Status of SuperB Project

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Warwick

April 14, 2009

Outline

- A bit of History.
- A glance at Physics opportunity with
- Organizing the TDR effort.
- Next steps.

SuperB is now in TDR Phase.

But a bit of HISTORY:

Several preparatory meetings from 2005 to form the community and to prepare the CDR, delivered in may 2007.

IRC appointed by the President of INFN in summer 2007 (Chair: John Dainton)

Preliminary meeting in Rome end July 2007 (committee with INFN management and proponents).

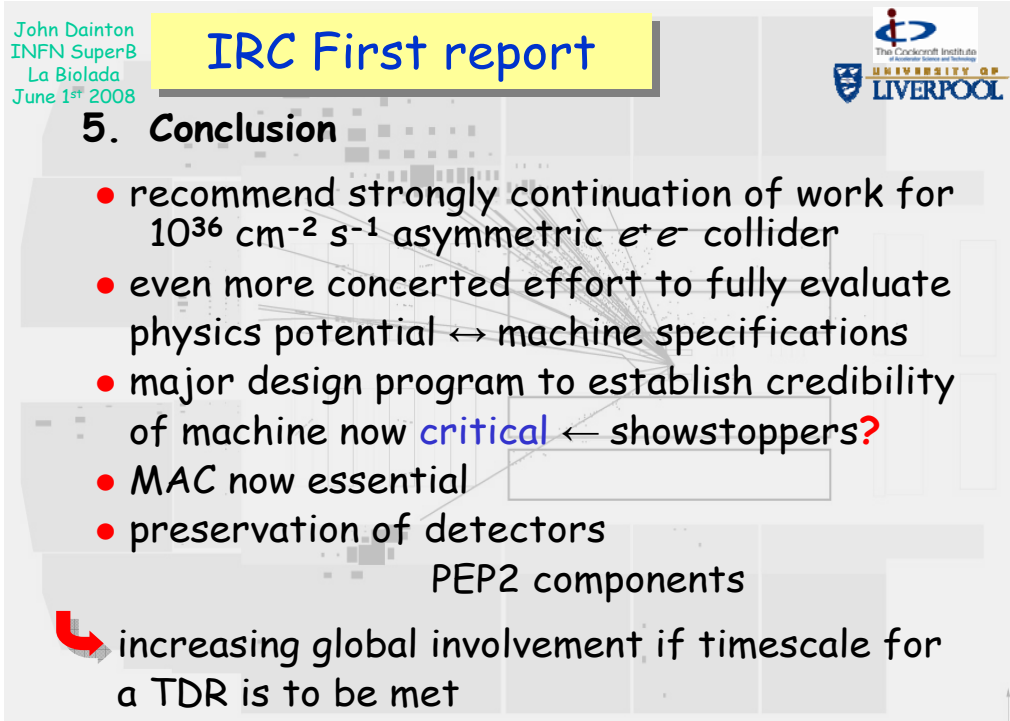
First review meeting in LNF Nov. 12-13 , 2007.

Final meeting before report to President of INFN in Rome, Apr. 29-30, 2008 .

IRC has delivered the report to the President of INFN on May 30,2008.

Comments on reviews

- Link to meetings and reports:
  http://www.pi.infn.it/SuperB/reviews
- Dainton committee →
- Mini MAC



•Very exciting project -- Committee is exhilarated by the challenge
•Physics requirement of 10**36 cm-2 sec-1 or 75 ab-1/5yr is very demanding
•Committee considers the SINGLE MOST ESSENTIAL ingredient for moving forward is the formation of a sanctioned management structure which formally incorporates a dedicated machine design team. The team members must have the strong support of their home institutions to work on the design. The team needs a designated leader, who is as close to full time as is possible

•The Committee sees no glaring showstoppers wrt achieving the design performance. However, in several key areas, more work is needed before the design can be blessed

FROM P 5

(Report released May 2008)

High-sensitivity Measurements

- The latest developments in accelerator and detector technology make possible promising new scientific opportunities through measurement of rare processes. Incisive experiments, complementary to experiments at the LHC, would probe the Terascale and possibly much higher energies.
- The panel recommends pursuing the muon-to-electron conversion experiment, subject to approval by the Fermilab PAC, under all budget scenarios considered by the panel.
- The intermediate budget scenario would allow in addition pursuing significant participation in one overseas next-generation B factory.
- The more favorable funding scenario, scenario C, would allow for pursuing a program in rare K decay experiments at Fermilab as well.

From MiniMac

MiniMac was appointed by the President

of INFN at end of June 2008

Mini Machine Advisory Committee

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

First meeting in July 16-17,2008

No glaring showstoppers

RECOMMENDATION:

Form a management structure!

Link to meetings and reports:

http://www.pi.infn.it/SuperB/reviews

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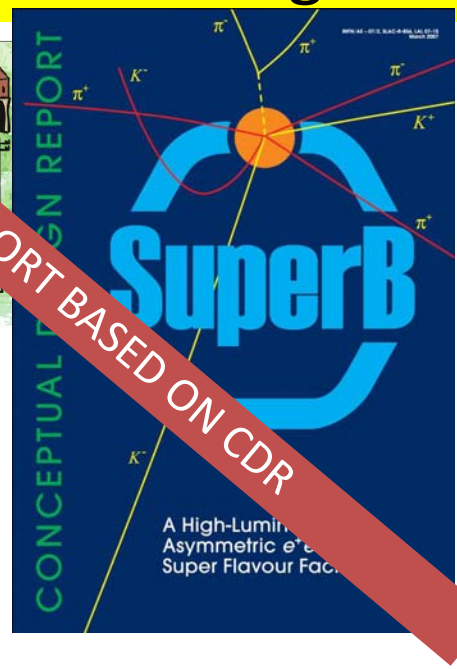
Presentations of the SuperB Project at ECFA meetings

Manchester ('07) :



Lisbon (March'08) :

Some Highlight on Physics Program
Quick update on Detector
Accelerator : preliminary results from test on Super*B* concepts in DaΦne upgrade at LNF.

RN (Nov28,2008):

The ECFA ad hoc Subcommittee:
T.Nakada(chair),Y.Karyotakis,F.Linde,B Spaan attended the May2008 SuperB Workshop in Elba and met with INFN Management and SuperB proponents in October 2008.

