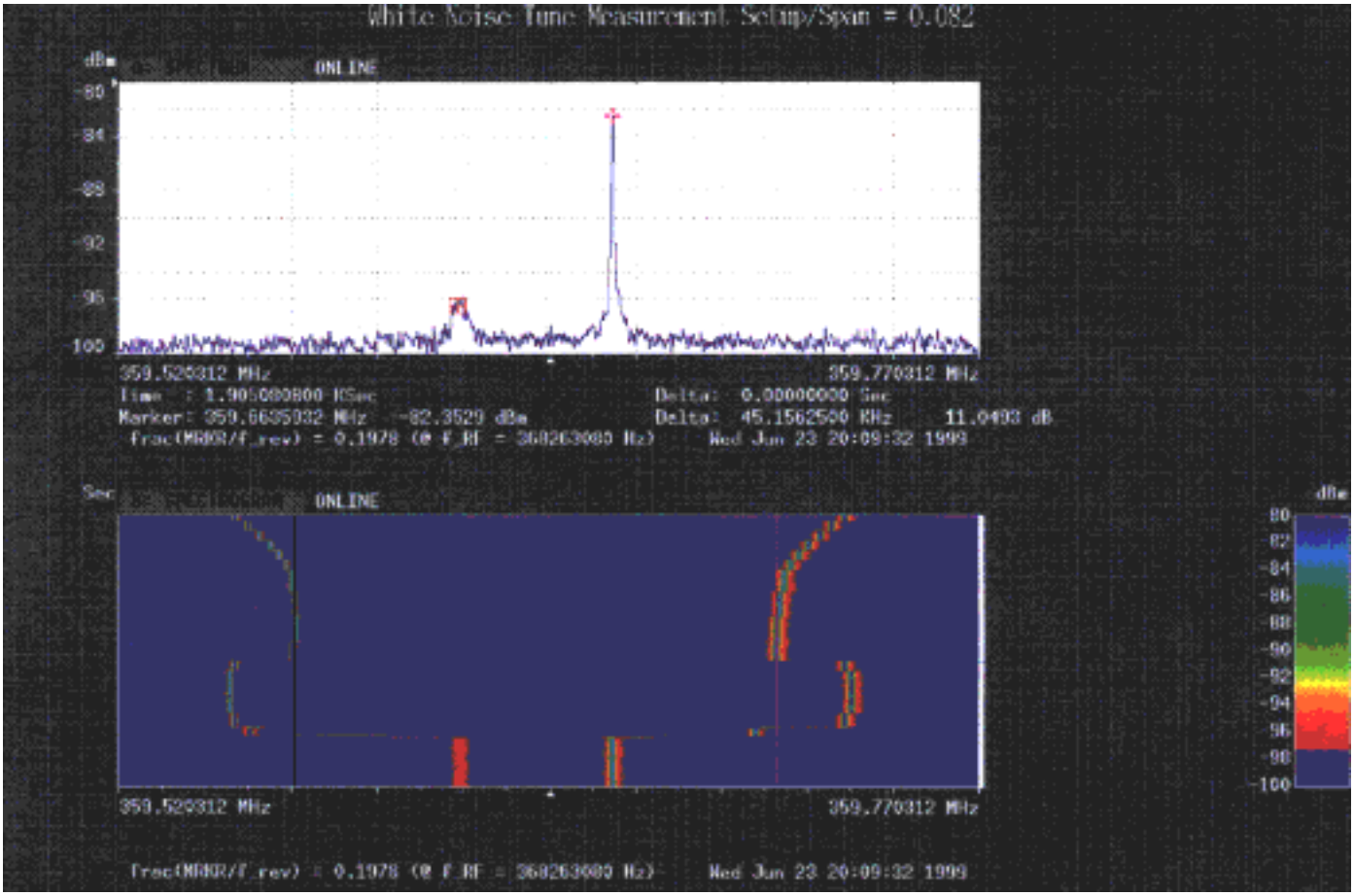
$\kappa = 0.80\%$



e^-

$\kappa = 0.98\%$

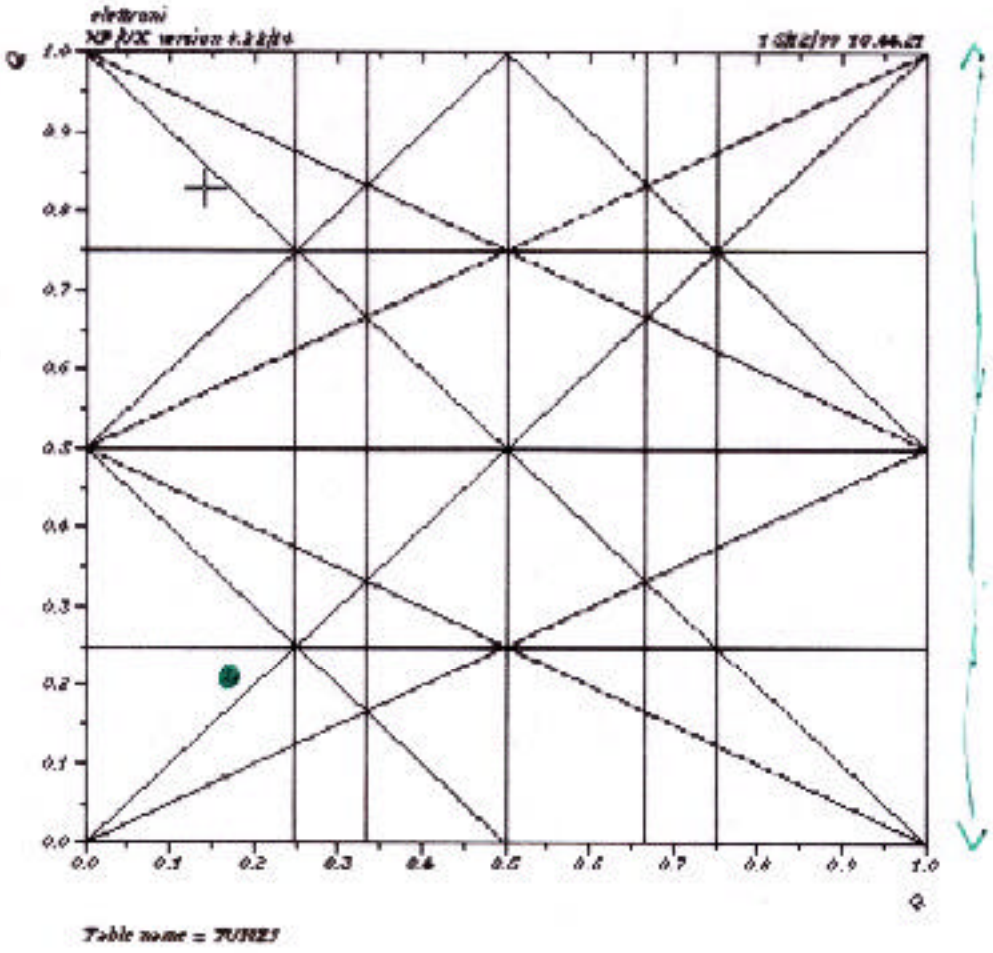
Correction of coupling - Closest tune approach ~ 0.015



TUNE DIAGRAM

$Q_x = 5.17$

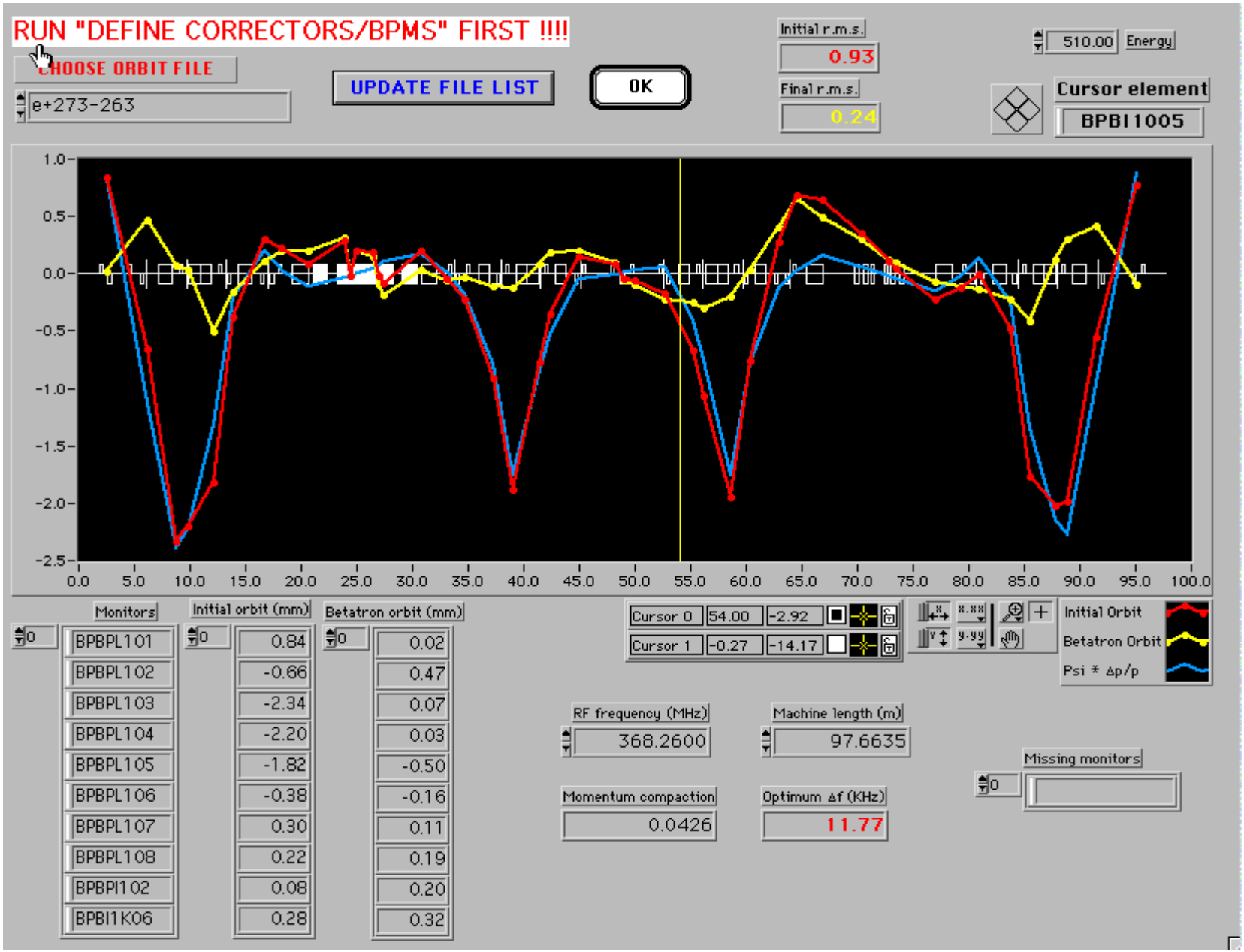
$Q_y = 5.21$



← ONE INTEGER →

= 20% of TOTAL PHASE ADVANCE

DISPERSION FUNCTION (e^+ Ring): MODEL AND MEASUREMENT



SINGLE RING

- **coupling compensation**

  Better than nominal 1% for both rings
  KLOE and low-beta quadrupole alignment inside tolerances

- **machine modelling**

  Good knowledge of both rings characteristics

- **high current**

  820 mA in positron and 700 in electron ring

- **vacuum**

  Total Ah in both rings (170 e^-, 120 e^+)

- **good reproducibility**

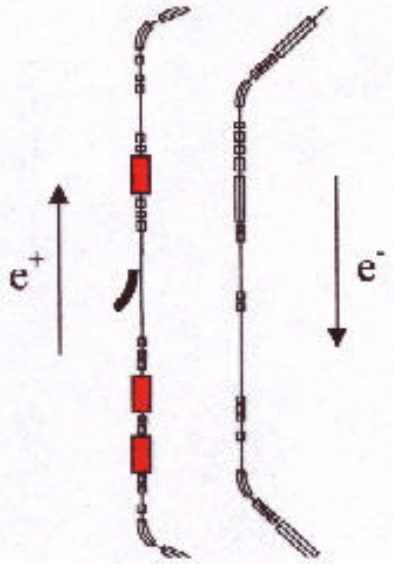
  Easy tools for "golden orbit" reproducibility and tune adjustments (machine operators)
  ~ 5 minutes per ring

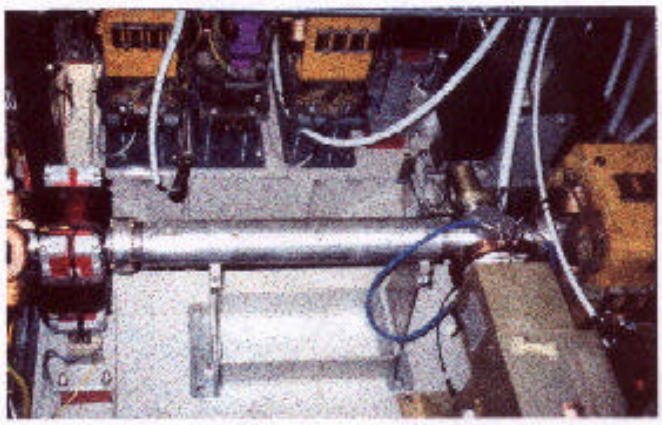
- **quick e^+/e^- switching and injection time**

