



A Novel Mouse Dosimetry with MOSFET Technology in Orthovoltage X-ray Irradiator

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Goals

- Application of MOSFET technology in small animal dosimetry using TLD as gold standard
- Determine the efficacy of MOSFET in small animal dose assessment

Materials

- X-ray Irradiator: AGFA X-RAD 320 orthovoltage (AGFA NDT Pantak Seifert GmbH & Co.KG, Ahrensburg, Germany)
 - Irradiator parameters: 135 kVp and 22 mA
 - filter type #4 (0.1 mm Copper + 2.5 mm Aluminum).



Materials

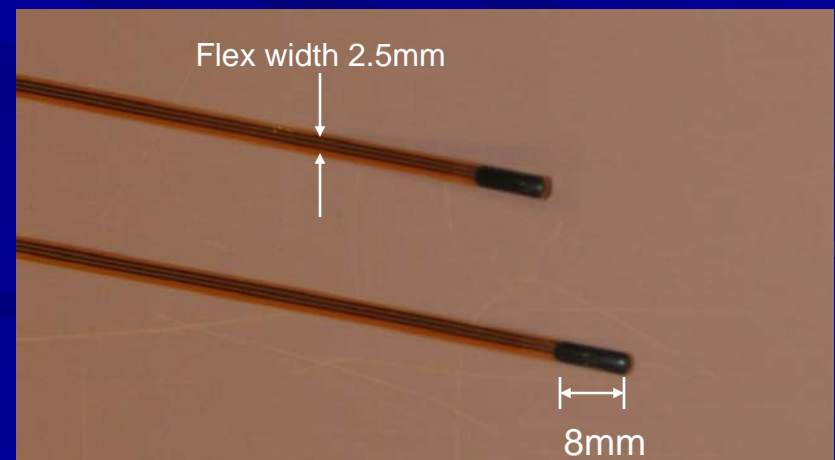
- mobileMOSFET dosimetry system (Best Medical Canada, LTD, Ottawa, Canada)
 - mobileMOSFET wireless system (model TN-RD-70-W)
 - PC-based user interface software (TN-RD-75)
 - Bluetooth wireless transceiver (TN-RD-38)
 - Reader module (TN-RD-16)
 - 5 high sensitivity detectors (TN-1002RDM)

Materials

■ Metal Oxide Semiconductor

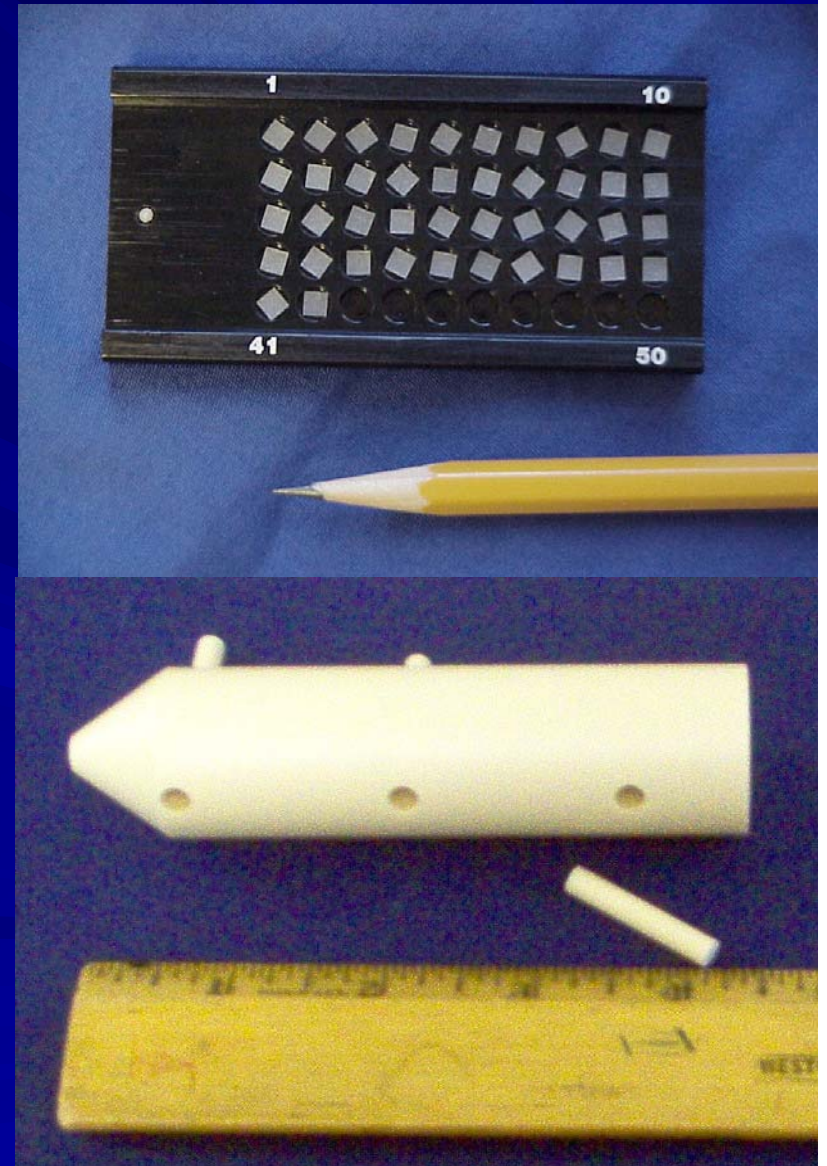
Field Effect Transistor (MOSFET)

