“Accelerator Facilities at the Energy, Precision and R&D Frontiers”

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LHC: *The Energy Frontier Machine*

After a one-year hiatus to address an issue in the connections between magnets, the LHC has now turned on at 3.5 TeV per beam and is being commissioned for physics running. The short-term goal is to deliver up to 1 ab^{-1} until the end of 2011, when a major campaign to ready the machine for up-to 7 TeV per beam is foreseen. Beam commissioning has made significant progress with luminosity having reached $1.5x10^{30}$ $cm^{-2}s^{-1}$ as of this writing. The commissioning tasks have included optics tuning; beam-collimation setup; the study of intensity-dependent effects and setup of the damping systems against multi bunch instabilities and injection transients. One of the difficulties faced is the enormous energy stored in the beam that easily can damage or destroy elements of the ring if not properly controlled. Safety of the machine has to be ensured before each step up in beam current. I will discuss selected beam-commissioning efforts of interest and the overall strategy of bringing such a challenging machine up to performance.

SuperB and SuperKEKB: *Towards $10^{36}cm^{-2}s^{-1}$ Luminosity for Flavor Physics and CP Violation studies*

The PEP-II and KEKB B-Factories and their experiments, *BABAR* and Belle, have broken new ground in the physics as well as in the design, construction and operation of high-luminosity e^+e^- colliders, with both facilities exceeding 10^{34} $cm^{-2}s^{-1}$ luminosity. Based on the success of these machines new facilities have been proposed with a luminosity up to 10^{36} $cm^{-2}s^{-1}$: SuperB at LNF Frascati, Italy, by a joint LNF - SLAC team and SuperKEKB in Tsukuba, Japan, an upgrade of the existing KEKB machine. They promise to open up new areas in physics presently unreachable by e^+e^- colliders. The machines share important design characteristics. In order to achieve the extreme luminosity with reasonable beam parameters, very small beam emittances are combined with a relatively large crossing angle ("Piwinski angle") which foreshortens the interaction region, thus allowing extremely low beta functions (well below 1 mm) without the need of similarly short bunches. Higher beam-beam parameters can be achieved by aligning the waist of one beam with the direction of the other; thus avoiding the high tune shift at the transverse tails of the beams due to the short depth of field. The principle was successfully tested at DAFNE in 2009, with a 3-fold increase in luminosity over the previous record. In case of SuperB, polarized electron beam capability is designed into the facility.

FACET: *A Facility at SLAC National Accelerator Laboratory, Stanford USA, for R&D of high-gradient Accelerating Mechanisms and other Studies in Accelerator Physics*

Presently, the FACET facility is being constructed at SLAC National Accelerator Laboratory, Stanford USA, using the first 2 km of the venerable SLAC 2-mile linac (the remainder being used for LCLS). A large part of the mission for this facility will be the proof in principle of the feasibility of using the high gradients possible in a plasma for practical acceleration. While in prior experiments at SLAC it was demonstrated that particles in the low-energy tail of a bunch can be accelerated to very high energy by energy transfer from the head of the bunch; at FACET we plan to actually accelerate a witness bunch. An important part of the program will be the acceleration of positrons by a preceding electron bunch; this has not been done before. Besides these acceleration experiments; FACET will be a user facility accepting proposals from other groups for accelerator physics experiments. Examples of proposals in preparation include the study of wakefields for CLIC and the study of the suitability of bent crystals as primary collimators for linear colliders as well as studying the channeling radiation from electrons and positrons passing through crystals.