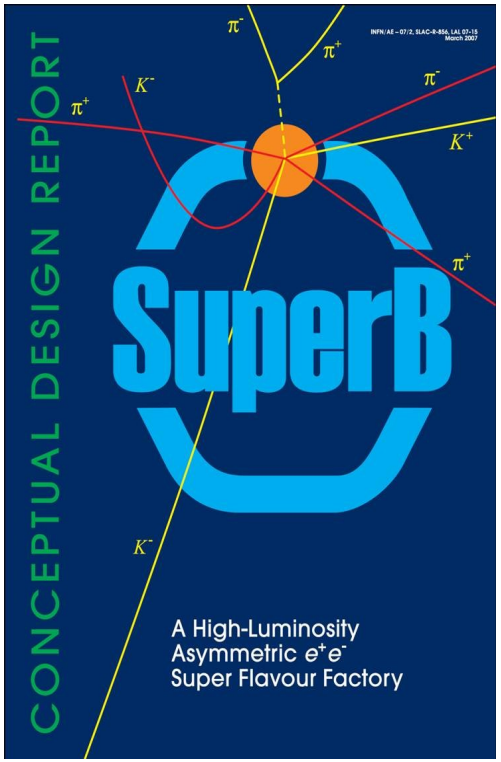
Ferrara, 9-12 March 2010

SuperB Computing R&D Workshop

M. Morandin – INFN Padova

What we would like to build

- **an asymmetric flavour factory with a two-order of magnitudes jump in performance**
  - **luminosity x O(100) w.r.t. B-Factories**
    - $L_{inst} = 10^{36}\ cm^{-2}s^{-1}$
    - $L_{int} = 75\ ab^{-1}$
    - $N_{BB} = N_{\tau\tau} = 7.5x10^{10}$
  - **flexible parameter choice**
  - **high reliability**
  - **longitudinally polarized beam (e-) at the IP (>80%).**
  - **ability to collide at the charm threshold.**

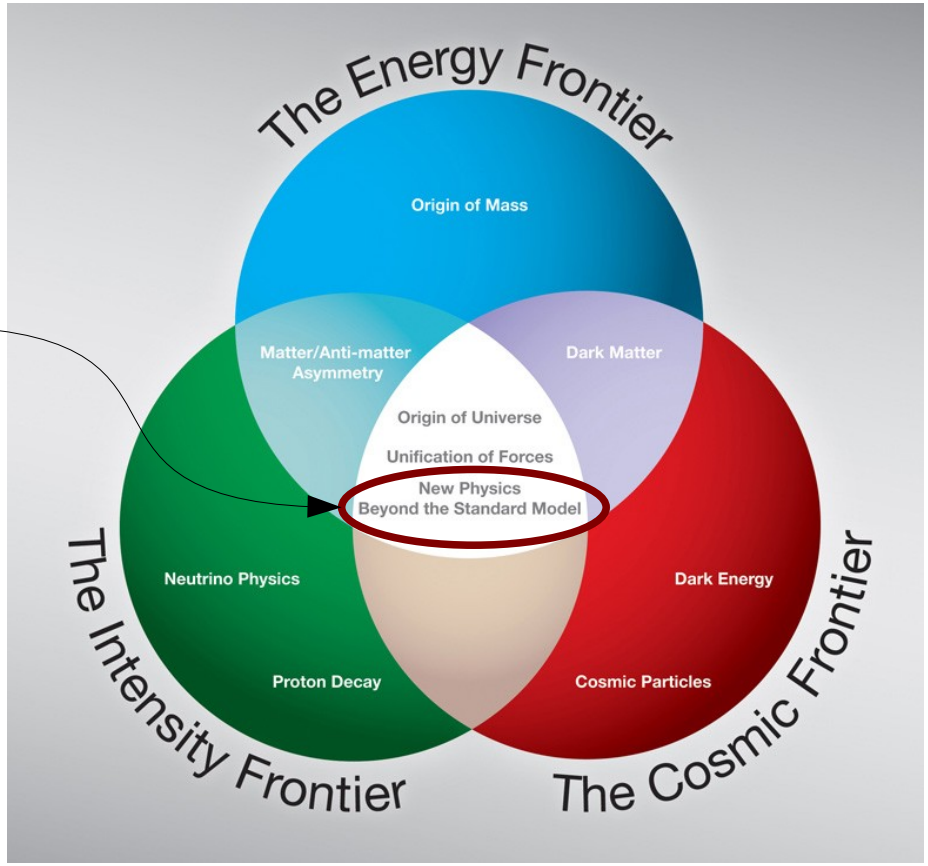


- **with the effort of a large international collaboration:**
  - **Italy, US, Russia, UK, France, Switzerland,**

