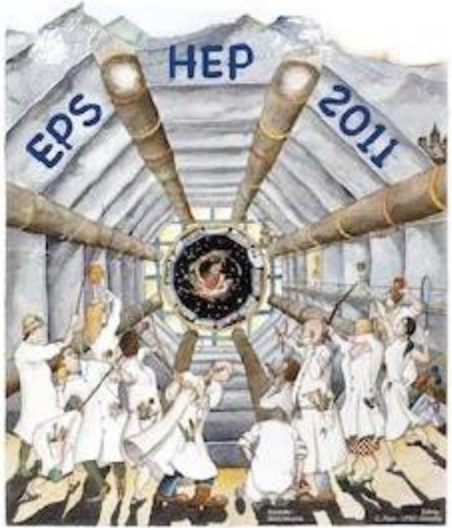


# The INFN SuperB Project

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INFN& Università di Pisa

Joint EPS-ECFA session @ EPS HEP 2011
Grenoble July 23,2011

# Approved !

SuperB has been approved as the first in a list of 14 "flagship" projects within the new national research plan (December 2010).

The national research plan has been endorsed by "CIPE" (the institution responsible for infrastructure long term plans) (April 2011).

A financial allocation of 250 M€ in about five years has been approved for the "superb flavour factory".

At the end of 2010 an initial sum of 19 M€ has been allocated.

A sum of the order of 50 M€ is expected in 2011 budget.

# Priorities

The site choice

The  management plan

The governance model

The WBS

Start Spending for:

Integrating the team: enrollment of new people

Civil engineering projects

Preliminary site related works

The transition from TDR to construction phase

# Site

Requirements defined in a document by the collaboration and reviewed by an International Review Committee:

- Size
- Electric power supply
- Water for cooling
- Low ground vibrations.
- Close to INFN and other research infrastructures.

Preferred: inside LNF or nearby .

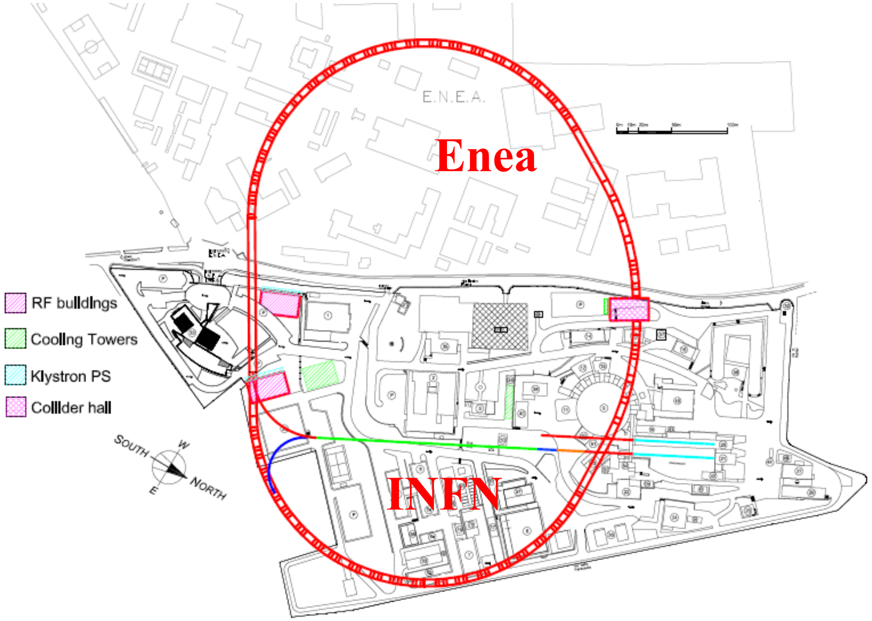
# Options considered

LNF but:

- Need to go deep underground
- Surface space strongly constrained
- Half below the "Enea" lab
- Strong limitations on possible light source beamlines
- More difficult evolution into an international structure

Other locations far from LNF :

- Piemonte ( near Torino)
- Sardinia
- Campania
- Puglia




And in the Rome area:

