Status Report on DAFNE

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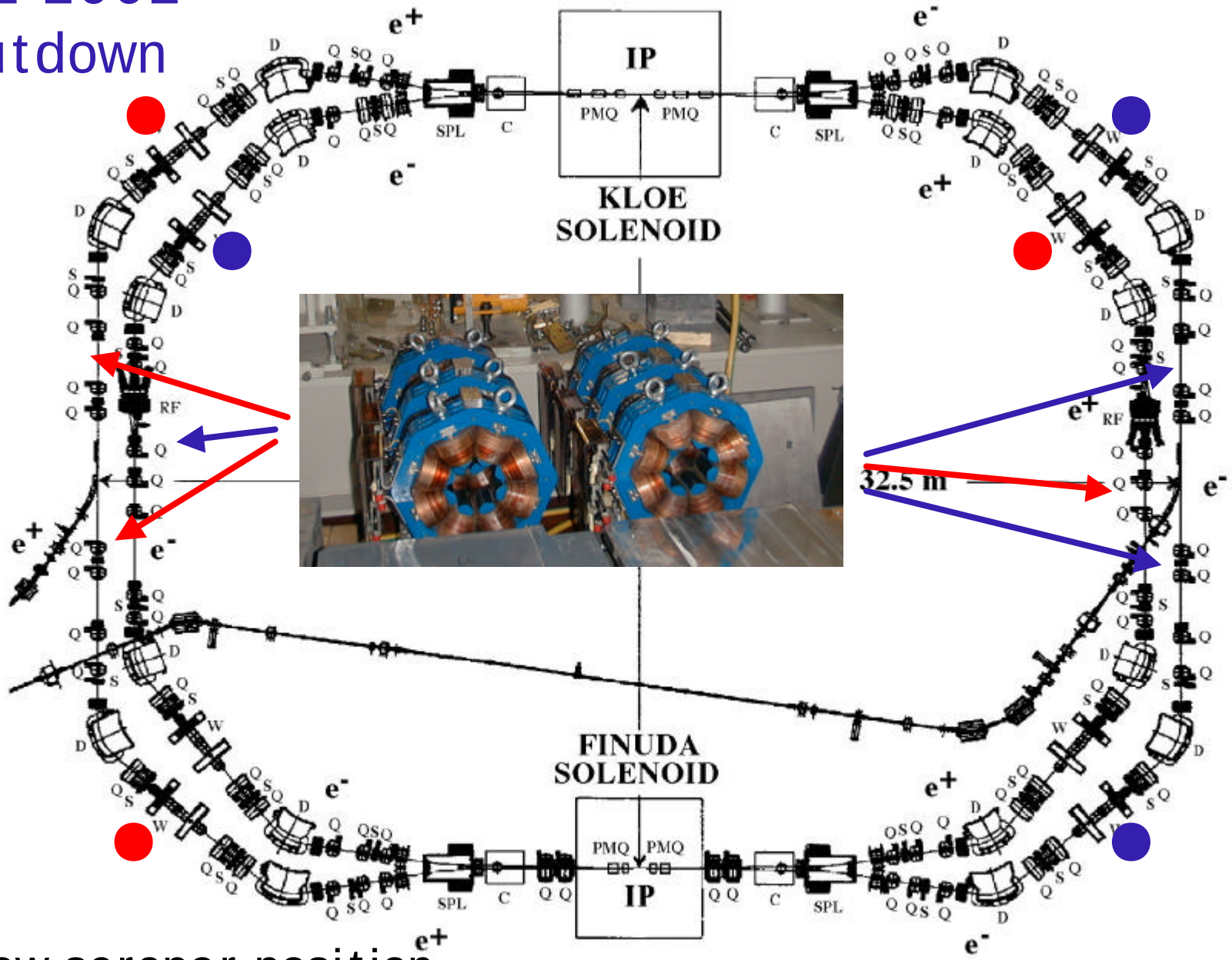
for the DAFNE team

2nd KLOE Physics Workshop, 10-12 June, Otranto

2002 DAFNE operations summary and plans

- Vacuum conditioning and start-up
- Dear test run commissioning
- Plans and expectations for the upcoming 2002 Kloe run
- BTF commissioning
- Medium-long terms plans
- Conclusions

2001-2002 Shutdown



- new scraper position

Vacuum conditioning

- 3 weeks Start up delay because crio and solenoid P.S. problems (Feb-25)
- Conditioning in both rings virtually completed by March-10, except the RF Cavities=>
- Dec-2001 Vacuum Levels in e-RF Cavity almost recovered

Dear Run Commissioning

- **Background Optimization**
- **Orbit Optimization**
- **Old and New Scrapers Optimization**
- **Sextupoles Optimization**
- **Octupoles Optimization**

=> achieved >10 times improvement w.r.t. 2001

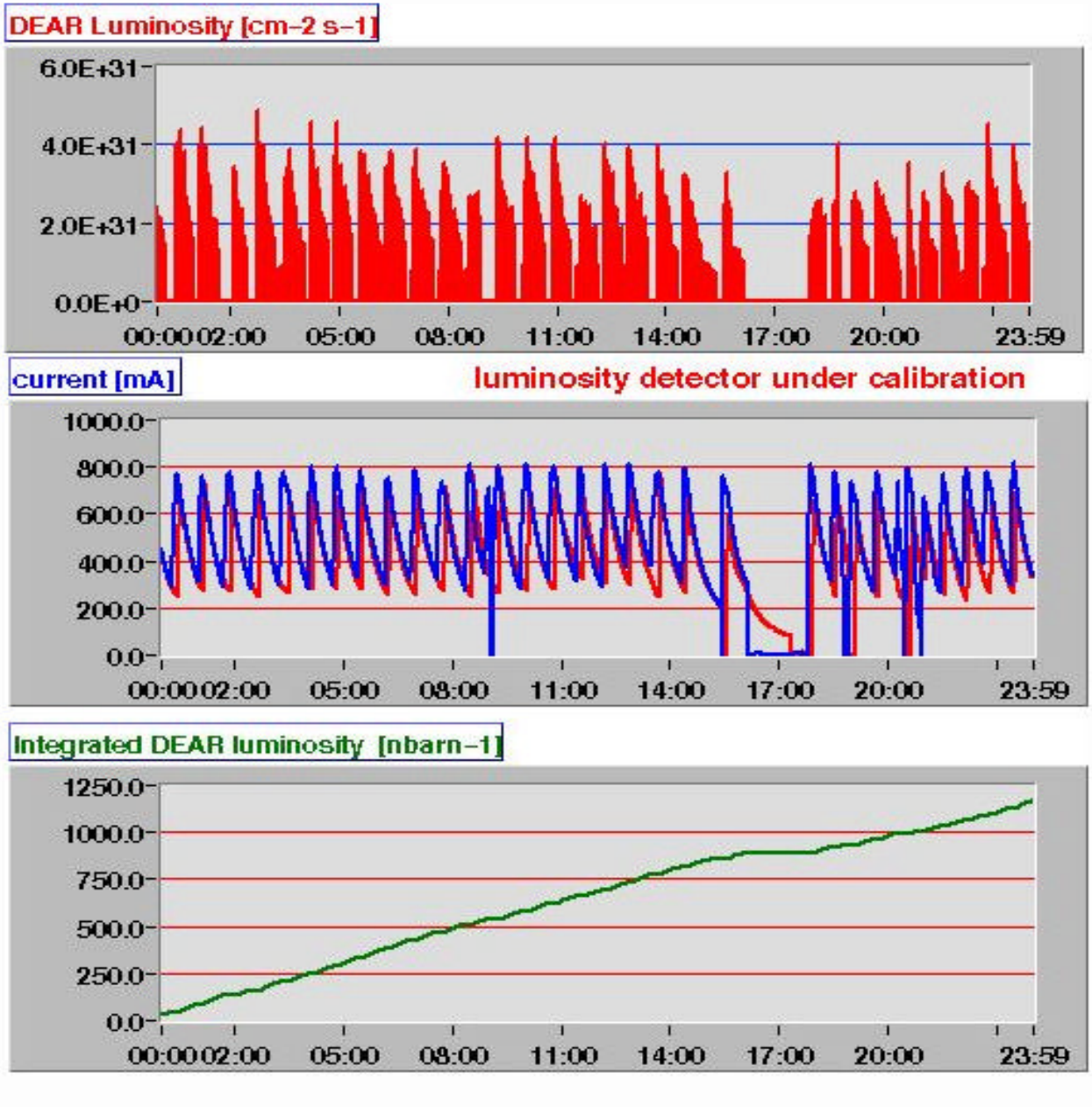
- **Luminosity Optimization**
- **Luminosity monitors improvements**
- **Adiabatic Tuning**
- **Low $?_x$**

=> achieved > 4 times improvement w.r.t 2001

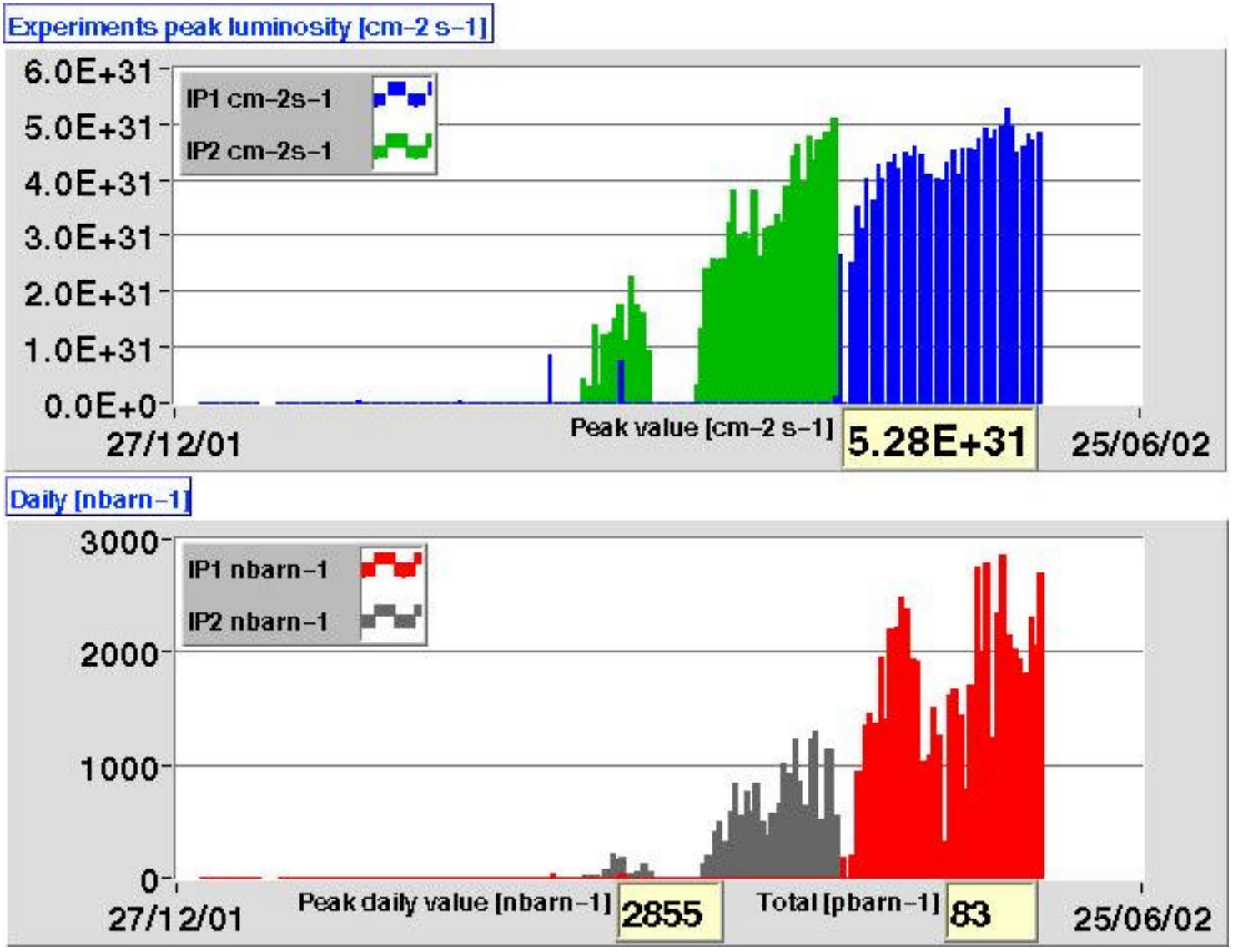
Present Performance with DEAR

- Number of bunches per beam — 45 + 45
- Total current per beam (A) — ~ 0.7
- Peak luminosity ($cm^{-2}s^{-1}$) — 4.6×10^{31}
- Average luminosity ($cm^{-2}s^{-1}$) — ~ 1.5×10^{31}
- Integrated luminosity per day (pb^{-1}) — 1.1
- Luminosity lifetime (h) — ~ 0.6
- Number of fillings per hour — ~ 1.7
- Data acquisition during injection — off
- With the luminosity collected in April shifts the capture of kaons in Nitrogen atoms clearly observed