The landscape

We need to attack the big questions from all sides

SuperB



The SuperB mission

NP(Λ) found at LHC

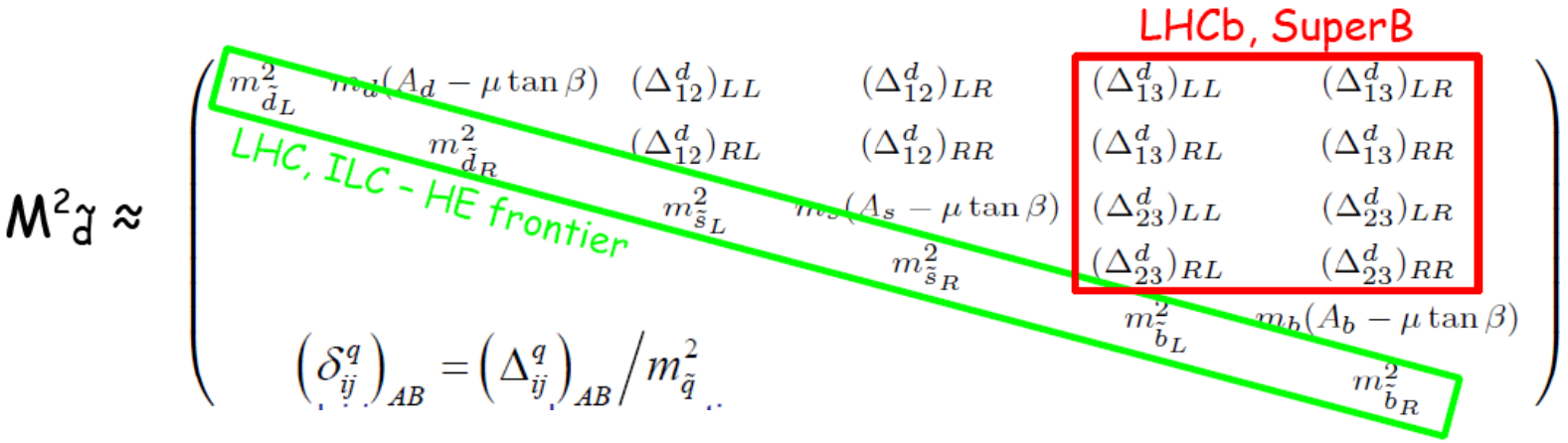
* determine the NP FV and CPV couplings
* look for heavier states
* study the flavour structure of NP

NP(Λ) not found at LHC

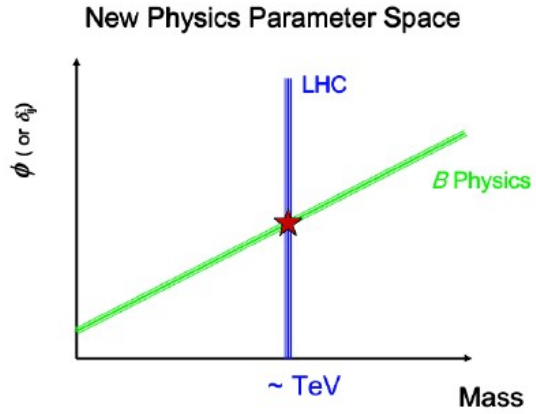
* look for indirect NP signals
* understand where they come from
* exclude regions in the parameter space

LHC complementarity

- **If new states (es. SUSY) are identified at LHC**
  - **SuperB can elucidate the flavor structure of NP with precision measurements**



- **and determine the coupling coefficients as it happened with the CKM matrix**



the SuperB breakthrough

SuperB has made the dream become real

		PEP-II		Super KEK-B '05 (0.4×10^{36})		Super PEP-II '05 (10^{36})		Super-B (10^{36})	
		LER	HER	LER	HER	LER	HER	LER	HER
Energy	(GeV)	3.1	9	3.5	8	3.5	8	4	7
Current	(A)	2.9	1.8	9.4	4.1	23	10	2.3	1.3
HOM losses	(MW)	0.8	2.1	9.0		17.8	2.9	2.3	2.1
SR losses	(MW)	1.6	5.7	26.0		22.3	22.0	4.4	4.3
RF AC power (50% eff.)	(MW)	4.9	15.6	73.0		80.3	49.8	13.4	12.7