- Active area 0.2mm x 0.2mm
- Voltage measurements are proportional to absorbed Dose



Materials

- Harshaw TLD-100 chips (Thermo Scientific, Franklin, MA)
 - TLD dimensions:
 $3 \times 3 \times 1 \text{ mm}^3$
- Ion Chamber 6cc (Model 9015, Radcal, Monrovia, CA)
- Tissue equivalent mouse phantom (CIRS, Norfolk, VA)
 - 115.4 mm x 29 mm diameter



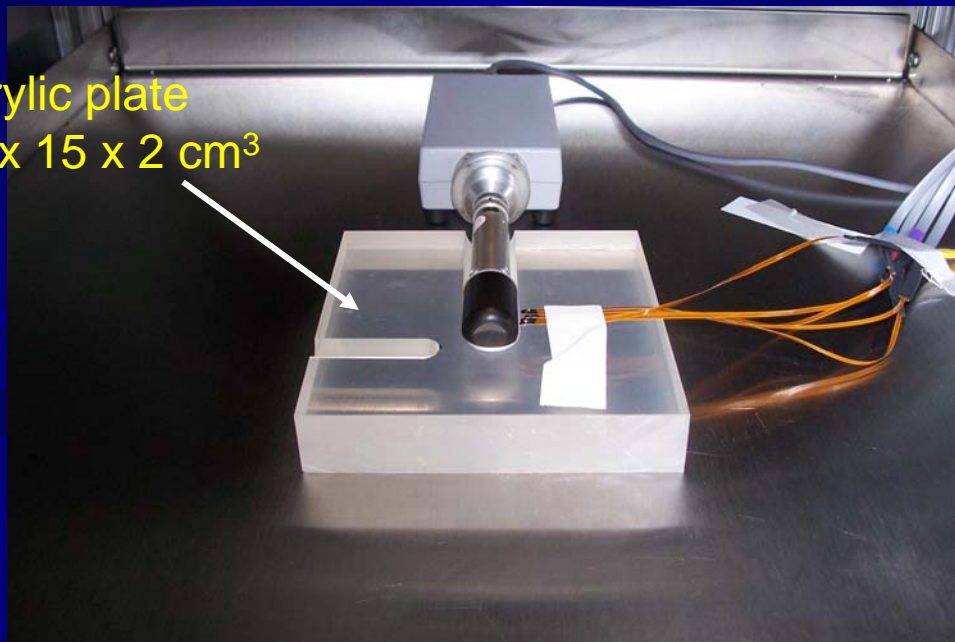
Methods

mobileMOSFET calibration

MOSFET calibration parameters			
Run	Time (min)	X (R)	Dose (cGy)
1	5	445.4	390.17
2	5	447.3	391.83