Quick update at CERN on Physics Program and Detector
Accelerator test results
Update on Process and Organization for TDR

ECFA report summary - 1

- We consider that **flavour physics should be seen as an important part of the European research programme of elementary particle physics**, complementary to physics provided by the energy frontier experiments. For the coming ~5 years, LHCb will do this job in the b and c quark sectors. To follow-up this progress, **collecting 50 ab**−1 **or more at** Υ**(4S) energy with e+e− storage rings by the end of the next decade would be a significant milestone, if this can be realised at a moderate cost**.
- The INFN Super Flavour Factory project team proposes a novel scheme to obtain luminosity of ≥1036 cm−2s−1, two orders of magnitude more than what has been achieved up to now, without increasing the beam currents. This is a distinct advantagefor some of the machine operation aspects and background to the experiment, as well as for the running cost of the machine. This idea of obtaining a high luminosity with tiny beam spots at the collision point based on very small emittance beams and crab waist collisions could revolutionize the design of the future colliders. **Therefore, westrongly support the R&D effort to see if such a machine can really be built.**

ECFA report summary –Part 2

- The current tests at DAFNE are promising and we would like to congratulate the team for this impressive achievement. **However, a substantial amount of work is still required for producing a Technical Design Report**, which will be a base for establishing an international consortium for the realisation of the project. **A strong core team of experienced accelerator physicists and engineers based at one location should be established already for the TDR work**. Without it, contributions from the various interested laboratories cannot be effectively utilized. **A strong team of experienced machine physicists will be needed also for the operation**. This machine has to achieve its design luminosity in order to be truly competitive.
- Given the complexity of the project, we feel that **a clear plan containing realistic technical milestones and resource requirements together with a strategy how to obtain them is needed as a necessary condition for an approval of the project**.
- Such a plan should aim at **obtaining an integrated luminosity of significantly more than 50 ab**$^{-1}$ **by not much later than the end of the next decade**. Given the very ambitious time scale, a clear decision taking process must be established soon.

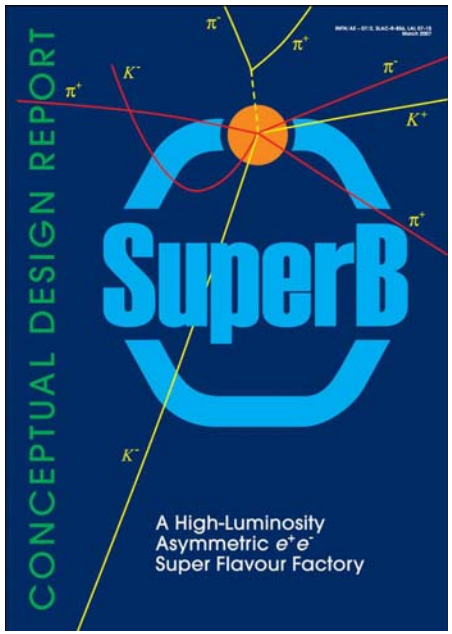
- project was presented at CERN Council in European Session.

- TDR phase was approved last December 2008 by the Board of Directors of INFN.

The document will be ready before the end of 2010

Physics

Physics goals have been discussed inside the SuperB community in the CDR published in May 2007 and in the proceedings of the Valencia SuperB Workshop in 2008 .It was reviewed in April 2008 by the IRC appointed by the President of INFN.



arXiv:0709.0451

Proceedings
of
SuperB Workshop VI

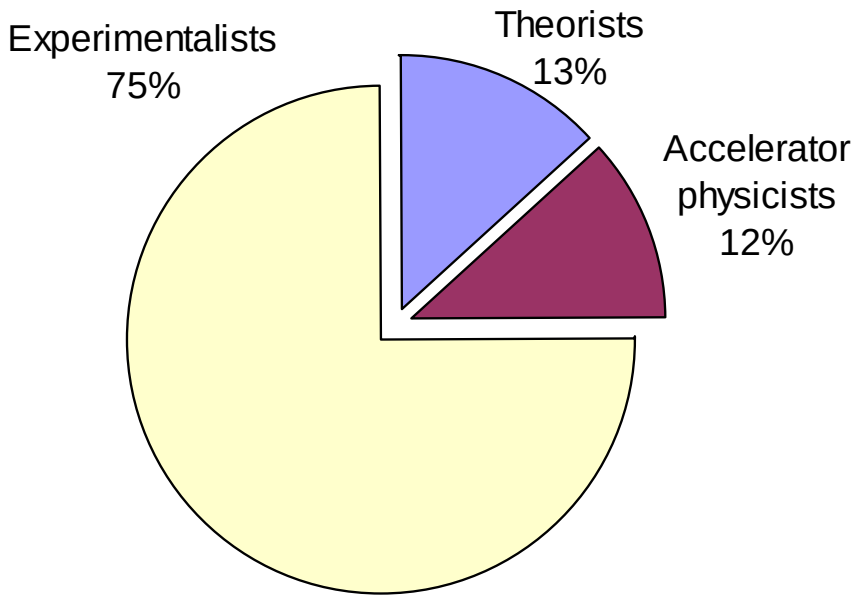
New Physics
at the
Super Flavour Factory

Valencia, Spain
January 7-15, 2008

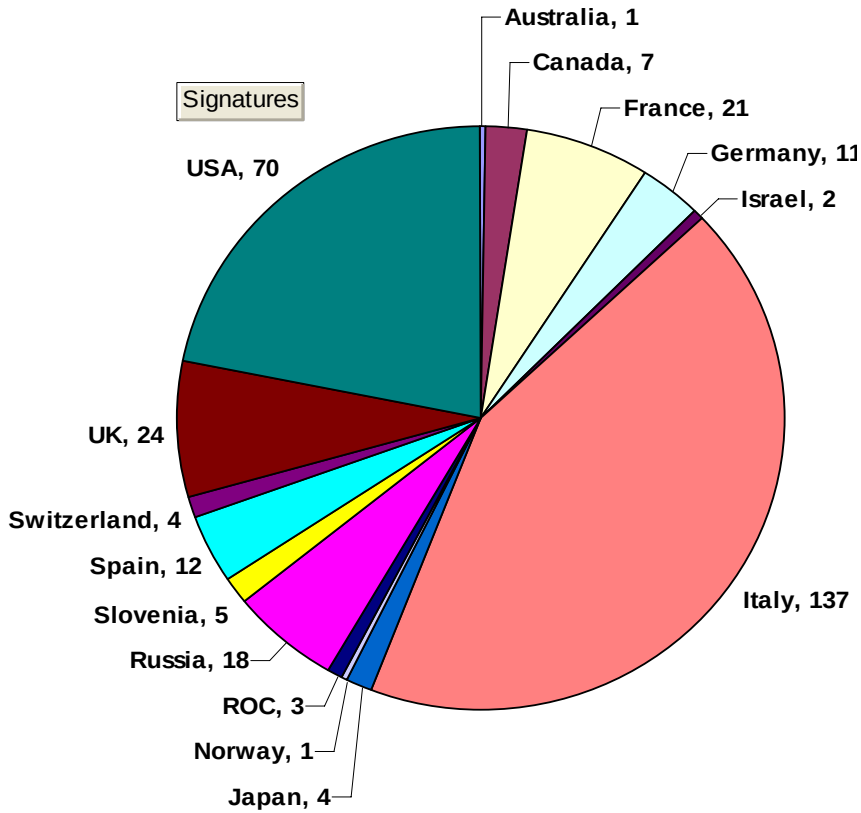
arXiv:0810.1312

CDR signatures: some numbers

- 320 Signatures
- About 85 institutions
- 174 Babar members
  - 65 non Babar exper.



