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COMPARATIVE STUDY BY MONTE CARLO SIMULATION OF RPL GD-301, TLD-100 AND AI2O3:C DETECTORS RESPONSES

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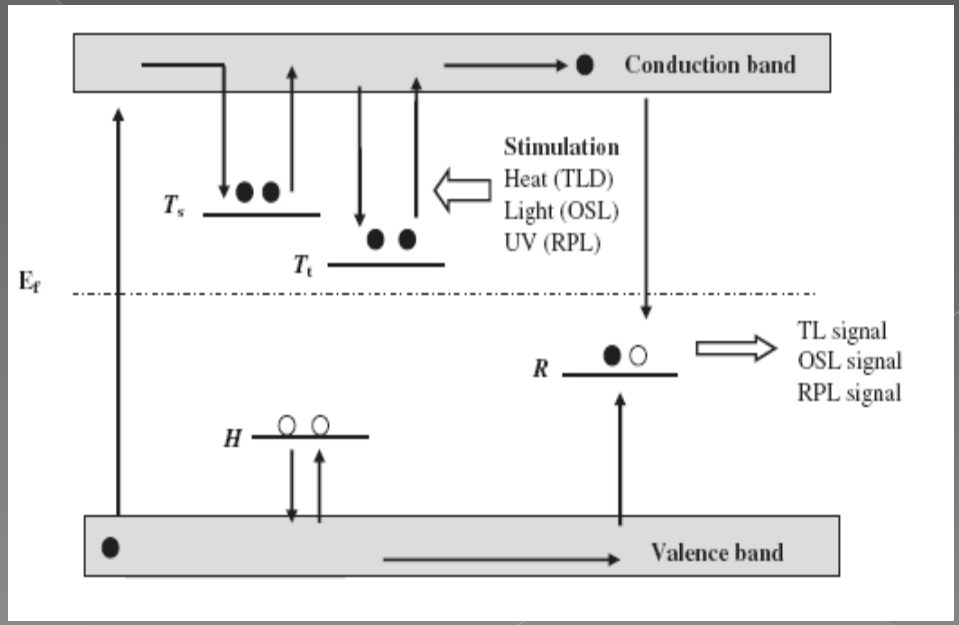
INTRODUCTION

For the monitoring of patient dose in external radiation therapy, the luminescent dosimeters are widely used, where the physical processes of their three types are very similar.

1.Thermoluminescence (TLD);
2.Radiophotoluminescence (RPL);
3. and Optically stimulated luminescence (OSL).

