Rapporto sul workshop di Alghero

Considerazioni / idee per un progetto di macchina ad alta luminosità o alta energia

C. Biscari
LNF, INFN

Workshop on

e+ e- in the 1-2 GeV range: Physics and Accelerator Prospects

ICFA Mini-workshop - Working Group on High Luminosity e+e- Colliders

10-13 September 2003, Alghero (SS), Italy

International Advisory Committee

T. Bressani (Università Torino)
S. Brodsky (SLAC)
M. Calvetti (Università Firenze)
F. Close (Oxford University)
E. De Sanctis (INFN-LNF)
D. Drechsel (Mainz University)
P. Franzini (Università Roma1)
C. Guaraldo (INFN-LNF)
J. Jowett (CERN)
J. Lee Franzini (INFN-LNF)
L. Maiani (CERN)
E. Perevedentsev (BINP)
R. Petronzio (Università Roma2)
D. Rice (Cornell)
J. Seeman (SLAC)
S. Serci (INFN-Cagliari)
E. Solodov (BINP)
C. Zhang (IHEP)

Organizing Committee

R. Baldini (INFN-LNF)
S. Bertolucci (Chairman) (INFN-LNF)
M. Biagini (INFN-LNF)
C. Biscari (INFN-LNF)
F. Bossi (INFN-LNF)
U. Bottigli (Università Sassari)
F. Ferroni (Università Roma1)
G. Isidori (INFN-LNF)
G. Pancheri (INFN-LNF)
M. Serio (INFN-LNF)
M. Zobov (INFN-LNF)

Secretariat

Manuela Giabbai, Lia Sabatini
INFN-LNF
Via Enrico Fermi, 40
00044 Frascati (RM)
Tel. +39-069403-2274/2552
Fax +39-0694032256
E-mail d2@lnf.infn.it

Sponsored by:

Università degli Studi di Cagliari

ICFA

INFN Istituto Nazionale di Fisica Nucleare

UNIVERSITÀ degli STUDI di SASSARI

http://www.lnf.infn.it/conference/d2/

114 participants
of which…

Agnello Michelangelo Politecnico di Torino
Alberico Wanda Maria Univ. Torino & INFN-
Antonelli Antonella INFN-LNF
Antonelli Mario INFN-LNF
Baldini Ferroli Rinaldo INFN-LNF
Battaglieri Marco INFN-Genova
Bencivenni Giovanni INFN-LNF
Benedetti Gabriele INFN-LNF
Bertani Monica INFN-LNF
Bertolucci Sergi INFN-LNF
Biagini Maria Enrica INFN-LNF
Biscari Caterina INFN-LNF
Bloise Caterina INFN-LNF
Boni Roberto INFN-LNF
Boscolo Manuela INFN-LNF
Bossi Fabio INFN-LNF
Botta Elena INFN-Torino
Bottigli Ubaldo Università Sassari
Bramon Albert Univ. Autonoma de Barcelona
Branchini Paolo INFN-Roma3
Bressani Tullio INFN-Torino
Brodsky Stanley SLAC
Busso Luigi INFN-Università Torino
Calvetti Mario Università Firenze & INFN-Firenze
Campana Pierluigi INFN-LNF
Capon Giorgio INFN-LNF
Ceccucci Augusto CERN
Cenci Patrizia INFN-Perugia
Chiavassa Emilio Università & INFN Torino
Cimino Roberto INFN-LNF
Clozza Alberto INFN-LNF
Conetti Sergio University of Virginia
Corcoran Marjorie Rice University
Czyz Henryk Inst. of Physics, Univ. of Silesia

D'Ambrosio Giancarlo INFN-Napoli
Dal Piaz Piero Università & INFN-Ferrara
De Falco Alessandro INFN-Cagliari
de Rafael Eduardo CPT-CNRS-Marseille
De Sanctis Enzo INFN-LNF
De Simone Patrizia INFN-LNF
Dell'Agnello Simone INFN-LNF
Denig Achim Universitaet Karlsruhe / IEKP
Di Domenico Antonio Univ. Roma1
Di Donato Camilla INFN-Napoli
Diemoz Marcella INFN-Roma1
Dosselli Umberto INFN-Padova
Drago Alessandro INFN-LNF
Dubnicka Stanislav Inst. of Physics SAS
Feliciello Alessandro INFN-Torino
Ferretti Dal Piaz Paola INFN-Ferrara
Ferroni Fernando Università Roma "La Sapienza"
Filippi Alessandra INFN-Torino
Fox John SLAC
Franzini Paolo Università Roma “La Sapienza”
Gallo Alessandro INFN-LNF
Gauzzi Paolo Università Roma 1 & INFN
Ghigo Andrea INFN-LNF
Giannini Mauro Università & INFN-Genova
Giovannella Simona INFN-LNF
Greco Mario Univ. Roma III
Guiducci Susanna INFN-LNF
Iacopini Enrico INFN-Firenze
Ikeda Hitomi KEK
Isidori Gino INFN-LNF
Jaffe David Brookhaven National Laboratory
Lanfranchi Gaia INFN-LNF
Lee-Franzini Juliet Università Roma 1 LNF
Ligi Carlo INFN-LNF

Lim Youb KEK
Llanes Estrada Felipe Univ. Complutense
Lubicz Vittorio Università Roma Tre
Mangano Michelangelo CERN
Mazzitelli Giovanni INFN-LoNF
Milardi Catia INFN-LNF
Mirazita Marco INFN-LNF
Miscetti Stefano INFN-LNF
Morra Ombretta INFN-CNR Torino
Moulson Matthew INFN-LNF
Muccifora Valeria INFN-LNF
Mueller Stefan Uni Karlsruhe
Napolitano Marco Univ. & INFN-Napoli
Nappi Aniello Università Perugia
Outa Haruhiko IPNS, KEK
Pacetti Simone Università Perugia & INFN
Palutan Matteo INFN-LNF
Passalacqua Luca INFN-LNF
Passeri Antonio INFN-Roma3
Patera Vincenzo INFN-LNF
Paticchio Vincenzo INFN-Bari
Pennington Michael University of Durham
Petrascu Catalina INFN-LNF
Placidi Massimo LBNL
Preger Miro Andrea INFN-LNF
Raimondi Pantaleo INFN-LNF
Ricci Ruggero INFN-LNF
Ripani Marco INFN-Genova
Rubin David Cornell University
Ruggiero Francesco CERN
Salmè Giovanni INFN-Roma1
Serci Sergio INFN-Cagliari
Serio Mario INFN-LNF
Shatunov Yuri BINP

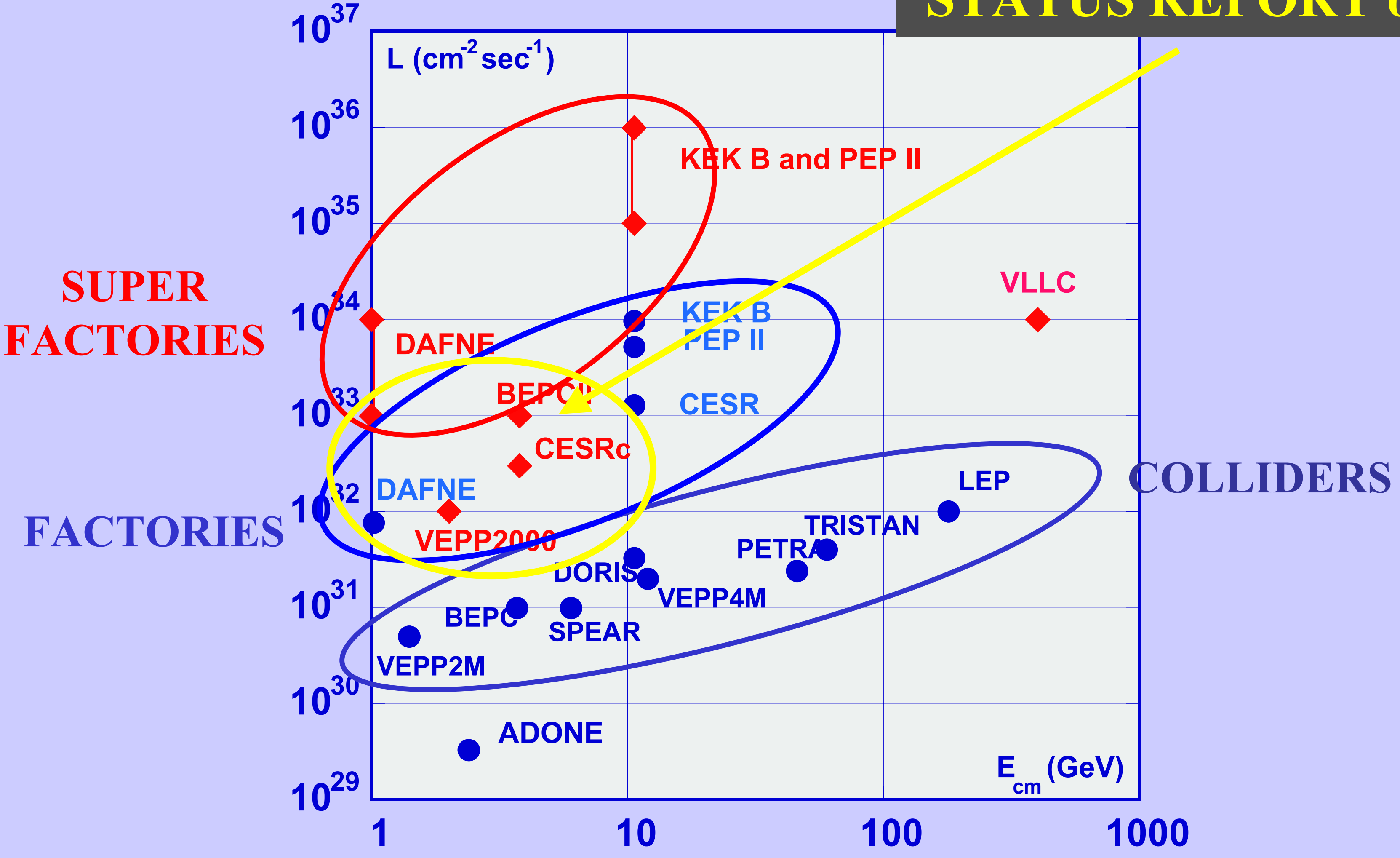
Sibidanov Aleksej BINP
Solodov Evgeni BINP
Sozzi Marco CERN
Spadaro Tommaso INFN-LNF
Temnykh Alexander Cornell University
Teytelman Dmitry SLAC
Tomassini Sandro INFN-LNF
Valente Paolo INFN-LNF
Vescovi Mario INFN-LNF
Zenoni Aldo Università Brescia
Zhang Chuang Institute of High Energy Physics
Zobov Mikhail INFN-LNF

30 for ACCELERATORS

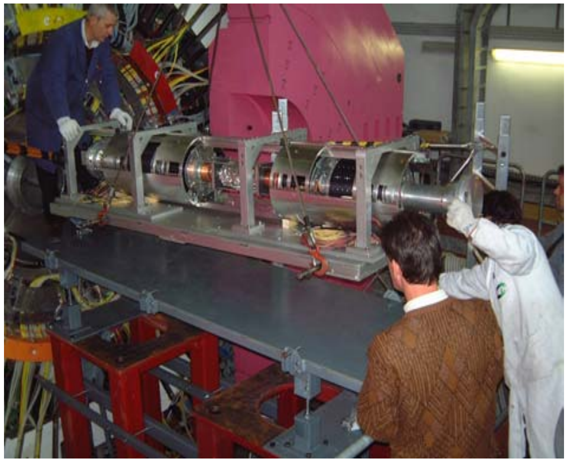
Benedetti Gabriele INFN-LNF
Biagini Maria Enrica INFN-LNF
Biscari Caterina INFN-LNF
Boni Roberto INFN-LNF
Boscolo Manuela INFN-LNF
Cimino Roberto INFN-LNF
Clozza Alberto INFN-LNF
Drago Alessandro INFN-LNF
Fox John SLAC
Gallo Alessandro INFN-LNF
Ghigo Andrea INFN-LNF
Guiducci Susanna INFN-LNF
Ikeda Hitomi KEK
Ligi Carlo INFN-LNF
Mazzitelli Giovanni INFN-LNF
Milardi Catia INFN-LNF
Placidi Massimo LBNL
Preger Miro Andrea INFN-LNF
Raimondi Pantaleo INFN-LNF
Ricci Ruggero INFN-LNF
Rubin David Cornell University
Ruggiero Francesco CERN
Serio Mario INFN-LNF
Shatunov Yuri BINP
Temnykh Alexander Cornell University
Teytelman Dmitry SLAC
Vescovi Mario INFN-LNF
Zhang Chuang Institute of High Energy Physics
Zobov Mikhail INFN-LNF

PAST, PRESENT AND FUTURE

STATUS REPORT on



DAΦNE



Restarting now from a long shutdown

VEPP-2000

Beam → end of 2004
Round Beams

CESR-c

Commissioning with wigglers
Lower energies

BEPC-II

Tau-charm factory
1st beam 2006 - full operation 2008

Basic concept:

Luminosity is generally higher for high energy rings for several reasons, some of the more beneficial are:

1) Tune shifts scales with 1/Energy (E) leading to a fundamental linear increase of the luminosity vs Energy
2) Radiation damping-time decrease with $1/E^3$ leading to higher limits for tune-shifts
3) Touschek effect decrease with $1/E^3$
4) Natural bunch length shorter
5) Beam stiffer, single and multi bunch instabilities decrease with 1/E

2) and 3) lead to smaller "Design" horizontal emittance for higher Energy colliders

CESR-c Energy dependence

Radiation damping

In CESR at 5.3 GeV, an electron radiates ~1MeV/turn

~> τ ~ 5300 turns (or about 25ms)

SR Power ~ $E^2B^2 = E^4/\rho^2$ at fixed bending radius

$1/\tau \sim P/E \sim E^3$

so at 1.9GeV, τ ~ 500ms

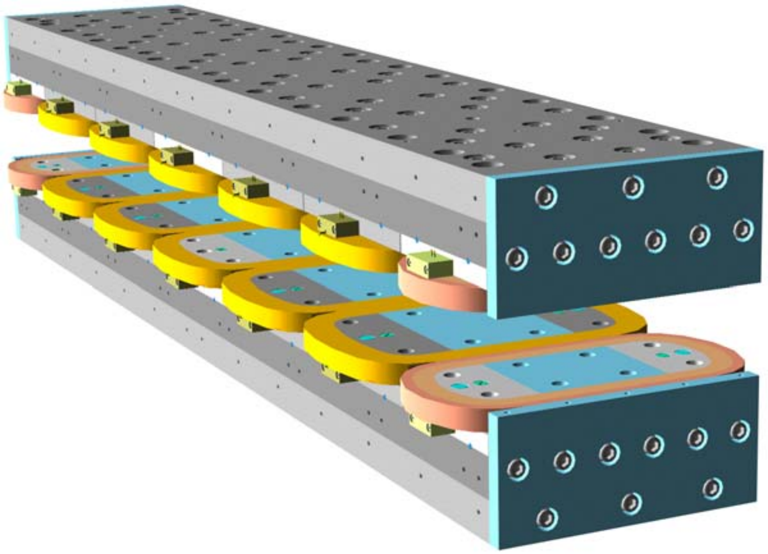
Longer damping time

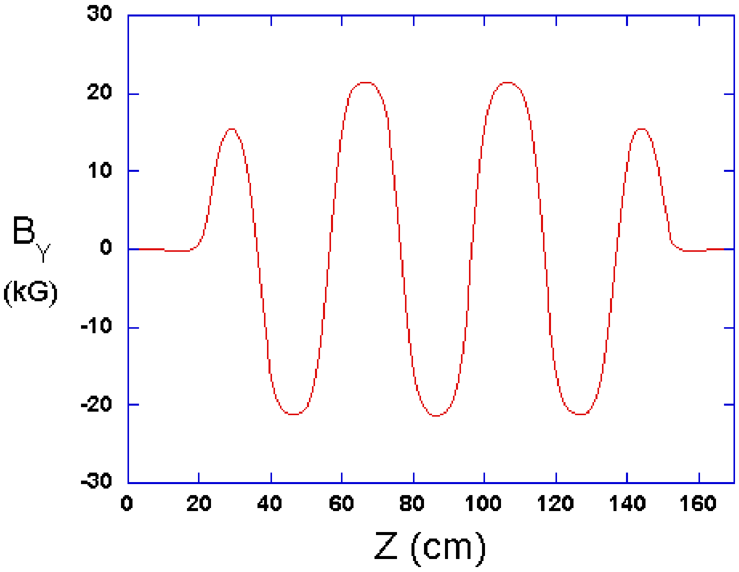
- Reduced beam-beam limit
- Less tolerance to long range beam-beam effects
- Multibunch effects, etc.
- Lower injection rate