Signatures breakdown by type



Signatures breakdown by country

Beyond SM

Flavor Physics : search for NP through VIRTUAL EFFECTS

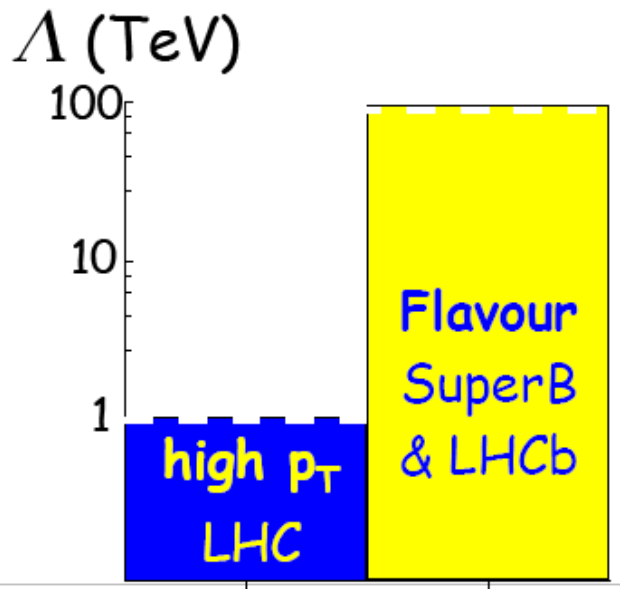
$$\mathcal{L}_{eff}^{NP} = \mathcal{L}_{SM} + \sum_k \left(\sum_i C_i^k Q_i^{(k+4)} \right) / \Lambda^k$$

New Physics effects in Flavor could come from :

- New Physics Scale Λ
- Effective Flavor Violating couplings

The "flavour problem":
if $\Lambda \approx 1$ TeV, $C's \ll 1$

The bright side:
flavour physics could probe NP scales beyond the reach of the LHC



See M.Ciuchini Talk at Orsay SuperB workshop. Feb.17,09

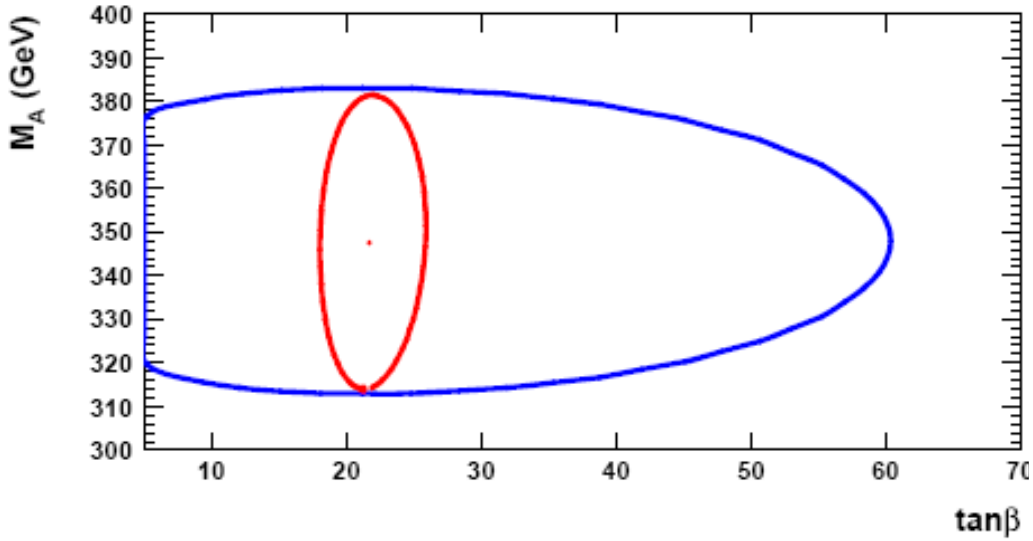
Physics Goals

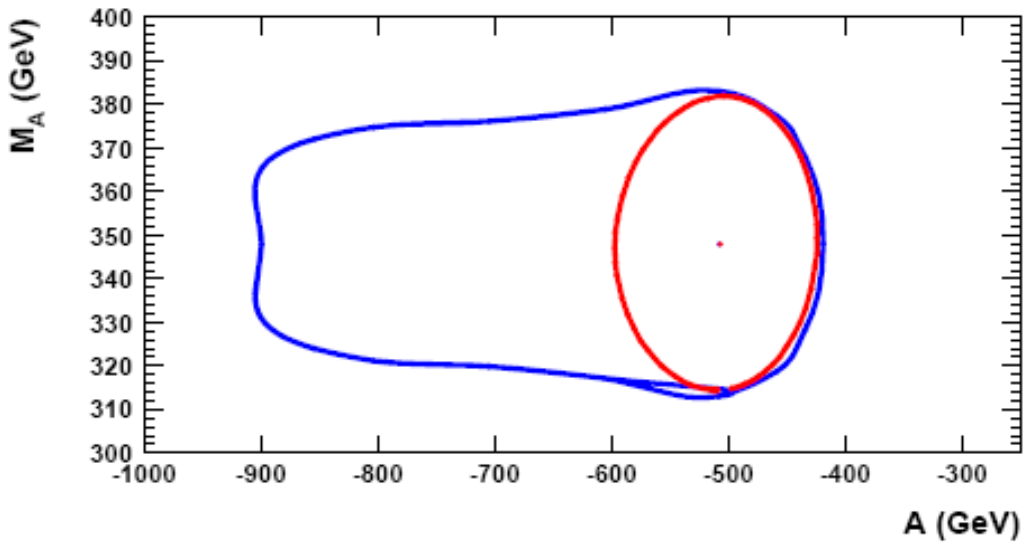
- Increase by O(10) the precision of BaBar &Belle (*)
- Challenge CKM at the level of 1% (*)
- τ LFV sensitivity improvement by a factor between 10 and 100.
- Explore T-violation in τ .
- Search for magnetic structure of τ .
- Explore CPV in Charm.
- Great new Spectroscopy exploration.

