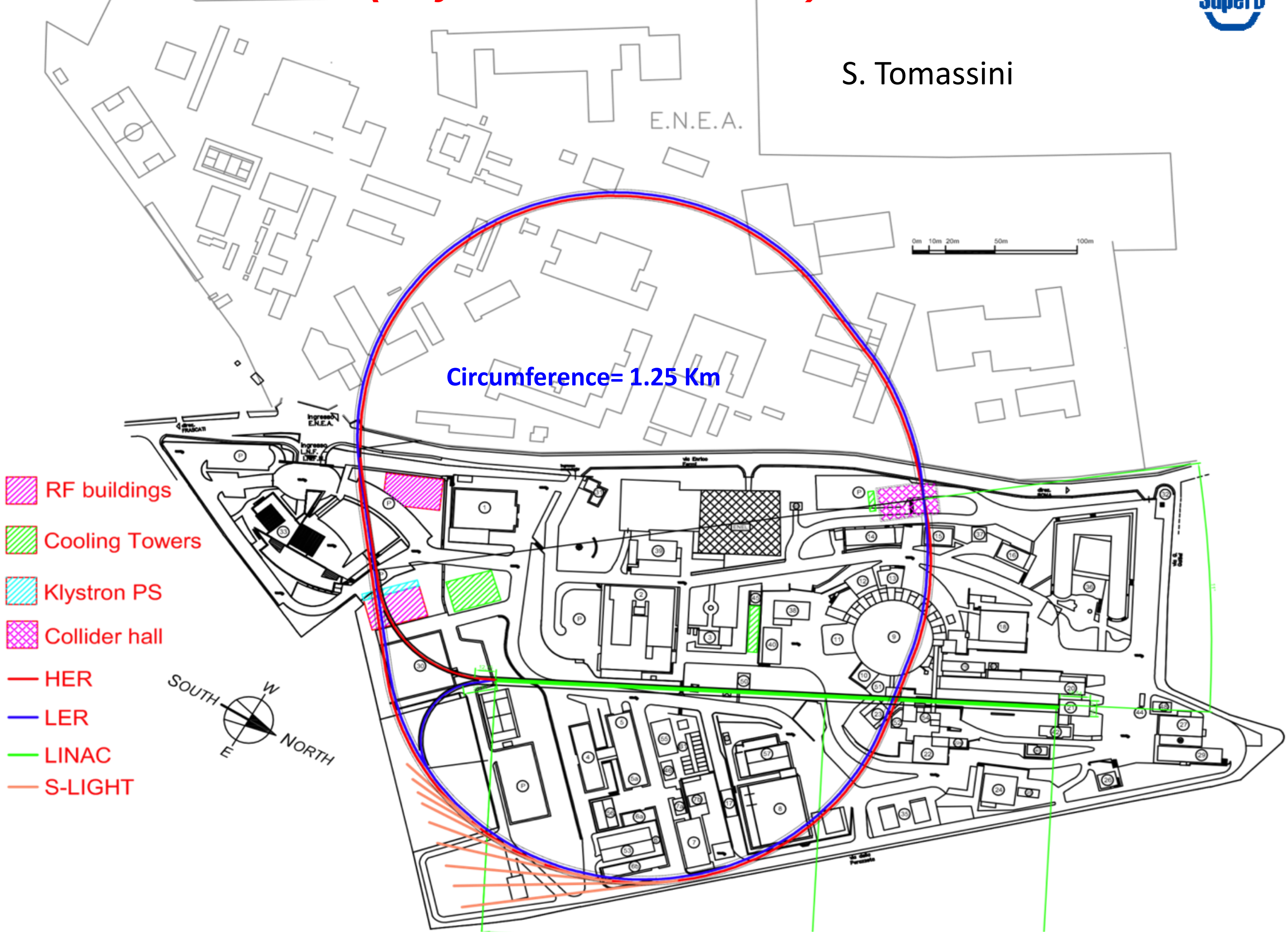
Accelerator Summary
SuperB Meeting
Elba, Italy

John Seeman (SLAC)
June 1, 2011

Present & Past SuperB Accelerator Contributors

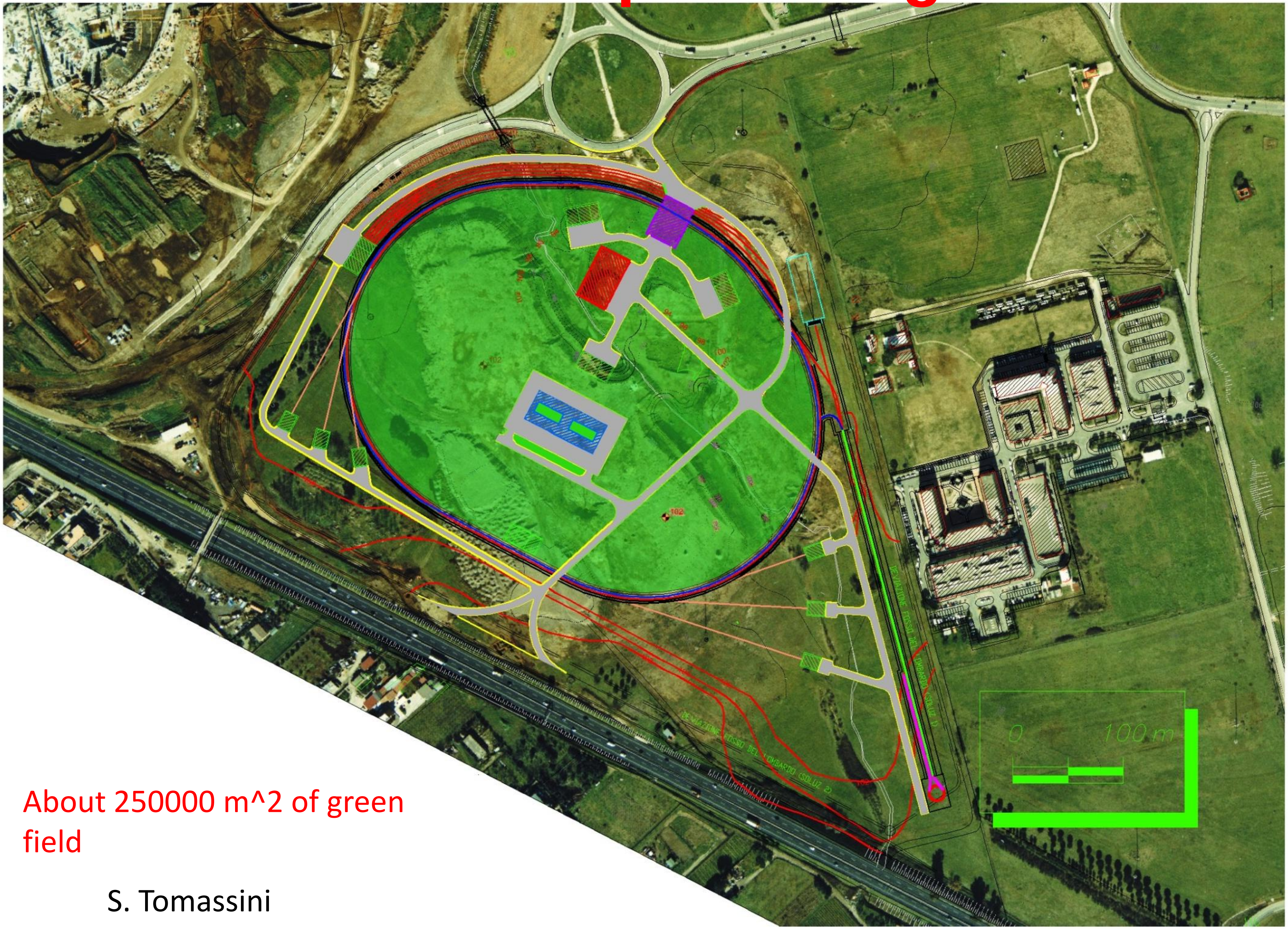
- M. E. Biagini, S. Bini, R. Boni, M. Boscolo, B. Buonomo, S. Calabro', T. Demma, E. Di Pasquale, A. Drago, M. Esposito, L. Foggetta, S. Guiducci, , S. Liuzzo, G. Mazzitelli, L. Pellegrino, M. A. Preger, P. Raimondi, R. Ricci, U. Rotundo, C. Sanelli, M. Serio, A. Stella, S. Tomassini, M. Zobov (INFN-LNF)
- F. Bosi, E. Paoloni (INFN & University of Pisa)
- P. Fabbricatore, R. Musenich, S. Farinon (INFN & University of Genova)
- K. Bertsche, A. Brachman, Y. Cai, A. Chao, R. Chestnut, M. H. Donald, C. Field, A. Fisher, D. Kharakh, A. Krasnykh, K. Moffeit, Y. Nosochkov, A. Novokhatski, M. Pivi, C. Rivetta, J. T. Seeman, M. K. Sullivan, S. Weathersby, A. Weidemann, J. Weisend, U. Wienands, W. Wittmer, M. Woods, G. Yocky (SLAC)
- A.Bogomiagkov, I. Koop, E. Levichev, S. Nikitin, I. Okunev, P. Piminov, S. Sinyatkin, D. Shatilov, P. Vobly(BINP)
- J. Bonis, R. Chehab, O. Dadoun, G. Le Meur, P. Lepercq, F. Letellier-Cohen, B. Mercier, F. Poirier, C. Prevost, C. Rimbault, F. Touze, A. Variola (LAL-Orsay)
- B. Bolzon, L. Brunetti, G. Deleglise, A. Jeremie (LAPP-Annecy)
- M. Baylac, O. Bourrion, J.M. De Conto, Y. Gomez, N. Monseu, D. Tourres, C. Vescovi (LPSC-Grenoble)
- A. Chancé (CEA-Saclay)
- D.P. Barber (DESY & Cockcroft Institute)
- S. Bettoni (PSI)
- R. Bartolini, A. Seryi, A. Wolski (UK)
- Y. Zhang (IHEP, Beijing)
- K. Ohmi (KEKB)

(May 2010 – release v12)



SuperB footprint at LNF Frascati

Site close up Tor Vergata



About 250000 m^2 of green field

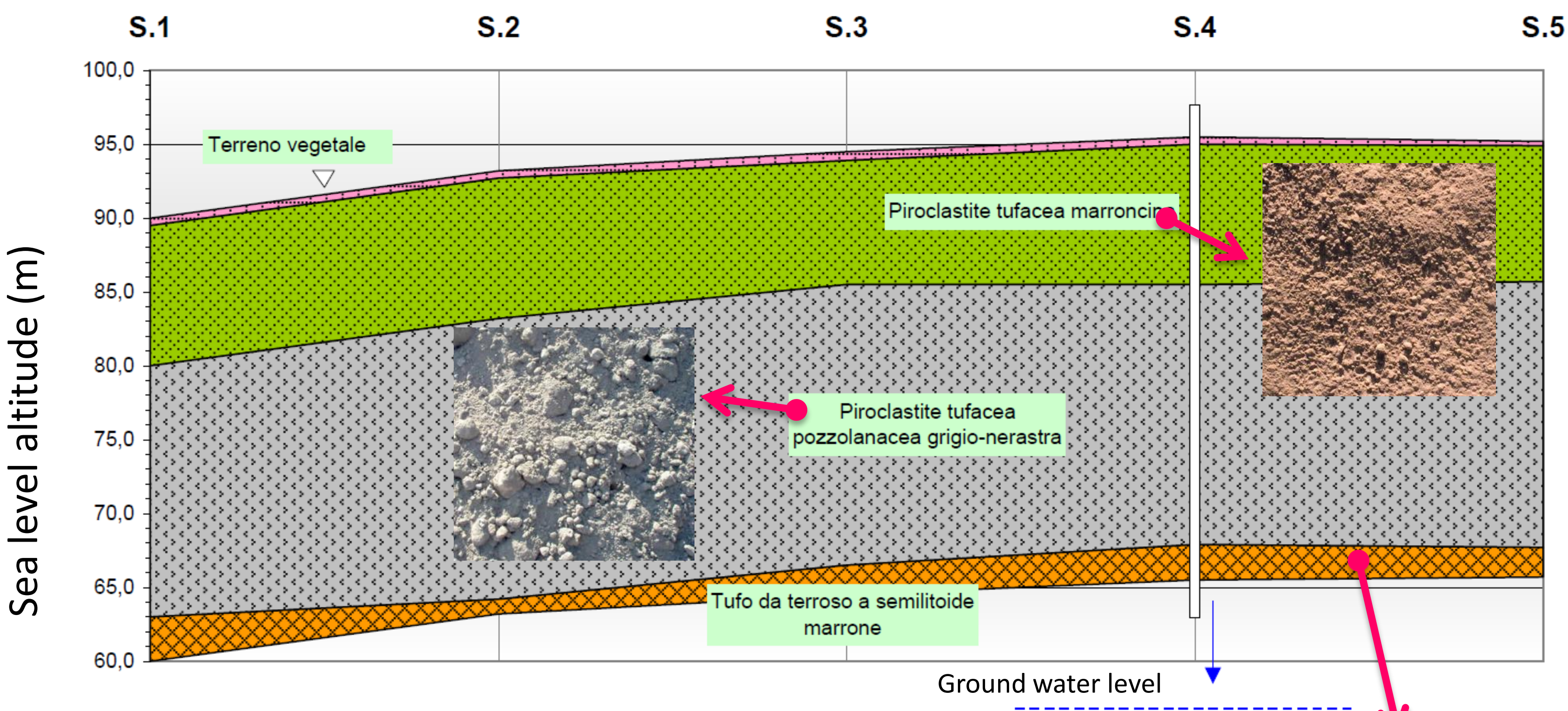
S. Tomassini

Ground x-section

Cantiere Roma - Comprensorio Universitario "Tor Vergata"

- SEZIONE GEOLOGICA INTERPRETATIVA

Località Tor Vergata - Sezione S.1 - S.5



Legenda :

- Brown pozzolan
- Tuff rock
- Vegetal soil (topsoil)
- Grey pozzolan

S. Tomassini

SuperB

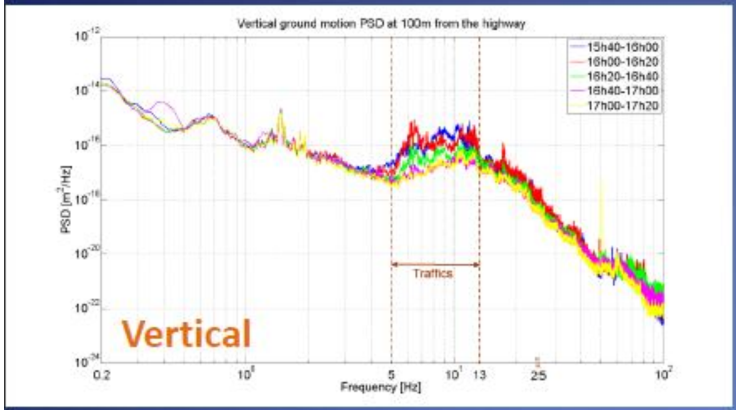
The SuperB Int. Site Committee April 19, 2011

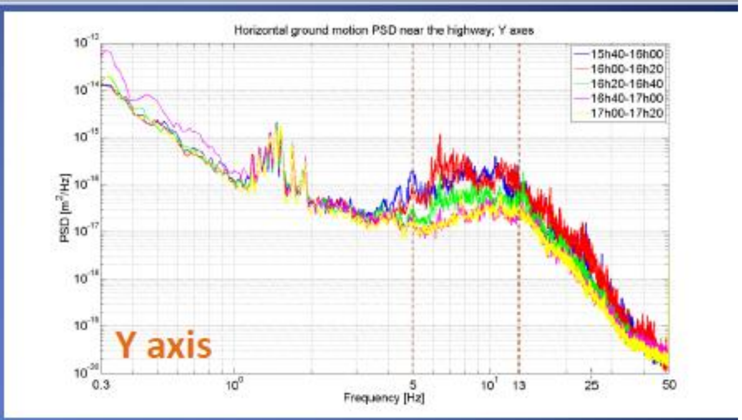
International Site Committee
Initial recommendations