D. Rubin

CESR-c Energy dependence

Damping and emittance control with wigglers





D. Rubin

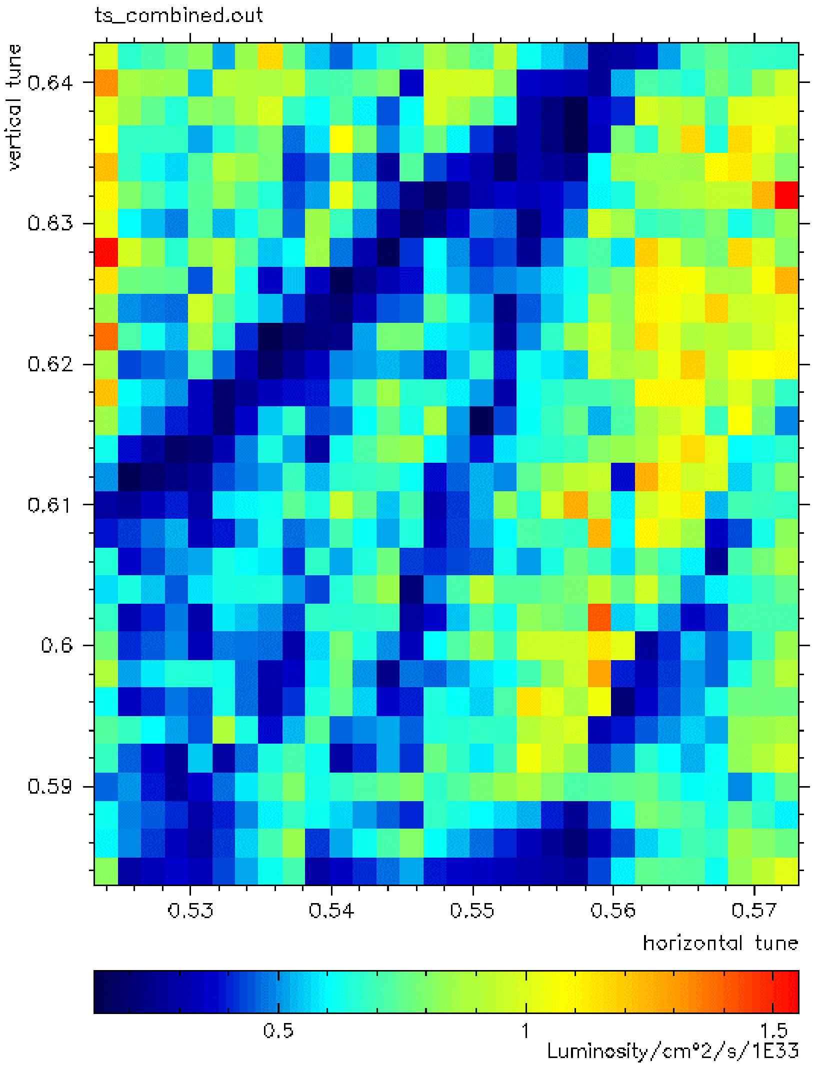
Simulation

-Machine model includes:

  - -Wiggler nonlinearities
  - -Beam beam interactions (parasitic and at IP)
  - -Synchrotron motion
  - -Radiation excitation and damping

-Weak beam

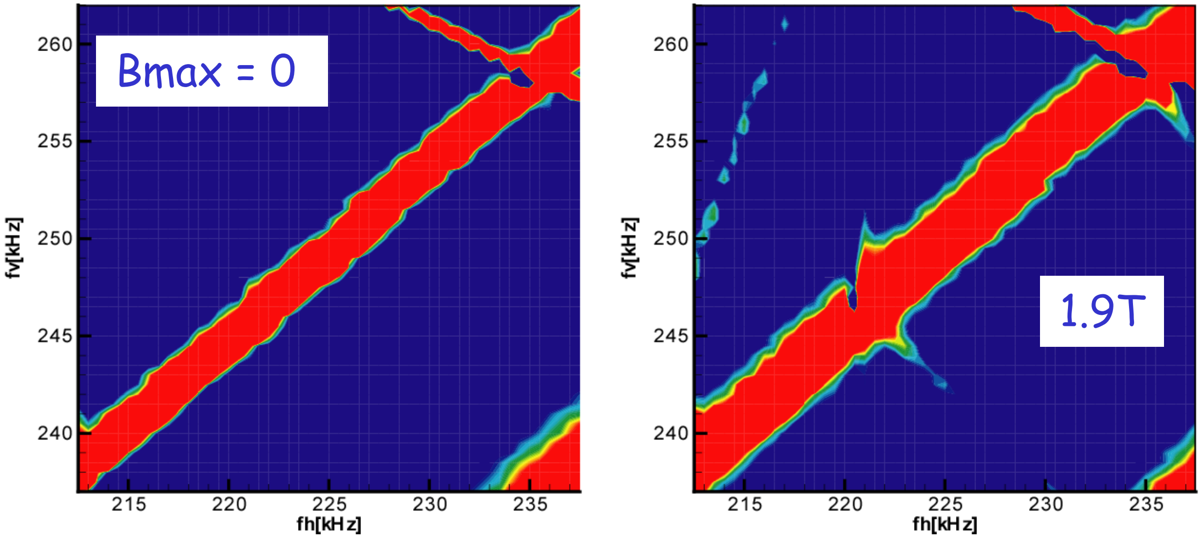
  - -200 particles
  - - initial distribution is gaussian in x,y,z
  - - track ~ 10000 turns

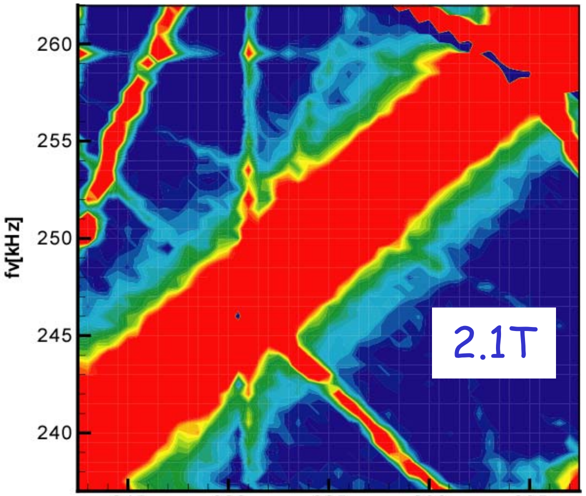


D. Rubin

Beam based characterization: Nov 2002, one wiggler optics, wiggler#1 (7p)

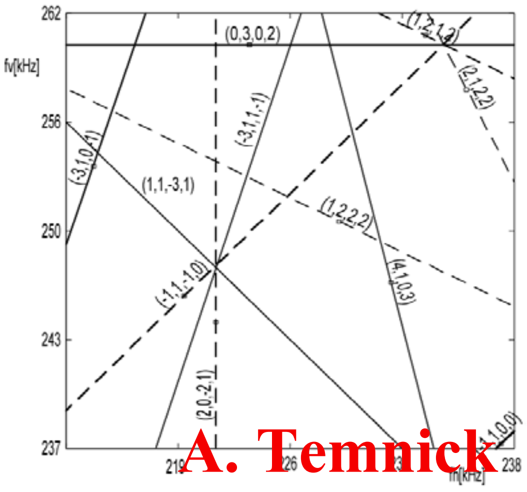
3) 2D tune scan: vertical beam versus tune, evaluation with wiggler field





Oct. 14 2002, Optics: 1843MeV_1WIG_R3_OT, fs = 25kHz

Observed resonances



A. Temnick

Wiggler OFF: -fh+fv = 0, -fh+fh-fs=0, fh+2fv + fs = 2f0, Pmax = 3

Wiggler ON: -3fh+fv= -f0, fh+fv-3fs=f0, 3fv=2f0, fh+2fv+2fs=2f0, 4fh+fv=3f0, 2fh+fv+2fs=2f0, 2fh-2fs=f0 and -3fh+fv+fs=-f0, Pmax = 5

Frascati colliders $e^+ e^-$

		E_{cm} (GeV)	L (10^{32})
ADA	1960	0.4	
ADONE	1969/78 1990/93	0.6/3.1	0.003
DAΦNE	1998/2003.. .. 2003/2006	1.	1.

FUTURE x 2 x 100

DAFNE2

Energy x 2

DAFNE2

Specifications

Upgrade of DAΦNE from the present energy of 1.02 GeV c.m. up to and above the neutron-antineutron threshold, 2-2.2 GeV c.m., using the existing systems and structures.

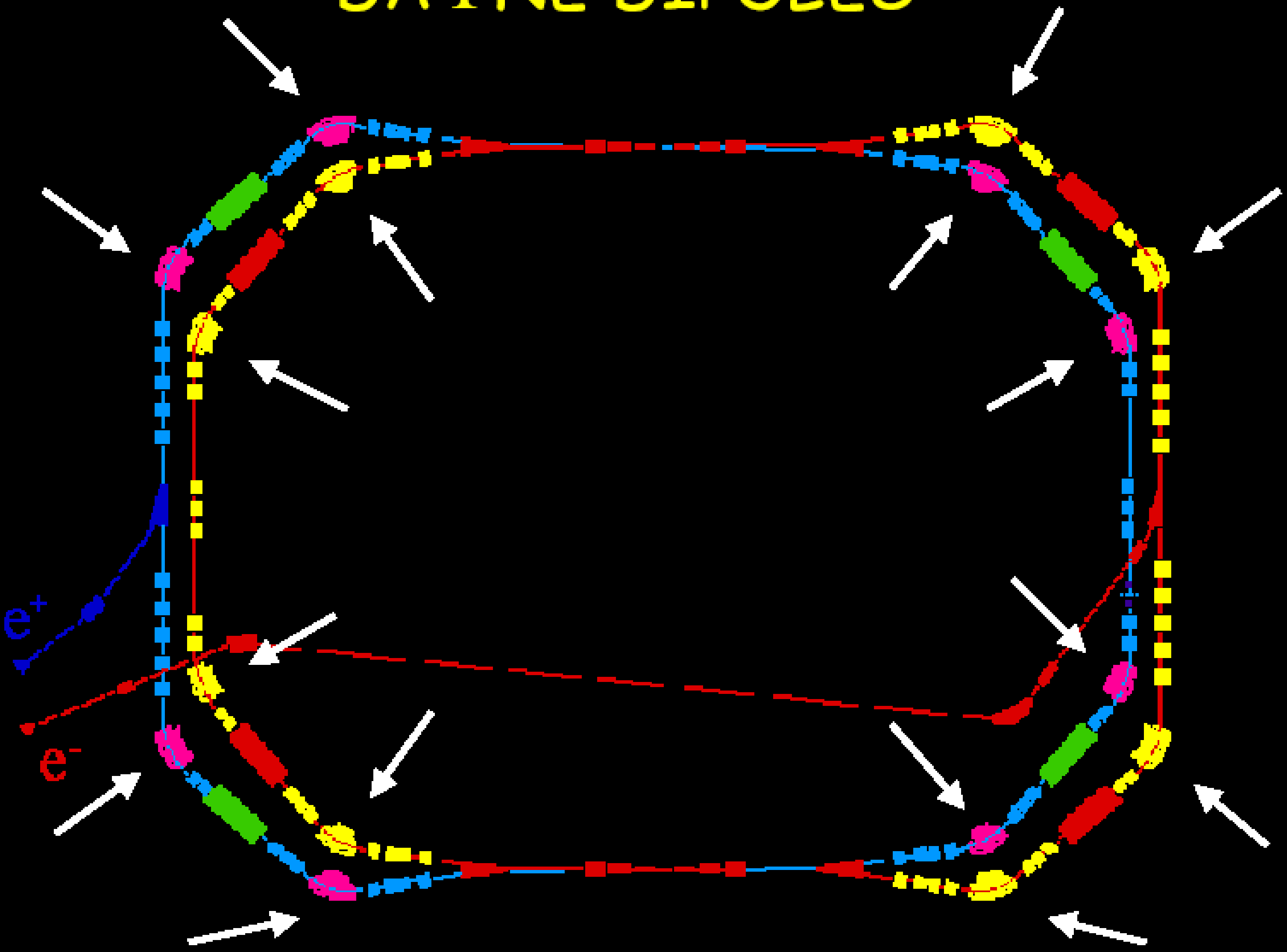
Luminosity ~ 10^{32} cm^{-2} s^{-1}

Compatibility with present operation at Φ

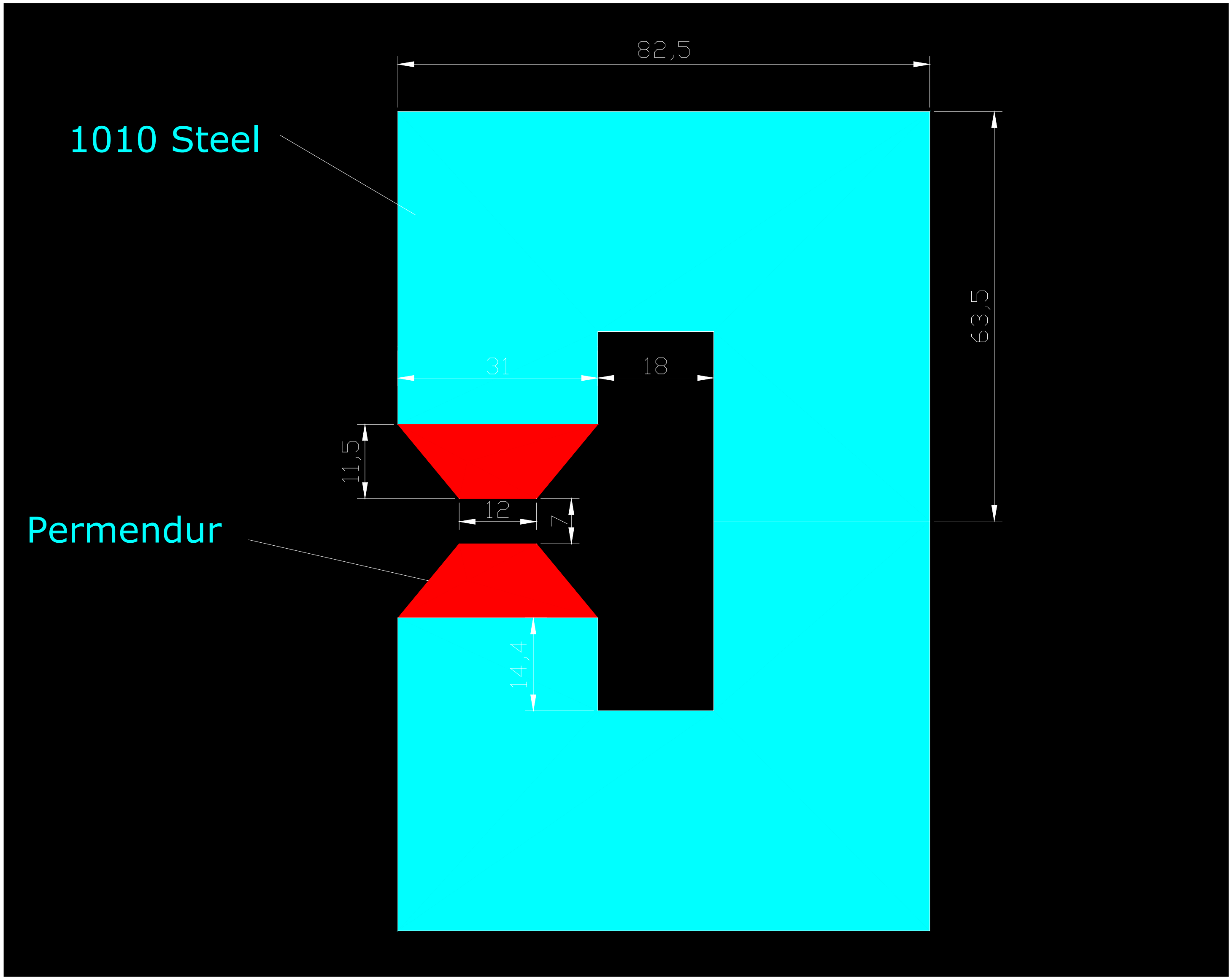
WHAT CAN BE USED FROM DAΦNE

- DAFNE2 can exploit DAΦNE hardware:
  - vacuum chamber
  - all quads and sexts
  - RF cavity
  - Feedback, vacuum system...
- But needs new:
  - stronger bending dipoles
  - 4 SC quads in IR2

