STUDY OF THE NUCLEAR STRUCTURE OF RADIOACTIVE ISOTOPES

THESIS

Submitted in Partial Fulfilment of the Requirement

For

The Degree of

MASTER OF SCIENCE

in

PHYSICS

By

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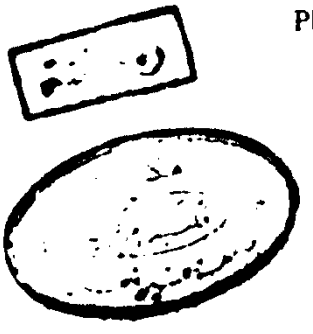

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قالوا

سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا
إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

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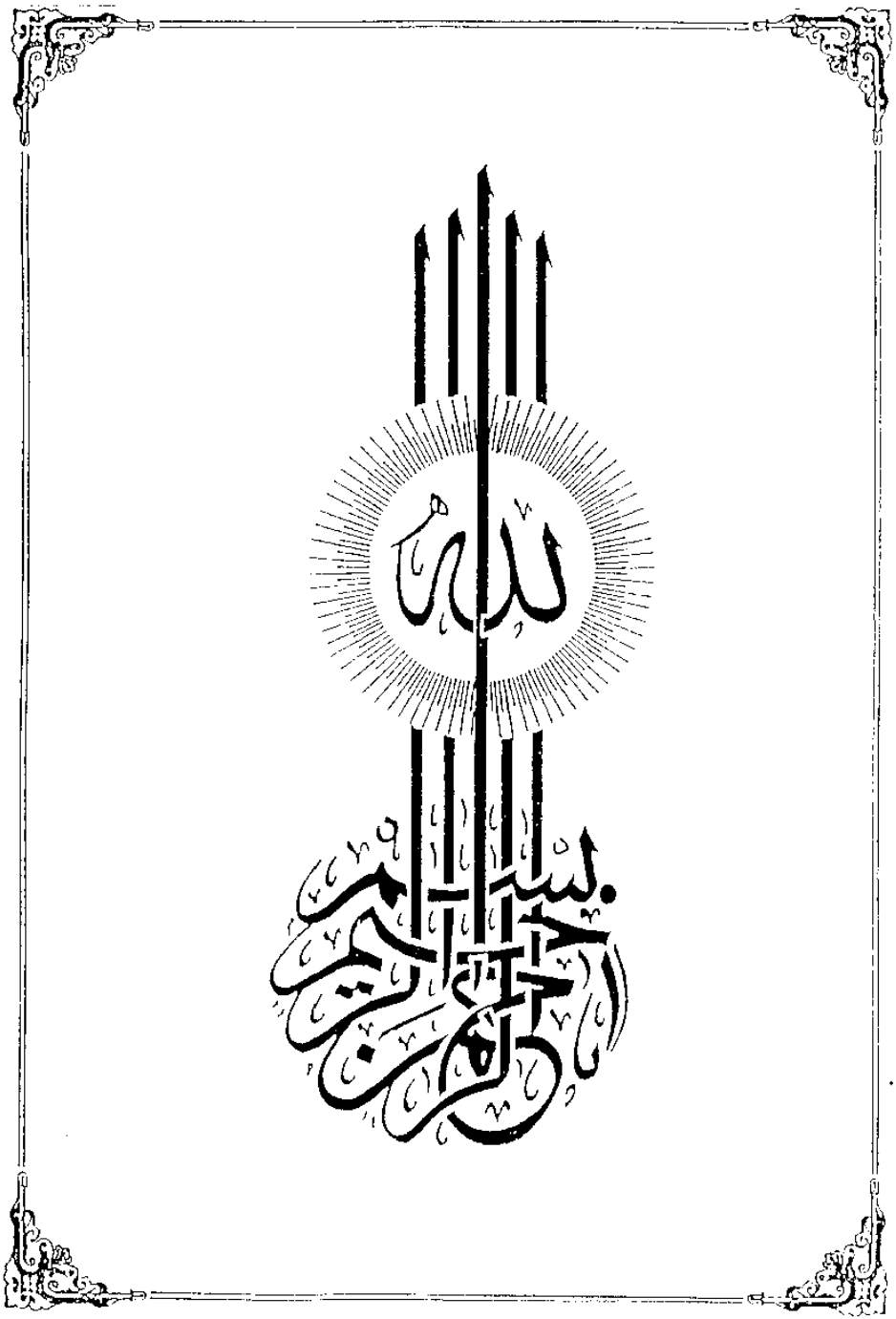