our Japanese colleagues have recently realized this too

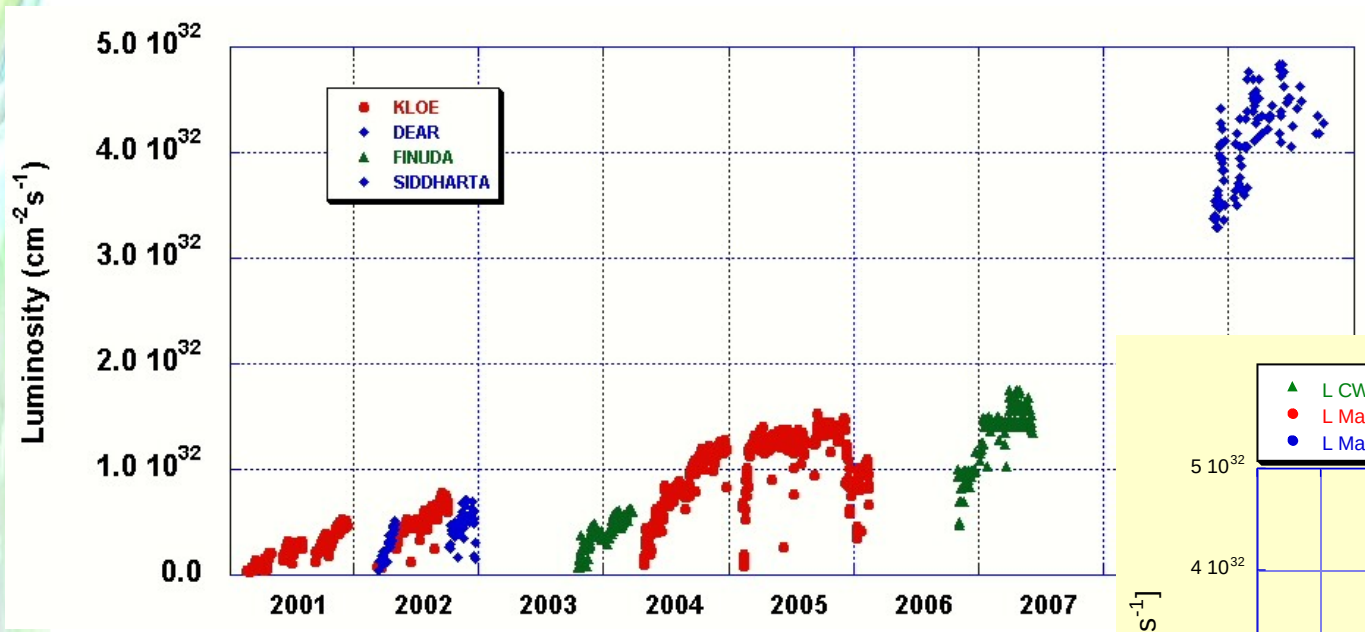
The SuperB breakthrough

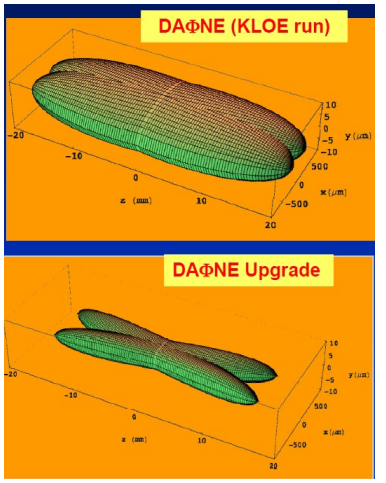
Thigher focus on beams at IP and a “large” crossing angle (large Piwinski angle) + use a couple of sextupoles/ring to “twist” the beam waist at the IP

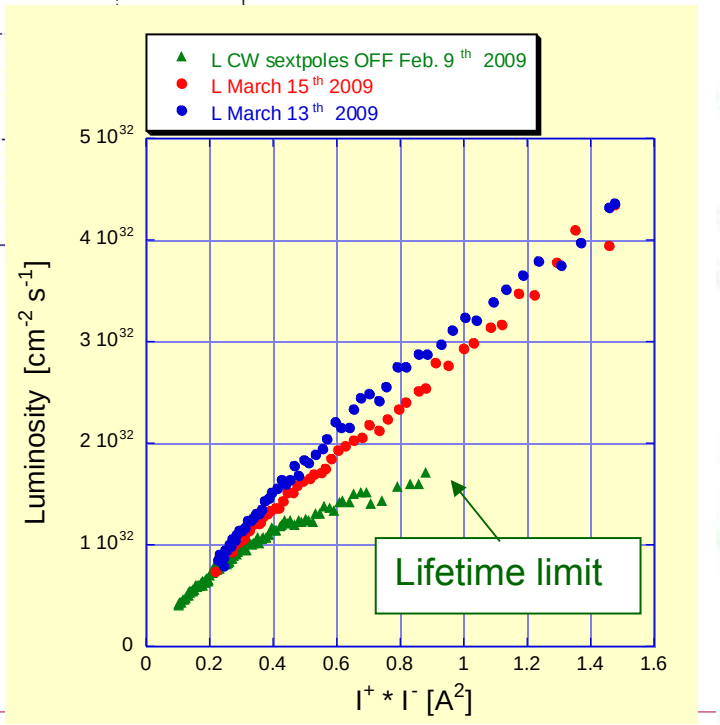
- Ultra-low emittance
- Very small β^* at IP
- Large crossing angle
- “Crab Waist” transformation
- Small collision area
- Lower β^* is possible
- NO parasitic crossings
- NO x-y-betatron resonances

1. *P.Raimondi, 2° SuperB Workshop, March 2006*
2. *P.Raimondi, D.Shatilov, M.Zobov, physics/0702033*