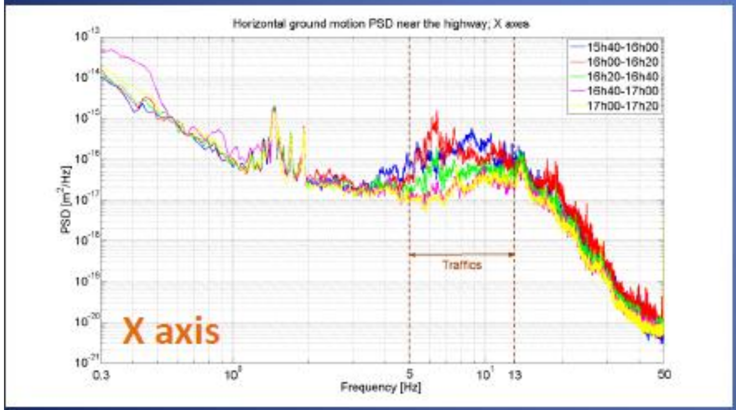
- On the TOR VERGATA site, there exists **a 10m thick layer of deposits**. The opinion of the committee is that it is most likely that this layer will have to be removed to found the new machine on ‘virgin’ ground.
- The committee recommends that the approval procedures (and time) needed for formal Project Approval by the authorities for the TOR VERGATA site is verified.
- The committee recommends that the design and construction phases of the project are somehow de-coupled (i.e. not the same company)
- A detailed schedule should be developed highlighting the critical milestones e.g. deposit removal, checking of vibration levels, compare construction methods (TBM or cut & cover)
- A cooling scheme needs to be further investigated including discussions with local authorities for supply and discharge water.
- The committee learnt that it is believed power stability/ quality of the electrical network is adequate for both the Frascati and TOR VERGATA sites
- Ground stability / vibration is a potential ‘show stopper’ for the site and as such, these investigations should have top priority

Recent Vibration Measurements

PSD of ground motion







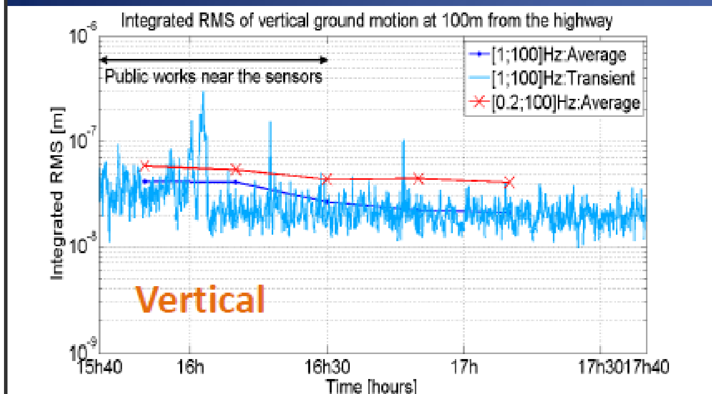
N.B: X axis→ noise below 0.3Hz
Y axis→ noise below 0.3Hz
Z axis→ noise below 0.2Hz

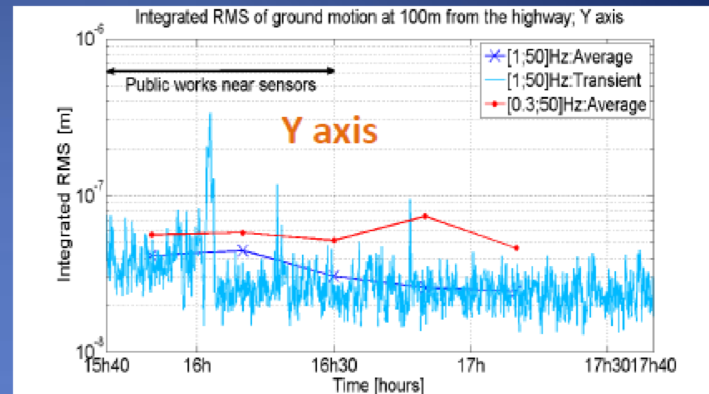
Bolzon et al

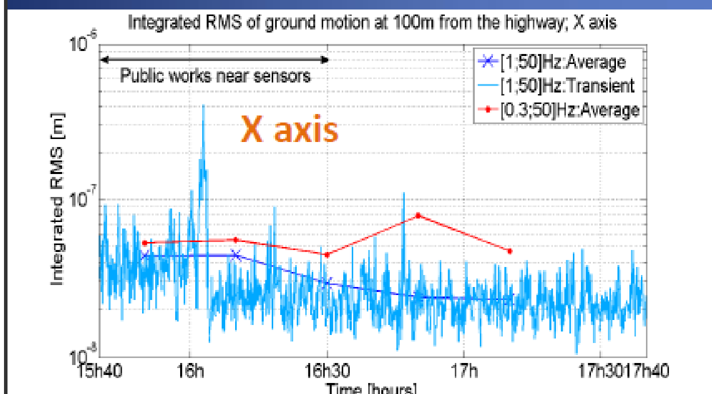
→ In the 3 axes: the high peak of traffic becomes lower with time and its amplitude and bandwidth are well lower than the one from measurements near the highway

Measurements 100 m from highway

Integrated RMS of ground motion







- ✓ N.B: Public works near the measurement point from 15h40 to 16h30

- ✓ Except during the public works, ground motion very low: between 20nm and 30nm in the three directions!!
  - ➢ Vibrations of the highway well attenuated with the distance (100m)!!

Bolzon et al

Vibration budget

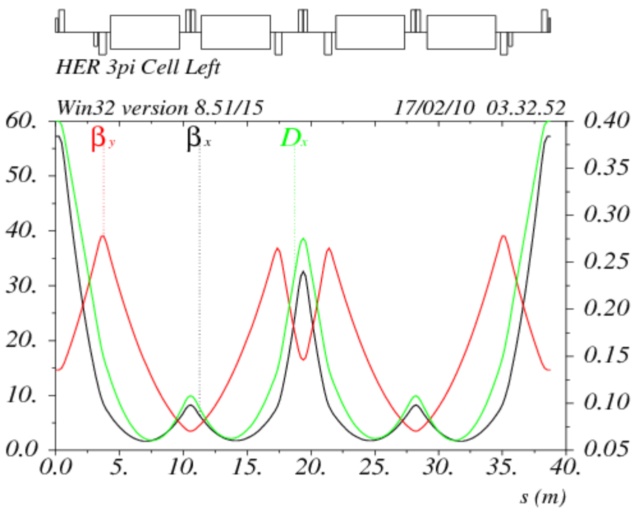
	Request (vertical displacement)	Measured (vertical displacement)
IP	**300 nm**	**20-40 nm**
Final Focus	**300 nm**	**20-30 nm**
Arcs	**500 nm**	**20-30 nm**

(see B. Bolzon and K. Bertsche Talks)

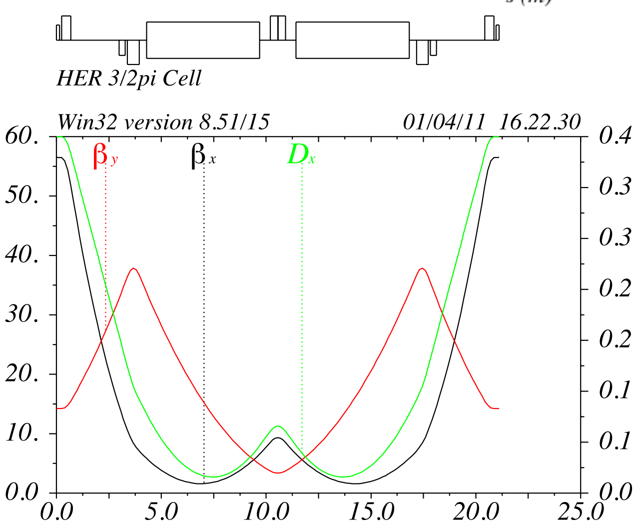
S. Tomassini

SuperB Arcs Raimondi

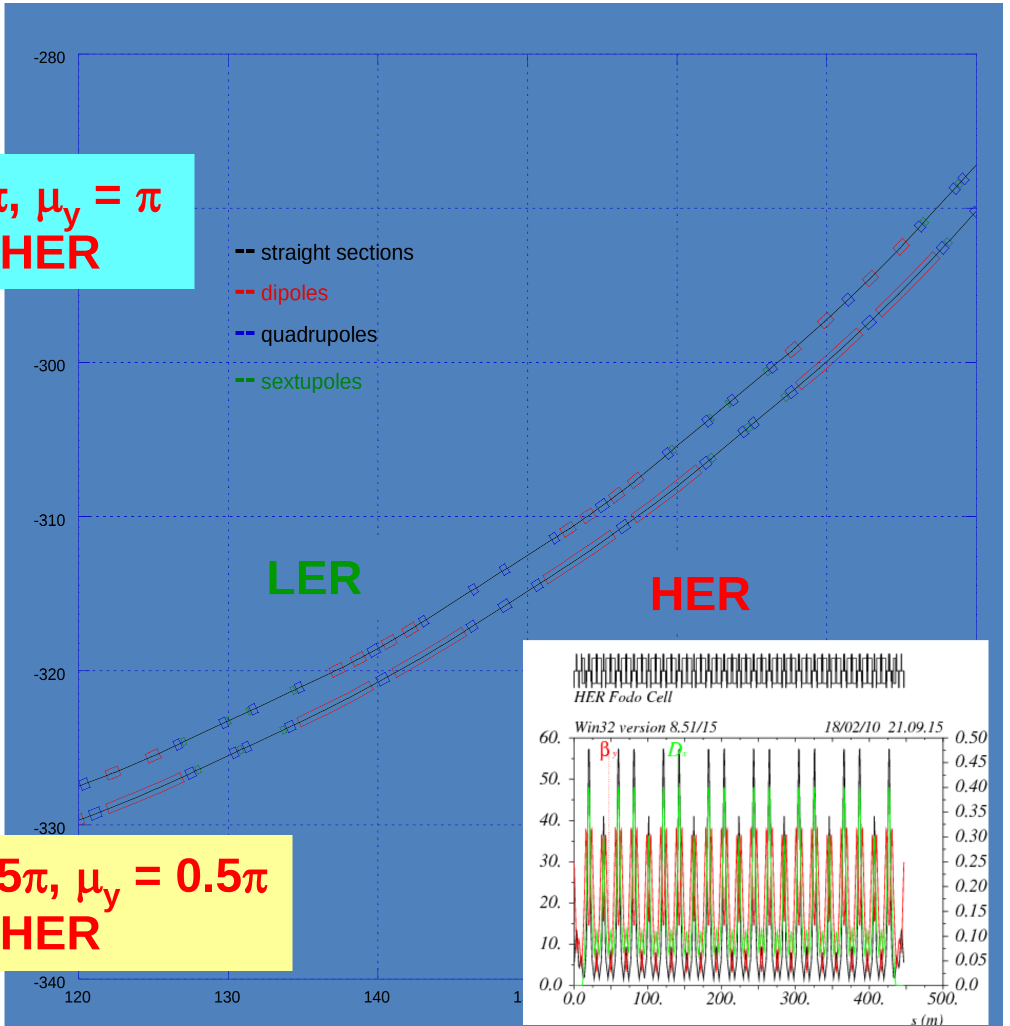
- HER and LER arcs have conceptually the same lattice. LER arc dipoles are shorter (bend radius about 3 times smaller) than in the HER in order to match the ring emittances at the asymmetric beam energies.



