Frascati Super-B Factory

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Outline

* Overview
* Project TDR organization
* Super-B parameters
* Frascati DAFNE crab waist results
* Beam-beam interaction
* Interaction region
* Lattice
* Polarization
* PEP-II reusable components
* April MiniMAC
* Conclusions

Super-B Project

* *Super-B* aims at the construction of a very high luminosity (1x 10^{36} cm^{-2} s^{-1}) asymmetric e^+e^- flavor factory with a possible location on or near the campuses of the University of Rome at Tor Vergata or the INFN Frascati National Laboratory.
* Aims:
  - Very high luminosity (~10^{36})
  - Flexible parameter choices.
  - High reliability.
  - Longitudinally polarized beam (e-) at the IP (>80%).
  - Ability to collide at the Charm threshold.

How Super-B accelerator fits in the Super-B Project

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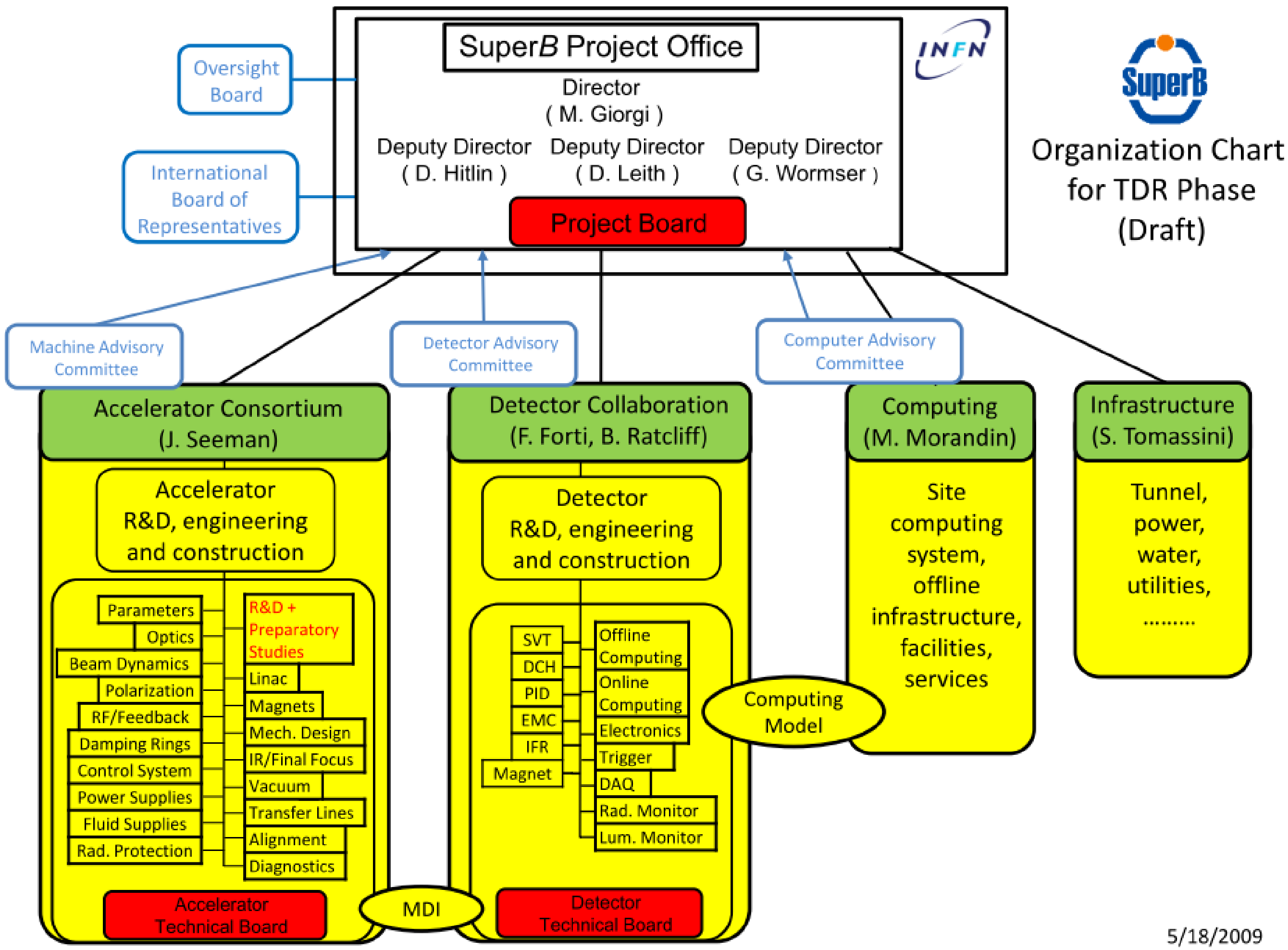

Super-B Accelerator CDR Contributors (2008)

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* A. Variola (LAL/Orsay, France)
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* F. Bosi, E. Paoloni (Pisa University, Italy)

* At present approximate totals:
  - 10 FTEs from LNF Frascati
  - 4.5 FTEs from SLAC
  - 3 FTEs from BINP Novosibirsk
  - 2.5 FTEs from France
  - 0.5 FTEs from Pisa

Super-B Accelerator Oversight

* Accelerator collaboration:
  – J. Seeman
* Scientific-Technical:
  – P. Raimondi
  – S. Tomassini
  – U. Wienands
* Regional coordinators:
  – M. Biagini Italy
  – M. Sullivan US
  – G. Bassi UK
  – E. Levichev Russia
  – A. Variola France

Luminosity Equation for a Circular e^+e^- Collider

ξ_y is the beam-beam parameter (~0.09)

I_b is the bunch current (~3 mA)

n is the number of bunches (~2500)

β_y^* is the IP lattice optics function (vertical beta) (<1 mm)

E is the beam energy (4 and 7 GeV)

Luminosity (10^{36} cm^{-2} s^{-1})

$$L = 2.17 x 10^{34} \frac{n \xi_y E I_b}{\beta_y^*}$$

Number of Bunches and Beam Currents

*

Collider	Bunches	e+ current	e- current
		(mA)	(mA)
DORIS-II	1	42	42
VEPP-4M	1	12	12
CESR	5x9=45	375	375
PEP-II	1722	3210	2070
KEKB	1585	1662	1340
Super-B (future)	2500	2800	2800

Bunch Length, β_y*, and Horizontal Emittance

*

Collider	Bunch length	β_y^*	ε_x^*
	(mm)	(mm)	(nm)
DORIS-II	36	40	571
VEPP-4M	50	50	1333
CESR	18	18	211
PEP-II	11	9	23-48
KEKB	7	6	20-23
Super-B (2008 design)	6	0.25/0.35	2-3

Crossing Angles, Beam-Beam Parameter, Luminosity

*

Collider	Crossing Angle	ξ_y^*	Luminosity
	(mrad)	(mm)	X $10^{32}/cm^2/s$
DORIS-II	0	0.026	0.33
VEPP-4M	0	0.059	0.2
CESR	0	0.068	12.8
PEP-II	0	0.065	121.
KEKB	22	0.09	192.
Super-B (future)	60	0.09	10000

Key technical advances for Super-B

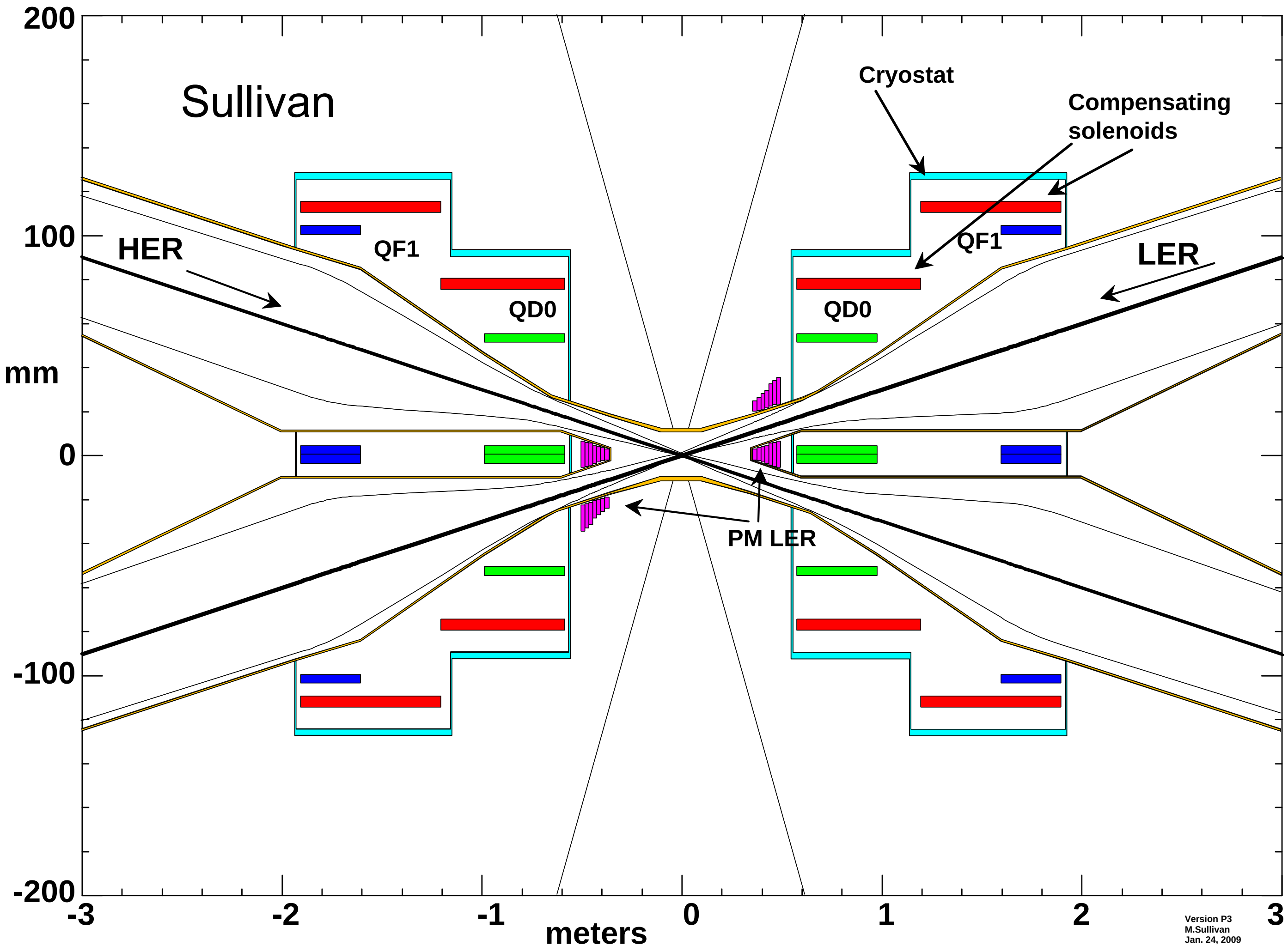
* Crossing angle IR with large Piwinski angle (DAFNE,KEKB)
* Crab waist scheme (Frascati, DAFNE)
* Very low IR vertical and horizontal beta functions (ILC)
* Low horizontal and vertical emittances (Light sources)
* Ampere beam currents (PEP-II, KEKB)

Super-B Parameter Options

*

LER/HER	Unit	June 2008	Jan. 2009	March 2009	LNF site
E+/E-	GeV	4/7	4/7	4/7	4/7
L	$cm^{-2}\ s^{-1}$	$1x10^{36}$	$1x10^{36}$	$1x10^{36}$	$1x10^{36}$
I^+/I^-	Amp	1.85 /1.85	2.00/2.00	2.80/2.80	2.70/2.70
N_{part}	$x10^{10}$	5.55 /5.55	6/6	4.37/4.37	4.53/4.53
N_{bun}		1250	1250	2400	1740
I_{bunch}	mA	1.48	1.6	1.17	1.6
$\theta/2$	mrad	25	30	30	30
β_x^*	mm	35/20	35/20	35/20	35/20
β_y^*	mm	0.22 /0.39	0.21 /0.37	0.21 /0.37	0.21 /0.37
ε_x	nm	2.8/1.6	2.8/1.6	2.8/1.6	2.8/1.6
ε_y	pm	7/4	7/4	7/4	7/4
σ_x	µm	9.9/5.7	9.9/5.7	9.9/5.7	9.9/5.7
σ_y	nm	39/39	38/38	38/38	38/38
σ_z	mm	5/5	5/5	5/5	5/5
ξ_x	X tune shift	0.007/0.002	0.005/0.0017	0.004/0.0013	0.004/0.0013
ξ_y	Y tune shift	0.14 /0.14	0.125/0.126	0.091/0.092	0.094/0.095
RF stations	LER/HER	5/6	5/6	5/8	6/9
RF wall plug power	MW	16.2	18	25.5	30.
Circumference	m	1800	1800	1800	1400

SuperB Interaction Region Layout View (Jan 2009)



M. Sullivan

Crab Waist Scheme (Raimondi)