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STUDY OF THE NUCLEAR STRUCTURE OF RADIOACTIVE ISOTOPES

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ABSTRACT

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ABSTRACT

The decay of ^{129m}Te and ^{129g}Te to levels in ^{129}I has been studied using a planer hyper pure Ge detector for $E_\gamma \leq 40$ Kev and a coaxial hyper pure Ge detector for $E_\gamma \geq 40$ Kev. A NaI (Tℓ)- HPGe) fast - slow coincidence spectrometer was used to test and confirm the different cascades and a delayed coincidence spectrometer to measure the half life of the 27.55 Kev level.

Gamma-ray energies and intensities were extracted, from the singles gamma-ray spectra and the gamma-gamma coincidence spectra, and were fitted in a proposed decay scheme.

A total of sixty five gamma-rays are accounted for by nineteen excited states, eight gamma-ray transitions are confirmed to be in more than one position in the decay scheme.

Two new gamma rays at energgies 474.29 Kev and 632.52 Kev have been observed and confirmed for the first time in the present singles and/or gamma-gamma coincidence measurements. These new transitions could be fitted into the proposed level scheme also a couple of the previously observed gamma trainsitions were fitted in the decay scheme for the first time.

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The half life of the 27.55 Kev level was determined by the delayed coincidence method to be 15.3846 ± 0.0549 n.s.

The energy levels of the nucleus under investigation have been discussed and compared with previous work.

The experimental results are compared with theoretical predicted level values obtained using the weak coupling madel.

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SUMMARY

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SUMMARY

The study of decay schemes of radioactive nuclei provides a powerfull tool for testing the validity of nuclear models as well as for gaining knowledge about nuclear structure,and the knowledge of the liftime of a nuclear state provides the essential information to obtain transition matrix elements for comparison with theoretical nuclear models.

Various instruments are used to study gamma-ray energies and intensities; scintillation and semiconductor detectors are the most commenly used ones.

Scientillation detectors have better efficiency and timing properties; however semiconductor detectors have better energy resolution and are usually used for accurate determination of energies and intensities.

In the present investigation the gamma-ray energies and relative intensities in the decay spectrum of the 33 day ^{129m}Te and 70 min state of ^{129g}Te isotopes was accomplished using a coaxial hyper pure Ge and a planer hyper pure Ge in singles gamma-ray spectrometers.

The different cascade relationships were studied and confirmed through gamma-gamma coincidence experiments using

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a fast-slow coincidence spectrometer in which a scintillation detector was used for gating purposes.

A delayed coincidence spectrometer was used for life time measurements. The used spectrometers were tested and calibrated before the measurements.

The Thesis Contains Three Chapters:-

Chapter (I) contains some theoretical basis; Interaction of gamma-rays with matter, gamma selection rules and a general review on the nuclear disintegration process

Chapter(II) contains a general descripion of the equipments used in the gamma singles spectrometer , the gamma-gamma fast-slow coincidence spectrometer and the delayed coincidence spectrometer used for lifetime measurements. In addition the different tests and spectrometer calibrations are included.

Chpater (III) is concerned with the present experimental results which can be summarized as follows.

Gamma-ray energies and intensities were extracted from the singles gamma-ray spectra and the gamma-gamma coincidence spectra, and were fitted in a proposed decay scheme.

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A total of sixty five gamma-rays are accounted for by nineteen excited states, eight gamma-ray transitions are confirmed to be in more than one position in the decay scheme.

Two new gamma-rays at energies 474.29 Kev and 632.52 Kev have been observed and confirmed for the first time in the present singles and / or gamma-gamma coincidence measurements. These new transitions could be fitted into the proposed level scheme.

The previously observed gamma transitions at 415.58 and 918. 07 Kev were fitted in the decay scheme for the first time.

According to the present singles and / or coincidence results the levels at 343, 560, 1022, 1077, 1083, 1378 and 1427 Kev previously observed by different authors were not confirmed and therefore not included in the proposed decay scheme . Yet the levels proviously proposed at 1047.02, 1196.4, 1204.07 and 1209.51 Kev were confirmed.

The half life of the 27.55 Kev level was determined by the delayed coincidence method to be 15.3846 $\pm$ 0.0549 n.s.

The energy levels of the nucleus under investigation have been analysed discussed and compared with previous work.

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