Best 2002 DEAR day



2002 DEAR and KLOE luminosity



Dear non-linearities Optimization

Dynamic aperture, Lifetimes and background have been optimized both with sextupoles (about 15%) (left picture) and octupoles (about 15%).
Octupoles have been found also useful to improve the lifetime in collision (~10%), compensating the strong beam-beam non linearities.

POSITRONS

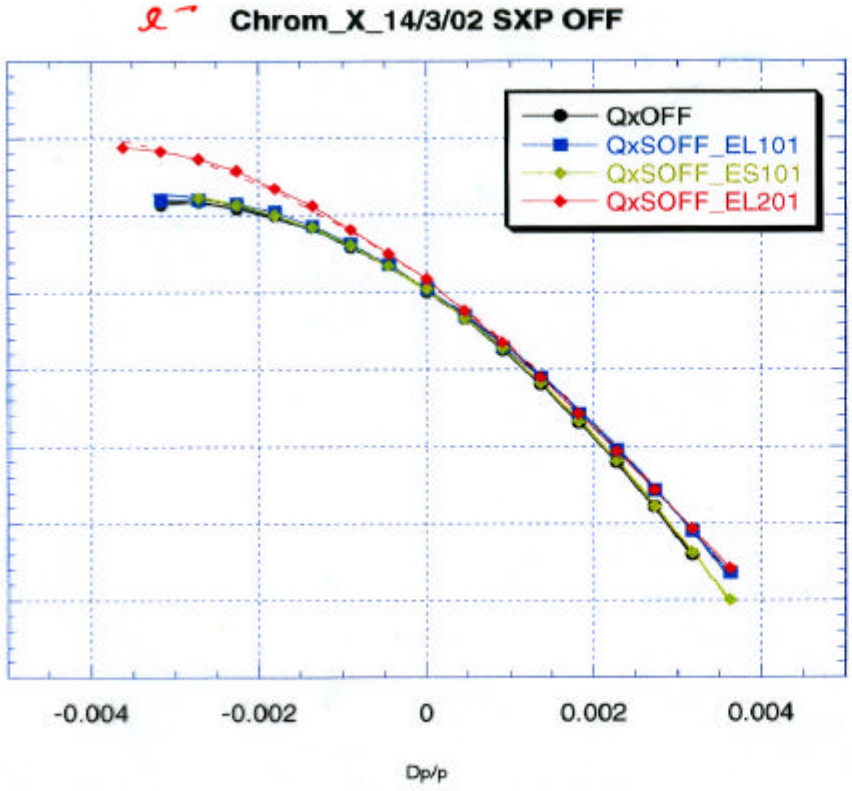
β_x	β_y	η_x	ν_x	ν_y	SEXT	OLD	NEW
2.973	7.491	-0.036	0.369	0.104	SXPPS201	0.	0.
5.183	1.362	0.921	0.510	0.236	SXPPS202	26.2	26.2
1.427	6.102	1.718	0.772	0.707	SXPPS203	84.	74.
9.991	9.433	0.341	1.026	0.767	SXPPS204	0.	0.
10.822	8.001	-0.351	1.437	1.431	SXPPL201	0.	0.
1.231	3.743	1.114	1.572	1.515	SXPPL202	45.	72.5
10.375	1.134	2.686	1.922	1.977	SXPPL203	30.	10.*
1.314	7.685	0.889	2.034	2.195	SXPPL204	0.	0.
1.260	7.204	0.878	3.122	2.511	SXPPL101	15.	0.
10.223	1.203	2.681	3.239	2.728	SXPPL102	26.7	30.*
0.998	4.073	1.158	3.570	3.191	SXPPL103	94.	72.5
7.912	6.116	-0.372	3.725	3.299	SXPPL104	0.	0.
8.664	5.215	0.346	4.12	4.419	SXPPS101	0.	0.
1.315	6.146	1.759	4.406	4.507	SXPPS102	79.	69.
5.349	1.321	0.939	4.643	4.977	SXPPS103	22.	22.

*experimentally found that these, unbalanced, have a better effect on τ.

ELECTRONS

β_x	β_y	η_x	ν_x	ν_y	SEXT	OLD	NEW
2.640	7.657	-0.063	0.353	0.090	SXPES201	0.	0.
5.537	1.347	0.91	0.497	0.224	SXPES202	38.8	30.
1.328	5.980	1.739	0.746	0.695	SXPES203	88.	83.
10.836	9.660	0.350	1.013	0.755	SXPES204	23.	0.
10.560	8.535	-0.390	1.426	1.409	SXPEL201	43.4	0.
1.367	3.758	1.116	1.555	1.490	SXPEL202	76.	71.5
9.925	1.166	2.729	1.910	1.952	SXPEL203	21.6	20.
1.434	7.493	0.891	2.020	2.176	SXPEL204	0.	0.
1.381	7.039	0.867	3.100	2.482	SXPEL101	0.	0.
9.842	1.233	2.615	3.213	2.705	SXPEL102	22.6	20.
1.106	4.079	1.161	3.552	3.169	SXPEL103	77.	71.5
7.755	6.567	-0.316	3.699	3.272	SXPEL104	0.	0.
9.460	5.427	0.315	4.105	4.384	SXPES101	0.	0.
1.242	5.976	1.739	4.394	4.473	SXPES102	67.	83.
5.774	1.300	0.967	4.619	4.942	SXPES103	23.	30.

Reduction of non-linearities with Octupoles



$Y = M0 + M1*x + \dots M8*x^8 + M9*x^9$	
M0	0.13025
M1	-7.2842
M2	-1139.3
R	0.99987

SXP OFF OCT OFF

$M_2 = -1140$

$Y = M0 + M1*x + \dots M8*x^8 + M9*x^9$	
M0	0.13044
M1	-6.9198
M2	-952.74
R	0.99964

$\Delta C_x = +0.4$

SXP OFF OCTEL101 @60 A

$\Delta M_2 = +187$

$Y = M0 + M1*x + \dots M8*x^8 + M9*x^9$	
M0	0.13022
M1	-7.3414
M2	-1062.6
R	0.99995

$\Delta C_x \simeq 0.$

SXP OFF OCTES101 @60 A

$\Delta M_2 = +77$

$Y = M0 + M1*x + \dots M8*x^8 + M9*x^9$	
M0	0.13148
M1	-7.7948
M2	-763.69
R	0.99964

$\Delta C_x = -0.5$

SXP OFF OCTEL201 @60 A

$\Delta M_2 = +376$

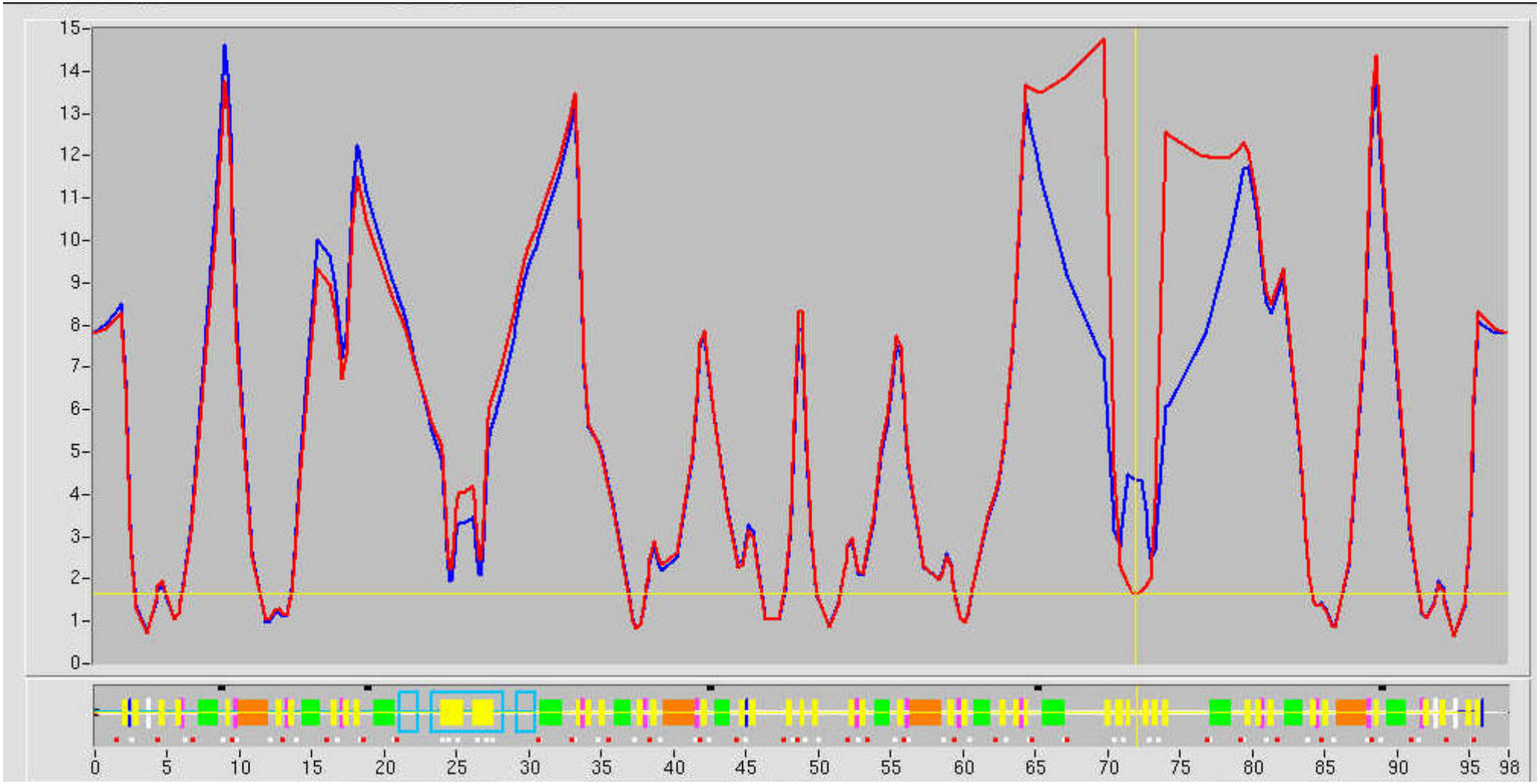
Background optimization with scrapers

Total Scrapers efficiencies	Colliding Beams (Ib=12.5mA)	Single beam
e+	~2.5 (Kloe) ~4 (Dear)	Same
e-	~6 (Kloe) ~4 (Dear)	Same