  Done totally by operators

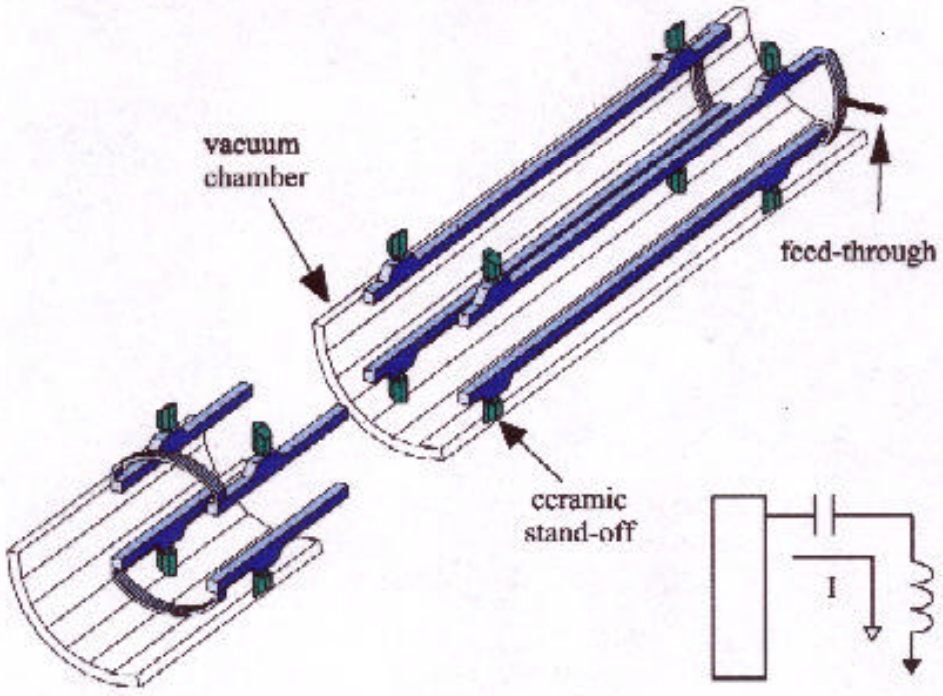
DAΦNE INJECTION KICKERS

• LAYOUT



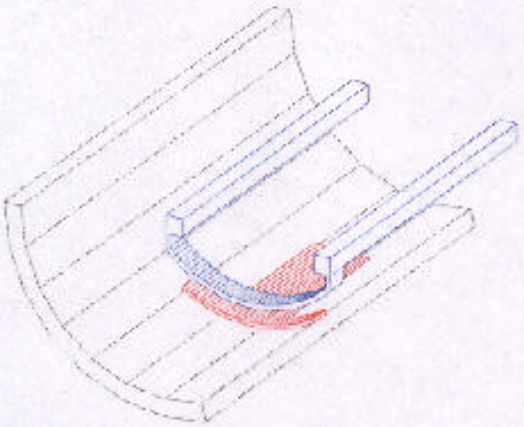


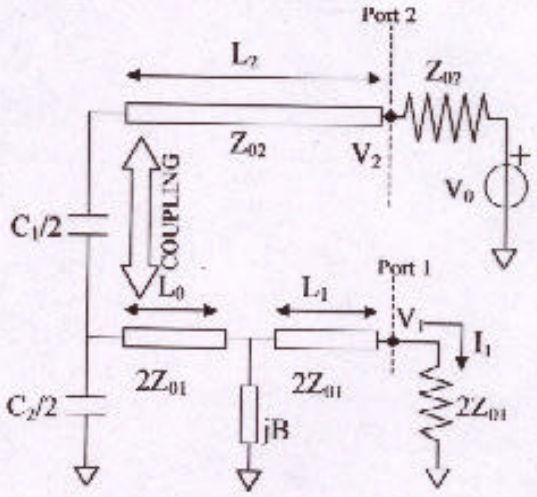
• SCHEMATIC VIEW



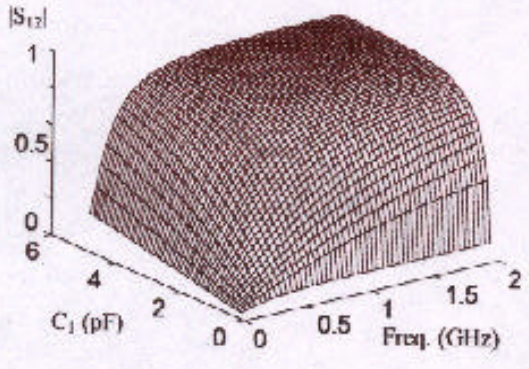
2A) ANTENNA DESIGN

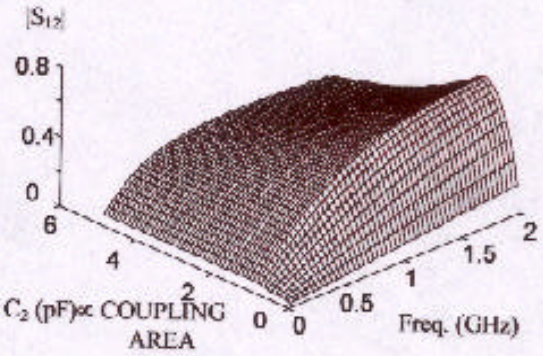
2A.1 TRANSMISSION LINE MODEL



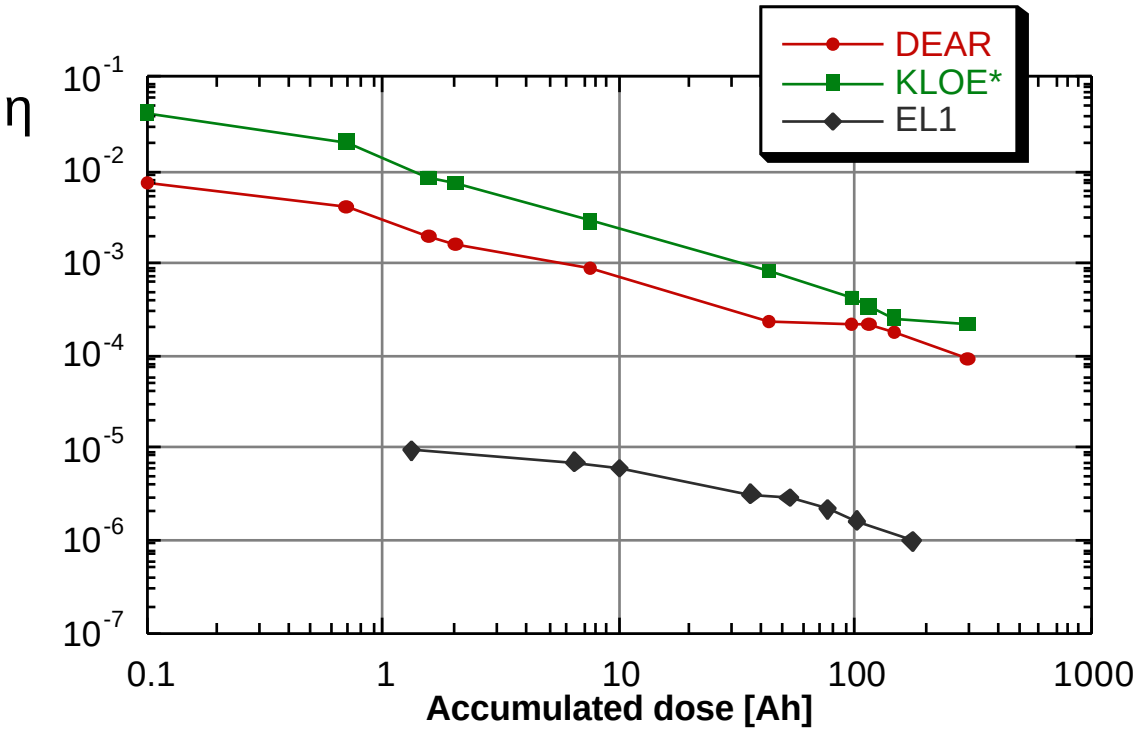


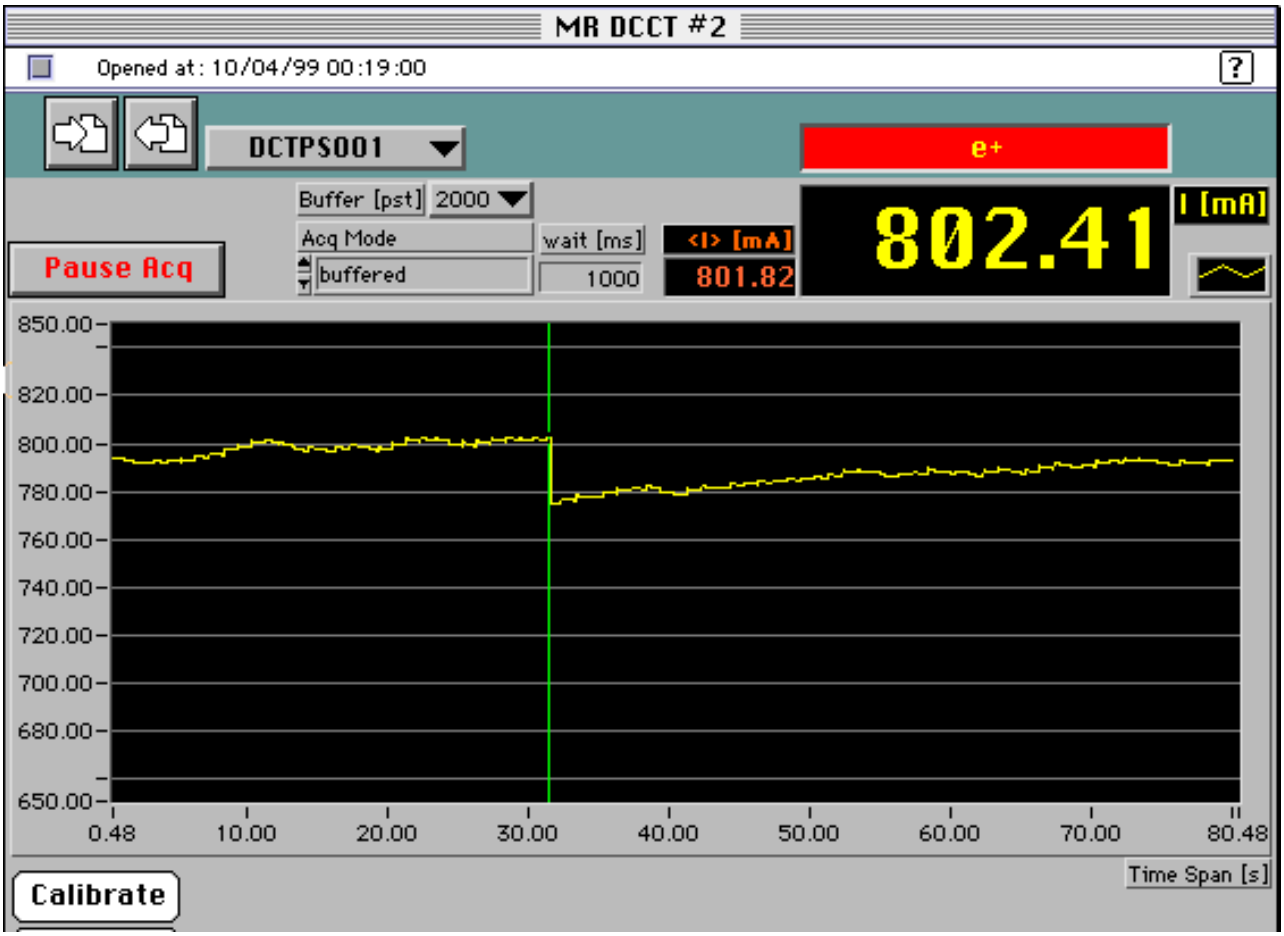
- **COUPLING VERSUS DIMENSIONAL PARAMETERS**

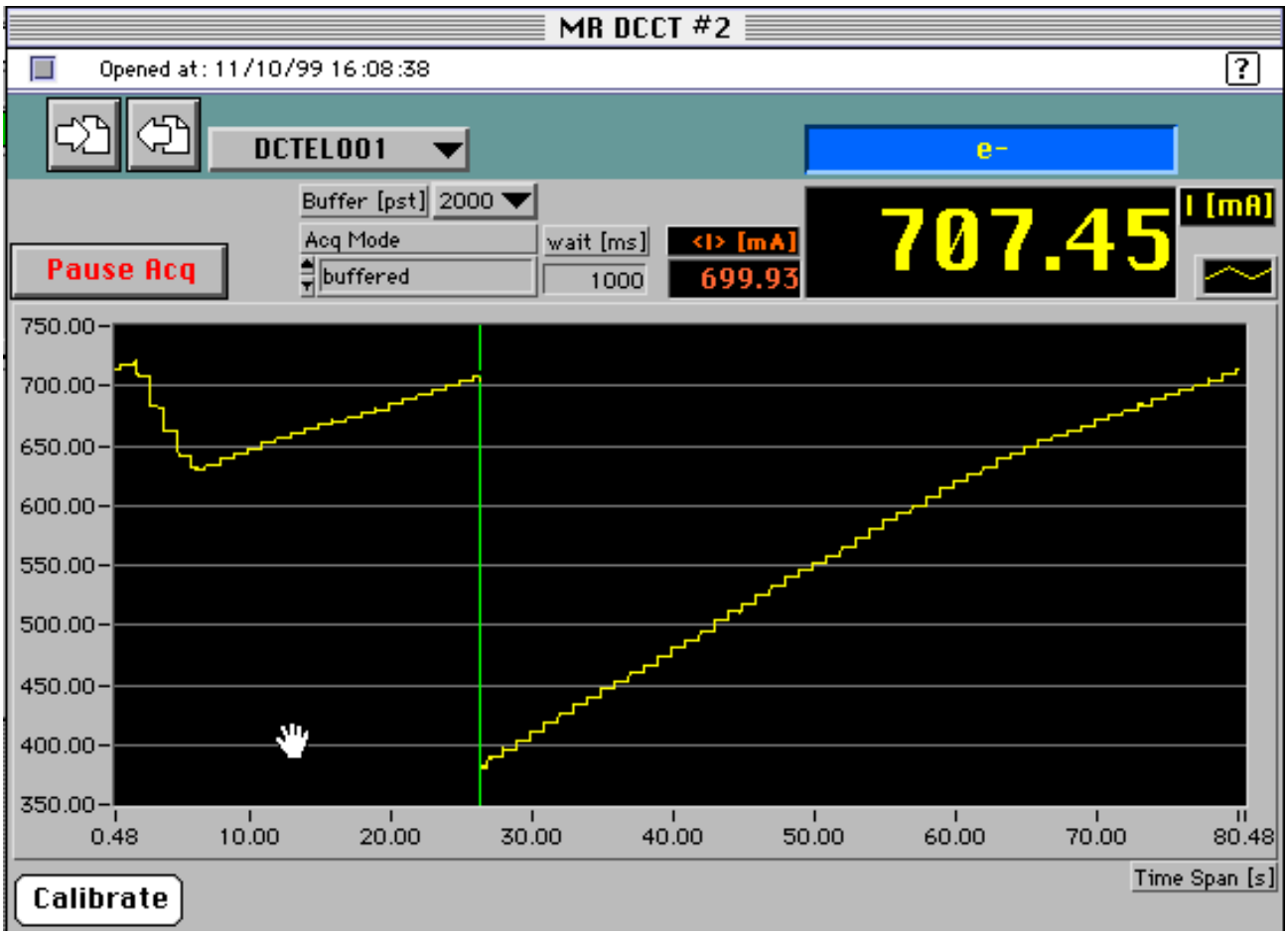




DESORPTION COEFFICIENT




MR DCCT #2
Opened at: 10/04/99 00:19:00
DCTPS001
e+
Buffer [pst] 2000
Acq Mode
buffered
wait [ms]
1000
<I> [mA]
801.82
802.41
I [mA]
Pause Acq
850.00
820.00
800.00
780.00
760.00
740.00
720.00
700.00
680.00
650.00
0.48
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.48
Time Span [s]
Calibrate