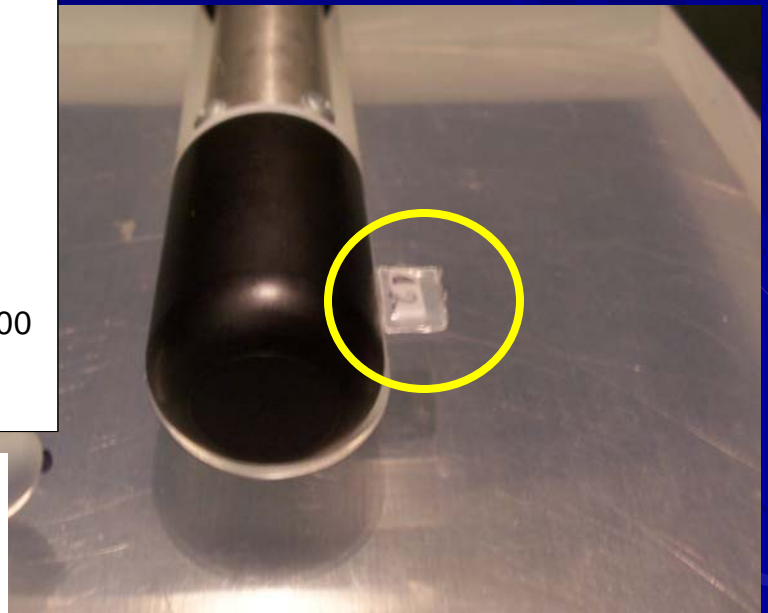
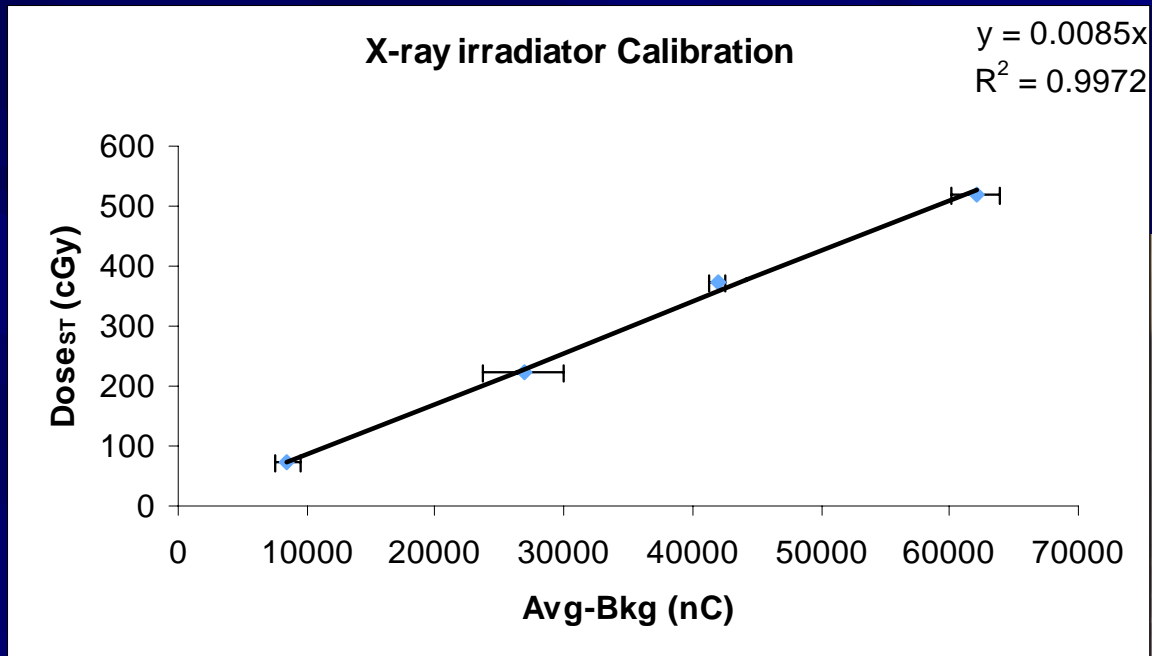
Acrylic plate
15 x 15 x 2 cm³