Beam Polarization option and possibility to run at charm threshold

It can be allowed with 75 ab^{-1} in 5 years at Y(4s) and a few months at Charm threshold with peak lumi of 10 ^{35} cm^2 s^{-1}.

COMPLEMENTARY: LHC and Flavour with 75 ab^{-1}





IF LHC DISCOVERS SUPERSYMMETRY

EXAMPLE FROM VALENCIA PROCEEDINGS

Red are LHC+EW constraints + SuperB

Blue is LHC alone

NOT ONLY LUMINOSITY !

SuperB Design has the unique possibility of running with one polarized beam and at charm threshold.

- Polarization is expected to contribute to tau physics .
- Low energy runs to add to potential discovery in Charm CP Violation.

In TDR these topics should be better addressed.

Specifications to hit the physics target
(NOT ONLY LUMINOSITY!)

- $L_{peak} \geq 10^{36}$ cm^{-2}s^{-1} (asymmetric 7.0+4.0 GeV $E_{cm} = m_{Y(4s)}$).
- 85% Polarization di e^- (7.0GeV) for τ :
  - T and CP Violation
  - BKG reduction in LFV, distinguish among LFV models.
  - τ g-2.
- Option to run *SuperB* still with a luminosity of 10^{35} cm^{-2}s^{-1} at charm threshold (4 .0 GeV) . Pure DD_{bar}, no additional fragmentation.
- High signal/bkg : optimal for channels with
- Quantum Coherence: unique opportunity to measure D^0-D^0_{bar}relative phase.
- ~10^9 DD /month at 10^{35} cm^{-2}s^{-1} . (using
  $\sigma(e^+e^- \rightarrow D^0D^0) \sim 3.6$ nb + $\sigma(e^+e^- \rightarrow D^+D^-) \sim 2.8$ nb ~ 6.4 nb as measured by CLEO-C)
- Misure dipendenti dTime dependent measurements at4 GeV as for B sector at Y(4s) in BABAR and Belle. I will be only possible at *SuperB.*

EXAMPLE FOR CHARM

Charm

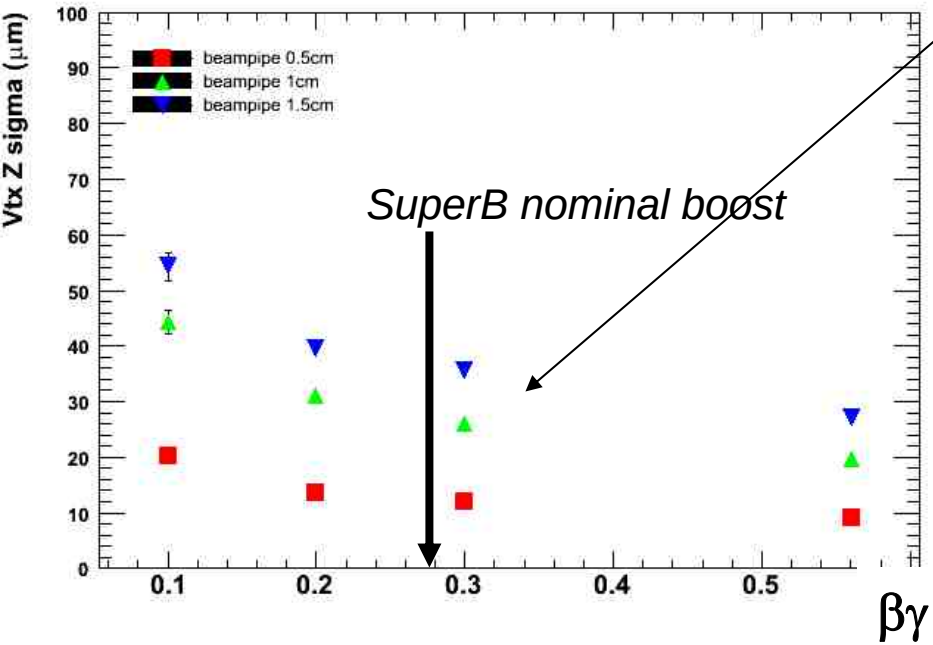
- Charm events at threshold are very clean: pure DD, no additional fragmentation
- High signal/bkg ratio: optimal for decays with neutrinos.
- Quantum Coherence: new and alternative CP violation measurement wrt to $\Upsilon(4S)$. Unique opportunity to measure D^0-D^0 relative phase.
- Increased statistics is not an advantage running at threshold: cross-section 3x wrt 10GeV but luminosity 10x smaller.
- SuperB lumi at 4 GeV = 10^{35} $cm^{-2}s^{-1}$ produces ~10^9 DD pairs per month of running. (using Cleo-c cross-section measurement

$\sigma(e^+e^- \rightarrow D^0D^0)$~3.6 nb + $\sigma(e^+e^- \rightarrow D^+D^-)$~2.8 nb ~ 6.4 nb)

- Time-dependent measurements at 4 GeV only possible at SuperB.

Time dependent measurements at DD threshold: only possible at SuperB

- Proper time resolution dominated by decay vertex resolution.
  - Production vertex precisely determined thanks to nm beamspot dimensions



SuperB lumi at 4 GeV = 10^{35} $cm^{-2}s^{-1}$
produces ~10^9 DD per month

$\beta\gamma ct = 0.28 \times 120\ \mu m \sim 30\mu m$

Average flight distance similar to vertex resolution → $\sigma_t \sim \tau$

Resolution is still adequate for time dependent measurements

$$\frac{\sigma_\tau}{\tau} \approx \sqrt{\frac{\tau^2 + \sigma_t^2}{N}} \approx \frac{\sqrt{2}\,\sigma_t}{\sqrt{N}}$$

Error on lifetime (wrt perfect resolution)