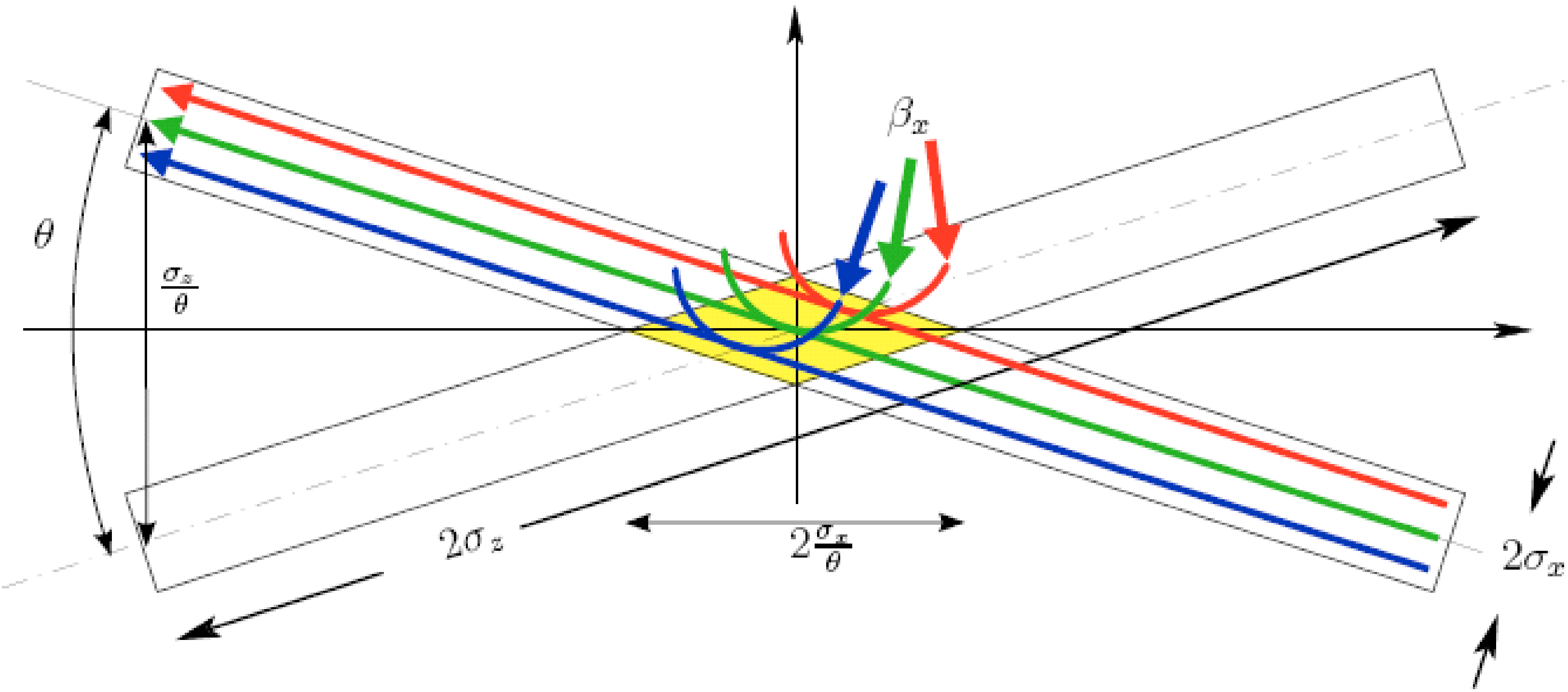
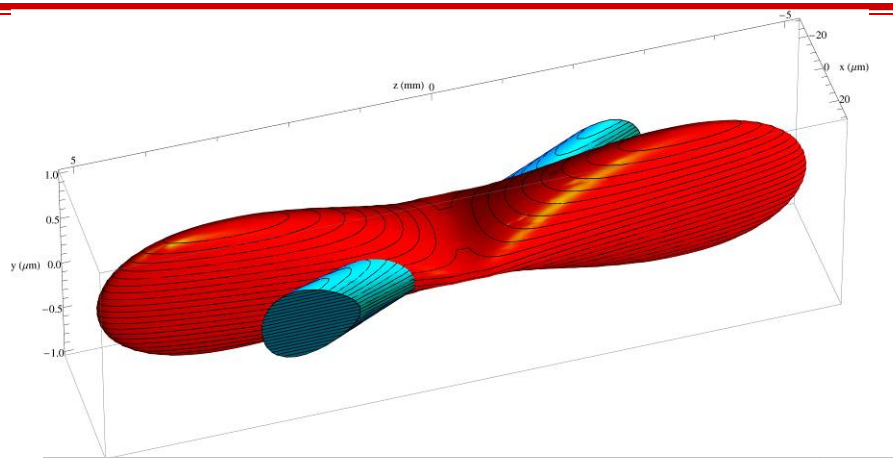
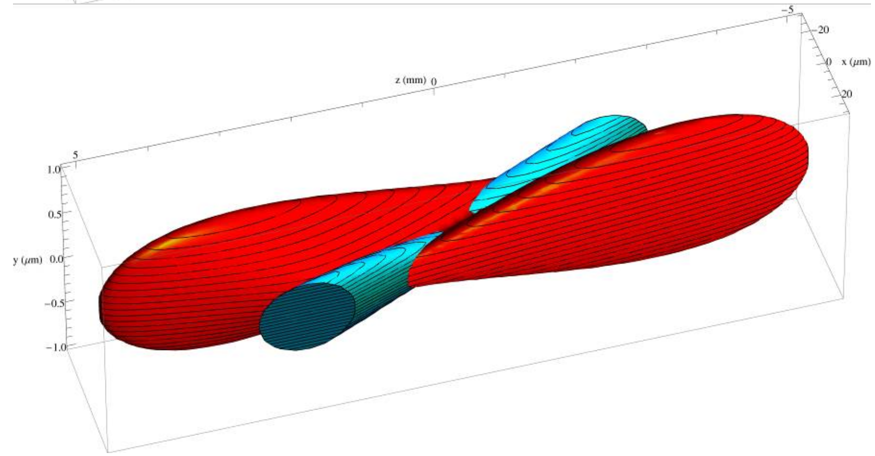


Figure 3-1. *Large Piwinski angle and crabbed waist scheme. The collision area is shown in yellow.*

Beam distributions at the IP



Without Crab-sextupoles

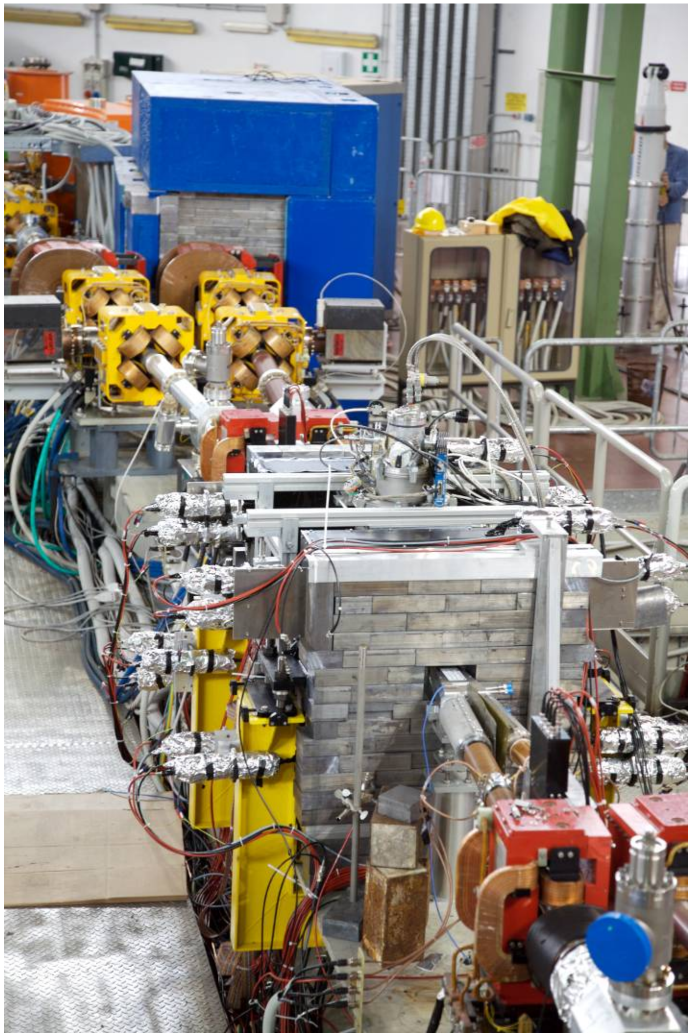


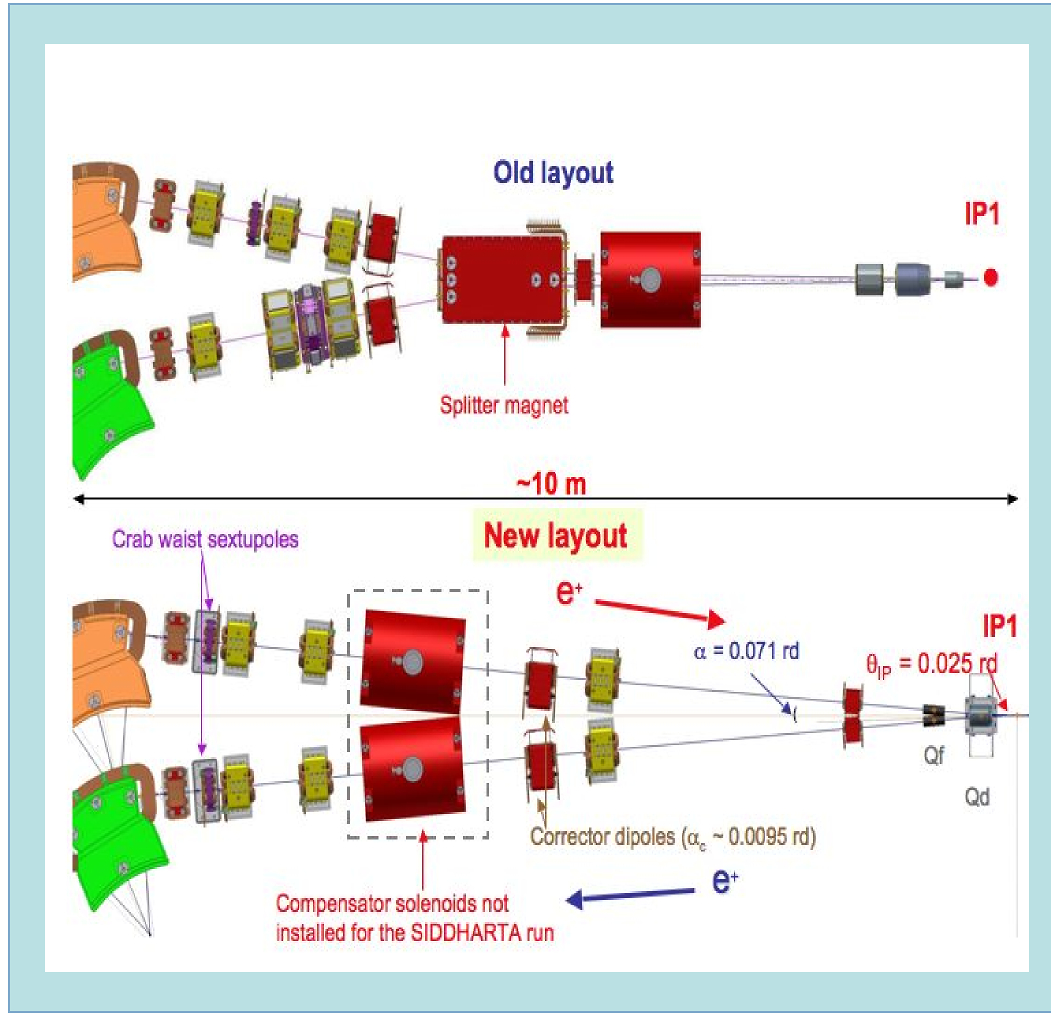
With Crab-sextupoles

E. Paoloni

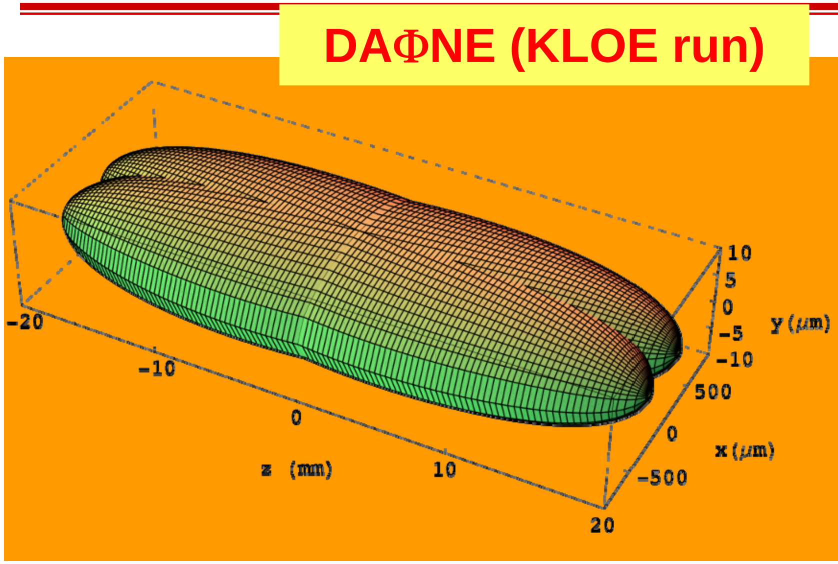
All particles from both beams collide in the minimum β_y region, with a net luminosity gain

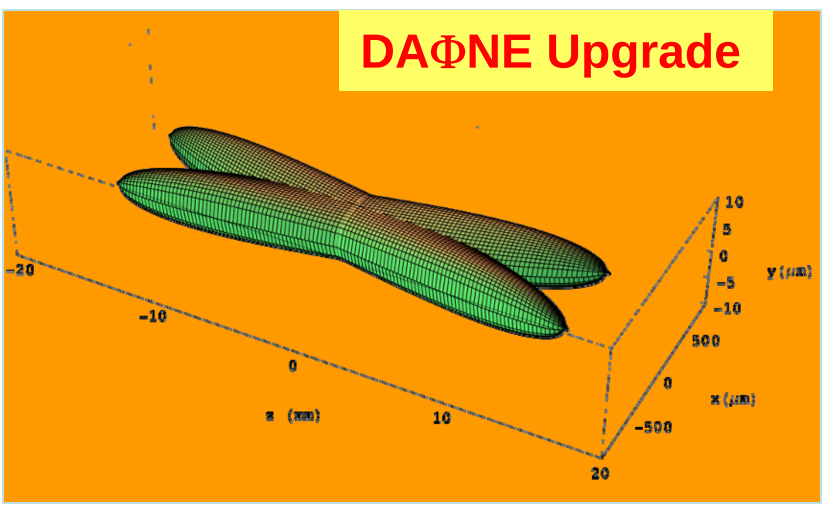
New Crab-Waist Interaction Region for DAFNE at Frascati





DAFNE BEAM PROFILES at the IP AND NEW PARAMETERS





	DAΦNE (KLOE run)	DAΦNE Upgrade
I_{bunch} (mA)	13	13
N_{bunch}	110	110
β_y^* (cm)	1.8	0.85
β_x^* (cm)	160	26
σ_y^* (μm)	5.4 low curr	3.1
σ_x^* (μm)	700	260
σ_z (mm)	25	20
Horizontal tune shift	0.04	0.008
Vertical tune shift	0.04	0.055
θ_{cross} (mrad) (half)	12.5	25
$\Phi_{Piwinski}$	0.45	2.0
L ($cm^{-2}s^{-1}$)	1.5×10^{32}	$>5\times10^{32}$

3 times more luminosity obtained with 3 times smaller vertical beam

DAFNE Luminosity versus Ib^2: Very positive! Congratulations to the DAFNE team!