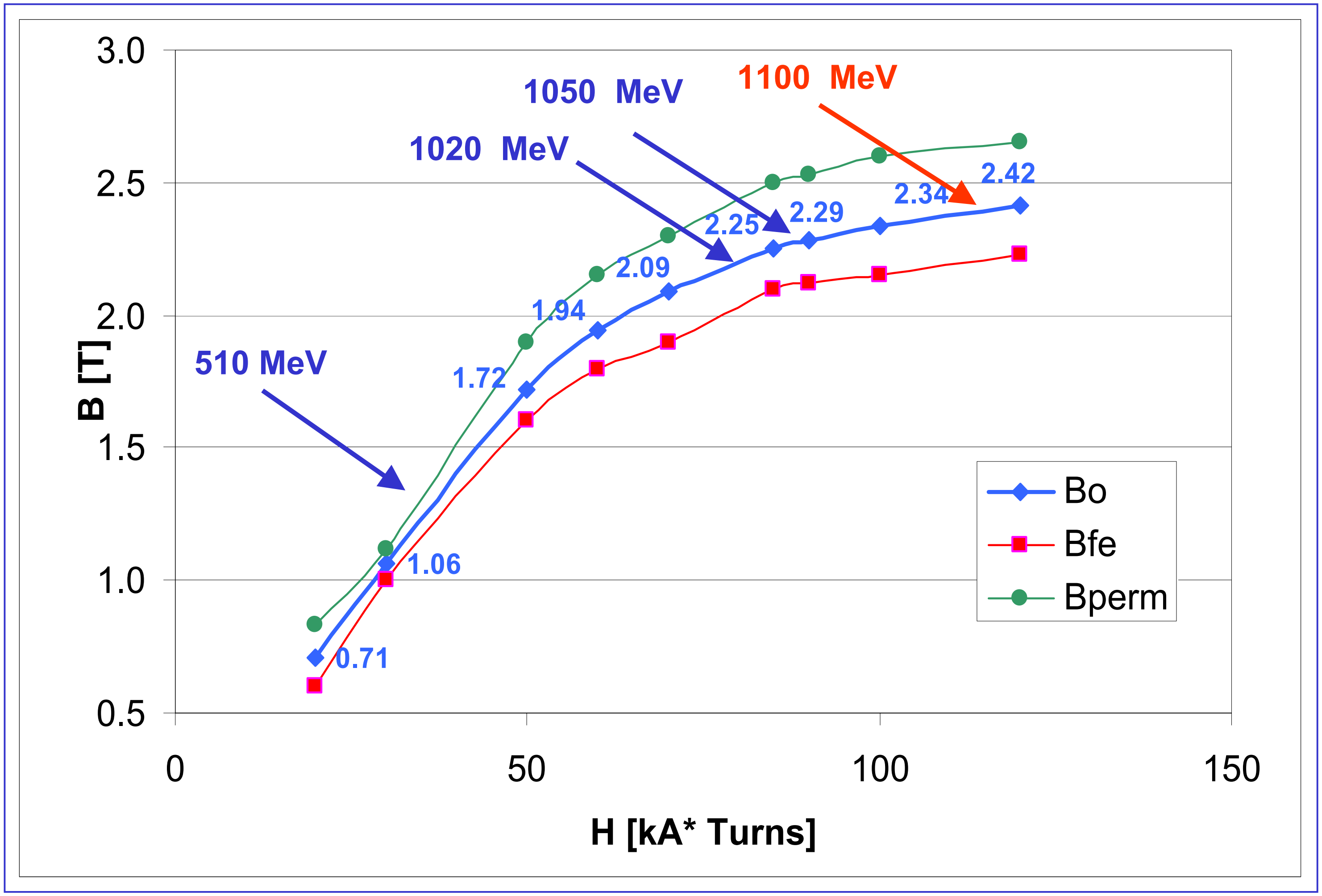
DAΦNE DIPOLES



Dipole Section

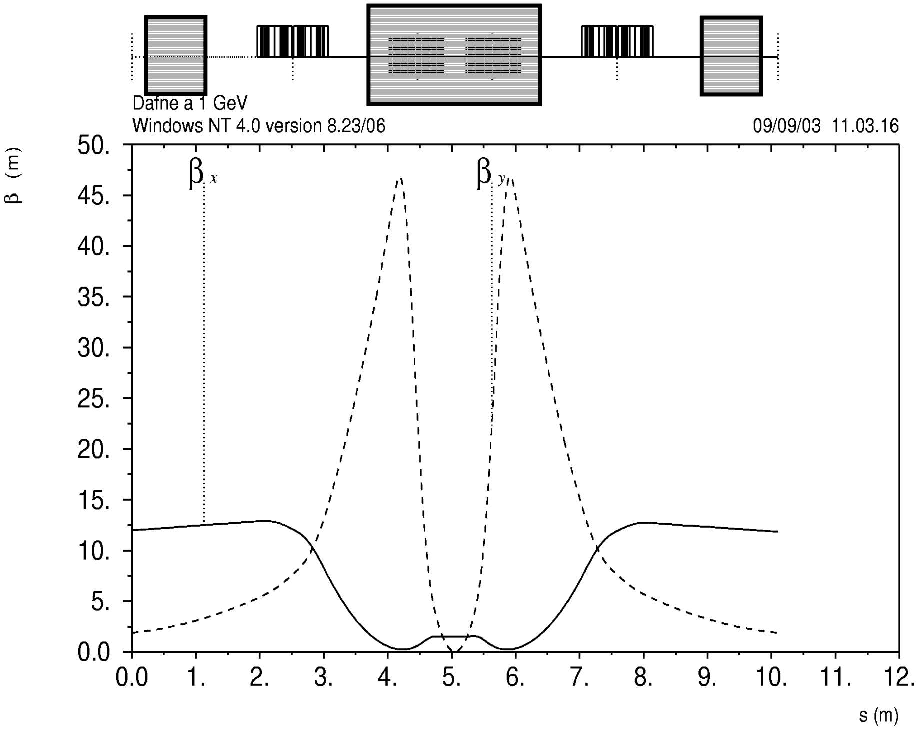


Magnetisation curve

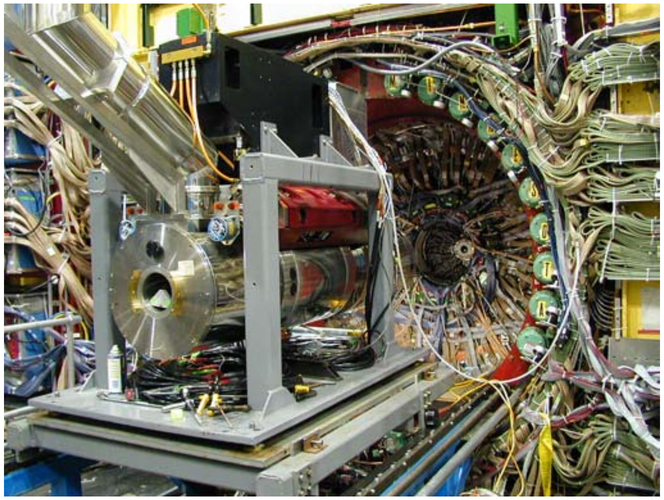


IR2 BETA FUNCTIONS

- $\beta_{\mathbf{x}}$ =2.5 *m* and $\beta_{\mathbf{y}}$ =2.5 *cm*, already achieved at DAΦNE
- FF DFFD FF quad sequence



Superconducting IR Quadrupoles



CESR IR

Requirements

Tunable: 510MeV -> 1.1GeV

Solenoid compensation
Superimposed skew quad windings

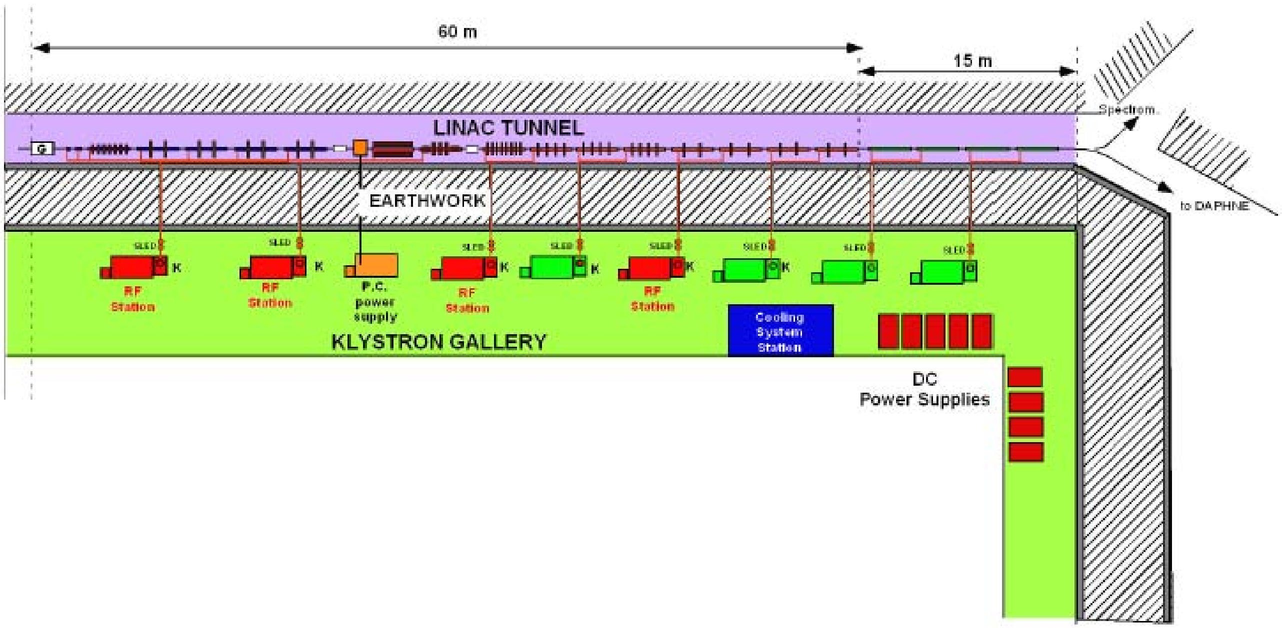
DAFNE2 PARAMETERS

- Luminosity requirements **not critical** for DAFNE2
- horizontal crossing angle at IP2 $\theta_x = \pm 15$ *mrad* : Piwinsky angle $\phi = \theta_x \sigma_L^*/\sigma_x^* = 0.22$ already exceeded in existing factories
- linear tune shift is $\xi_x / \xi_y = 0.014 / 0.024$, below the limit achieved in DAΦNE
- 30 bunches we can inject out of collision and collide with a fast RF phase jump
- **$L = 1{\cdot}10^{32}$ s^{-1} cm^{-2}** is straightforward to achieve with a **total current of 0.45 A**

Energy E_0	1.0 GeV
Luminosity L	$1{\cdot}10^{32}$ $s^{-1}\ cm^{-2}$
Circumference C	97.69 *m*
Emittance ε	$0.5{\cdot}10^{-6}$ *rad m*
Coupling $\kappa = \varepsilon_x / \varepsilon_y$	0.009
Beta functions at IP β_x^*/ β_y^*	1.5 / 0.025 *m*
Crossing angle at IP θ_x^*	±15 *mrad*
Bunch width at IP σ_x^*/ σ_y^*	0.95 / 0.008 *mm*
Bunch natural length σ_z	13.9 *mm*
Linear tune shift ξ_x / ξ_y	0.014 / 0.024
Betatron tunes ν_x / ν_y	5.15 / 5.21
Momentum compaction α_c	0.012
Number of bunches	30
Harmonic number *h*	120
Beam current I_{tot}	450 *mA*

Injection - Full Energy

DAPHNE2 LINAC PLAN-VIEW ..... tomorrow



Linac upgrade up to 1.1 GeV
injecting directly in rings
+ transfer lines + septa

DOUBLING THE DAFNE-LINAC ENERGY IS FEASIBLE AT MODERATE COST (~6 MEuros)

or Injection - Ramping

… there is no problem implementing energy ramping for DAFNE II

Inject and ramp time « beam lifetime at 1.1GeV

All of the PS can be reused
It simply requires:

- High Level Software development
- careful hardware configuration.

Conclusions of High E wg

Energy upgrade to 1.02 GeV/beam straight forward and at moderate cost

Exploit most of existing hardware

Preliminary design for dipoles with some questions about
- maximum achievable field (-> E_{max} ~1.1 GeV)
- current dependence of field quality

Parameters of superconducting IR quadrupoles are well within the range of existing designs

Super DAΦNE

Luminosity x 100

Ideas for Luminosity increase

Some will be tested in near future:

- ☐ **Crab cavities (KEK-B)**
- ☐ **Collisions with round beams (VEPP2000)**
- ☐ **Negative α_C (KEK-B, DAΦNE)**

Others …

- *collisions with neutralized beams (four beams) + feedback system*
- *ring against linac*
- *Monochromators*
- *Collisions with large crossing angle:*

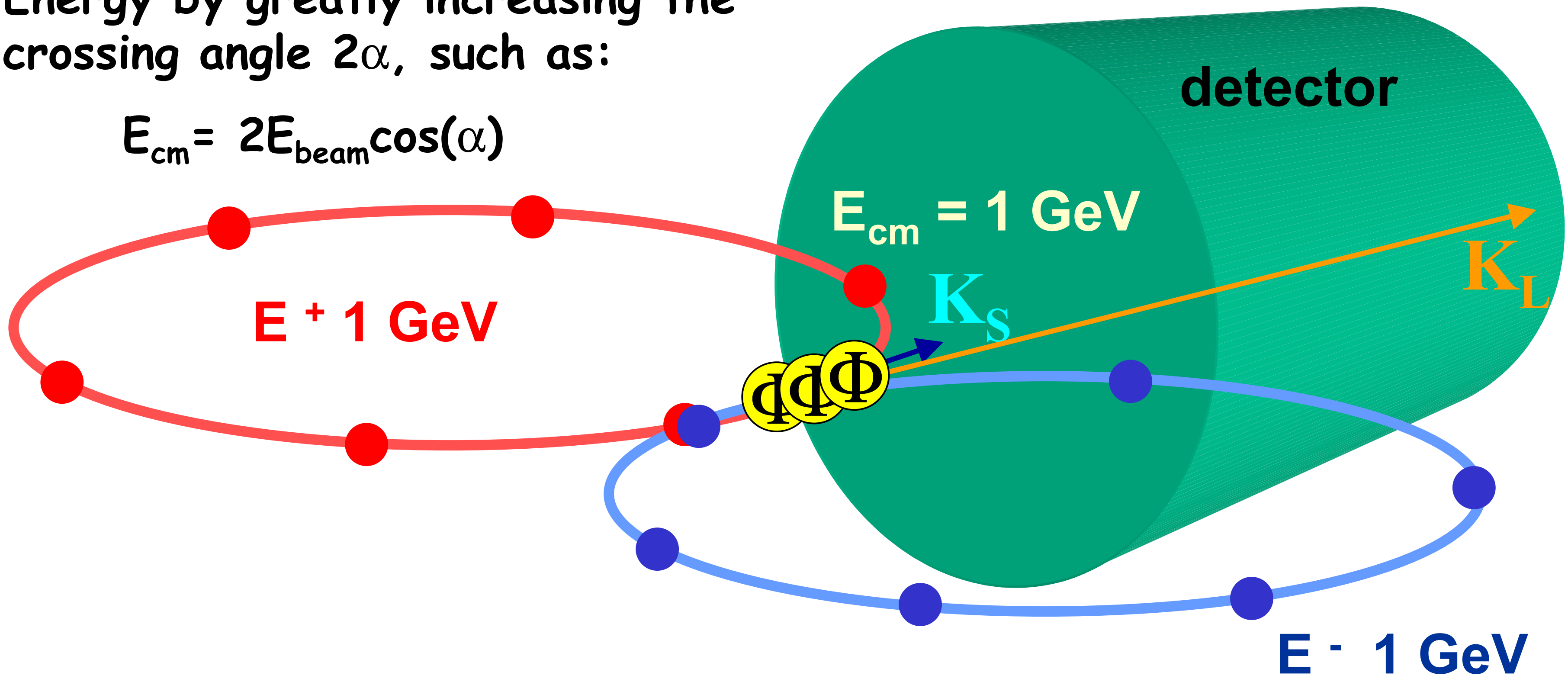
$E_{cm} = 2E_{beam}\cos(\theta_c/2)$,

e.g. $\theta_c/2 = 60°$, $E_{beam} = 1 GeV$

Large crossing angle

If we want to collide at the Φ-pole, we could increase the ring Energy by greatly increasing the crossing angle 2α, such as:

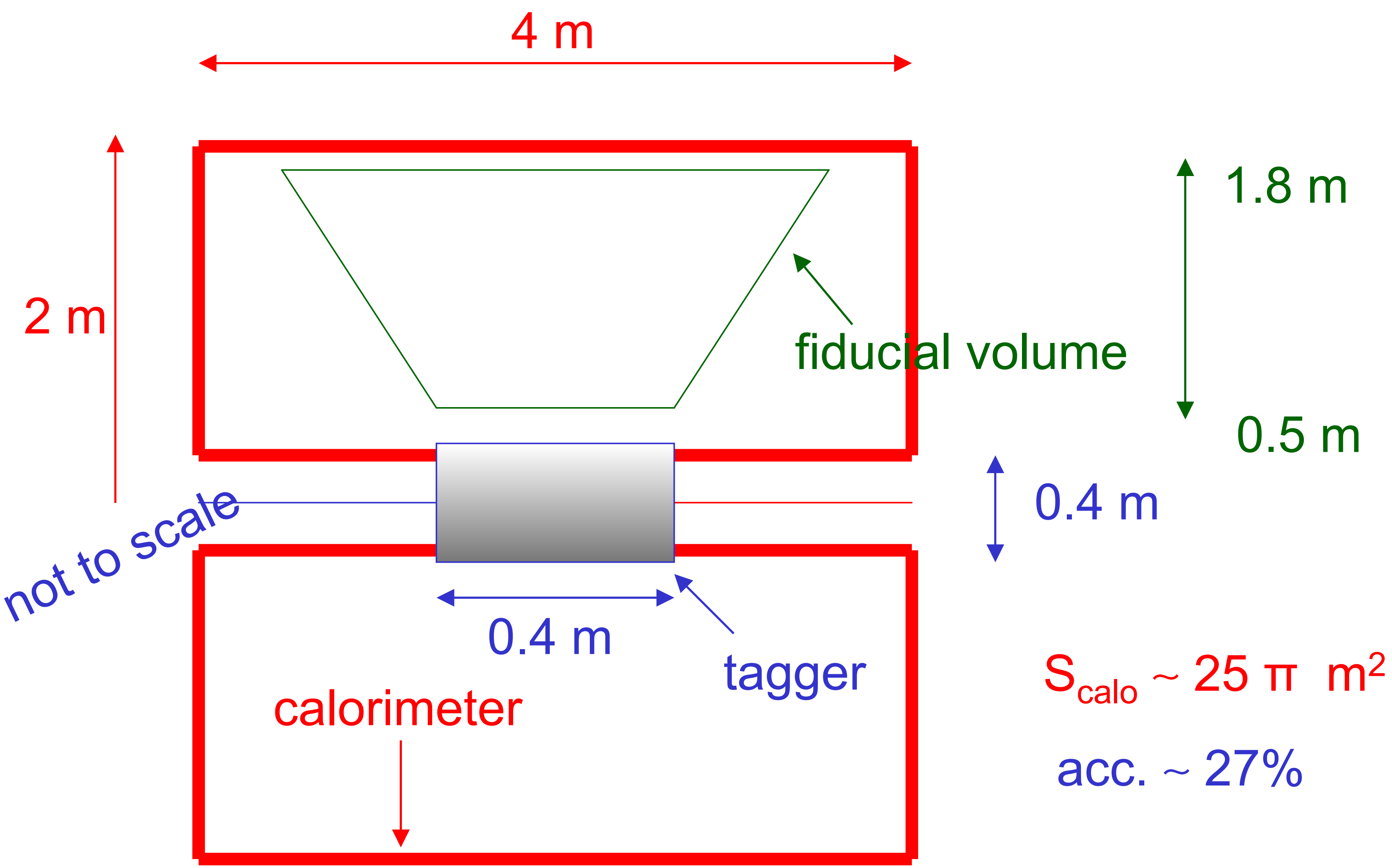
$$E_{cm} = 2E_{beam}\cos(\alpha)$$



For example α=60°

corresponds to E_{beam}=1GeV

Detector concepts: "conventional"