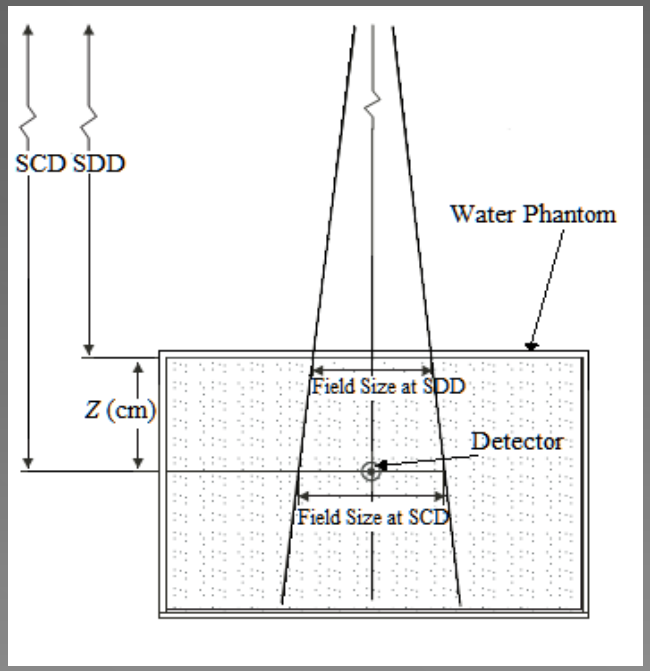


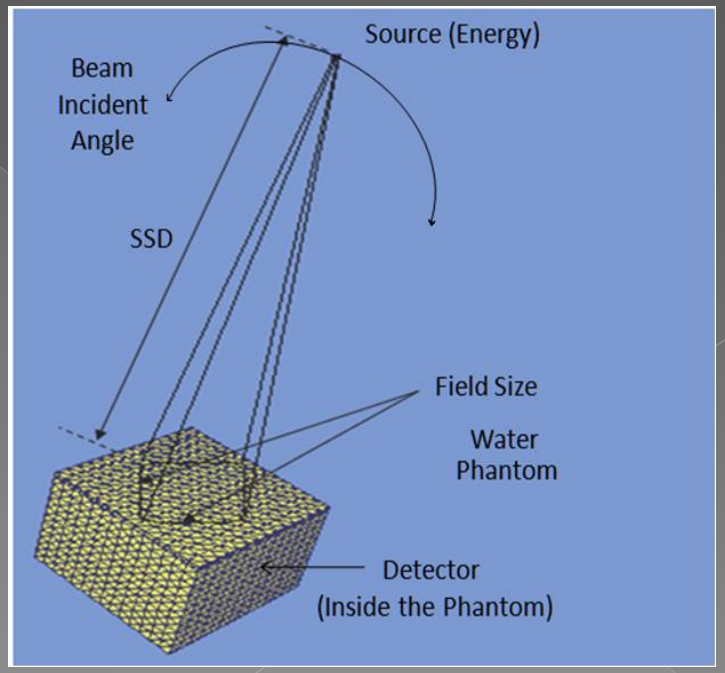
PURPOSE

The purpose of this work was to compare the dosimetric proprieties of three kind of luminescent detectors, RPL glass dosimeter, commercially known as GD-301, with lithium fluoride TLD-100 (LiF:Mg,Ti) and carbon-doped aluminum oxide (Al2O3:C).

METHODS & MATERIALS

In our study, a Monte Carlo simulation with MCNP5 was carried out to estimate the responses of these dosimeters in terms of absorbed dose, output factor, the angular and energy dependence.





The simulations were carried out for 700 millions histories for each orientation, which yielded the relative error less of 0.5 % was obtained for each single calculation.

$H_{Q,Q0}$ obtained is referred to as the Monte Carlo calculated energy dependence

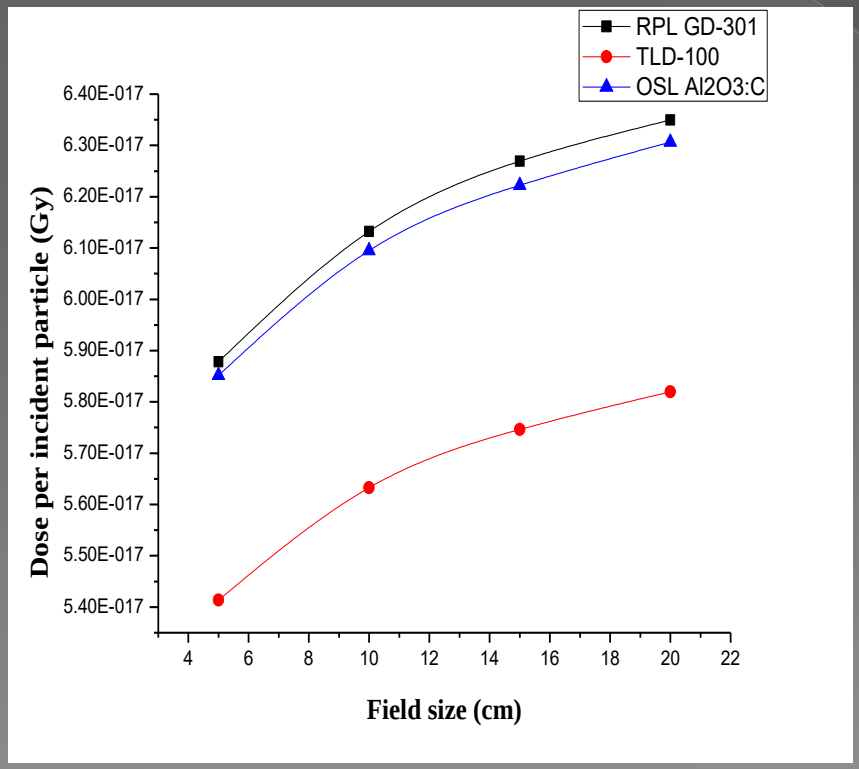
$$F_{Q,Q_0} = \frac{(r/D_w)_Q}{(r/D_w)_{Q_0}} = \frac{(r/D_{dos})_Q}{(r/D_{dos})_{Q_0}} \frac{(D_{dos}/D_w)_Q}{(D_{dos}/D_w)_{Q_0}} = G_{Q,Q_0} H_{Q,Q_0}$$

