

# Is the transient dose significant and is it compensated in GK Icon?

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## INTRODUCTION

Gamma Knife ICON has three collimators: 4mm, 8mm, and 16mm, and therefore three on-off treatment positions (Figure 1). Each has its own inherent transient dose and time (timer error). The 16mm has an additional transient dose from the 4mm collimator when the source is passing it by. The transient doses could be significant clinically and therefore need to be measured.

## AIM

The current timer error calculation method measures the integral dose. It cannot separate the inherent transient dose from the inherent transient dose. For large chambers, the 4mm collimator dose is undervalued and the overall accuracy is subpar.

This study uses a new differential method to measure the transient dose and time directly using a fast electrometer.

## METHOD

- Standard LGK measurement setup: 16cm diameter solid water phantom, CNMC PR05P chamber, Sun Nuclear PCElectrometer, with scanning rate at 0.05 sec;
- From Gamma Plan (RTP), plan and export three shots, all at (x, y, z) = [100, 100, 100] mm which is the center of the phantom / chamber; with shot time of 6, 6, and 9 sec, for collimators 4mm, 8mm, and 16mm, respectively;
- Deliver the three shots. Note, although all three shots are at the same point, GK source will go back to the Block position after each shot;
- The differential data is plotted (see Figure 2). The current data is collected every 0.05 sec. The 4mm collimator contributions in the 16mm collimator treatment are the two triangles, one before and one after;

## RESULTS

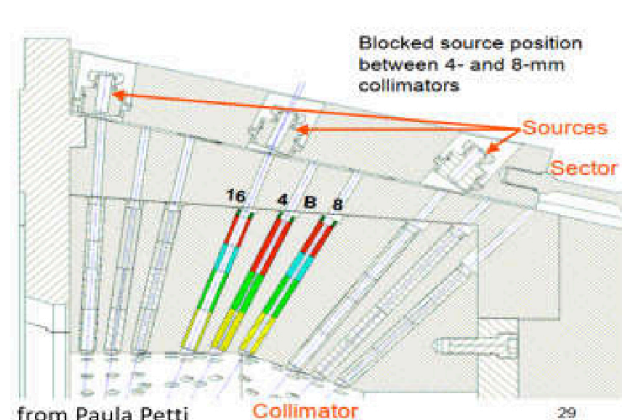


Figure 1. Sagittal view of LGK ICON Collimators

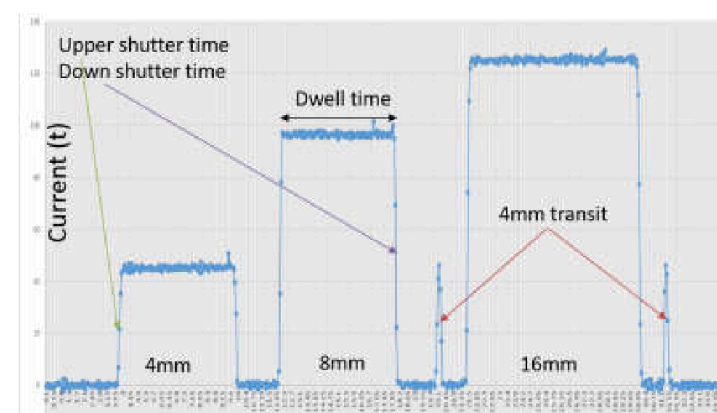


Figure 2. Differential data Current of every 0.05 sec. 4mm contribution are shown.

t(sec)	4mm-in	Up-shutter	Dwell	Down-shutter	4mm-out	Error + dwell	nominal	Diff	Diff%
4mm	NA	0.10 ± 0.03	5.81 ± 0.02	0.10 ± 0.02	NA	6.01 ± 0.04	5.98	0.03	0.50%
8mm	NA	0.07 ± 0.03	5.89 ± 0.02	0.07 ± 0.02	NA	6.03 ± 0.04	6.00	0.03	0.60%
16mm	0.15 ± 0.02	0.18 ± 0.02	8.54 ± 0.02	0.18 ± 0.02	0.15 ± 0.02	9.2 ± 0.2	8.99	0.2	2%

For 4mm, 8mm, and 16mm collimators, respectively:

- The up and down shutter time is the same for all collimators;
- The timer errors are 0.2, 0.14, 0.66 sec, 3%, 2%, 7% of 6, 6, 9 sec;
- The timer errors are compensated: timer error + dwell time = nominal;

The dwell time is 5.81, 5.89, and 8.54 sec for the nominal shot time of 6, 6, and 9 sec for 4mm, 8mm, and 16mm; (Nominal shot time = dwell time + timer error) proves that the transient doses are compensated in LGK ICON;

## CONCLUSIONS

- For all three collimators, the up-shutter time (timer error) is the same as the down-shutter time;
- 8mm collimator has the smallest shutter time;
- For 16mm collimator, the shutter time 0.36 sec is comparable with the 4mm transient time of 0.30 sec;
- The transient dose is significant;
- The transient dose is compensated;

## REFERENCES

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## CONTACT INFORMATION

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