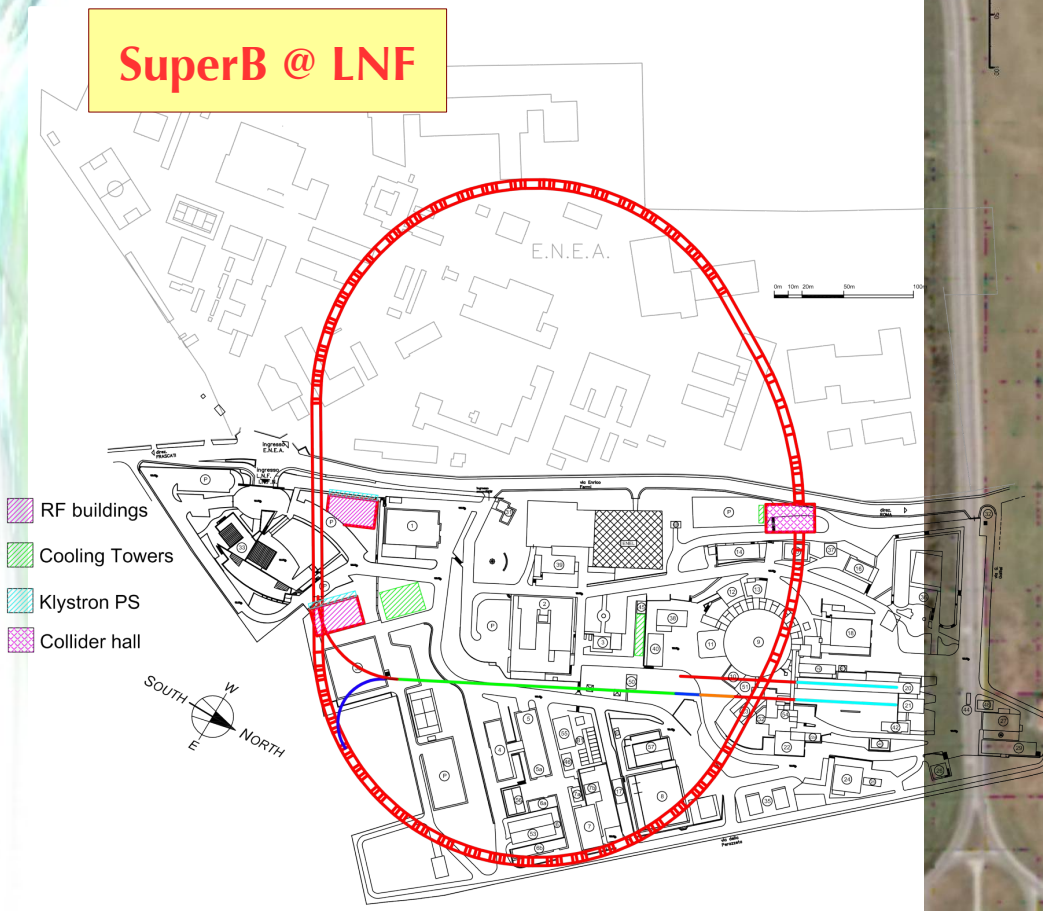
Dafne as Proof of principle

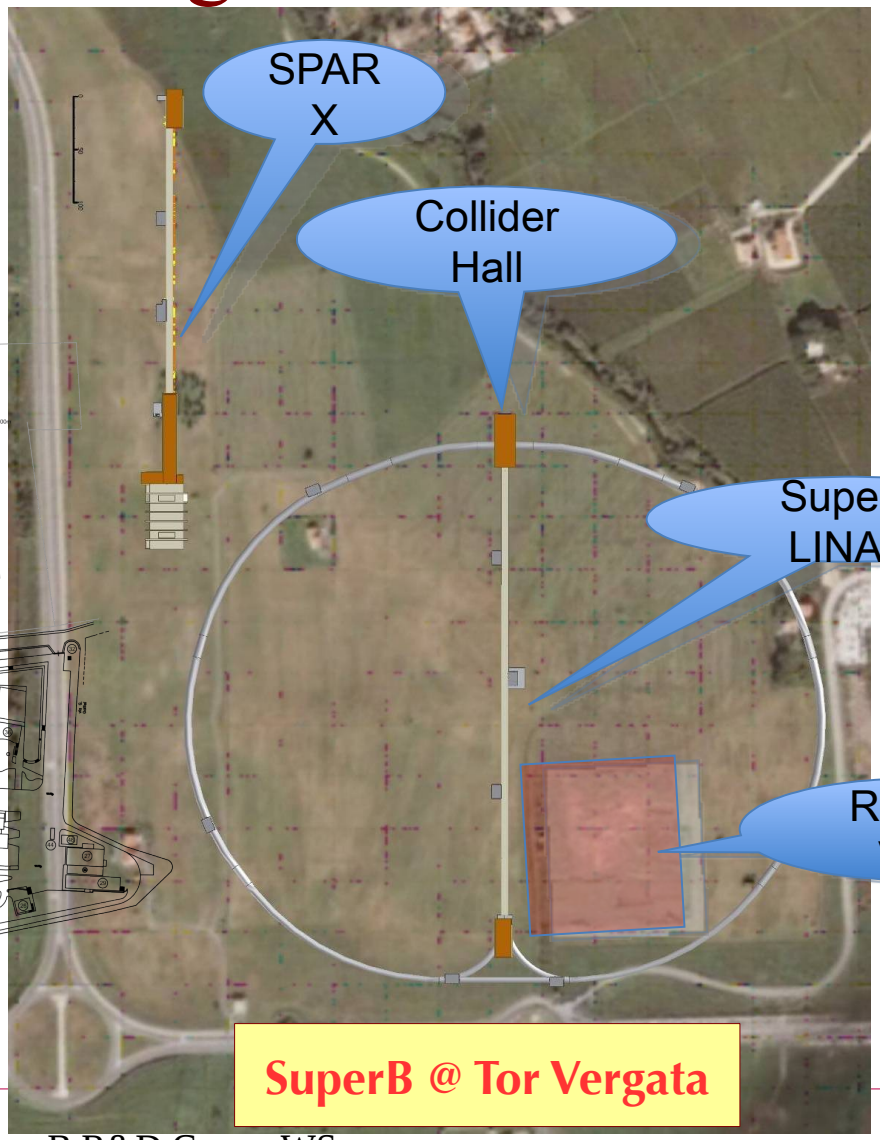






Site: options being studied

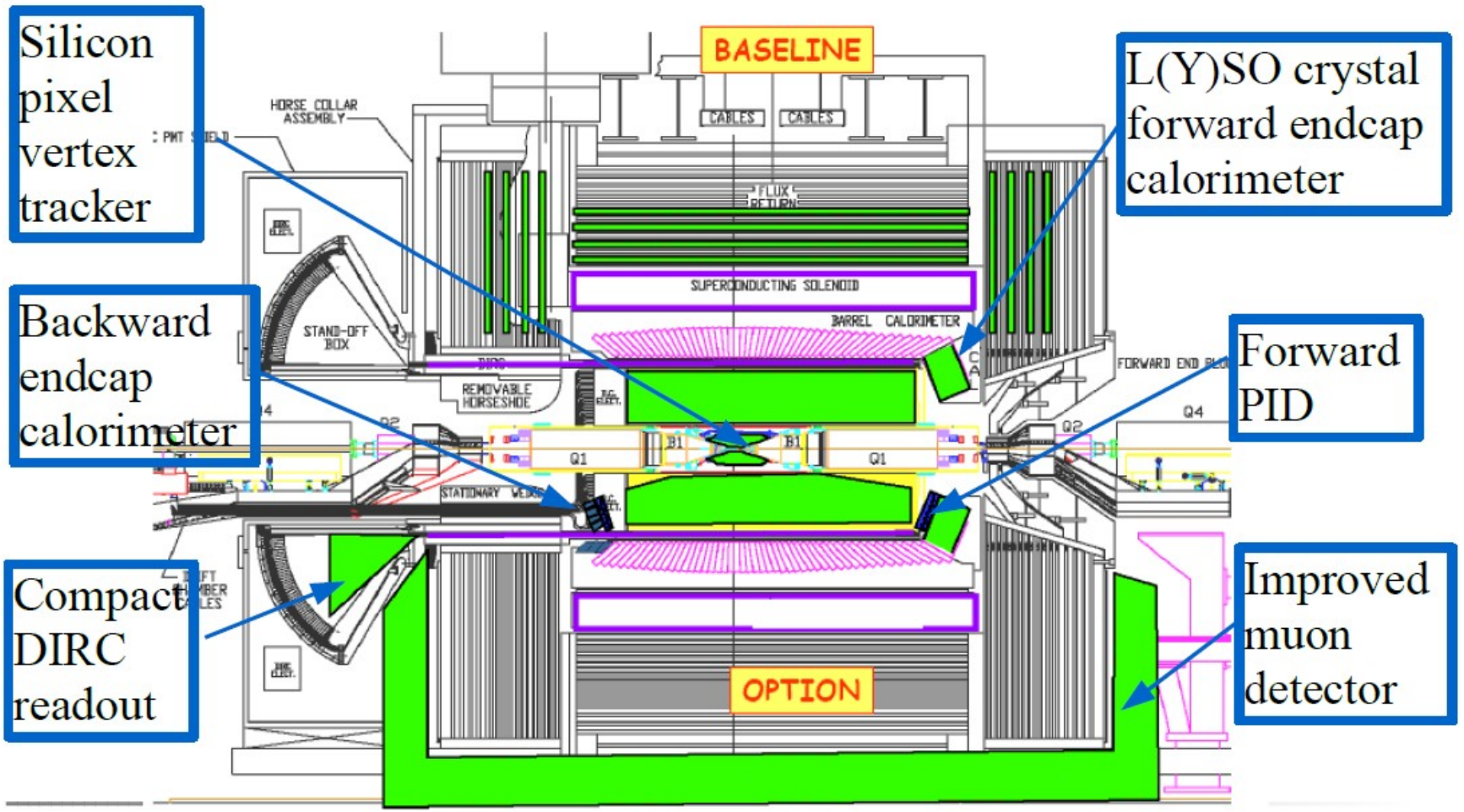




The SuperB detector

- **Babar and Belle designs have proven to be very effective for B-Factory physics**
- **Follow the same ideas for SuperB detector**
  - **Try to reuse same components as much as possible**
- **Main issues:**
  - **Machine backgrounds – somewhat larger than in Babar/Belle**
    - **affects mainly SVT layer 0 design**
  - **crossing angle should help w.r.t. current PEP-II I.R.**
    - **but dipole component act on one of then beams passing off-axis through the closest quadrupoles**
  - **Beam energy asymmetry – a bit smaller**
    - **smaller bean pipe and improved SVT resolution needed to preserve vertex z reconstruction performance**
- **Strong interaction with machine design**

The SuperB detector



Current detector related activities

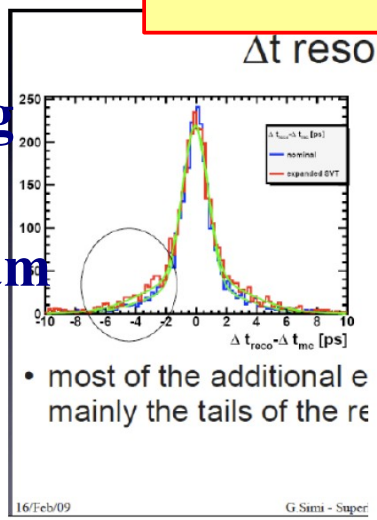
- **Geometry task force setup**
  - **brand new Fast Montecarlo developed for SuperB is being used**
  - interfaced to BaBar analysis tools
