Ain Shams University
Faculty of Girls for Art.
Science and Education
Physics Department

STUDY OF RADIATION DOSE-DEPTH DISTRIBUTION USING SOLID STATE DETECTORS

Thesis Submitted in Partial Fulfillment
of the Requirement for M.Sc. Degree in Physics

Presented by

KASSEM ABDEL HALIM MOSTAFA

Supervisory Committee

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Head of Nuclear Research Center
A.E.A.

Prof. Dr. M.A. El Fiki
Head of Applied Physics
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Date of Research:

Approval Stamp

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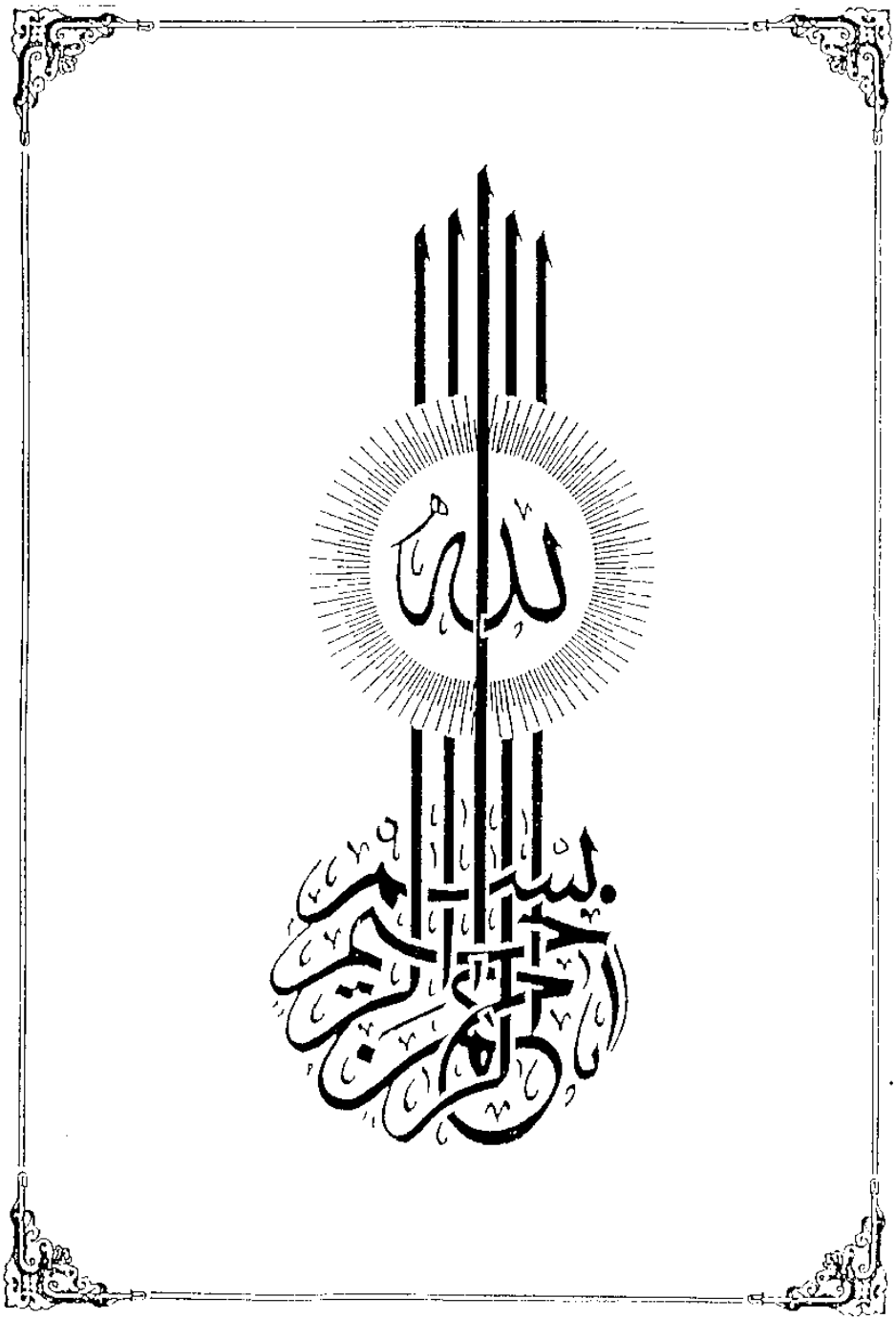
Approval of Faculty Council

Approval of University Council



Name of Student: Kassem Abdel Halim Mostafa

Title of Thesis: Study of radiation dose-depth distribution using solid state detectors

Scientific Degree: B. Sc.

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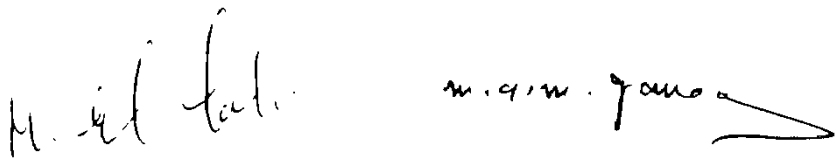
ABSTRACT

In radiotherapy it is Customary to derive the dose given to a tumour from ion chamber measurements at fixed position and measured depth dose curves. As the accuracy of delivered tumer dose using TLD's at more than one position, for high energy photon and electron beams were energy independent. An intercomparison study of TLD LiF 700 chips and tlat ionization chamber which show that the TLD system can used successfully for depth dose determinations.



