Preface to the second edition

Scientific knowledge is a body of statements of varying degrees of certainty – some most unsure, some nearly sure, but none absolutely certain.

Richard Feynman

The book on Particle Detectors was originally published in German ('Teilchendetektoren') with the Bibliographisches Institut Mannheim in 1993. In 1996, it was translated and substantially updated by one of us (Claus Grupen) and published with Cambridge University Press. Since then many new detectors and substantial improvements of existing detectors have surfaced. In particular, the new proton collider under construction at CERN (the Large Hadron Collider LHC), the planning for new detectors at a future electron–positron linear collider, and experiments in astroparticle physics research require a further sophistication of existing and construction of novel particle detectors. With an ever increasing pace of development, the properties of modern detectors allow for high-precision measurements in fields like timing, spatial resolution, energy and momentum resolution, and particle identification.

Already in the past, electron–positron storage rings, like LEP at CERN, have studied electroweak physics and quantum chromodynamics at energies around the electroweak scale ($\approx 100\,\mathrm{GeV}$). The measurement of lifetimes in the region of picoseconds required high spatial resolutions on the order of a few microns. The Large Hadron Collider and the Tevatron at Fermilab will hopefully be able to solve the long-standing question of the generation of masses by finding evidence for particles in the Higgs sector. Also the question of supersymmetry will be addressed by these colliders. Detectors for these enterprises require precision calorimetry and high spatial resolution as well as unanticipated time resolution and extreme selectivity of events, to cope with high backgrounds. Particles in crowded

https://doi.org/10.1017/9781009401531.001 Published online by Cambridge University Press

jets have to be identified to allow for the invariant-mass reconstruction of short-lived particles. Radiation hardness is certainly also a hot topic for detectors at hadron colliders.

Particle detection in astroparticle physics also presents a challenge. The origin of the highest-energy cosmic rays, even in spite of recent indications of possible correlations with active galactic nuclei, is still an unsolved problem. Detectors like in the Auger experiment or possibly also the giant IceCube array under construction in Antarctica will very likely find the sources of energetic cosmic rays either in our galaxy or beyond. Also the interaction mechanisms at very high energies, which are inaccessible at present and future accelerators and storage rings, will be attacked by measuring the shape and the elemental composition of the primary cosmic-ray spectrum beyond the expected Greisen cutoff, where energetic protons or nuclei are assumed to lose significant energy, e.g. in proton–photon collisions with the omnipresent blackbody radiation.

These modern developments in the field of particle detection are included in the second edition which is substantially updated compared to the first English edition. Also new results on modern micropattern detectors only briefly mentioned in the first edition and chapters on accelerators and neutrino detectors are included. The chapters on 'Electronics' and 'Data analysis' are completely rewritten.

We would like to mention that excellent books on particle detectors already exist. Without trying to be exhaustive we would like to mention the books of Kleinknecht [1], Fernow [2], Gilmore [3], Sauli [4], Tait [5], Knoll [6], Leo [7], Green [8], Wigmans [9], and Leroy and Rancoita [10]. There are also many excellent review articles in this field published in the literature.

We gratefully acknowledge the help of many colleagues. In particular, we would like to thank Helmuth Spieler for contributing the chapter on 'Electronics'. Archana Sharma has contributed some ideas for micropattern detectors and muon momentum measurement. Steve Armstrong assisted in rewriting the chapter on 'Data analysis'. Iskander Ibragimov very carefully transformed those figures which were recycled from the first edition, where they were just pasted in manually, into an electronic format. He also took care of the labelling of all figures to make them look uniform. T. Tsubo-yama, Richard Wigmans and V. Zhilich provided a number of figures, and A. Buzulutskov and Lev Shekhtman explained us several details concerning microstrip detectors. They also suggested a couple of relevant references. Some useful discussions with A. Bondar, A. Kuzmin, T. Ohshima, A. Vorobiov and M. Yamauchi were very helpful. Simon Eidelman and Tilo Stroh have carefully read the whole book and checked all problems. Tilo Stroh has also taken over the Herculean task to set the text in LaTeX, to improve the figures, to arrange the layout, and prepare a comprehensive index. This was of enormous help to us.

References

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