- **Background studies and detector optimization with full simulation ongoing**
- **R&D detector activities**
- **Electronics/DAQ design team well established**
- **Computing group being consolidated**
  - **work on SuperB computing model will start soon too**

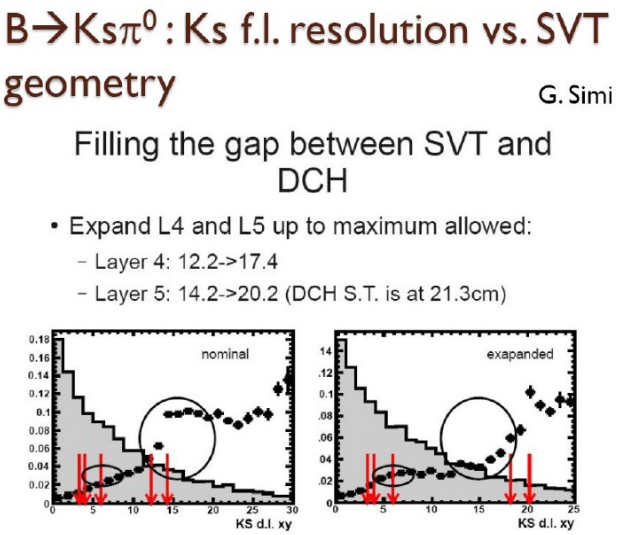
do we need a forward PID(eventually backward) ?

do we need a backward EMC ?

amount of absorber in the IFR ?

internal geometry ofSVT / Space between SVT and DCH





Recent SuperB project progress (I)

- **March 2007: Conceptual Design Report**
- **2008:**
  - **tests performed at the Dafne e+e- collider confirmed the most innovative aspects of the SuperB machine design (“crab waist”)**
  - **international CDR review outcome very positive**
  - **ECFA report also recommended to ahead**
  - **on December 1998, INFN approved the beginning of the TDR phase**

Recent SuperB project progress (II)

- **2009**
  - **March: meeting at LNF of the European Laboratory Directors, promoted by the Strategy Group, to discuss participation in SuperB. Directors expressed their support.**
    - **Two French Directors and the CERN Research Director indicated their willingness to provide people to participate in the TDR phase of the project**
  - **summer: the INFN Superb Project was submitted to the Italian Inter-ministerial Committee for the Economic Planning**
    - **the project has been vigorously supported by the Minister for Education, University and Research**
    - **in France, IN2P3 has approved participation in the SuperB TDR phase**
    - **groundwork for approval of participation from other countries (US, Canada, ….) is underwaythe**

Recent SuperB project progress (III)

- **2010**
  - **INFN President will present the status of the approval process at the CERN Council Meeting next week**
  - **we are expecting in that occasion a clear indication of the governmental willingness to give green light to the project**
  - **Intermediate document (Status Report) foreseen for Spring 2010**
    - **Preliminary budget and schedule**
  - **Technical Design Report foreseen by the end of 2010.**
    - **Full technical detail (blueprint for constrution)**
    - **Baseline budget and schedule**
    - **No (or very very few) options open**
    - **Good for a full technical review**

