



Doctoral Thesis

## Nuclear spectroscopy with harmonic oscillator wave-functions

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# Nuclear Spectroscopy with Harmonic Oscillator Wave-Functions

THESIS

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by

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# Nuclear Spectroscopy with Harmonic Oscillator Wave-Functions

by Igal Talmi.

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*Zusammenfassung:* Die Beschränkung auf harmonische Zentralpotentiale ermöglicht die Entwicklung einer neuen (vom üblichen Slaterschen Verfahren verschiedenen) Methode zur Berechnung der Matrixelemente der Wechselwirkung zwischen den äusseren Nukleonen im Schalenmodell, welche insbesondere auch den Fall nichtzentraler Kräfte in einfacher Weise zu behandeln gestattet. Als Anwendung wird gerechnet: Die Ordnung der Niveaus in der  $j^n$ -Konfiguration, für einige physikalisch interessante Fälle; die von der Spin-Bahn-Kopplung zwischen den Nukleonen herrührende Dublettaufspaltung, und die Lage der untersten Terme von  $Li^7$  bei Berücksichtigung von Spin-Bahn-Kopplung und Tensorkräften.

## Introduction.

The discovery of the "magic numbers" and the general success of the shell model in explaining many experimental facts about nuclei have led theoretical physicists to work with the methods of atomic spectroscopy in the calculation of nuclear levels. In this attempt three main difficulties are encountered:

- (a) The form of the interaction potential and its exchange character are not sufficiently known. In addition, the form of the wave-functions can be only guessed. These facts make necessary the examination of various forms of the potential.
- (b) There exists a lack of sufficient experimental information about nuclear spectra. There are only a few excited states for which the spin and parity assignments have been carried out. Whereas in atomic spectroscopy it was possible from the vast amount of experimental material to determine easily the several parameters used to describe the atomic levels, here these parameters must be mathematically evaluated.
- (c) Non-central interactions, such as tensor forces, must here be taken into account, whereas in atomic spectra such interactions give a negligible small contribution.