

# A Dosimetric Evaluation Using the Monte Carlo Method Considering Geometric Variations of the Iodine-125 Seed for Brachytherapy

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## INTRODUCTION

IPEN is studying a new iodine-125 seed model, with similar geometry to Amershan/GE, seen in Figure 1 (nominal). This source is used in brachytherapy.

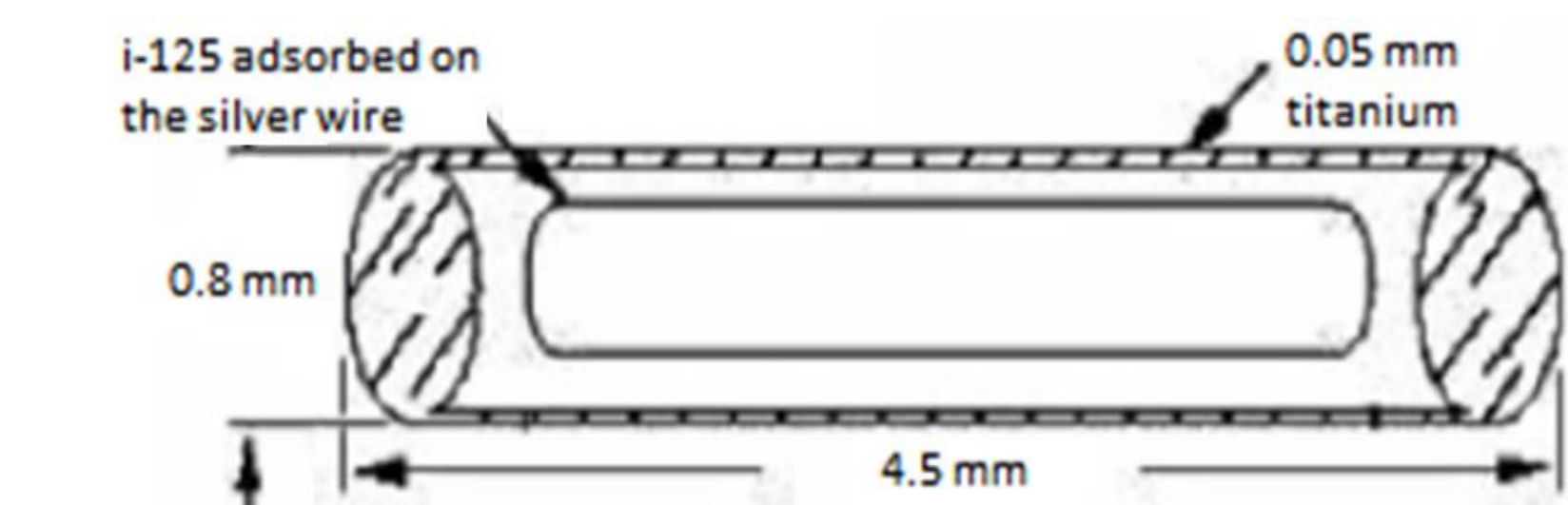


Figure 1. Iodine-125 seed geometry.

The Task Group 43 dosimetric protocol does not take into account possible geometric variations of the seed for simulation. The objective is to investigate two geometric variations with Monte Carlo simulation.

## METHODOLOGY

A batch of 100 seeds with the following variations was investigated: a) 100 seeds with varying lengths; b) 100 nuclei of varying length. To measure the variations, a caliper was used. The measurements were used to write 100 inputs for each variation. The variations and the nominal seed were simulated by Monte Carlo. The results were evaluated by MATLAB up to 4.5 centimeters around the seed. The following calculations were applied: relative difference in variation a) and b) in relation to the nominal seed, standard deviation for tests on the same batch and Type A uncertainty for each simulation.