SuperB computing (I)

Computing at SuperB is going to be a big enterprise

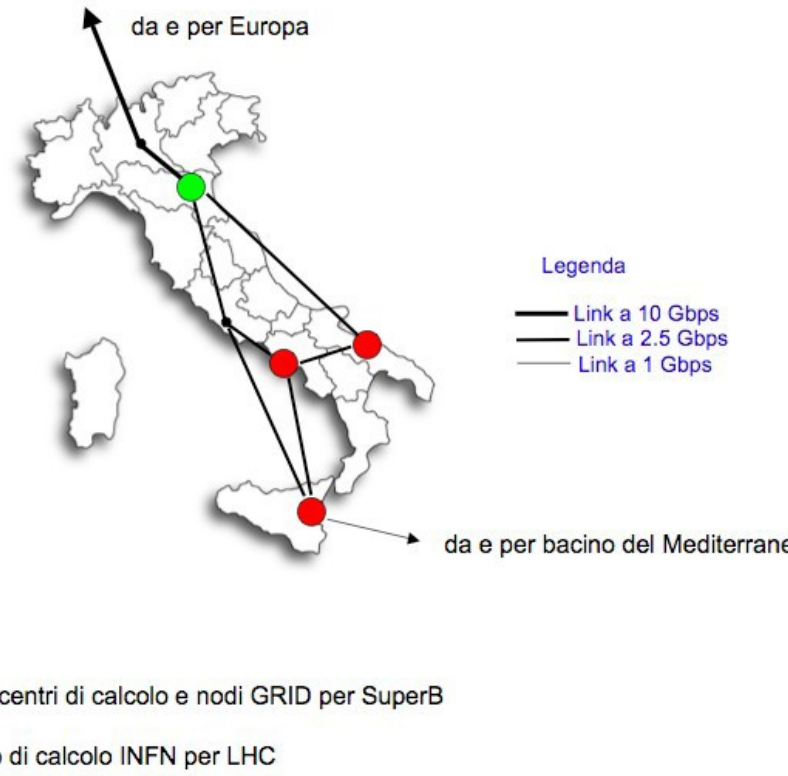
- **in a typical data taking year, computing resources needed by SuperB will be comparable to the current (2010) ones of Atlas or CMS (see F. Bianchi's talk later)**

The big effort up to now went into providing the simulation and analysis tools needed for the development of the Detector TDR

- **Fast + Full simulation tools**
- **production system has been setup**
- **large coordinated productions on the GRID**

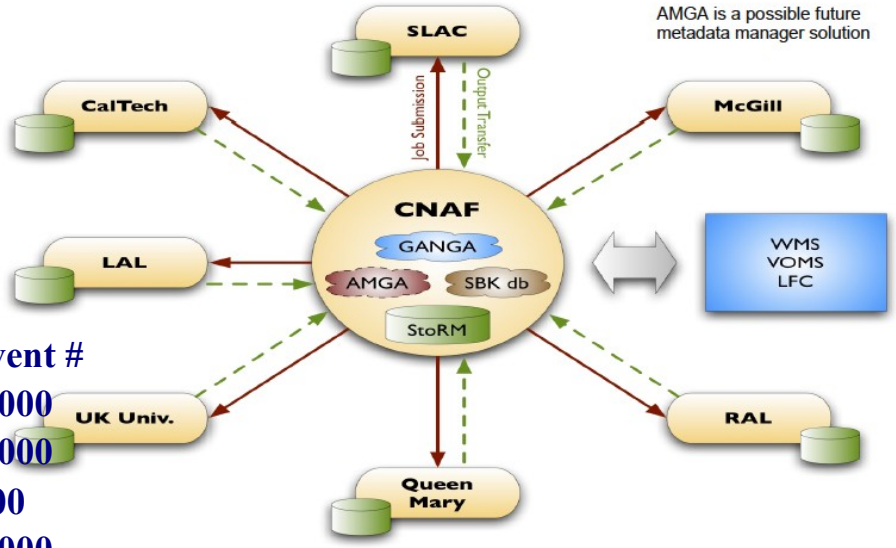
SuperB Computing local impact

- **Computing infrastructures are of strategic value for fostering scientific, technological and economic development**
- **SuperB, with its large demand of computing resources and advanced services, will provide a unique opportunity of consolidation and growth for the network and computing infrastructures of the Southern part of Italy**



Production in the last three weeks

- **Full Sim:**
  - **Full Simulation (Bkg frames for Fast Sim): 10^6 events**
  - **Full Simulation for background studies: 8x10^5 events**
- **Fast Sim:**
  - **Generics w/o bkg mixing: 10^9 events**
  - **Generics w/ bkg mixing: 10^8 events**
  - **Analysis BtoTauNu: 3x10^6 events**
  - **Analysis BtoKstarNuNu: 6x10^6 events**
  - **Analysis KplusNuNu: 6x10^7 events**
  - **Analysis BtoKNuNu: 6x10^6 events**



