

# Super*B* Detector Technical Design Report

## Abstract

In this Technical Design Report (TDR) we describe the Super*B* detector to be installed on the Super*B*  $e^+e^-$  high luminosity collider. The Super*B* asymmetric collider, foreseen to be constructed on the Tor Vergata campus near the INFN Frascati National Laboratory, is designed to operate both at the  $\Upsilon(4S)$  energy in the center of mass with a luminosity of  $10^{36} \text{ cm}^{-2}\text{s}^{-1}$  and at the  $\tau$ /charm production threshold with a luminosity of  $10^{35} \text{ cm}^{-2}\text{s}^{-1}$ . This high luminosity, producing a data sample about a factor 100 larger than present *B* Factories would allow investigation of new physics effects in rare decays, CP Violation and Lepton Flavour Violation. This document details the detector design presented in the Conceptual Design Report (CDR) in 2007. The R&D and engineering studies performed to arrive at the full detector design are described, and an updated cost estimate is presented.

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# Preface

Flavour physics not only provides insight in the physics of the standard model but also offers great discovery potential for new physics processes, as the B-Factories experiments, *BABAR* at SLAC and *Belle* at KEK, have demonstrated very effectively. Increasing the luminosity has been identified from the very beginning as the key element to extend the physics reach of these machines. Since 2003 a group of physicists began to explore the physics potential of very high luminosity B-Factory machines. An upgrade of the the PEP-II accelerator was initially investigated; then the *BABAR* and *Belle* community started in 2004 a series of joint workshops in Hawaii.

The *SuperB* Project was formally born in 2005 when INFN inserted in its three-years planning document the intention of building a high luminosity flavour factory in the Frascati area. In the course of the years *SuperB* has evolved from an intention into a full-fledged project, with a Conceptual Design Report published in 2007, progress reports in 2009, and a formal collaboration structure setup in 2010 with hundreds of members from several countries. All aspects of the project, physics potential, accelerator design, detector design, successfully passed several international reviews setup by INFN. In 2010 *SuperB* was inserted in the Italian Research Ministry National Research Plan as Flagship Project, and a good fraction of the required funds were allocated, although not the full amount. The decision to build *SuperB* on the land of the University of Rome Tor Vergata lead, in 2011, to the formation of the Cabibbo Laboratory consortium between INFN and TorVergata, with the explicit mission of constructing and managing a new research infrastructure for flavour physics. A ministerial cost and schedule review of the accelerator project was held in fall 2012. A combination of a more realistic cost estimates and the unavailability of funds due of the global economic climate lead to a formal cancelation of the project on Nov 27, 2012.

The community who had been committed to the project for so long, although devastated by the sudden cancelation, decided to try to preserve and document as much as possible of the work done in *SuperB*, both to retain a lasting trace of the committment of the group and, more importantly, to provide a written basis of the technical achievements for the use of future scientific endeavours. It is in this spirit that this Detector Technical Design Report, whose preparation was quite advanced at the time of the cancelation of the project, has been completed and is being published. We felt that the tone and grammar of the text should remain that of a project that will be built rather than that of a project that would have been built. Therefore we kept the assertiveness and optimism of a community that was expecting to start constructing the machine and experiment within a few months. We sincerely hope that it can be of use to the scientific community.

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M. Baszczyk, P. Dorosz, J. Kolodziej, W. Kucewicz, M. Sapor  
*AGH University of Science and Technology, Kraków, Poland*

A. Jeremie  
*LAPP - Annecy, Annecy-le-Vieux, France*

E. Grauges Pous  
*Universitat de Barcelona, Barcelona, Spain*

G. E. Bruno<sup>ab</sup>, G. De Robertis<sup>b</sup>, D. Diacono<sup>b</sup>, G. Donvito<sup>b</sup>, P. Fusco<sup>ab</sup>, F. Gargano<sup>b</sup>,  
F. Giordano<sup>ab</sup>, F. Loddo<sup>b</sup>, F. Loparco<sup>ab</sup>, G. P. Maggi<sup>b</sup>, V. Manzari<sup>b</sup>, M. N. Mazziotta<sup>b</sup>, E. Nappi<sup>b</sup>,  
A. Palano<sup>b</sup>, B. Santeramo<sup>ab</sup>, I. Sgura<sup>b</sup>, L. Silvestris<sup>b</sup>, V. Spinoso<sup>b</sup>  
<sup>a</sup>*Dipartimento di Fisica dell'Università e del Politecnico di Bari; <sup>b</sup>INFN - Sezione di Bari, Bari, Italy*