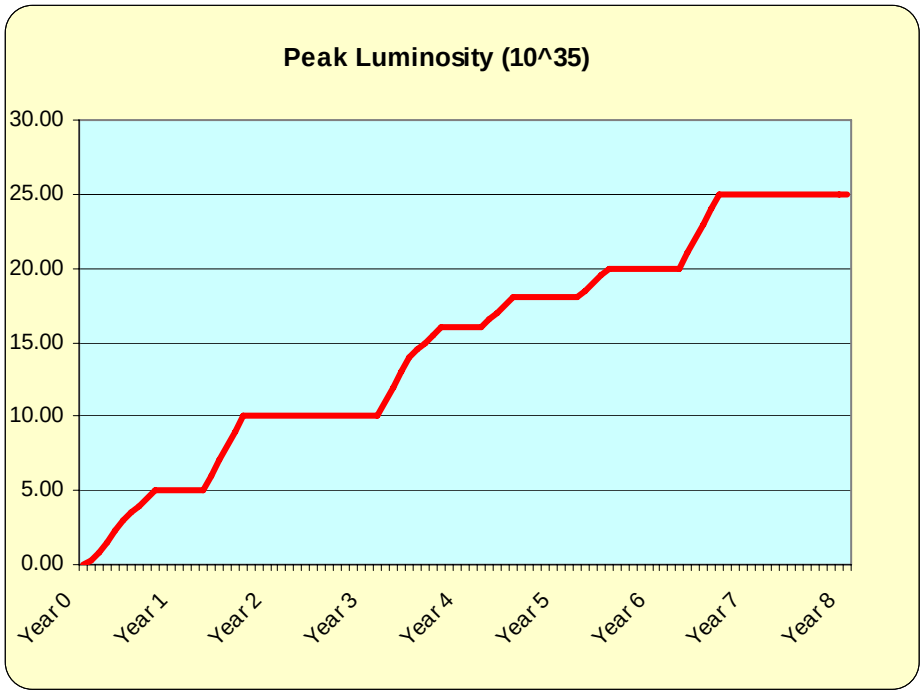
Crab Waist test was successful

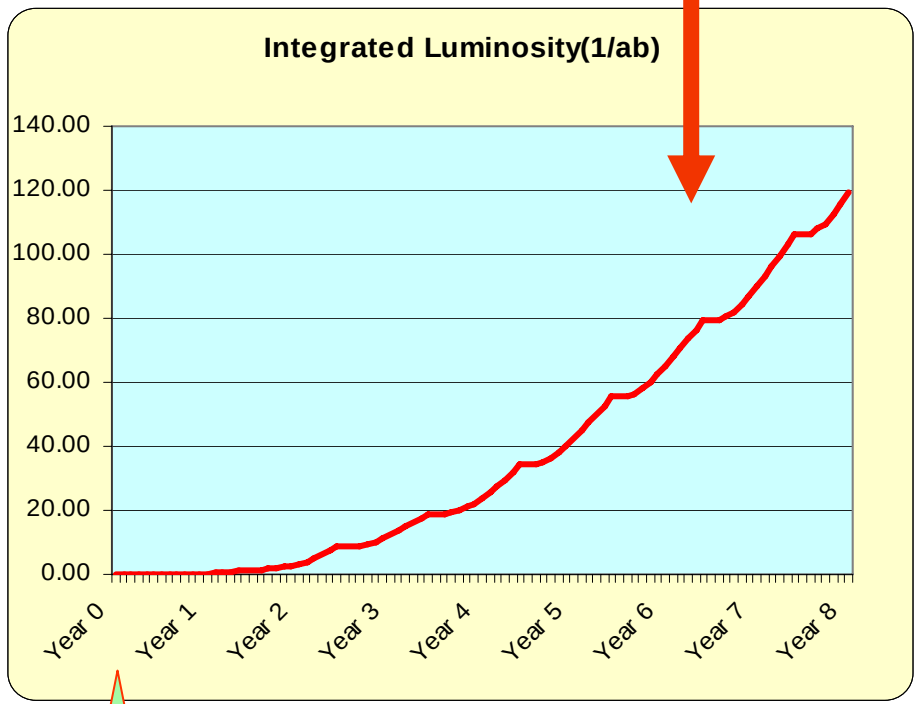
DaΦne test in Frascati very successful, the luminosity has grown by more than a factor 3 as expected from simulations.
All the results agree with beam beam simulations, now also with strong-strong