Dosimeter	CF (mV/cGy)
1	4.68
2	4.49
3	4.71

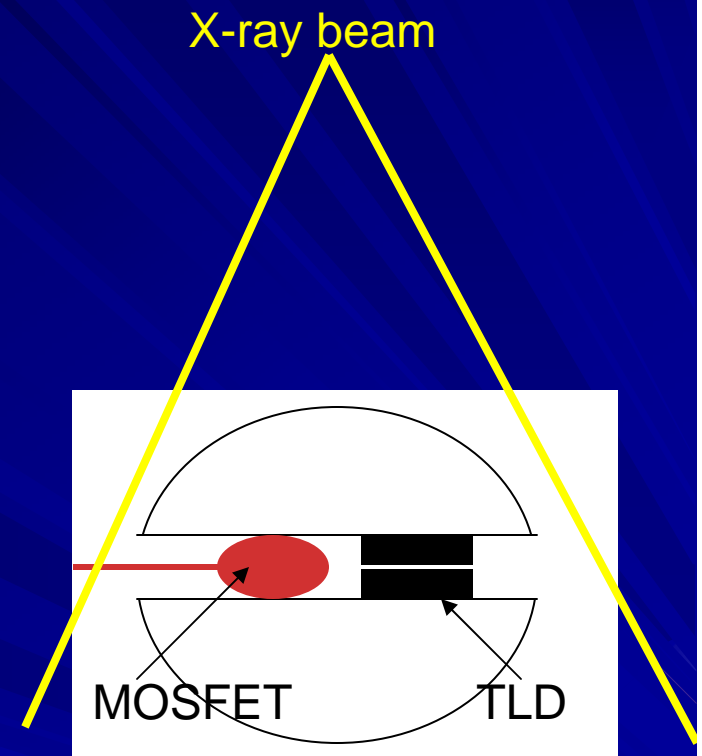
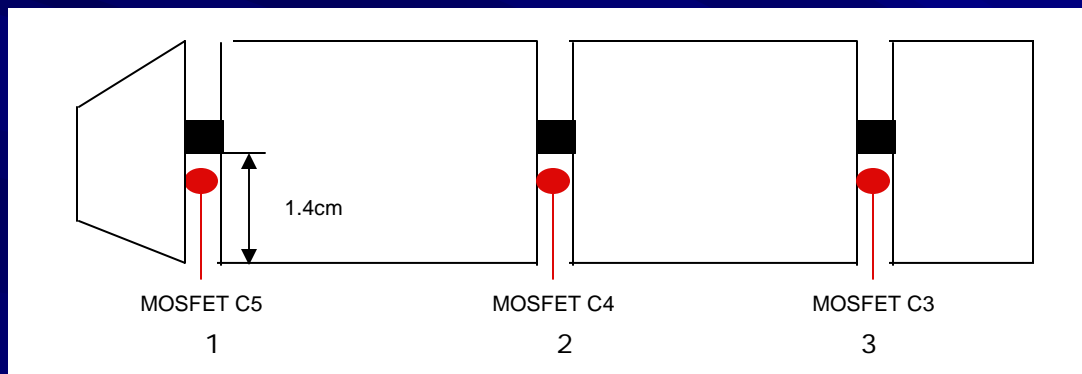
Methods

TLD calibration



$$D_{ST}(\text{rad}) = 0.867 \left(\frac{\text{rad}}{R} \right) \cdot X(R) \cdot \frac{\left(\frac{\mu}{\rho} \right)_{ST}}{\left(\frac{\mu}{\rho} \right)_{Air}}$$