MR DCCT #2
Opened at: 11/10/99 16:08:38
DCTEL001
e-
Buffer [pst] 2000
Acq Mode
buffered
wait [ms]
1000
<I> [mA]
699.93
707.45
I [mA]
Pause Acq
750.00
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
0.48
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.48
Time Span [s]
Calibrate

SINGLE BUNCH LUMINOSITY

$$L_{SB} = f_c \frac{N^+ N^-}{2\pi \Sigma_x \Sigma_y}$$

$$\Sigma_x = \sqrt{\sigma_{+x}^2 + \sigma_{-x}^2} \qquad \Sigma_y = \sqrt{\sigma_{+y}^2 + \sigma_{-y}^2}$$

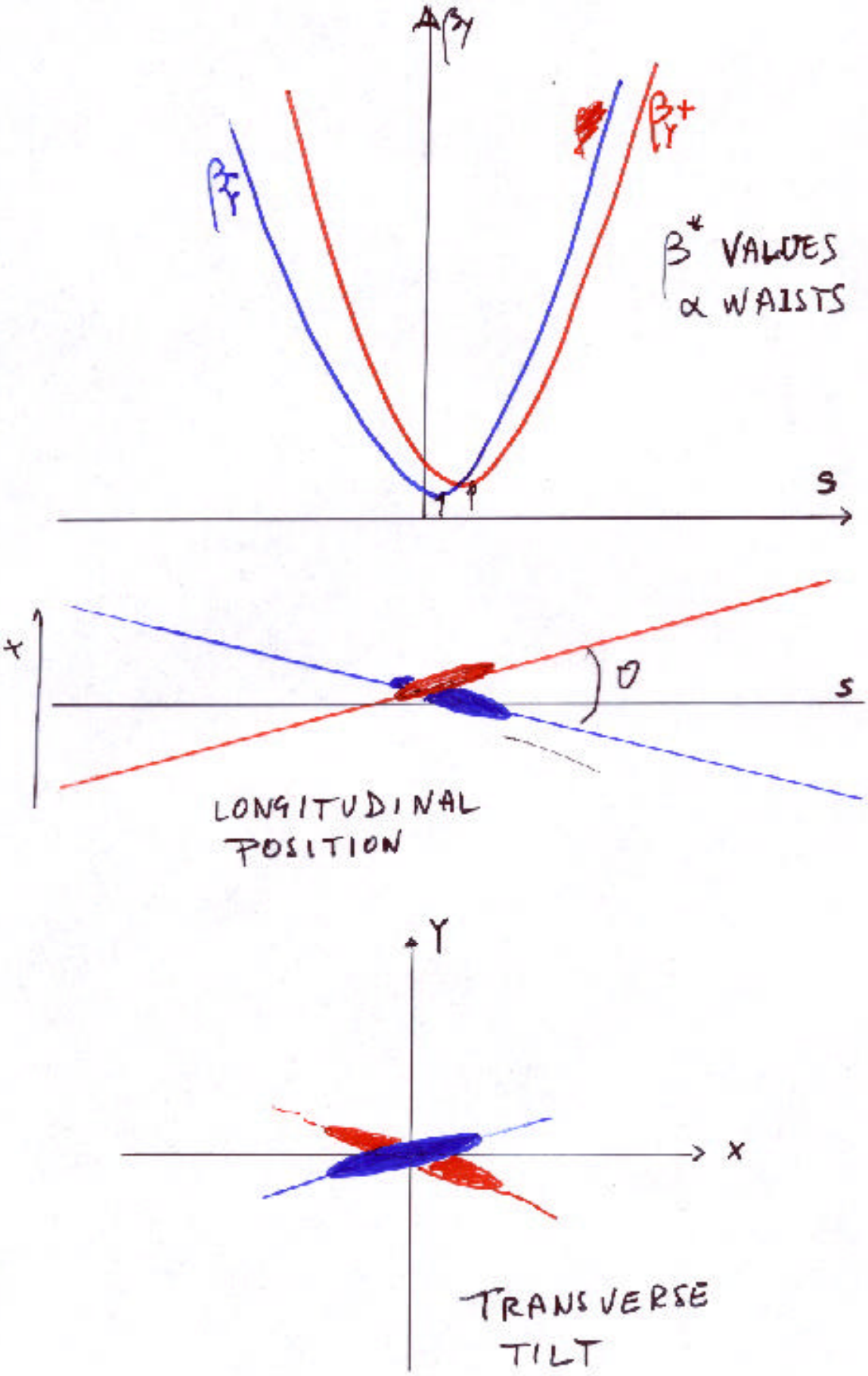
parameters:

- **emittance**
- **coupling**
- β_x^*, β_y^*
- **vertical waist position**
- **longitudinal IP position**
- **transverse tilt**
- **horizontal crossing angle**

diagnostics:

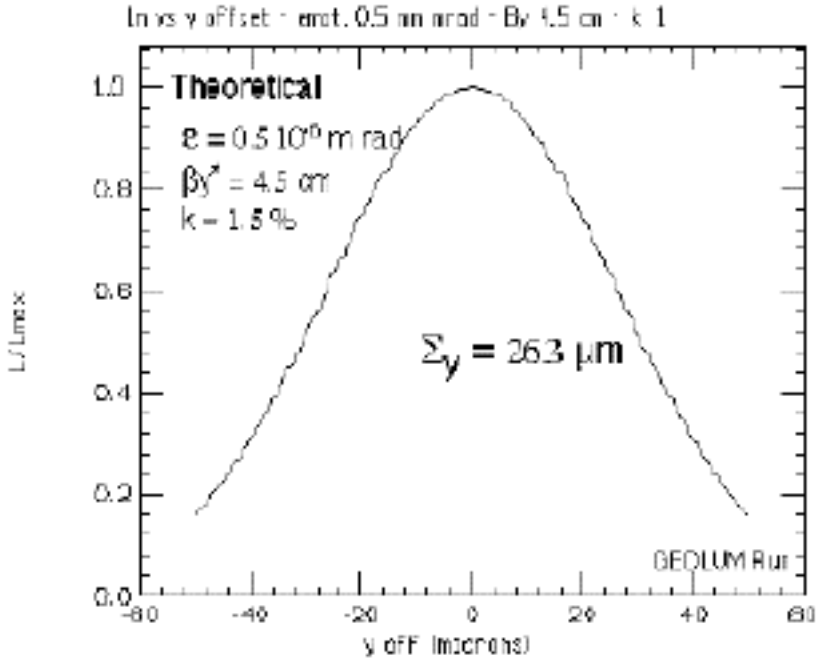
- **vertical, horizontal, longitudinal scanning**

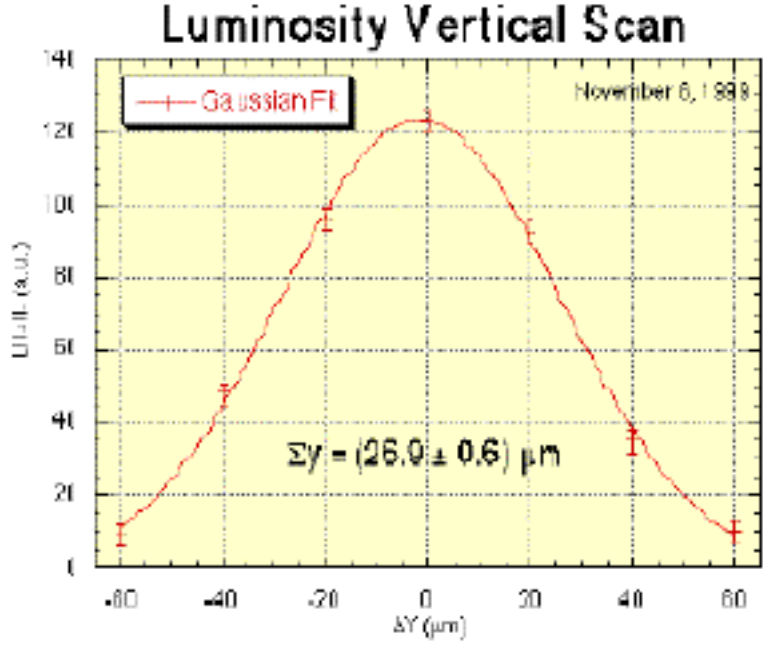
***L* ~ 85% nominal @ low beam intensity**


β_y
β_y^+
β_y^-
β^* VALUES
α WAISTS
s
x
θ
s
LONGITUDINAL
POSITION
Y
x
TRANSVERSE
TILT

Luminosity Vertical Scan

$$\Sigma_y = \sqrt{\sigma_{y+}^2 + \sigma_{y-}^2} \qquad \Sigma_y = \sqrt{2}\ \sigma_y \qquad if:\ \sigma_{y+} = \sigma_{y-}$$





$$\Sigma_y = \sqrt{2}\ \sigma_y \quad \Rightarrow \quad \sigma_y = (19.0 \pm 0.4)\ \mu m$$

$\Delta x \; (\Delta f = 10 \text{ kHz}) = -0.4$ mm @ IP

Δy [.08 / .1] } voi 2 monitors

$$\Delta x = D \frac{\Delta p}{p} = D \frac{1}{\alpha} \frac{\Delta f}{f} \qquad D = \frac{\alpha \Delta x}{\Delta f / f} = \frac{\alpha \Delta x}{2.7 \times 10^{-5}}$$

$f_{sagrada} = 25$ kHz $\rightarrow \alpha = .0178$

Salvate le dispersioni come "263 / 273" @ IR1

è la disp. totale come "263 277"

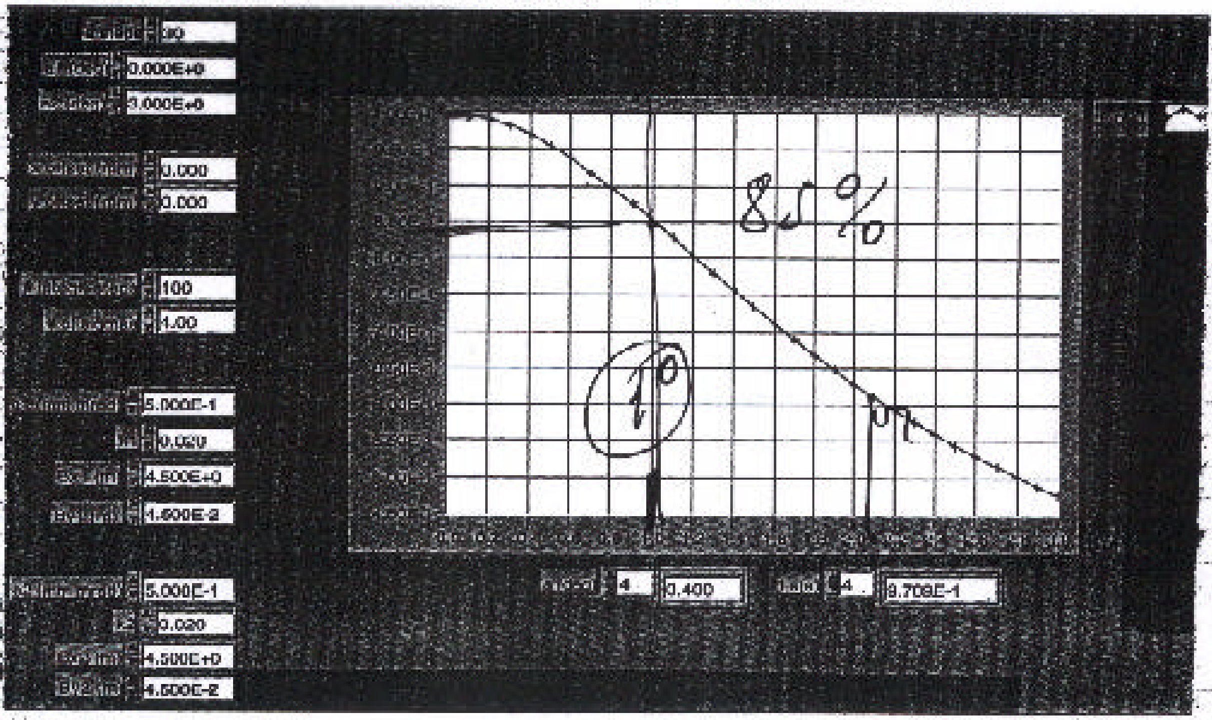
IR1 : $D_x^+ = \frac{.4 \times .0178}{2.7 \, 10^{-5}} = 26$ cm $\qquad D_y^+ = 1.3$ cm

$D_x^- = -10$ cm $\qquad D_y^- = \frac{.08 \times .0188}{2.7 \times 10^{-5}} = 5.6$ cm