With 7th year integrated Luminosity can grow at rate of ~40 ÷ 60 ab^{-1}/year

expectation

>80ab-1 after 6 years

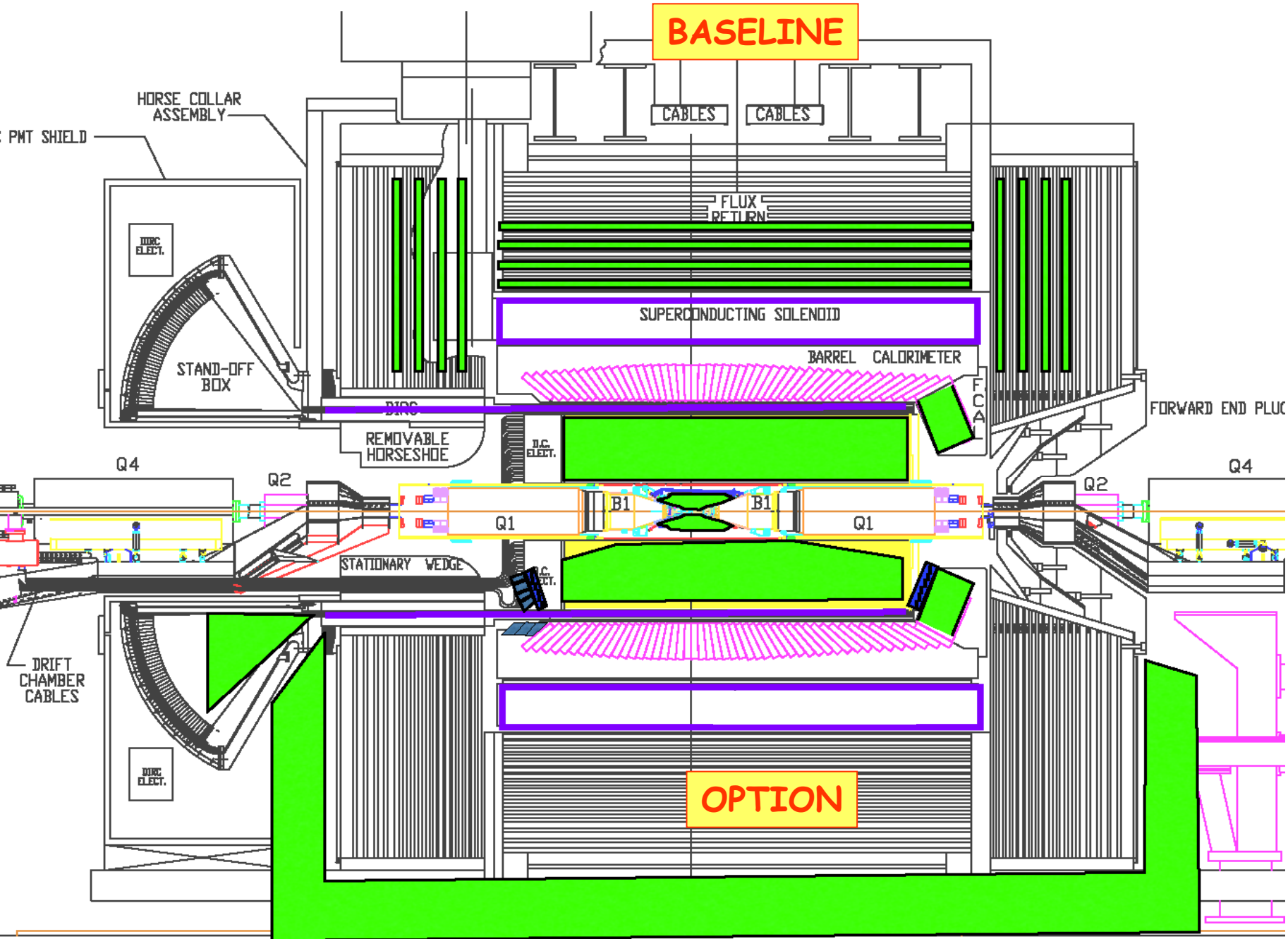




With more money a second interaction can be included in SuperB, without compromising on Luminosity!

2015 ?

Detector Layout – Reuse parts of Babar (or Belle)



Progress and Reuse

A lot of progress in Detector design including R&D.

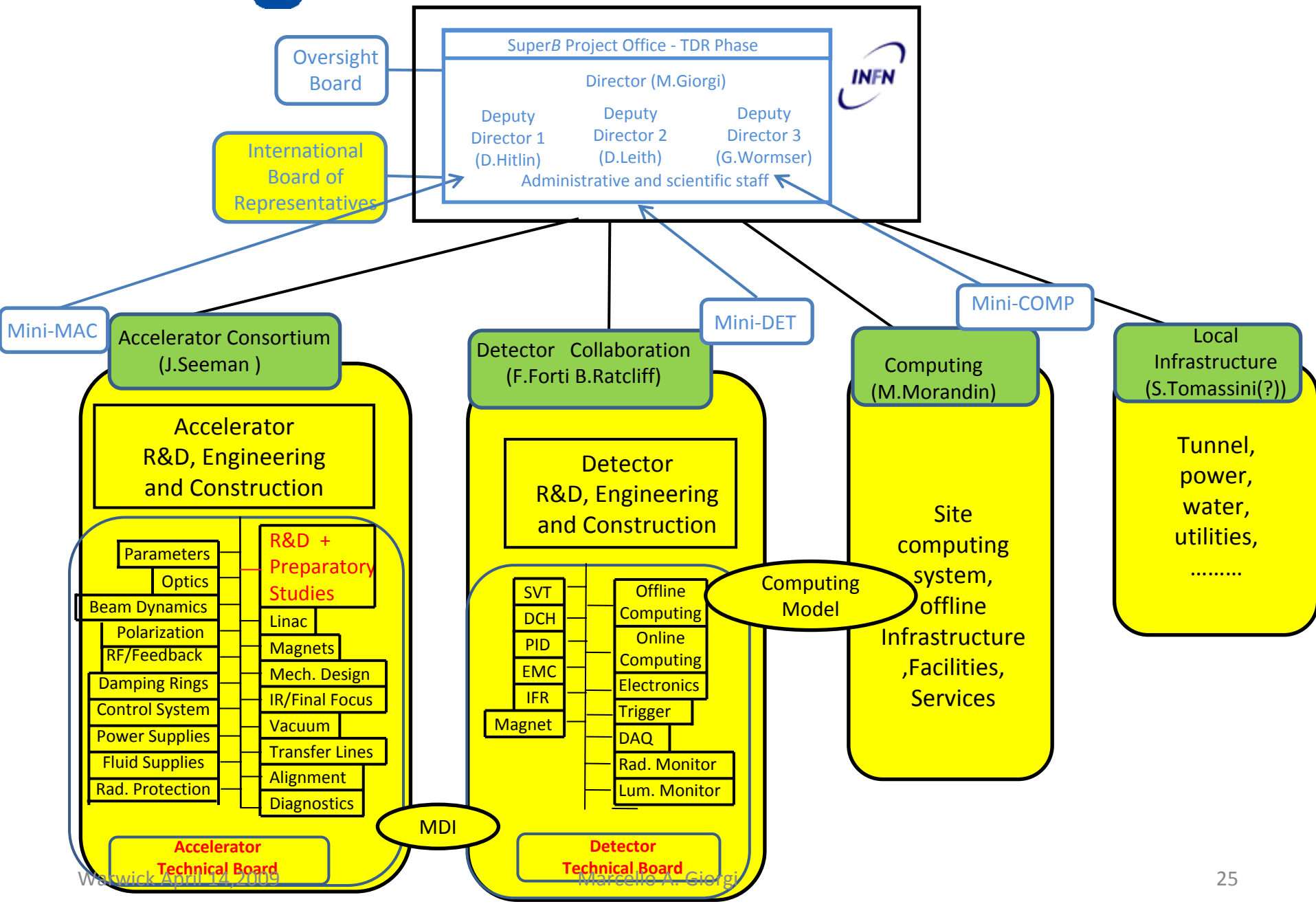
An ad hoc committee on geometry set up by Coordinators.

Reuse in SuperB of BABAR and PEPII will be defined soon. About PEPII there was a constructive interactions between INFN management and the SLAC Directorate.

D&D Review on March 23-24 at SLAC.

ORGANIZATION

Organization Chart for TDR Phase



Steering Committee

Since 2006 a Steering Committee is in place

M.G. (INFN Italy-Chair)
W.Gradl (Germany)
P.Harrison (UK)
D.Hitlin (USA)
H.Jawahery (USA)
D.Leith (USA)
E.Levichev(Russia)
F. Martinez-Vidal (Spain)
P.Raimondi (INFN Italy)
M.Roney (Canada)
G.Wormser (France)

+ Detector Coordinators +Accelerator Coordinators

This committee is in a restructuring phase and will evolve into the International board of representatives.

Detector (Proto) Technical Board

Detector Coordinators – B.Ratcliff, F. Forti
Technical Coordinator – W.Wisnieswki

- SVT – G. Rizzo
- DCH – G. Finocchiaro
- PID – N.Arnaud, J.Va'vra
- EMC – D.Hitlin → C.Cecchi, F.Porter
- IFR – R.Calabrese
- Magnet – W.Wisniewski
- Electronics, Trigger, DAQ – D. Breton, U. Marconi
- Online/DAQ –
- Offline SW –
  - Simulation coordinator – D.Brown
  - Fast simulation – M. Rama
  - Full Simulation – F. Bianchi
- Rad monitor –
- Lumi monitor –
- Background simulation & Machine Detector Interface –– M.Boscolo, E.Paoloni +M.Sullivan

Detector R&D

- Main parts of Babar to reuse
  - Quartz bars of the DIRC
  - Barrel EMC CsI(Tl) crystal and mechanical structure
  - Superconducting coil and flux return yoke.