G. Eigen, J. Zalieckas, Z. Zhuo  
*University of Bergen, Bergen, Norway*

L. Jenkovszky  
*Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine*

D. Bonacorsi<sup>ab</sup>, M. Dallavalle<sup>b</sup>, F. Fabbri<sup>b</sup>, L. Fabbri<sup>ab</sup>, P. Giacomelli<sup>b</sup>, F. Giorgi<sup>b</sup>, C. Grandi<sup>b</sup>,  
S. Lo Meo<sup>ab</sup>, U. Marconi<sup>b</sup>, A. Montanari<sup>b</sup>, M. Piccinini<sup>ab</sup>, T. Rovelli<sup>ab</sup>, N. Tosi<sup>ab</sup>, M. Villa<sup>ab</sup>  
<sup>a</sup>*Università di Bologna; <sup>b</sup>INFN - Sezione di Bologna, Bologna, Italy*

J.-F. Caron, C. Hearty<sup>1</sup>, P. F.-T. Lu, T. S. Mattison, J. A. McKenna, R. Y.-C. So  
*University of British Columbia, Vancouver, British Columbia, Canada*

M. Yu. Barnyakov, V. E. Blinov, A. A. Botov, V. P. Druzhinin, V. B. Golubev, S. A. Kononov,  
E. A. Kravchenko, E. B. Levichev, A. P. Onuchin, S. I. Serebnyakov, D. A. Shtol, Y. I. Skovpen,  
E. P. Solodov  
*Budker Institute of Nuclear Physics, Novosibirsk, Russian Federation*

A. Cardini<sup>b</sup>, M. Carpinelli<sup>ab</sup>  
<sup>a</sup>*Università di Sassari; <sup>b</sup>INFN - Sezione di Cagliari, Cagliari, Italy*

D. S.-T. Chao, C. H. Cheng, D. A. Doll, B. Echenard, K. Flood, J. Hanson, D. G. Hitlin,  
P. Ongmongkolkul, F. C. Porter, R. Y. Zhu  
*California Institute of Technology, Pasadena, CA, USA*

N. Randazzo  
*INFN - Sezione di Catania, Catania, Italy*

Y. Zheng  
*Graduate University of Chinese Academy of Sciences, Beijing, China*

P. Campos, M. De Silva, A. Kathirgammaraju, B. Meadows, B. Pushpawela, Y. Shi, M. Sokoloff  
*University of Cincinnati, Cincinnati, OH, USA*

---

<sup>1</sup>Also with Institute of Particle Physics , Canada.

E. De La Cruz Burelo  
*Centro de Investigación y de Estudios Av. de IPN, Mexico City, Mexico*

V. Ciaschini, P. Franchini, F. Giacomini, A. Paolini  
*INFN - CNAF, Bologna, Italy*

G. A. Calderon Polania  
*Universidad Autónoma de Coahuila (UAdeC), Coahuila, Mexico*

S. Laczek, P. Romanowicz, B. Szybinski  
*Cracow University of Technology, Kraków, Poland*

M. Czuchry, L. Flis, D. Harezlak, J. Kocot, M. Radecki, M. Sterzel, T. Szepieniec, T. Szymocha,  
P. Wójcik  
*Academic Computer Center CYFRONET AGH, Kraków, Poland*

M. Andreotti<sup>ab</sup>, W. Baldini<sup>b</sup>, R. Calabrese<sup>ab</sup>, V. Carassiti<sup>b</sup>, G. Cibinetto<sup>b</sup>, A. Cotta Ramusino<sup>b</sup>,  
F. Evangelisti<sup>b</sup>, A. Gianoli<sup>b</sup>, E. Luppi<sup>ab</sup>, R. Malaguti<sup>b</sup>, M. Manzali<sup>b2</sup>, M. Melchiorri<sup>b</sup>,  
M. Munerato<sup>b</sup>, C. Padoan<sup>ab</sup>, V. Santoro<sup>b</sup>, L. Tomassetti<sup>ab</sup>  
<sup>a</sup>*Università di Ferrara;* <sup>b</sup>*INFN - Sezione di Ferrara, Ferrara, Italy*