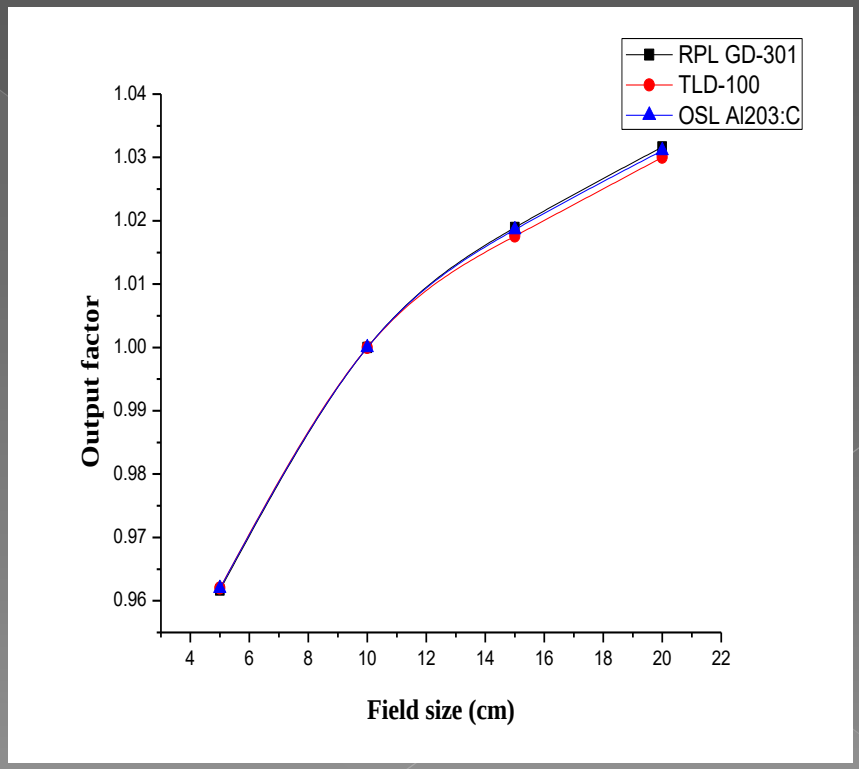
$$H_{Q,Q_0} = \frac{(D_{dos}/D_w)_Q}{(D_{dos}/D_w)_{Q_0}}$$