KLOE Scraper for KLOE Background is more efficient with other scrapers in

(same for DEAR case)

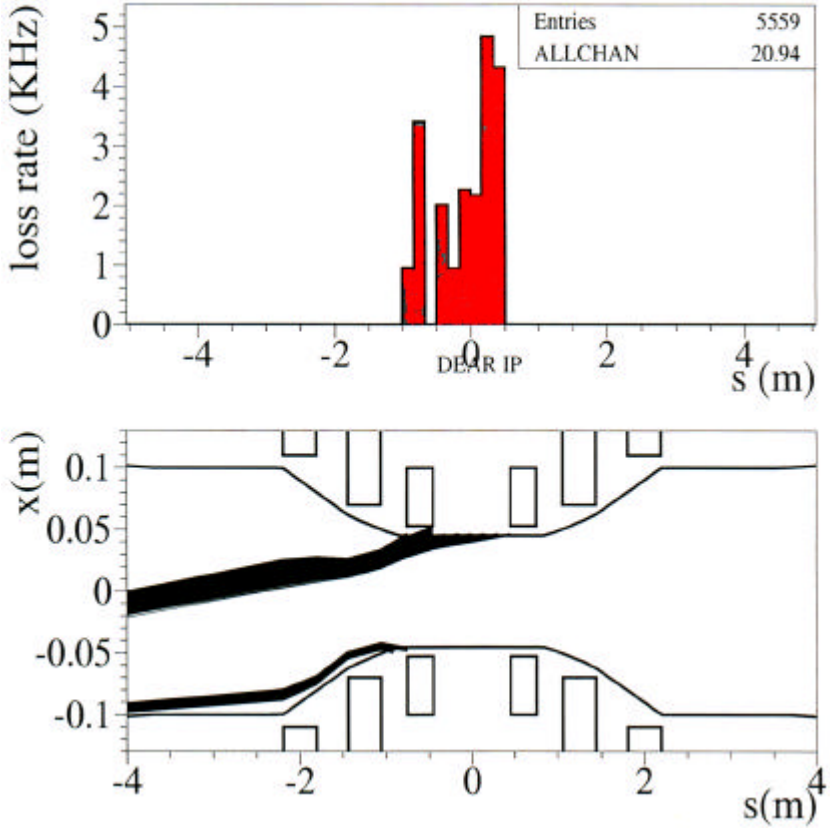
Low ?x in Dear



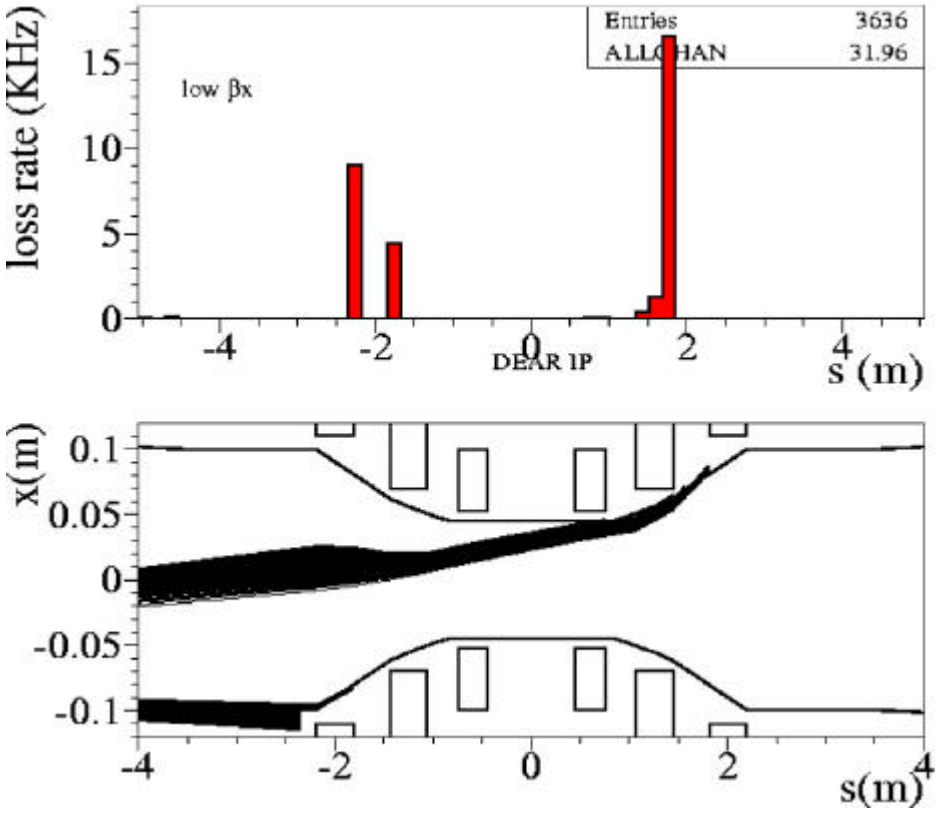
?x=4.4m in December ?x=1.7m in April

Touschek particles trajectories at DEAR IR

calculated background
With last December 2001 optics

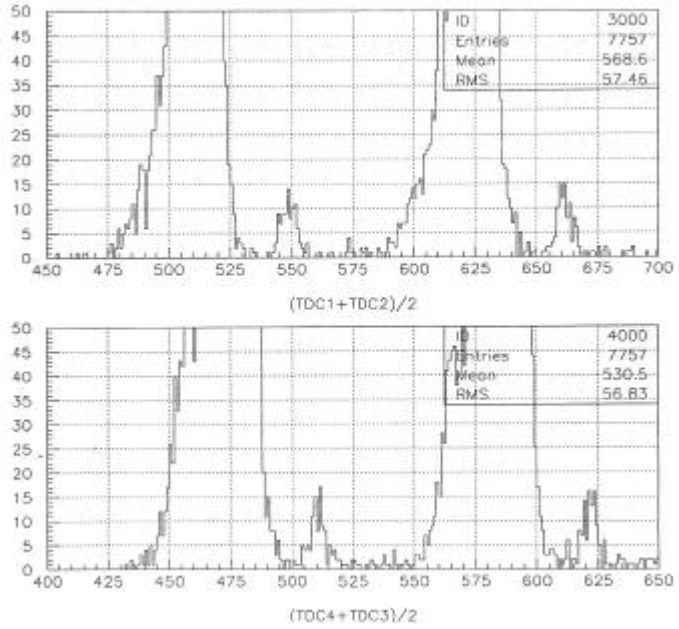


calculated background
with April 2002 optics
(low-β_x at IP and at first quad-F)

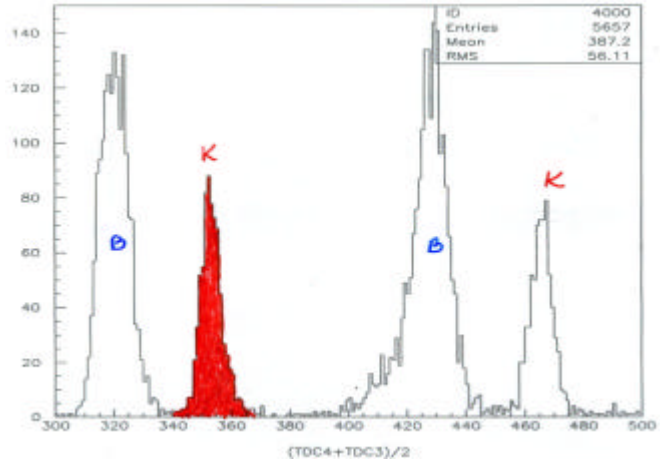


Background reduction in the DEAR Kaon Monitor

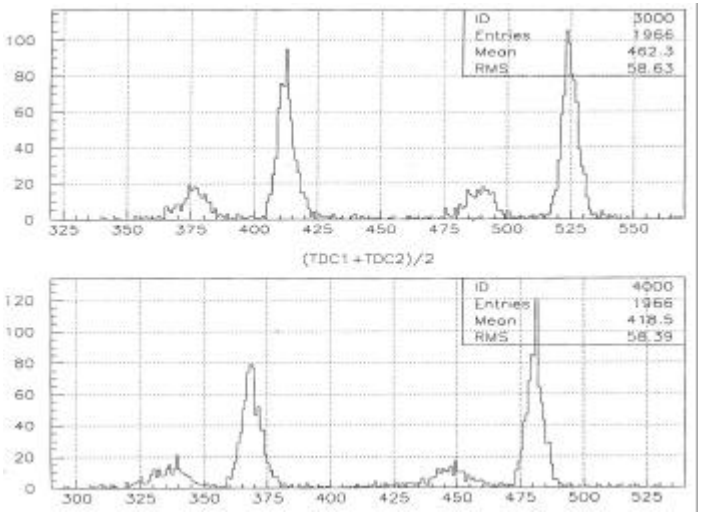
After machine and collimation optimization ->



Initial (Dec-like) Background and Kaons



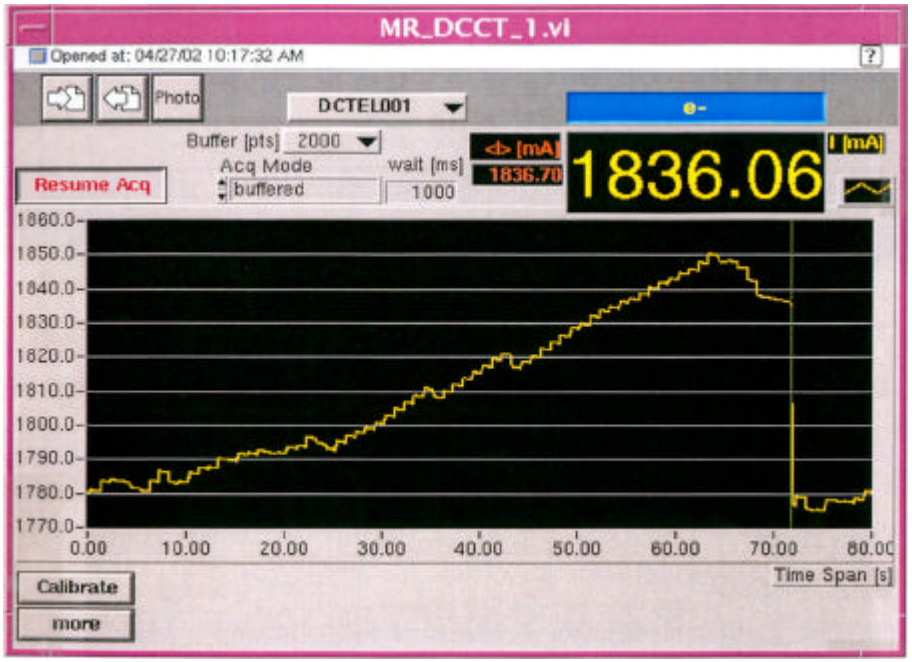
With low $?_x$ ->



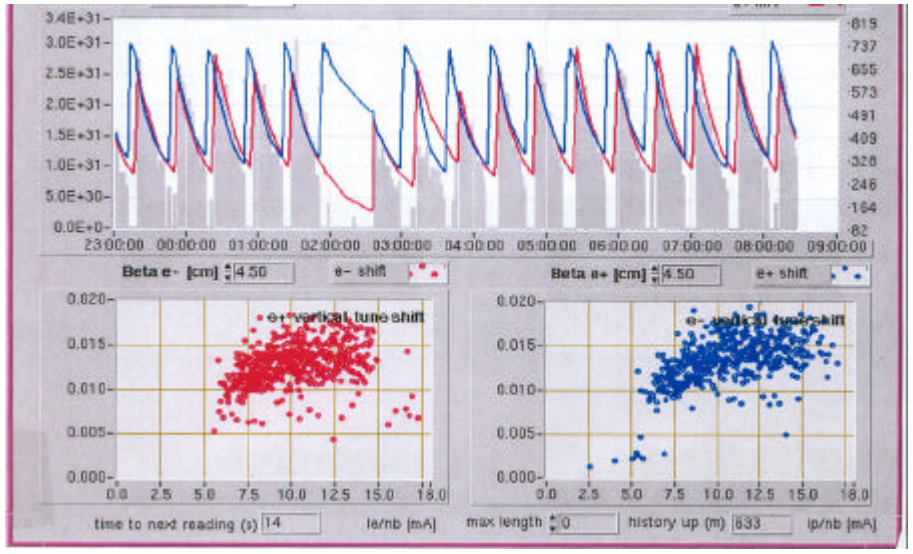
90 bunches collisions in DEAR

- With Low betax in Dear has been possible to successfully collide with 90 bunches/mod1 in DEAR
- Higher current: up to 1.3 Amps
- Longer lifetimes: less single bunch currents
- Less background