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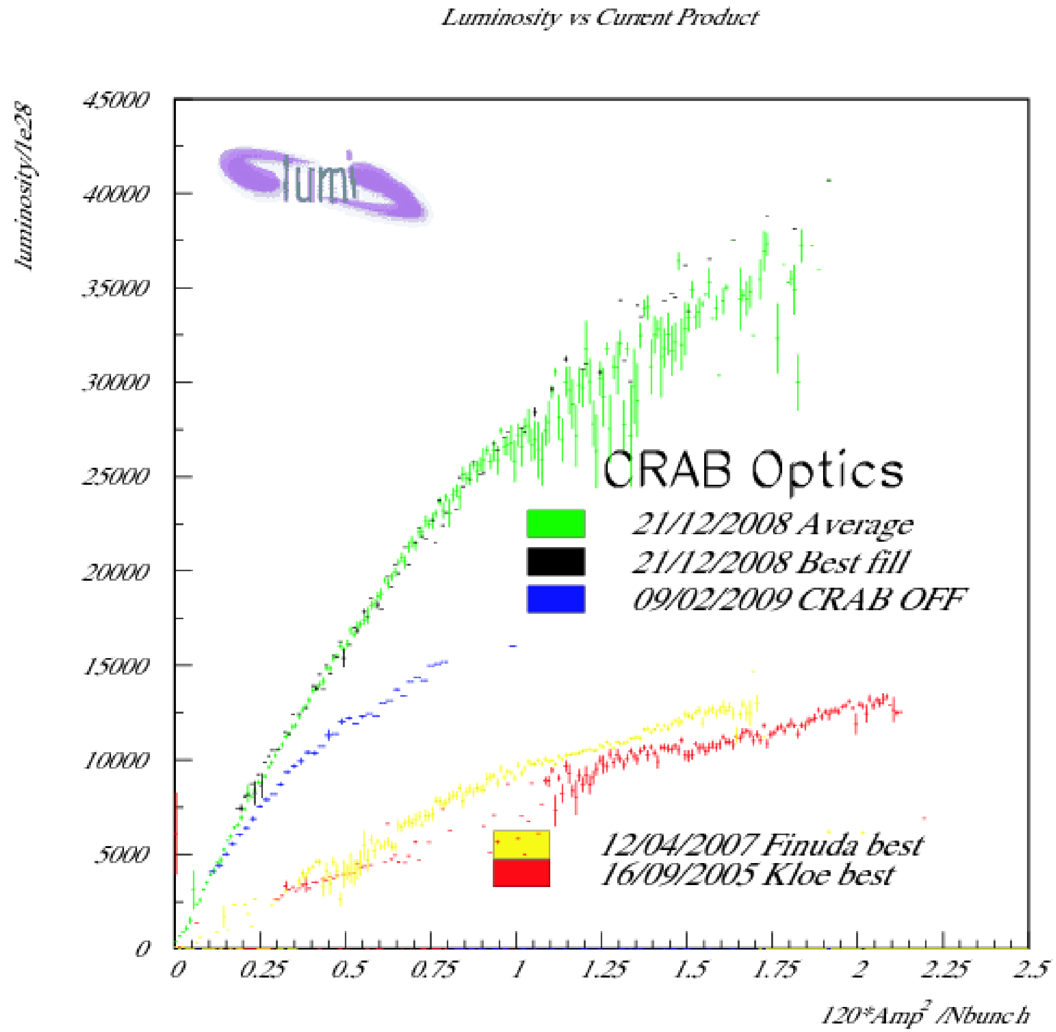
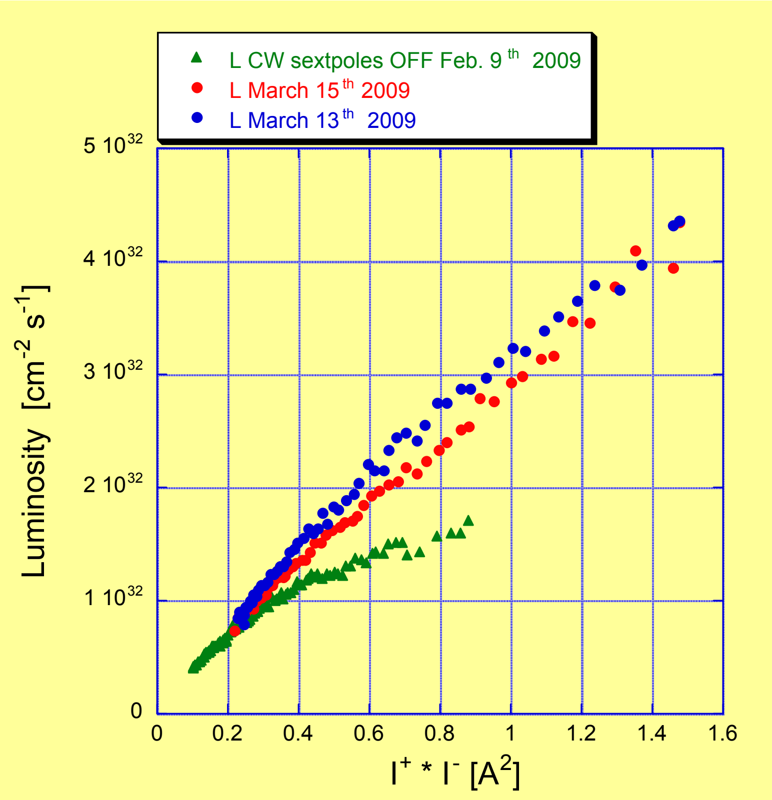
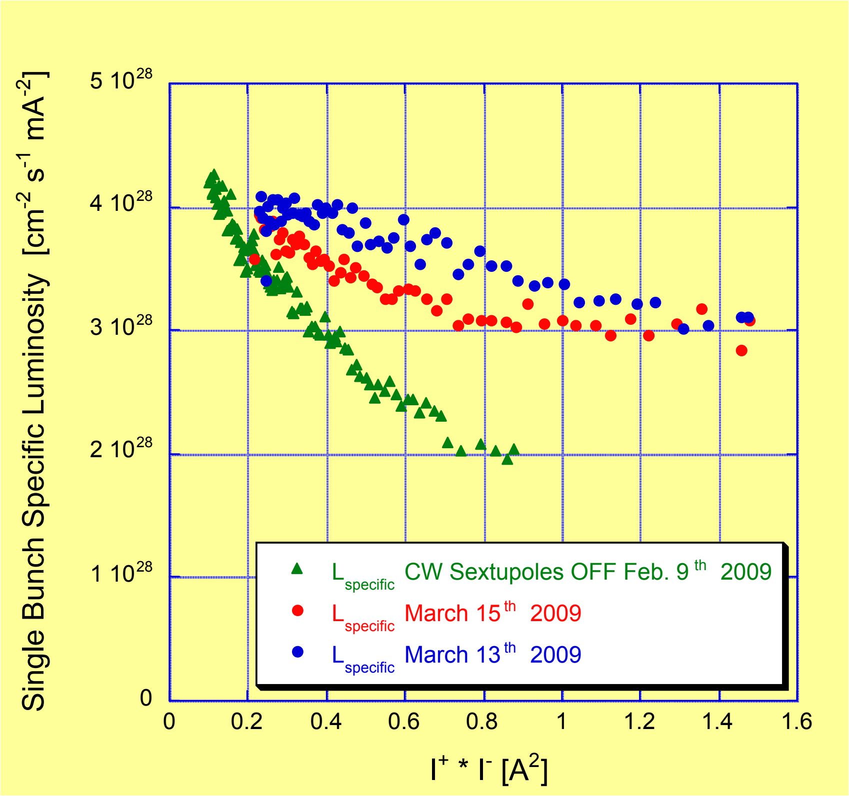


(P. Raimondi et. al.)

DAΦNE Results

Crab ON (blue, red) & OFF (green) luminosity *versus* product of beam currents





Beam-Beam Simulation of DAFNE (K. Ohmi)

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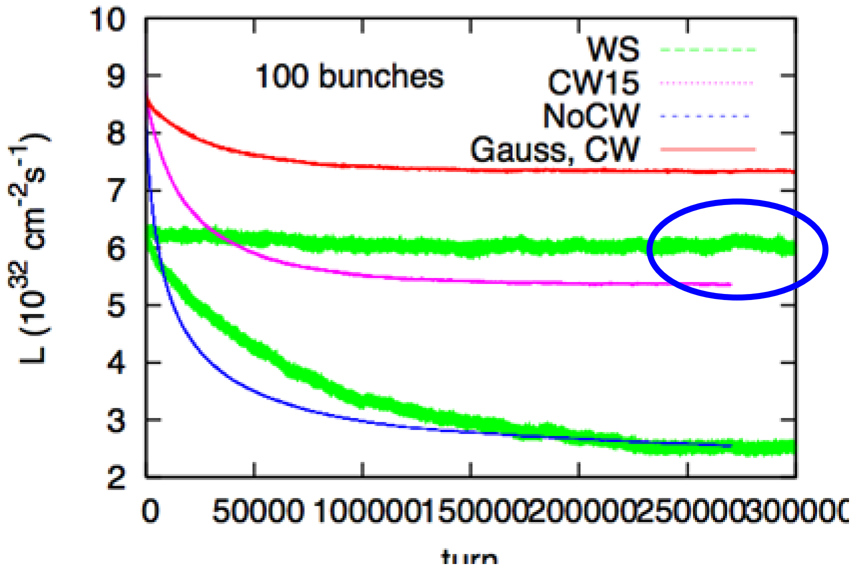
DAFNE

- Measured luminosity=4.5x10^{32} cm^{-2}s^{-1}.



(Fall 2008)

Super-B Site:
Tor Vergata University and Frascati LNF Locations

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Tor Vergata Site

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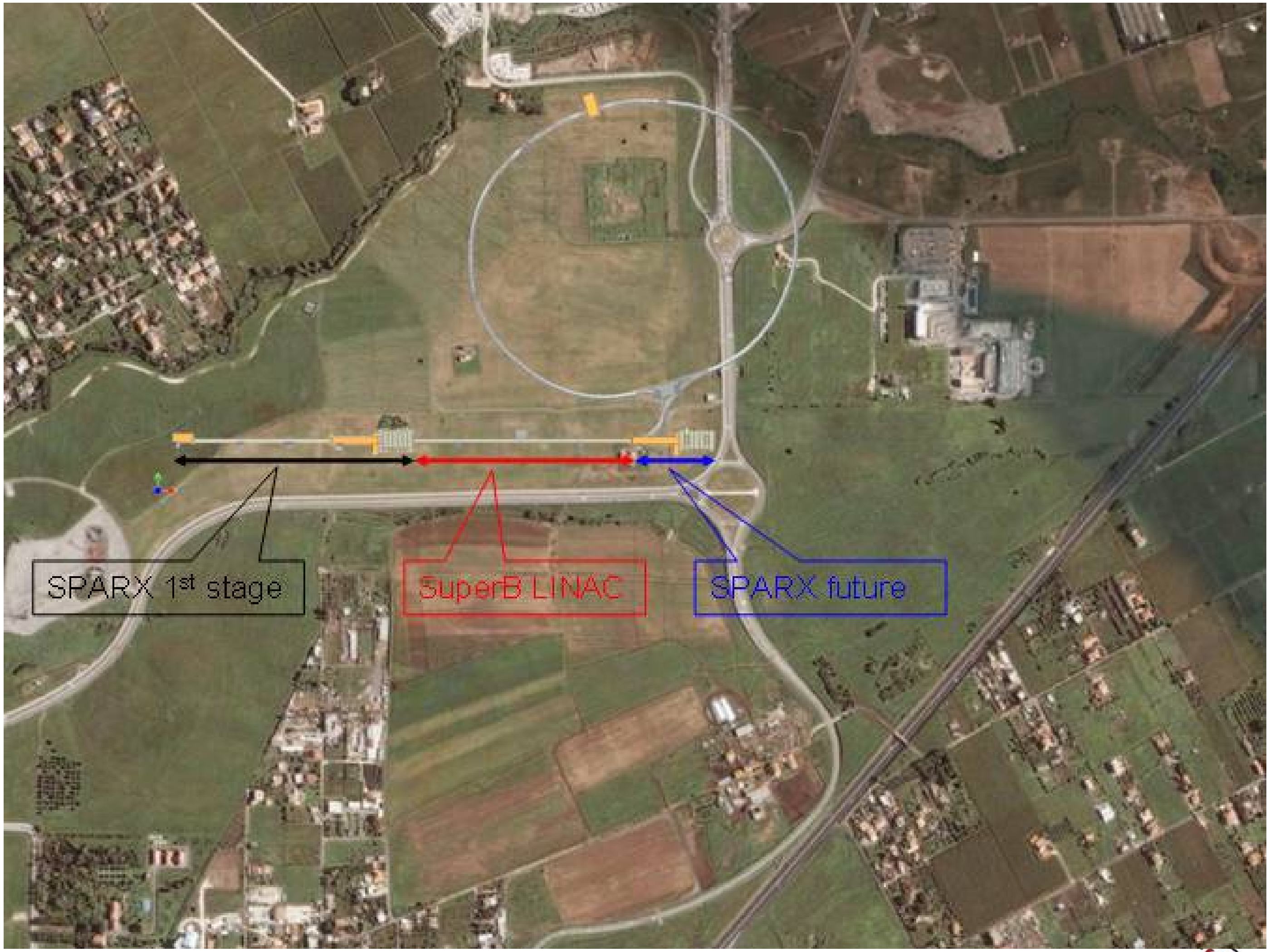