$\mu_x = 3\pi$, $\mu_y = \pi$
Cell in HER

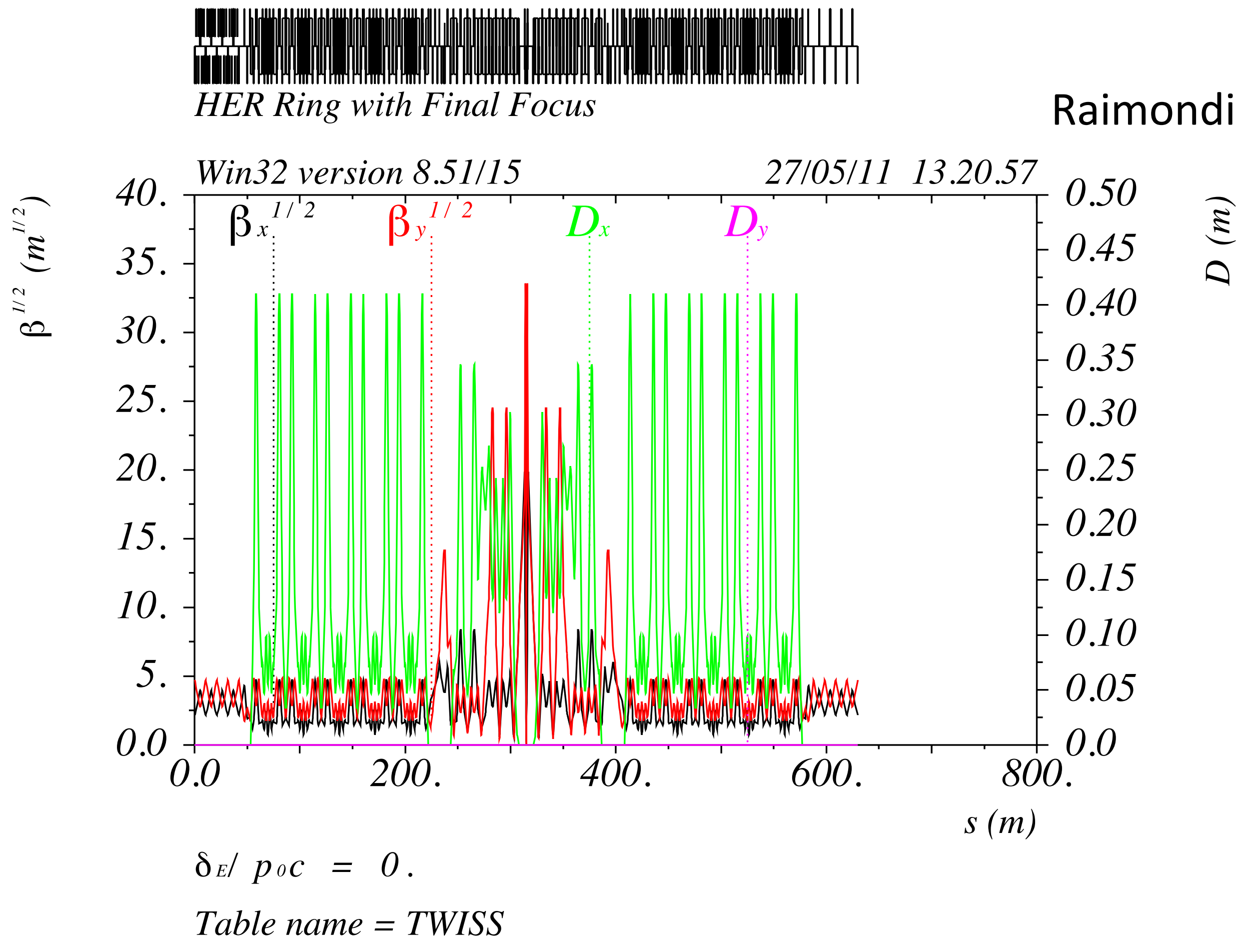


$\mu_x = 1.5\pi$, $\mu_y = 0.5\pi$
Cell in HER

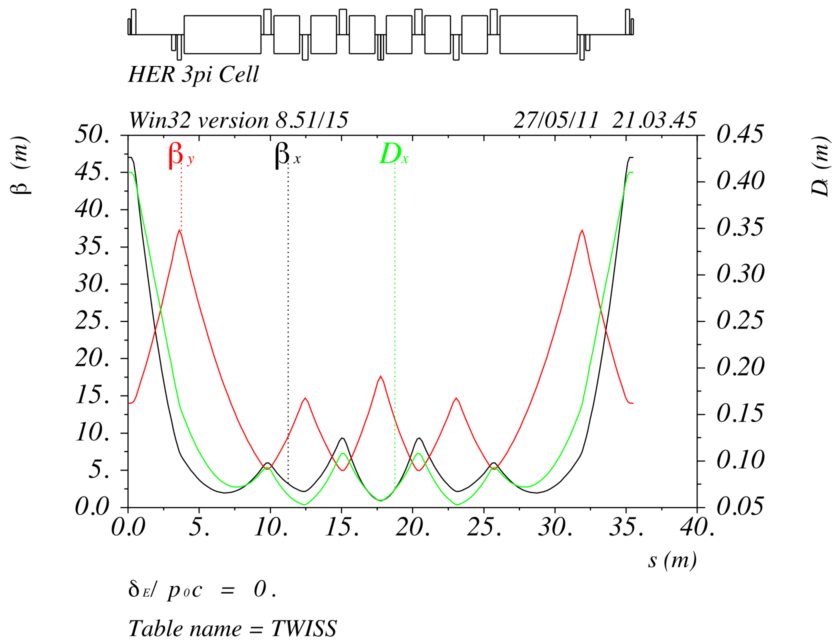


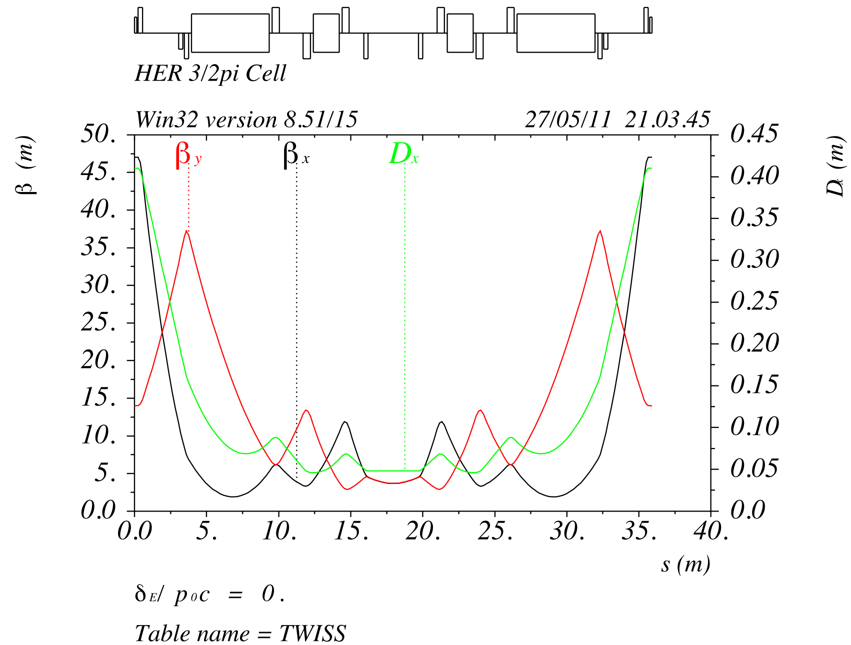
What if LER is half size HER

Raimondi



6 Distributed Insertions





Alternating sequence of:

Cell1 mux = 1.5, muy=0.5

Cell2 mux = 1.215, muy=0.688

Undulator insertions: length = 3.5m betax/y = 3.2m

Optic flexible to change beta’s and mu’s

Raimondi

To Do list

Raimondi

- - Iterate the layout and lattice optimization with site constraints

  - Work out the injection lines.

  - Make the FF H/L L/R like for the V12 (add/subtract 30mrad to the FF L/R)

  - Work out the vertical separation: hopefully find the solution for the two arcs vertically displaced by about 0.5m. This will double the availability for SR lines.

  - Insert the Injection cells in the proper places

Oxford SuperB mini-workshop

SuperB miniworkshop

Main Page
Agenda
Transport
Local Facilities
Contact

The John Adams Institute and the Physics Department of QMUL are organising a mini-workshop to explore the possible interests of the UK accelerator and detector communities in the recently funded SuperB project.

The aim is to provide updated information on the various aspects of the project and to participate in discussions so that anyone with a potential interest in SuperB has the opportunity to step forward and participate.

The meeting will take place at Jesus College, Oxford on 18th and 19th of May 2011

We note that there is very limited accommodation via colleges during this period, and we therefore recommend that participants would arrange accommodation in local hotels or bed and breakfast via Daily info.

For further information and to register your interest, please click on the contact link on the left

For further details about the meeting, please email (s.geddes1@physics.ox.ac.uk).

Organising committee

A. Seryi JAI Oxford
R. Bartolini JAI Oxford
A. Bevan QMUL

Areas of interest emerged from the parallel session on accelerators

Low emittance tuning
Linear optics correction
Nonlinear optics correction

3 talks

Impedance computation
Single bunch effects
Multi bunch effect
Codes development

2 talks

Diagnostics
and feedback systems

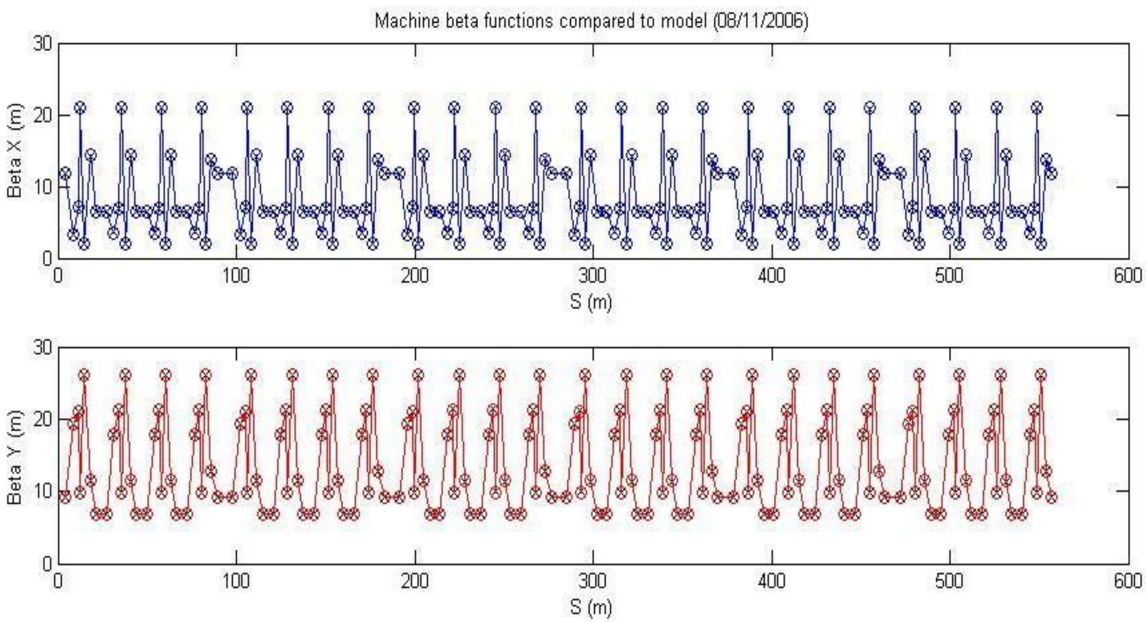
2 talks
+ A. Drago's talk

Hardware
Magnets and wigglers

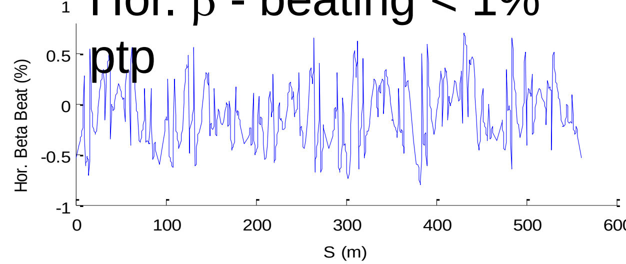
1 talk

Bartolini

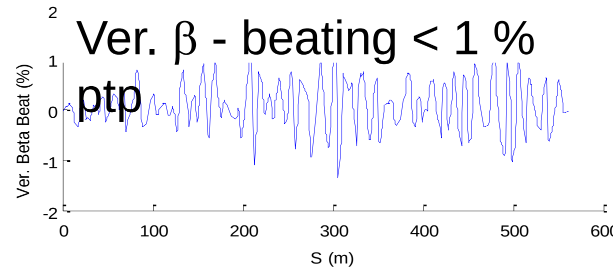
Linear optics correction with LOCO (R. Bartolini)



Hor. β - beating < 1% ptp



Ver. β - beating < 1 % ptp



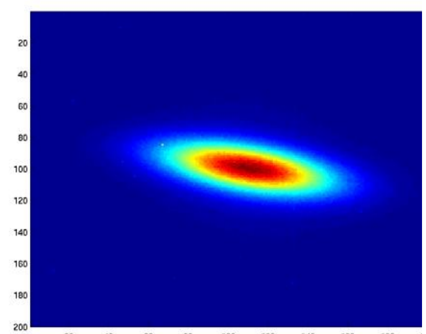
Emittance [2.78 - 2.74] (2.75) nm

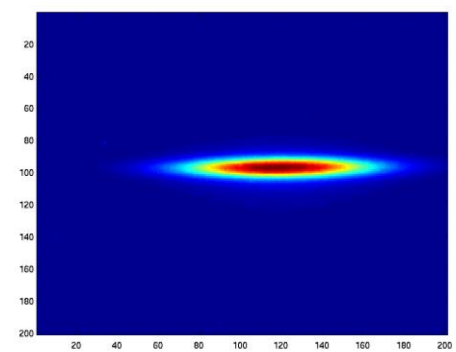
Energy spread [1.1e-3 - 1.0-e3] (1.0e-3)

Coupling correction to below 0.1%

V beam size at source point 6 μm

V emittance 2.2 pm





Very good control of the linear optics with LOCO

Magnets, Wigglers and Undulators (J. Clarke)

Conventional magnets

Dipoles, Quadrupoles, Sextupoles, ...

Kickers & Septums

DC, AC, & Pulsed

Recent projects Diamond, ALICE, EMMA

Wigglers and undulators

In-vacuum, Apple-II

Permanent magnets

Superconducting, SC helical

Recent projects include SRS, Diamond, ALPHA-X, ALICE, ILC

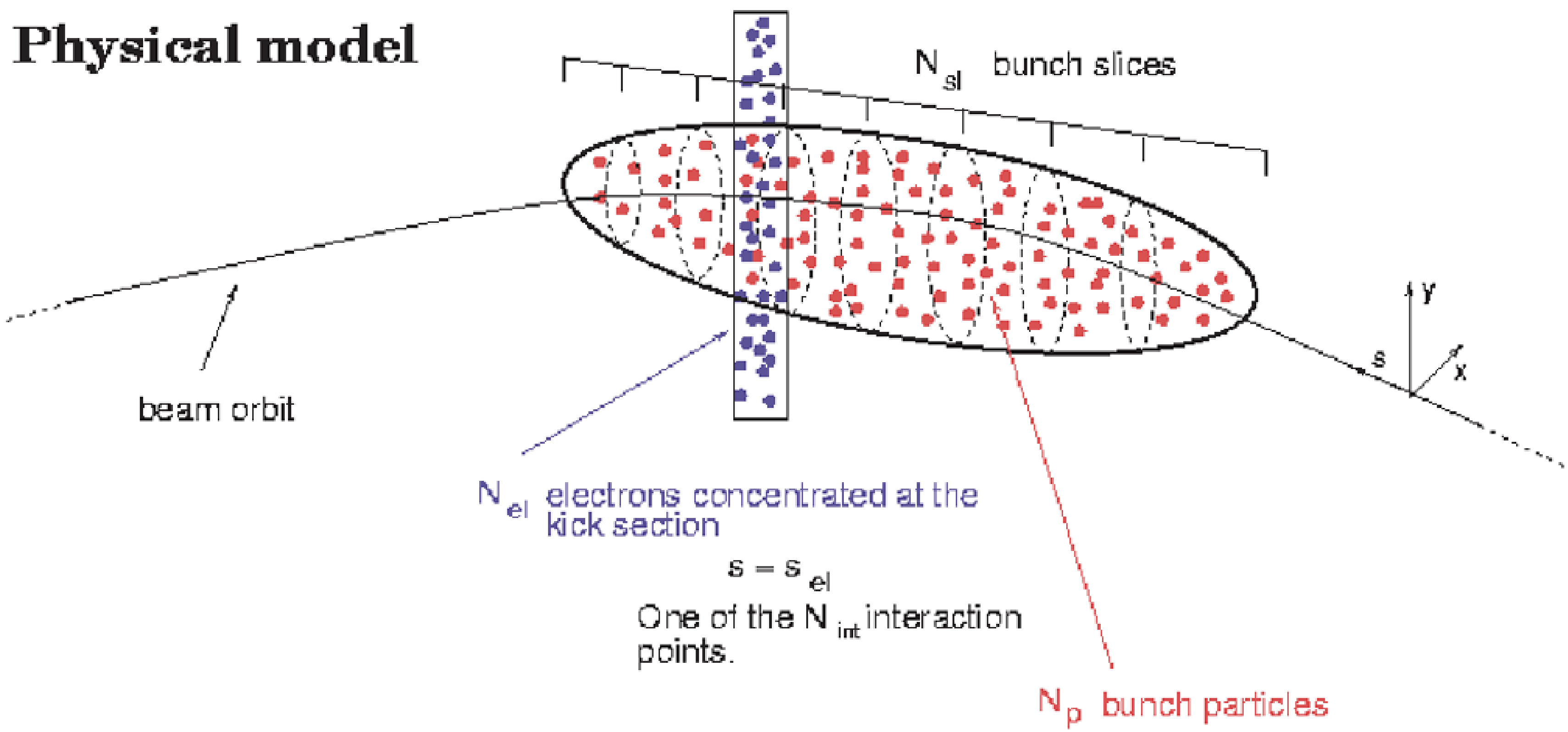
Codes for magnet modelling

Opera 2D, Opera 3D, Tosca ,Elektra

CST EM Studio (3D)