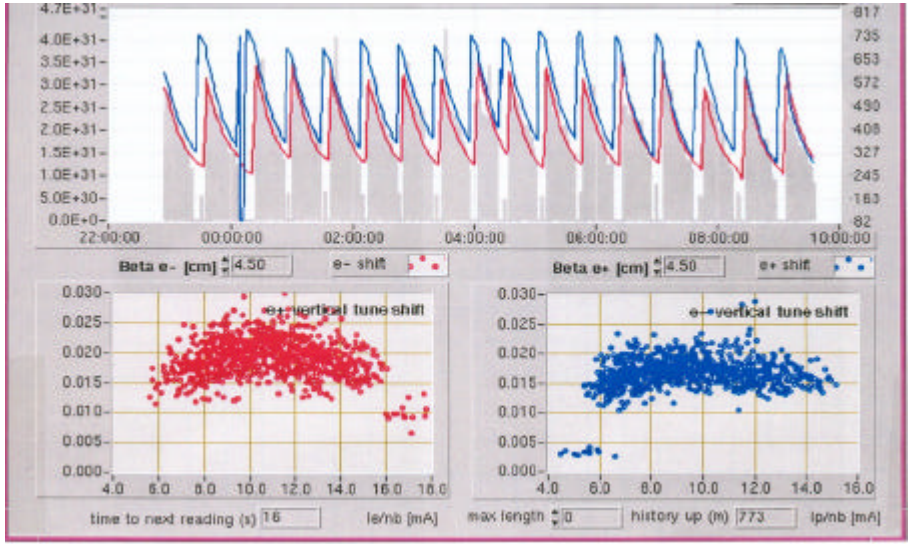
In the next DEAR run we should routinely collide with 90 bunches



90 bunches stable beam



Tune shift with β_x =4.4m



Tune shift with β_x=1.7m

Dear Tune shifts

- Tune shift increases like $1/\sqrt{\beta_x}$
- Tune shift flat above ~7mAmps single bunch

=>

No beam limit in the vertical plane, horizontal blow-up could be reduced with better machine-tunes working points

Kloe Run Commissioning

- **Background Optimization**
- Orbit Optimization (done 1st pass)
- Old and New Scrapers Optimization (done 1st-2st pass)
- Sextupoles Optimization (done 1st-2st pass)
- Octupoles Optimization (in progress)
- Increase Dynamic aperture with better ?s on Sexts. (in progress)
- Increase lifetimes with larger ?s on Wigglers
- **Luminosity Optimization**
- Adiabatic Tuning (in progress anytime)
- Different Working Point for e- (done 1st pass)
- Low $?_y$
- Low $?_x$
- Decrease horizontal emittance

Present Performance with KLOE

• Number of bunches per beam	45+45 -> 47+47
• Total current per beam (A)	~ 0.8
• Peak luminosity ($cm^{-2}s^{-1}$)	4.5 -> 4.8×10^{31}
• Average luminosity ($cm^{-2}s^{-1}$)	~ 3.0 -> 3.5×10^{31}
• Integrated luminosity per day (pb^{-1})	2.5 -> 2.9
• Luminosity lifetime (h)	~ 0.3 -> 0.4
• Number of fillings per hour	~ 4
• Data acquisition during injection	on

Best 2002 KLOE day

Netscape: Daily DAFNE Report

File Edit View Go Communicator

Bookmarks Location: http://dafne/cgi-bin/24hour

Google http://www.slac.stanford.edu/spires/ Directory listing of /home The BTeV

24 Hour Report for Operation
Date: Sunday 09 June 2002

8/6 DAY:

11 10 CWVE1101 in fault muoiono elettroni e meta' bunch positroni
11 30 muoiono elettroni a 590 mA

DAFNE	e-	e+	Storing	Down	Up
	5.6 Ah	5.4 Ah	100 %	0 %	100 %
Program	Delivered	Running	Logging	Average	Peak
KLOE	980.3	96 %	94 %	3.35e+31	4.68e+31

Personnel on duty:

Bolli Ceccarelli R. Fallica Lanzi Passarelli Quaglia Scampati

8/6 SWING:

14 10 si spengono vari quadrupoli sestupoli wiggler e dipoli e muoiono i due
19 05 DME*E*001 va a 0 i due fasci muoiono RF e- 00 si ricomincia da capo

DAFNE	e-	e+	Storing	Down	Up
	2.6 Ah	1.9 Ah	100 %	7 %	78 %
Program	Delivered	Running	Logging	Average	Peak
KLOE	211.8	11 %	8 %	6.06e+30	4.79e+31

Personnel on duty:

Boiro Debiase Divirgilio Giovinti Paven Pieri

9/6 OWL:

22.00. Problemi per scarsa luminosita'. KLOE ci avverte che siamo fuori energi
Rifacendo i cicli ai dipoli e ai Wiggler si torna in energia.
0.30. Riprendono collisioni per KLOE
2.55. Non si iniettano gli elettroni.Dopo doppio switch tutto torna OK
4.15. Muore cavita' elettroni (900 mA fil regolare) mentre si iniettano positr
5.15. Nuova correzione orbita elettroni con ottimizzazione della luminosita' e

DAFNE	e-	e+	Storing	Down	Up
	4.4 Ah	4.2 Ah	100 %	3 %	96 %
Program	Delivered	Running	Logging	Average	Peak
KLOE	580.4	8 %	8 %	1.94e+31	4.55e+31

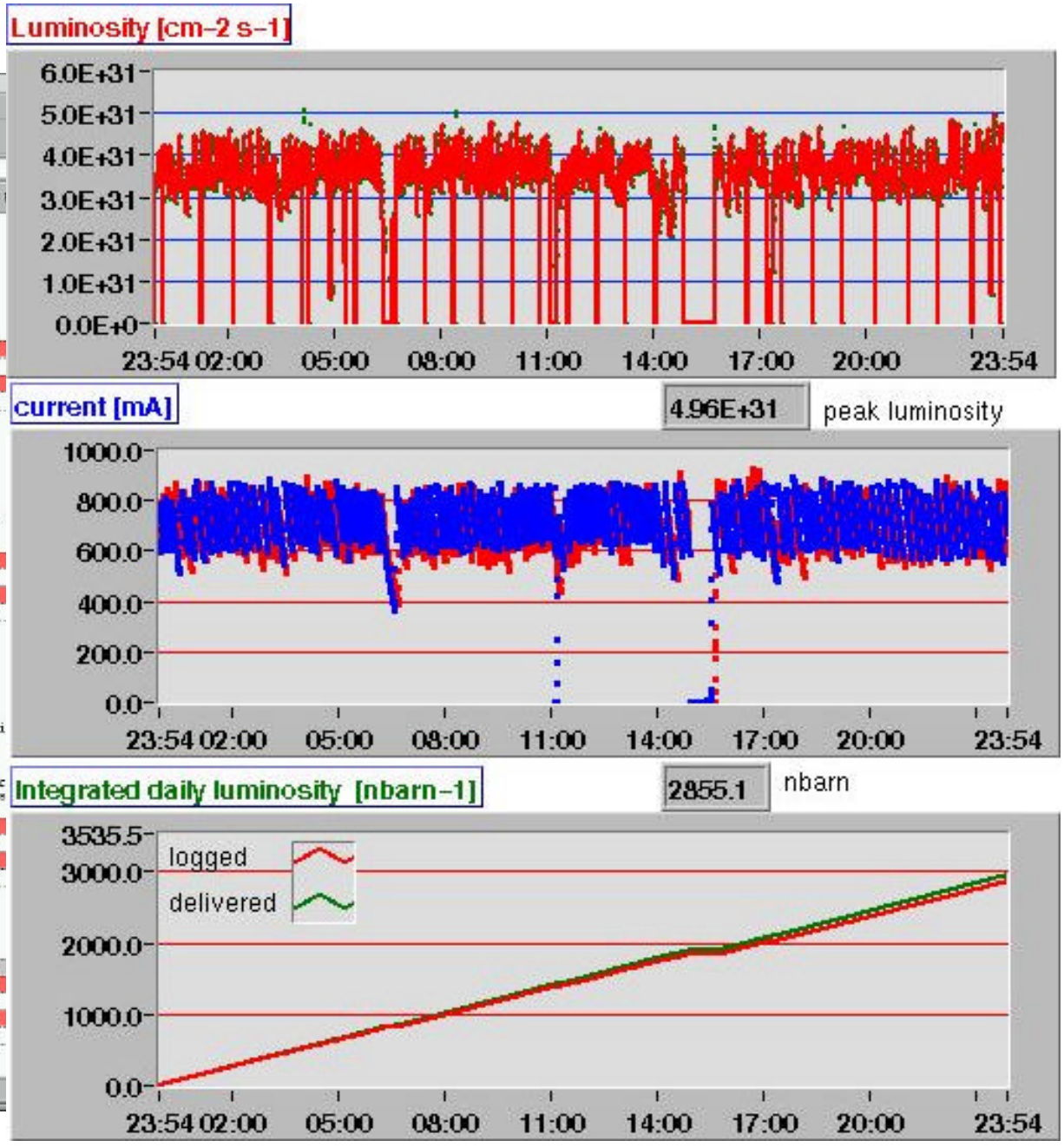
Personnel on duty:

Bolli Ermini Grossi Sorgi

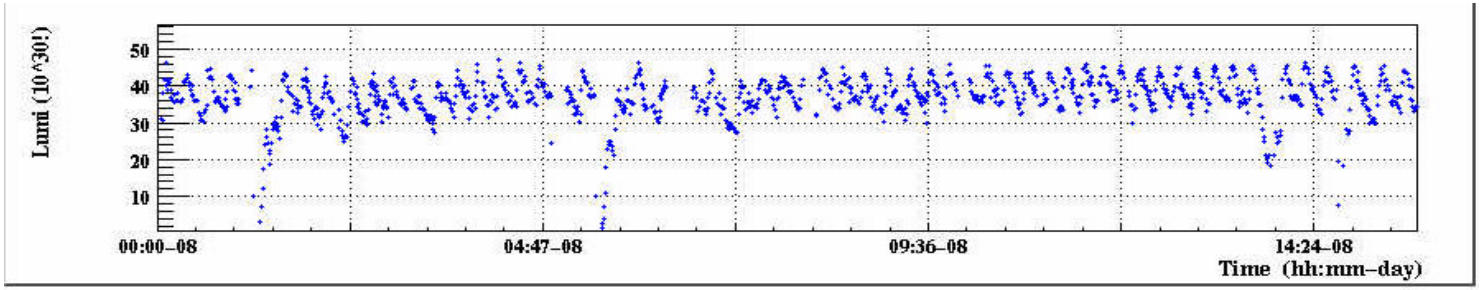
Summary Report

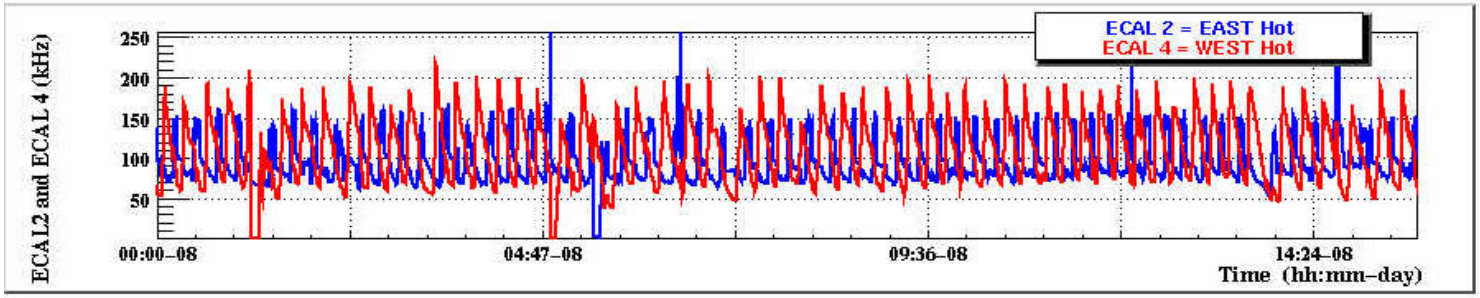
DAFNE	e-	e+	Storing	Down	Up
	12.6 Ah	11.5 Ah	100 %	3 %	92 %
Experiment	Delivered	Running	Logging	Average	Peak
	1772.5	39 %	37 %	1.97e+31	4.79e+31

100%

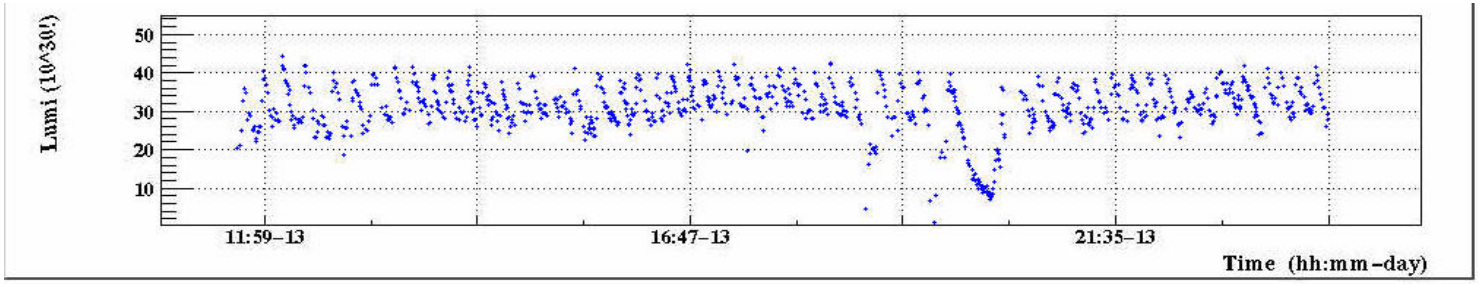


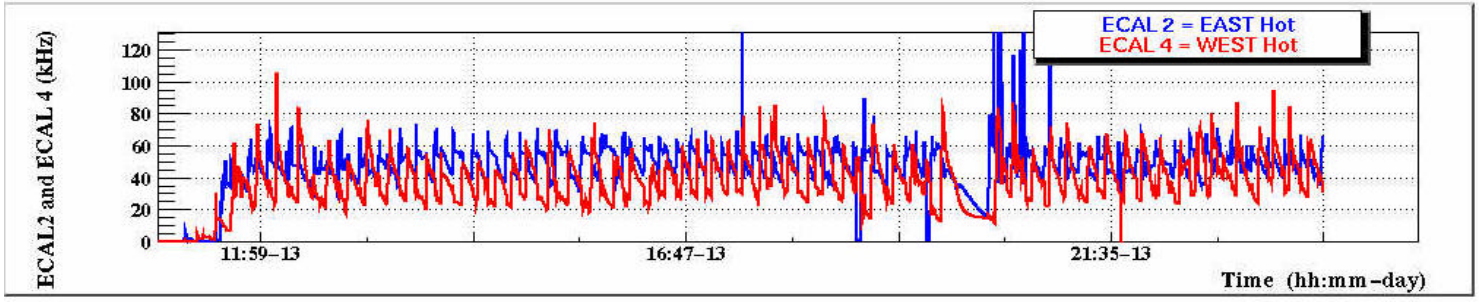
KLOE Background





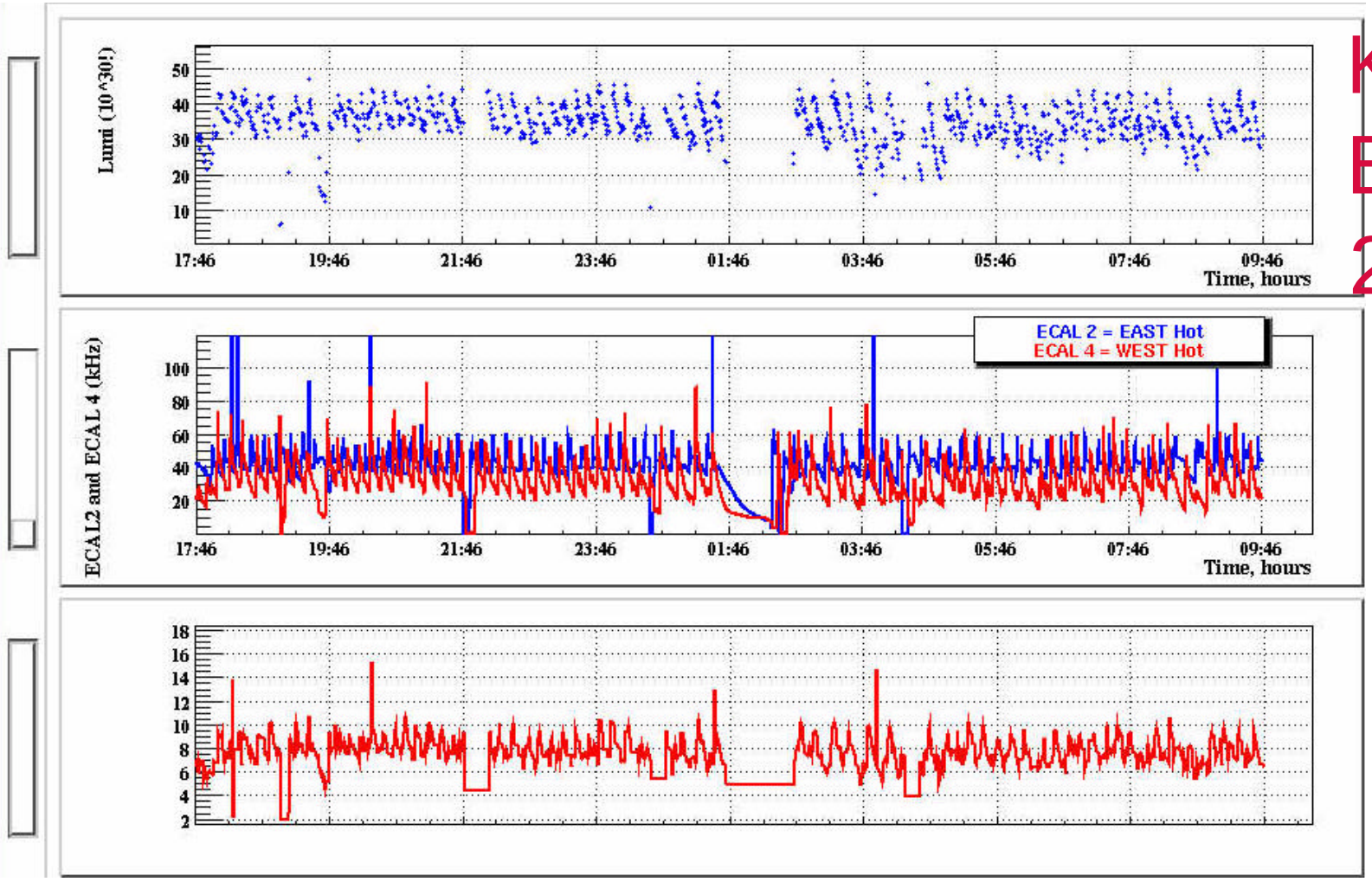
December:
Luminosity~4e31 ECAL Background~130KHz