...s(a)
Last modified on 10/7/99 at 18:05
Printed on 10/7/99 at 18:39

Luminosity vs Transverse Tilt

2



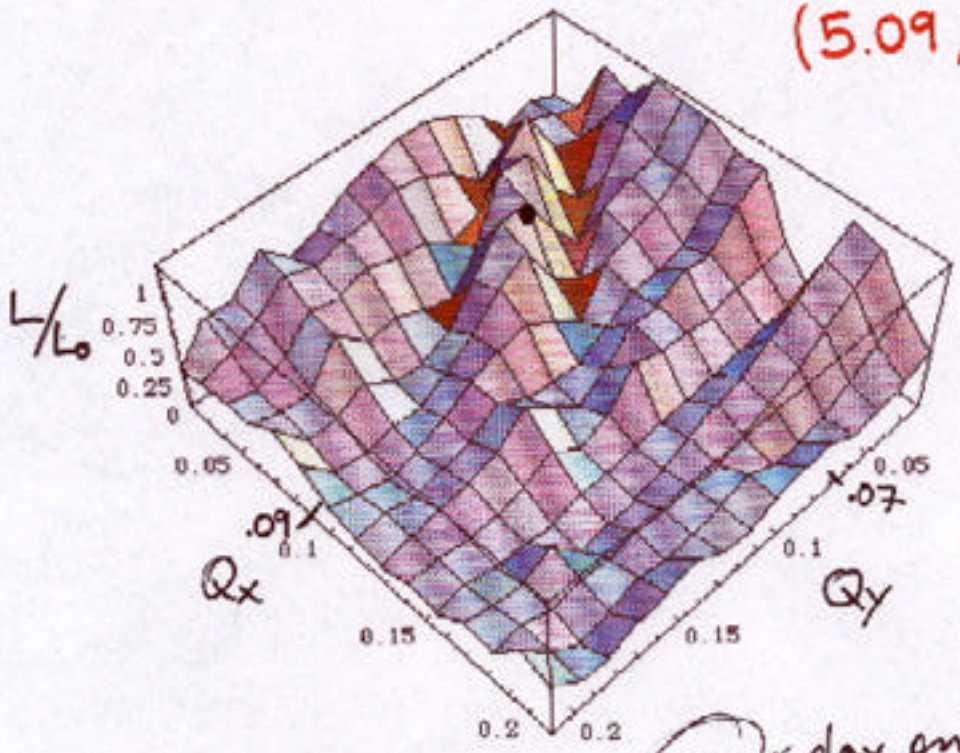
HIGH INTENSITY

SINGLE BUNCH LUMINOSITY

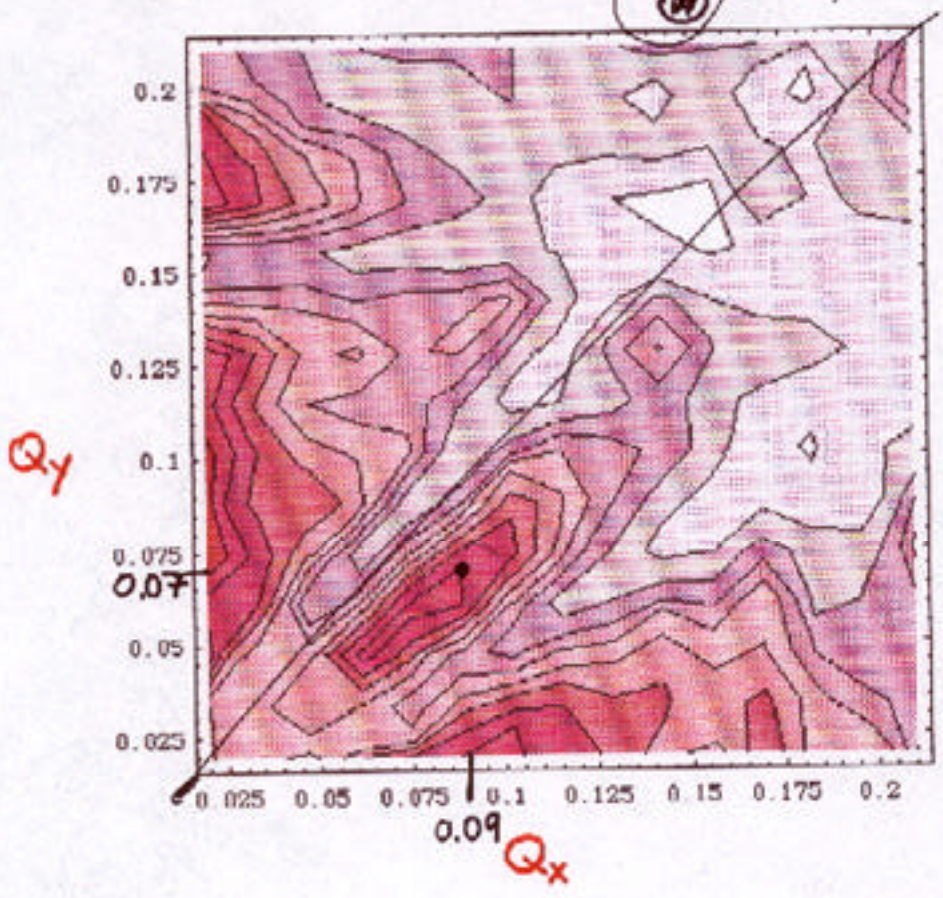
DAΦNE Relative Luminosity (scan)

BBC

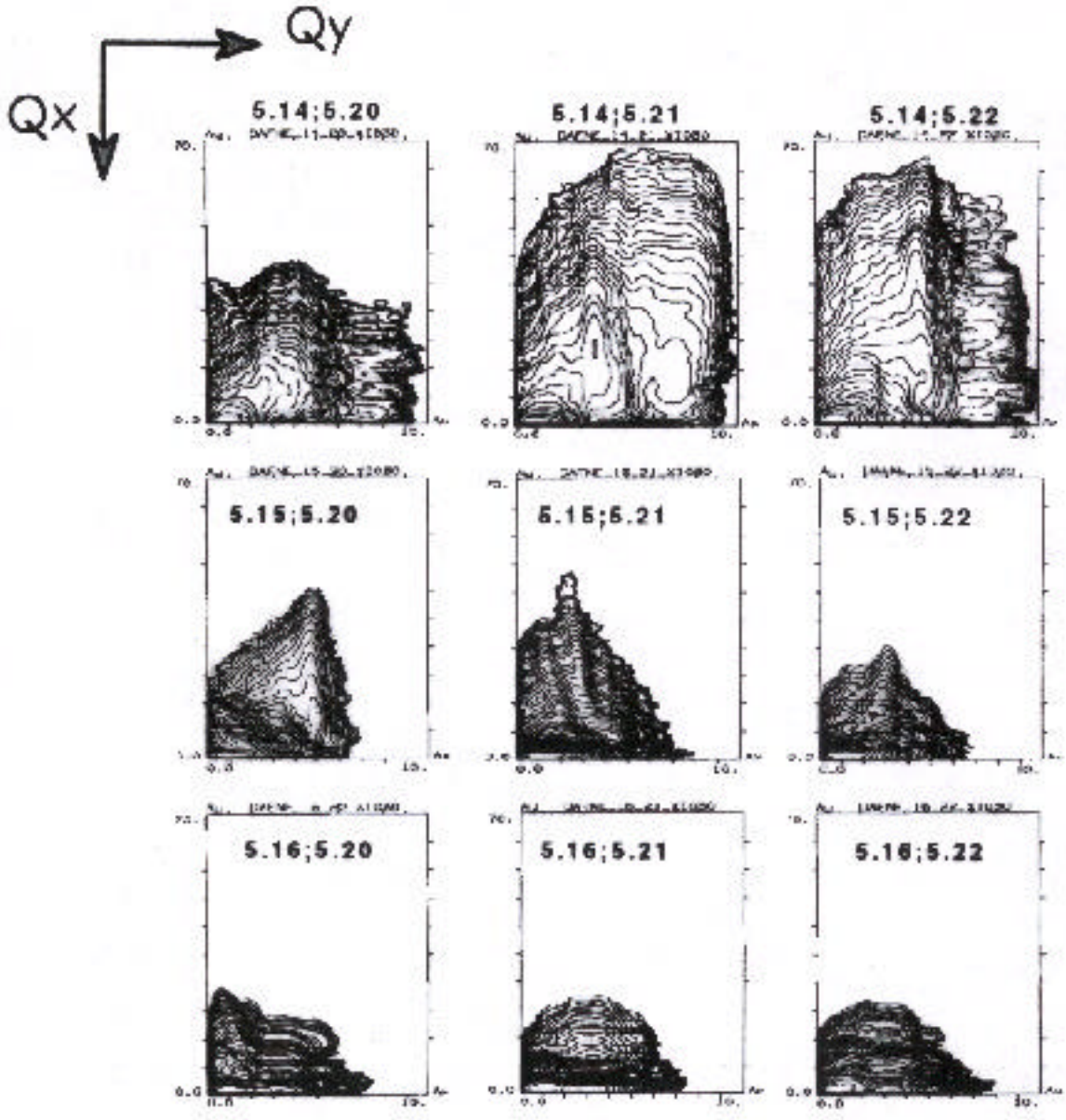
(5.09 ; 5.07)



day one . 03



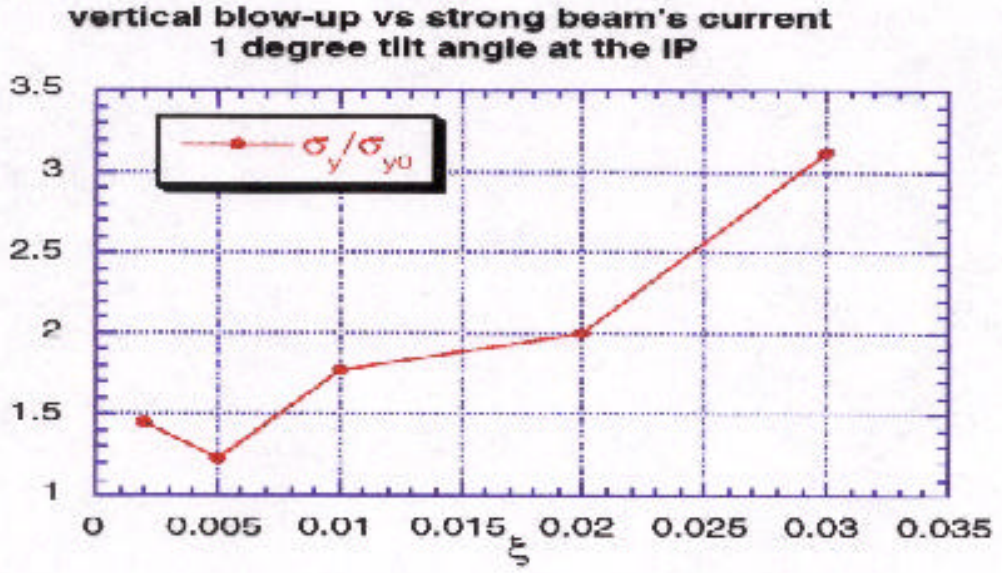
Beam-Beam Simulations

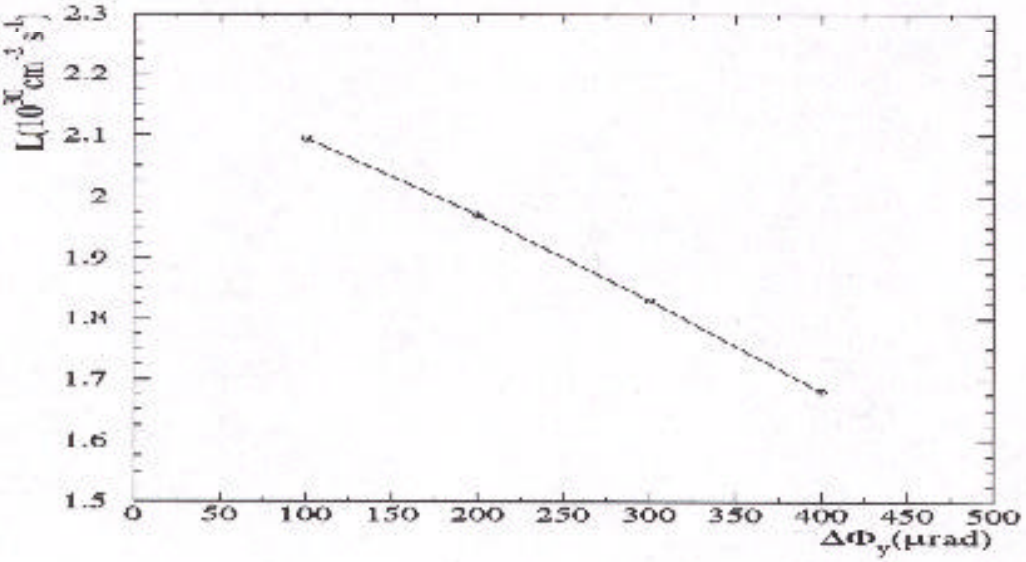


Beam-Beam Simulations

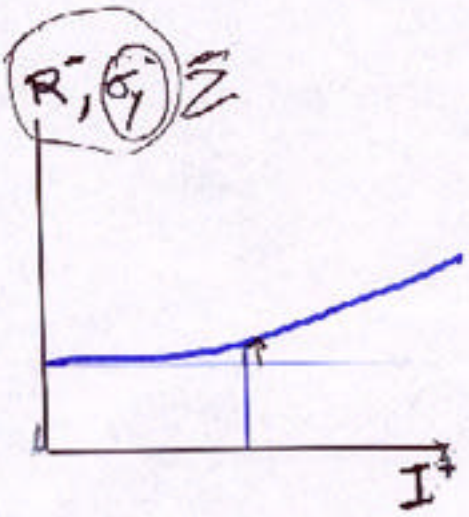
Dependence of luminosity on

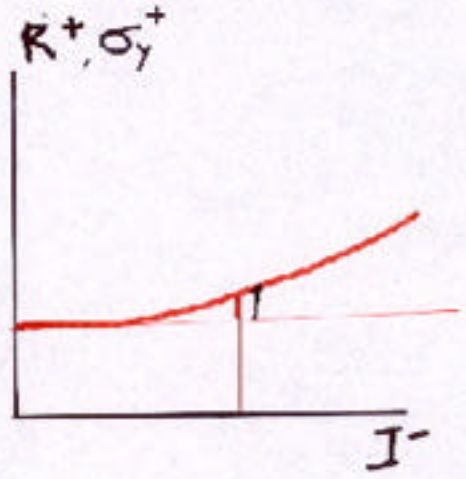
- Vertical Crossing Angle
- Transverse Tilt Angle
- Horiz. Dispersion