**Private land (green field)**

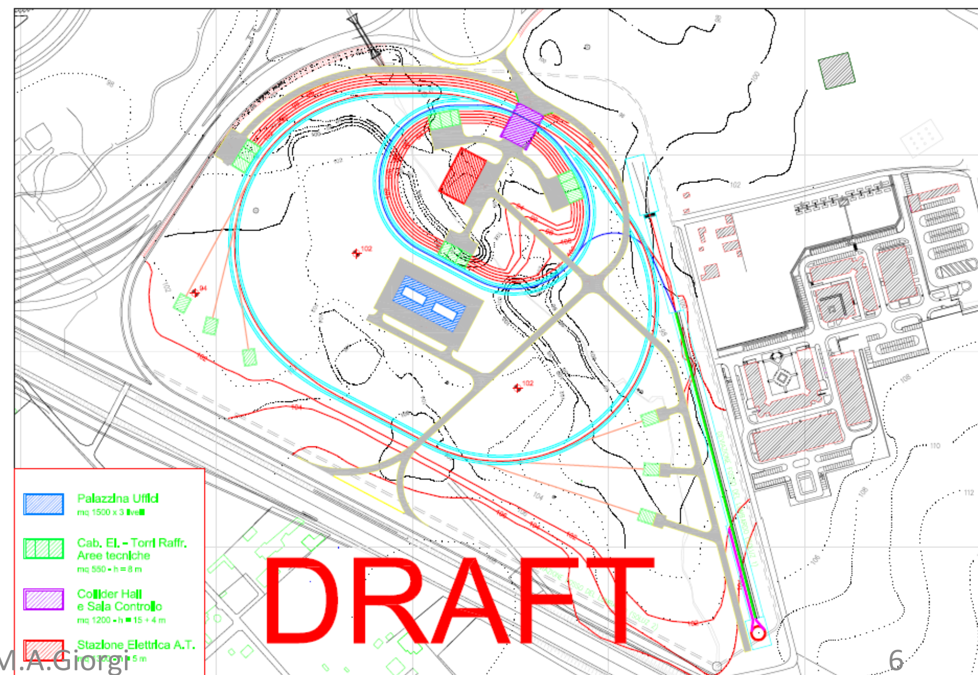
**The campus of Tor Vergata (one big University not a Green Field)**

# Tor Vergata Choice

A letter from the Rector on May 28,2011 has made the site available

The decision to move with this solution was taken by the May 29 INFN board of directors .

**The site has been decided ! It is not a GREEN FIELD!**

# Organization & Structure : 3 Phases

1.
   - INFN: the past and present phase
   - Consortium: as soon as possible as an independent legal entity
     - More flexibility in the organisation
     - Can directly associate foreign partners (EGO like)
     - An “intermediate solution”
   - Initial partners: INFN, Tor Vergata and soon IIT
   - European consortium (ERIC): the final structure

# Governance

Cern like organisation

- A director general and a directorate
  - Departments under director's supervision
- Scientific evaluation committee
  - Science
  - Machine
- Finance evaluation committee

A known and working scheme!

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The Name of the Structure

Cabibbo Lab

# Meanwhile

- Moving towards the completion of TDR.
- Machine parameters are stable.
- Detector R&D is in an advanced status, of testing on beam the prototypes
- A well integrated group of theorists and experimentalists is focusing on the program for discovery with a careful evaluation of sensitivities and looking at interplay between different measurements looking at complementarities of various flavor measurements.

## The impact of Super*B* on flavour physics

July 1, 2011

### Abstract

This report provides a succinct summary of the physics programme of Super*B*, and describes that potential in the context of experiments making measurements in flavour physics over the next 10 to 20 years. Detailed comparisons are made with Belle II and LHCb, the other *B* physics experiments that will run in this decade. SuperB will play a crucial role in defining the landscape of flavour physics over the next 20 years.