$$k_{Q,Q0} = (F_{Q,Q0})^{-1} = (H_{Q,Q0})^{-1}$$

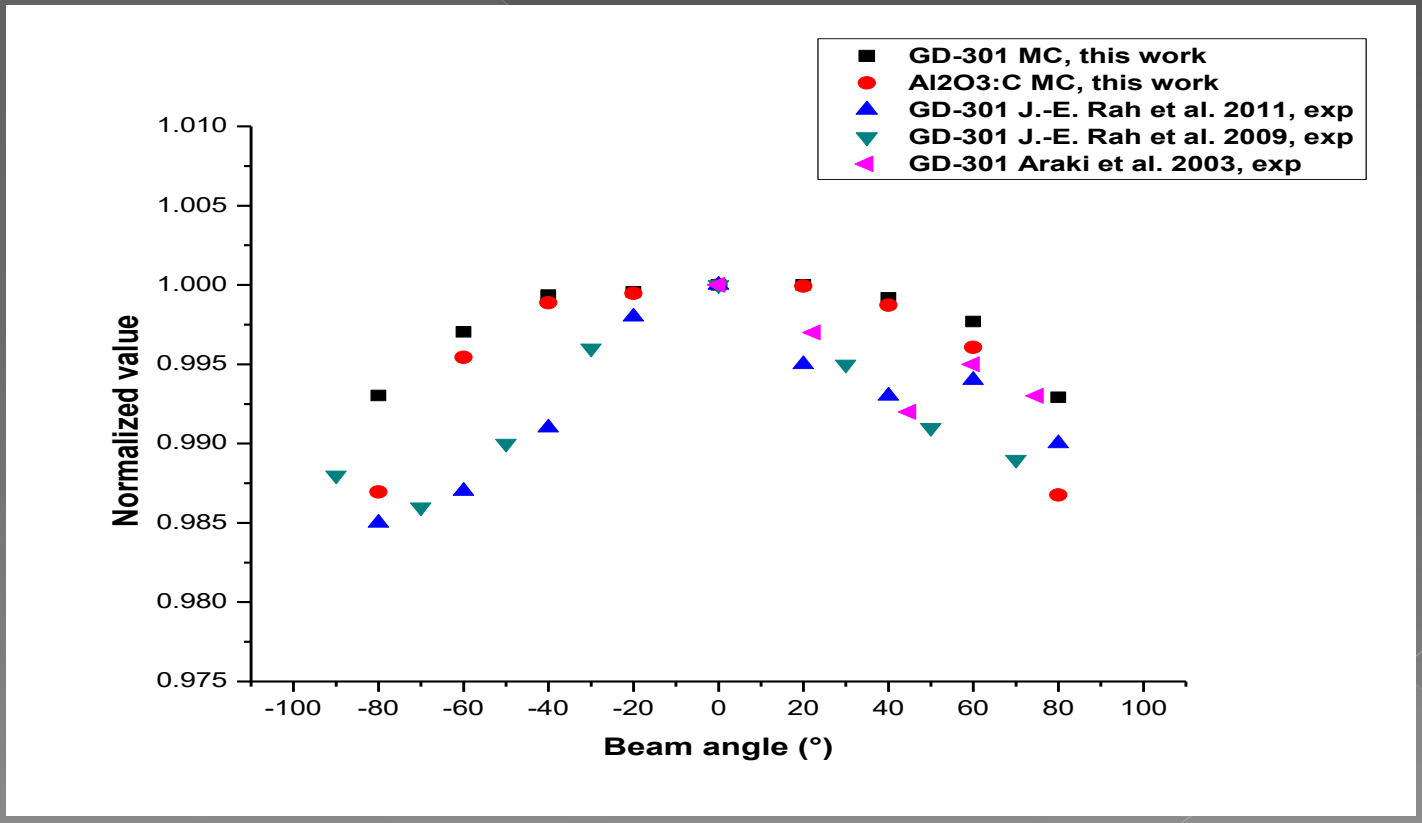
RESULTS & DISCUSSIONS

In this work we found that the difference between the output factor was less than ±4.2 % for the three dosimeters.