RADIA (3D) - very good for PM undulators

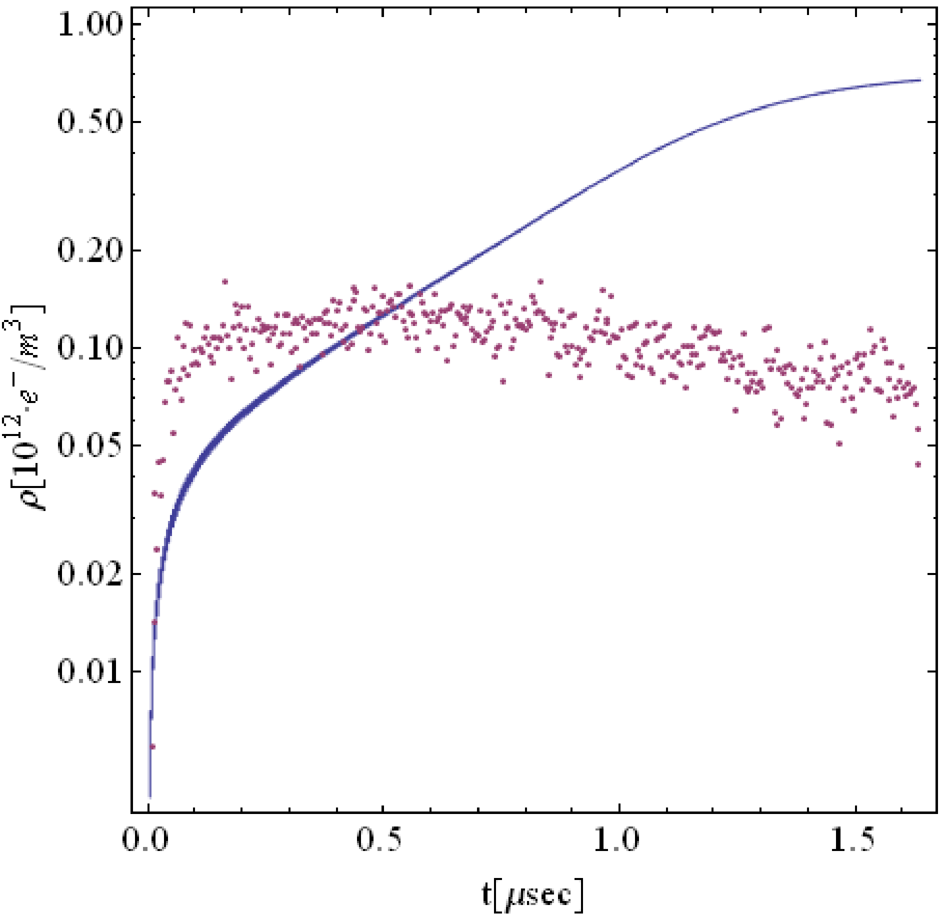
E- Cloud
Single-bunch instability mechanisms*

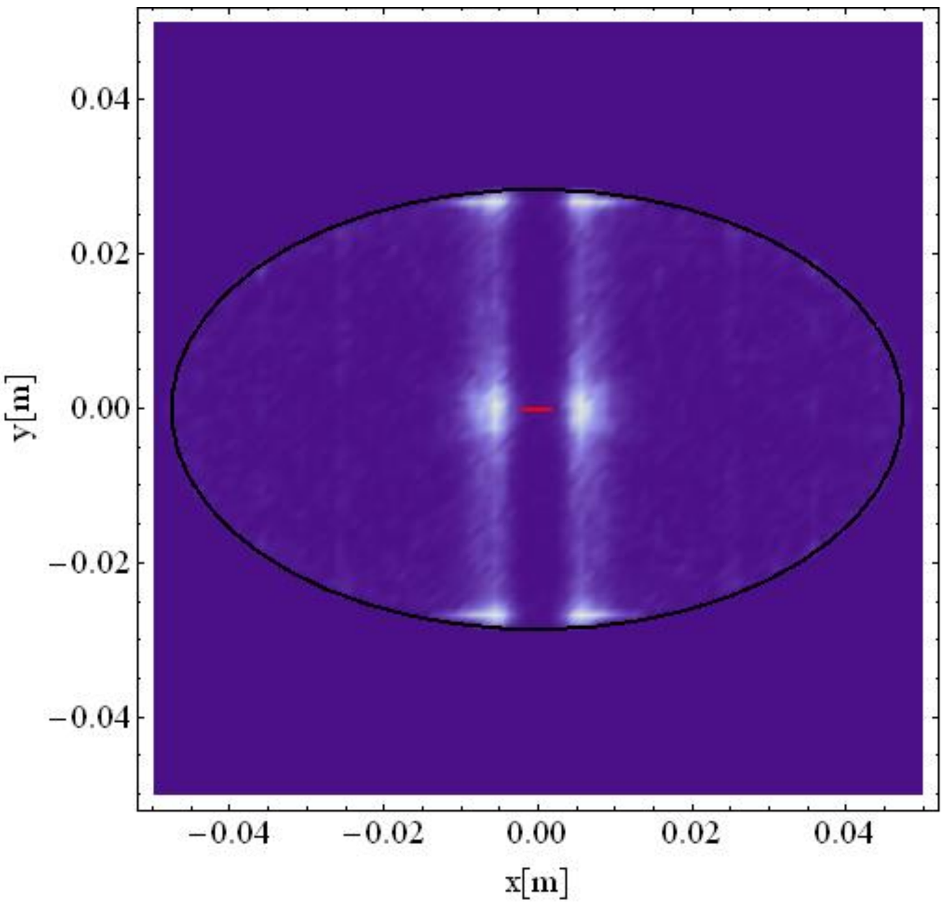


T. Demma

Buildup in SuperB V12 HER Dipoles

By=0.3 T; η=95% SEY=1.1





T. Demma

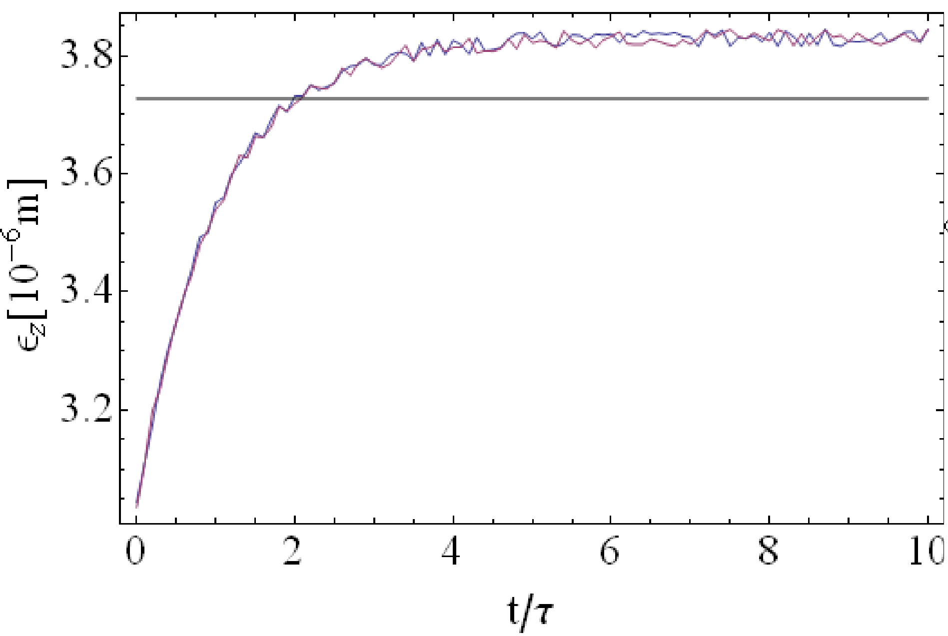
Summary by T. Demma

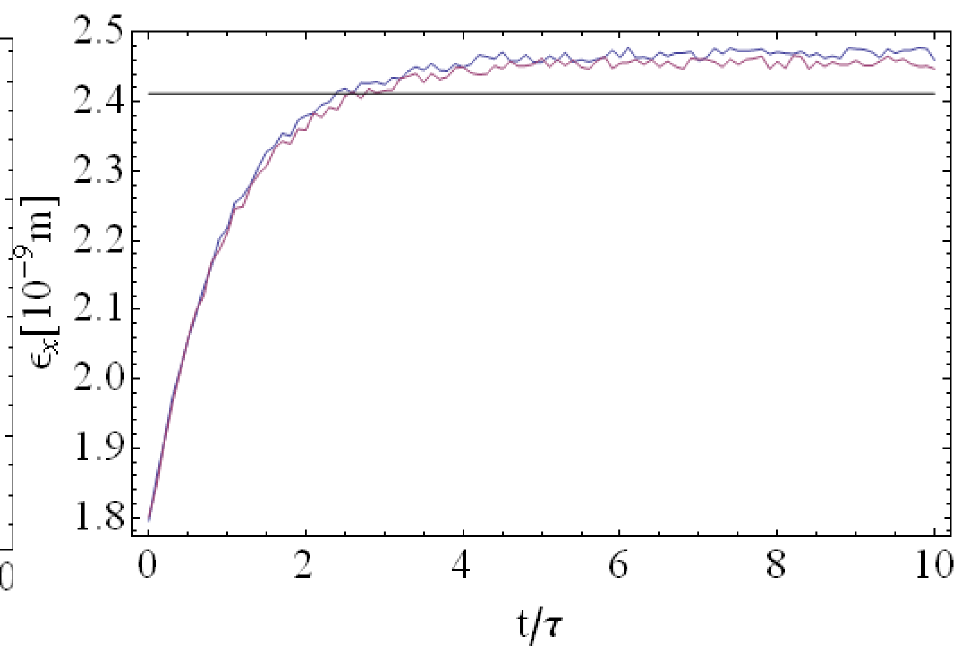
- Single bunch instability simulations for SuperB HER V12 taking into account the effect of solenoids have been performed using CMAD. They indicate a threshold density of ~10^{12} e-/m^3 (roughly 2 times previous estimates).

- The obtained thresholds have to be compared with build-up simulations using updated parameters to determine safe regions of the parameter space (SEY, PEY)…

Update on LER Multi-particle Simulation of IBS

M.E. Biagini, M. Boscolo, T. Demma (INFN-LNF)
A. Chao, M.T.F. Pivi (SLAC).





IBS Status

Demma

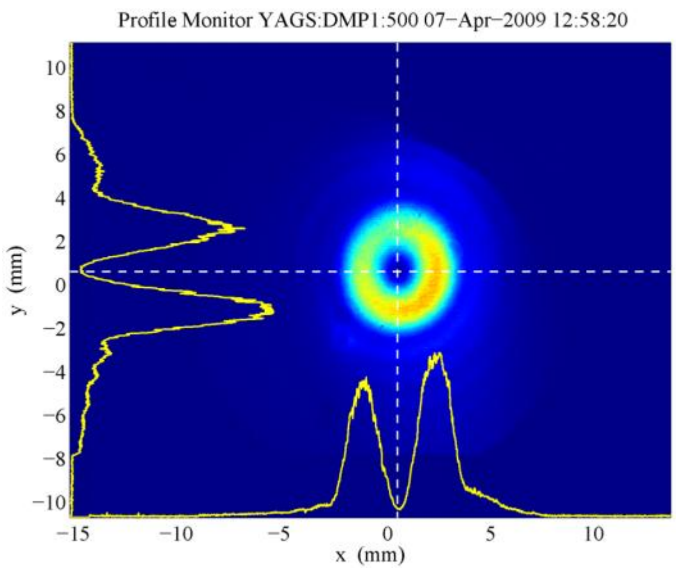
- The effect of IBS on the transverse emittances is about 30% in the LER and less then 5% in HER that is still reasonable if applied to lattice natural emittances values.
- Interesting aspects of the IBS such as its impact on damping process and on generation of non Gaussian tails may be investigated with a multiparticle algorithm.
- Started studying SuperB full lattice (including coupling and errors?)

What is CSR ?

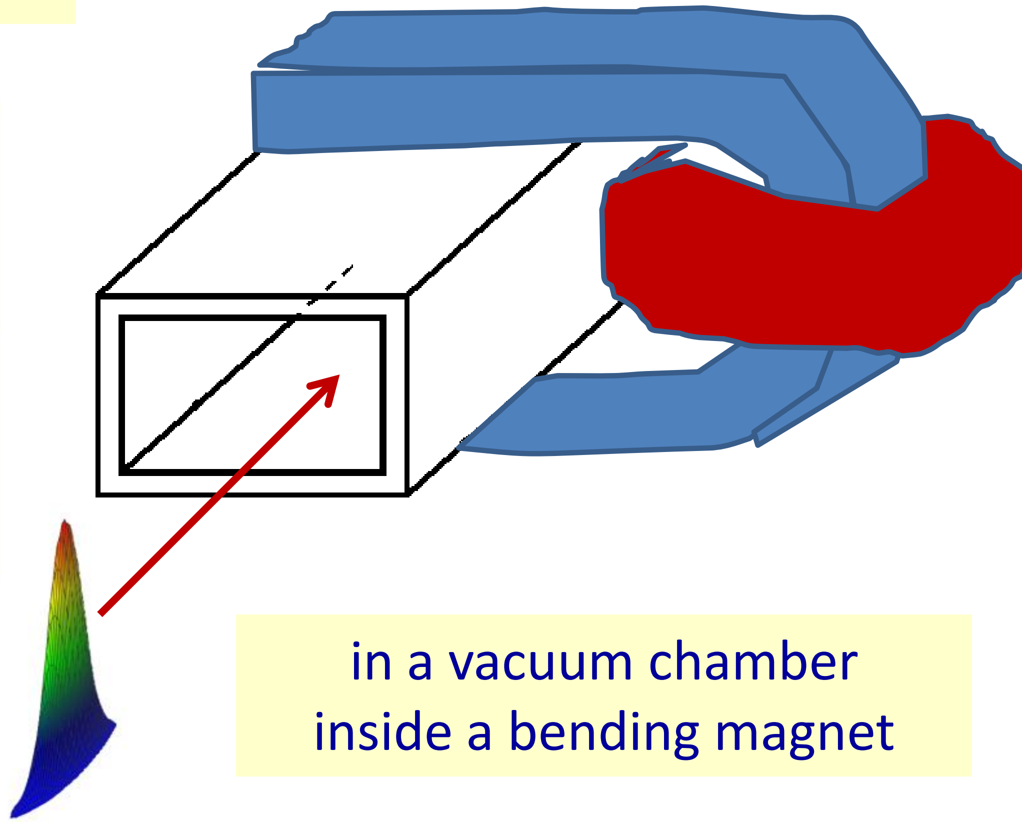
Coherent Synchrotron Radiation

S. Novokhatski

electro-magnetic fields
image from LCLS

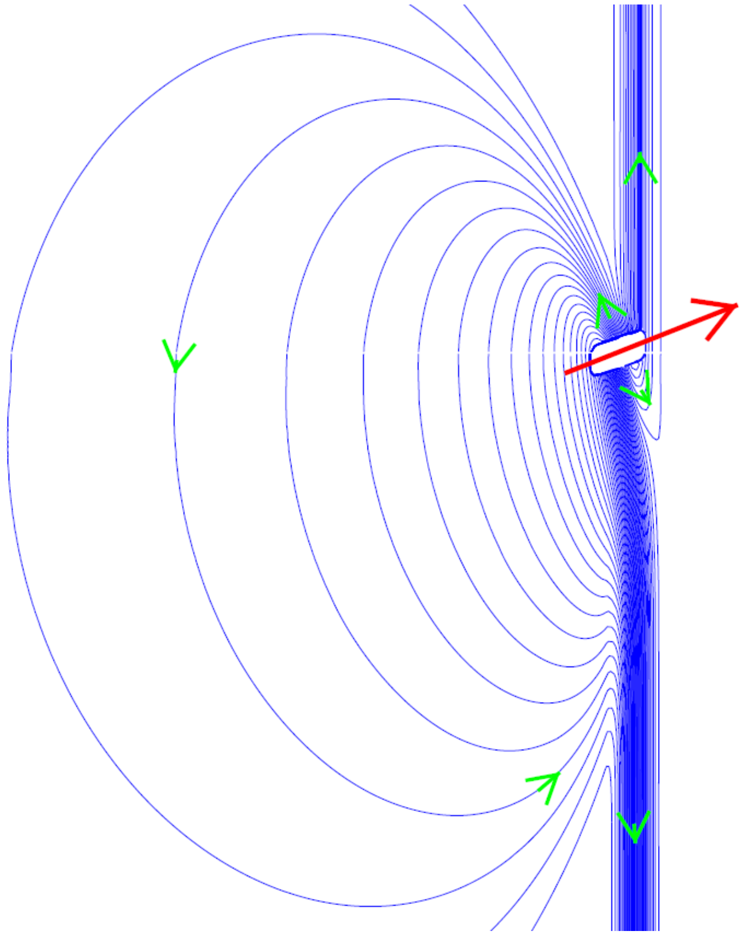


excited by
a short bunch



in a vacuum chamber
inside a bending magnet

Bunch self-field remakes itself moving in a magnetic field



The upper field lines take the position of the lower lines

The white box shows the bunch location

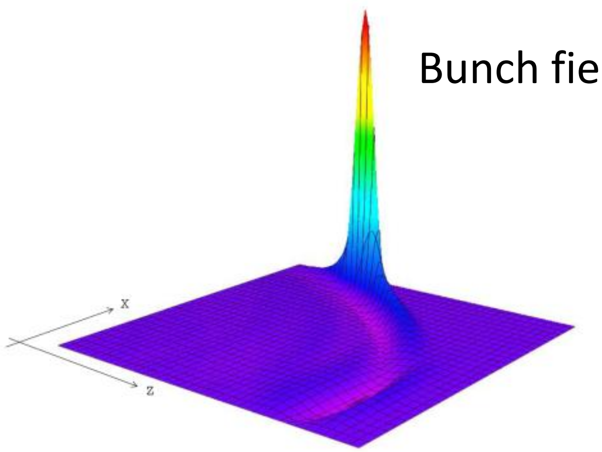
The red arrow shows the bunch velocity vector

