10 The DØ experiment at the Tevatron $p\bar{p}$ Collider: Search for Rare Decays of B_s-Mesons and a New Silicon Detector for Run IIb

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The DØ collaboration consists of 80 institutes from 18 countries: Argentina (1), Brazil (3), China (1), Czech Republic (3), Colombia (1), Ecuador (1), France (7), Germany (6), India (3), Ireland (1), Korea (1), Mexico (1), Netherlands (3), Russia (5), Sweden (4), United Kingdom (3), U.S.A. (35) and Vietnam (1)

(DØ Collaboration)

Until LHC at CERN starts its operation in 2007, the Tevatron at the Fermi National Accelerator Laboratory, Batavia, USA, is the world's highest energy accelerator with an available center of mass energy of 1.8 TeV. The so-called Run IIa phase of the $p\bar{p}$ collider has started in 2001 and addresses some of the most important questions in particle physics. The most recent physics results [1] involve direct searches for as yet unknown particles and forces, including those that are predicted or expected (like the Higgs boson and supersymmetry) and those that would come as a surprise. Other highlights of this programme will be the precise measurements of the top quark properties, new accurate determinations of the mass of the W boson and the couplings of the electroweak bosons. Moreover, numerous measurements of various B meson decay modes allow the investigation of CP-violating effects.

Because of the tantalising physics prospects a high integrated luminosity run will bring, a second phase of Tevatron running, the Run IIb which will cover the years 2005 and beyond, is presently being prepared. To optimise its physics capability for the future run, the existing silicon detector of the DØ experiment at Tevatron is being replaced [2]. This replacement is necessary, since the present silicon vertex detector will suffer from the harsh radiation environment at Run IIa.

After the DØ detector is now fully operational for Run IIa and $p\bar{p}$ collision data are being taken, Ralf Bernhard has started with his physics analysis programme of rare B_s decay searches. The study of the B_s meson is unique to hadron colliders since they can not be produced at the $\Upsilon(4S)$ resonance at which e^+e^- B-Factories like BaBar and Belle are running. We will focus in our searches on flavor-changing neutral currents, which are forbidden at tree level. Of particular interest is the decay $B_s \to \mu^+\mu^-$. This decay channel is very sensitive to new physics beyond the Standard Model (SM) since it has a very small SM branching ratio of $3.5 \cdot 10^{-9}$ and supersymmetric extension of the SM could enhance this branching ratio significantly [3]. Within the framework of the well-motivated minimal supergravity model mSUGRA, the search for $B_s \to \mu^+\mu^-$ is a powerful tool to probe the model in the region of high $\tan\beta$. We expect to improve the existing branching ratio limit for $B_s \to \mu^+\mu^-$ of $2.6 \cdot 10^{-6}$ at 95% C.L. [4] by a factor of almost 20 in Run IIa. This branching ratio limit will already start to constrain the allowed parameter space of mSUGRA models at high $\tan\beta$.

We are also involved in the design and construction of the new DØ silicon detector for Run IIb. We have worked on the sensor design and specifications and have defined the quality assurance procedures and methods for the more than 2200 silicon sensors which are being ordered now [5]. One of us (Frank Lehner) is the responsible coordinator at DØ for the silicon sensor procurement and testing program. In addition we have designed a long analog low-mass cable with a very fine pitch geometry to route the silicon analog signals in the innermost detector layer to further readout electronics. Together with the Swiss company Dyconex [6] several cable prototypes based on different design layouts have been developed and characterised.

[1] *New results from Run IIa Searches from CDF and DØ*,
talks presented by S. Rolli (CDF) and G. Brooijmans (DØ) at the XXXVIIIth Rencontres de Moriond, Electroweak Interactions and Unified Theories, Les Arcs, France, March 15-22, 2003.

[2] The DØ Run IIb silicon detector collaboration: *DØ Run IIb silicon detector upgrade, Technical Design Report*, http://d0server1.fnal.gov/projects/run2b/Silicon/www/smt2b/smt2b.html.

[3] A. Dedes, H. Dreiner and U. Nierste, Phys.Rev.Lett.**87**, 251804, 2001.

[4] F. Abe et al. [CDF Collaboration], Phys.Rev.D **57**, 3811 (1998).

[5] A. Bean et al., *Silicon Sensor Quality Assurance for the DØ RunIIb Silicon Detector: Procedures and Equipment*, internal DØ publication, DØ-note 4120
http://www.physik.unizh.ch/ lehnerf/dzero/run2b.html

[6] Dyconex advanced circuit technologies, Zurich, Switzerland