May:
Luminosity~3.5e31 ECAL Background~50KHz

KLOE Background 2nd step

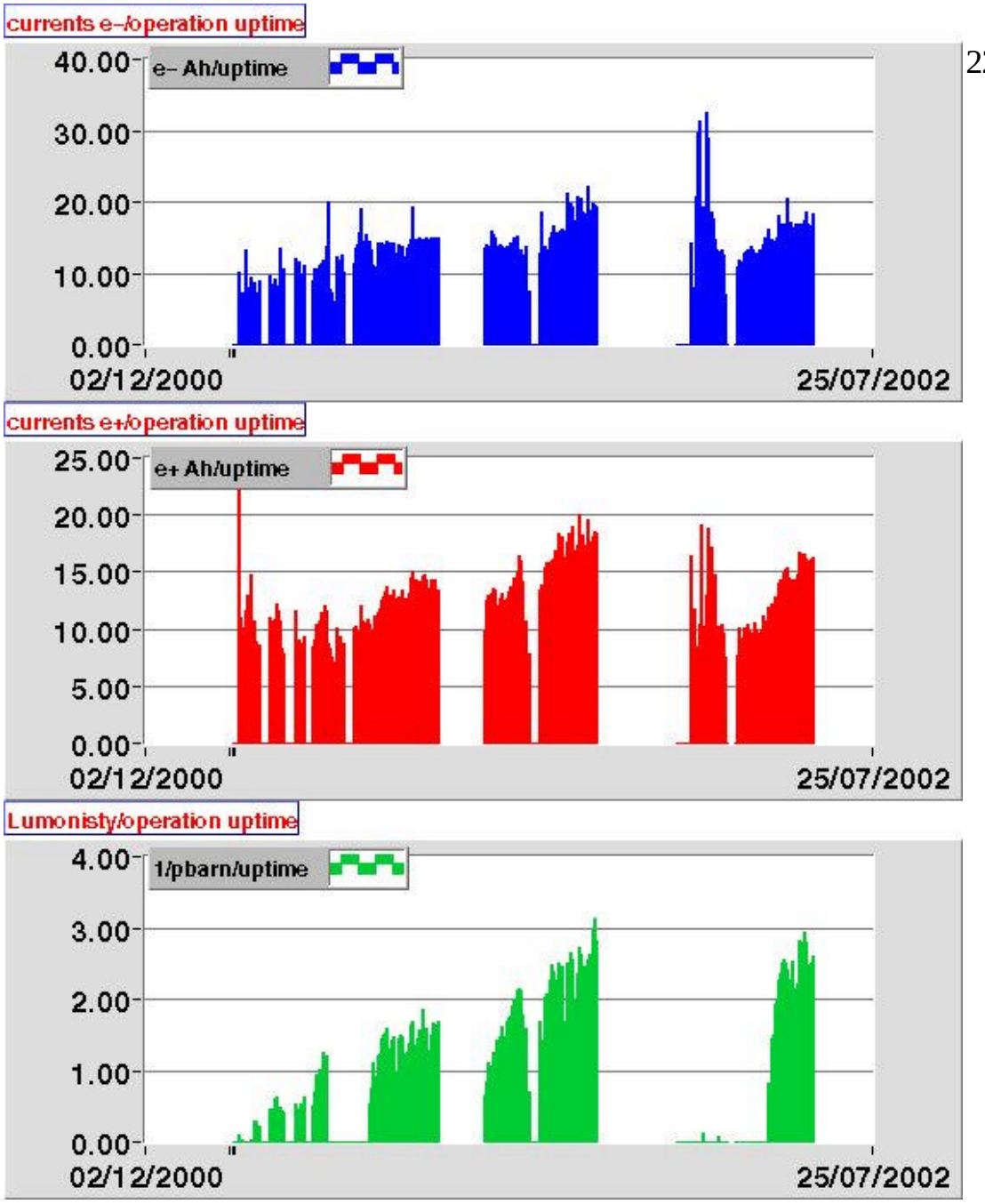


June: Luminosity~4.0e31

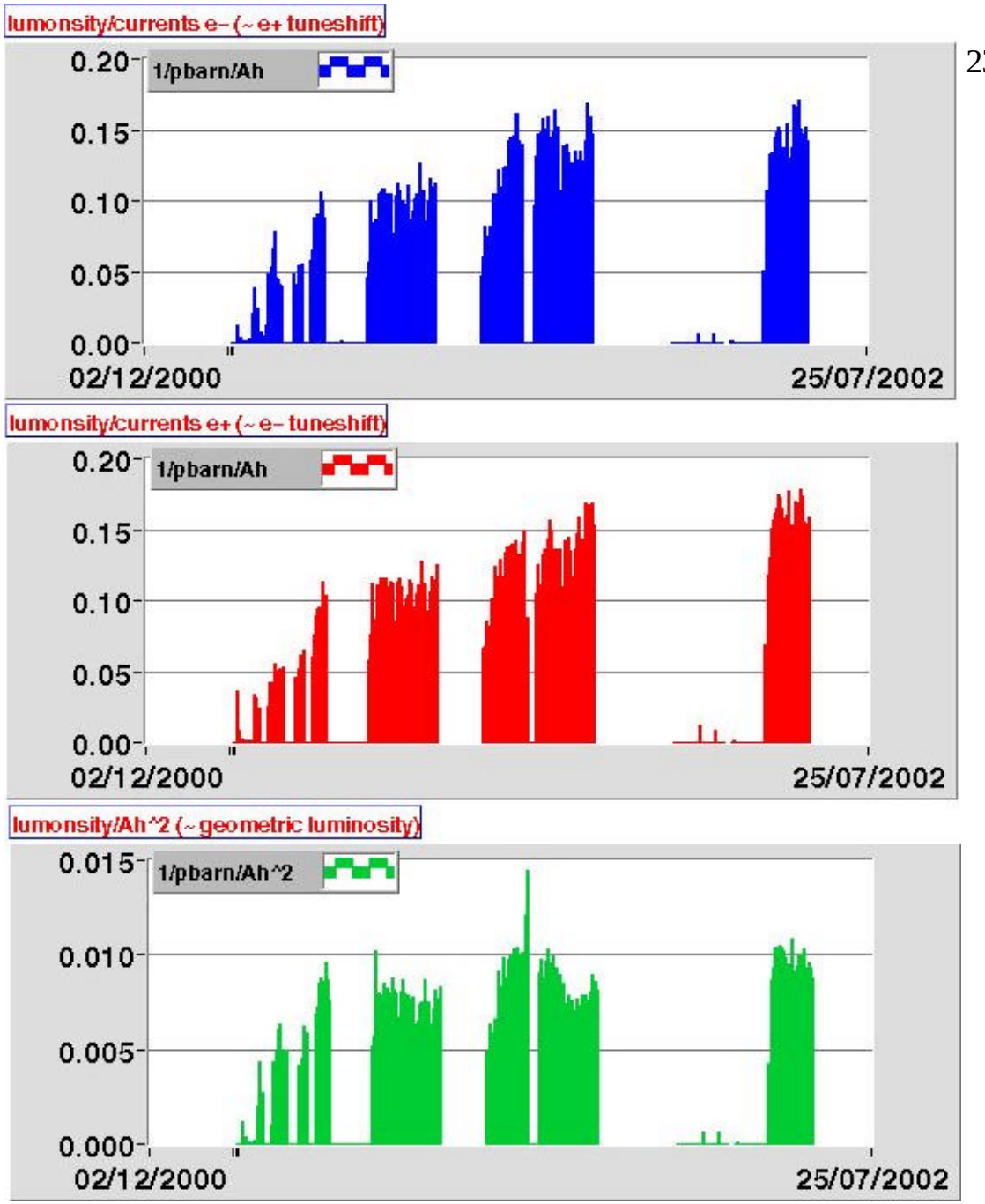
ECAL Background~30-40KHz

Lowest background in drift chamber

2001-2002 Amp*h and luminosity/uptime history



2001-2002
Pseudo Tune-shifts
and Specific-luminosity



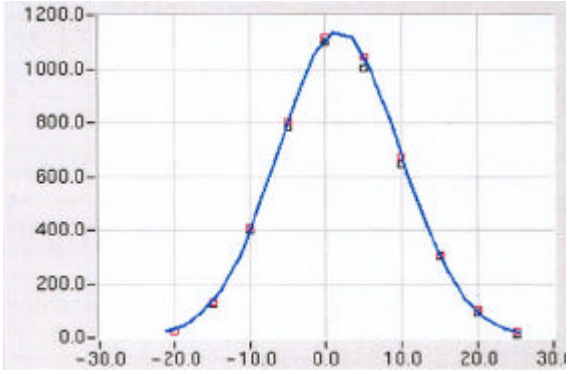
Orbit Optimization in KLOE

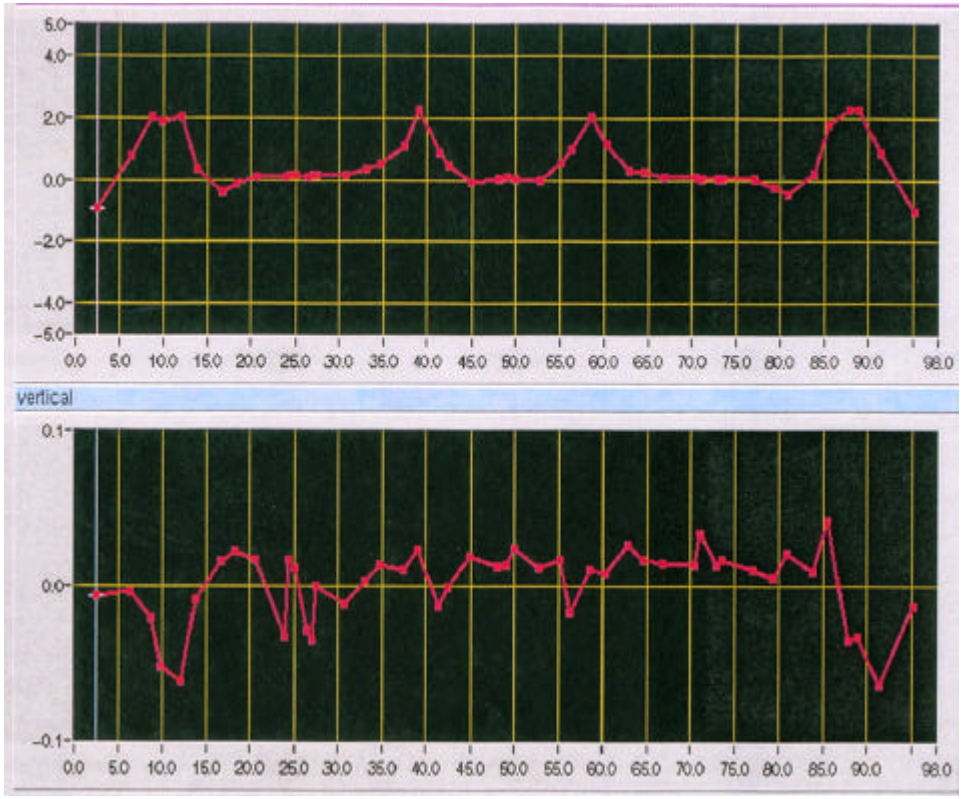
An improved steering algorithm to simultaneously minimize orbit and correctors let us to reach optimal orbit and corrector settings.

Consequently the vertical dispersion is one of the smallest ever reached in a storage ring: << 1cm

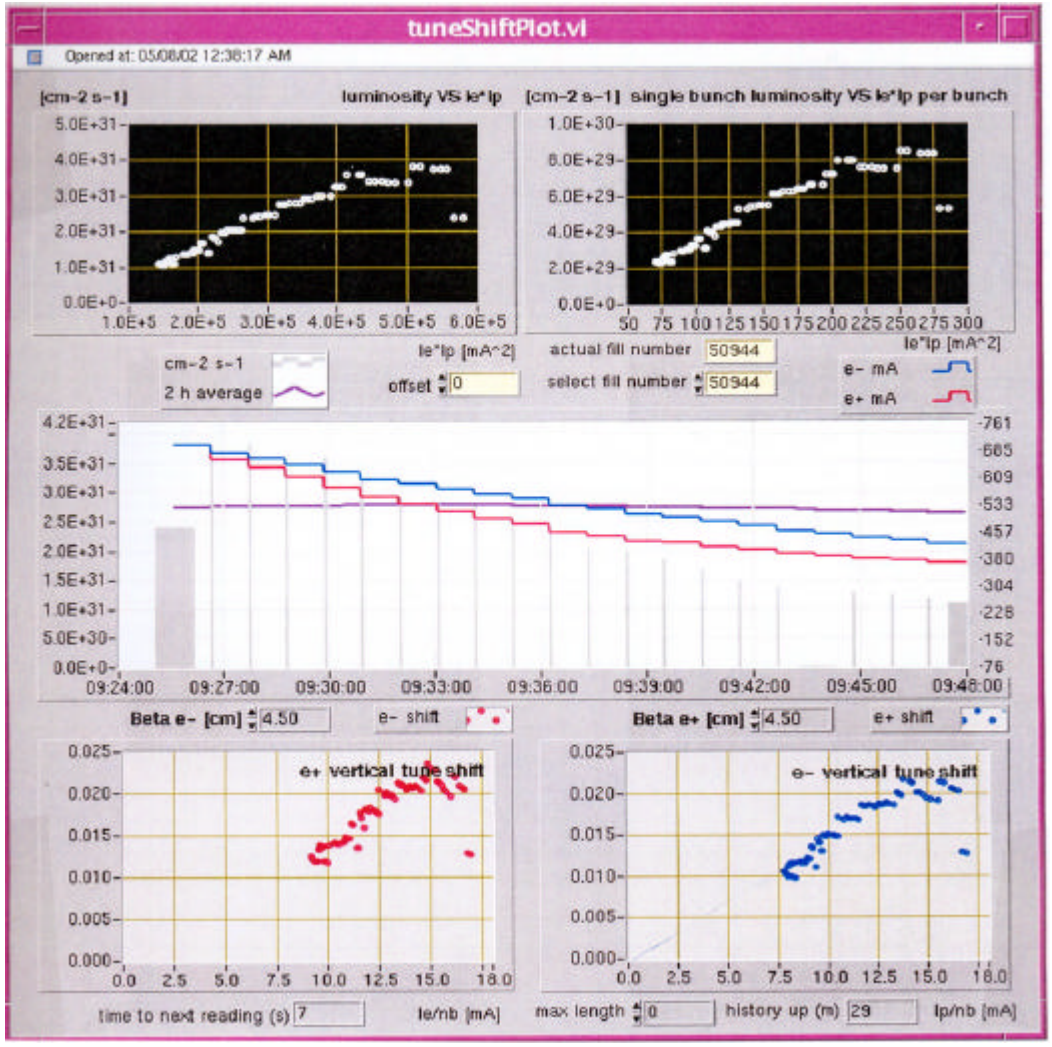
$?_Y$~??m,

$?_y$~$10^{-3}?_x$





Horizontal (up) and vertical (down) dispersion in the e- Ring



KLOE Tune shifts

- **Tune shift almost linear up to ~15mAmps single bunch**

  =>

- **No beam limit in the vertical and horizontal plane**
- **Machine-tunes working points almost ideal**

  e-: Q_x~0.112 Q_y~0.145

  e+: Q_x~0.151 Q_y~0.215
- **Possible to decrease Betas and increase currents**

Background Expectations for the Kloe Run

- **Supposing Dear-like Results:**

  Background multiplicative improvements:

  70-80 % from better orbits **(70% now)**

  50-70 % from new scrapers **(80% 70% now)**

  80-90 % from sextupoles opts. **(70% 60% now)**

  70-80 % from octupoles (new) **(100% 90% now)**

  40-80 % from Lattice changes **(100% now)**

? **overall between 2 (>2.5 and 3.5 now) and 12 reduction**

(Dear obtained reduction: >10)

Luminosity expectation for the Kloe Run

- Luminosity multiplicative improvements:
  - 1.0 – 1.2 from Different e+ working point
  - 1.1 – 1.2 from longer lifetimes (sexts+octs) (in progress)
  - 1.0 – 1.2 from lower β_y
  - 1.0 – 2.0 from smaller emittances

=> 1.1 - 3.4 improvement (L~5-16e31)

(Dear obtained improvement: 4, L~4.6e31)

- 1.2 – 1.7 from lower β_x (next year)
- 1.0 – 1.5 from 94 bunches operation

Present limits to ring Currents

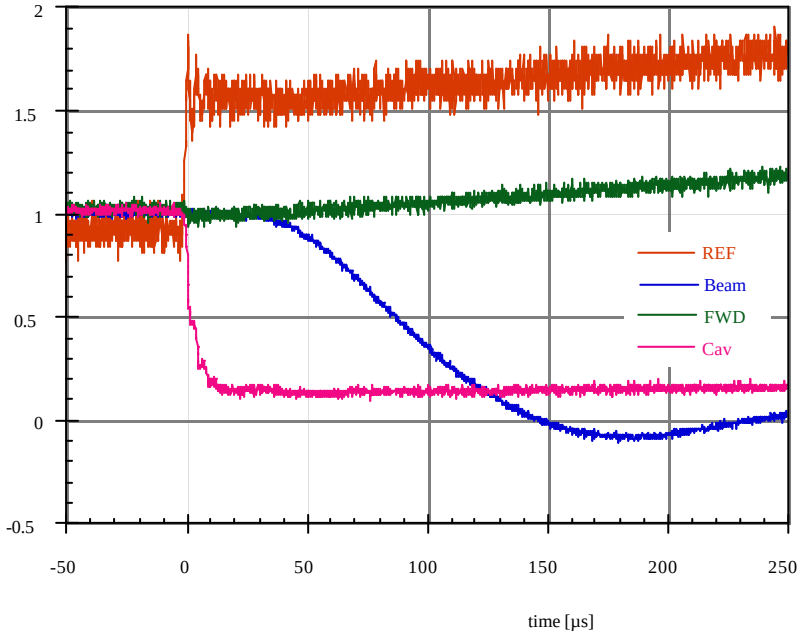
- **Both e+/e- currents limited to ~0.85 Amps in normal running condition**

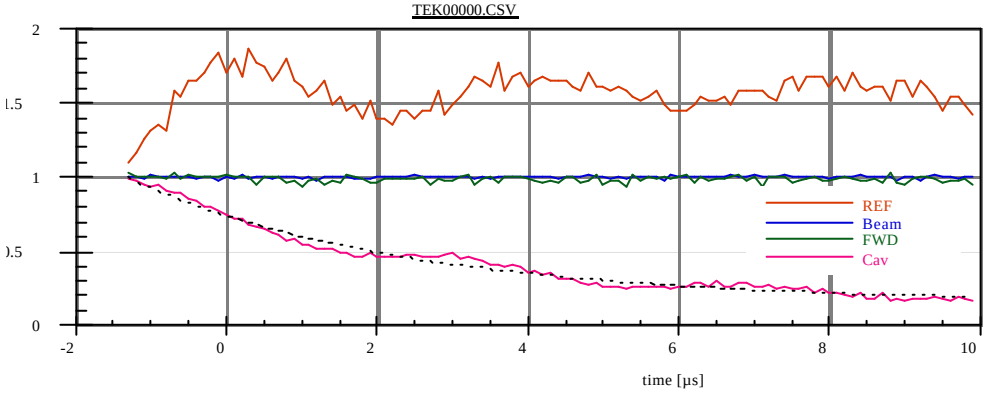
At higher currents: Background too high
Lifetimes too short

At the present, the e- RF cavity trips at about 0.9Amps in the 45bunches/mod2 mode. No trips seen in the 90bunches/mod1 mode => Higher order mode from the beam…

e- RF cavity problem

- e⁻ RF cavity refurbished in the January stop because sparking at the tuner
- At same time changed the beta for both cavity by rotating the coupling loops
- The cavity trips because a trapped high order mode

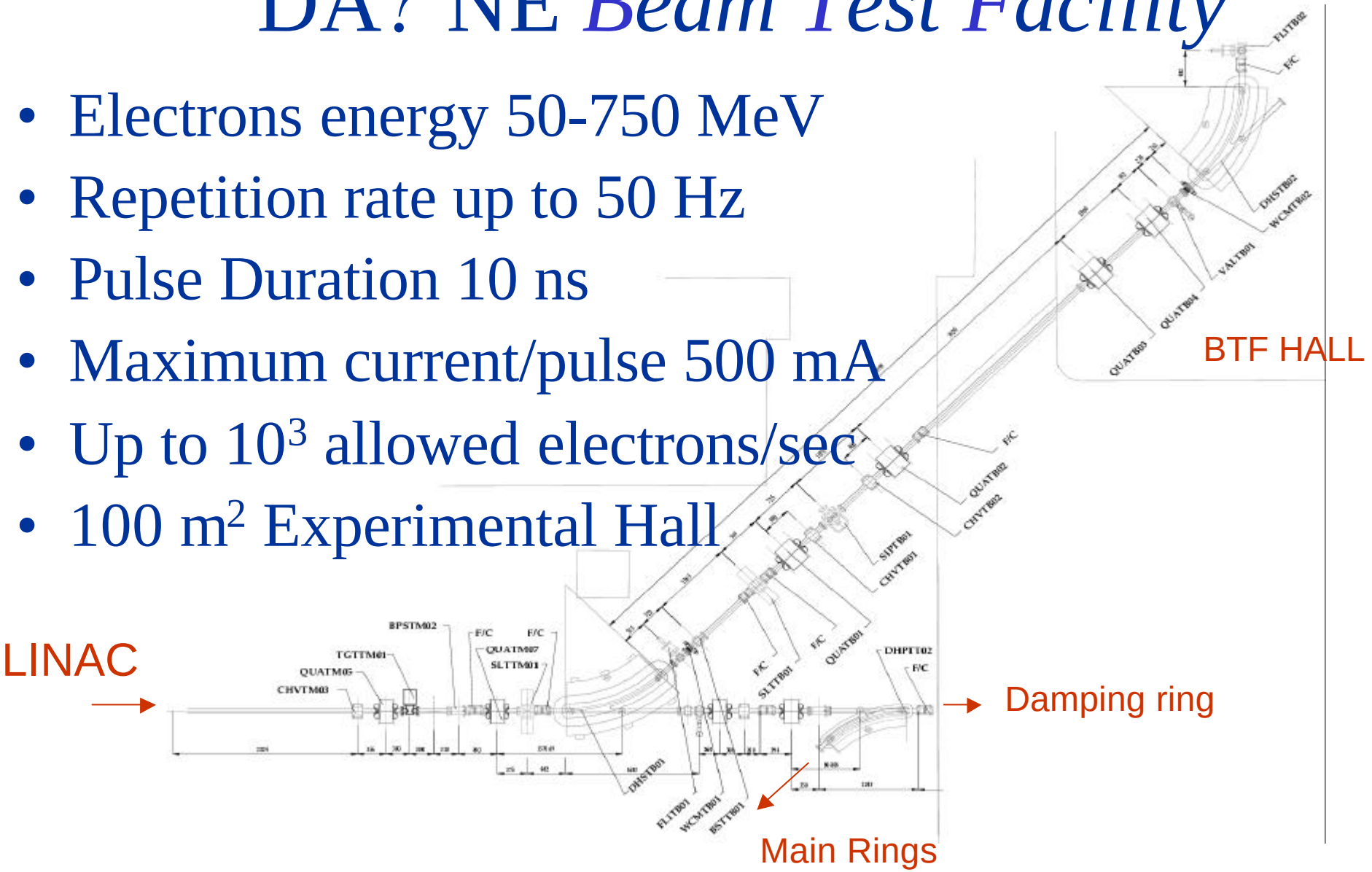




y = m1 + m2 * exp(-(M0-m3)/m...		
	Value	Error
m1	0.15746	0.010466
m2	0.82737	3.3371e+05
m3	-1.2461	1.4601e+06
?	**3.62 μs**	0.14891
Chisq	0.10838	NA
R	0.99014	NA

DA? NE *Beam Test Facility*

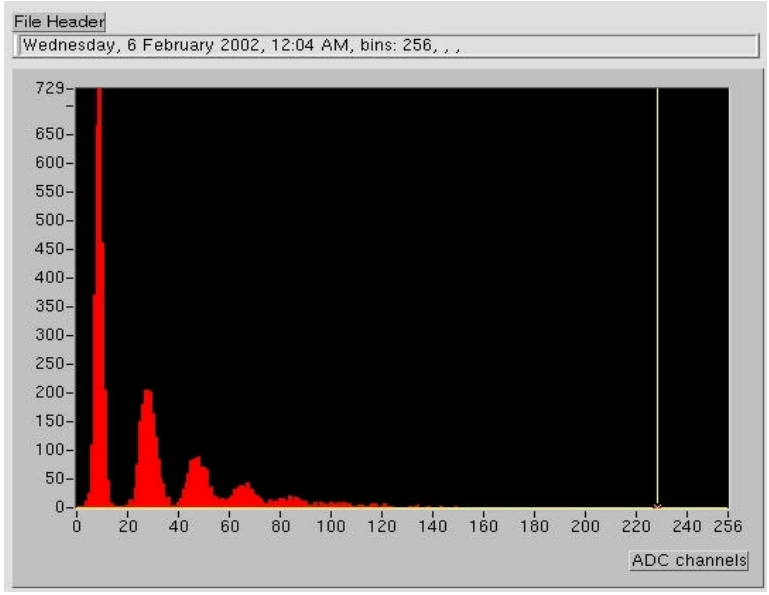
- Electrons energy 50-750 MeV
- Repetition rate up to 50 Hz
- Pulse Duration 10 ns
- Maximum current/pulse 500 mA
- Up to 10^3 allowed electrons/sec
- 100 m^2 Experimental Hall