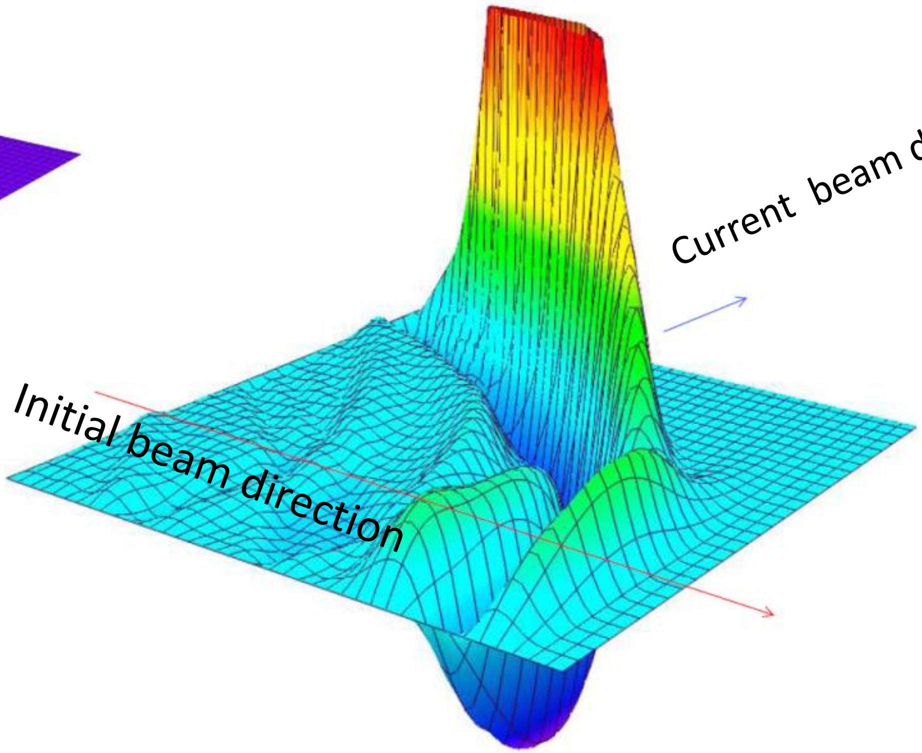
Green arrows show field line directions

The lower field lines take the place of the upper lines

S. Novokhatski

Magnetic field plots

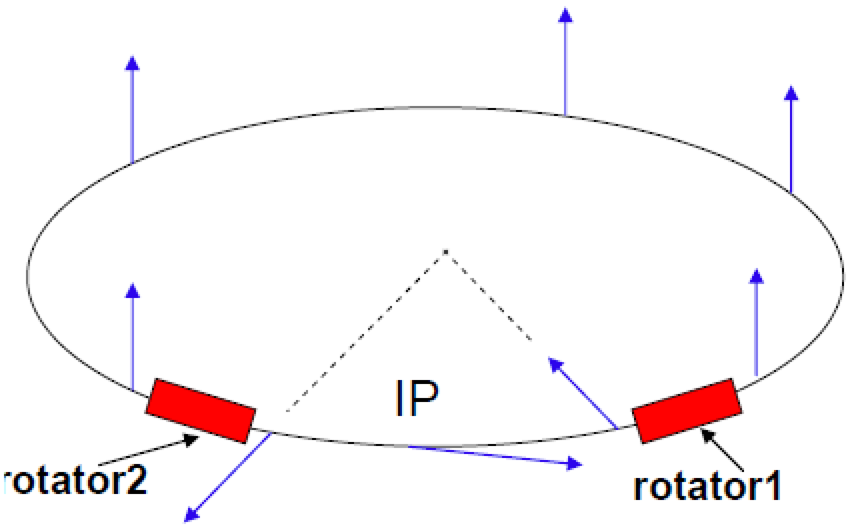




S. Novokhatski

Two 90^0 spin rotators scheme at LER

Spin is directed longitudinally at IP at two specific energies.
It makes a half turn in the FF-arc when E = 1.4 GeV
and it makes 1.5 turns at E=4.18 GeV (that's is nominal E)

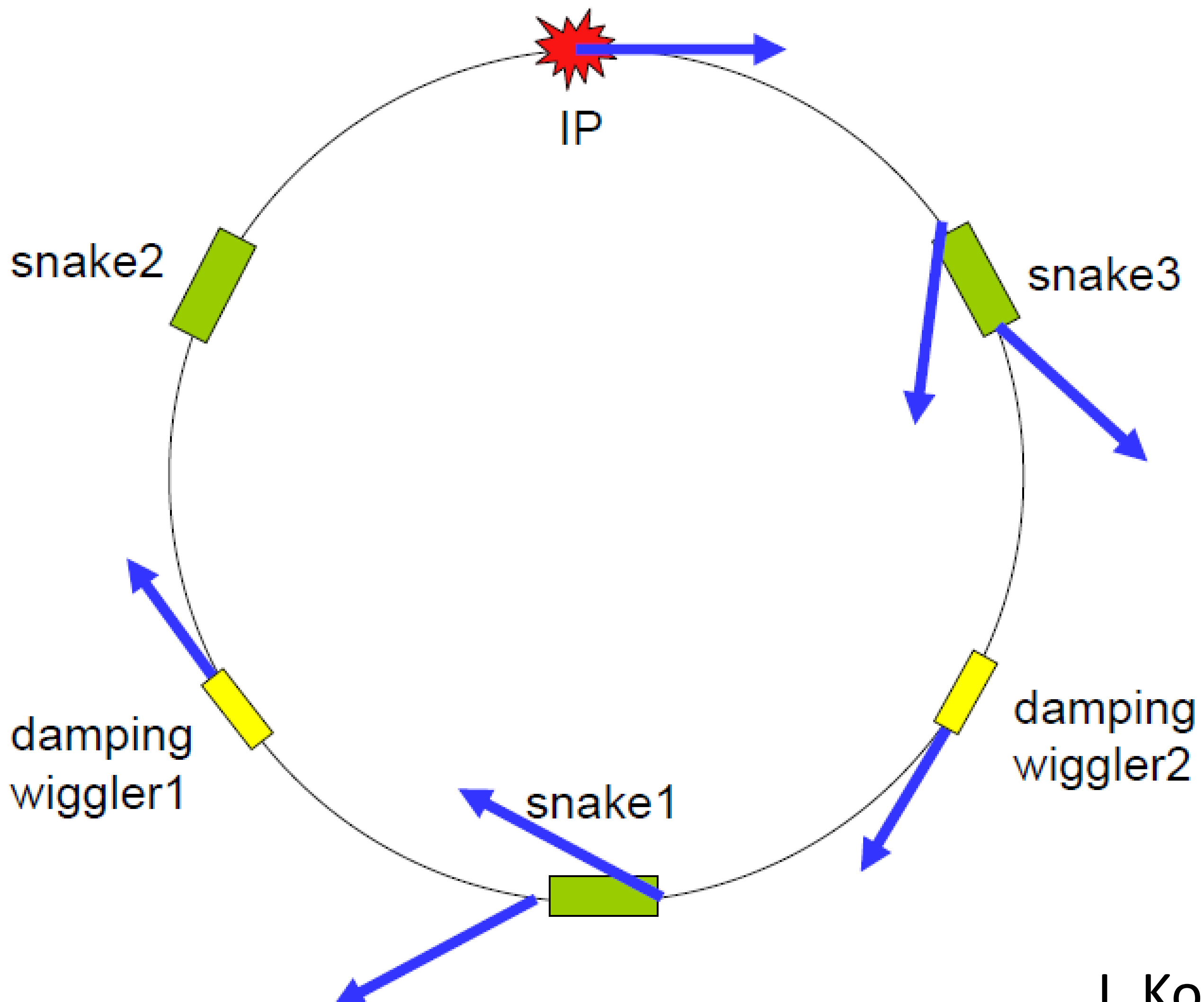


$\vec{d} = \gamma \dfrac{\partial \vec{n}}{\partial \gamma}$ - the spin – orbit coupling vector, $|\vec{d}| \sim \gamma$

I. Koop

$$\tau_p^{-1} = \frac{5\sqrt{3}}{8} \lambda_e r_e c \gamma^5 \left\langle \frac{1 - \frac{2}{9}(\vec{n}\vec{v})^2 + \frac{11}{18}\vec{d}^2}{|r|^3} \right\rangle \sim \begin{cases} \gamma^5 \text{ if } |\vec{d}| \leq 1 \\ \gamma^7 \text{ if } |\vec{d}| \gg 1 \end{cases}$$

Polarization scheme with 3 snakes (arc=120^0 +2 damping wigglers in the arc's middle)



I. Koop

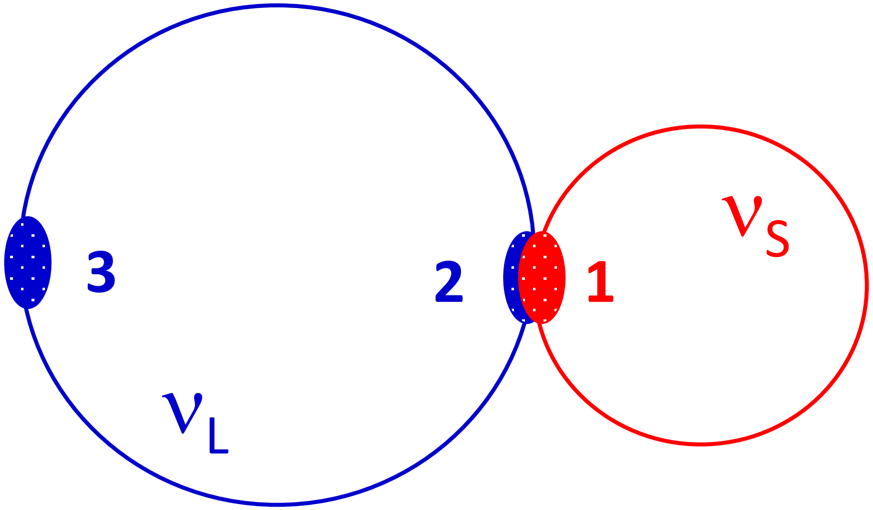
Conclusion on polarization

- A scheme with two 90^0 spin rotators provides up to 80% of the longitudinal polarization in LER at 4.2 GeV.
- Single snake scheme is feasible at E<2 GeV
- 3 snakes option looks not favorable
- Tolerances on the quads gradient integrals and the solenoid field integrals are in a range of few percents

Koop

Beam-Beam Simulations (2 size rings)

Full Turn ("Super-period")



1. Interaction between "1" and "2".
   "3" unchanged

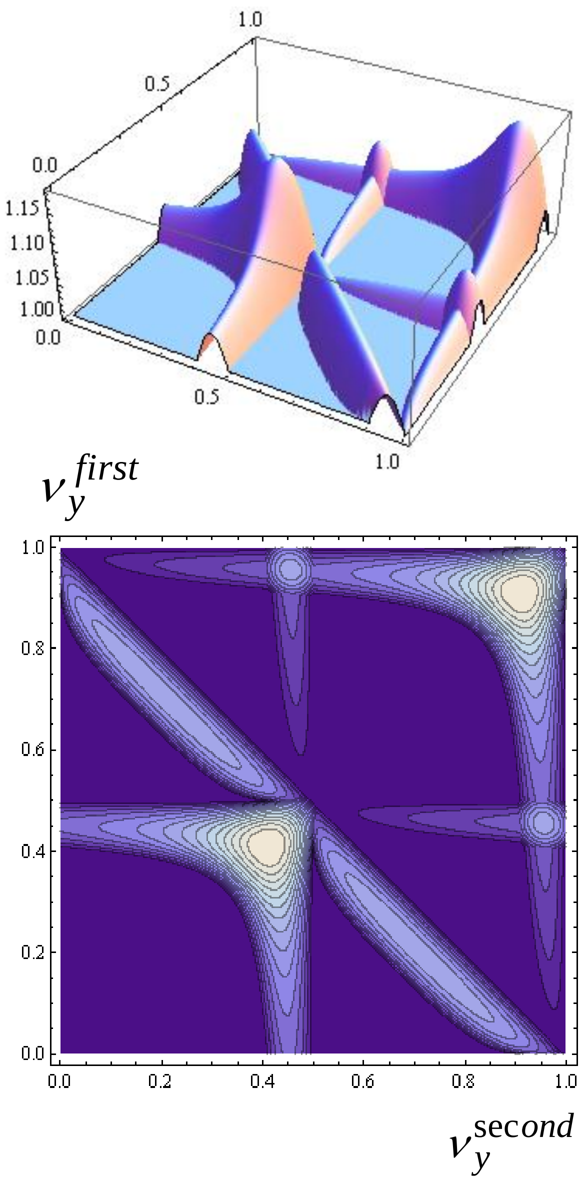
2. "1" full revolution with $2\pi\nu_s$
   "2" and "3" half revolution with $2\pi(\nu_L/2)$