Sys	R&D	Engineering
SVT	Layer 0 thin pixels Low mass mechanical support	Silicon strip layers Readout architecture
DCH	High speed waveform digitizing	CF mechanical structure Gas speed, cell size
Barrel PID	Photon detection for quartz bars	Standoff box replacement
Forw PID	Time of flight option Focusing RICH option	Mechanical integration. Electronics
EMC	LYSO characterization Light detection	Readout electronics Forward EMC mechanical support
IFR	Fiber disposition in scintillator	Location of photo-detectors
ETD	High speed data link Radiation hard devices	Trigger strategy Bhabha rejection

Resources for Detector and Computing

Item	Required man power person - months in 2 years				Physicists sou		Engineers sou		Tech sources		ComProf sou	
	Phys	Eng	Tech	ComPr	Avail	Miss	Avail	Miss	Avail	Miss	Avail	Miss
SVT	218	236	144	0	162	56	165	71	144	0	0	0
DCH	71	50	3	12	48	23	22	28	0	3	0	12
Barrel PID	149	45	12	4	85	64	20	25	10	2	0	4
Forw PID	165	33	5	4	85	80	21	12	5	0	0	4
EMC	162	102	65	0	64	98	26	76	26	39	0	0
IFR	95	29	33	0	39	56	29	0	33	0	0	0
ETD	84	114	0	0	6	78	10	104	0	0	0	0
Comp	164	0	8	161	98	66		0	8	0	29	132
TOTAL (mm)	**1108**	**609**	**270**	**181**	**587**	**521**	**293**	**316**	**226**	**44**	**29**	**152**
FTE (2 yrs)	**46.2**	**25.4**	**11.3**	**7.5**	**24.5**	**21.7**	**12.2**	**13.2**	**9.4**	**1.8**	**1.2**	**6.3**

Comment: We don't consider at the moment the need for hiring engineers for detector outside the present institutions that are taking commitments in SuperB.

About experimentalists:we are verifying the interest of people already in SuperB, that have not yet chosen the detector subsystem . We estimate however the need to recruitment about 10 postdocs..

Computer manpower (mostly postdocs) are needed quite soon.

Accelerator responsibilities (already assigned)

Linac: Boni/Seeman
Parameters: Raimondi/ Seeman
Magnets: (LNF)/XX
Optics: Biagini/Wienands
Mechanical Design: Tomassini/XX
Beam Dynamics: Zobov/Novokhatski
IR/Final Focus: Sullivan/Raimondi
Polarization: Wienands/Wittmer
Vacuum: (LNF)/ XX
RF/Feedback: Drago/Bertsche
Damping Rings/Transfer Lines: Guiducci
Alignment: Sgamma/XX
Control System: Stecchi/ XX
Diagnostics: Serio/XX
Power Supplies: Ricci/ XX
Fluids: Pellegrino/ XX
Rad. Protection: Esposito/ XX

Beyond Italy and USA the inventory of available resources is in progress and the assignment of responsibilities is not yet final.
From a recent meeting in France we know that a total of 8.5 FTE for accelerator are available from Annecy,Orsay and Saclay.

Recruitment is going on:
8 FTE from Novosibirsk
We expect soon to finalize the participation from UK and Canada.

Accelerator and Facilities Contributors (in progress)

Project Oversite	Seeman
	Raimondi
Accelerator Physics	Raimondi
	Variola
Magnets	Sanelli
Mechanical design	Tomassini
	Kharakh
Reused components	Sullivan
	MacFarlane
	Kharakh
Parameters	Raimondi
	Seeman
Diagnostics	Serio
	Wittmer
Power supplies	Ricci
Beam dynamics	Zobov
	Novokhatski
	Nikitin
Mechanical design	Tomassini
	Kharakh
Reused components	Sullivan
	MacFarlane
	Kharakh
Parameters	Raimondi
	Seeman
Diagnostics	Serio
	Wittmer
Power supplies	Ricci

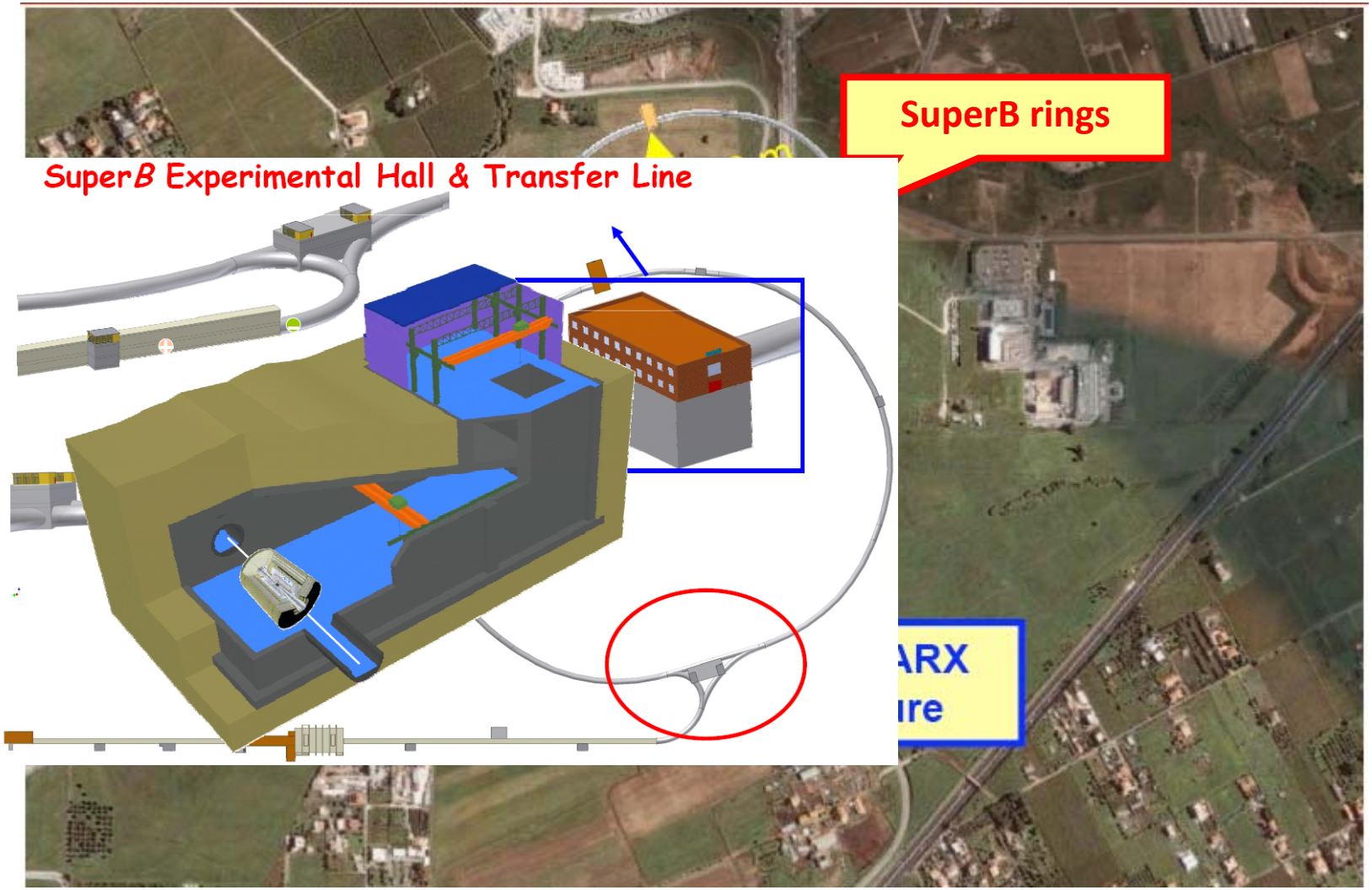
Beam dynamics (alread	Zobov
	Novokhatski
	Nikitin
	Boscolo
	Demma
Vacuum	Clozza
	Lollo
	Kharakh
RF/Feedback	Drago
	Bertsche
Alignment	Sgamma
Control system	Stecchi
Cooling systems	Pellegrino
Parameters	Raimondi
	Seeman
Radiation monitoring	Esposito
Polarization	Wienands
	Cai
IR/Final Focus	Sullivan
	Raimondi
	Paoloni
Damping rings and transport lines	Guiducci
	Yocky
Beam-beam simulations	Piminov
	Levichev
	Shatilov

