Small Organic Scintillators for Dosimetry

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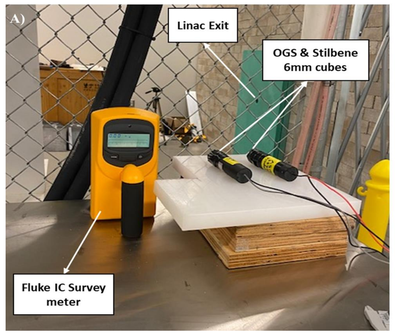
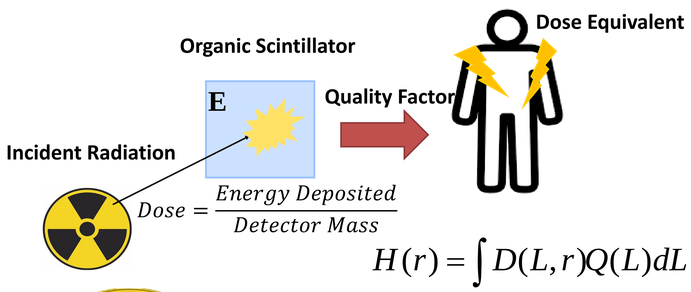
Introduction and Motivation

- Radiation dose monitoring and whole-body dose assessment are essential aspects of radiation protection and safety.
- Commonly used dose monitors are sensitive to one radiation type (photon/neutron).
- Dual dosimeters have potential to measure photon/neutron dose with a single device.



- We tested applicability of small organic scintillators (OS); 6 mm cube stilbene and Organic Glass Scintillators (OGS) as a dual dosimeters for photon dosimetry.

Theory



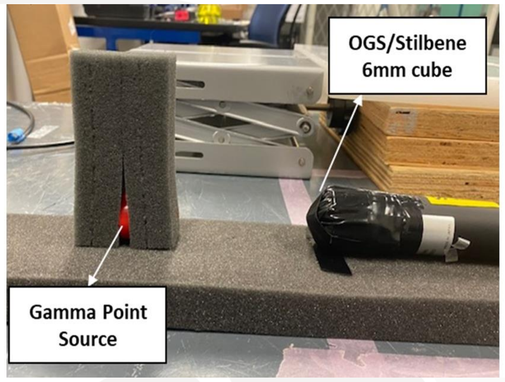
$$Dose = \frac{Energy\ Deposited}{Detector\ Mass}$$

$$H(r) = \int_L D(L,r)Q(L)dL$$

H: dose equivalent
L: Linear energy transfer
Q: Quality factor
r: Measurement point in the detector

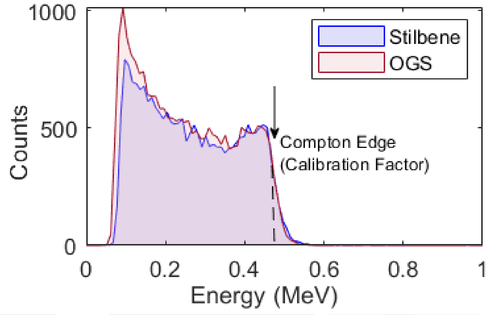
Experimental Setup

Stilbene, OGS cubes measured dose from several photon isotropic sources; ^{137}Cs, ^{22}Na, ^{60}Co and a 9 MV research Linac.



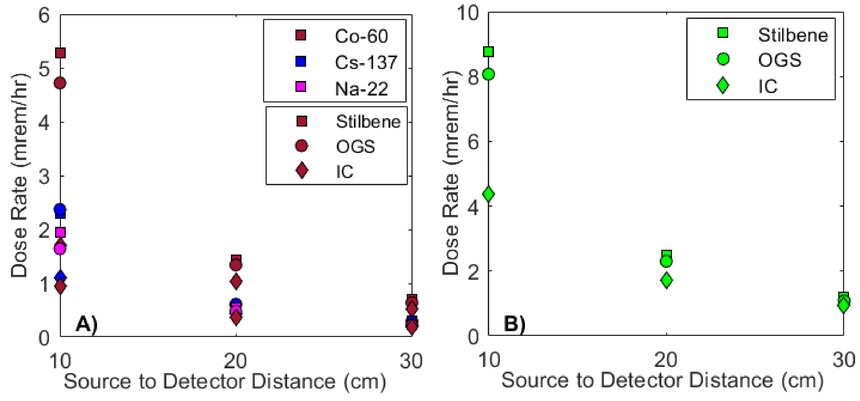
Measured Energy Deposition

Pulse integral measured with OS detectors reflects the effective energy deposition range and the resulting calibration factor. Figure shows the deposited E spectrum and the differences in the measured threshold between stilbene, OGS.



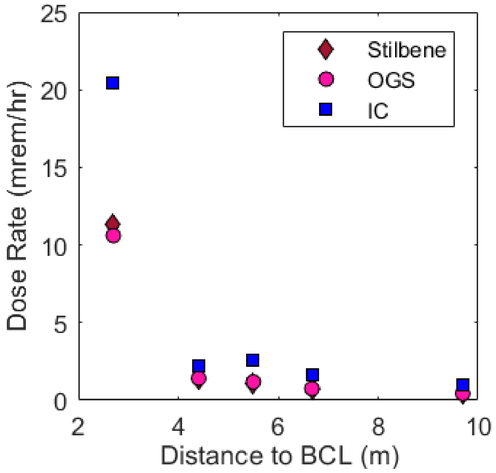
Dose Results

Dose measured with stilbene and OGS are comparable. At 10 cm doses with OS was twice the IC readings for all sources. Dose decreases as distance to source increases.



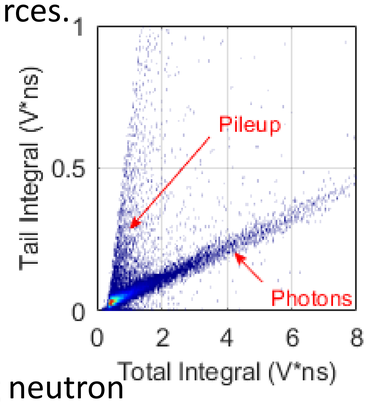
The measured equivalent dose for the different isotopic photon sources measured at different distances to the detector using stilbene, OGS and Fluke IC A) for different point sources B) all point sources measurement

Dose measured with stilbene and OGS are comparable and always lower than IC readings due to pileup effect and smaller detector size. Dose decreases as distance to BCL increases.



Conclusions

- The method showed agreement with simulation results within 20% or less for isotropic energy sources.
- The high source rate of linac resulted in high pulse pile-up effect, further corrections are needed to improve results.



Next Steps: Performing neutron measurements and testing 2.54 cm thick crystals for Linac measurements.

MTV Impact

- The OGS were casted in collaboration with Sandia National Lab
- This approach will have wider applications for personnel dose monitoring in non-proliferation applications, industry and medicine.

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