M. M. Beretta, M. Biagini, M. Boscolo, E. Capitolo, R. de Sangro, M. Esposito, G. Felici,  
G. Finocchiaro, M. Gatta, C. Gatti, S. Lauciani<sup>3</sup>, P. Patteri, I. Peruzzi<sup>4</sup>, M. Piccolo, P. Raimondi,  
M. Rama, C. Sanelli, S. Tomassini  
*INFN - LNF (Laboratori Nazionali di Frascati), Frascati, Italy*

S. Passaggio  
*INFN - Sezione di Genova, Genova, Italy*

D. Delepine, M. A. Reyes Santos  
*Universidad de Guanajuato León, Guanajuato, Mexico*

M. Chruszcz, R. Grzymkowski, P. Knap, J. Kotula, T. Lesiak, J. Ludwin, J. Michalowski,  
B. Pawlik, B. Rachwał, M. Stodulski, J. Wiechczynski, M. Witek, L. Zawiejski, M. Zdybal  
*H. Niewodniczanski Inst. of Nuclear Physics PAS, Kraków, Poland*

V. Y. Aushev, A. Ustynov  
*Kiev Institute for Nuclear Research, Kiev, Ukraine*

N. Arnaud, P. Bambade, C. Beigbeder, F. Bogard, M. Borsato, D. Breton, J. Brossard,  
L. Burmistrov, D. Charlet, V. Chaumat, O. Dadoun, M. El Berni, J. Maalmi, V. Puill,  
C. Rimbault, A. Stocchi, V. Tocut, A. Variola, S. Wallon, G. Wormser  
*Laboratoire de l'Accélérateur Linéaire, Univ. Paris-Sud, CNRS/IN2P3, Orsay, France*

F. Grancagnolo  
*INFN - Sezione di Lecce, Lecce, Italy*

---

<sup>2</sup>Also with INFN - CNAF.

<sup>3</sup>Also with Laboratoire de l'Accélérateur Linéaire, Univ. Paris-Sud, CNRS/IN2P3, Orsay, France.

<sup>4</sup>Also with Università di Perugia.

E. Ben-Haim, S. Sitt  
*LPNHE - Paris, Paris, France*

M. Baylac, O. Bourrion, J.-M. Deconto, Y. Gomez Martinez, N. Monseu, J.-F. Muraz, J.-S. Real  
*LPSC (UJF-CNRS/IN2P3-INPG), Grenoble, France*

R. Cenci, A. Jawahery, D. Roberts, E. W. Twedt  
*University of Maryland, College Park, MD, USA*

R. Cheaib, D. Lindemann, S. Nderitu, P. Patel<sup>5</sup>, S. H. Robertson, D. Swersky, A. Warburton  
*McGill University, Montréal, Québec, Canada*

E. Cuautle Flores, G. Toledo Sanchez  
*Universidad Nacional Autónoma de Mexico, Mexico City, Mexico*

P. Biassoni<sup>c</sup>, L. Bombelli<sup>ac</sup>, M. Citterio<sup>c</sup>, S. Coelli<sup>c</sup>, C. Fiorini<sup>ac</sup>, V. Liberali<sup>bc</sup>, M. Monti<sup>c</sup>,  
B. Nasri<sup>ac</sup>, N. Neri<sup>c</sup>, F. Palombo<sup>bc</sup>, F. Sabatini<sup>c</sup>, A. Stabile<sup>bc</sup>  
<sup>a</sup>*Politecnico di Milano*; <sup>b</sup>*Università di Milano*; <sup>c</sup>*INFN - Sezione di Milano, Milano, Italy*

A. Berra<sup>ab</sup>, D. Lietti<sup>ab</sup>, G. Pessina<sup>b</sup>, M. Prest<sup>ab</sup>  
<sup>a</sup>*Università degli Studi dell'Insubria di Como*; <sup>b</sup>*INFN - Sezione di Milano Bicocca, Milano, Italy*

J.-P. Martin, M. Simard, N. Starinski, P. Taras  
*Université de Montréal, Montréal, Québec, Canada*

A. Drutskoy, S. Makarychev, A. V. Nefediev  
*ITEP - Moscow, Moscow, Russian Federation*

A. Aloisio<sup>c</sup>, S. Cavaliere<sup>c</sup>, G. De Nardo<sup>c</sup>, M. Della Pietra<sup>bc</sup>, A. Doria<sup>c</sup>, R. Giordano<sup>ac</sup>, A. Ordine<sup>c</sup>,  
S. Pardi<sup>c</sup>, G. Russo<sup>c</sup>, C. Sciacca<sup>c</sup>  
<sup>a</sup>*Università di Napoli "Federico II"*; <sup>b</sup>*Università Parthenope di Napoli*; <sup>c</sup>*INFN - Sezione di Napoli, Napoli, Italy*