Accelerator and Facilities Contributors

Italy area coordinator	Marica Biagini	LNF INFN
	Pantaleo Raimondi	LNF INFN
UK area coordinator	Gabriele Bassi	Cockroft
France area coordinator	Alessandro Variola	IN2P3 LAL
United States area coordinator	Michael Sullivan	SLAC
	John Seeman	SLAC
Russia area coodinator	E. Levichev	BINP
Project oversite	John Seeman	SLAC
	Pantaleo Raimondi	LNF INFN
Accelerator physics overview	Pantaleo Raimondi	LNF INFN
	Alessandro Variola	Orsay
	Uli Wienands	SLAC
Alignment	Sgamma	LNF INFN
Beam-beam simulations	Piminov	BINP
	E. Levichev	BINP
	D. Shatilov	BINP
	Mikhail Zobov	LNF INFN
Beam dynamics	Alexander Novokhatski	SLAC
	Manuela Boscolo	LNF INFN
	Theo Demma	LNF INFN
	Mauro Pivi	SLAC
	Olivier Napoly	IRFU-LAPP
	J. M. DeConto	IN2P3 LAL
	A. Chance	IRFU Saclay
Control system	Stecchi	LNF INFN
Cooling systems	Pellegrino	LNF INFN
Cryogenics	J. Wiesend	SLAC
Damping rings and transport lines	Susanna Guiducci	LNF INFN
	Gerry Yocky	SLAC
Diagnostics	Mario Serio	LNF INFN
	Walter Wittmer	SLAC
Dynamic Aperture	E. Levichev	BINP
	Gerry Yocky	SLAC
Interaction region and final focus	Michael Sullivan	SLAC
	Pantaleo Raimondi	LNF INFN
	Eugenio Paoloni	Pisa
	Simona Bettoni	CERN
Linac-Injection	Roberto Boni	LNF INFN
	John Seeman	SLAC
Low Level RF	Tourres	CNRS LPSC
Machine detector interface	Michael Sullivan	SLAC

Magnets	Sanelli	LNF INFN
	Miro Preger	LNF INFN
	Nanyang Li	SLAC
Mechanical design and systems	Sandro Tomassini	LNF INFN
	David Kharakh	SLAC
	Francesco Sgamma	LNF INFN
	Giancarlo Sensolini	LNF INFN
	Marco Esposito	LNF INFN
Optics-lattice-tuning	Marica Biagini	LNF INFN
	Walter Wittmer	SLAC
	Uli Wienands	SLAC
	Martin Donald	SLAC
	Yuri Nosochkov	SLAC
	Andy Wolski	Cockroft
Parameters	Pantaleo Raimondi	LNF INFN
	John Seeman	SLAC
PEP-II reused components	Michael Sullivan	SLAC
	David MacFarlane	SLAC
	David Kharakh	SLAC
Polarization	Uli Wienands	SLAC
	S. Nikitin	BINP
	Yunhai Cai	SLAC
	Alex Chao	SLAC
	M. Baylac	IN2P3
	J. M. DeConto	IN2P3
	Gomez	CNRS LPSC
Positron source	A. Variola	IN2P3 LAL
	F. Poirier	IN2P3 LAL
	R. Chehab	IN2P3 LAL
	J. Bonis	IN2P3 LAL
	G. Lemeur	IN2P3 LAL
	F. Touze	IN2P3 LAL
Power supplies	Ricci	LNF INFN
	A. Di Lira	SLAC
Radiation monitoring	Esposito	LNF INFN
RF and feedback	Allesandro Drago	LNF INFN
	Kirk Bertsche	SLAC
IR stabilization	A. Jaremie	CNRS LAPP
Vacuum	Clozza	LNF INFN
	Lollo	LNF INFN
	David Kharakh	SLAC
	C. Prevost	IN2P3 LAL
	B. Mercier	IN2P3 LAL

SuperB on Tor Vergata site



Meanwhile in KEK…

We have understood that in KEK are now considering an alternative design not entirely based on “BRUTE FORCE”.
Nanobeams are considered in a scheme that is named “italian” or “half-italian”.
It is a good news for us since it is a further validation of SuperB approach.
I invited A.Suzuki or a person designated by him from KEK to come to our next general meeting and discuss with us their new strategy towards SuperKEKB.

NEXT SuperB EVENTS

LNF April 23-24,2009 –MiniMac (J.Dorfan)

Perugia June 16-20- General Meeting (Claudia Cecchi is the meeting coordinator).

SLAC October 5-9 – General Meeting

Intermediate document ready by December 2009.

END