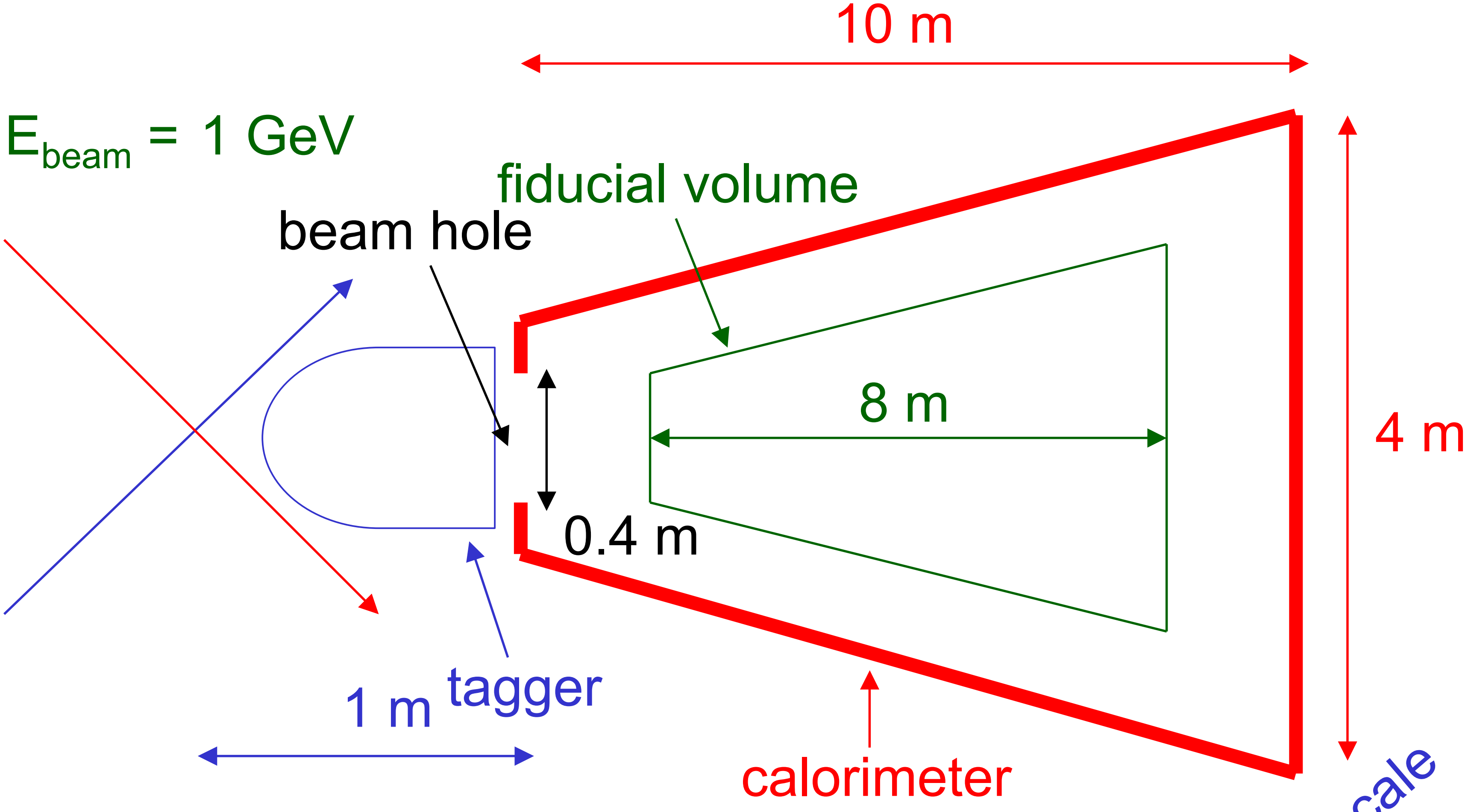
$S_{calo} \sim 25\ \pi\ m^2$

acc. ~ 27%

F. Bossi

Detector concepts: "forward"

E_{beam} = 1 GeV



10 m

fiducial volume

beam hole

8 m

4 m

0.4 m

1 m

tagger

calorimeter

$S_{calo} \sim 25\ \pi\ \ m^2$

acc. ~ 23%

not to scale

F. Bossi

Main guidelines for the design
$L \sim 10^{34}$ at Φ energy

Double ring

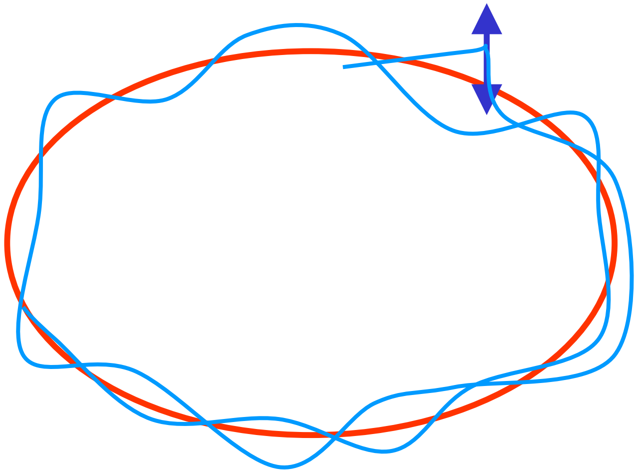
Multibunch operation

+

- Powerful damping
- Negative momentum compaction
- Very short bunch at IP

Damping time, energy and dipole dependent

(# of turns after which a perturbation is forgotten)



$$\tau_x \approx \frac{C}{C_\alpha}\frac{1}{E^3 I_2}$$

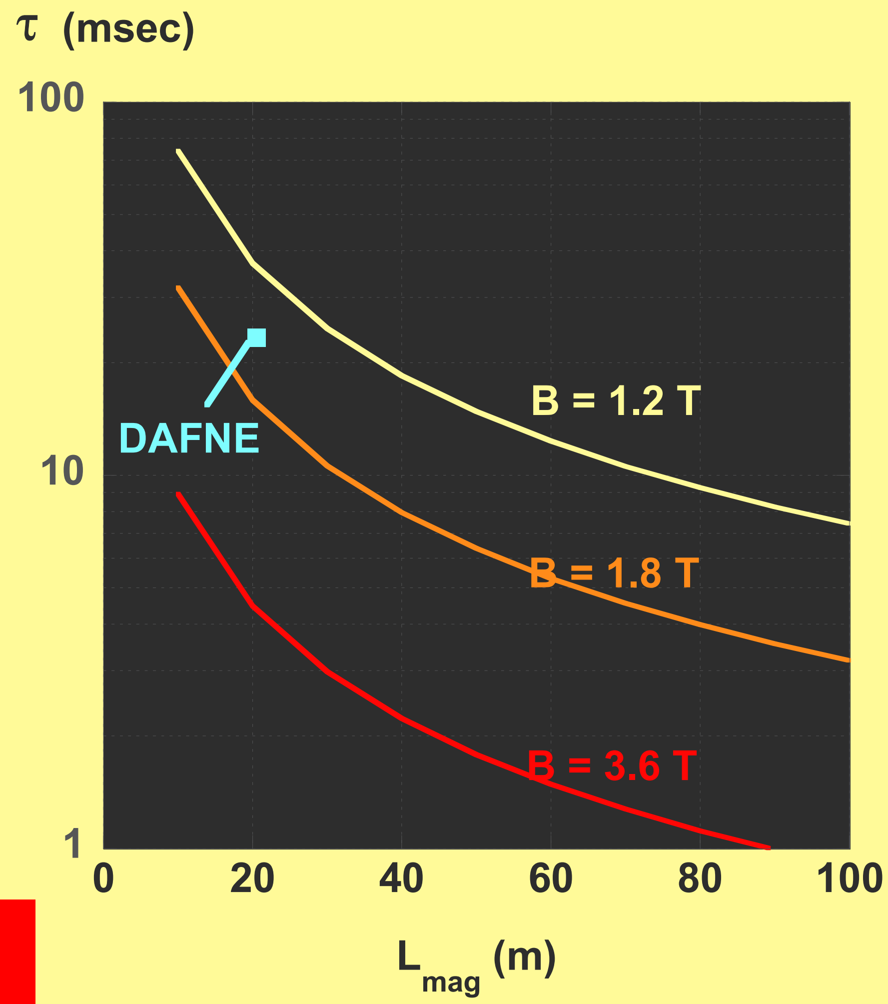
Small ρ: High B
Strong non-linearities

	N_{turns}
DAΦNE :	**60.000**
PEP-II :	**4.000/2.500**
KEKB:	**2.000/2.000**

Damping time on magnetic field

For C = 100 m
E = 510 MeV

$$\tau_x(\mathrm{sec}) \approx \frac{\rho^2}{2.8\,L_{dip}}$$



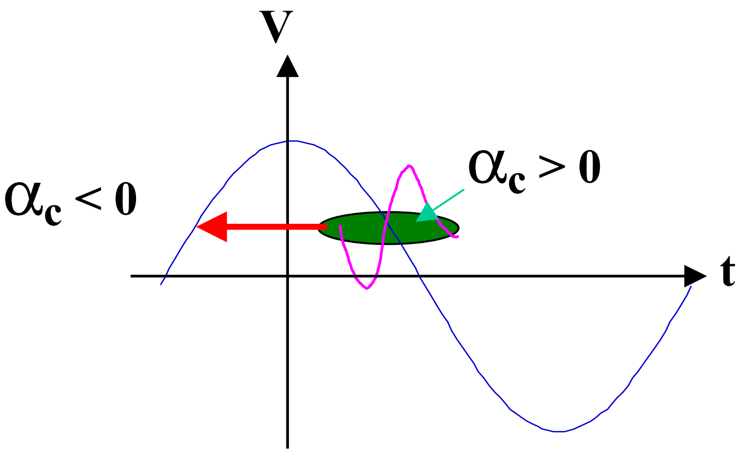
Factor 2 on tuneshift
by factor 10 on damping time

Momentum compaction α_c

relates longitudinal position and energy deviation

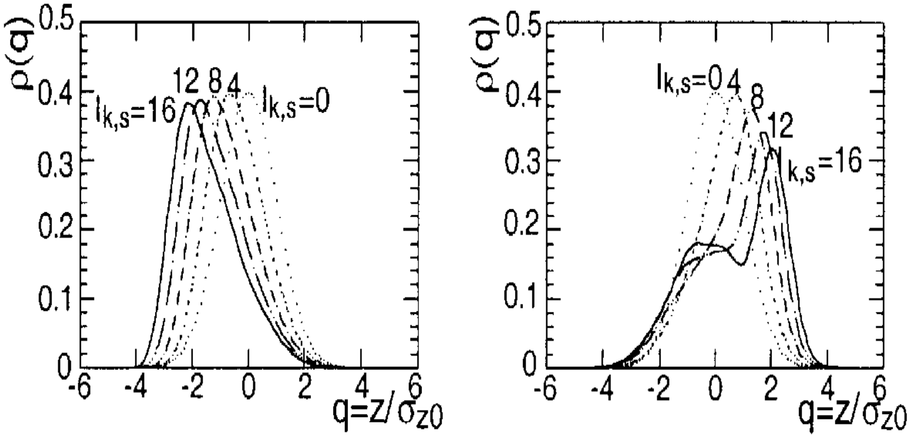
$$\Delta l = \alpha_C \frac{\Delta p}{p}$$

$\alpha_c > 0$
the higher the energy,
the longer the path length



Beam Dynamics with $\alpha_c < 0$

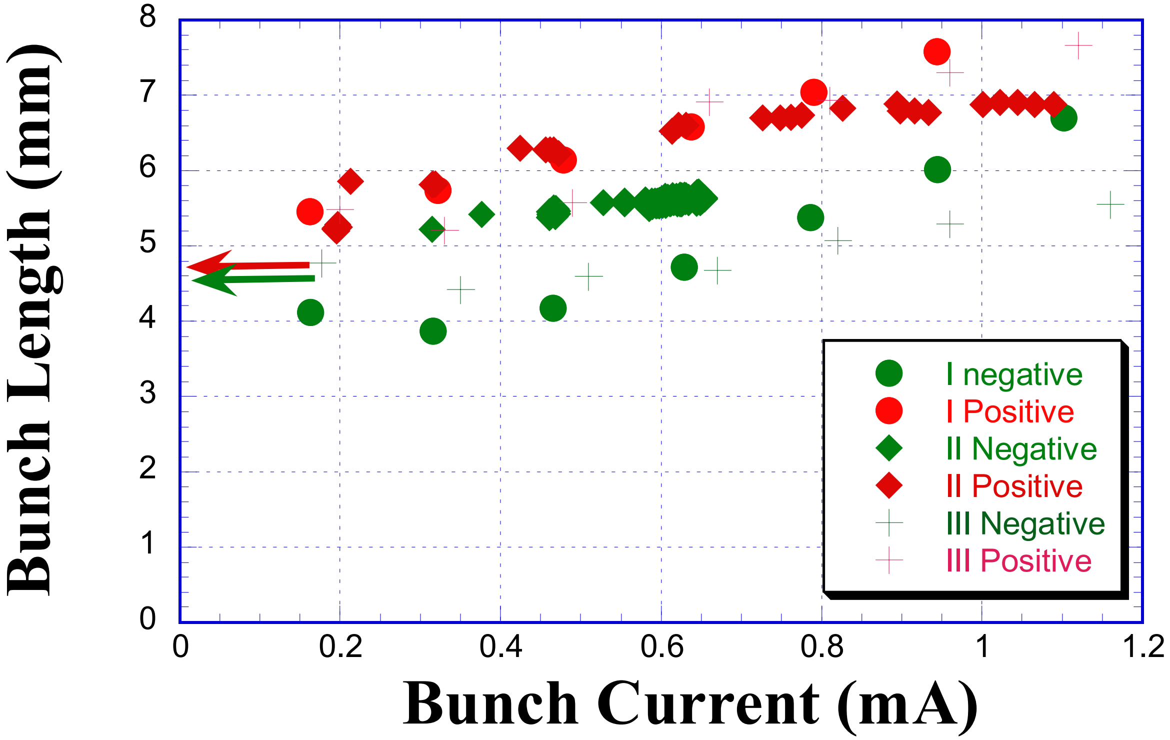
- **Bunch is shorter with a more regular shape**
- **Longitudinal beam-beam effects are less dangerous**
- **Microwave instability threshold is higher**
- **Sextupoles can be relaxed since head-tail disappears**



(a) α < 0

(b) α > 0

Negative alfa tests at KEKB



Ikeda, KEKb

- **It is worthwhile to try a collider operation with a negative momentum compaction factor since this can provide several advantages in beam dynamics**

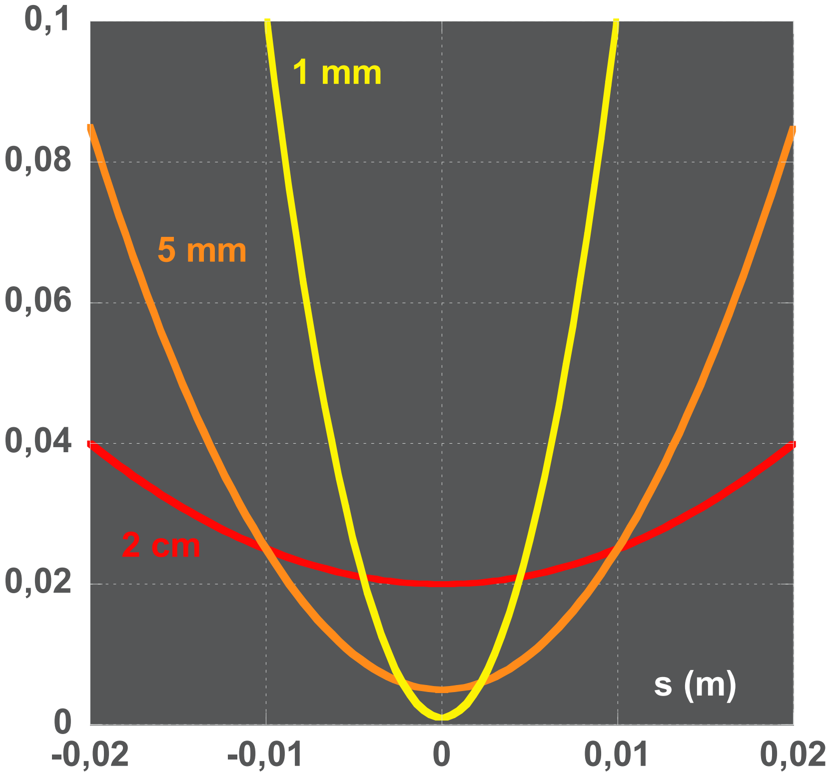
- **Simulations indicate that by shifting the working point close to the integers and applying a lattice with the negative momentum compaction we have a possibility to push DAΦNE luminosity to 10^{33} $cm^{-2}s^{-1}$ level**

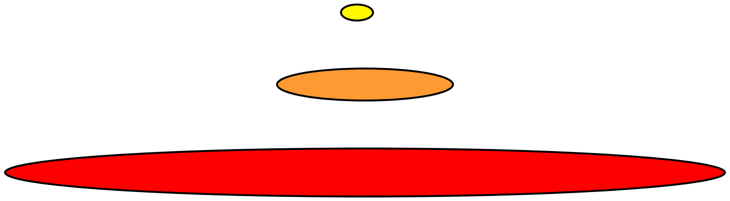
I, mA (bunch)	ξ_x	ξ_y	σ_z, cm	L, 10^{30} (expected)
5	0.009	0.020	**1.359,1.545**	0.728
10	0.018	0.040	**1.314,1.651**	2.889
15	0.027	0.060	**1.337,1.773**	6.550
20	***0.036***	***0.080***	**1.376,1.939**	***11.64***
25	0.045	0.100	**1.436,2.056**	1.819
30	0.054	0.120	**1.489,2.171**	2.620

Hour-glass effect

$\beta_y \sim \sigma_y^2$

Squeezing vertical betatron function is effective only if bunch length is also decreased to the same value





Bunch length

Short bunches

Can be obtained with small α_c and high rf Voltage but

High densities produce wake fields
which lengthen the bunch itself

Strong RF Focusing for Luminosity Increase

A. Gallo, P. Raimondi, M.Zobov

Workshop on

e+ e- in the 1-2 GeV range:
Physics and Accelerator Prospects

ICFA Mini-workshop - Working Group on High Luminosity e+e- Colliders

10-13 September 2003, Alghero (SS), Italy

Organizing Committee

R. Baldini (INFN-LNF)
S. Bertolucci (Chairman) (INFN-LNF)
M. Biagini (INFN-LNF)
C. [illegible] (INFN-LNF)
[illegible] (INFN-LNF)
U. Bottigli (Università Sassari)
F. Ferroni (Università Roma1)
G. Isidori (INFN-LNF)
G. P[illegible]cheri (INFN-LNF)
M. S[illegible]io (INFN-LNF)
M. [illegible] (INFN-LNF)