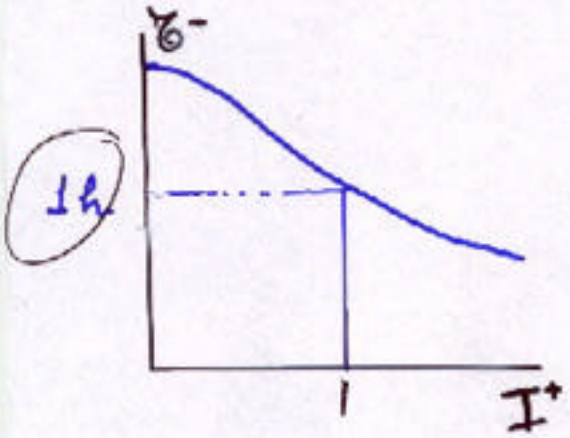


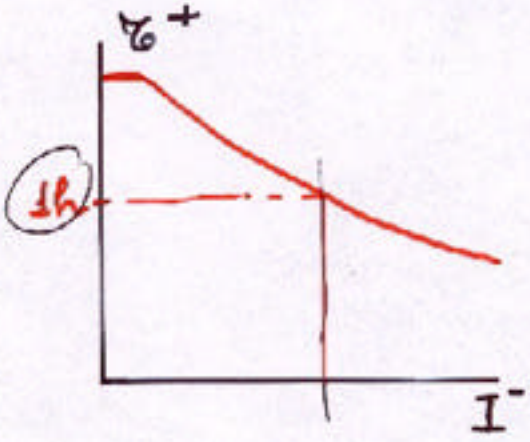


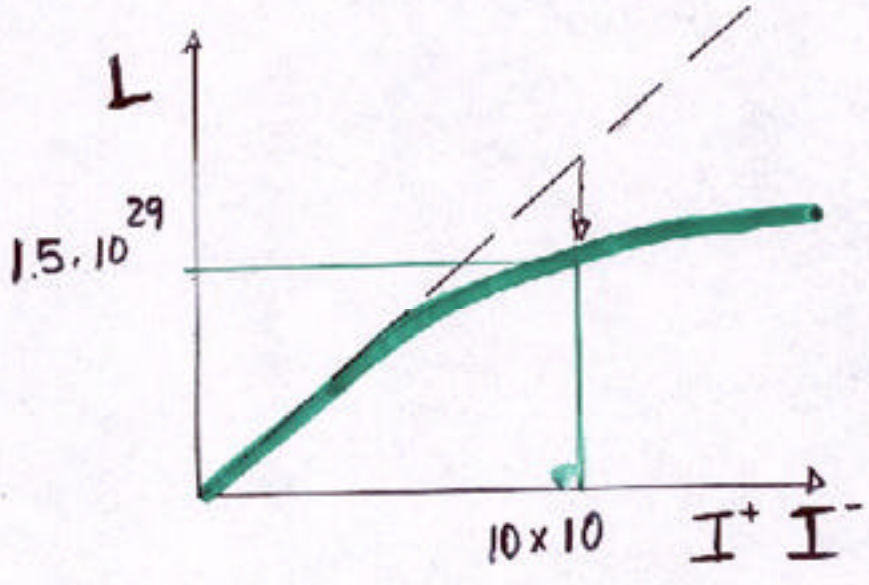
Beam - beam


R^-, σ_y^-
I^+

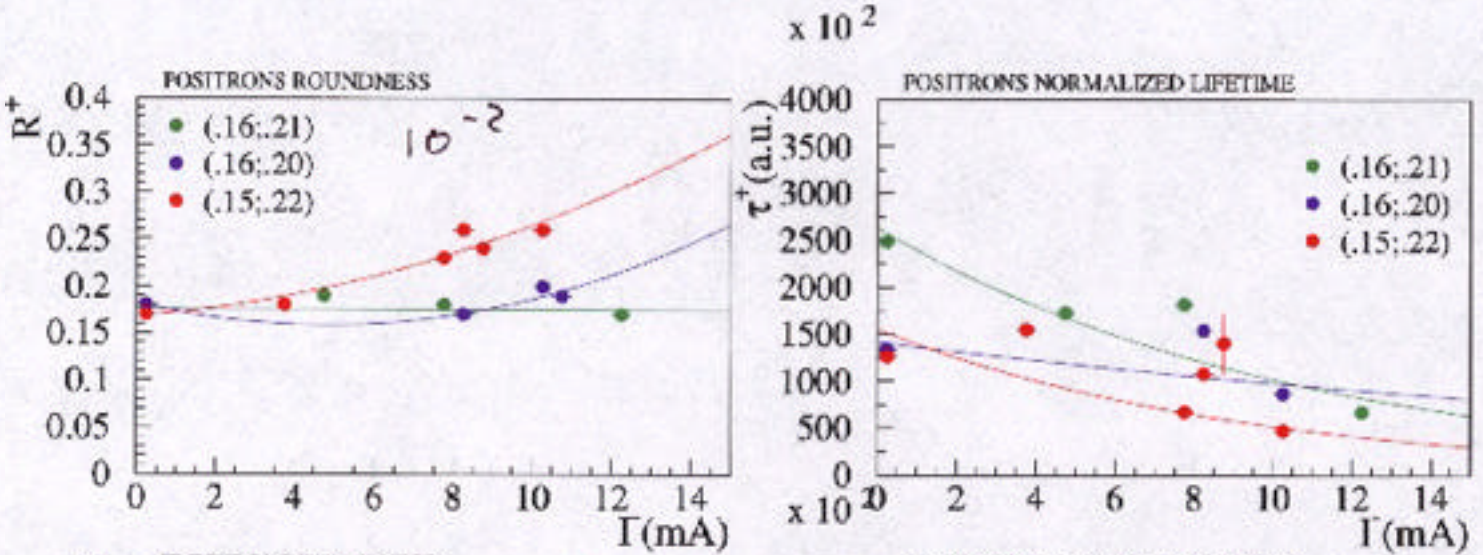

R^+, σ_y^+
I^-

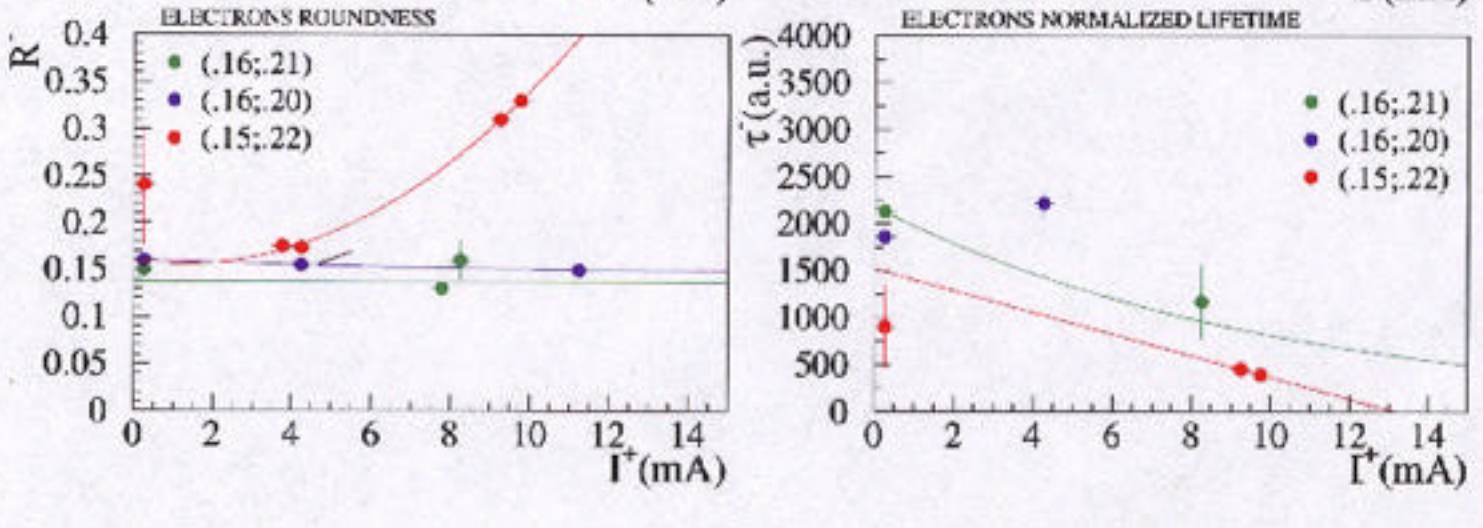

γ^-
1h
1
I^+


γ^+
1h
I^-


L
$1.5 \cdot 10^{29}$
10×10
I^+ I^-

TUNE Beam-Beam Scan





BEAM - BEAM TUNE SHIFT

$$\xi_X^+ = \frac{N^- \beta_X^+}{\left(\sigma_X^-\right)^2} = \frac{N^- \beta_X^+}{\varepsilon^- \beta_X^-}$$

$$\xi_Y^+ = \frac{N^- \beta_Y^+}{\sigma_X^- \sigma_Y^-} = \frac{N^- \beta_Y^+}{\varepsilon^- \sqrt{\kappa \beta_X^- \beta_Y^-}}$$

$$\xi_{nom} = 0.04$$

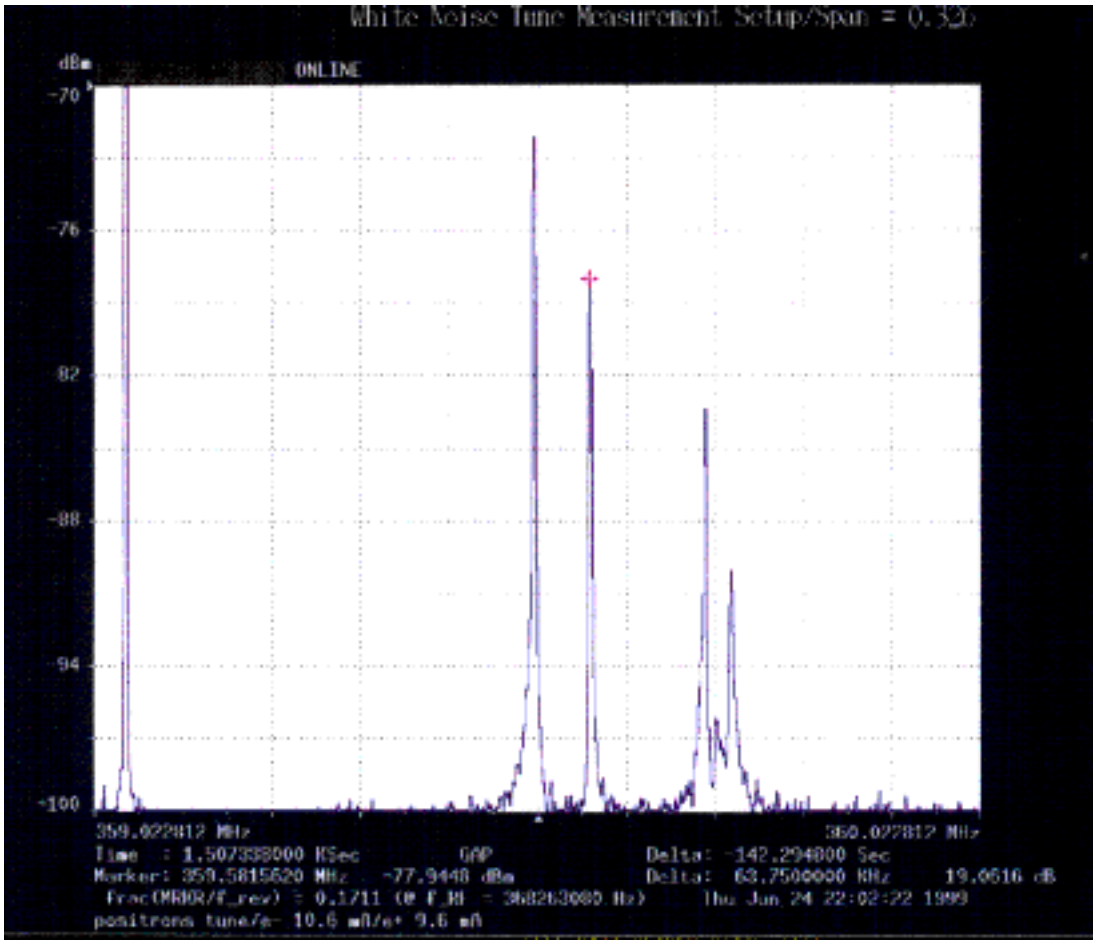
$$N^- = N^+ \approx N_{\max} / 4$$

$$\varepsilon \approx \varepsilon / 2$$

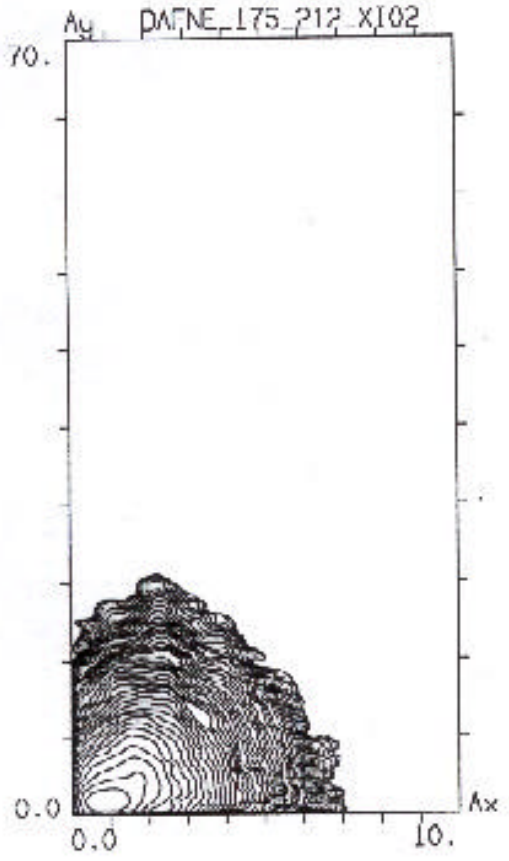
$$\beta_x , \beta_y , \kappa \approx \text{nominal}$$

$$\xi_x \approx \xi_y \approx \xi_{nom} / 2 = 0.02$$

Beam-Beam Tune Split



b-b simulations (lifetrack)



WORKING POINT
@ DECEMBER PP
(S.175, S.212)