3. Interaction between "1" and "3".
   "2" unchanged

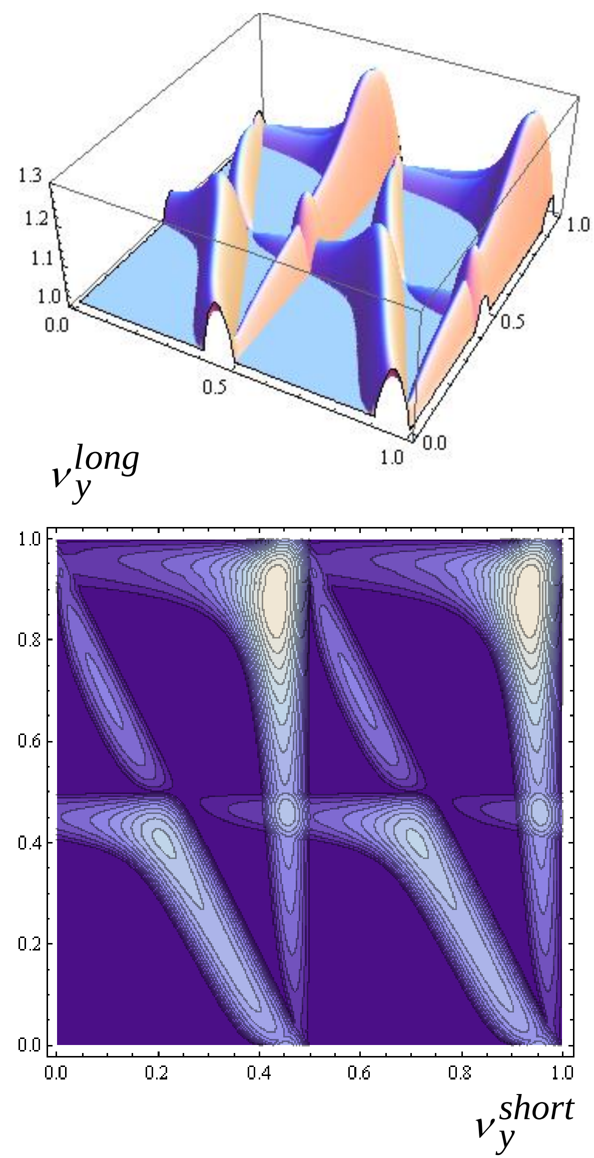
4. "1" full revolution with $2\pi\nu_s$
   "2" and "3" half revolution with $2\pi(\nu_L/2)$

Zobov

Symmetric Rings

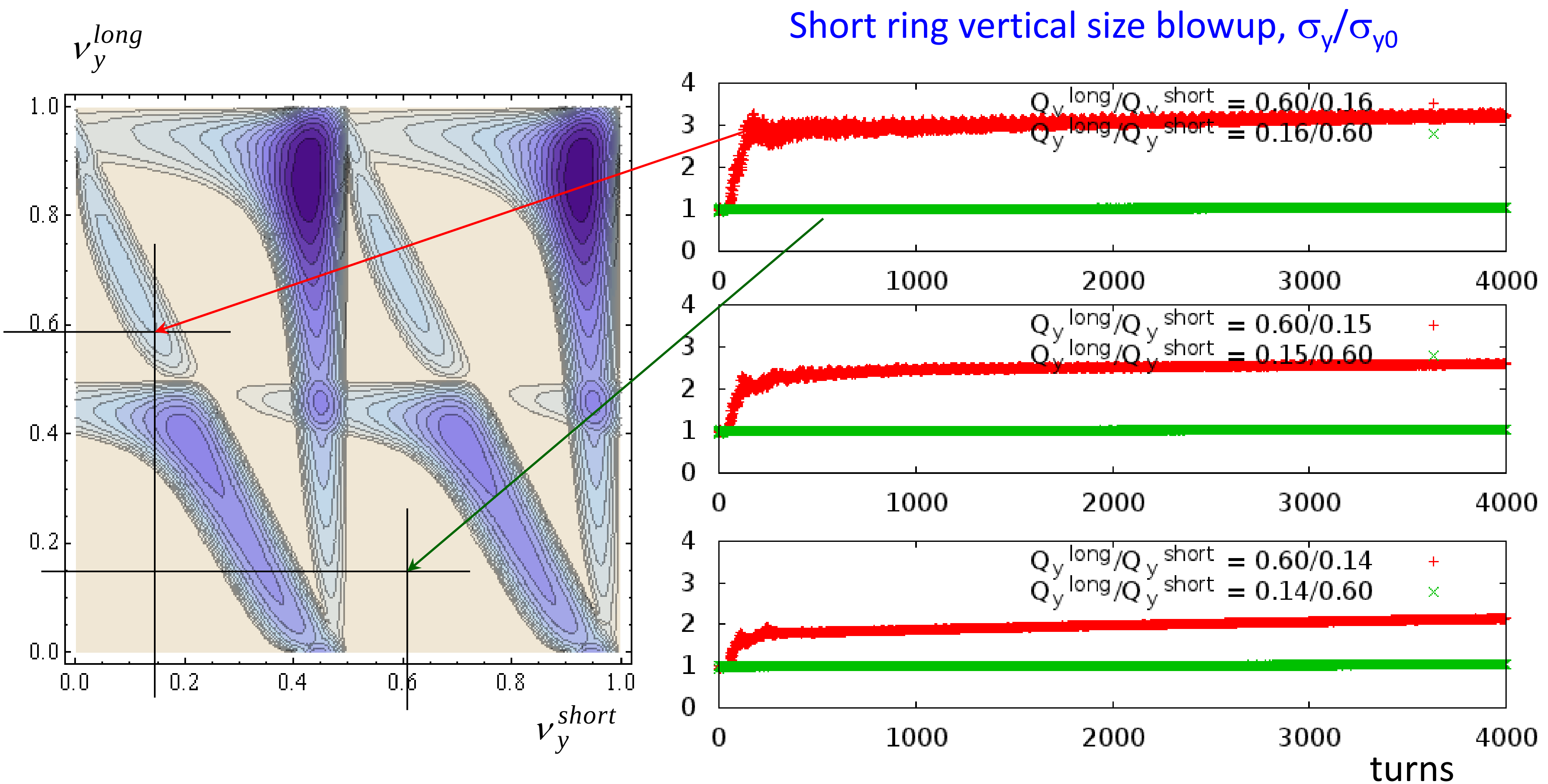


Asymmetric Rings (2:1)



Zobov

Asymmetric Case Beam Blowup



Zobov

Asymmetric Beam-Beam CONCLUSIONS

Zobov

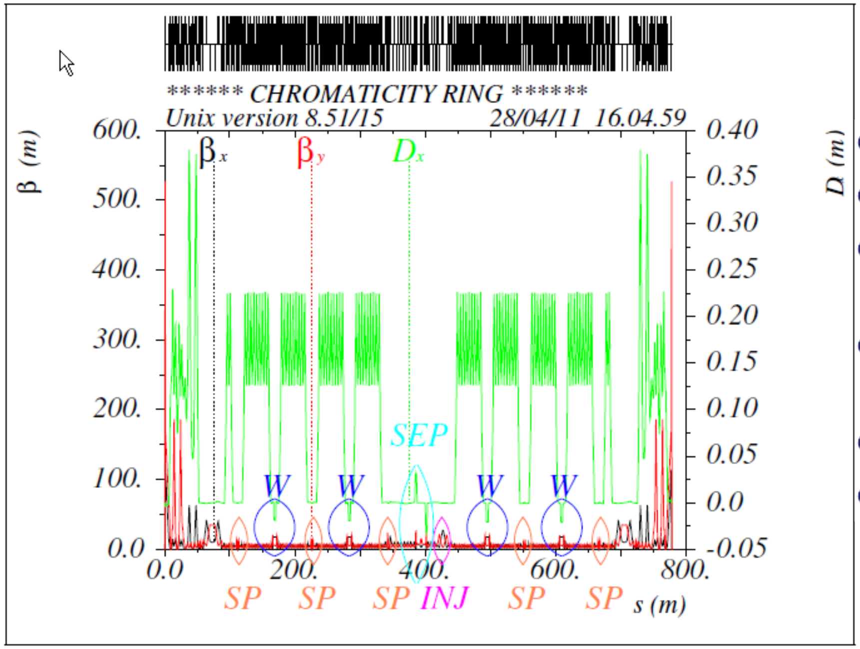
1. *The coherent beam-beam resonances are a potential danger for the performance of Superb with asymmetric rings.*

2. *The problem can be avoided by placing the vertical tune of the long ring in the tune area above the integer (instead of the area above the half-integer). At least, beam-beam interaction and dynamic aperture are not critical issues for such a choice.*

Problems of Tau-Charm factory lattice

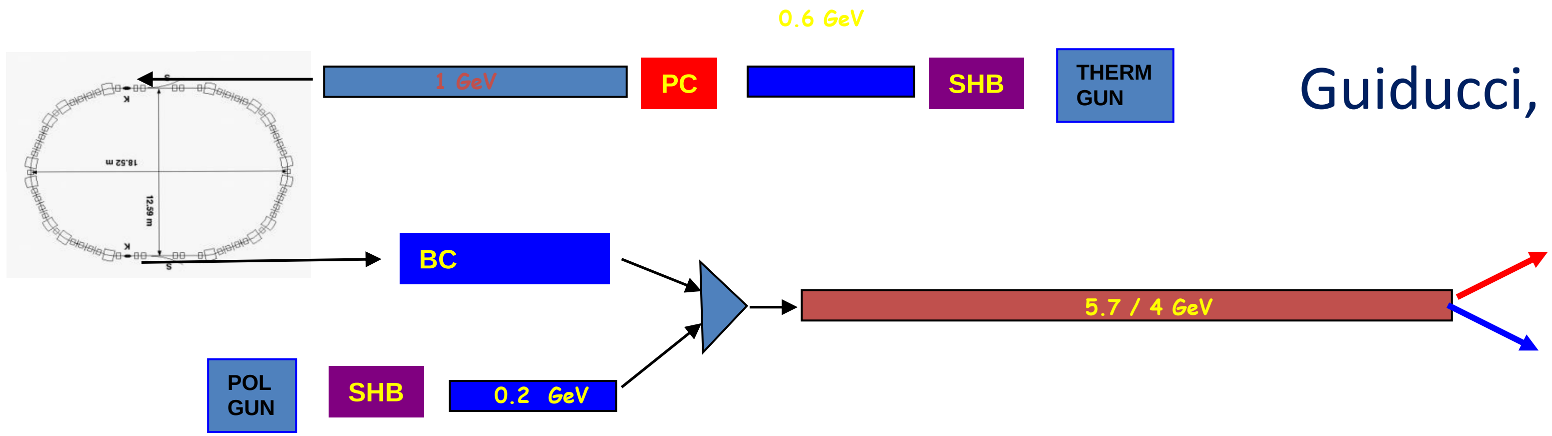
A. Bogomyagkov, E. Levichev, P. Piminov, S. Sinyatkin

Budker Institute of Nuclear Physics
Novosibirsk



- Breaking symmetry of the ring decreases energy acceptance.
- Introduction of insertions decreases energy acceptance.
- Manual tuning of phase advance per cell helps to increase energy acceptance.
- Manual tuning of additional sextupoles helps to increase energy acceptance.
- Chromatic functions matching is needed.
- New periodic cell is needed.

New Proposal for the Injection System

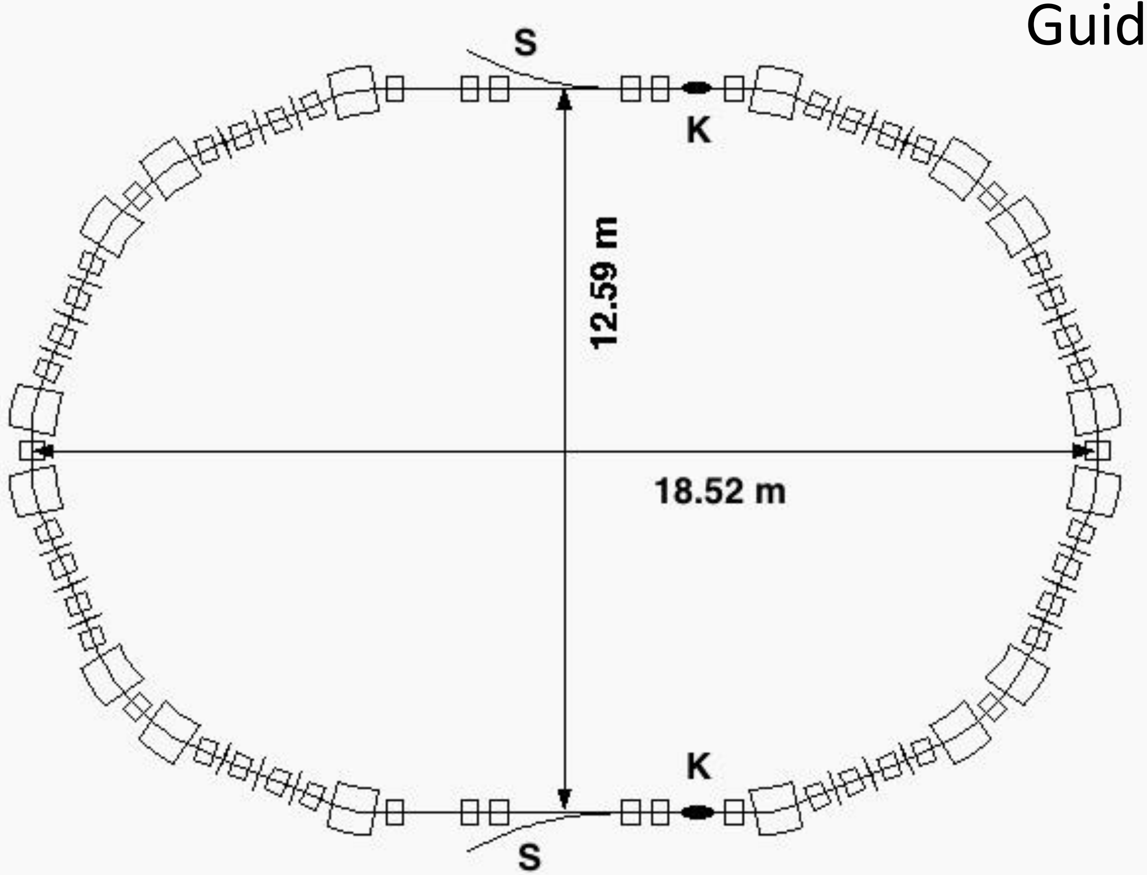


Guiducci, Boni

- Only the **e^+ beam** is stored in the DR
- S band linac at 100 Hz
- Injection in each ring at 50 Hz
- 2 electron guns
  - a “high current” gun for positron production
  - a “low emittance” polarized gun for electron injection
- Additional 200 MeV linac for e^-
- Reduced transfer lines and kickers for DR injection/extraction
- Conversion e^-/e^+ at low energy 0.6 GeV as in CDR2