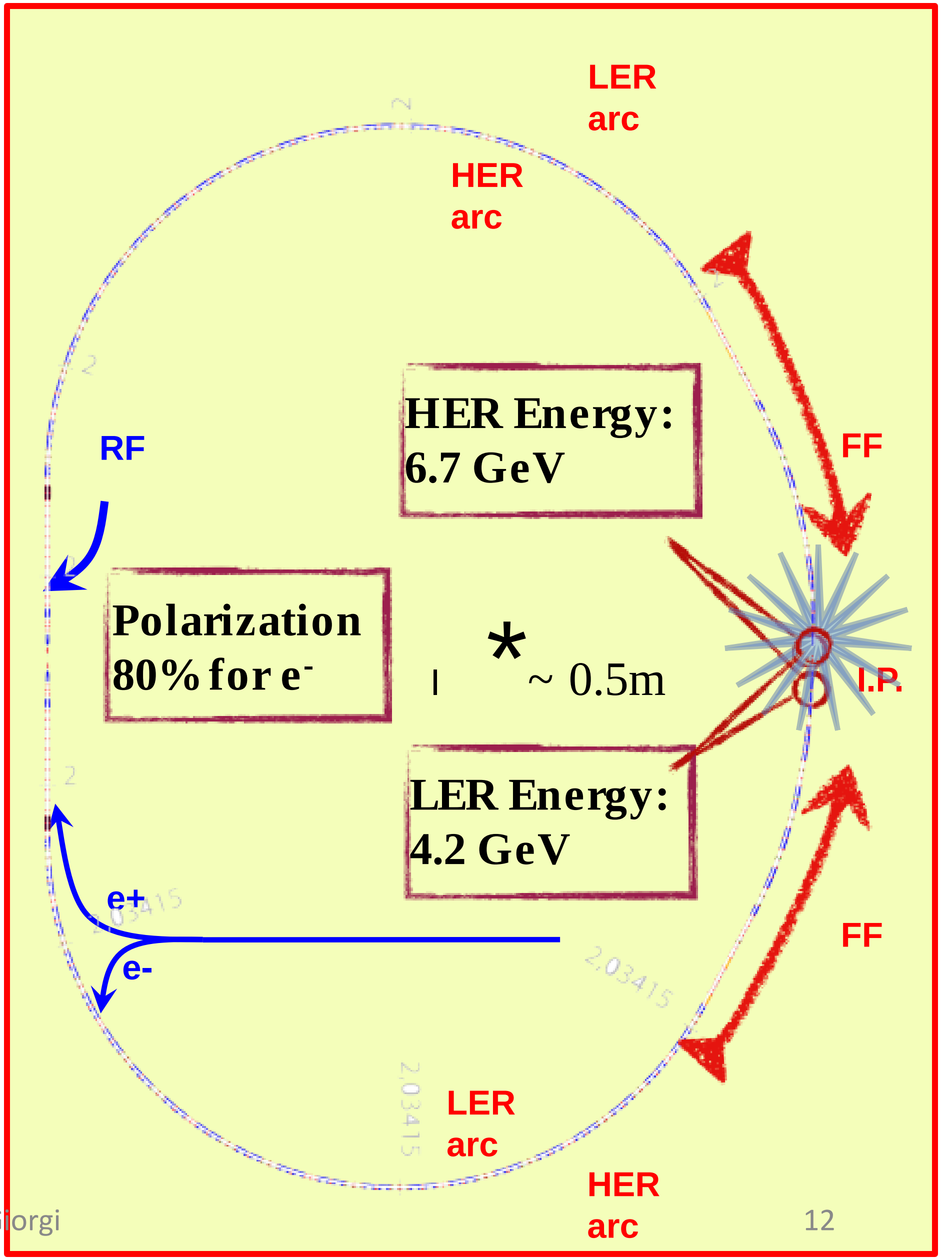
# REQUIREMENTS FROM PHYSICS

| Parameter | Requirement | Comment |
|---|---|---|
| Luminosity (top-up mode) | $10^{36}$ cm$^{-2}$s$^{-1}$ @ $\Upsilon(4S)$ | Baseline/Flexibility with headroom at 4. $10^{36}$ cm$^{-2}$s$^{-1}$ |
| Integrated luminosity | 75 ab$^{-1}$ | Based on a "New Snowmass Year" of 1.5 x $10^7$ seconds (PEP-II & KEKB experience-based) |
| CM energy range | $\tau$ threshold to $\Upsilon(5S)$ | For Charm special runs (still asymmetric……) |
| Minimum boost | $\beta\gamma$ ≈0.237 ~(4.18x6.7GeV) | 1 cm beam pipe radius. First measured point at 1.5 cm |
| $e^-$ Polarization<br><br>Boost up to 0.9 in runs at low energy under evaluation for charm physics | ≥80% | Enables $\tau$ *CP* and *T* violation studies, measurement of $\tau$ *g*-2 and improves sensitivity to lepton flavor-violating decays. Detailed simulation, needed to ascertain a more precise requirement, are in progress. |