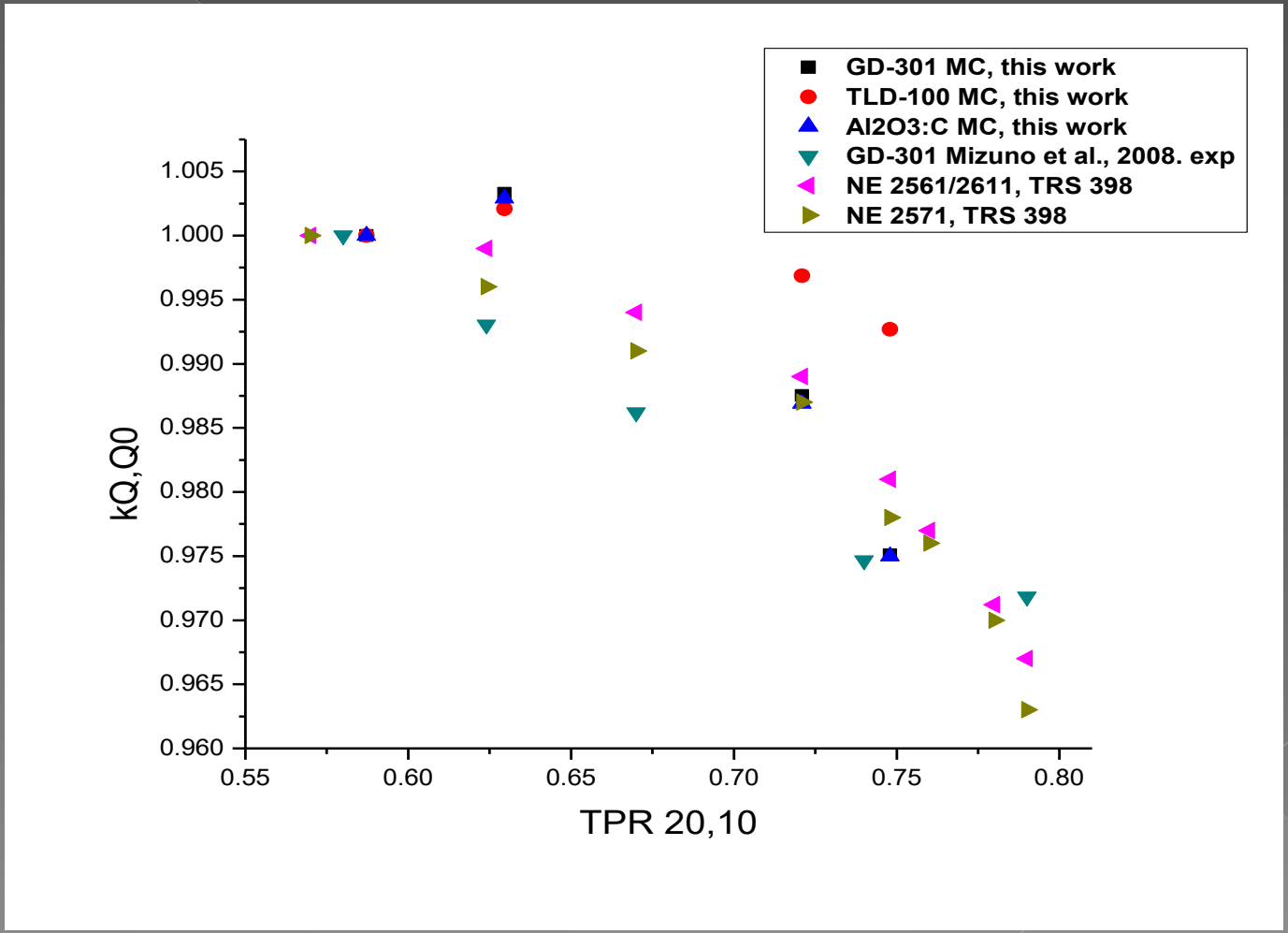
The variations in sensitivity for angles up to ±80° from the central axis of the beam were approximately 1% and 1.5 % for the GD-301 and Al_2O_3:C, respectively.



The energy dependence of dosimeters are in the next table. The results were in agreement with published data (*Mizuno et al.* 2008; *Waldeland et al.* 2010; *Rah et al.*, 2011).

Energy response ($F_{Q,Q0}$), with megavoltage photon beams in water phantom				
Energy	$TPR_{20,10}$	GD-301	TLD-100	Al_2O_3:C
Co-60	0,587	1	1	1
6 MV	0,630	0,996	0,998	0,997
10 MV	0,721	1,013	1,003	1,013
15 MV	0,748	1,026	1,007	1,026

The next figure show the values of kQ,Q0 as a function of photon beam quality, Q (TPR20,10).



CONCLUSION

From the results, it is concluded that the dosimeters RPL GD-301, TLD LiF:Mg,Ti and OSL Al_2O_3:C have a considerable potential use for clinical and experimental dosimetry especially for in-field dose measurements in radiotherapy.