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STATEMENT OF INTEREST IN A

HIGH-ENERGY LINEAR e^+e^- COLLIDER

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Scientific Goals

A linear e^+e^- collider operating in the 500 GeV to 1 TeV energy range in the latter half of the next decade will be a vital facility to explore fully the new physics regime that will be probed by the LHC. The e^+e^- environment is intrinsically clean, the experimental signatures are expected to be clear, and details of the background physics processes are well calibrated against measurements at LEP, SLC, HERA and the Tevatron, leading to unambiguous discovery potential. Furthermore, one (or both) beams will be made highly spin-polarised to help unravel the spin structure of new dynamics. The operating centre-of-mass energies will be chosen successively to allow systematic study of a series of new particle thresholds; some of these may already have been discovered at the LHC. For example, likely first energy points will be above the thresholds for $e^+e^- \to Z^0 \quad H^0$, which current world data imply is below 300 GeV, and $e^+e^- \to t\bar{t}$; the Collider will provide Higgs and top 'factory' supplies of tens of thousands of particles per year.

A decade of experience with linear collider technology has been gained with the SLC at SLAC, and major test facilities for a next-generation collider have been operated at SLAC, DESY and KEK. For the main linac of this collider DESY is pursuing a superconducting design (TESLA), and the U.S. and Japan are collaborating on room-temperature X-band klystron technology (NLC/JLC). DESY has committed itself to presenting its Technical Design Report (TDR) to the German Government in Spring 2001; SLAC hopes to present its equivalent Conceptual Design Report (CDR) to the U.S. Dept. of Energy in Spring 2002, and KEK will deliver a similar document to the Japanese Science Ministry. Mechanisms for comparison of the respective designs and for worldwide coordination are now being discussed. In addition, CERN is studying a novel two-beam acceleration scheme (CLIC) which may eventually provide a path to the multi-TeV scale. A likely scenario is that a second-generation linear collider based on relatively mature X-band or superconducting RF technology will be built in the next decade to explore c.m. energies up to around 1 TeV; a two-beam accelerator may provide a later upgrade path to several TeV.

Current Activities

We are involved in many aspects of the Collider project.

• We have been playing leading roles in the studies to establish the physics case for the Collider, as part of the ECFA/DESY and Worldwide study groups. Several of us (GB, PNB, JMB, DJM, MHS, HTP, GWW) lead international working groups on physics simulations, detector design, and the accelerator/detector interface.

• We are engaged in R&D for the detectors. Those of us in the Linear Collider Flavour Identification (LCFI) Collaboration are building on the decade of experience gained at SLD/SLC to develop larger, thinner, faster readout CCDs for a high-precision vertex detector at the collider. A number of us with experience in LEP gamma-gamma physics and luminosity measurement intend to develop specialised calorimetry and other detectors for measurement of small angle electrons, both inside and outside the tungsten shielding mask which will sit at about 100 mr around the beam in the forward regions.

• We are starting a programme of accelerator physics and related studies. Some of us (GB, PNB, JMB, AKM, HTP, MWP, SLS, VPS, AW) have already been in contact with groups at SLAC, DESY and CERN as part of an assessment of the specific area of work most appropriate for a UK contribution. It is important to address topics not yet covered by the international collaborations, and which match current expertise in the UK and the interests of the particle physics community. We propose to develop tools to study the beam dynamics in the beam delivery system, particularly on issues relevant to backgrounds in the interaction region; this would mean the study of halo formation and collimation, secondary particle formation and instabilities arising from wake fields. The aim would be to optimise the design of the collimation section, as well as sections of the beam delivery system up to the interaction point. There are also opportunities for the development of generic RF technology, and one of us (DMD) has made a start on assessing the potential for a UK contribution in this field.

In all of these activities we are collaborating with colleagues in the European, North American and Asian study groups. We expect to play a major role in the production of the design reports for the accelerator and detectors. We welcome additional interest and participation from members of the UK particle physics and accelerator communities.

Strategy and Resources Required

• In the short term (definition and design phase: to 2002) we aim to develop sufficient expertise to be able credibly to take on responsibility for the engineering design of substantial parts of the Collider and detector(s).

We will request continued support for travel to allow us to maintain our leadership roles in the final phase of the ECFA/DESY and Worldwide studies, leading up to the presentation of the TESLA and NLC/JLC design reports. We will also require financial support for new personnel to start the accelerator-related R&D programme, as well as for travel to SLAC, DESY and CERN to work with the local Collider design teams. Subgroups of us have already applied successfully to the PPESP for travel support and detector R&D funds, as well as to PPARC for a CASE studentship. Applications to the PPARC Opportunity for support for starting the accelerator-related programme are pending. Subgroups of us shall continue to apply to the PPESP for specific project support, and also for 'responsive' RAs and PPARC resources for the rolling grants as appropriate.

• In the medium term (engineering phase: 2002-2005) we aim to develop and prototype hardware for both the collider and detector(s). We will explore opportunities for UK industrial participation; one company is already involved in development of NLC klystrons, as well as CCDs. We anticipate the need for resources at the level of £3M/annum.

• In the longer term (construction phase: 2005-2011) we expect the participation of UK physicists to increase dramatically as other programmes reach completion. We aim to build substantial components of the collider and detector(s) and estimate the need for resources at the Cashmore panel level of £116M total.

• In the long term (exploitation phase: 2011-2021) we aim to play a major role in the exploitation of the physics potential. We will require support for operations, as well as any upgrades.