$\xi_x = .02$

$\frac{\sigma_x}{\sigma_{x0}} = 1.03$

$\frac{\sigma_y}{\sigma_{y0}} = 2.32$

MULTIBUNCH LUMINOSITY

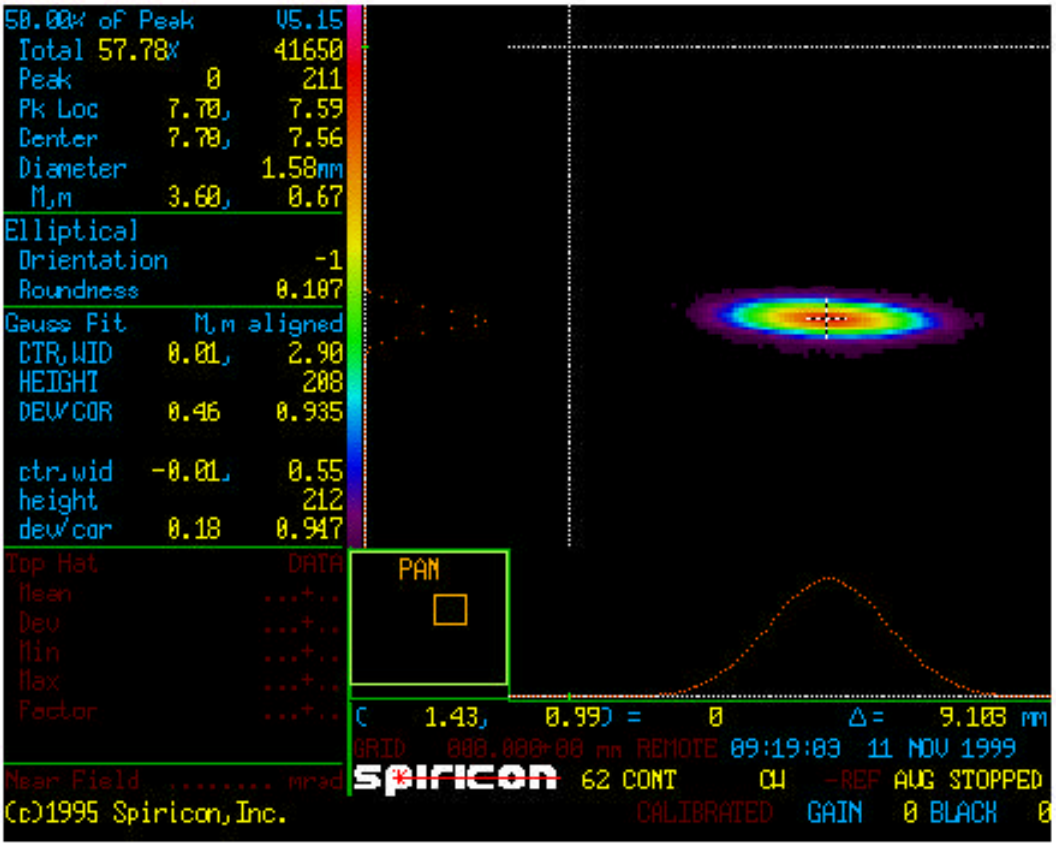
$$L = f_c N_b \frac{N^+ N^-}{2\pi \Sigma_x \Sigma_y} = f_c \frac{1}{N_b} \frac{N_t^+ N_t^-}{2\pi \Sigma_x \Sigma_y}$$

