

Chapter IV

ELECTROMAGNETIC AND WEAK INTERACTIONS IN THE NUCLEUS

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I. INTRODUCTION

Electromagnetic and Weak Interactions in the Nucleus constitute a vast and varied subject. These lectures cover a wide range but are by no means complete. We have tried to include all relevant topics that are of a fundamental nature. The main body of the lectures is at the graduate school level. Discussion of topics at this level are more detailed and self-contained. Topics at a more advanced level are treated comparatively briefly and are supplemented by references to the literature.

Chapter II introduces some basic concepts on scale, units and dimension that are useful in appreciating the magnitudes of observables discussed in these lectures. Here the basic ingredients of interactions - currents and fields - are also introduced and general formulas for the calculation of decay widths and cross sections are given. Chapter III deals with the electromagnetic interaction in the nucleus and Chapter IV with the weak interaction. A pattern that will emerge from these two chapters is that on the whole the electromagnetic interaction is used as a tool to probe nuclear structure whereas the nucleus is more often used as a laboratory to test our understanding of the weak interaction. The last section in III, on deformation, vibration and core polarization, perhaps would not come under the chapter under other circumstances. It was included here because the three phenomena play such an important role in revealing the electromagnetic properties of the nucleus and also because they probably would not be discussed by another lecturer in this Winter School. In Chapter V are topics pertaining to the relatively recent but extremely important discovery of the unification of the electromagnetic and weak interactions. Here the underlying picture that the unified electroweak interaction is an interaction among leptons and quarks, mediated by the vector bosons, the photon and the W-bosons, is brought forth. In Chapter VI another degree of freedom - the presence of mesons in the nucleus - is considered. Its manifestation in meson-exchange-current effects in the nucleus is discussed.