International Advisory Committee

T. Bressani (Università Torino)
S. Brodsky (SLAC)
M. Calvetti (Università Firenze)
F. Close (Oxford University)
E. De Sanctis (INFN-LNF)
D. Drechsel (Mainz University)
P. Franzini (Università Roma1)
C. Guaraldo (INFN-LNF)
[illegible] (CERN)
[illegible] (INFN-LNF)
[illegible] (CERN)
[illegible] (BINP)
R. Petronzio (Università Roma2)
D. Rice (Cornell)
J. Seeman (SLAC)
[illegible] (INFN-Cagliari)
[illegible] (BINP)
[illegible] (IHEP)

Secretariat

Manuela Giabbai, Lia Sabatini
INFN-LNF
Via Enrico Fermi, 40
00044 Frascati (RM)
Tel. +39-069403-2274/2552
Fax +39-0694032256
E-mail d2@lnf.infn.it

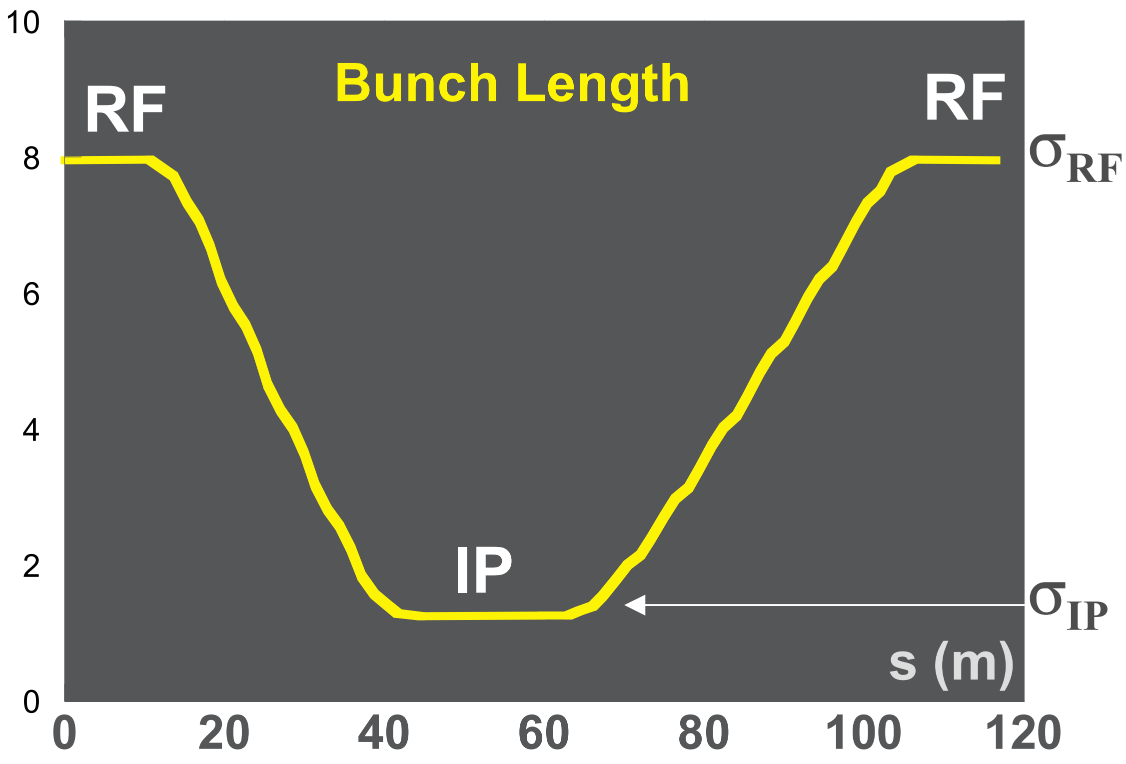
Sponsored by:

ICFA
INFN
UNIVERSITÀ degli STUDI di SASSARI

http://www.lnf.infn.it/conference/d2/

Strong RF Focusing (SRFF)

**Modulation of bunch length
along the ring with a minimum at the IP**

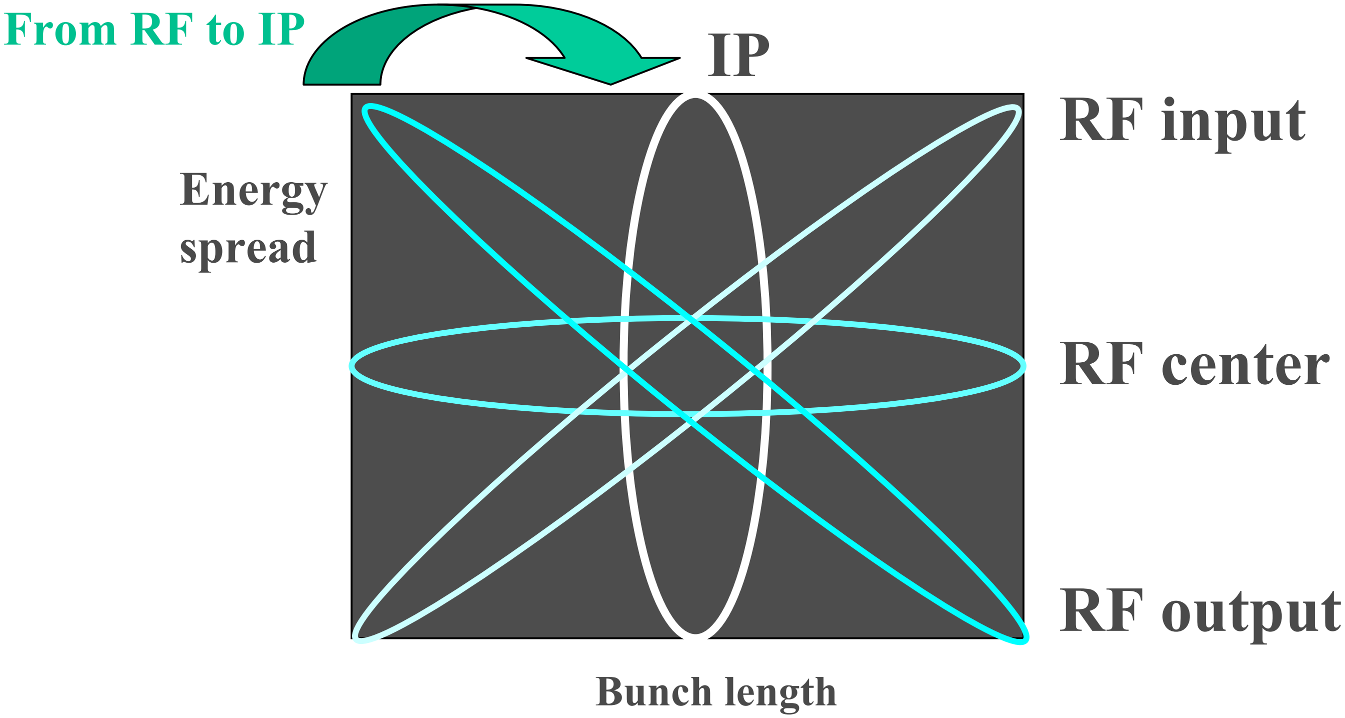


High rf voltage

+

Magnetic lattice which correlates longitudinal position with energy deviation (high momentum compaction)

Longitudinal phase space

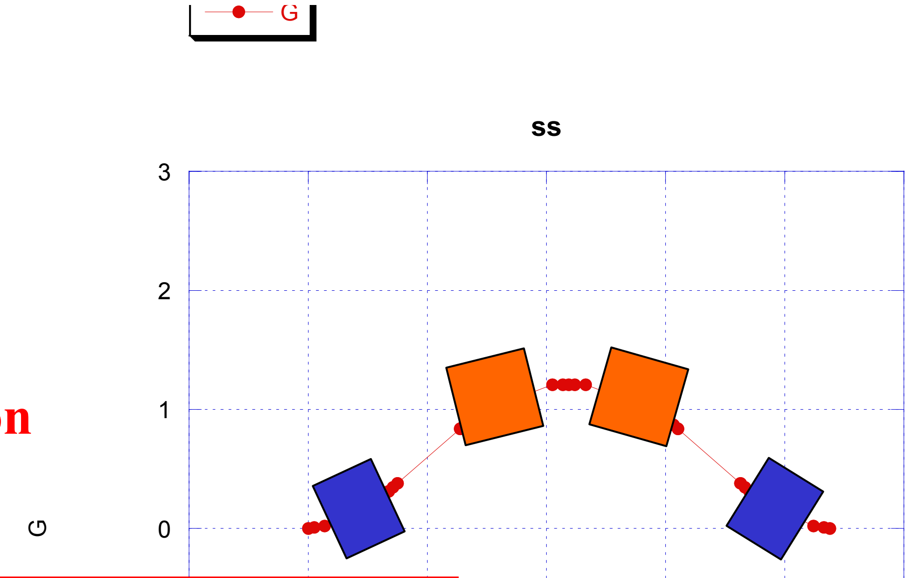


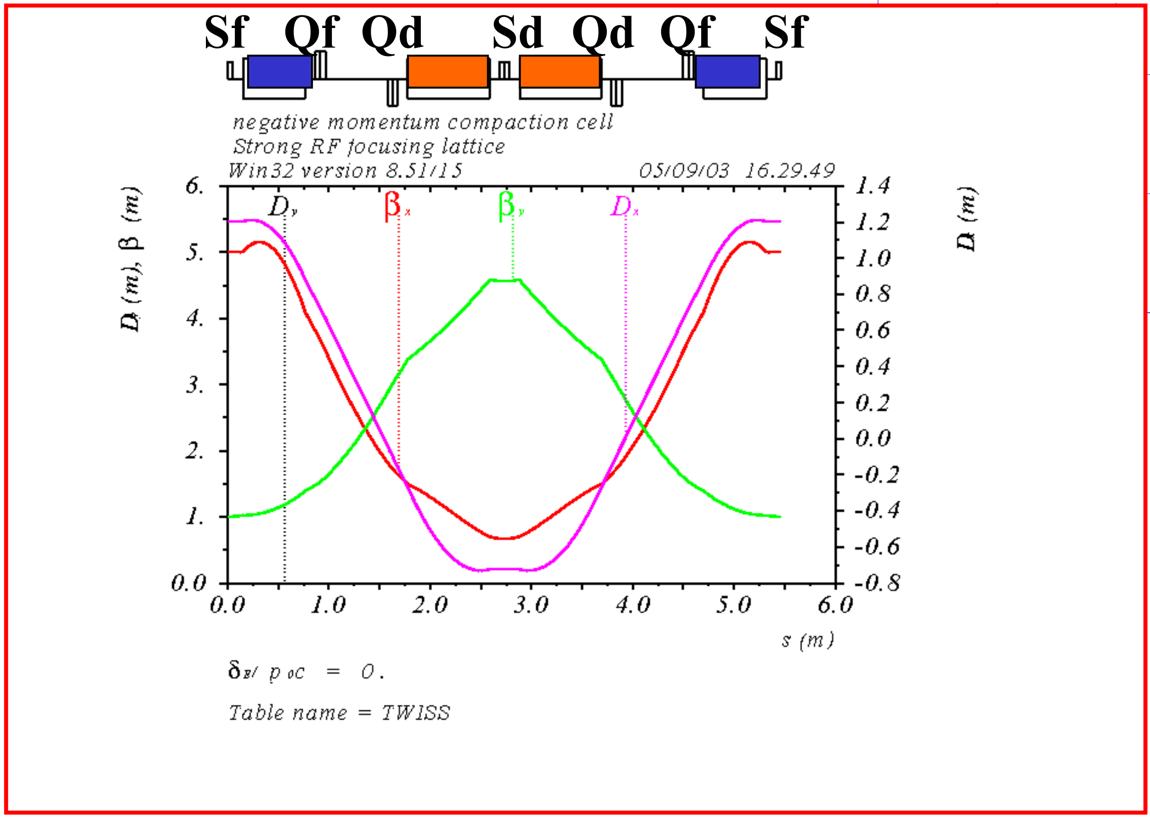
$$\cos\mu = 1 - \pi \frac{\alpha_c L}{\lambda_{rf}} \frac{V_{rf}}{E/e}$$

High |momentum compaction|
+ high Voltage

HIGH and NEGATIVE MOMENTUM COMPACTION

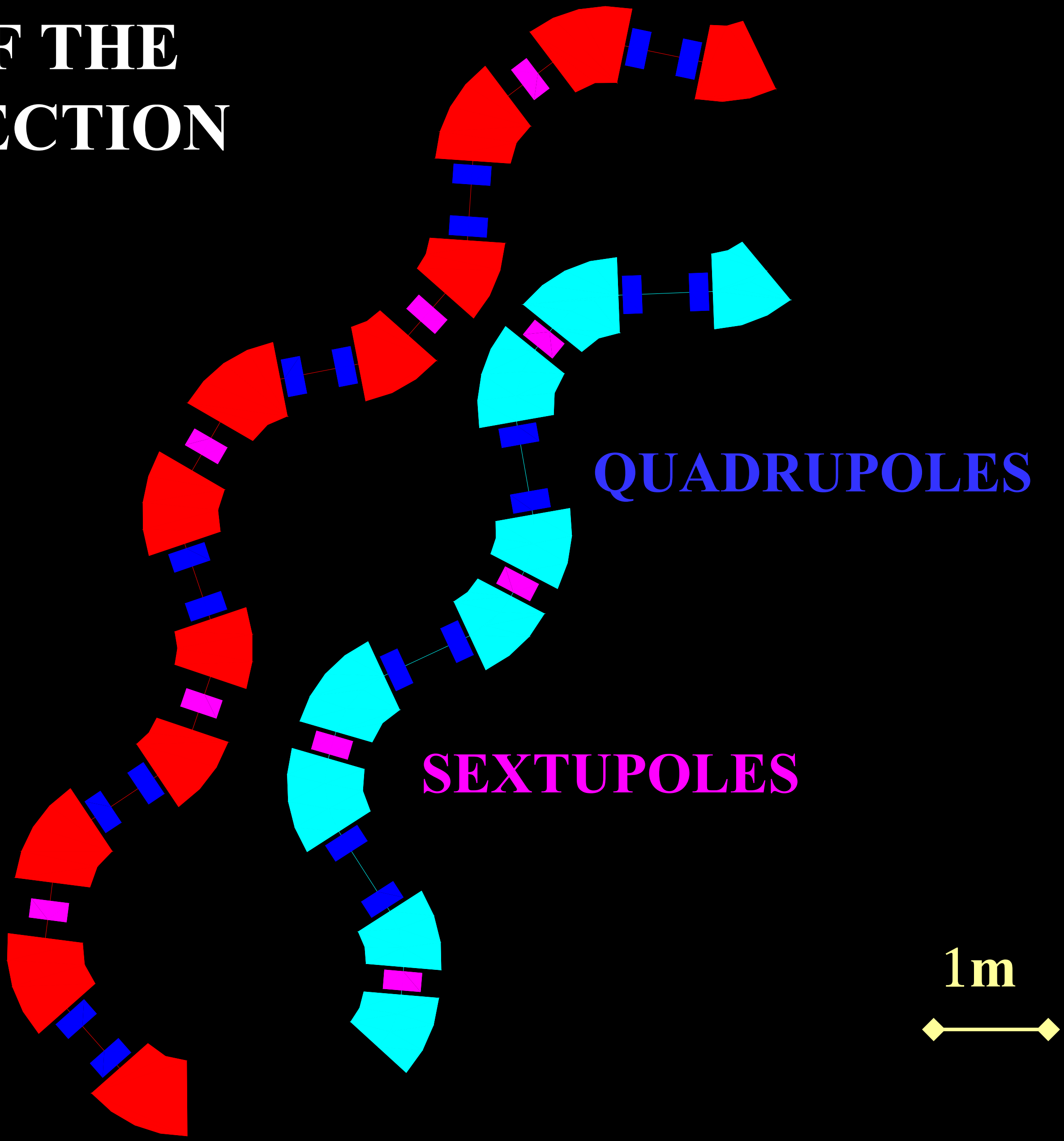
strong RADIATION emission





Alternating positive and negative bending dipoles

ZOOM OF THE RINGS SECTION



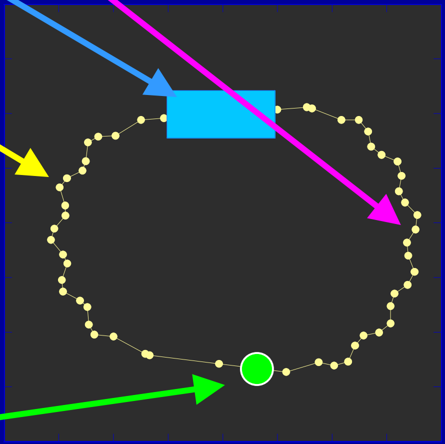
Layout similar to present DAΦNE rings:

One IR

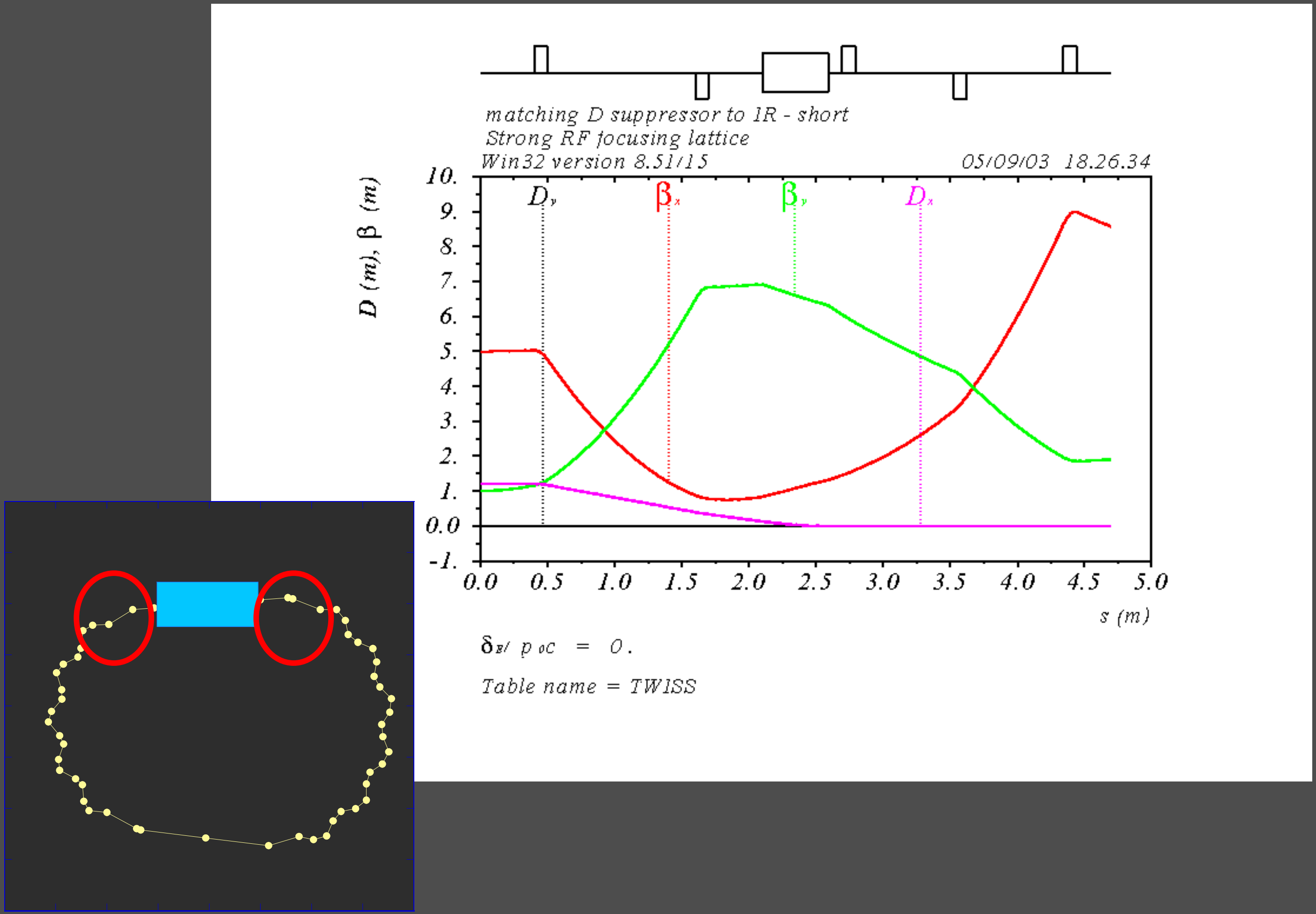
Second crossing for injection, rf, diagnostics

Short inner arc and long outer arc with the condition of equal longitudinal phase advance between cavity and IP in both directions

$$R_{56}(rf \rightarrow IP) = R_{56}(IP \rightarrow rf)$$



ARCS to IR : Dispersion suppressors

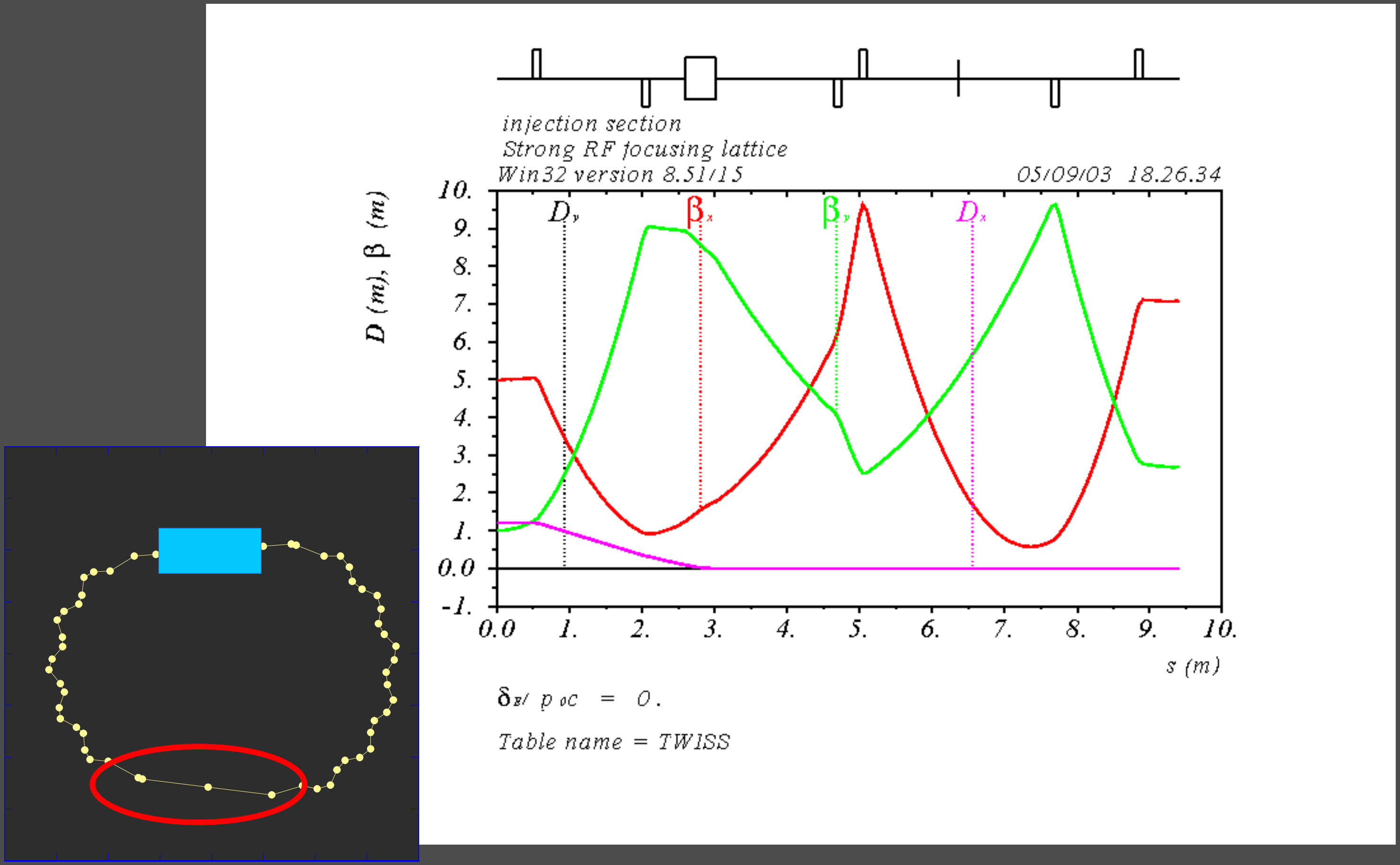


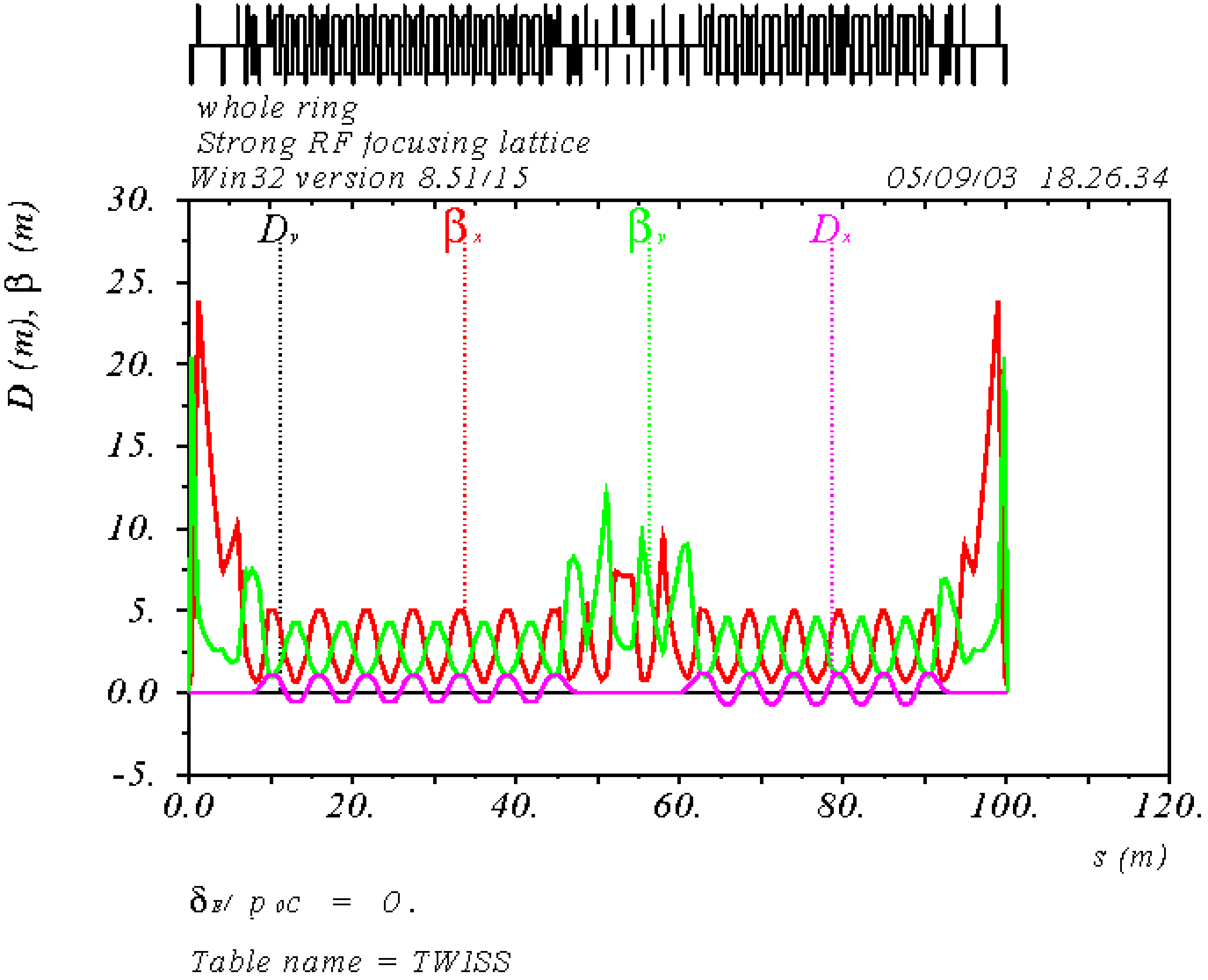
matching D suppressor to IR - short
Strong RF focusing lattice
Win32 version 8.51/15 05/09/03 18.26.34

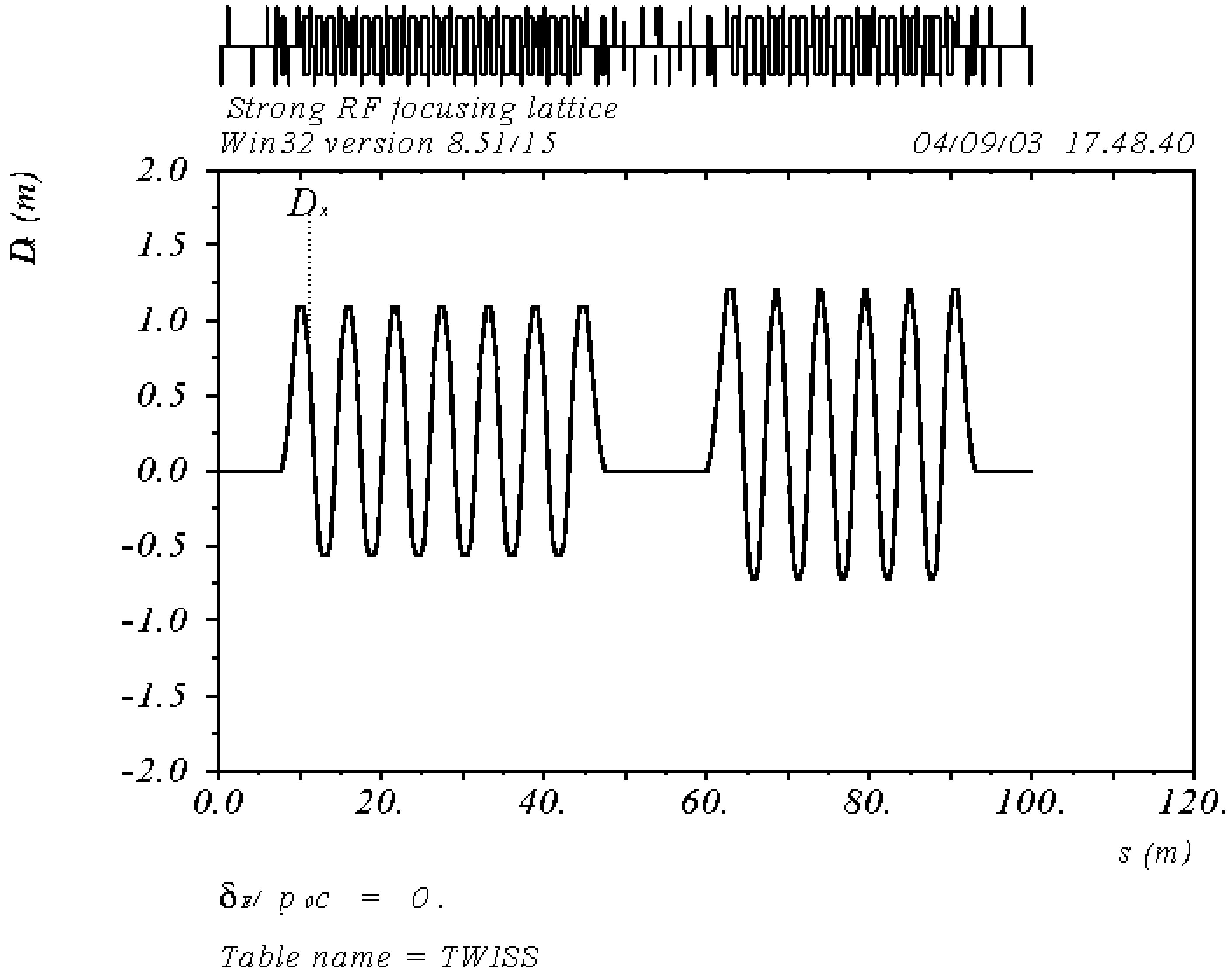
δ_E/p_0c = 0.

Table name = TWISS

ARCS to Injection and rf section, with D suppressor

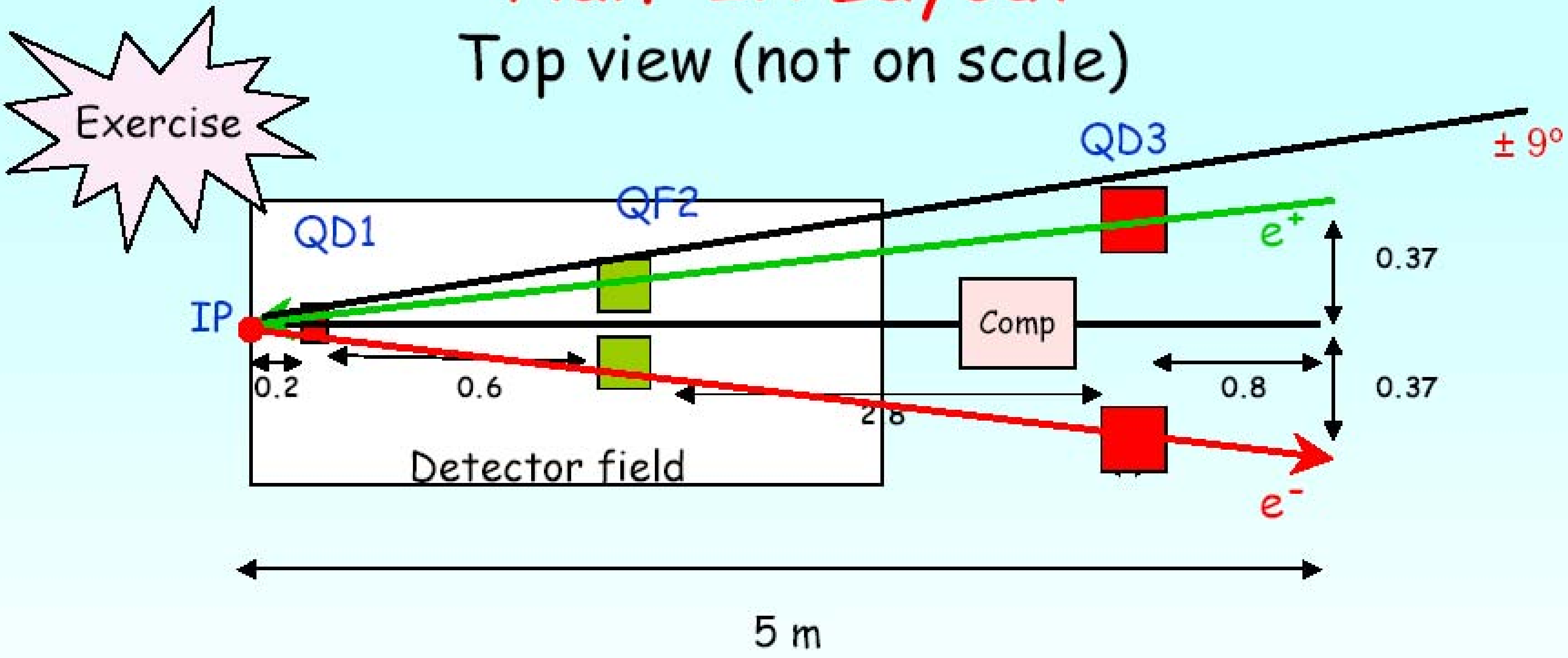



whole ring
Strong RF focusing lattice
Win32 version 8.51/15
05/09/03 18.26.34
D (m), β (m)
30.
25.
20.
15.
10.
5.
0.0
-5.
D_y
β_x
β_y
D_x
0.0
20.
40.
60.
80.
100.
120.
s (m)
δ_E/p_0c = 0.
Table name = TWISS


Strong RF focusing lattice
Win32 version 8.51/15
04/09/03 17.48.40
D (m)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
D_x
0.0
20.
40.
60.
80.
100.
120.
s (m)
δ_{E}/p_0c = 0.
Table name = TWISS

Half-IR Layout

Top view (not on scale)