$\Rightarrow$ N_b **choice based on:**

- **Single bunch luminosity**
- **Lifetime**
- **Total current thereshold**

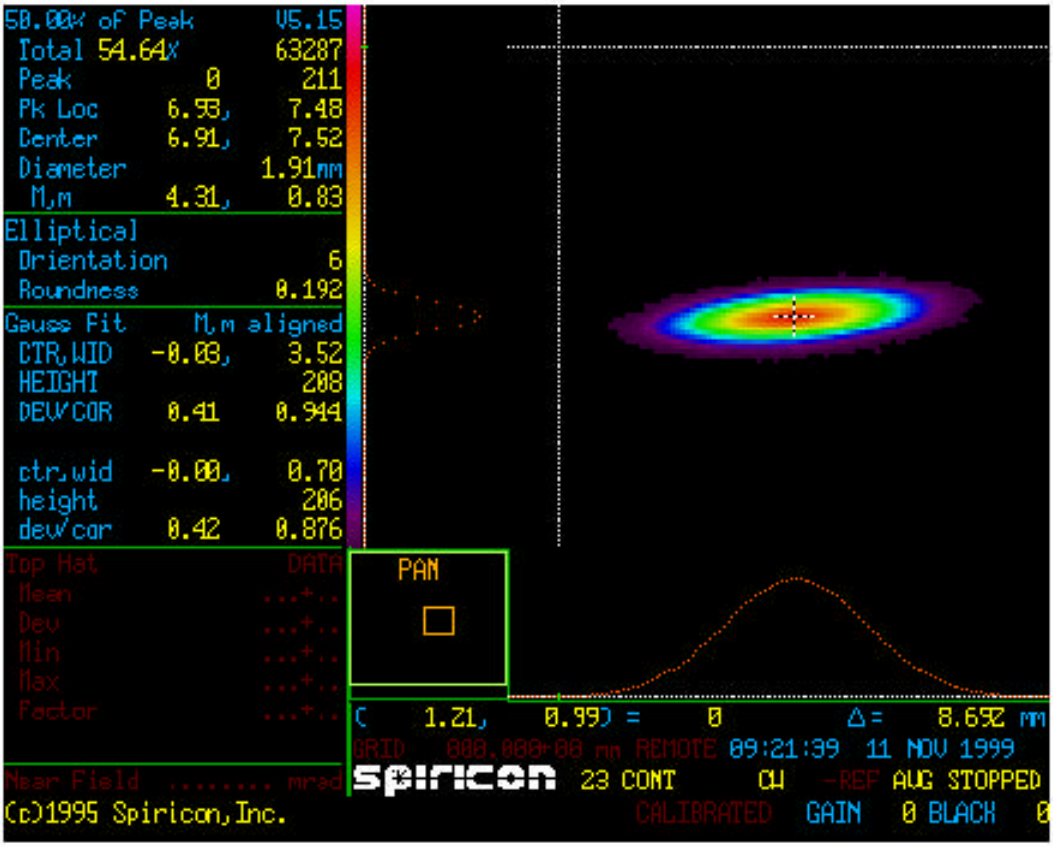
$\Rightarrow$ N_b **30 ÷ 50**

Beams in collision



e^+

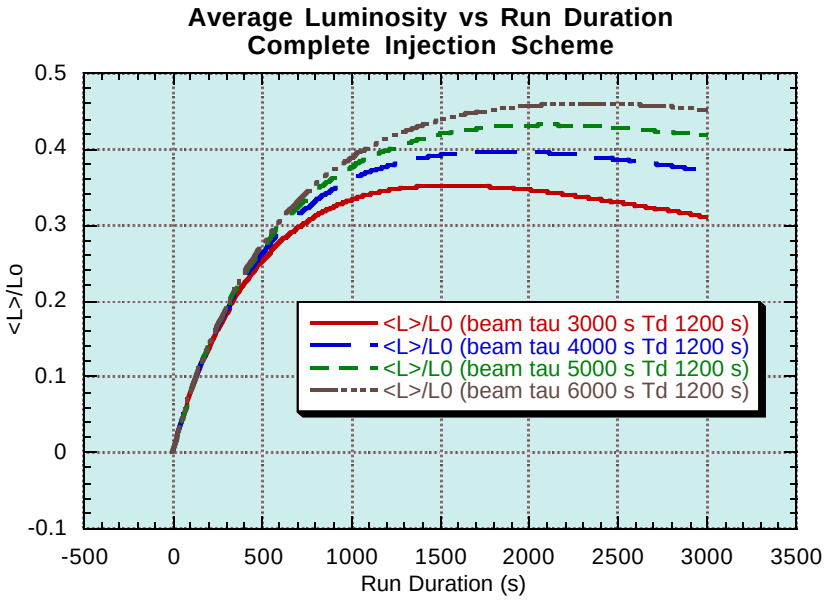
$\kappa = 1.7\%$

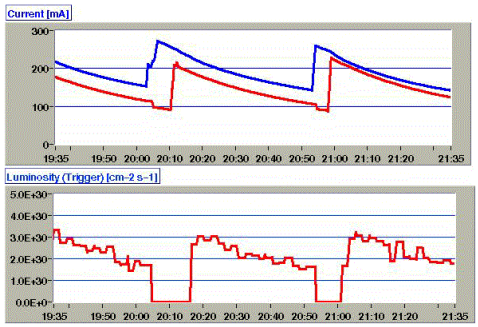


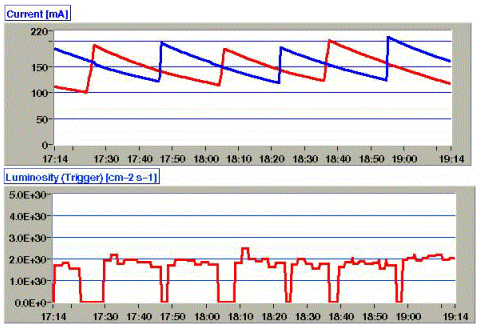
e^-

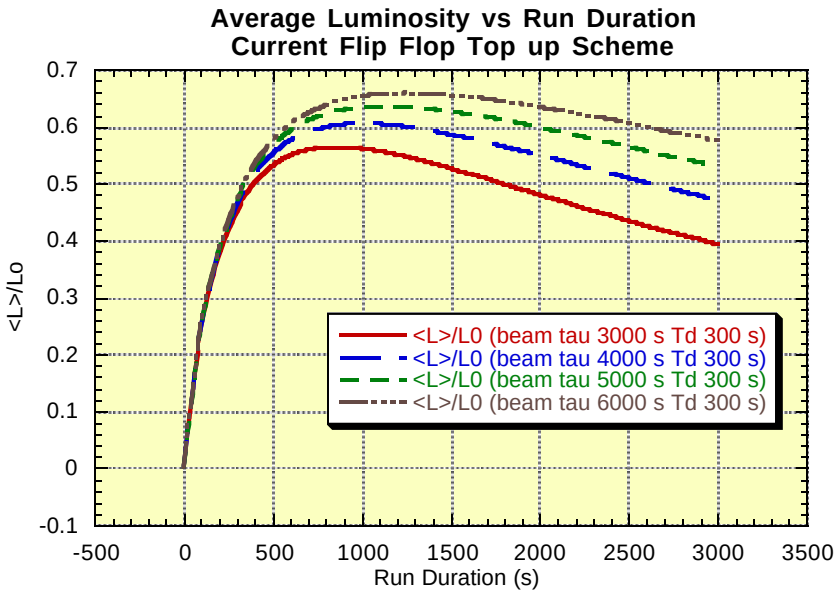
$\kappa = 1.8\%$

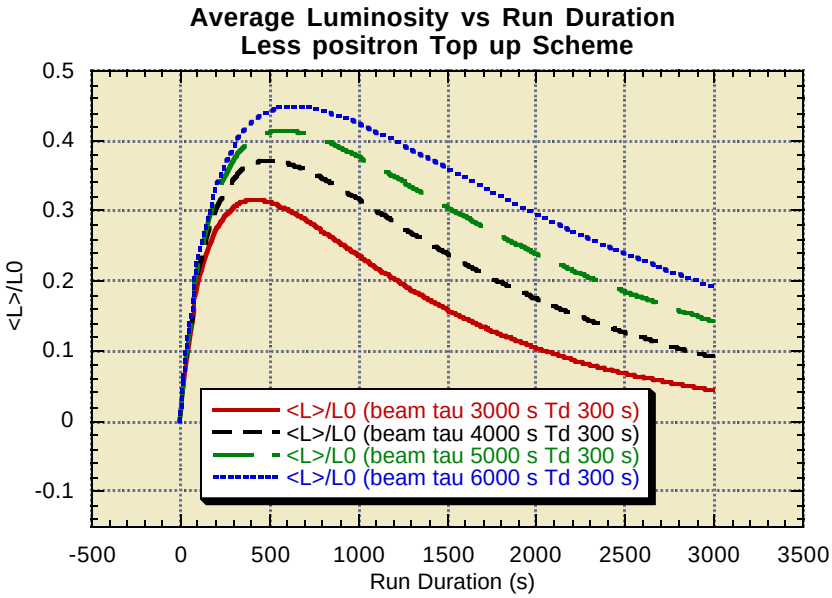
Integrated Luminosity Optimization

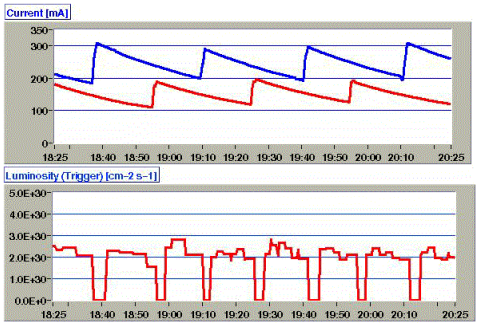






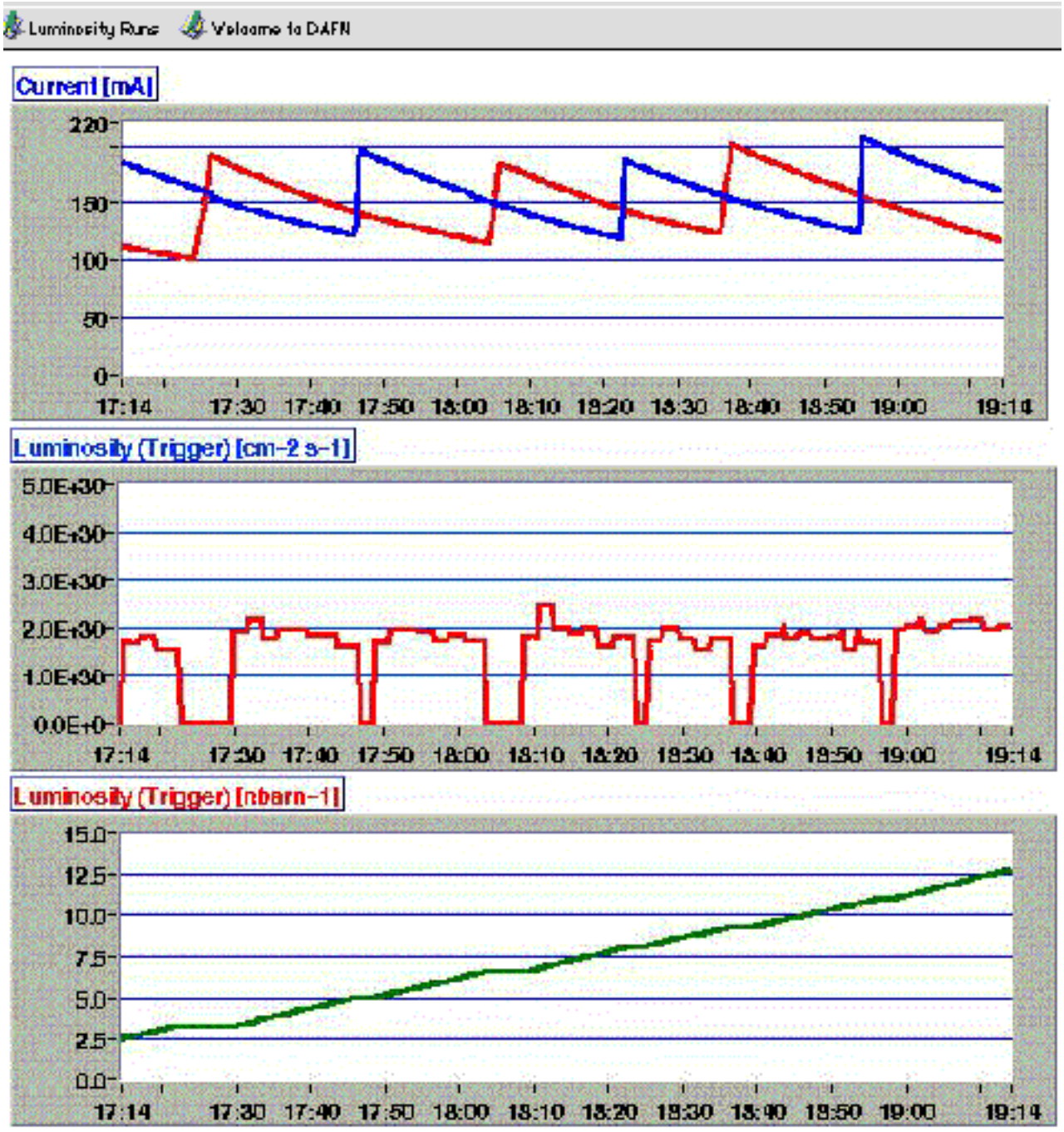




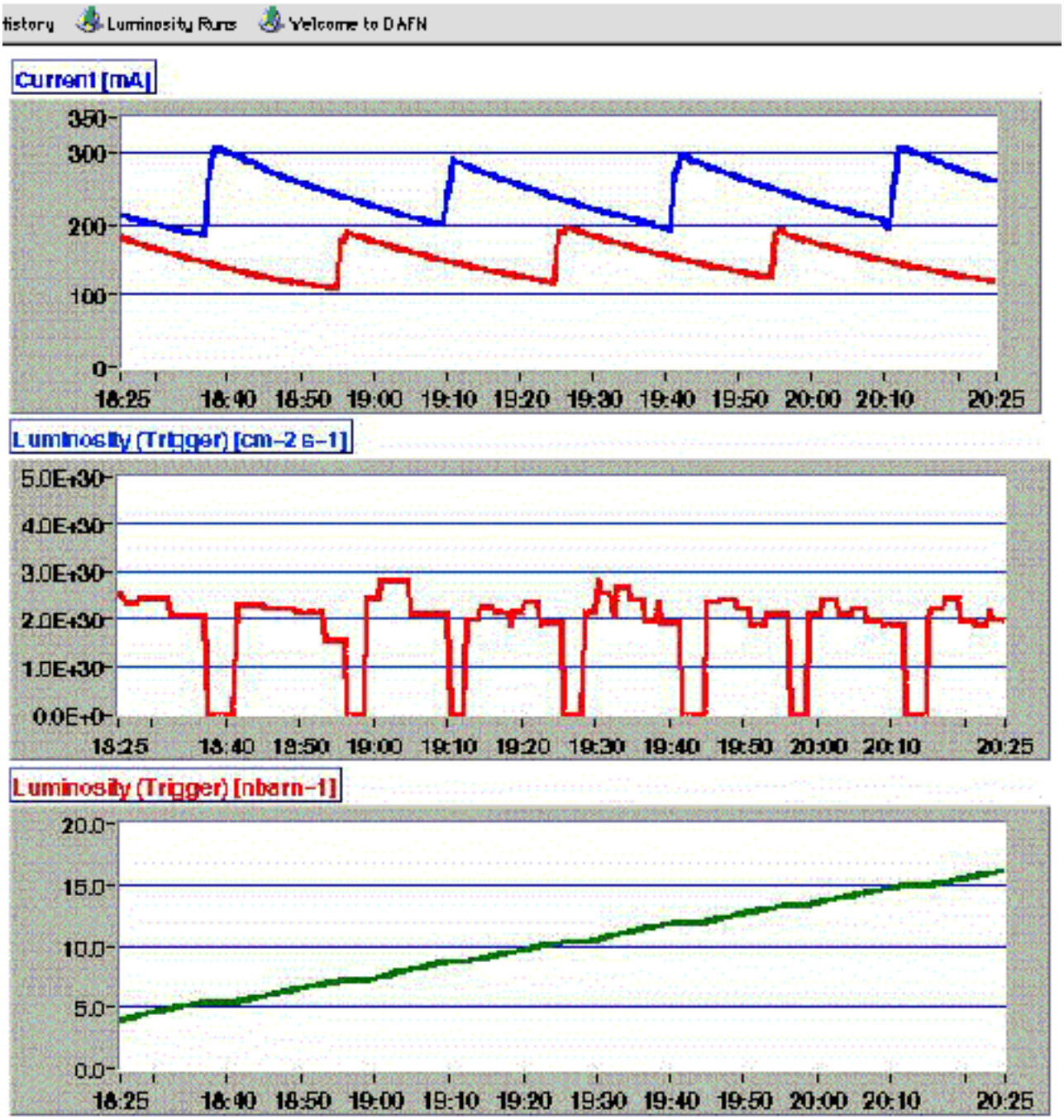


LUMINOSITY RUNS

20 + 20 BUNCHES

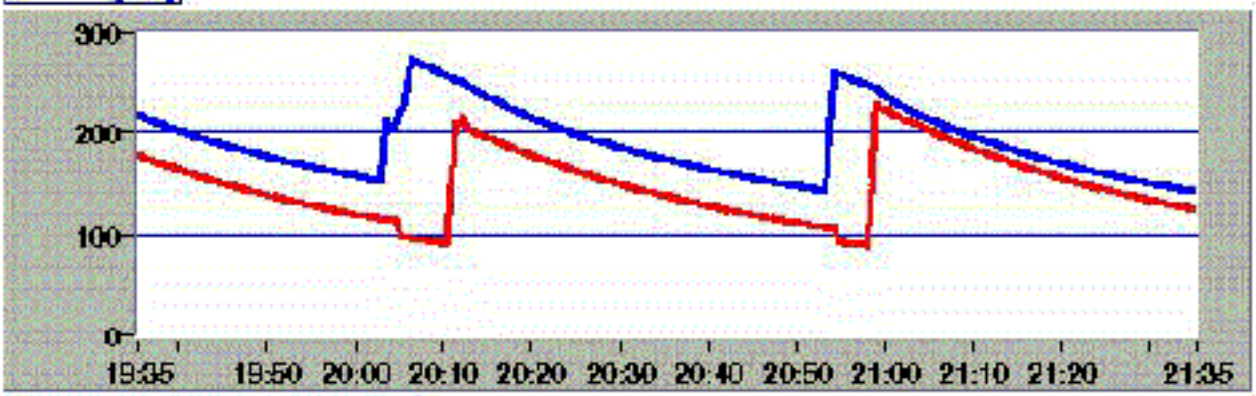


LUMINOSITY RUNS
40 + 40 BUNCHES



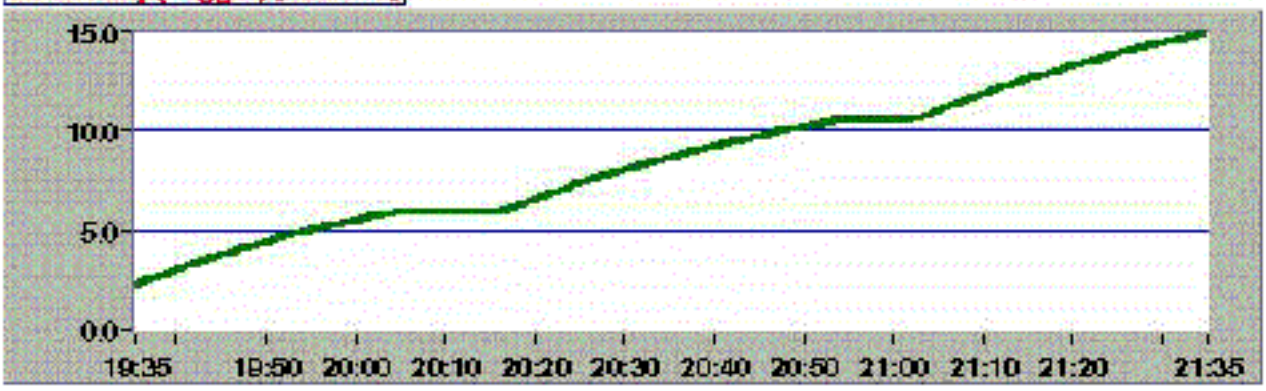
n1 History | Luminosity Runs | Welcome to DAFN

Current [mA]

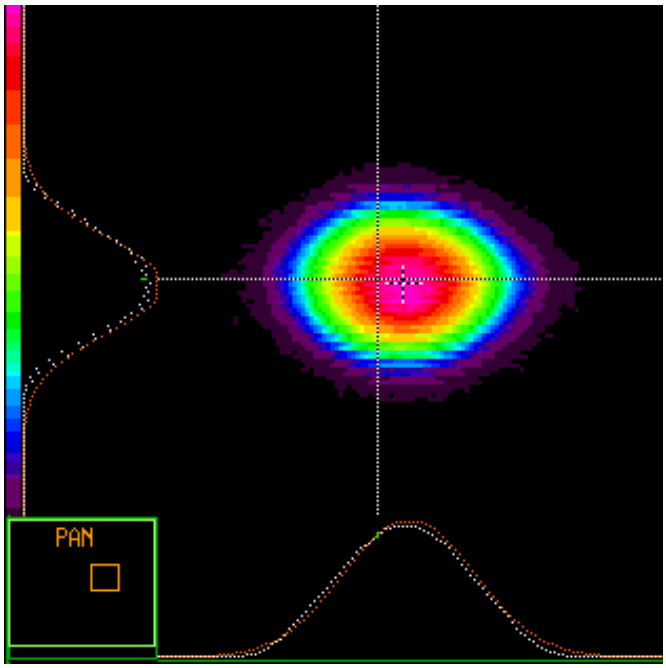


Luminosity (Trigger) [cm-2 s-1]

Luminosity (Trigger) [nbarn-1]

