Preface

The results from a linear electron positron collider, working in the centre of mass energy range from about 200 to 500 GeV and onwards to the region of 1 TeV, will be both strategically important and rich in detail. An international consensus [1] continues to grow — that this machine is needed, alongside the large Hadron Collider at CERN (the LHC), to address the fundamental questions on the origin of electroweak symmetry breaking: Is there a Higgs boson? Is Supersymmetry there as well? If neither the Higgs nor Supersymmetry exists, then what is the new physics that makes the standard model work so well, giving mass to particles and interconnecting the forces? Could it involve extra, hidden, spatial dimensions?

As was seen with the LEP and SLC colliders, an e^+e^- machine with the luminosity and precision required to address strategic questions will also shed light (and generate Ph.D. theses) on a rich variety of physics. Examples include the detailed properties of W and Z bosons and of the top quark, QCD, beauty, charm and tau-lepton physics; perhaps also the origins of CP violation. And if Higgs bosons are found, or Supersymmetry, their detailed properties will also be explored in ways which will be inaccessible to LHC.

This book is aimed at graduate students and others who want to understand the physics to be done at a next generation linear collider. It presents the whole range of topics which can be studied there, explaining the strategic situation in some theoretical depth and reporting the extensive simulations which have shown that clean samples of many different final states can be separated and measured, and how the important parameters can be extracted from them.

In August 2004 a panel of "wise persons" recommended [2] that the machine should be built using the superconducting technology that had been developed in the TESLA project. This choice was endorsed by ICFA (the International Committee for Future Accelerators) and is supported by all participating laboratories from around the world. At the time of going to press the accelerator designers who have worked on both the warm

(X−band) and the superconducting technologies [3] have got together in a Global Design Effort to produce plans for the International Linear Collider [4, 5]. A Conceptual Design Report for the machine is planned for the end of 2006, with commitment to construct in 2009 and completion in 2015. Government funding agencies from around the world are already meeting informally to review progress and they have welcomed the technology choice as a critical step in moving forward towards the design of a linear collider.

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References

1. International consensus document http://sbhep1.physics.sunysb.edu/ grannis/lc_consensus.html
2. Executive summary of the International Technology Recommendation Panel decision http://www.fnal.gov/directorate/icfa/execsum_ITRP.pdf
3. International Linear Collider Technical Review Committee; Second report, 2003. SLAC-R-606. This reviews all available linac technologies in great detail. http://www.slac.stanford.edu/pubs/slacreports/slac-r-606.html
4. The webpage of the International Committee for Future Accelerators reports progress on this process - see: http://www.fnal.gov/directorate/icfa/icfa_home.html
5. There is a new public webpage for the GDE at http://www.interactions.org/linearcollider/gde/