# Collider Parameters are “stable”

| Parameter | Units | Base Line | | Low Emittance | | High Current | | Tau-charm | |
|---|---|---|---|---|---|---|---|---|---|
| | | HER (e+) | LER (e-) | HER (e+) | LER (e-) | HER (e+) | LER (e-) | HER (e+) | LER (e-) |
| LUMINOSITY | $cm^{-2} s^{-1}$ | 1.00E+36 | | 1.00E+36 | | 1.00E+36 | | 1.00E+35 | |
| Energy | GeV | 6.7 | 4.18 | 6.7 | 4.18 | 6.7 | 4.18 | 2.58 | 1.61 |
| Circumference | m | 1258.4 | | 1258.4 | | 1258.4 | | 1258.4 | |
| X-Angle (full) | mrad | 66 | | 66 | | 66 | | 66 | |
| $\beta_x$ @ IP | cm | 2.6 | 3.2 | 2.6 | 3.2 | 5.06 | 6.22 | 6.76 | 8.32 |
| $\beta_y$ @ IP | cm | 0.0253 | 0.0205 | 0.0179 | 0.0145 | 0.0292 | 0.0237 | 0.0658 | 0.0533 |
| Coupling (full current) | % | 0.25 | 0.25 | 0.25 | 0.25 | 0.5 | 0.5 | 0.25 | 0.25 |
| Emittance x (with IBS) | nm | 2.00 | 2.46 | 1.00 | 1.23 | 2.00 | 2.46 | 5.20 | 6.4 |
| Emittance y | pm | 5 | 6.15 | 2.5 | 3.075 | 10 | 12.3 | 13 | 16 |
| Bunch length (full current) | mm | 5 | 5 | 5 | 5 | 4.4 | 4.4 | 5 | 5 |
| Beam current | mA | 1892 | 2447 | 1460 | 1888 | 3094 | 4000 | 1365 | 1766 |
| Buckets distance | # | 2 | | 2 | | 1 | | 1 | |
| Ion gap | % | 2 | | 2 | | 2 | | 2 | |
| RF frequency | MHz | 476. | | 476. | | 476. | | 476. | |
| Revolution frequency | MHz | 0.238 | | 0.238 | | 0.238 | | 0.238 | |
| Harmonic number | # | 1998 | | 1998 | | 1998 | | 1998 | |
| Number of bunches | # | 978 | | 978 | | 1956 | | 1956 | |
| N. Particle/bunch ($10^{10}$) | # | 5.08 | 6.56 | 3.92 | 5.06 | 4.15 | 5.36 | 1.83 | 2.37 |
| $\sigma_x$ effective | μm | 165.22 | 165.30 | 165.22 | 165.30 | 145.60 | 145.78 | 166.12 | 166.67 |
| $\sigma_y$ @ IP | μm | 0.036 | 0.036 | 0.021 | 0.021 | 0.054 | 0.0254 | 0.092 | 0.092 |
| Piwinski angle | rad | 22.88 | 18.60 | 32.36 | 26.30 | 14.43 | 11.74 | 8.80 | 7.15 |
| $\Sigma_x$ effective | μm | 233.35 | | 233.35 | | 205.34 | | 233.35 | |
| $\Sigma_y$ | μm | 0.050 | | 0.030 | | 0.076 | | 0.131 | |
| Hourglass reduction factor | | 0.950 | | 0.950 | | 0.950 | | 0.950 | |
| Tune shift x | | 0.0021 | 0.0033 | 0.0017 | 0.0025 | 0.0044 | 0.0067 | 0.0052 | 0.0080 |
| Tune shift y | | 0.097 | 0.097 | 0.0891 | 0.0892 | 0.0684 | 0.0687 | 0.0909 | 0.0910 |
| Longitudinal damping time | msec | 13.4 | 20.3 | 13.4 | 20.3 | 13.4 | 20.3 | 26.8 | 40.6 |
| Energy Loss/turn | MeV | 2.11 | 0.865 | 2.11 | 0.865 | 2.11 | 0.865 | 0.4 | 0.17 |
| Momentum compaction ($10^{-4}$) | | 4.36 | 4.05 | 4.36 | 4.05 | 4.36 | 4.05 | 4.36 | 4.05 |
| Energy spread ($10^{-4}$) (full current) | dE/E | 6.43 | 7.34 | 6.43 | 7.34 | 6.43 | 7.34 | 6.43 | 7.34 |
| CM energy spread ($10^{-4}$) | dE/E | 5.0 | | 5.0 | | 5.0 | | 5.0 | |
| Total lifetime | min | 4.23 | 4.48 | 3.05 | 3 | 7.08 | 7.73 | 11.4 | 6.8 |
| Total RF Wall Plug Power | MW | 16.38 | | 12.37 | | 28.83 | | 2.81 | |