	Job #	Event #
• GRIF (LAL)	2081	183650000
• IN2P3-CC	4457	383930000
INFN-BARI	29	2850000
• INFN-LNL-2	1214	120070000
• INFN-PISA	2505	183310000
• INFN-T1	4143	284660000
• SLAC	699	69900000
• UKI-LT2-QMUL	3672	337745000
• UKI-SOUTHGRID-RALPP	1217	94025000

SuperB computing (II)

… but we have also been planning the future computing model

- **a computing planning groups was formed some time ago**
- **a timeline for the development and implementation of the SuperB computing model was defined**
  - **phase 1 [2009-2011]: R&D work, computing model design**
  - **phase 2 [2012-2013]: base computing model implementation**
  - **phase 3 [2014-2015]: consolidation, tests**

Phase 1: [mid-2009 --> mid-2011]

- **major R&D program for SuperB computing;**
  - **invitation to new people and new ideas;**
- **continued support and development of simulation tools for TDR and subsequent detector development; physics-book-type activity**
- **designing for performance is a major cross-cutting goal;**
  - **training available for project participants**
- **formal SuperB project should start during this phase**
- **computing TDR should be complete by the end of 2011**

Phase 2: [mid-2011 --> end-2013]

- **integration of R&D program results into a complete SuperB software system;**
- **major online software development gets under way;**
- **series of data challenges**
- **End of phase 2:**
  - **fully-functional beta of SuperB offline computing, usable for physics studies;**
  - **retirement of the phase-0 simulation tools**

Phase 3: [end-2013 --> 2015]

- **tests and development;**
- **converging on final full-scale system;**
- **acquisition of hardware;**
- **use of online system for detector integration, cosmics, commissioning**
- **first beams**

Reality check

1992/ 1993	**Blue-sky computing R&D; C++ experiments (e.g., gismo); ASLUND and other Fortran simus for det. design**	**fast and full sim tools developed, production infrastructure setup**	2009
end-of-1993/ 1994	**Project start / collaboration formed**	**definition of R&D Plan; start of R&D activities; detector and machine TDR**	2010
1995	**RJ appointed reco manager; rough design; freeze for overall computing design; TDR**	**completion of R&D activities; preparation of Computing TDR**	2011
1996	**Beta appears; physics workshops start; MDC1; Serious online software development starts**	**building up the computing sytem**	2012
1997	**Last really major changes to offline design**		2013
1998	**MDC2; online software supports commissioning**	**scaling tests and further developments**	2014
1999	**Collisions**	**Collisions**	**2015**
2003	**Computing model 2**	**(still happy with CM1 ?)**	2019

This Workshop

First of all, we would like to warmly thank all the conveners and speakers that have accepted with enthusiasm to contribute and participate in the workshop

- **developing the SuperB computing model while LHC is started is already providing significant benefits for our production capabilities, but will also be largely beneficial for the experience we can exploit**

In these three days we will cover a lot of interesting topics at the frontier of HEP computing, and it's important that we keep the workshop focused on its goals

Goals and outcome of the Workshop

- **Goals:**
  - **identify the key aspects we should work on in the R&D phase:**
    - **the "known known": how shall we attack the main problems we are already aware of (i.e.: BaBar code legacy) ?**
    - **the "known unknown": what are the key issues we should explore ? the ones that might have the largest impact on the design of our computing model ?**
  - **discuss what are the R&D activities that can be carried out in a time-scale of 9 to 12 months**
- **Outcome (to be started here and finalized in a few weeks)**
  - **document describing the SuperB R&D plan, specifying : motivations, deliverables, timeline, resources needed**

Workshop important side-effects

- **Some of the issues that are relevant to Super, will also be of interest for LHC experiments and the HEP community:**
  - **let's explore the possibility of cooperating in addressing them**
    - **e.g.: education of young physicists and comp. prof. to the latest technologies is a field where collaboration has already started**
- **We hope that this Workshop will be also an initial opportunity to attract the interest of new people**
  - **the SuperB computing group is rather thin at the moment**
    - **"As you know, you go to war with the army you have, not the army you might want or wish to have at a later time." D. Rumsfeld**
  - **but it will have to grow: the good side of it is that there will big opportunities for talented and enthusiastic young people to join, have fun and take important responsibilities**

Layout of the workshop

- **structure:**
  - **introductory session**
  - **6 plenary sessions**
  - **1 free session (useful for individual and/or breakout groups work)**
  - **3 plenary sessions**
  - **1 breakout groups working session**
  - **final session**
- **we have tried to allocate time for discussions (although not as much as we would have hoped)**
  - **… let's preserve it, by staying with the presentation assigned time**

Welcome to Ferrara
Have a few enjoable days