## RESULTS AND DISCUSSION

For variation a), values ranging from 4.48 mm to 4.69 mm were found, with an average of 4.58 mm. For variation b), values ranged from 2.91 mm to 3.03 mm, with an average of 2.97 mm. According to Figure 2 a and b, the most significant points are far from the seed and do not exceed 4.48% for the relative difference.

The result may be related to the variation in the welds at the ends of the seed, as in points with less titanium there is less dose attenuation.

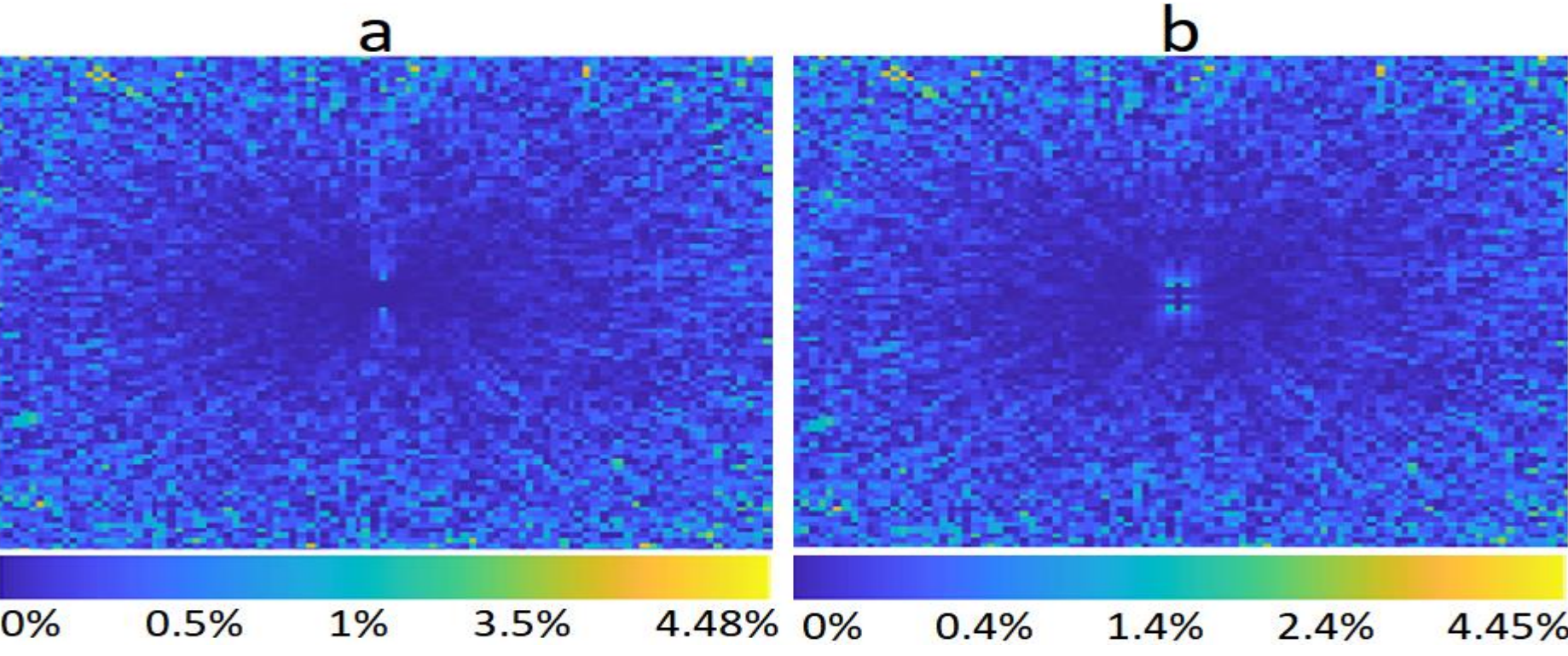


Figure 2. Relative difference. a) seed length; b) core length.