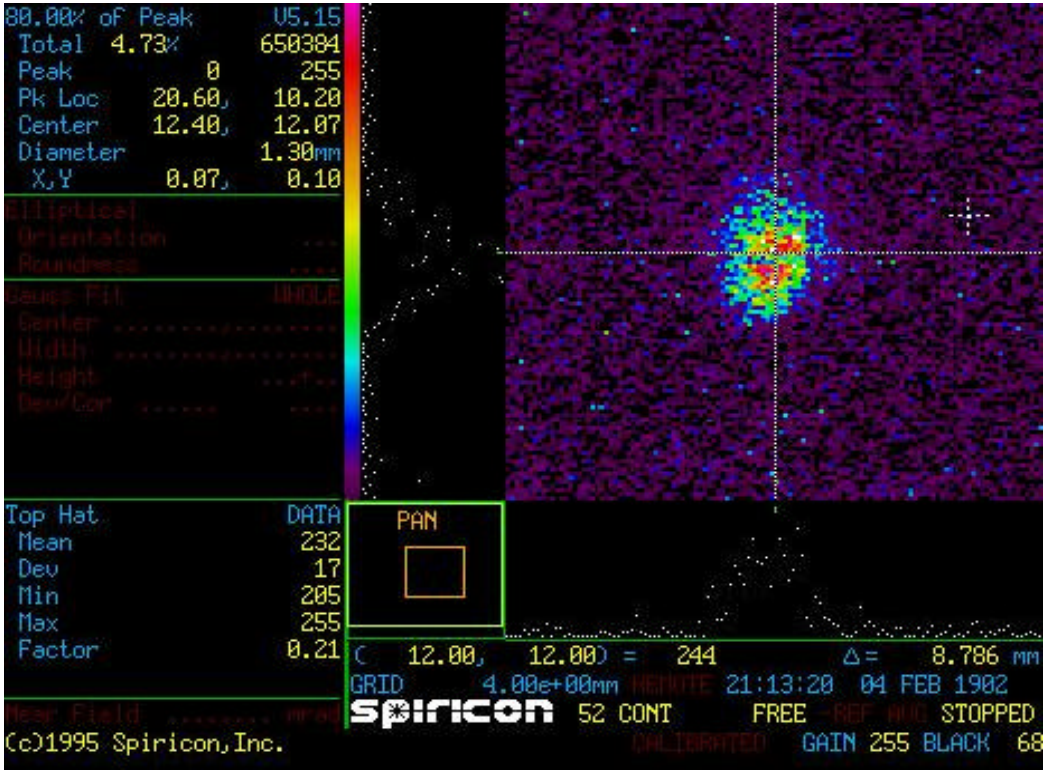


Commissioning

- The *1st of February* we started the commissioning of the line

- The *2nd of February* we obtain the first single electron distribution



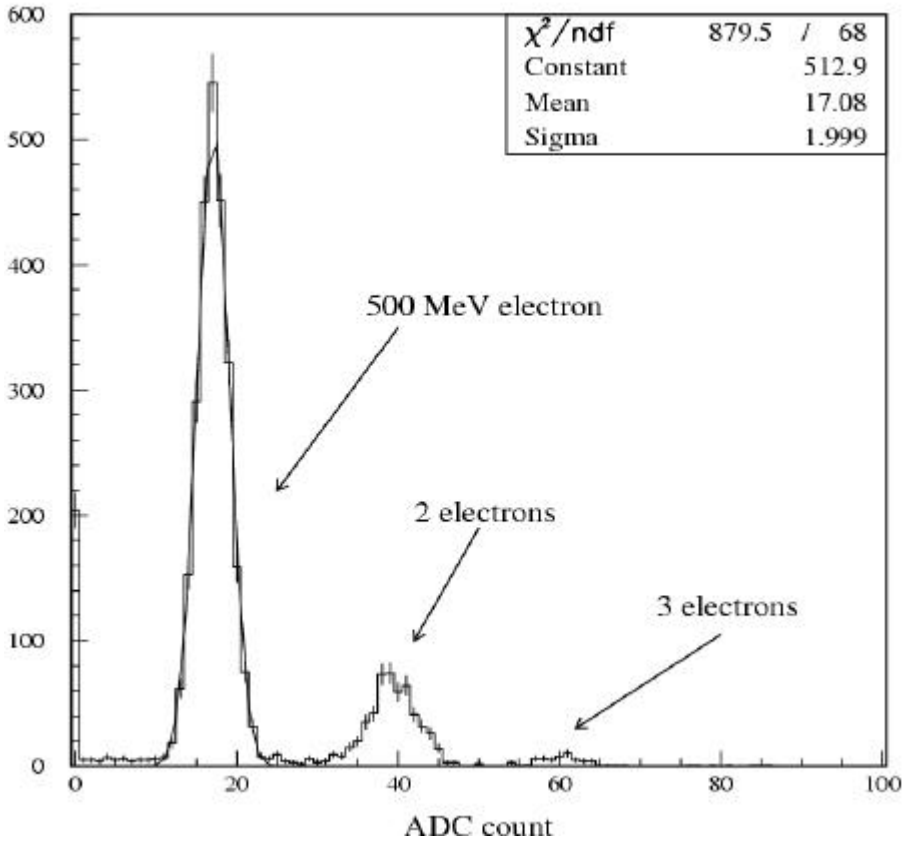


Flag TB002

DA? NE *Beam Test Facility*

The **DA? NE** ***Beam Test Facility*** is a beam transfer line designed in order to optimize the operation mode in which single electrons are stochastically produced for detector calibration purpose.
The facility has been successfully commissioned and is now in the optimization phase (efficient transportation, work in parasitic mode, etc)

- 50 ÷ 750 MeV electrons
- pulse duration: 10 ns
- 30% efficiency for single electron production already achieved
- 10^3 electrons/s allowed by radiation protection



2 mA Linac pulses have been attenuated by means of a 1.7 X_0 copper target (2.0 or 2.3 X_0 depths can also be chosen).

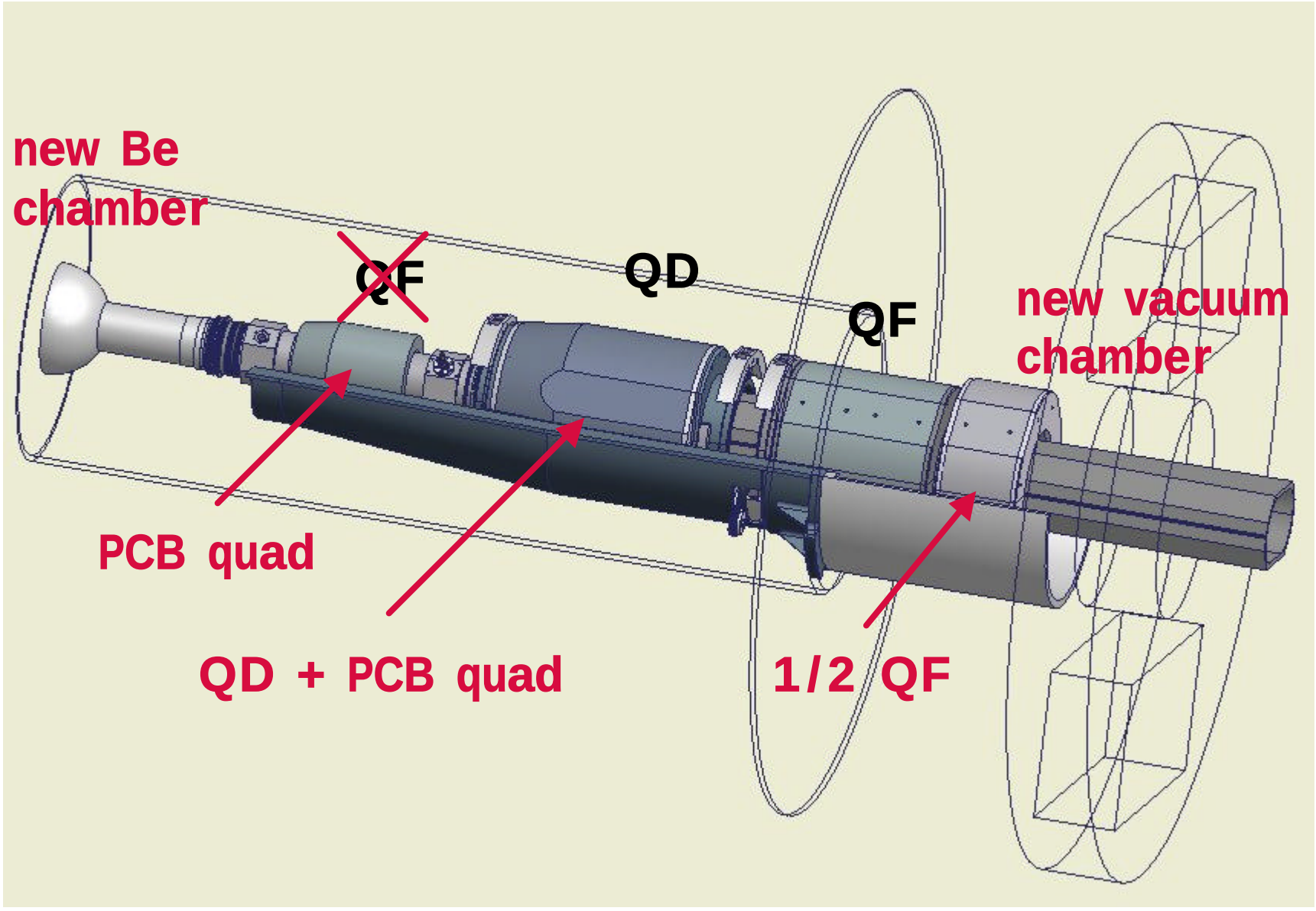
2002 time schedule

- 2 months for Dear => 40-60 pb^{-1}
- 4 months for Kloe => 250-500 pb^{-1}
- 2 months for Finuda and Kloe N.I.R. installation

2002 goals

- **Deliver > 300 pb^{-1} to KLOE**
- **Further improve luminosity performance and signal-to-background ratio in order to observe and measure the properties of kaonic hydrogen in DEAR (~ 50 pb^{-1})**
- **During a long shutdown (from November 2002 to January 2003) install new interaction regions for KLOE and for a new magnetic detector (FI.NU.DA.,aimed at the study of hypernuclear physics on IP2), with modified optic and supports in order to decrease the IP beta-functions, optimise background rejection and provide variable quadrupole rotation to operate at different magnetic fields (from 0 to maximum) in the solenoids.**

KLOE New Interaction Region



Conclusions

DAFNE understanding steadily improving

DAFNE limitations slowly overcome

DAFNE performances steadily improving

2002 Goals very tight but still possible

Expectations for a new DEAR Run

- **Background multiplicative improvements:**

  70-90 % from better shielding

  50-90 % from further optic improvements

  70-90 % from 90 bunches operation

  => between 1.3 and 4 reduction overall

- **Luminosity multiplicative improvements:**

  1.1 – 1.5 from different e-/e+ working point

  1.2 – 1.5 from 90 bunches operation

  => 1.3 – 2.3 improvement (L~5-10e31) overall