Damping Ring

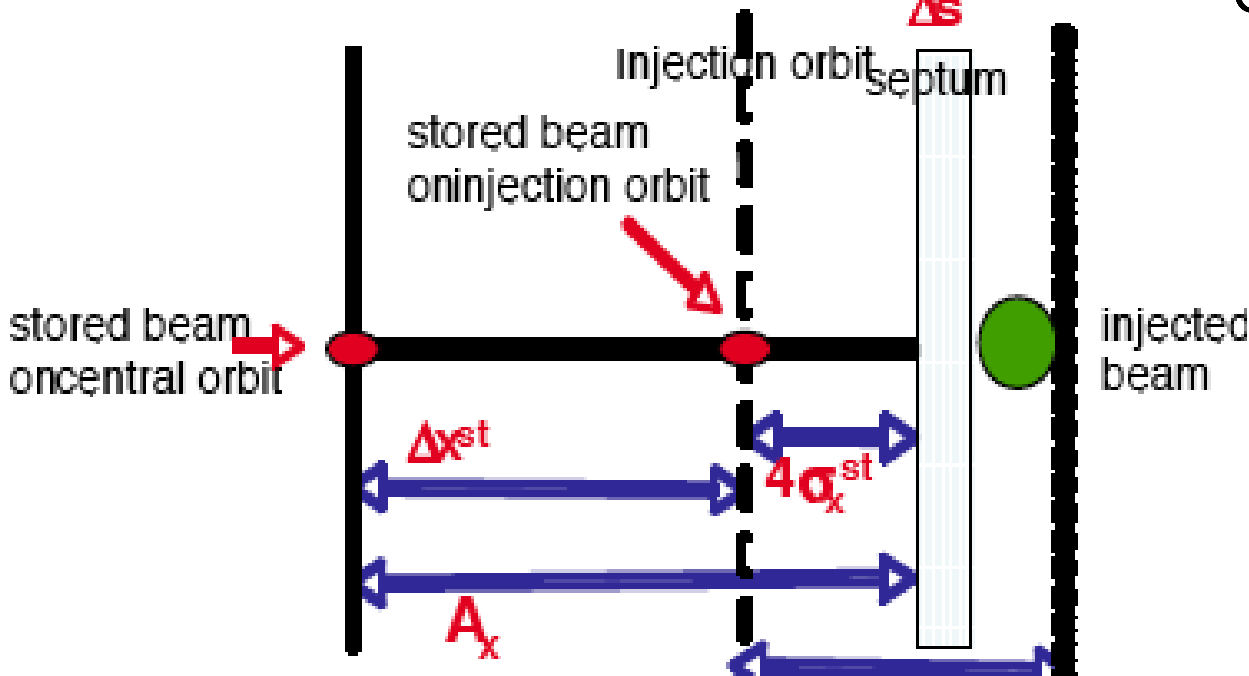
Guiducci, Preger



A damping ring at 1 GeV is used to reduce the positron beam injected emittance

Injection into Main rings

Guiducci



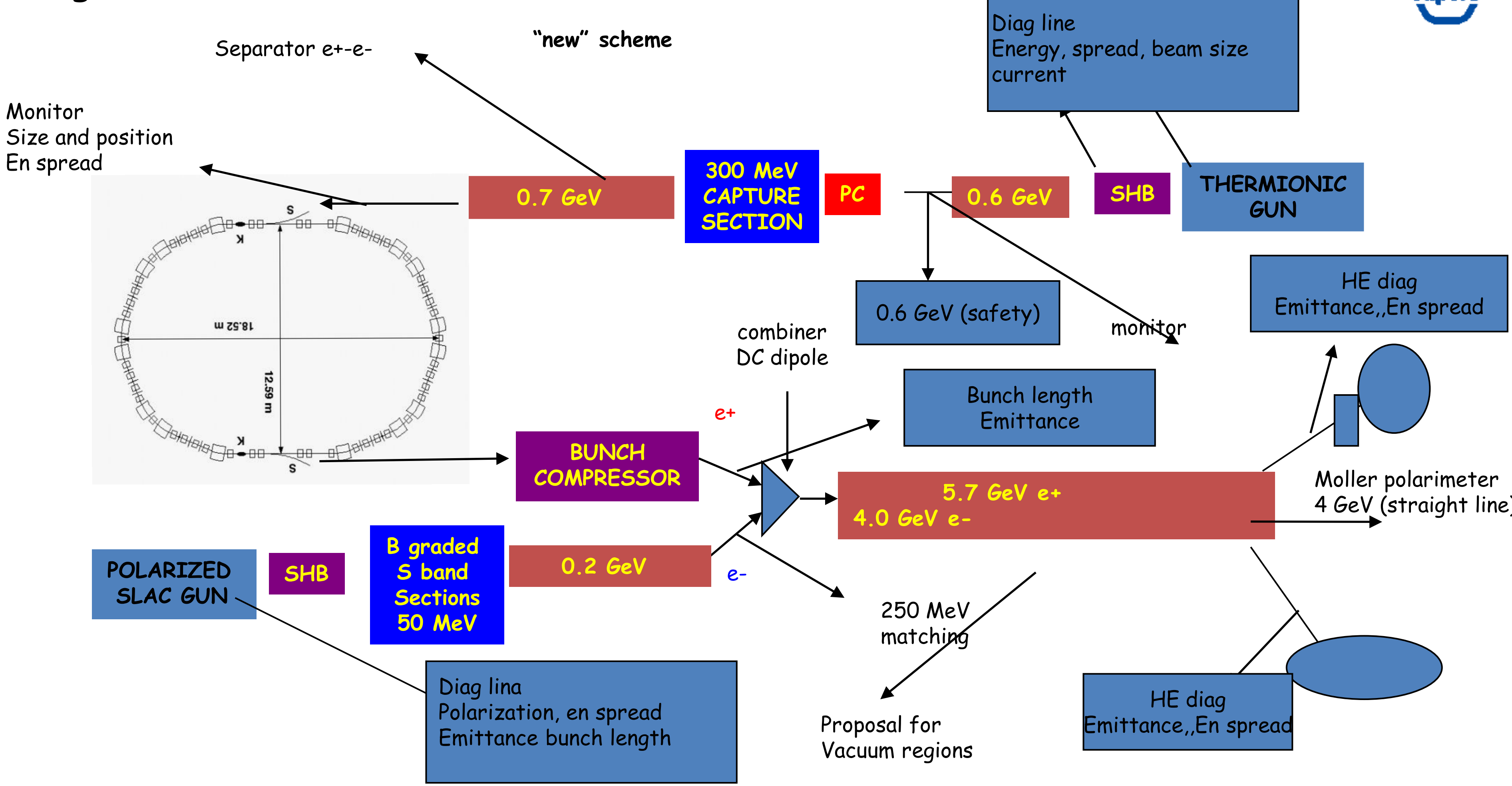
We accept $\pm 3\sigma_x^i$ of the injected beam

2different configurations are considered

zero dispersion at injection point $D_x^{st} = D_x^{inj} = 0$

non zero dispersion *Dxst = Dxinj 1 0 and an energy offset d of the injected* beam

Preger - Guiducci Scheme



A. Variola

We propose to stay with the SLAC gun in the positron line and to have a custom Polarised, low charge electron sources in the electron line

Recap

- 4 Scenarios under investigation

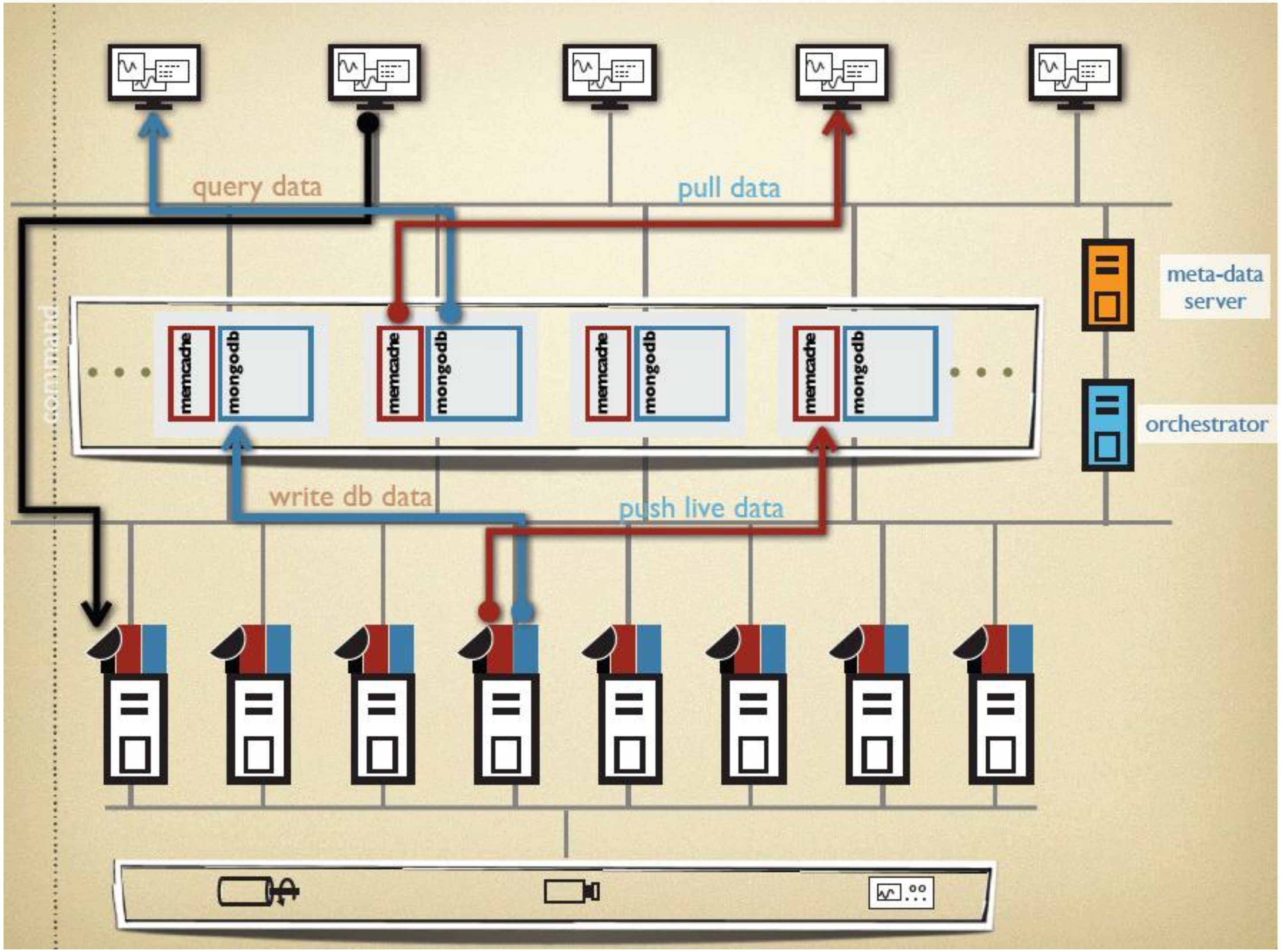
Variola

25MV/m for acceleration

Scenario	1	2	3	4
RF (MHz) – strategy	2856 - acc	2856 – dec (S-band)	1428 – dec (L-band)	3000 dec + 1428 - acc
Mean Energy (MeV)	302	287	295	333
E_{rms} (MeV)	21.4	32.3 (12)	16.83 (9.09)	5.2 (3.2)
Z_{rms} (mm)	2.7	6.4	8.89	3.5
X_{rms} (mm)	3.8	4.4	8.0	8.1
X'_{rms} (mrad)	1.02	1.11	1.69	1.4
E_x =X'X (mm.mrad)	3.8	4.6	13.0	11.4
Total Yield (%)	2.8	7.53	32.3	31.9
Yield 10MeV (%)	**1.3**	**3.9**	**19.6**	**29.3**

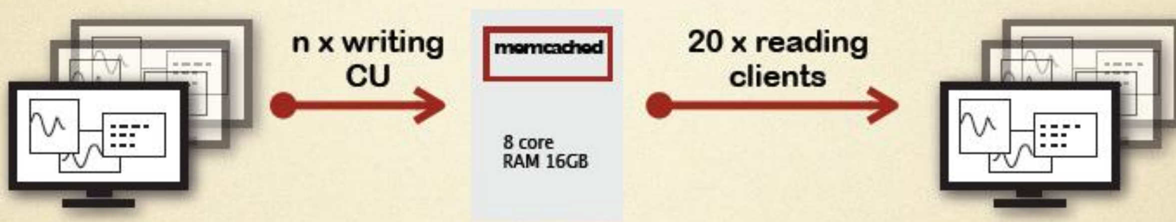
With a positron injection of 10 nC and a yield of 3.9%, we will have 2.43 10^9 positrons at 300 MeV ±10MeV (scenario 2 - 2.8 GHz)

L. Catani: Control Systems



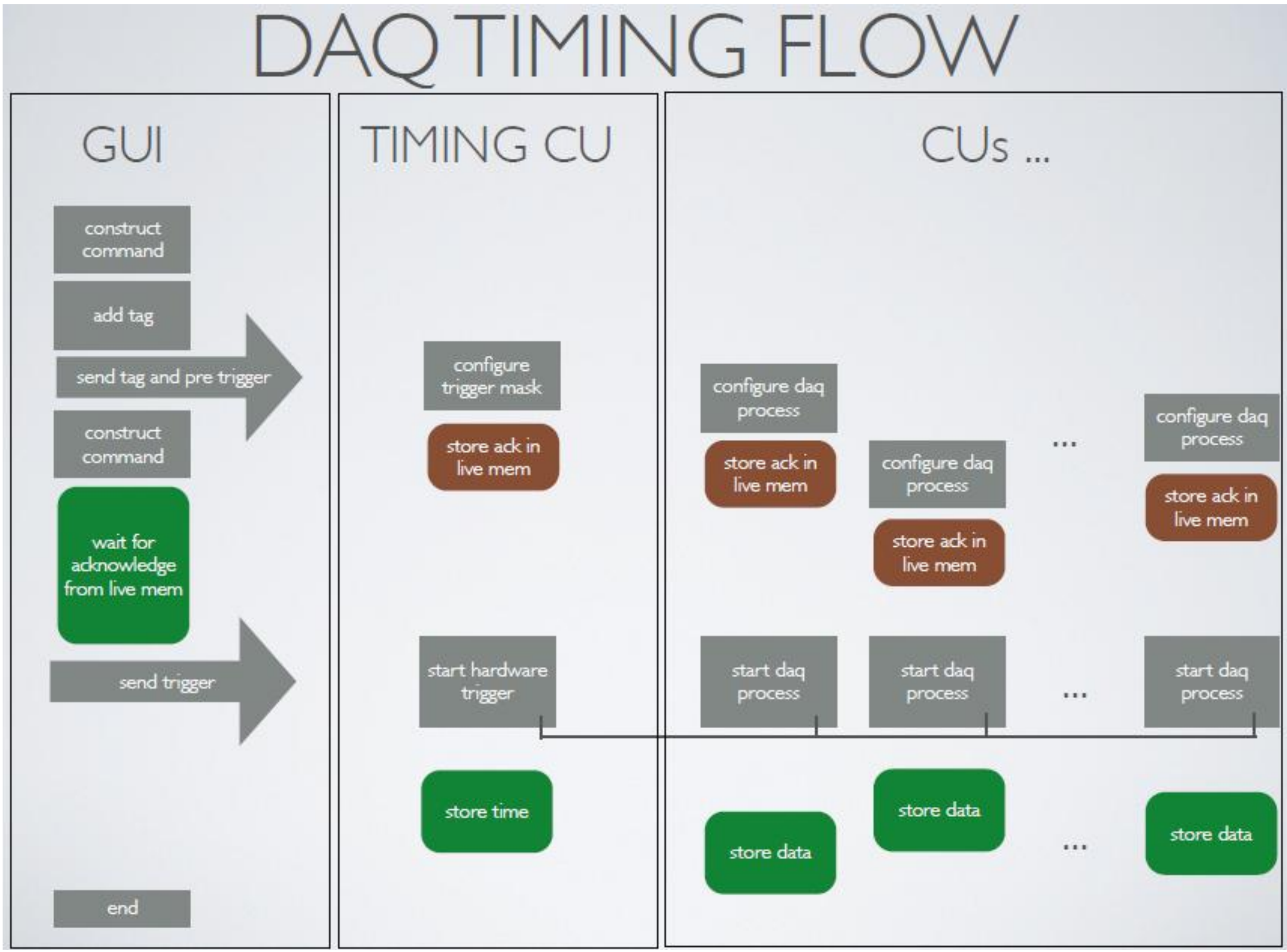
Meta Data storage test (Catani)

test#3.1



writing every... (msec)	#CU (Write)	#clients (Read)	#servers	#processes/ server	CPU load (%)
20	60	20	1	1	3-5
20	80	20	1	1	4-6
20	80	20	2	1	2-3
50	60	20	1	1	1-3
50	80	20	2	1	0-2
100	60	20	1	1	?
100	80	20	2	1	?