With ± 10σ_x clearance, ± 9° cone, ±30 mrad angle:

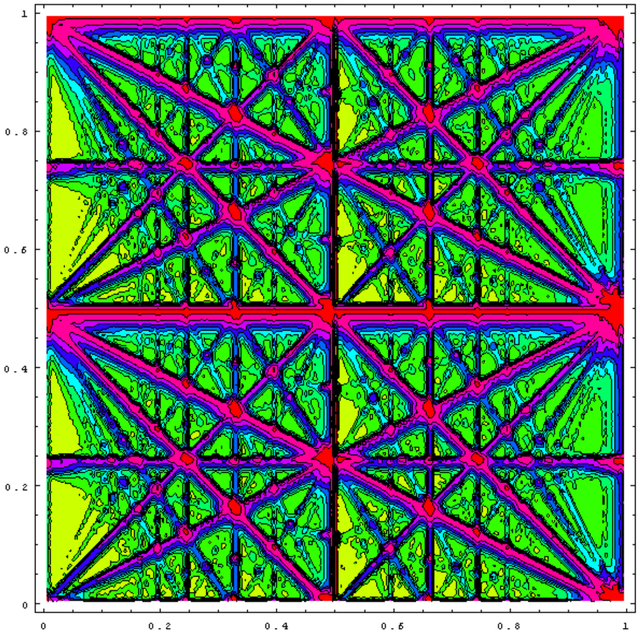
QD1: L= 20 cm, pole radius = 1.5 cm, R_{ext} = 3 cm, pm thickness= 1.5 cm small

QF2: L= 20 cm, pole radius = 11 cm, R_{ext} = 16 cm, pm thickness= 1.5 cm,
4 cm space between 2 quads

QD3: L= 20 cm, pole radius = 15 cm , R_{ext} = 63 cm, 25 cm space between 2 quads

Dynamic aperture

Choice of the working point



Tune footprint
in 2D - transverse

Adding the longitudinal phase plane:

3D – resonances

First evaluation by *E.Levichev, P.Piminov*$^{*)}$

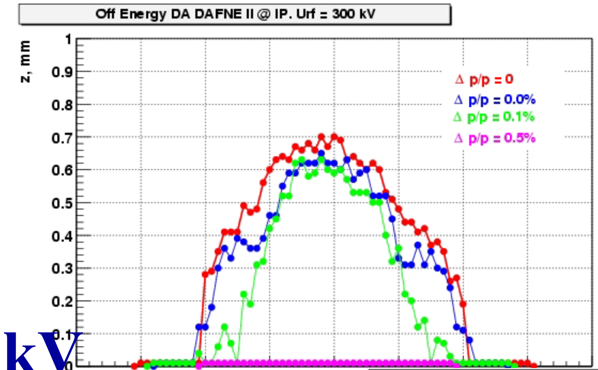
BINP, Lavrentiev 13, Novosibirsk 630090, Russia

----- no synchr oscill

----- Dp/p = 0

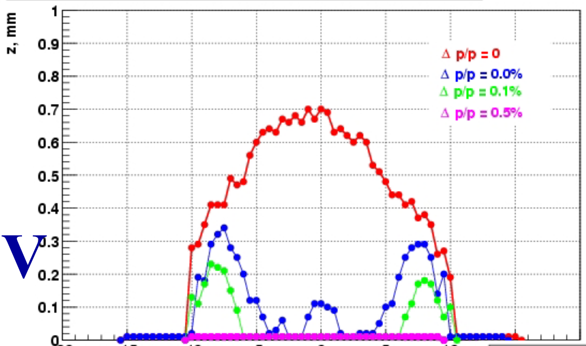
----- Dp/p = 0.1%

----- Dp/p = 0.5%



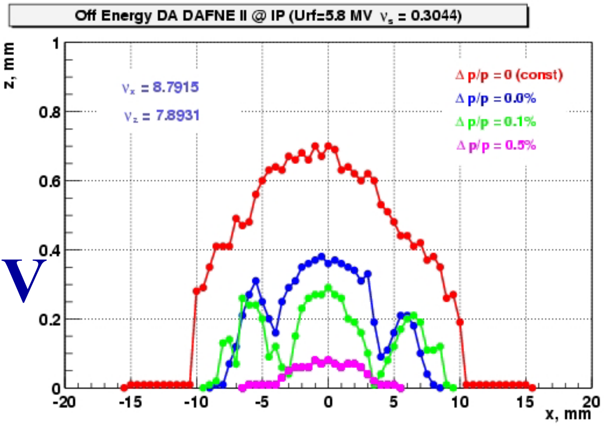
V = 300 kV

Q_s = 0.059



V = 3 MV

Q_s = 0.2



V = 5 MV

Q_s = 0.3

Strong dependence on V
but specially on Q_s
=> Resonances in 3D

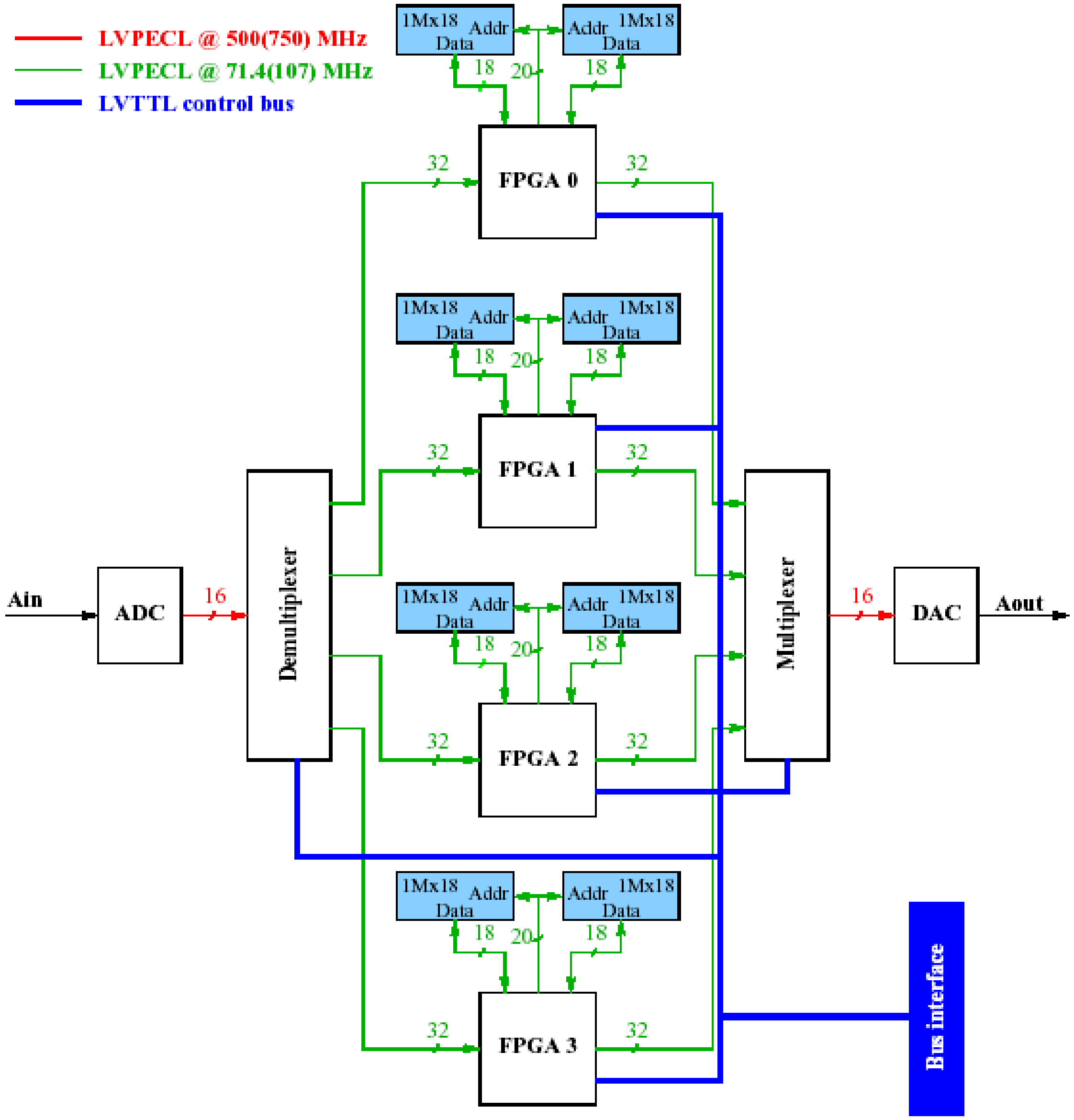
Feedback systems
First analysis

by J.Fox, D. Teitelmann

SLAC

GBoard 1.5 GS/sec. processing channel

- Next-generation instability control technology
- SLAC, KEK, LNF-INFN collaboration - useful at PEP-II, KEKB, DAFNE and several light sources.
- Transverse instability control
- Longitudinal instability control
- High-speed beam diagnostics (1.5 GS/sec. sampling/ throughput rate)
- Builds on existing program in instability control and beam diagnostics.
- Significant advance in the processing speed and density previously achieved.



DAΦNE with strong RF focusing

As an example we will consider the effect of proposed RF configuration on longitudinal feedback

The proposed design has a much higher gap voltage which results in significantly shorter bunches at the IP and higher synchrotron frequency.

Parameter	Current	Proposed
RF frequency (f_{rf})	368.25 MHz	500 MHz
Momentum compaction (α_c)	0.029	-0.171
Circumference (L)	97.69 m	105 m
Revolution frequency (f_{rev})	3.069 MHz	2.857 MHz
Harmonic number	120	175
RF voltage (V_{rf})	120 kV	10.677 MV
Synchrotron frequency (f_s)	30 kHz	1.31 MHz
Revolutions per synchrotron period	~102	2.18
Bunch length (σ_z)	19 - 38 mm	2.6 - 20.4 mm

Beam lifetime

Touschek lifetime has been calculated with a preliminary set of longitudinal parameters. A further optimization is possible.

Anyway

At $L = 10^{34}$

lifetimes are of the order of 10 minutes

- continous injection is needed

Background

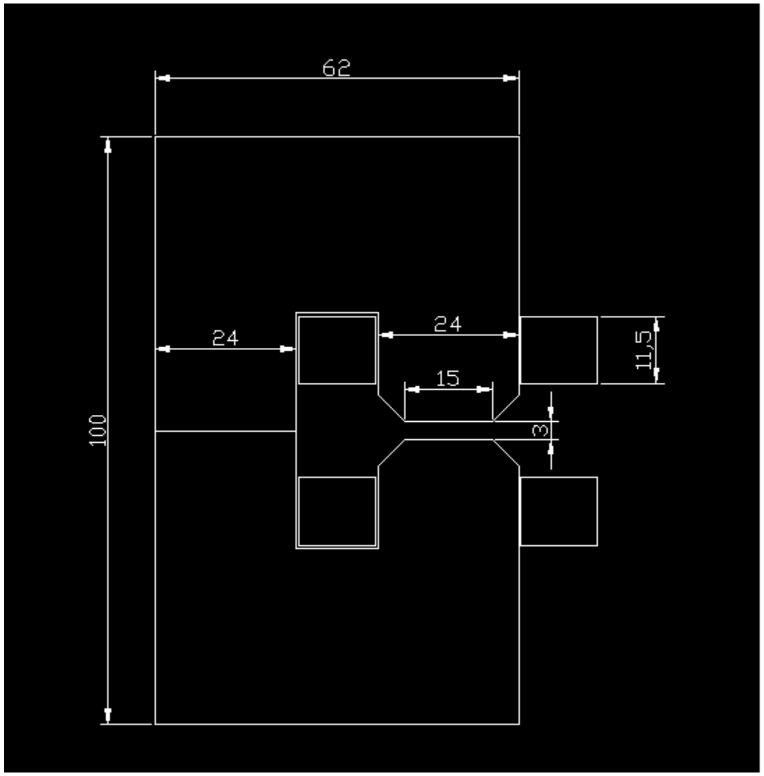
High current
Short beam lifetime
Continuos injection

} **High rate of particle losses**

Dominated by Touschek lost particles
IR design together with detector design

Dipole parameters

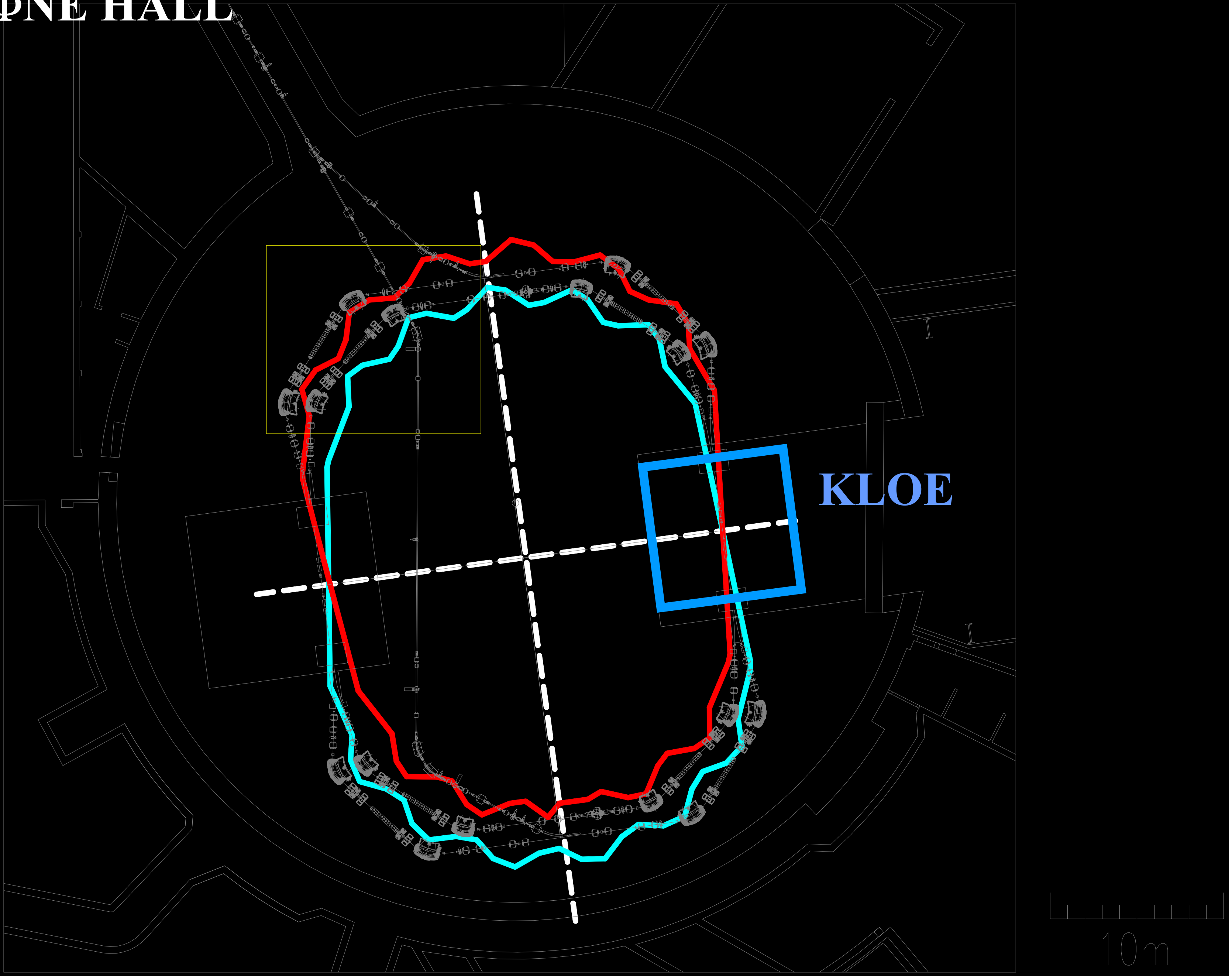
Type	A	B	C
N	22	22	4
Alfa [rad]	0.6545	0.8528	0.5236
Chord [m]	0.607	0.781	0.489
Sagitta [m]	0.050	0.085	0.032
Mag lenght	0.618	0.805	0.494
Vol Fe [mc]	0.282	0.362	0.227
Vol Cu [mc]	0.041	0.047	0.037
Weight Fe [kg]	2222	2859	1789
Weight Cu [kg]	359	410	324
Total Weight [kg]	2581	3269	2113
Power [W]	7234	8260	6537