Potential Frascati LNF Location

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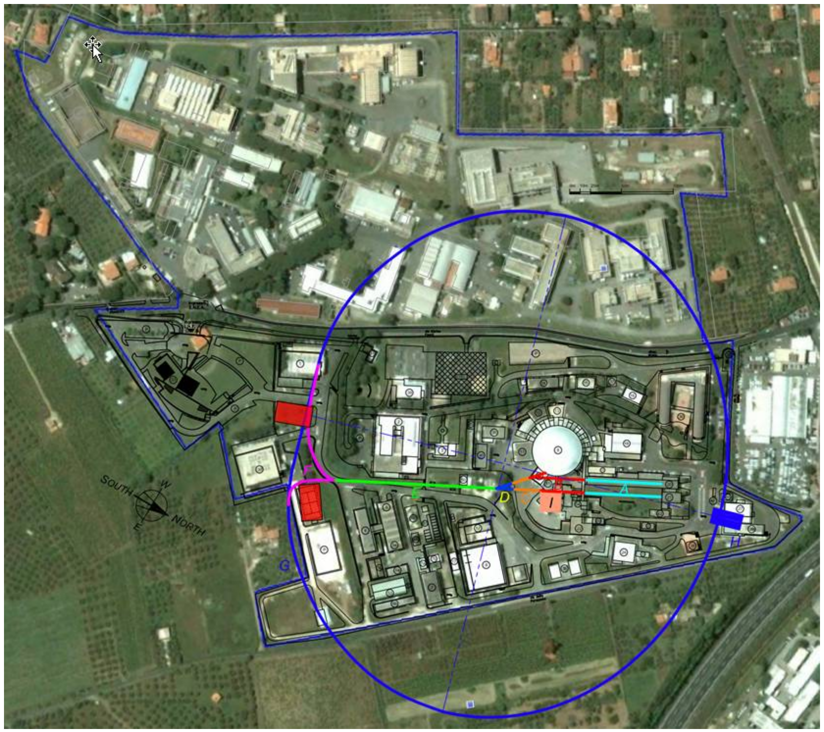
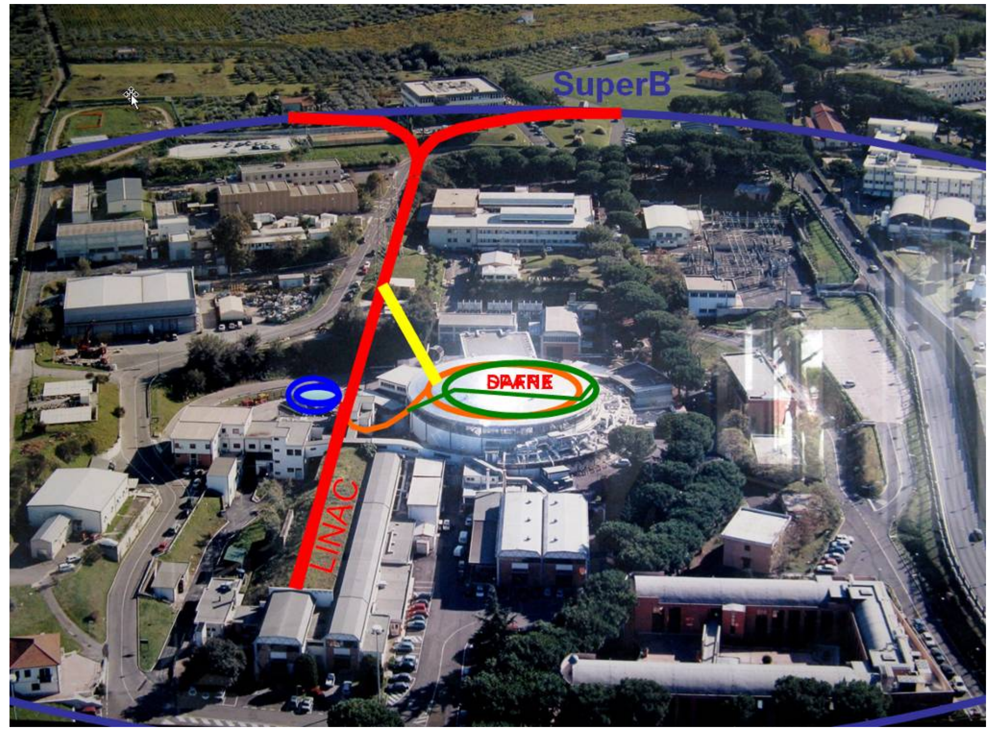
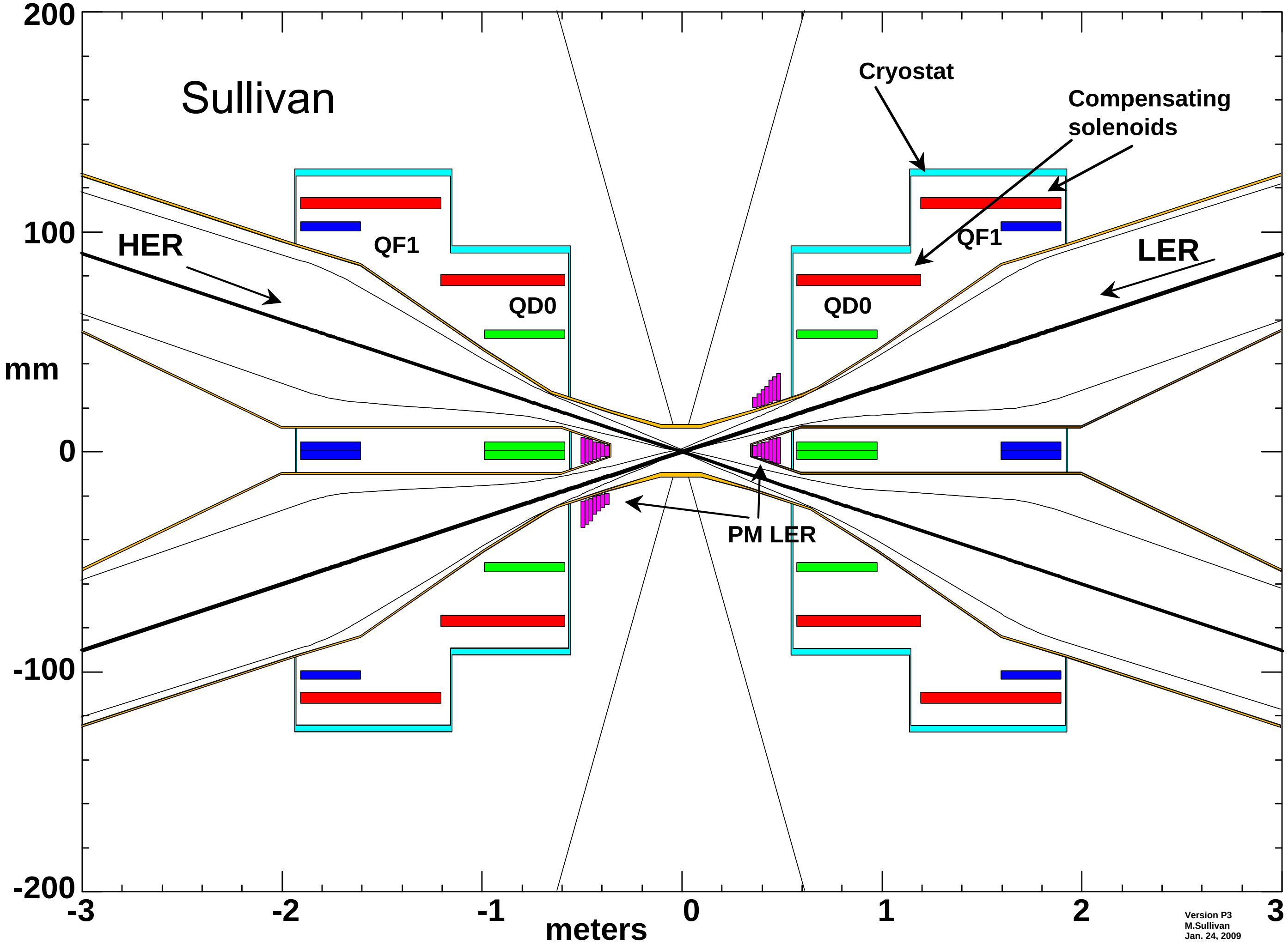


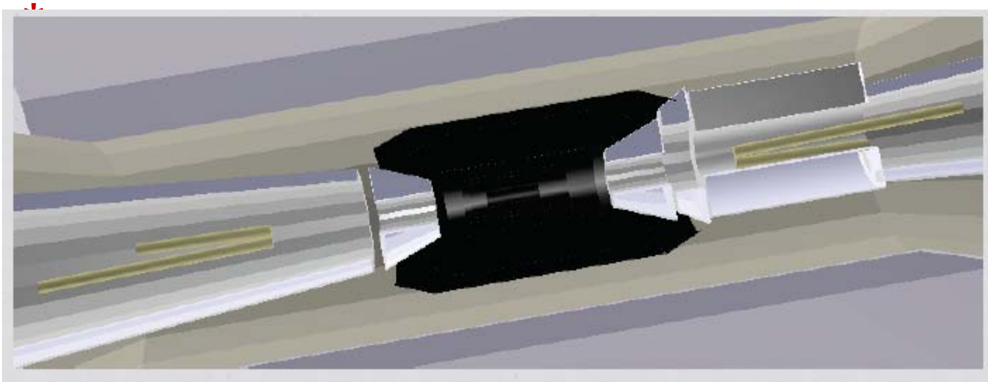


SuperB Interaction Region Layout View (Jan 2009)



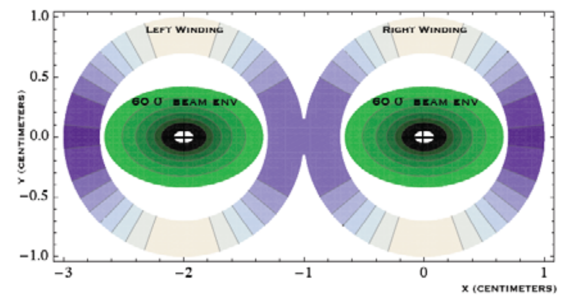
M. Sullivan

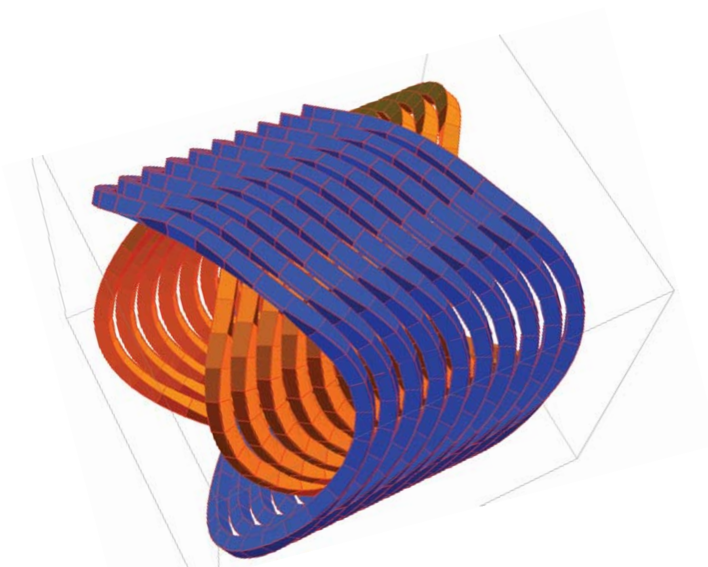
SC Quadrupoles at the IP (E. Paoloni, S. Bettoni)

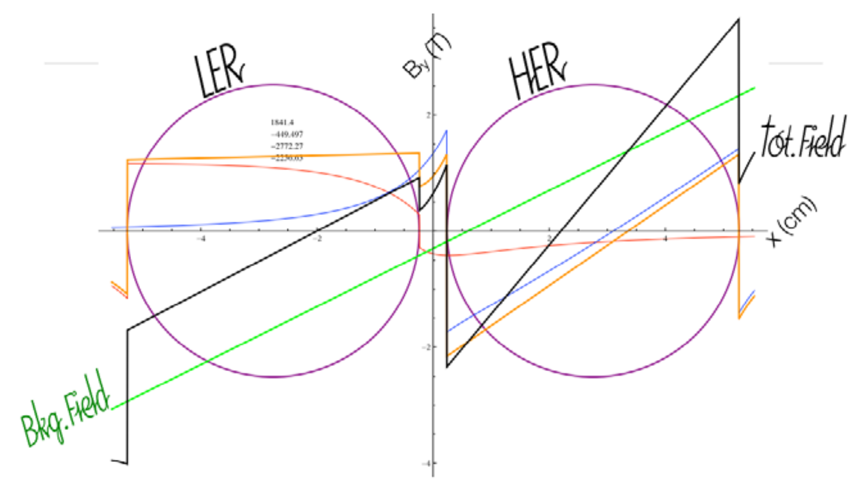


SIAM TWINS QD0

- Beam lines separation @ QD0 entrance: 2 cm
- 60 σ ($\sigma_x \sim 110\ \mu m$) beam envelope leave space for a very thin double quadrupole (2 x 3 mm)
- Cross talk among the two magnets not negligible







Lattice overview

* Studies on the SuperB lattice have continued since the CDR completion for optimization of:
  – Dynamic aperture
  – Chromaticity correction
  – Rings circumference for sites matching
  – Final Focus properties (in close collaboration with the IR and backgrounds studies)
  – Spin rotator matching in the HER for polarization manipulation

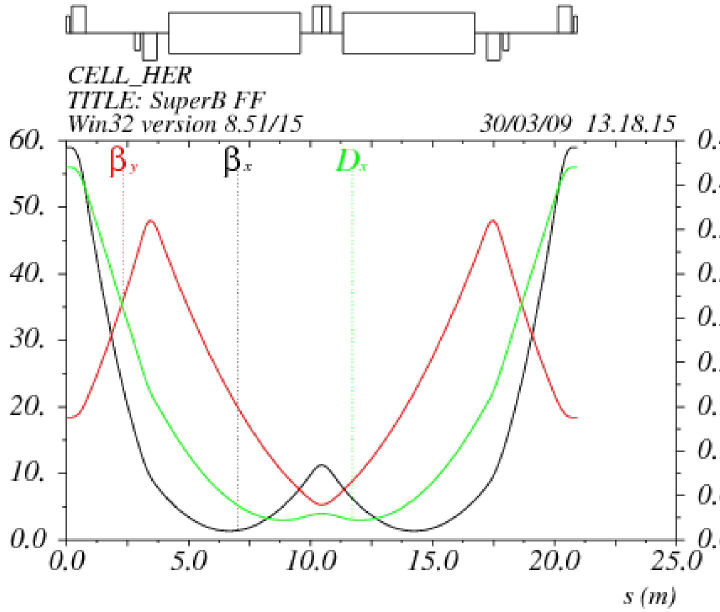
* The design is flexible: emittance and momentum compaction can be easily tuned and the ring circumference can scale down maintaining the design emittances. The Super-B latttice is now being looked at for the ILC DR 3Km long option (M. Biagini).