I. I. Bigi, C. P. Jessop, W. Wang  
*University of Notre Dame, Notre Dame, IN, USA*

A. Caratti<sup>b</sup>, M. Corvo<sup>b6</sup>, A. Crescente<sup>b</sup>, F. Dal Corso<sup>b</sup>, U. Dosselli<sup>b</sup>, A. Gianelle<sup>b</sup>, S. Longo<sup>b</sup>,  
M. Michelotto<sup>b</sup>, F. Montecassiano<sup>b</sup>, M. Morandin<sup>b</sup>, R. Pengo<sup>b</sup>, M. Posocco<sup>b</sup>, M. Rotondo<sup>b</sup>,  
G. Simi<sup>ab</sup>, R. Stroili<sup>ab</sup>  
<sup>a</sup>*Università di Padova*; <sup>b</sup>*INFN - Sezione di Padova, Padova, Italy*

L. Gaioni<sup>c</sup>, A. Manazza<sup>c</sup>, M. Manghisoni<sup>ac</sup>, L. Ratti<sup>bc</sup>, V. Re<sup>ac</sup>, S. Zucca<sup>c</sup>  
<sup>a</sup>*Università di Bergamo*; <sup>b</sup>*Università di Pavia*; <sup>c</sup>*INFN - Sezione di Pavia, Pavia, Italy*

S. Bizzaglia<sup>b</sup>, M. Bizzarri<sup>ab</sup>, C. Cecchi<sup>ab</sup>, S. Germani<sup>b7</sup>, M. Lebeau<sup>b8</sup>, P. Lubrano<sup>b</sup>, E. Manoni<sup>b</sup>,  
A. Papi<sup>b</sup>, A. Rossi<sup>b</sup>, G. Scolieri<sup>b</sup>  
<sup>a</sup>*Università di Perugia*; <sup>b</sup>*INFN - Sezione di Perugia, Perugia, Italy*

---

<sup>5</sup>Deceased.

<sup>6</sup>Also with Laboratoire de l'Accélérateur Linéaire, Univ. Paris-Sud, CNRS/IN2P3, Orsay, France.

<sup>7</sup>Also with Laboratoire de l'Accélérateur Linéaire, Univ. Paris-Sud, CNRS/IN2P3, Orsay, France.

<sup>8</sup>Also with Caltech.

G. Batignani<sup>bc</sup>, S. Bettarini<sup>bc</sup>, G. Casarosa<sup>c</sup>, A. Cervelli<sup>c</sup>, A. Fella<sup>c9</sup>, F. Forti<sup>bc</sup>, M. Giorgi<sup>bc</sup>,  
L. Lilli<sup>c</sup>, A. Lusiani<sup>ac</sup>, B. Oberhof<sup>bc</sup>, A. Paladino<sup>c</sup>, F. Pantaleo<sup>c</sup>, E. Paoloni<sup>bc</sup>, A. L. Perez Perez<sup>c</sup>,  
G. Rizzo<sup>bc</sup>, J. Walsh<sup>c</sup>  
<sup>a</sup>*Scuola Normale Superiore*; <sup>b</sup>*Università di Pisa*; <sup>c</sup>*INFN - Sezione di Pisa, Pisa, Italy*

A. Fernández Téllez  
*Benemérita Universidad Autónoma de Puebla, Puebla, Mexico*

G. Beck, M. Berman, A. Bevan, F. Gannaway, G. Inguglia, A. J. Martin, J. Morris  
*Queen Mary, Univ. of London, London, United Kingdom*

V. Bocci<sup>b</sup>, M. Capodiferro<sup>b</sup>, G. Chiodi<sup>b</sup>, I. Dafinei<sup>b</sup>, N. V. Drenska<sup>b</sup>, R. Faccini<sup>ab</sup>, F. Ferroni<sup>ab</sup>,  
C. Gargiulo<sup>b</sup>, P. Gauzzi<sup>ab</sup>, C. Luci<sup>ab</sup>, R. Lunadei<sup>b</sup>, G. Martellotti<sup>b</sup>, F. Pellegrino<sup>b</sup>, V. Pettinacci<sup>b</sup>,  
D. Pinci<sup>b</sup>, L. Recchia<sup>b</sup>, D. Ruggeri<sup>b</sup>, A. Zullo<sup>b</sup>  
<sup>a</sup>*Università di Roma*; <sup>b</sup>*INFN - Sezione di Roma, Roma, Italy*