SUPERB COLLIDER PROGRESS REPORT



# Future Super B Factories
# ( SuperB goal is 75 $ab^{-1}$ in 5 years)

| | Or | Super KEKB |
|---|---|---|
| Peak Luminosity | $>10^{36}$ | $0.8 \times 10^{36}$ |
| Integrated Luminosity | 75 $ab^{-1}$ | 50 $ab^{-1}$ |
| Site | Tor Vergata Campus | KEKB Laboratory |
| Collisions | mid 2016 | 2015 |
| Polarization | 80% electron beam | No |
| Low energy running | $10^{35}$ @ charm threshold | No |
| Approval status | Approved | Approved |

# SuperB is then the tool for unique quality measurements

Experiment: Red = No Result, Yellow = Moderate Precision, Blue = Precise, Green = Very Precise

Theory: Yellow = Moderately clean, Blue = Clean Need lattice, Green = Clean

SuperB Physics Group

| Observable/mode | Current (now) | LHCb (2017) | SuperB (2021) | LHCb upgrade ') | theory | |
|---|---|---|---|---|---|---|
| **τ Decays** | | | | | | |
| $\tau \to \mu\gamma$ | Yellow | Yellow | Green | Yellow | Green | Benefit from polarised e⁻ beam |
| $\tau \to e\gamma$ | Yellow | Yellow | Green | Yellow | Green | |
| **$B_{u,d}$ Decays** | | | | | | |
| $B \to \tau\nu, \mu\nu$ | Yellow | Red | Blue | Red | Blue | very precise with improved detector |
| $B \to K^{(*)+}\nu\overline{\nu}$ | Red | Red | Green | Red | Green | Statistically limited: Ang. analysis with >75ab$^{-1}$ |
| $S$ in $B \to K^0_S\pi^0\gamma$ | Yellow | Red | Green | Red | Yellow | Right handed currents |
| $S$ in other penguin modes | Yellow | Yellow | Green | Blue | Yellow | SuperB measures many more modes |
| $A_{CP}(B \to X_s\gamma)$ | Blue | Yellow | Green | Yellow | Green | systematic error is main challenge |
| $BR(B \to X_s\gamma)$ | Blue | Yellow | Green | Yellow | Yellow | control systematic error with data |
| $BR(B \to X_s\ell\ell)$ | Yellow | Red | Green | Red | Green | |
| $BR(B \to K^{(*)}\ell\ell)$ | Yellow | Blue | Green | Green | Yellow | SuperB measures e mode well, LHCb does μ |
| **$B_s$ Decays** | | | | | | |
| $B_s \to \mu\mu$ | Red | Blue | Red | Green | Green | |
| $\beta_s$ from $B_s \to J/\psi\phi$ | Red | Blue | Red | Green | Green | |
| $B_s \to \gamma\gamma$ | Red | Red | Blue | Red | Green | |
| $a_{sl}$ | Red | Red | Green | Red | Green | |
| **$D$ Decays** | | | | | | |
| mixing parameters | Yellow | Blue | Green | Green | Green | |
| CPV | Red | Blue | Green | Green | Green | Clean NP search |
| **Precision EW** | | | | | | |
| $\sin^2\theta_W$ at $\Upsilon(4S)$ | Red | Red | Green | Red | Green | Theoretically clean |
| $\sin^2\theta_W$ at Z-pole | Green | Blue | Red | Green | Yellow | b fragmentation limits interpretation |

END

# SuperB Luminosity model