

EXPRESSION OF INTEREST

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The successes of the B factory experiments, BABAR and Belle, have verified the Cabibbo-Kobayashi-Maskawa (CKM) mechanism for quark mixing and CP violation. This can be seen as a further triumph of the Standard Model (SM). Nonetheless, there are strong reasons to believe that new physics (NP) should exist at the TeV scale. Unless such NP is flavour-blind (which could only be determined experimentally), it should cause measurable effects in flavour physics, for example through the influence of virtual massive particles in loop diagrams. In fact, much of the most constraining information about NP currently comes from precision flavour observables, such as $b \rightarrow s\gamma$, ϵ_K , EDMs, *etc.* Flavour physics is therefore an essential part of the search for new physics, and will be crucial to diagnose the origin of the NP, once discovered.

An indispensable part of this program is a high luminosity ($\mathcal{O}(10^{36}/\text{cm}^2/\text{s})$) e^+e^- collider, operating in the region of the $\Upsilon(4S)$ rest mass. Such a ‘‘Super Flavour Factory’’ produces copious samples of bottom mesons, charmed hadrons and τ leptons, in a clean environment ideal for precision studies. Among the most important of the numerous measurements that can be made by such a machine are: precise tests of the CKM mechanism by overconstraining the Unitarity Triangle, studies of the photon polarization in $b \rightarrow s\gamma$ (and $b \rightarrow d\gamma$) transitions, searches for very rare B decays, including leptonic decays and decay modes including neutrinos, searches for CP violation and lepton flavour violation in τ decays, studies of flavour oscillations and CP violation in the charm sector. All of the above measurements are sensitive to NP effects, and most cannot be well studied at other planned experiments. Notably, the Super Flavour Factory and LHCb programs complement each other, and the overall physics reach is greatly enhanced if both operate on a similar timescale.

The possibilities of upgrading the existing PEP-II and KEKB machines have been studied over the last few years, and a proposal for a SuperKEKB with a peak luminosity of $4 \times 10^{35}/\text{cm}^2/\text{s}$ was submitted in Japan in 2005. Recently, new ideas have emerged in which designs of the damping rings and the final focus for the International Linear Collider (ILC) are adapted for an e^+e^- collider operating near the $\Upsilon(4S)$ rest mass. A luminosity above $10^{36}/\text{cm}^2/\text{s}$ appears to be achievable with very small bunch sizes and smaller currents than the SuperKEKB proposal. This reduces the backgrounds in the detector, as well as the power required to run the machine. We note that there is a synergy between such a Super Flavour Factory design and the ILC. In particular, experience gained in the design, testing and commissioning of the Super Flavour Factory should lead to enhancements of the ILC luminosity performance.

We foresee a program of involvement in studies to determine the optimum Super Flavour Factory scheme. This entails participation in the design and testing of the ILC-inspired concept, which, to date, has been based on simulation studies. The high luminosity is achieved through very small bunches, but emittance blow-up through beam-beam effects in the interaction region can disrupt the stability of the collisions. Various possibilities to control this effect have been suggested, including the use of a so-called ‘‘crabbed waist’’ scheme. Essential experimental tests are planned to be undertaken over the next few years. These will provide a unique opportunity for UK-based accelerator scientists to take prominent roles in the project. Additionally, further studies are necessary to ensure that the full physics capability of the machine can be exploited. Examples include the possibility to run with one (or both) beams polarized, and to run at energies other than the $\Upsilon(4S)$ rest mass, such as the τ -charm threshold region. Finally, the design of the detector is also under consideration, and several opportunities exist for significant research and development.

In order for the Super Flavour Factory to be realised in a timely manner, the optimum design should be established urgently. We therefore seek to contribute to these developments. Notable dates in the planning include workshops on the ILC-inspired machine, at SLAC in June and Frascati in October of this year, respectively. A joint workshop aimed to establish convergence with the SuperKEKB team is also being planned for early 2007.