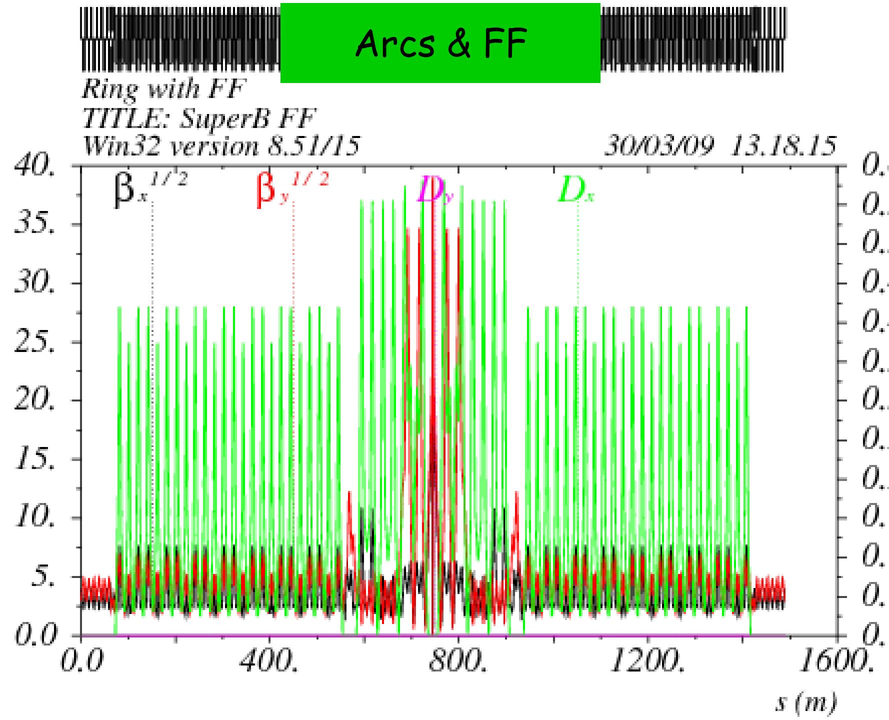
* For the longer circumference (Tor Vergata site), beam dynamics and emittance tuning studies are ongoing.

Arc Lattice

Raimondi, Biagini, Wittmer, Wienands

- Arc cell: flexible solution is based on decreasing the natural emittance by increasing μ_x/cell, and simultaneously adding weak dipoles in the cell drift spaces to decrease synchrotron radiation
- All cells have: μ_x=0.75, μ_y=0.25 → about 30% fewer sextupoles
- Better DA since all sextupoles are at –I in both planes (although x and y sextupoles are nested)
- Distances between magnets compatible with PEP-II hardware
- All quads-bends-sextupoles in PEP-II range



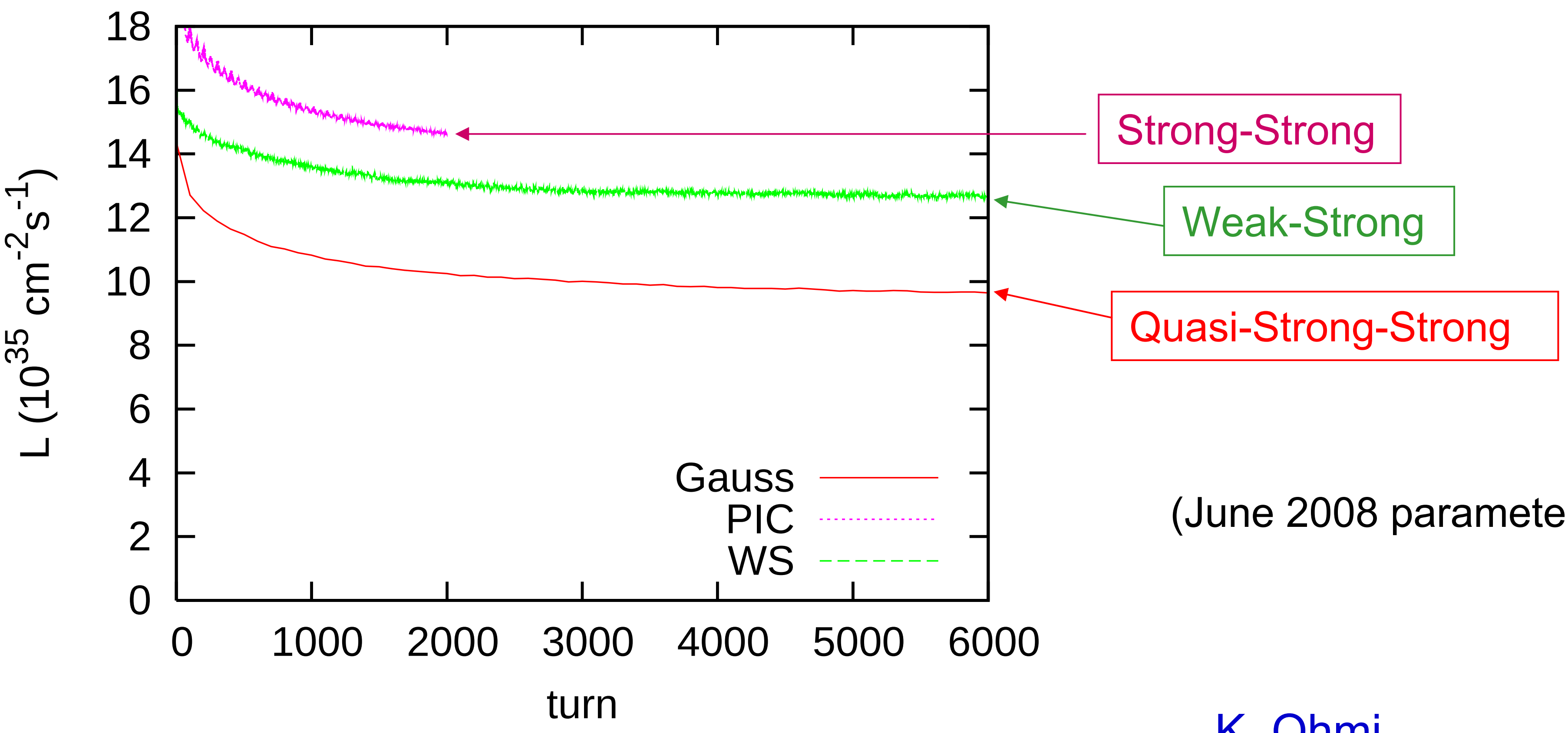


Comparison of design and achieved beam emittances (*achieved)

	E (GeV)	C (m)	γ	ε_x (nm)	$\gamma\varepsilon_x$ (μm)	ε_y (pm)	$\gamma\varepsilon_y$(nm)
Spring-8	8	1430	15656	6	94	5	78
ILC-DR	5	6400	9785	1	10	2	20
Diamond*	3	561	5871	2.7	16	2	29
ATF*	1.28	138	2524	1	2.5	4	10
SLS*	2.4	288	4700	6	28	3.2	15
SuperB LER	4	1800	7828	2.8	22	7	55
SuperB HER	7	1800	13699	1.6	22	4	55

Emittance tuning techniques and algorithms have been tested in simulations and experiments on the ATF and on the other electron storage rings to achieve such small emittances (ex. CesrTA as an ILC-DR test facility has a well established one).

Simulations for SuperB

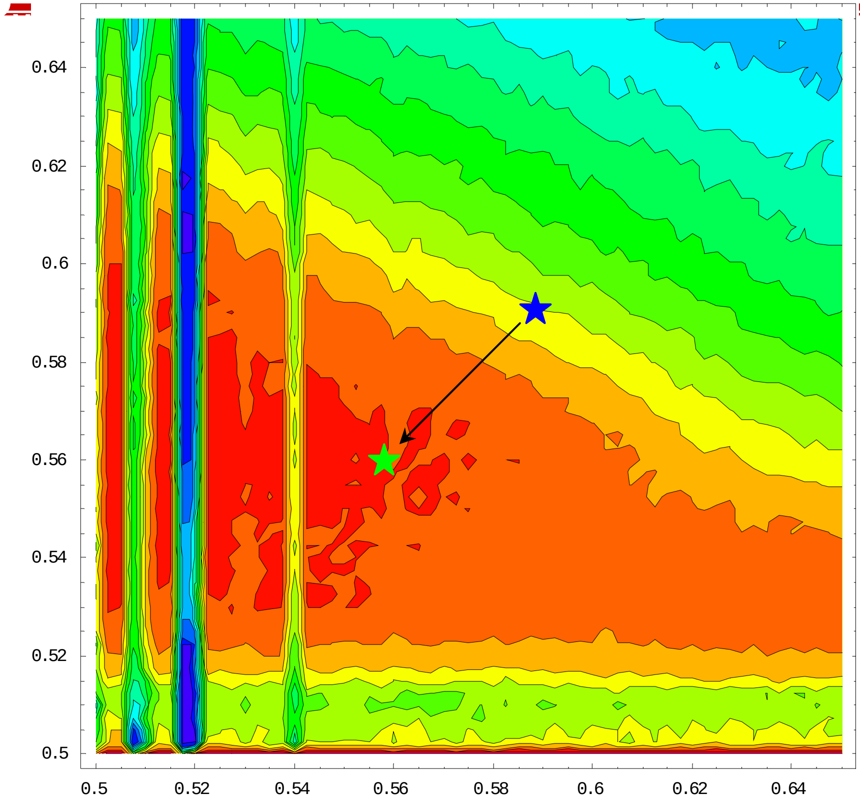


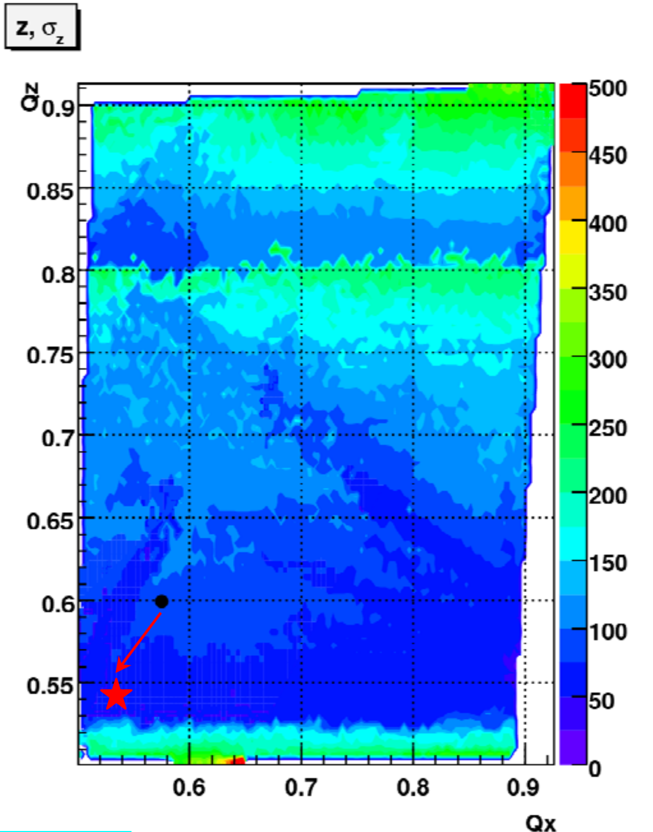
(June 2008 parameters)

K. Ohmi

Luminosity and Dynamic Aperture Scans

Piminov, Shatilov, Zobov





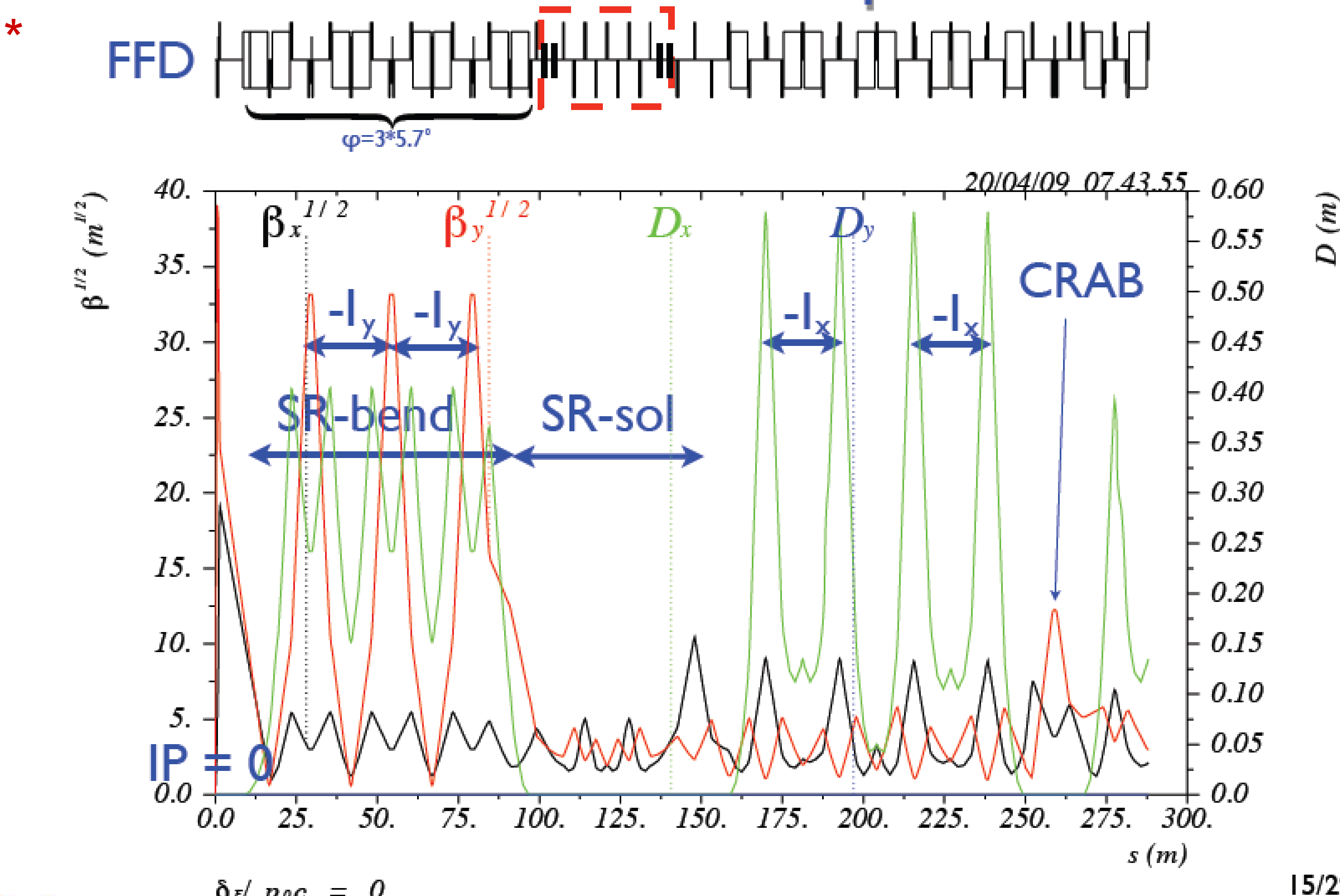
Tune point optimization is done together with bb simulations and luminosity and lifetime optimization

IR Longitudinal Polarization

* Polarization of one beam is included in *SuperB*
  - Either energy beam could be the polarized one.
  - The LER would be less expensive, the HER easier.
  - HER was chosen for now.
* Longitudinal polarization times and short beam lifetimes indicate a need to inject vertically polarized electrons.
  - The plan is to use a polarized e- source similar to the SLAC SLC source.
* There are several possible IP spin rotators:
  - Solenoids look better at present (vertical bends give unwanted vertical emittance growth).
* Expected longitudinal polarization at the IP of about 87%(inj) x 97%(ring)=85%(effective)
* Polarization section implementation in lattice: in progress with strong success