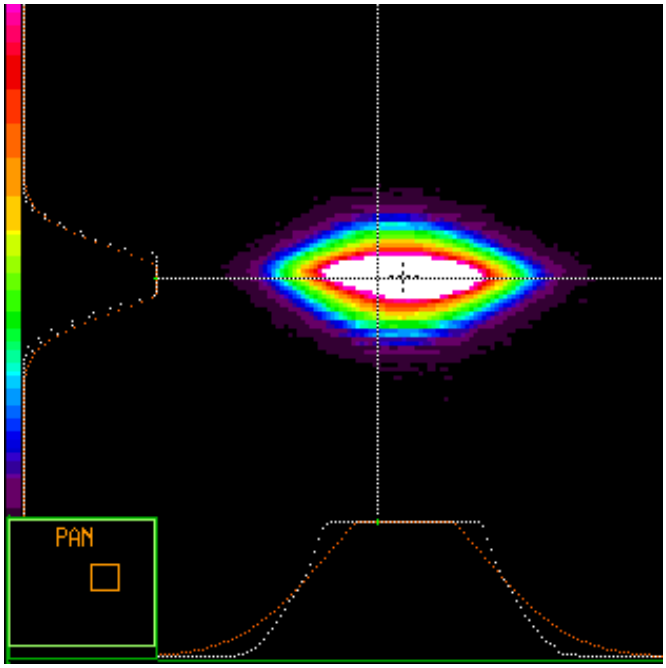


B-B DAMPING



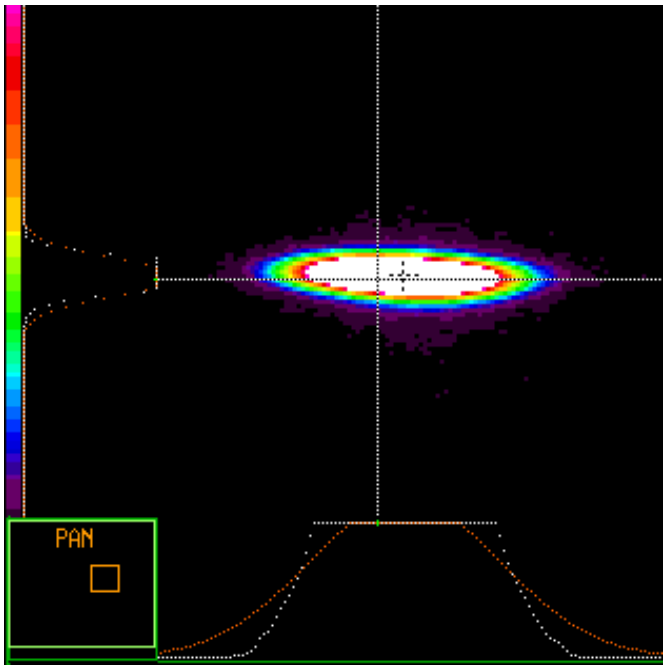
Ie^{+} = 250 mA

Ie^{-} = 0 mA



Ie^{+} = 250 mA

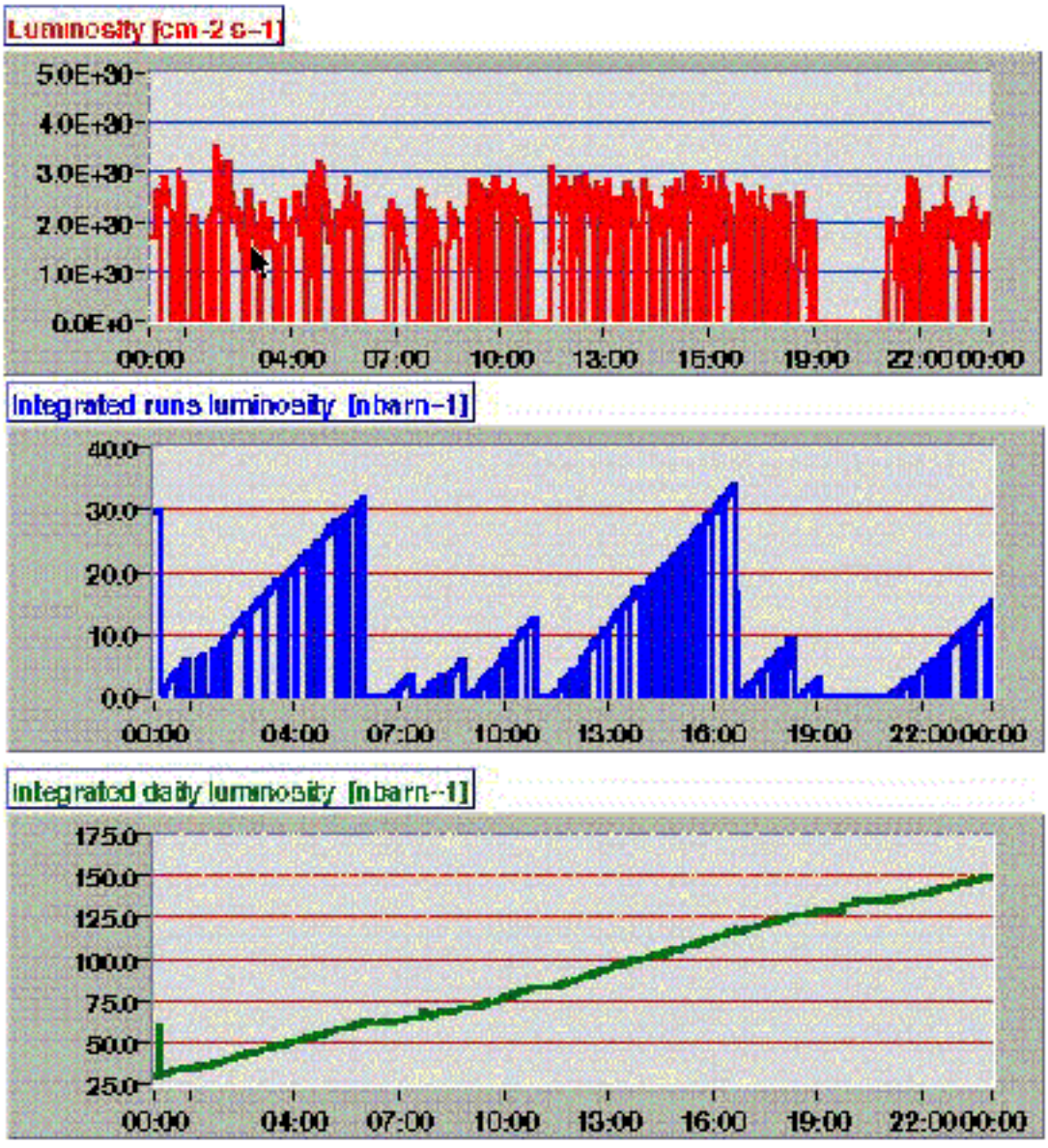
Ie^{-} = 80 mA

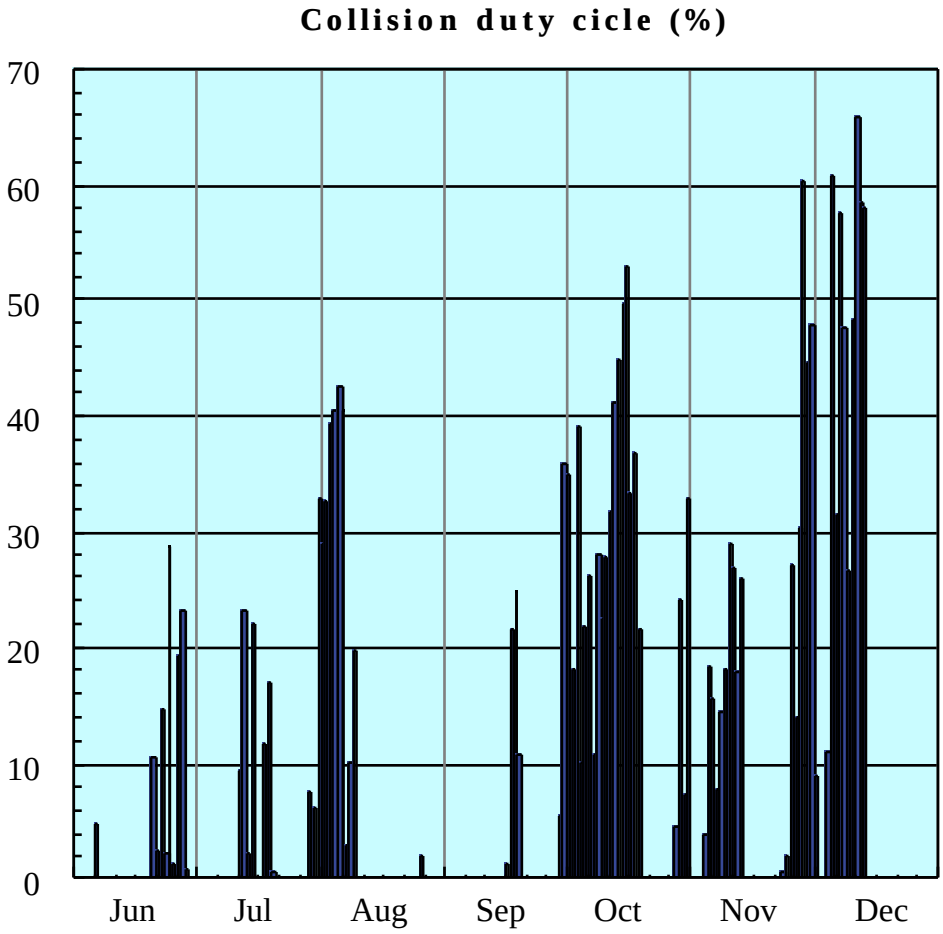


Ie^{+}= 250 mA

Ie^{-} = 200 mA

KLOE Luminosity History: 10/12/1999




Collision duty cicle (%)
70
60
50
40
30
20
10
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec

DAFNE: e- Inject e- 210 mA e+ 114 mA 22-22 bunches e+lifetime: 4726 s

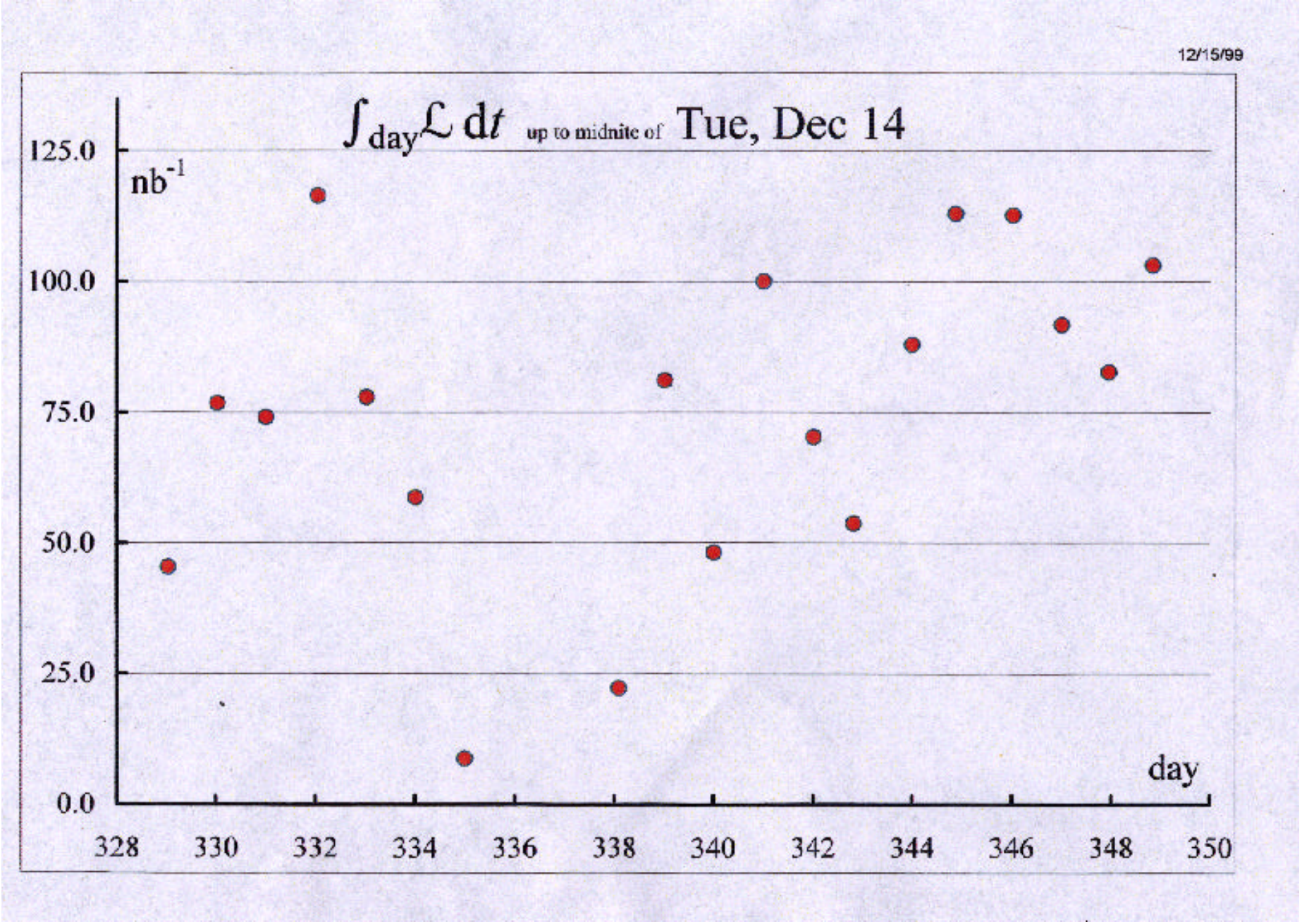
Daily Statistcs

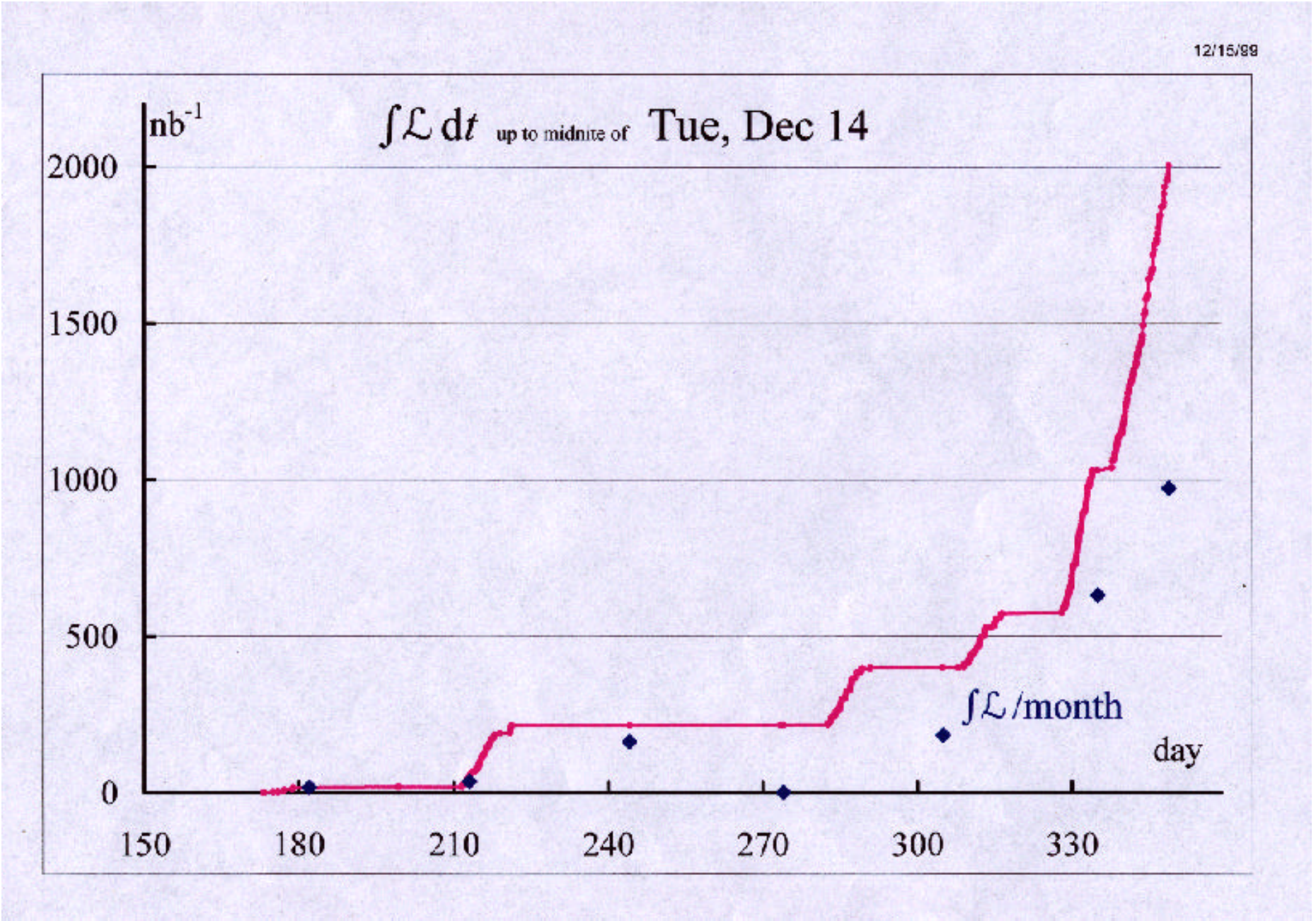
DAFNE DAILY STATISTICS: Saturday, December 11, 1999 data from on-line acquisition tasks			
Stored records	Storing live time		Data history up to [h]
5751	99.8		24.0
e- [Ah]	e+ [Ah]	L1 Kloe* [nbarn-1]	Running Time
4.858	2.859	100.2	50.4
e- stored [h]	e+ stored [h]	standby [h]	colliding [h]
3.89	3.63	1.32	14.05
fill 1247 to 1350		last record: 00:00:10 AM	

* KLOE estimated on-line luminosity, Warning: luminosity data before 30 November are no more avaiable

Stored data:

19991214.dat 19991213.dat 19991212.dat 19991211.dat 19991210.dat 19991209.dat 19991208.dat
19991207.dat 19991206.dat 19991205.dat 19991204.dat 19991203.dat 19991202.dat 19991201.dat
19991130.dat 19991129.dat 19991128.dat 19991127.dat 19991126.dat 19991125.dat 19991124.dat
19991123.dat 19991122.dat 19991121.dat 19991120.dat 19991119.dat 19991118.dat 19991117.dat
19991116.dat 19991115.dat 19991114.dat *OLD DATA*


12/15/99
$\int_{day} \mathcal{L}\, dt$ up to midnite of Tue, Dec 14
125.0
100.0
75.0
50.0
25.0
0.0
nb^{-1}
day
328
330
332
334
336
338
340
342
344
346
348
350


12/15/89
nb-1
∫ℒ dt up to midnite of Tue, Dec 14
2000
1500
1000
500
0
150
180
210
240
270
300
330
∫ℒ/month
day

	e^+	e^-	
MAXIMUM CURRENTS (OUT of collision)	800	700	mA
IN COLLISION	400^-	300^+	

LUMINOSITY	$\hat{L}$
DESIGN (1st STAGE)	10^{32}
MEASURED	4.5×10^{30} -
INTEGRATED L/day	~ 100 nbarn^{-1} -
Total L for Kloe	2.2 pbarn^{-1}