Methods



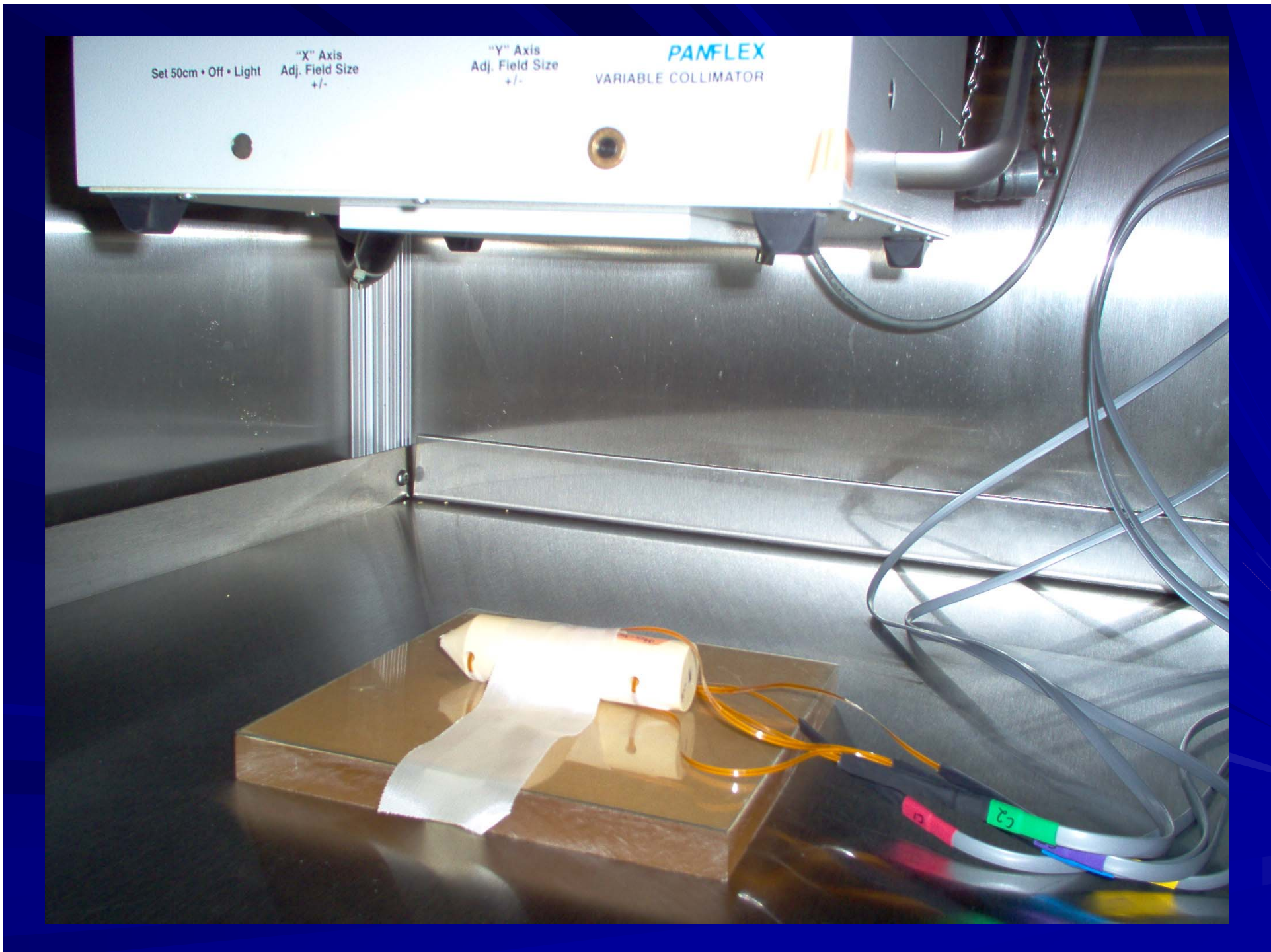
- MOSFET detectors (red)
- TLD (black)