W. Wittmer

HER IR with SR Linear Optics V1.04.010



Polarization versus Energy of HER (Wienands)

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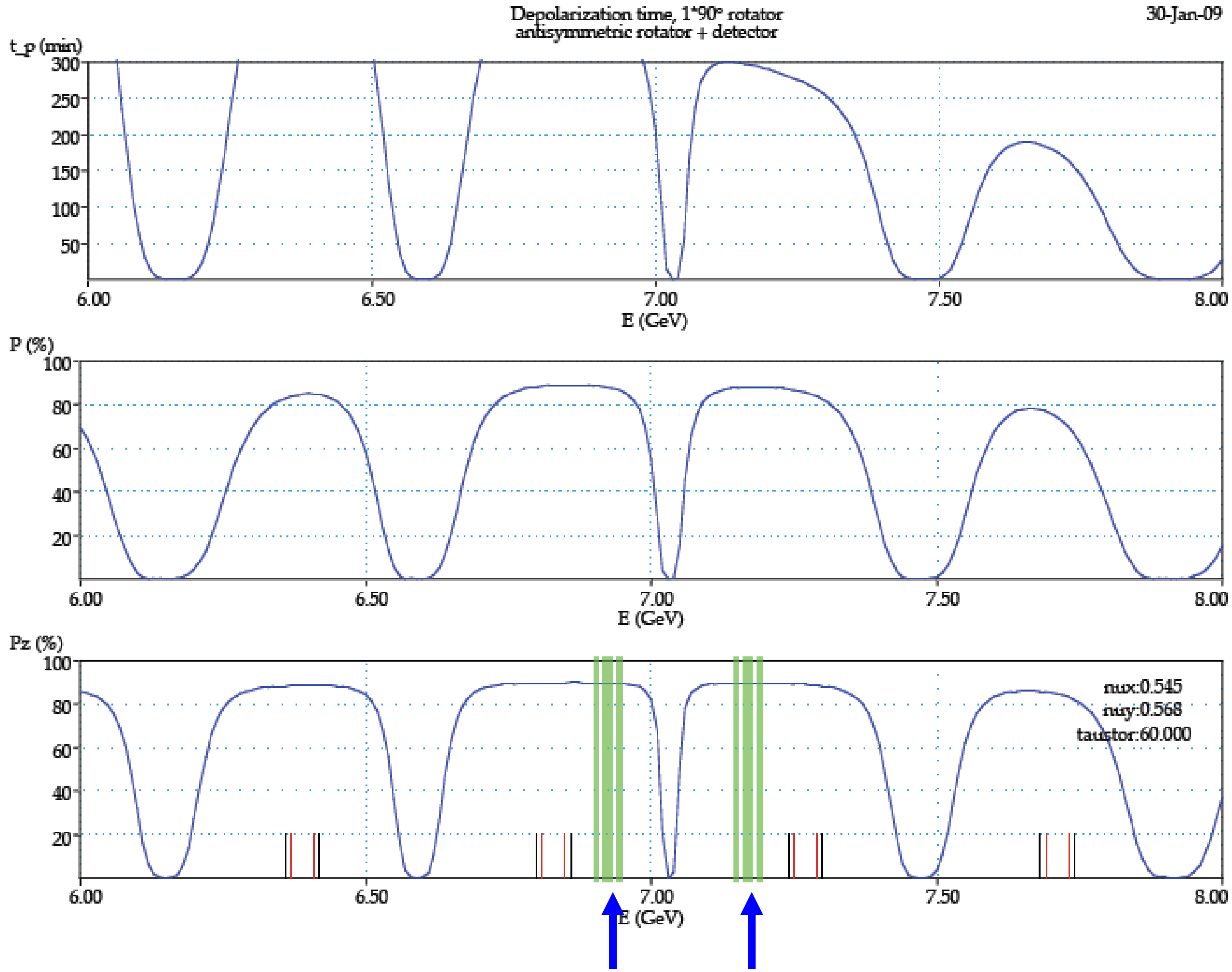

Possible layout with spin rotators near IR (Wienands, Wittmer)

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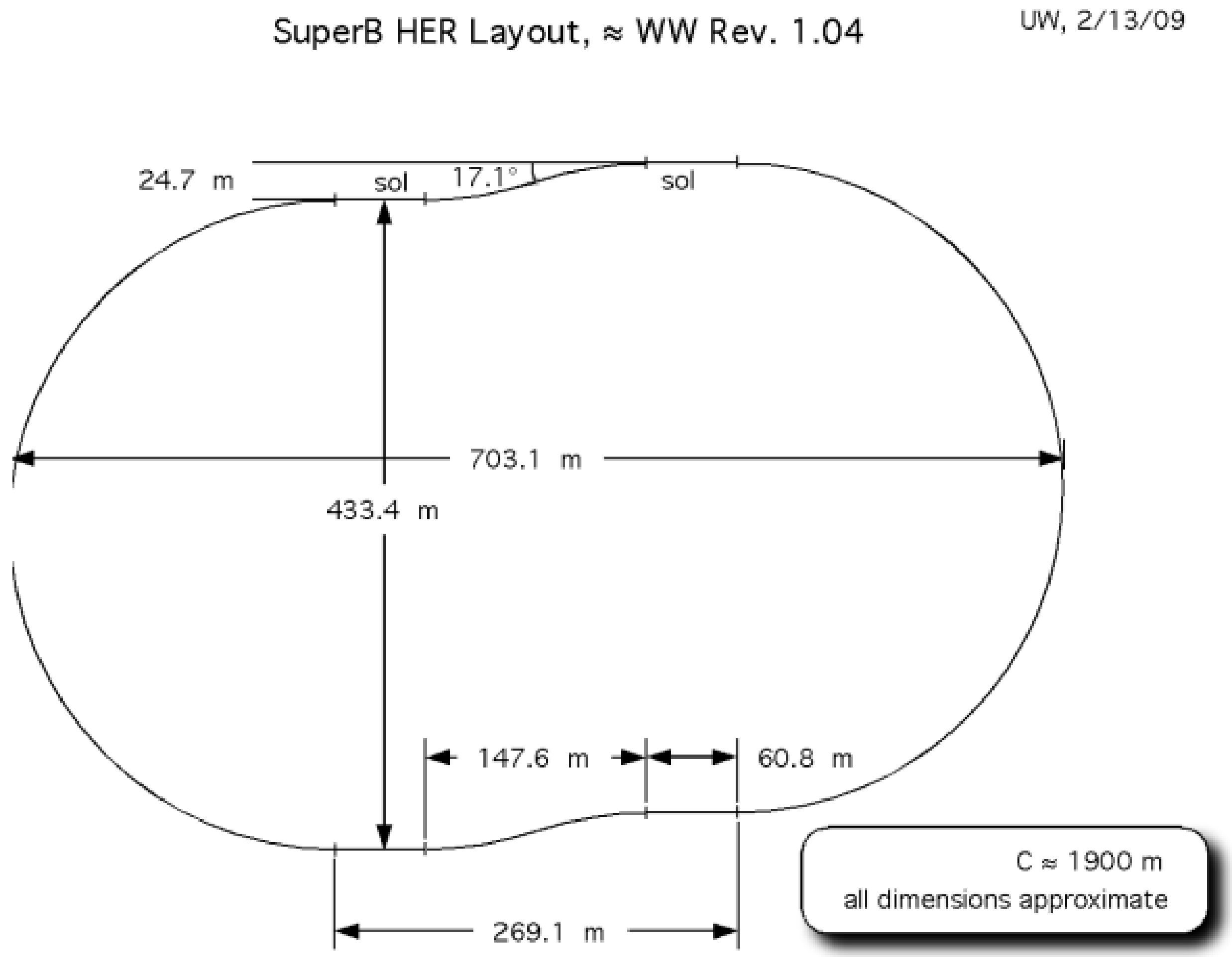

RF Plan: Use PEP-II RF system and cavities

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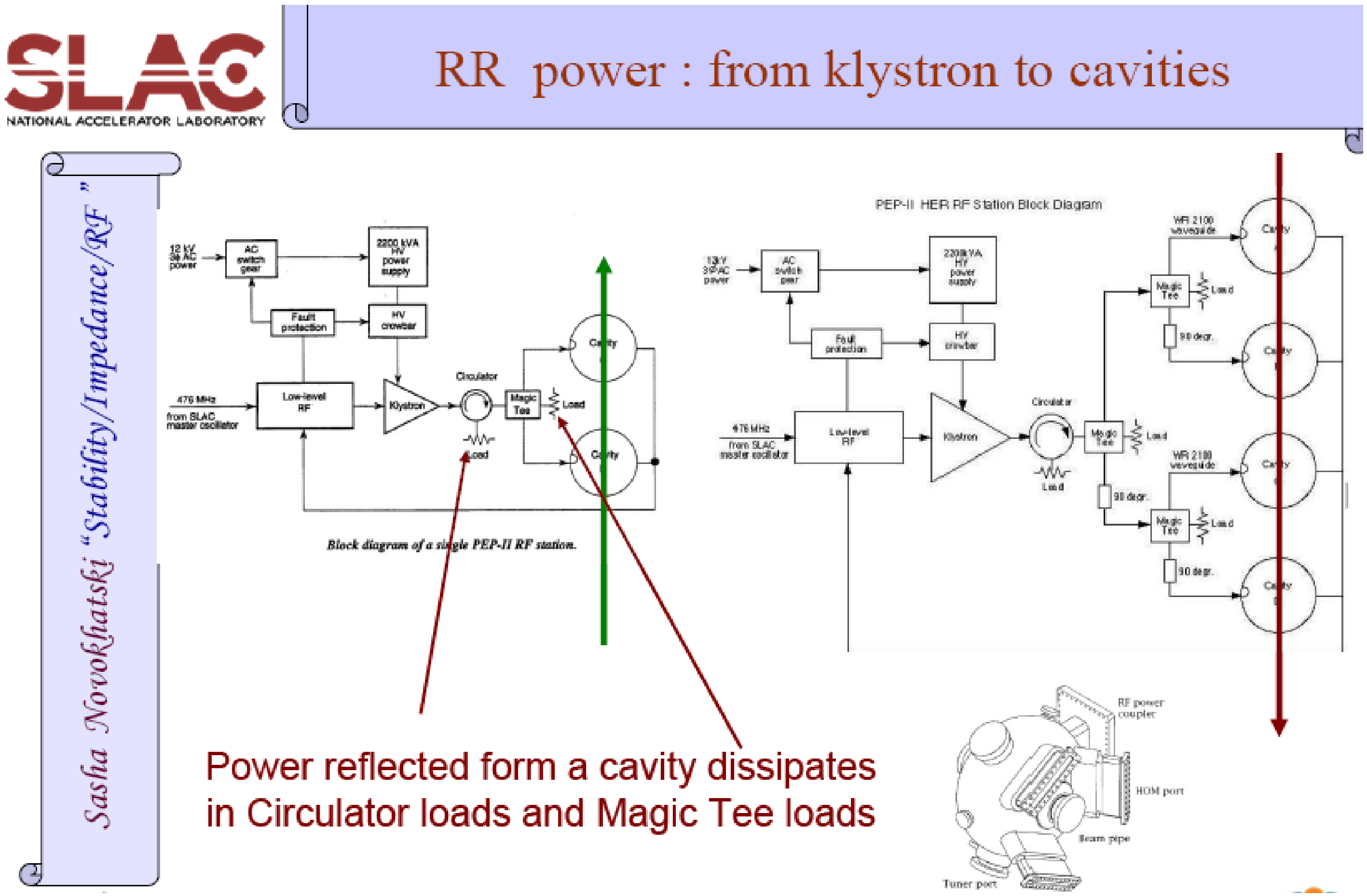
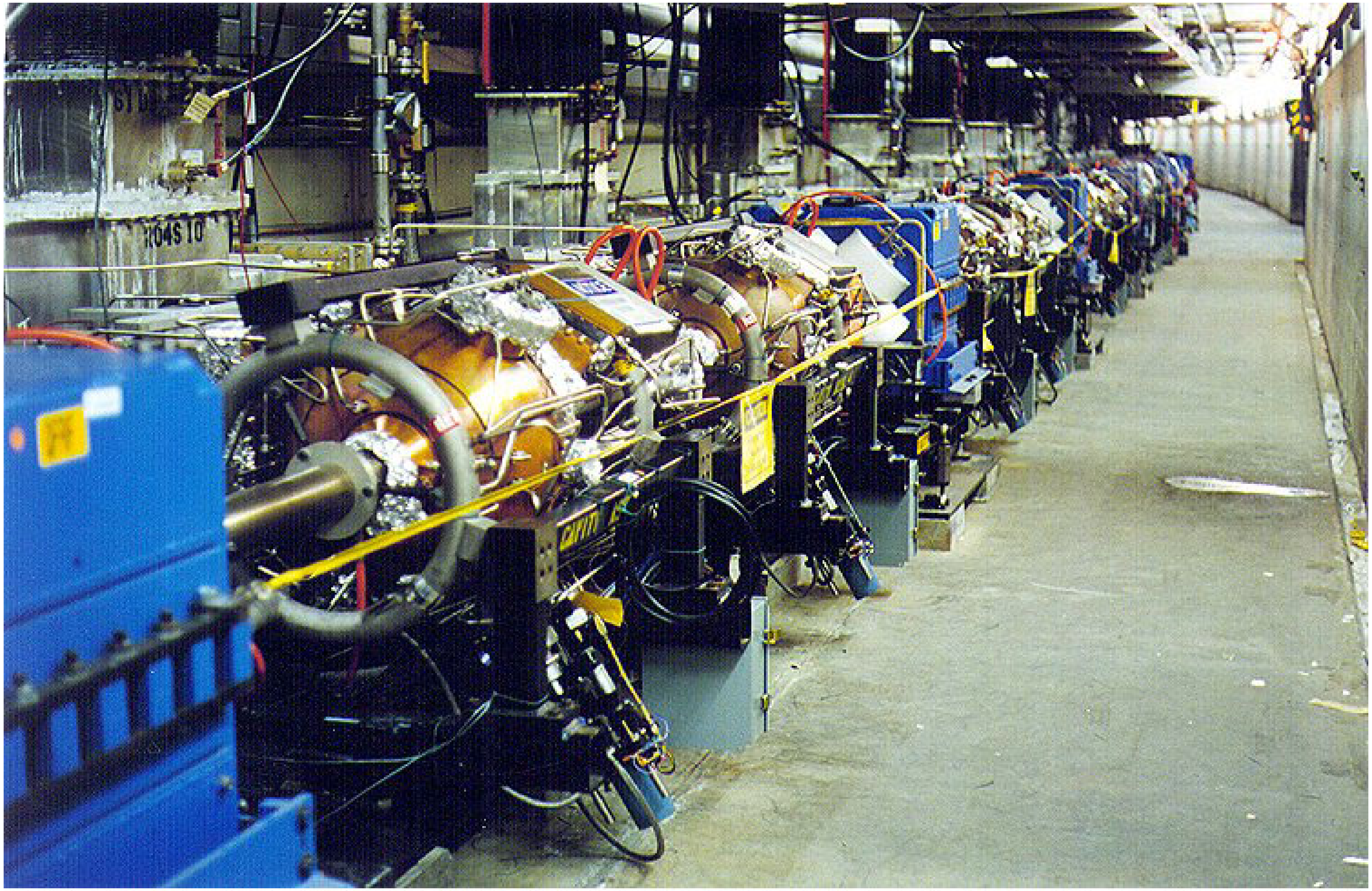


(Novokhatski, Bertsche)

PEP-II RF Cavities match Super-B needs.