NI [A]	26350
J [A/mmq]	3.2
Total power [kW]	370

Cost evaluated: 1600 k€

DAΦNE HALL

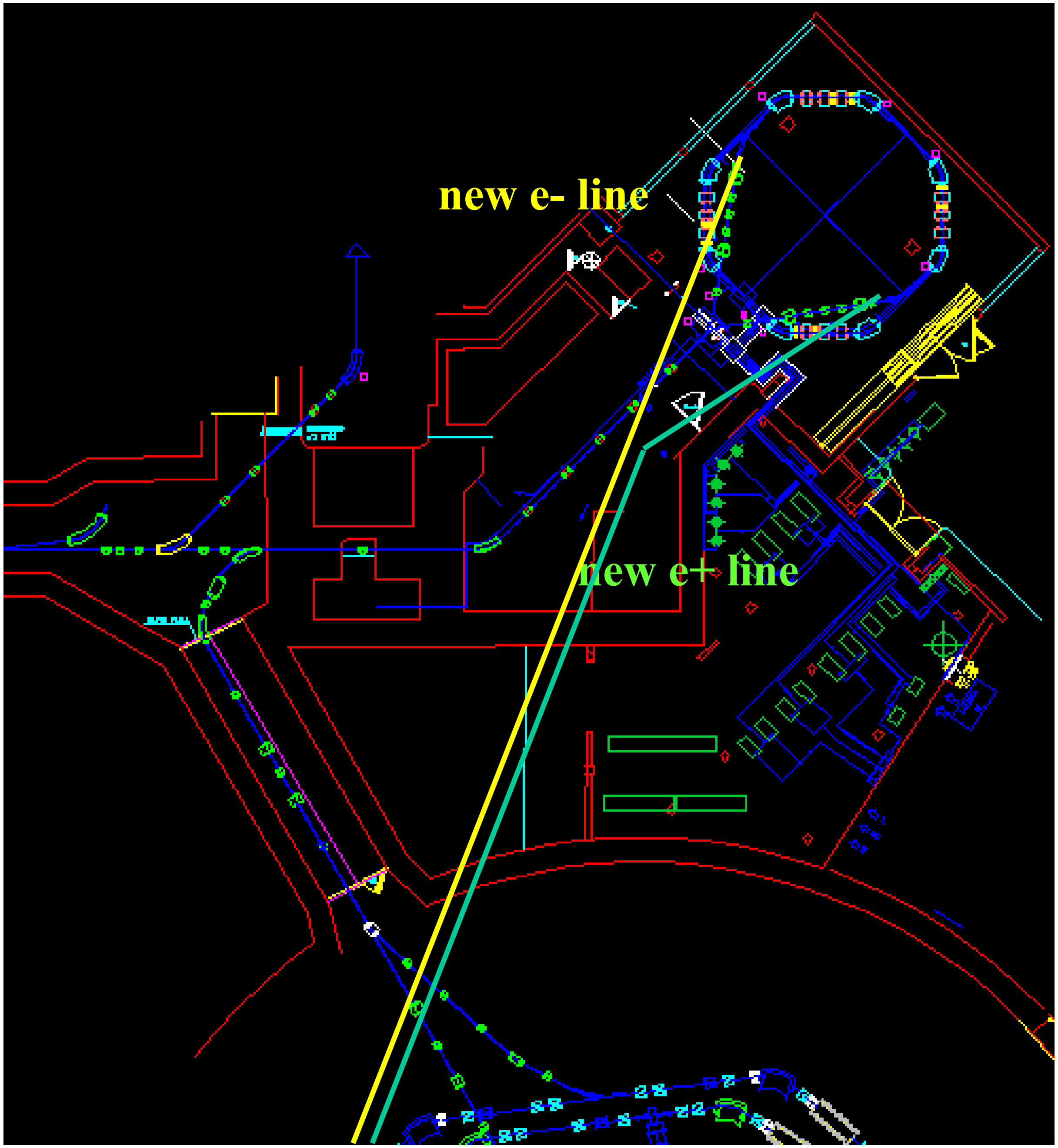


F. Sgamma

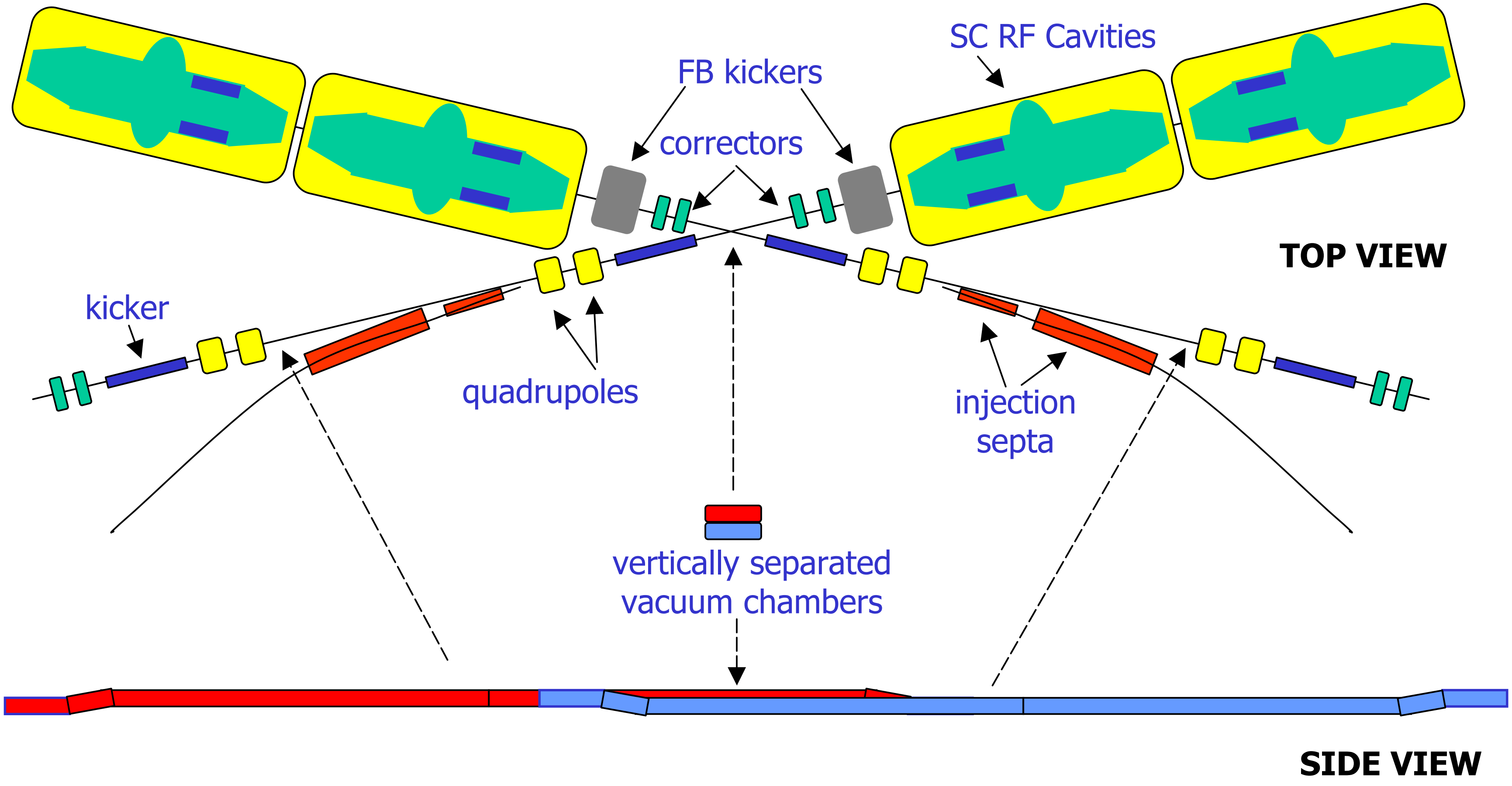
Injection system upgrade

- The proposed transfer lines pass in existing controlled area

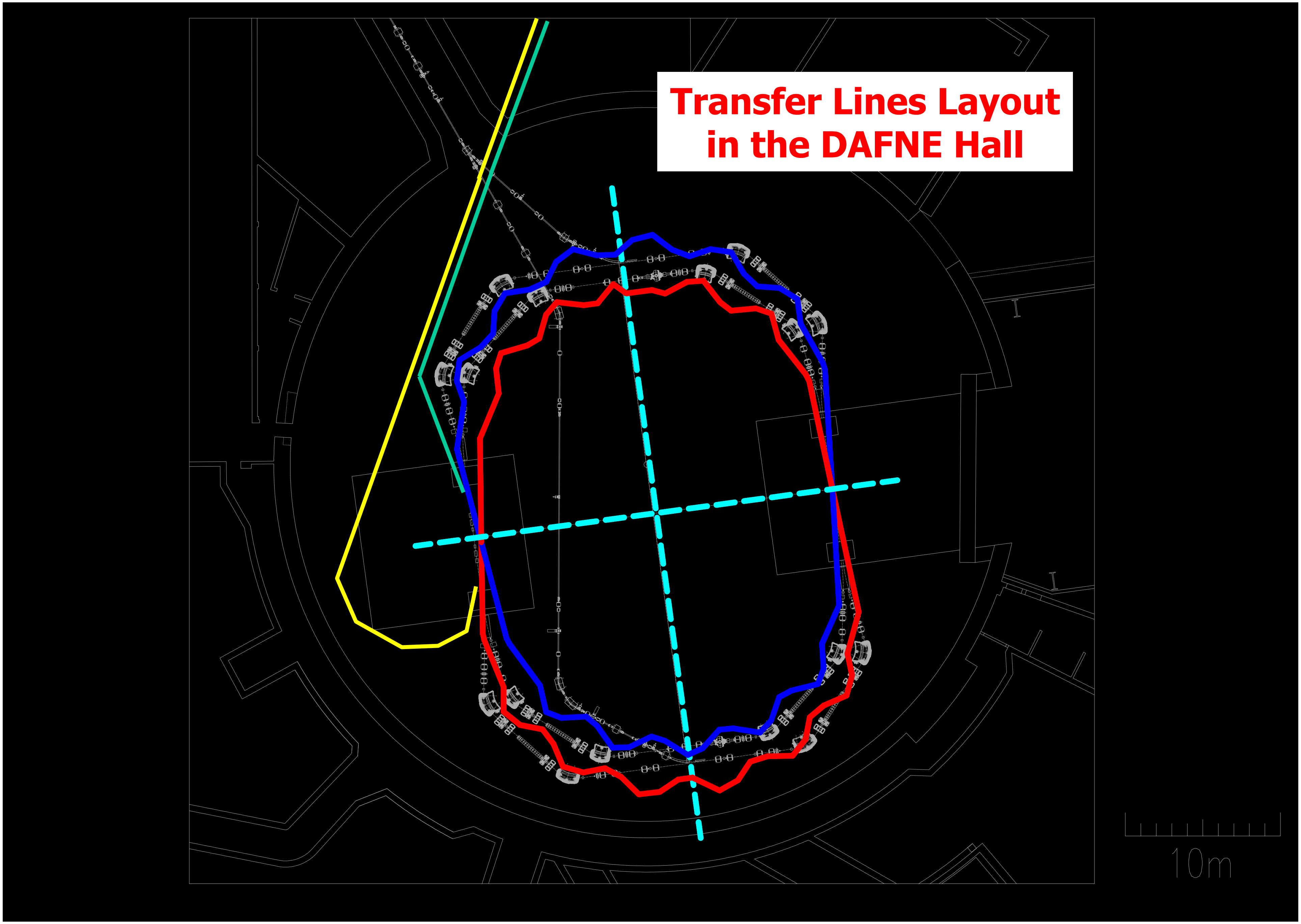
- Additional shielding needed in the area between the accumulator and DAFNE buildings



Crossing point section schematic layout

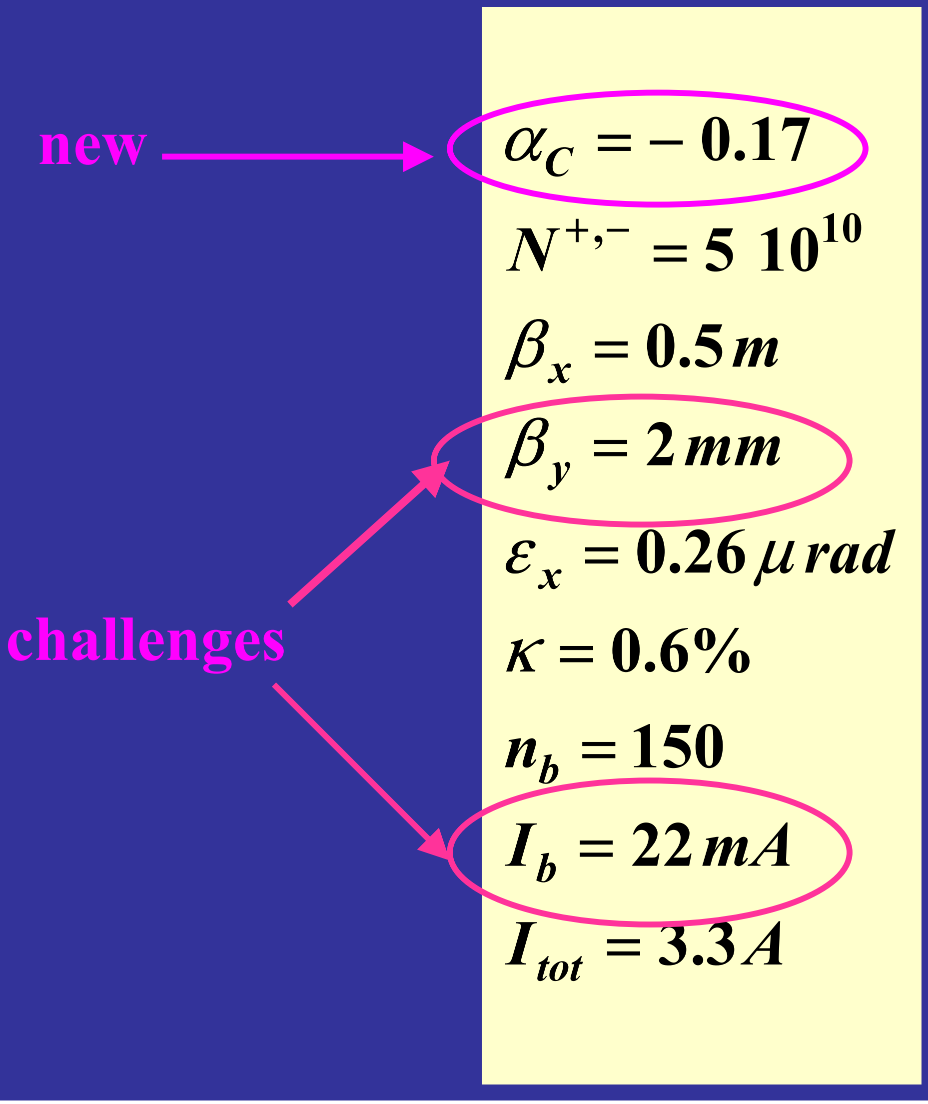


Transfer Lines Layout in the DAFNE Hall



Luminosity 10^{34}

set of consistent parameters



new

$\alpha_C = -0.17$

$N^{+,-} = 5\ 10^{10}$

$\beta_x = 0.5 m$

$\beta_y = 2 mm$

$\varepsilon_x = 0.26 \mu rad$

$\kappa = 0.6\%$

$n_b = 150$

$I_b = 22 mA$

$I_{tot} = 3.3 A$

challenges

MAIN PARAMETERS	
C (m)	105
E (MeV)	510
f_{rf} (MHz)	497
V (MV)	10
ε_x (μ rad)	0.26
ε_y (μ rad)	0.002
α_c	- 0.165
β_x^* (m)	0.5
β_y^* (mm)	2.0
N / bunch	5 e10
h	180
L /bunch (cm^{-2} sec^{-1})	9 10^{31}
L tot (cm^{-2} sec^{-1})	$\sim$ 1. 10^{34}

10^{33}

Optimistic extrapolation of present knowledge and technologies

10^{34}

Very challenging design based on new ideas
Proofs of principle and validation needed

10^{35}

……………

A. Gallo, The Strong RF Focusing: a possible approach to get short bunches at the IP

		$\sigma_z(IP) = 3\ mm$	$\sigma_z(IP) = 2\ mm$	$\sigma_z(IP) = 1\ mm$
Bunch length at the RF position	$\sigma_z(RF)$	12 mm	12 mm	12 mm
One-turn synchrotron phase advance	μ	151°	161°	170°
Energy spread in the strong RF focusing regime	$\frac{\sigma_E}{E}$	1.2 ‰	1.4 ‰	1.4 ‰
One-turn normalized path elongation (total ***R*** $_{56}$)	$R_{56}(L) = \alpha_c L$	19.4 m	16.9 m	17.1 m
Natural energy spread ("weak" focusing regime, μ <<1)	$\left.\frac{\sigma_E}{E}\right\|_0$	0.45 ‰	0.45 ‰	0.45 ‰
A function	$A[\mu, \rho(s), \beta_l(s)]$	0.446	0.263	0.074
RF wavelength - RF frequency	$\lambda_{RF} - f_{RF}$	0.6 m - 500 MHz	0.6 m - 500 MHz	0.6 m - 500 MHz
RF Voltage	V_{RF}	9.43 MV	11.19 MV	11.28 MV
Energy acceptance (@ IP - RF)	$\left.\frac{\Delta E}{E}\right\|_{\max}$	0.98 % - 0.41%	1.16% - 0.45%	1.2% - 0.47%

RF system

Collaboration with KEK, CESR
for compact 500 MHz cavity design

Figure 2: A picture of four SCC modules in Nikko-D11 tunnel

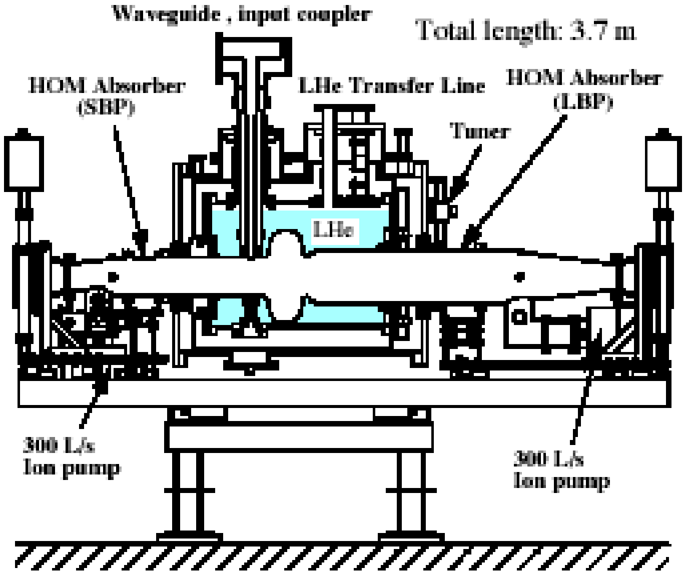


Figure 1: Superconducting cavity module for KEKB

where can we test the strong RF focusing scheme?

experiment at Qs=0.5,

CESR Qs=0.1-0.2 maximum at 1.5 GeV,

DAFNE-2 design value near 0.4

possibilities at SLAC DR?

PETRA or DORIS (nobody from DESY at this workshop!)

SPEAR-III (1st task?)

DAFNE status and outlook

- **Adiabatic changes on DAFNE approaching to an end.**
- **DAFNE performances expected to reach the original design goals (L= 5 * 10 ^{32}), within the next 2 years.**
- **3- 4 years of physics program fully booked with current (or slightly upgraded) detectors.**
- **After that, only radical changes possible**

S. Bertolucci, closing Alghero workshop

Next steps

- Keep going!
- Interim status report at the DAFNE conference in spring 2004 and at the CERN October 2004 meeting.
- Repeat this workshop !
- Start the R&D and test measurements on accelerator and detectors.