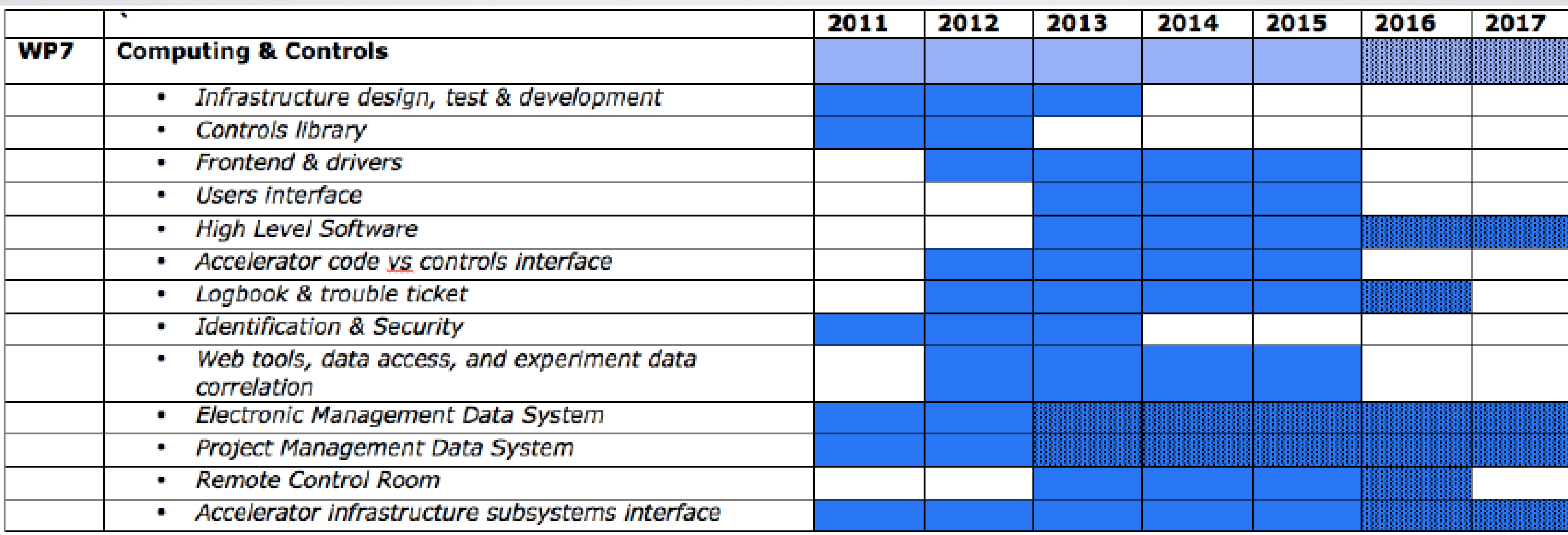
Data Flow Design (Mazzitelli)



Control System (G. Mazzitelli)

WORK TO CARRY OUT

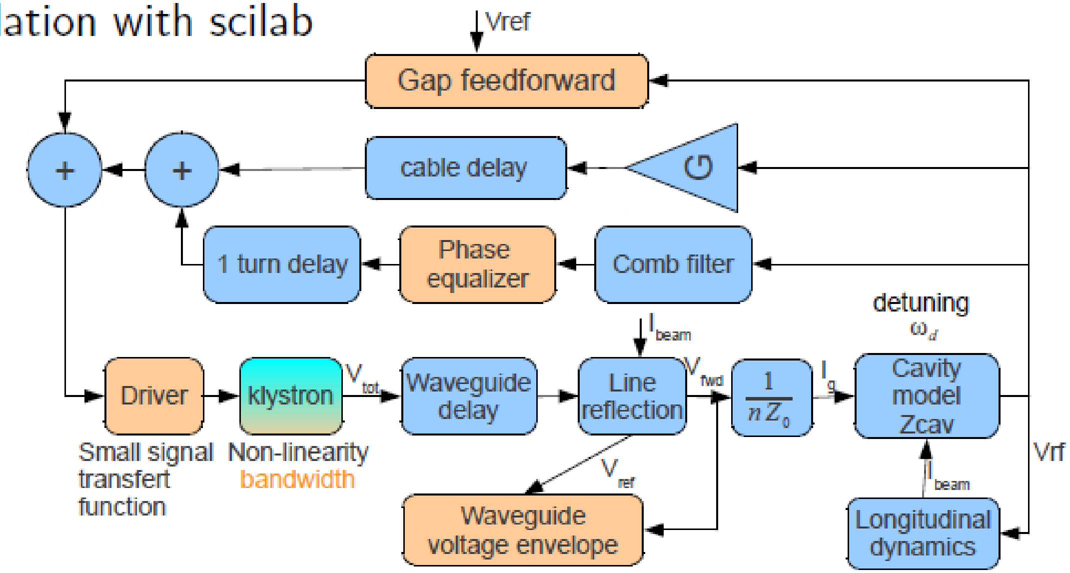
SuperB Control System Development Schedule



O. Bourrion: RF Simulation and control

Time domain simulation

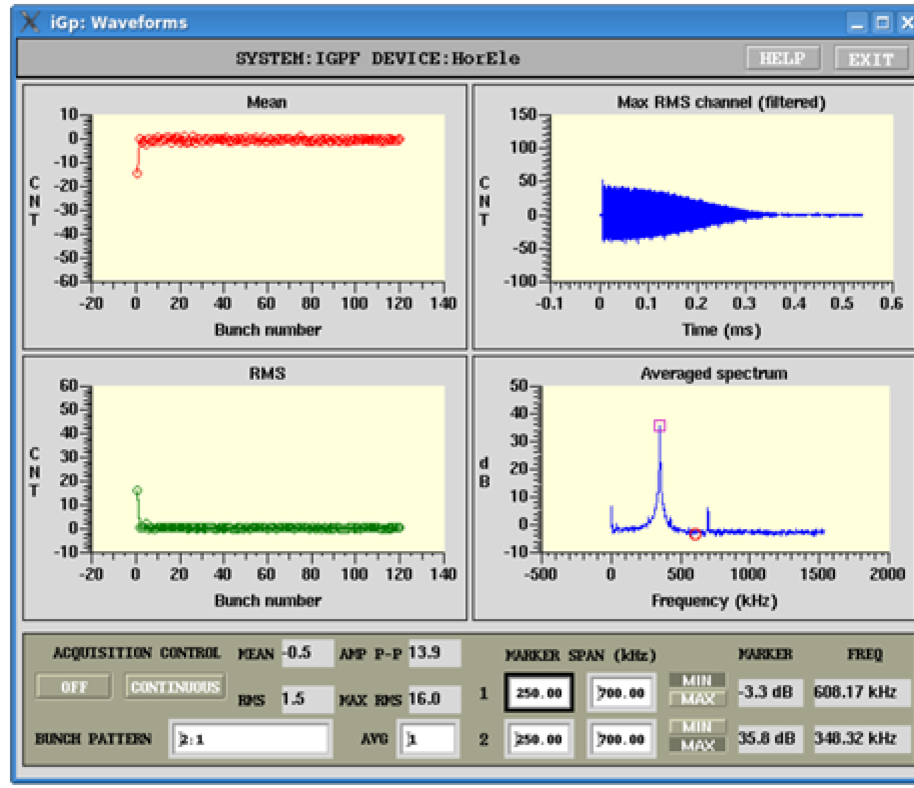
- Simulation with scilab

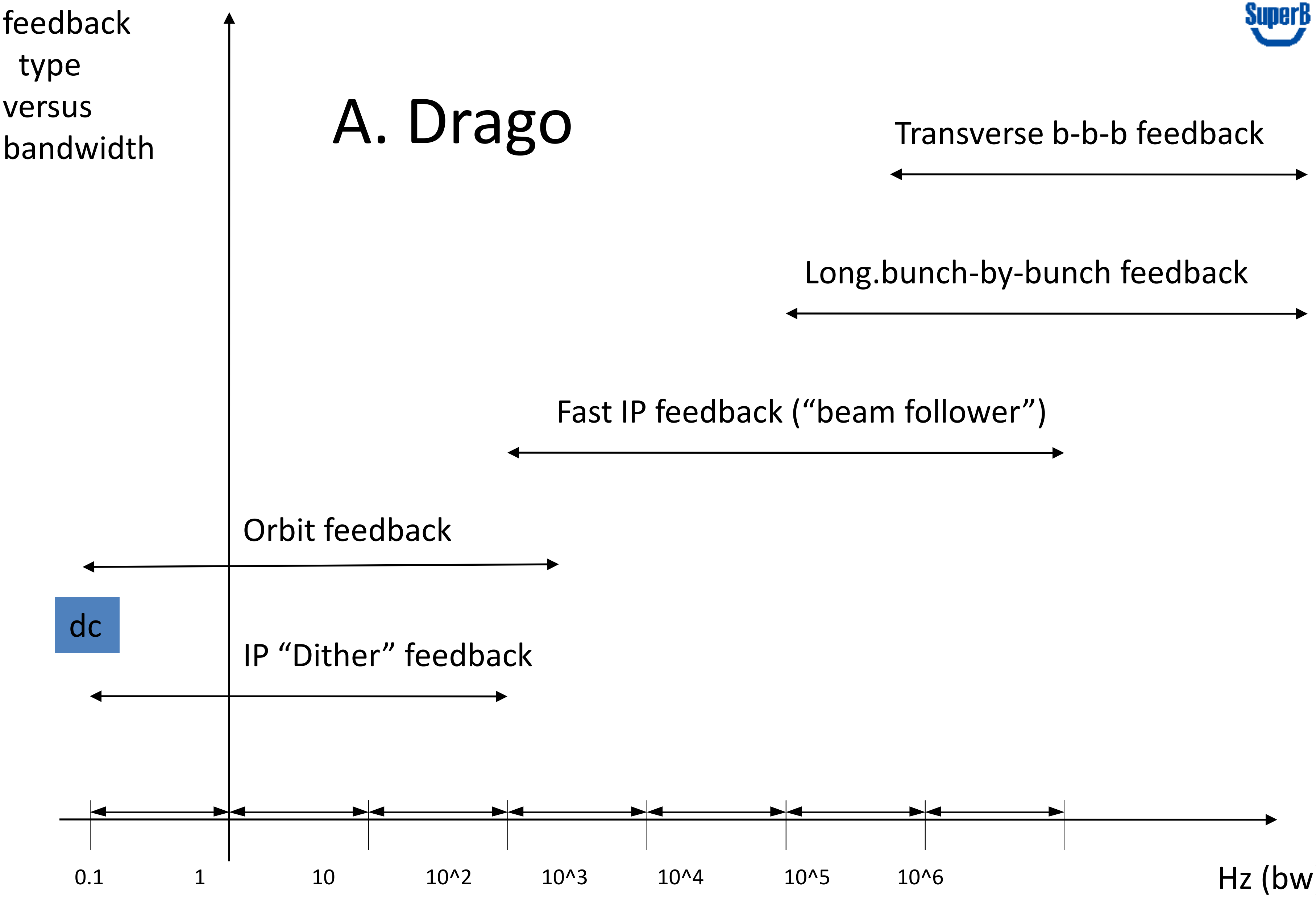


- Effect of non optimal detuning (klystron power)
- Klystron non-linearity effect (can be corrected in the FPGA)
- Small signal driver transfer function (was non linear in PEP2)
- Blocks in orange are not modeled yet (see next slide)

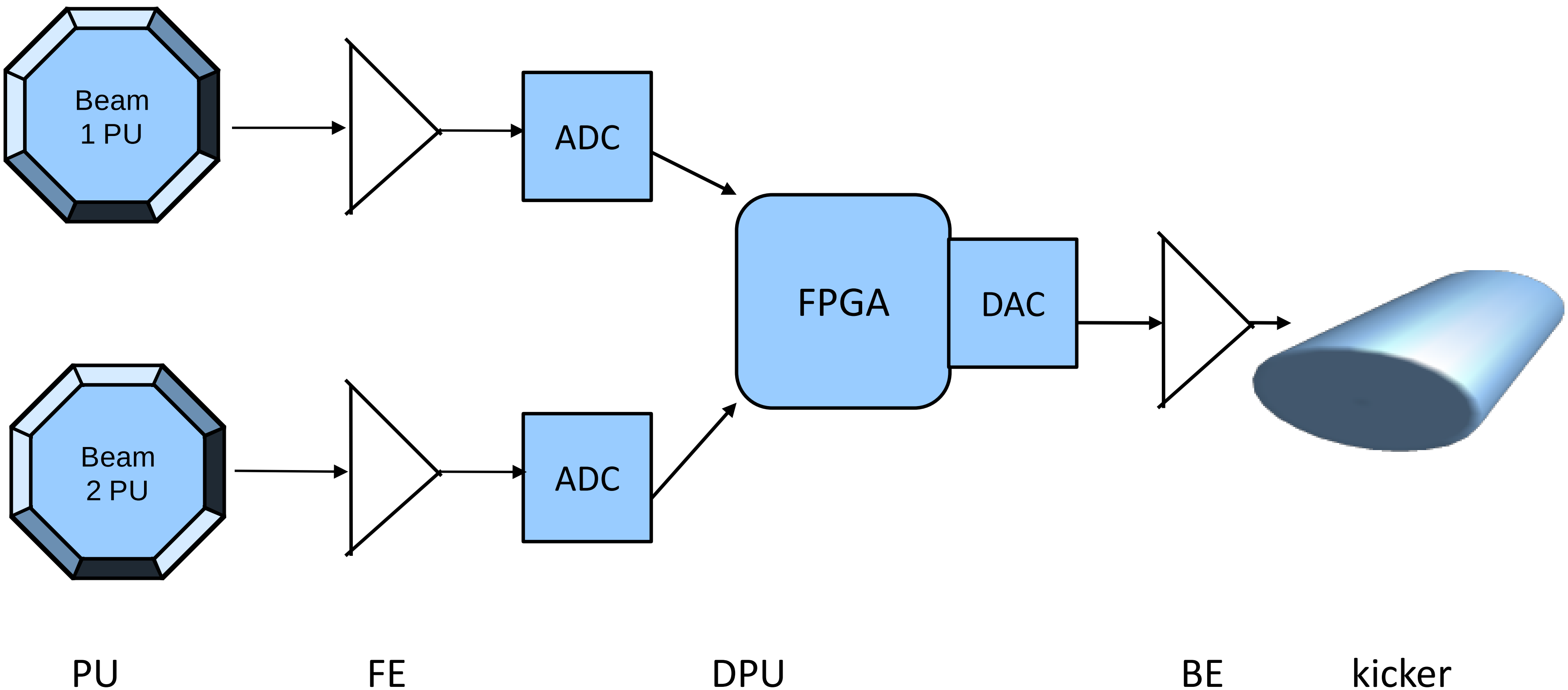
Bunch by Bunch Feedback Conclusions (A. Drago)

- New betatron and synchrotron bunch-by-bunch feedback systems have been succefully tested at DAFNE this year.
- The upgrade consists in using 50% bit more in conversion (8 ➔ 12), in having more memory available for data tracking, in having much more powerful FPGA with more DSP inside and, last but not least, a perfect software compatibility with the previous systems
- Three applications have been developed or are in progress with minimum manpower and efforts.
- In particular a tune feedback could be easily implemented using the internal iGp12 diagnostics




feedback type versus bandwidth
A. Drago
Transverse b-b-b feedback
Long.bunch-by-bunch feedback
Fast IP feedback ("beam follower")
Orbit feedback
dc
IP "Dither" feedback
0.1
1
10
10^2
10^3
10^4
10^5
10^6
Hz (bw)

Fast IP feedback (Drago)
R&D activity: schematic plot



Simulations are necessary to find an algorithm with good noise immunity

Discussion of Accelerator Future Plans

- Discussed mechanisms of management structure
- Discussed potential contributions from teams:
  - Italy: LNF and INFN
  - France: Orsay, Saclay, LAL, IN2P3
  - Russia: BINP
  - UK: Oxford
  - US: SLAC
  - Others potential collaborators
- Next meeting at Frascati in December 2011