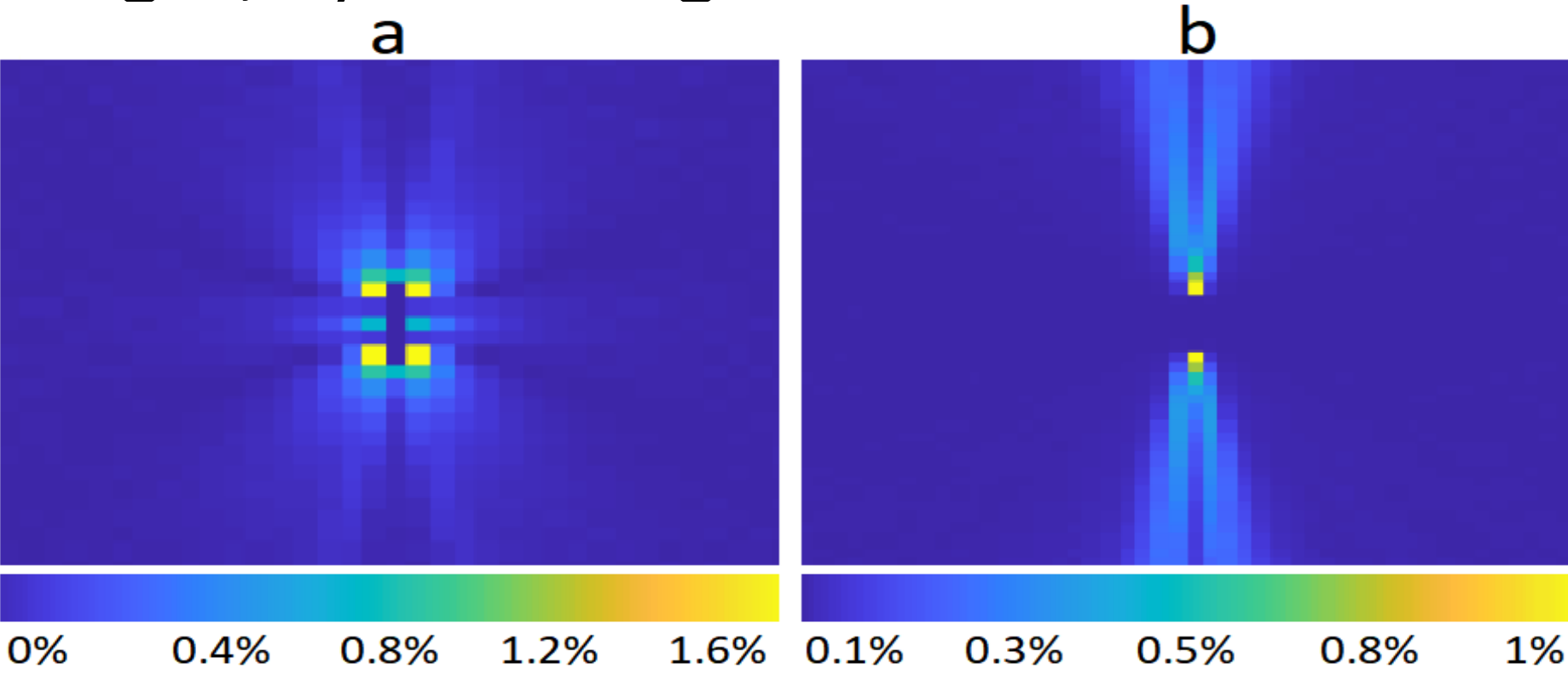


Figure 3. Standard deviation. a) seed length; b) core length.

According to figures 3 a and b, the highest percentage for standard deviation was 1.6% at points around the nucleus, but it is not significant. For Type A uncertainty, there was no point around the seed above 0.0018%, this guarantees the reliability of the simulations.

## CONCLUSIONS

The relative difference and standard deviation must be taken into account in future work, because the final dose (with variations) is discrepant from the requested (nominal) dose. It is necessary to improve the seed approval methodology during conception, so that it approaches the reference geometry.

## ACKNOWLEDGEMENTS

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