BR_049 HER Cavities Region 12 8-19-97

S. Novokhatski
Jan. 2009

Super-B RF: power required

Lumi	Beam energy GeV	Beam current A	S.R. energy loss per turn MeV	Momentum compaction	Momentum spread	Total RF voltage MV	Zero I Bunch length mm	Bunch spacing nsec	Max voltage per cavity MV	Number of cavities klystrons	S.R. power MW	HOM power MW	Total cavity loss MW	Total reflected power MW	Total forward power MW	Power for one cavity MW	LER Total forward MW
1E+36	7	2	1.95	3.8E-04	5.8E-04	8	5.1	4.2	0.65	12	3.9	0.386	0.702	0.5912	5.58	0.46	8.98
										6							
1E+36	7	2.82	1.95	3.8E-04	5.8E-04	10	4.5	2.1	0.65	16	5.499	0.4901	0.822	1.2384	8.05	0.50	12.73
										8							
1E+36	7	4	1.95	3.8E-04	5.8E-04	16	3.6	2.1	0.7	22	7.8	1.517	1.531	1.2733	12.12	0.55	19.63
										11							

LER Lumi	LER Beam energy GeV	LER Beam current A	LER S.R. energy loss per turn MeV	LER Momentum compaction	LER Momentum spread	LER Total RF voltage MV	LER Zero I Bunch length mm	LER Bunch spacing nsec	LER Max voltage per cavity MV	LER Number of cavities klystrons	LER S.R. power MW	LER HOM power MW	LER Total cavity loss MW	LER Total reflected power MW	LER Total forward power MW	LER Power for one cavity MW	HER+LER Supply Power eff.~50% MW
1E+36	4	2	1.16	3.2E-04	8.0E-04	6	5.6	4.2	0.65	10	2.32	0.3205	0.474	0.2863	3.40	0.34	17.96
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1E+36	4	2.82	1.16	3.2E-04	8.0E-04	7	5.2	2.1	0.65	10	3.2712	0.3569	0.645	0.4038	4.68	0.47	25.45
										5							
1E+36	4	4	1.16	3.2E-04	8.0E-04	9	4.5	2.1	0.65	14	4.64	0.9391	0.761	1.1691	7.51	0.54	39.26
										7							

(A. Drago)

SuperB feedback parameters

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FB Sampling frequency	476	MHz
Harmonic number	2850	
Revolution period	~ 6	us
Stored bunches	~1250 (2500)	Ph-1 (Ph-2)
Bucket length	~2	ns
Ph-1 (ph-2) bunch spacing	1.26 (.63)	m
n_s HER/LER	0.0141/0.0133	
Synchrotron frequency	~2.35/2.2	kHz
Longitudinal damping time	~20	ms
$n_{x,y}$ HER/LER	0.52/.54 (???)	
Betatron frequency	86.8/90.2	kHz
Transverse damping time	40	ms
Transv. feedback expected damping time	>120 (> 20 turns)	us
Power amplifier (long.)	4x250	W
Power amplifier (trasv.)	2x500	W
Trasverse kickers (1xV, 1xH)	2-ports	Stripline type
Longitudinal kicker	4-ports	Cavity type

New feedback Kicker design (A. Krasnykh)

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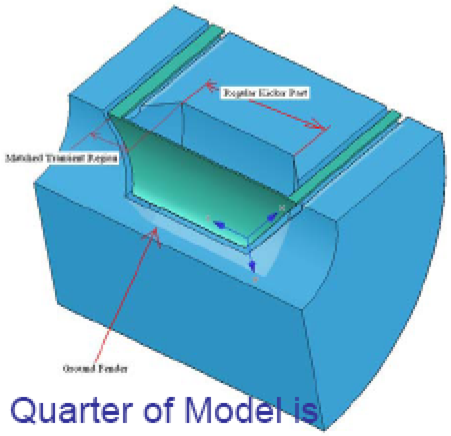
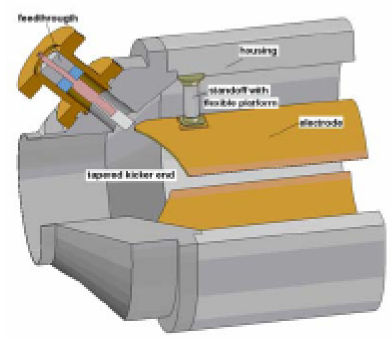
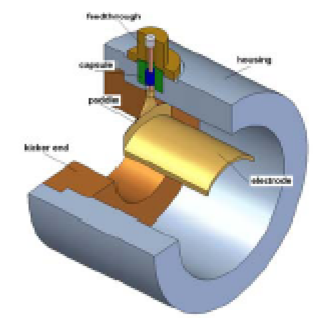
SuperB Kicker Assembly (proposal)



Quarter of Model is shown



PEP TFB Design



Electrodynamic Structure with:

- Regular Kicker Part
- Two Matched Transition Regions at the Kicker Ends
- Ground Fenders
- Broadband Constant Impedance Feedthrough

20

Locations of Fast Dipoles for Luminosity Feedback

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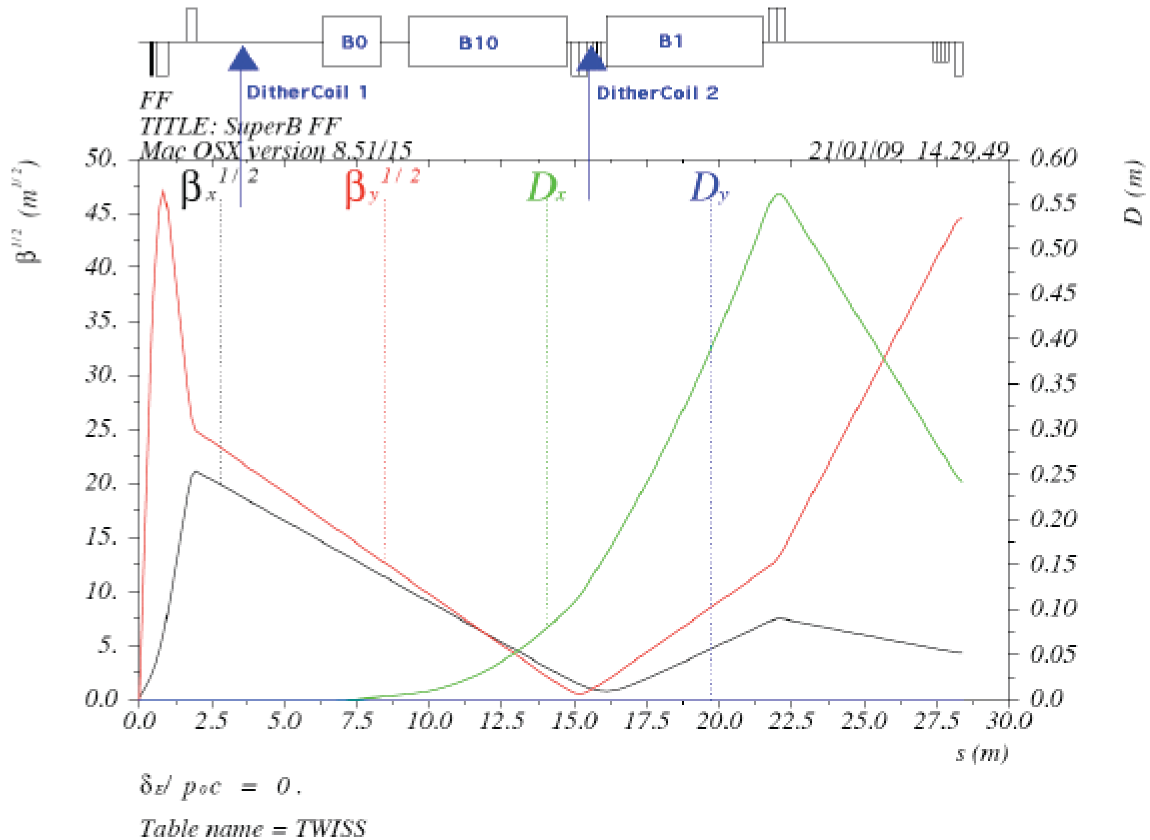
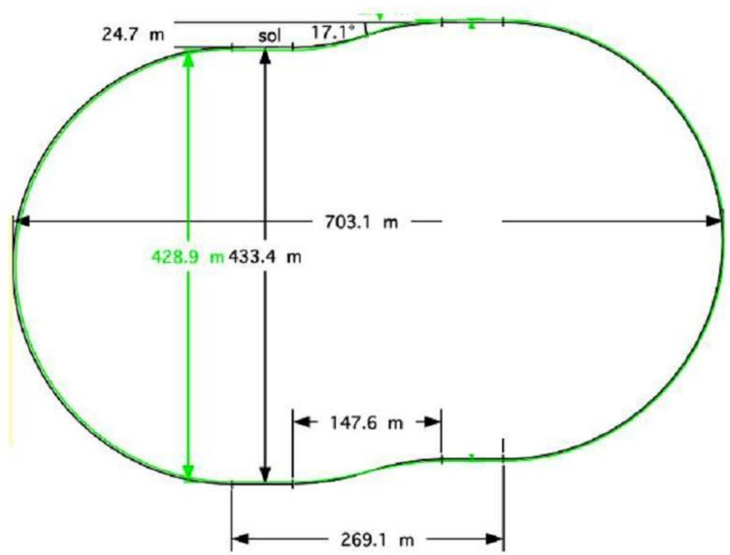


K. Bertsche

Layout: PEP-II magnets reuse



Available

Needed

Quads

L_{mag} (m)	0.45	5.4
PEP HER	-	194
PEP LER	194	-
SBF HER	-	130
SBF LER	224	18
SBF Total	224	148
Needed	30	0

L_{mag} (m)	0.56	0.73	0.43	0.7	0.4
PEP HER	202	82	-	-	-
PEP LER	-	-	353	-	-
SBF HER	165	108	-	2	2
SBF LER	88	108	165	2	2
SBF Total	253	216	165	4	4
Needed	51*	134	0	4	4

Sexts

L_{mag} (m)	0.25	0.5
PEP HER/LER	188	-
SBF Total	372	4
Needed	184	4

All PEP-II magnets can be used, dimensions and fields are in range
RF requirements are met by the present PEP-II RF system

PEP-II D&D Review (March 2009)

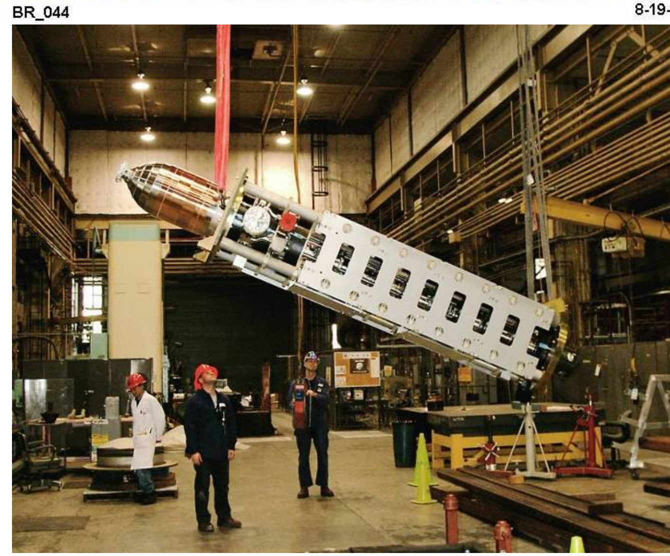
* DOE conducted a two day review of removing and disposing PEP-II components.
* Table was made of component weights, volumes, and areas.
* ES&H studies have been done and are ongoing.
* Many parts could go to a future Super-B in Frascati.
  – ~350 shipping containers
* Some parts could go to a future Project-X at FNAL.
  – ~60 shipping containers
* Some parts would stay at SLAC for a future PEP-X.
* The remainder goes to disposal.

