Structure functions in the three nucleon system

François René Pierre Bissey

Thesis submitted for the degree of
Doctor of Philosophy
at
The University of Adelaide
(Department of Physics and Mathematical Physics)

18th March 2002

Contents

Abstract

In this thesis, we study the structure functions, both polarised and unpolarised, of the three nucleon system and how they can give us information on two aspects of nuclear physics. First, we examine how to extract information on the free neutron structure functions and second we ask how does the nucleon's structure change in nuclei. Starting from a non-relativistic wave function for the three nucleon system, we use the standard convolution formalism to produce both polarised and unpolarised structure functions of ^{3}He and ^{3}H. In the unpolarised case we demonstrate a new way of extracting the unpolarised structure function F_2 of the neutron from the measurement of the EMC effects in both ^{3}He and ^{3}H. In the polarised case we discuss how close an approximation $g_1^{^3\mathrm{He}}$ is to g_1^n. We also study the different corrections which must be included to obtain the best possible estimate for g_1^n. In this case we study the nuclear effects included in the convolution formalism, the contribution of the Δ-resonance and novel off-shell corrections to the free structure functions inside ^{3}He computed in QMC (Quark Meson Coupling model). With respect to the effects of the nuclear medium on nucleons, this thesis presents estimates of the EMC effect in both ^{3}He and ^{3}H and of the nuclear medium on the Gottfried sum rule. Finally, we present a clear signature of off-shell effects on the proton inside ^{3}H. In this case off-shell corrections from QMC have been used but the results show that a variety of off-shell effects are, in fact, enhanced by the convolution formalism and consequently, can be similarly identified.