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In the last 20 years the disciplines of particle physics, astrophysics, nuclear physics and cosmology have grown together in an unprecedented way. A brilliant example is nuclear double beta decay, an extremely rare radioactive decay mode, which is one of the most exciting and important fields of research in particle physics at present and the flagship of non-accelerator particle physics.

While already discussed in the 1930s, only in the 1980s was it understood that neutrinoless double beta decay can yield information on the Majorana mass of the neutrino, which has an impact on the structure of space-time. Today, double beta decay is indispensable for solving the problem of the neutrino mass spectrum and the structure of the neutrino mass matrix. The potential of double beta decay has also been extended such that it is now one of the most promising tools for probing beyond-the-standard-model particle physics, and gives access to energy scales beyond the potential of future accelerators.

This book presents the breathtaking manner in which achievements in particle physics have been made from a nuclear physics process. Consisting of a 150-page highly factual overview of the field of double beta decay and a 1200-page collection of the most important original articles, the book outlines the development of double beta decay research _ theoretical and experimental _ from its humble beginnings until its most recent achievements, with its revolutionary consequences for the theory of particle physics. It further presents an outlook on the exciting future of the field.

Contents:
From the Early Days until the Gauge Theory Era
The Nuclear Physics Side _ Nuclear Matrix Elements
Double Beta Decay, Neutrino Mass Models and Cosmological Parameters _ Status and Prospects
Other Beyond Standard Model Physics: From SUSY and Leptoquarks to Compositeness and Space-Time Structure

The Experimental Race: From the Late Eighties to the Discovery of 0?ßß Decay
The Future of Double Beta Decay