P. Camarri<sup>ab</sup>, R. Cardarelli<sup>b</sup>, C. De Santis<sup>b</sup>, A. Di Ciaccio<sup>ab</sup>, V. Di Felice<sup>b</sup>, F. Di Palma<sup>b</sup>,  
A. Di Simone<sup>b</sup>, L. Marcelli<sup>b</sup>, R. Messi<sup>ab</sup>, D. Moricciani<sup>b</sup>, R. Sparvoli<sup>ab</sup>, S. Tammaro<sup>b</sup>  
<sup>a</sup>*Università di Roma Tor Vergata*; <sup>b</sup>*INFN - Sezione di Roma Tor Vergata, Roma, Italy*

P. Branchini<sup>b</sup>, A. Budano<sup>b</sup>, S. Bussino<sup>ab</sup>, M. Ciuchini<sup>b</sup>, F. Nguyen<sup>b</sup>, A. Passeri<sup>b</sup>, F. Ruggieri<sup>b</sup>,  
E. Spiriti<sup>b</sup>  
<sup>a</sup>*Università di Roma Tre*; <sup>b</sup>*INFN - Sezione di Roma Tre, Roma, Italy*

F. Wilson  
*Rutherford Appleton Laboratory, Didcot, United Kingdom*

I. Leon Monzon, J. R. Millan-Almaraz, P. L. M. Podesta-Lerma  
*Universidad Autónoma de Sinaloa, Sinaloa, Mexico*

D. Aston, B. Dey, A. Fisher, P. D. Jackson, D. W. G. S. Leith, S. Luitz, D. MacFarlane,  
M. McCulloch, A. Novokhatski, R. Prepost, B. Ratcliff, J. Seeman, M. Sullivan, J. Va'vra,  
U. Wienands, W. Wisniewski  
*SLAC, Menlo Park, CA, USA*

B. D. Altschul, M. V. Purohit  
*University of South Carolina, Columbia, SC, USA*

J. Baudot, I. Ripp-Baudot  
*IPHC - Strasbourg, Strasbourg, France*

P. Cirrone, G. Cuttone  
*INFN - LNS (Laboratori Nazionali del Sud), Catania, Italy*

O. Bezshyyko, G. Dolinska  
*Taras Shevchenko National University of Kyiv, Kiev, Ukraine*

---

<sup>9</sup>Also with INFN - Ferrara and Laboratoire de l'Accélérateur Linéaire, Univ. Paris-Sud, CNRS/IN2P3, Orsay, France.



A. Soffer

*Tel Aviv University, Tel Aviv, Israel*

F. Bianchi<sup>ab</sup>, F. De Mori<sup>ab</sup>, A. Filippi<sup>b</sup>, D. Gamba<sup>b</sup>, S. Marcello<sup>ab</sup>

<sup>a</sup>*Università di Torino*; <sup>b</sup>*INFN - Sezione di Torino, Torino, Italy*

M. Bomben<sup>c</sup>, L. Bosisio<sup>ac</sup>, P. Cristaudo<sup>c</sup>, L. Lanceri<sup>ac</sup>, B. Liberti<sup>c</sup>, I. Rashevskaya<sup>c</sup>, C. Stella<sup>bc</sup>,

E. S. Vallazza<sup>c</sup>, L. Vitale<sup>ac</sup>

<sup>a</sup>*Università di Trieste*; <sup>b</sup>*Università di Udine*; <sup>c</sup>*INFN - Sezione di Trieste, Trieste, Italy*

G. Auriemma<sup>ab</sup>, C. Satriano<sup>ab</sup>

<sup>a</sup>*Università degli Studi della Basilicata*; <sup>b</sup>*INFN - Sezione di Roma, Potenza, Italy*

F. Martinez Vidal, J. Mazorra de Cos, A. Oyanguren, P. Ruiz Valls

*University of Valencia-CSIC, Valencia, Spain*

A. Beaulieu, S. Dejong, J. Franta, M. J. Lewczuk, M. Roney, R. Sobie

*University of Victoria, Victoria, British Columbia, Canada*



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