PEP-II Magnets and RF Components

*

bw_001 Installation of the First HER Straight Section Quad Raft (730) 8-19-97

BR_044 8-19-97



INFN Requests for PEP-II Components

*

Request to SLAC for PEP-II and Linac Components for Super-B				5-Mar-08
System	Component description	Number requested	Replacement value per unit (kEuro)	Total replacement value (kEuro)
PEP-II	Dipole (0.5 m)	144	10	1440
PEP-II	Dipole (0.5 m) supports	144	4	576
PEP-II	Dipole (5.4 m)	176	15	2640
PEP-II	Dipole (5.4 m) supports	176	2	352
PEP-II	Dipole (2 m)	4	10	40
PEP-II	Dipole (2 m) supports	4	2	8
PEP-II	Quadrupole (0.43m)	341	10	3410
PEP-II	Quadrupole (0.43m) supports	341	1	341
PEP-II	Quadrupole (0.5)	70	10	700
PEP-II	Quadrupole (0.5) supports	70	1	70
PEP-II	Quadrupole (0.56)	287	10	2870
PEP-II	Quadrupole (0.56) supports	287	1	287
PEP-II	Quadrupole (0.73)	138	10	1380
PEP-II	Quadrupole (0.73) supports	138	1	138
PEP-II	Sextupole (0.25m)	452	7.5	3400
PEP-II	Sextupole (0.25m) supports	452	0.5	226
PEP-II	Sextupole (0.6m)	8	4	32
PEP-II	Sextupole (0.6m) supports	8	1	8
PEP-II	Dipole correctors	836	1	836
PEP-II	Dipole corrector supports	836	0.5	418

INFN Requests (cont)

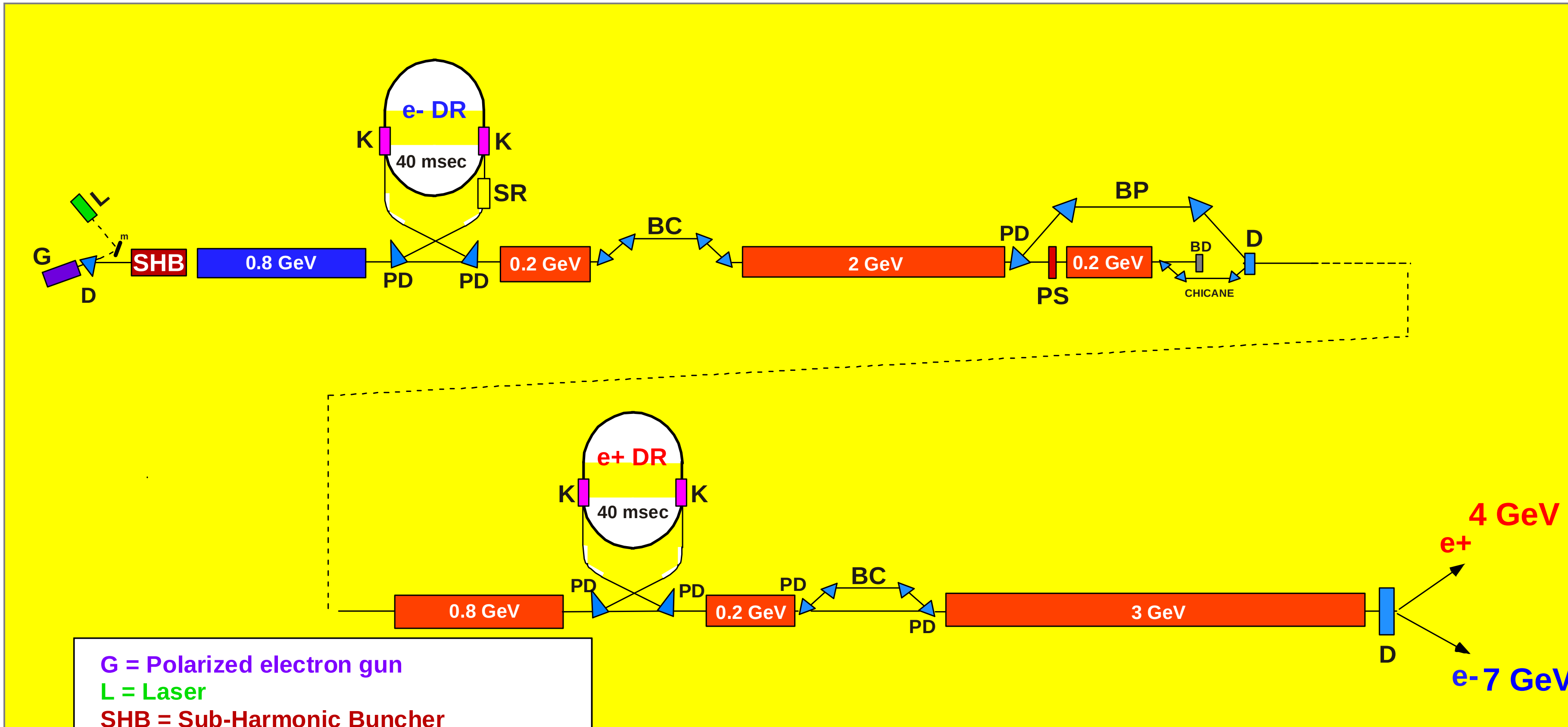
*

PEP-II	Skew quadrupoles	24	5	120
PEP-II	Skew quadrupoles supports	24	1	24
PEP-II	Vacuum chambers	1500	10	15000
PEP-II	Vacuum chamber supports	1500	1	1500
PEP-II	RF station	15	4000	60000
PEP-II	Transverse feedback system	2	2000	4000
PEP-II	Longitudinal feedback system	2	3000	6000
PEP-II	Injection kickers	4	250	1000
PEP-II	Injection transport lines	2	5000	10000
PEP-II	Synchrotron light monitor	2	500	1000
PEP-II	Bunch current monitor	2	100	200
PEP-II	Beam loss monitors	300	1	300
PEP-II	Luminosity monitor	1	200	200
PEP-II	IP orbit fast feedback	1	400	400
PEP-II	Bunch length monitor	2	300	600
PEP-II	Temperature monitors	2000	0.5	1000
PEP-II	Power supplies	1000	10	10000
PEP subtotal				130516

PEP-II Components Volumes and Weights								Seeman		March 16, 2009						
Component	Number	Width	Length	Height	Weight	Weight	Stacking	Volume	Total	Area	Total	Shipping	Shipping	INFN	INFN	FNAL
Unit					per unit	total	factor		Volume		Area	containers	containers	containers	containers	containers
		Ft	Ft	Ft	Lb	Lb		Ft^3	Ft^3	Ft^2	Ft^2	needed	needed	Full request	FNAL out	Full request
												(weight)	(area)			
Suspension components												31000 lbs	(150 sq-ft)			
HER quadrupole-sext raft arc	200	3	7	4	8000	1600000	1	84.0	16800.0	21.0	4200.0	51.6	28.0	52	52	0
HER dipoles	196	2.3	19	1.5	15338	35277	1	65.6	12847.8	43.7	8565.2	97.0	57.1	72	48	50
HER dipole supports	388	3.5	2	1.5	500	194000	3	10.5	4074.0	7.0	905.3	6.3	2.0	7	3	4
HER IR dipoles and supports	10	4	2	4	4000	40000	1	32.0	320.0	8.0	80.0	1.3	0.5	2	2	0
HER quadrupole raft straight	120	3	4.5	1.5	6500	780000	1	20.3	2430.0	13.5	1620.0	25.2	10.8	25	13	12
HER dipole vacuum chamber	192	1	20	0.5	685	131520	3	10.0	1920.0	20.0	1280.0	4.2	2.8	4	4	0
HER straight vacuum chamber	130	0.5	16	0.5	300	39000	5	4.0	520.0	8.0	208.0	1.3	0.3	2	2	0
HER misc vacuum parts	200	2	2	2	100	20000	3	8.0	1600.0	4.0	266.7	0.6	0.6	1	1	0
LER quad-dipole-sext raft arc	200	3	10.5	3	10000	2000000	1	94.5	18900.0	31.5	6300.0	64.5	42.0	65	65	0
LER quadrupole raft straight	120	3	3.5	1.5	7000	840000	1	15.8	1890.0	10.5	1260.0	27.1	8.4	27	27	0
LER IR dipoles and supports	10	4	2	4	4000	40000	1	32.0	320.0	8.0	80.0	1.3	0.5	2	2	0
LER raft vertical supports	320	2	5	5.5	5000	1600000	2	55.0	17600.0	10.0	1600.0	51.6	5.3	0	0	0
LER arc pumping vac chamber	200	1.7	18	2	1500	300000	2	61.2	12240.0	30.6	3060.0	9.7	10.2	0	0	0
LER misc vacuum parts	200	2	2	2	100	20000	3	8.0	1600.0	4.0	266.7	0.6	0.6	1	1	0
Power cables in tunnel remove	7000	4	1	0.2	30	210000	15	0.8	5600.0	4.0	1866.7	6.8	0.8	0	0	0
Injection magnets	100	2	1	1	400	40000	2	2.0	200.0	2.0	100.0	1.3	0.3	1	1	0
Injection supports	100	1	1	6	300	30000	4	6.0	600.0	1.0	25.0	1.0	0.0	1	1	0
Inj kicker magnets & pulsers	6	4	4	4	400	2400	2	64.0	384.0	16.0	48.0	0.1	0.2	0	0	0
RF cavities+ support	36	3	5	4	2000	72000	1	60.0	2160.0	15.0	540.0	2.3	3.6	4	4	0
Diagnostics <I>-Coll-lum-SLM	50	2	1	1	100	5000	2	2.0	100.0	2.0	50.0	0.2	0.2	1	1	0
Controls in tunnel	50	2	4	2	300	15000	2	16.0	800.0	8.0	200.0	0.5	0.7	1	1	0
Base grout and bolts	1000	2	3	0.2	50	50000	12	1.2	1200.0	6.0	500.0	1.6	0.3	0	0	0
Release components																
Power supplies	1000	2	2	5	400	400000	1	20.0	20000.0	4.0	4000.0	12.9	26.7	27	27	0
Power cables outside remove	3000	4	1	0.2	30	90000	15	0.8	2400.0	4.0	800.0	2.9	0.4	3	3	0
Controls outside tunnel	200	2	1	1	100	20000	3	2.0	400.0	2.0	133.3	0.6	0.3	1	1	0
RF klystron and raft	15	3	12	4	6000	90000	1	144.0	2160.0	36.0	540.0	2.9	3.6	8	8	0
RF circulator and support	15	5	6	10	3000	45000	1	300.0	4500.0	30.0	450.0	1.5	3.0	4	4	0
RF power waveguide	1000	1.5	1	1	50	50000	3	1.5	1500.0	1.5	500.0	1.6	1.1	2	2	0
RF power supplies	16	12	10	10	64000	1024000	1	1200.0	19200.0	120.0	1920.0	33.0	12.8	33	33	0
Suspension totals						8064197			104105.8		33021.5	356.0	175.3	268	228	66
Release totals						1719000			50160.0		8343.3	55.5	47.8	78	78	0
Overall totals						9783197			154265.8		41364.9	411.4	223.1	346	306	66

SuperB Injector layout

R. Boni



G = Polarized electron gun
L = Laser
SHB = Sub-Harmonic Buncher
PD = Pulsed Dipole
D = DC Dipole
K = Injection/Exctraction Kicker
SR = Spin Rotator
BC = Bunch Compressor
PS = Positron Source
BP = By-Pass Line
BD = e- Beam Dumper

F_{LINAC} = **2856 MHz**

Highlights from the MAC Committee April 23-24, 2009

Committee: Klaus Balewski (DESY), John Corlett (LBNL), Jonathan Dorfan (SLAC, Chair), Stuart Henderson (ORNL), Tom Himel (SLAC), Claudio Pellegrini (UCLA) , Daniel Schulte (CERN), Ferdi Willeke (BNL), Andy Wolski (Liverpool), Frank Zimmermann (CERN)

* “The MAC now feels secure in enthusiastically encouraging the SuperB design team to proceed to the TDR phase, with confidence that the design parameters are achievable.” Recent strong progress:
  - Crab waist tests at DAFNE
  - Beam-beam measurements (DAFNE) and simulations
  - IR design
  - Lattice
  - Polarization spin rotators

* “Nonetheless, much detailed work remains to bring the design to the level where (a) *ground-breaking,* (b) *final engineering of accelerator components* can commence.” Further needed work areas:
  - Emittance tuning and evaluate tolerances
  - Dynamic aperture calculations
  - IR and arc vacuum systems
  - Injection system
  - Vibration studies
  - Polarization lattice

TDR Topic List

- Injection System
  - Polarized gun
  - damping rings
  - spin manipulators
  - linac
  - positron converter
  - beam transfer systems
- Collider design
  - Two rings lattice
  - Polarization insertion
  - IR design
  - beam stay clear
  - ultra-low emittance tuning
  - detector solenoid compensation
  - coupling correction
  - orbit correction
  - stability
  - beam-beam simulations
  - beam dynamics and instabilities
  - single beam effects
  - operation issues
  - injection scheme
- RF System
  - RF specifications
  - RF feedbacks
  - Low level RF
  - Synchronization and timing
- Site
  - Civil construction
  - Infrastructures & buildings
  - Power plants
  - Fluids plants
  - Radiation safety
- Magnets
  - Design of missing magnets
  - Refurbishing existing magnets
  - Field measurements
  - QD0 construction
  - Power supplies
  - Injection kickers
- Mechanical layout and alignment
  - Injector
  - supports
- Vacuum system
  - Arcs pipe
  - Straights pipe
  - IR pipe
  - e-cloud remediation electrodes
  - bellows
  - impedance budget simulations
  - pumping system
- Diagnostics
  - Beam position monitors
  - Luminosity monitor
  - Current monitors
  - Synchrotron light monitor
  - R&D on diagnostics for low emittance
- Feedbacks
  - Transverse
  - Longitudinal
  - Orbit
  - Luminosity
  - Electronics & software
- Control system
  - Architecture
  - Design
  - Peripherals

Frascati Super-B Conclusions

* The Super-B parameters are being optimized around 1 x 10^{36}.
* The team is addressing the Accelerator MAC suggestions from the April meeting.
* IR present design is a solid basis; now start adding engineering features.
* IR polarization (spin) rotators have now been added to the HER lattice. Polarization has changed the geometrical layout.
* Beam-beam and lattice dynamic aperture calculations are continuing. The new lattice layouts show improvement.
* Beam loading and RF parameters have taken the next solid step. Looks acceptable.
* Organizing and planning for the Technical Design Report aiming at Fall 2010.

Back-up slide:
Super-KEKB options (Ohnishi April 2009)

* **Table 1:** Machine parameters for SuperKEKB. Left is LER and right is HER. The parenthesis indicates a half finite-crossing angle for a crab crossing. *1beam-beam simulation. *2geometrical calculation.

Parameter LER/HER	*Unit*	*2008*	*Travel Waist*	*Super-bunch(T)*	*Super-bunch(H)*
Energy	GeV	3.5/8.0			
Circumference	m	3016			
Current	A	9.4/4.1		2.70/1.55	2.65/1.55
No of bunches		5018		2500	1200
No of particles ($\times10^{10}$)		11.8/5.13		6.78/3.89	13.9/8.11
Horizontal emittance	nm	12/12	24/18	1/10	1/10
Vertical emittance	pm	60/60	240/90	3.5/25	3.5/25
Horizontal beta	mm	200/200	200/200	35/20	35/10
Vertical beta	mm	3/3	3/6	0.35/0.22	0.35/0.22
Bunch length	mm	3/3	5/3	6/6	6/6
Half crossing angle	mrad	0 (15)	0 (15)	30	30
Piwinski angle		0/0 (0.92/0.92)	0/0 (1.1/0.75)	30/13	30/18
Horizontal beam-beam		0.272/0.272	0.182/0.138	0.003/0.001	0.006/0.002
Vertical beam-beam		0.295/0.295	0.295/0.513	0.067/0.068	0.139/0.139
Luminosity ($\times10^{35}$)	$cm^{-2}s^{-1}$	5.5*1	5.3*1	5.0*2	10*2