IN THE NAME OF GOD

STATISTICAL PRESCRIPTION OF FISSION FRAGMENT ANGULAR DISTRIBUTIONS

By

MOHAMMAD ALI DEHBOZORGI

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EVALUATED AND APPROVED BY THE THESIS COMMITTEE AS: **EXCELLENT**

A.N.BEHKAMI,Ph.D,PROF. OF PHYSICS.
(CHAIR MAN)

N.GHAHRAMANI,Ph.D,ASSOCIATE PROF.
OF PHYSICS .

H.NADGARAN,Ph.D,ASSISTANT PROF.
OF PHYSICS.

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Dedicated

To

My parents and my wife

for their patiance , forbearance and encouragement

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ABSTRACT

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Mohammad Ali Dehbozorgi

The statistical scission model (SSM) is explained and applied to analog reactions; ^{11}B,^{12}C,^{14}N+^{209}Bi [11].
In this model it is assumed to be analogous to complex particle evaporation,governed entirely by the phase space available at scission.
In this thesis we calculate variance S_0^2 (the most important parameter in SSM) by using theoretical calculations and experimental data. During the research, we understand a lot of important notes such as 'a'=A/8, 'E_D'=20 MeV, method of calculating l_{min} and l_{max} and so on. In addition we find D-Factor in form of special functions, Leg. and Gamma, and find new methods to calculate S_0^2 from experimental data.
Before this, in all research using this model, someone had used approximate parameters, but we try to use absolute values although it was too difficult.
As it is clear from Fig.6.1-3, we are too successful to use this model for mentioned reaction (it seems that using SSM for this kind of targets has being done for the first time).

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CHAPTER ONE

INTRODUCTION

Nuclear physics is a subject of enduring interest and importance. The nucleus of the atom is a unique example of a quantum system of relatively few particles displaying both single - particle and collective motions, and it is governed by three out of the four forces of nature, namely the electromagnetic, the strong nuclear and the weak interactions. The radiations from nuclei have found many applications in medicine, agriculture and industry, and nuclear fission may become the major energy source of the future until, perhaps, its place is taken by nuclear fusion.

Heavy element radioactivity has played a central role in the development of nuclear science ever since the penetrating radiations of uranium were discovered by Becquerel at the end of the last century.

The discovery of artificial radioactivity, the discovery of the neutron, the preparation of radioactive isotopes by neutron - induced reactions, the invention of machinery for the accelaration of charged particles, and the discovery of fission - events which occured in about a ten year span from 1930 to 1940 - led to great qualitative changes in our knowledge of the structure of nuclei and the nature of radioactivity. In one sense these developments switched emphasis a way from the heavy elements as the interest of experimentalists and theorists was drown to the study of artificial radioactivities of nearly every element in the periodic system. But the heavy elements were of unique importance for the phenomenon of nuclear fission Furthermore, the techniques for the preparation of artificial redioactivity were just as applicable to the heavy as to the light elements and were applied to them by many workers. It was a particularly interesting matter to explore the possiblility of synthesizing elements above uranium.

And about fission;

The story of the discovery of nuclear fission actually began with the discovery of the neutron in 1932 by James Chadwick in England. Shortly there after, Enrico Fermi and his associates in Italy undertook an extensive investigation of the nuclear reactions produced by the bombardment of various elements with this uncharged particle. The term fission was first used by the German physicists Lise Meitner and Otto Frisch in 1939 to discribe the disintegration of a heavy nucleus into two lighter nuclei of approximately equal size. The conclusion that such an unusual nuclear reaction can infact occur was the culmination of a truly dramatic episode in the history of science , and it set in motion an extremely intense and productive period of investigation. Nuclear fission is a complex process that involves the rearrangment of hundreds of nucleons in a single nucleus to produce two separate nuclei. A complete theoretical understanding of this reaction would require a detailed knowledge of the forces involved in the motion of each of the nucleons through the process. Since such knowledge is still not available, it is necessary to construct simplified models of the actual system to simulate its behaviour and gain as accurate a description as possible of the steps in the process.

The successes and failures of the models in accounting for the various observations of the fission process can provide new insights into the fundamental physics governing the behaviour of real nuclei, particularly at the large nuclear deformations encountered in a nucleus undergoing fission.

Whenever a fission happenes, we will have two or three fragments with some neutrons. One way to learn a lot about fission is considering these fragments angular distribution. Recently, there has been considerable interest in the angular distribution of fragments produced by heavy - ion [1,2]. For the first time, Winheld, Demos and Halpern [3] observed non isotropic fissin fragment in photo fission of ^{232}Th and ^{238}U. Such anisotropies were soon reported for fission induced by neutron and other charged particles [4,5].

Aage Bohr [6] then sketched out an extension of the transition - state model (TSM) [7] to address angular distributions. He suggested that when a heavy nucleus captures a neutron or absorbs a high energy photon, a compound nucleus is formed in which the excitation energy is distributed among a large number of degrees of freedom of the nucleus.

The complex state of motion there by initiated may be described in terms of collective nuclear vibrations and rotations coupled to the motion of individual nucleons. The compound nucleus lives for a relatively very long period, usually of the order of a million times longer than the fundamental nuclear period, after which it decays by emission of radiation or of