SUMMARY

1-a- A sets of TLD's crystals each set 25 crystals from different types of LiF (100, 600 and 700) were used.

b- The irradiation of the irradiated dosimeters were carried out using a Harshow 3000 TL analyzer. The response was determined by integrating the TL intensity between the room temperature (25°c) and (280°c) with a heating rate of 10°c / sec at 30 sec.

c- The samples were annealed before irradiation by heat treatment viz 1hr at 400°c followed by 2hr at 100°c. After 24hr the TL reading of the irradiated samples were taken.

d- A correction for TLD readings have been made by a set of TLD's crystals, each set 25 chips to cobalt 60 gamma rays. The average reading for TLD's chips was determined and a correction factor for each TLD chips was obtained.

2-a- For the water absorbed dose calibration, the NE 2571 cylindrical chamber with the victoreen electrometer (Model 500) was used.

b- The reference point of the chamber was positioned at 5cm depth in the standard water phantom (20 × 20cm) at the centeral axis of gamma ray beam emitted from the THERATRON 80Co-60 unit.

c- The forgoing calibration system was also applied for absorbed dose calibration of the electron beam using the full scattered standard phantom (30 × 40cm) at the reference point of measurment (5cm).

d- For the central axis depth dose measurment the surface dose was determined according to the photon and electron beam energies by fixing the flat ionization chamber (without cap) on its tray at the surface of the water back scatter phantom (20 × 20cm).

e- For the studies of the dose response and energy dependence by using the TLD (100, 600 and 700) LiF crystals the irradiation was done on the surface of the standard water phantom (20 × 20cm) as a back scatter by fixing the TLD crystals in a tray carton to make a separation between the crystals about 1mm to be irradiated from all sides, and centralize the beam axis in the center of the chips.

f- For the comparative studies of central axis dose-depth measurments between the flat ionization chamber and TLD's crystals LiF 700, the surface dose was determined according to the photon and electron beam energies, 8MVand 6, 10, 12, 14, 17 MeV respectively by fixing the tray carton with the samples in sets 3 or 4 crystal emersed in the perspex sheats on the surface of the standard phantom.

g- Following the same steps of previous experiment in geometry of irradiation and arrangement of samples to,study the central axis depth dose distribution by using the standard perspex phantom 30 × 30cm sheats. To have the deferent depths by adding the sheats gradually over the samples in the steps of irradiation.

According to the forgoing experimental set up and irradiation conditions, the following measured characteristics of TLD[LiF]chips have been obtained:

a- The energy dependence of LiF TLD crystals (100, 600, 700):the energy dependence was measured at different photon energies (140 k V, Cs^{137}, Co^{60}, 8 and 16 M V) and for electron energies from 6 to 17MeV. The surface dose given to the TLD chips fixed at water tank was 1Gy. We found that the sensitivity of the TLD dosimeters decreases with increasing the photon energy. While there is an energy

independence for the electron energies. Also it was found that LiF 700 has the highest response.

b- Dose dependence of LiF TLD crystals (100, 600 and 700):the dose dependence was measured at different photon and electron doses from 0.5 up to 5Gy for different photon energies from 140k V up to 16 M V and different electron energies from 6 to 17 MeV. We found that there is a linear increase in the dosimeters sensitivity LiF 700 has the highest sensitivity for the dosedependence measurments. Also it was found that the dose dependence decreases with increasing the photon energy. The dose dependence of LiF crystals (100, 600 and 700) irradiated with electron doses found that there is a small dose dependence with increasing the electron energy.

c- For the usefulness of the TLD 700, dosimeter to study the dose distribution measurements, central axis depth-dose in prespex phantom measurments, was done for various electron beam energies, the depth doses measured using both flat ionization champer and LiF 700 dosimeters. So that the given dose at the surface of the phantom was 2Gy, the depth doses at all the energies obtained at 6 to 17 Mev show a basic similarity in shape but the penetration in prespex phantom increases with increasing beam energy.

f- Intercomparison of central axis depth-dose measurments was obtained by using the flat ionization chamber and LiF 700 TLD dosimeter for 8 M V photon and different electron energies ranges from 6 up to 17 MeV electrons. The dosimeters used in the procedure are inserted and centered in plate which is machined to accept the chamber and the TLD chips. These plates can be inserted into any desired stack of plane prespex sheets,so that the dosimeters can be

irradiated at different depths.The comparison of the central axis depth-dose data showed that, the curves are very similar and gives the same depth dose curves within experimental limits. Also the practical parameters determined from the central-axis depth-dose measurments for photon and electron beam energies using the flat chamber and LiF chips indicate no significant difference between the two techniques.

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CHAPTER.I
INTRODUCTION