Set 50cm • Off • Light

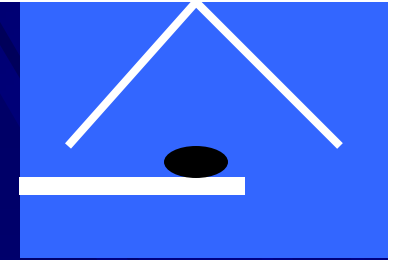
"X" Axis
Adj. Field Size
+/-

"Y" Axis
Adj. Field Size
+/-

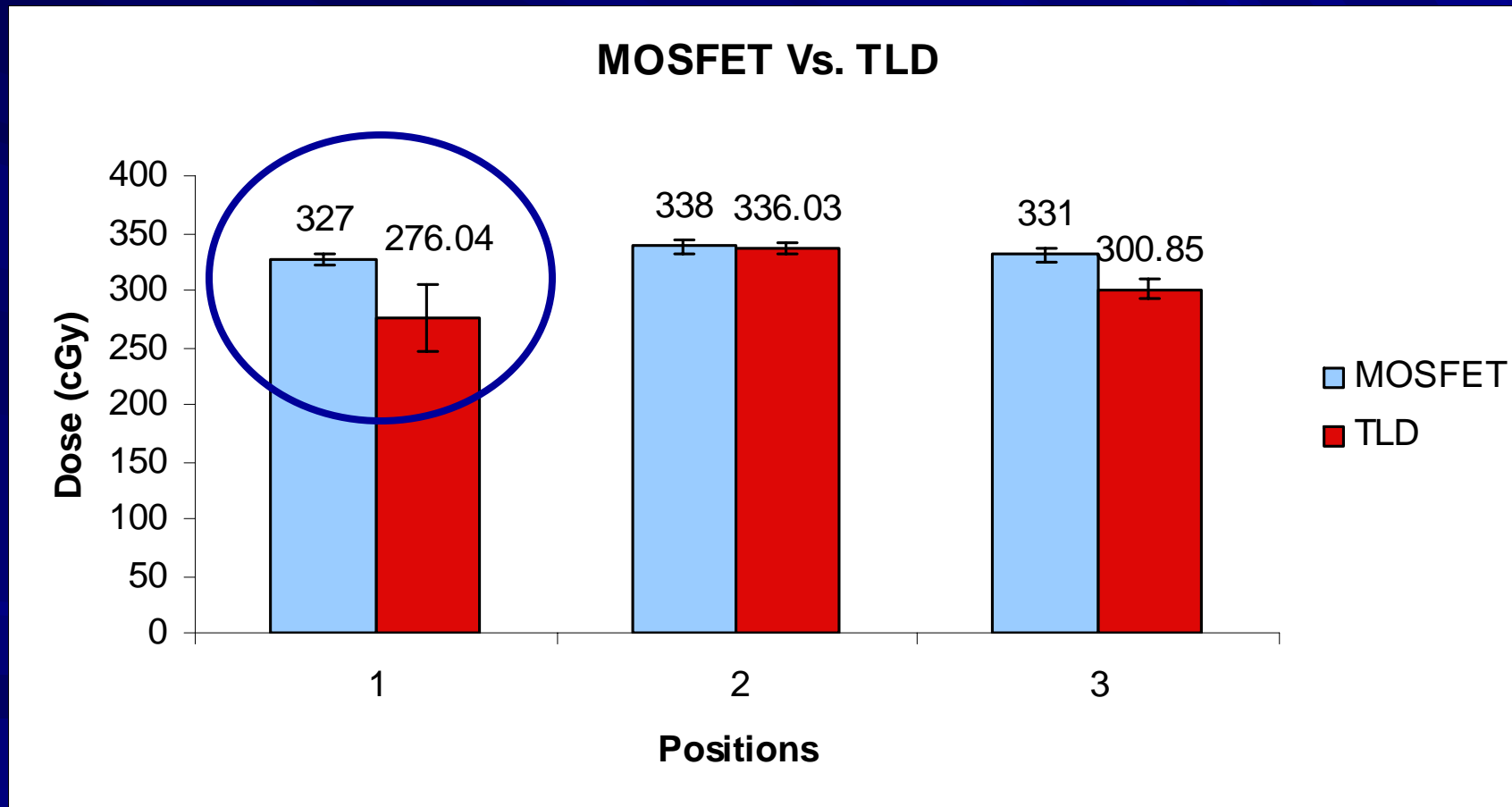
PANFLEX
VARIABLE COLLIMATOR



Results

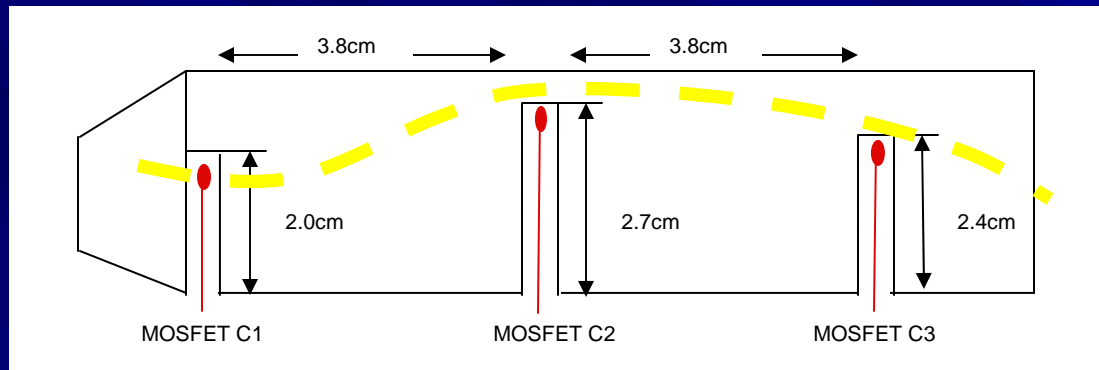


- Detector surface Perpendicular to the beam



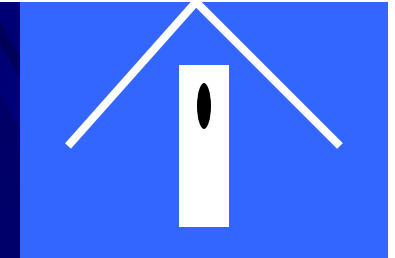
Additional Results

- long-axis of detector surface parallel to the beam

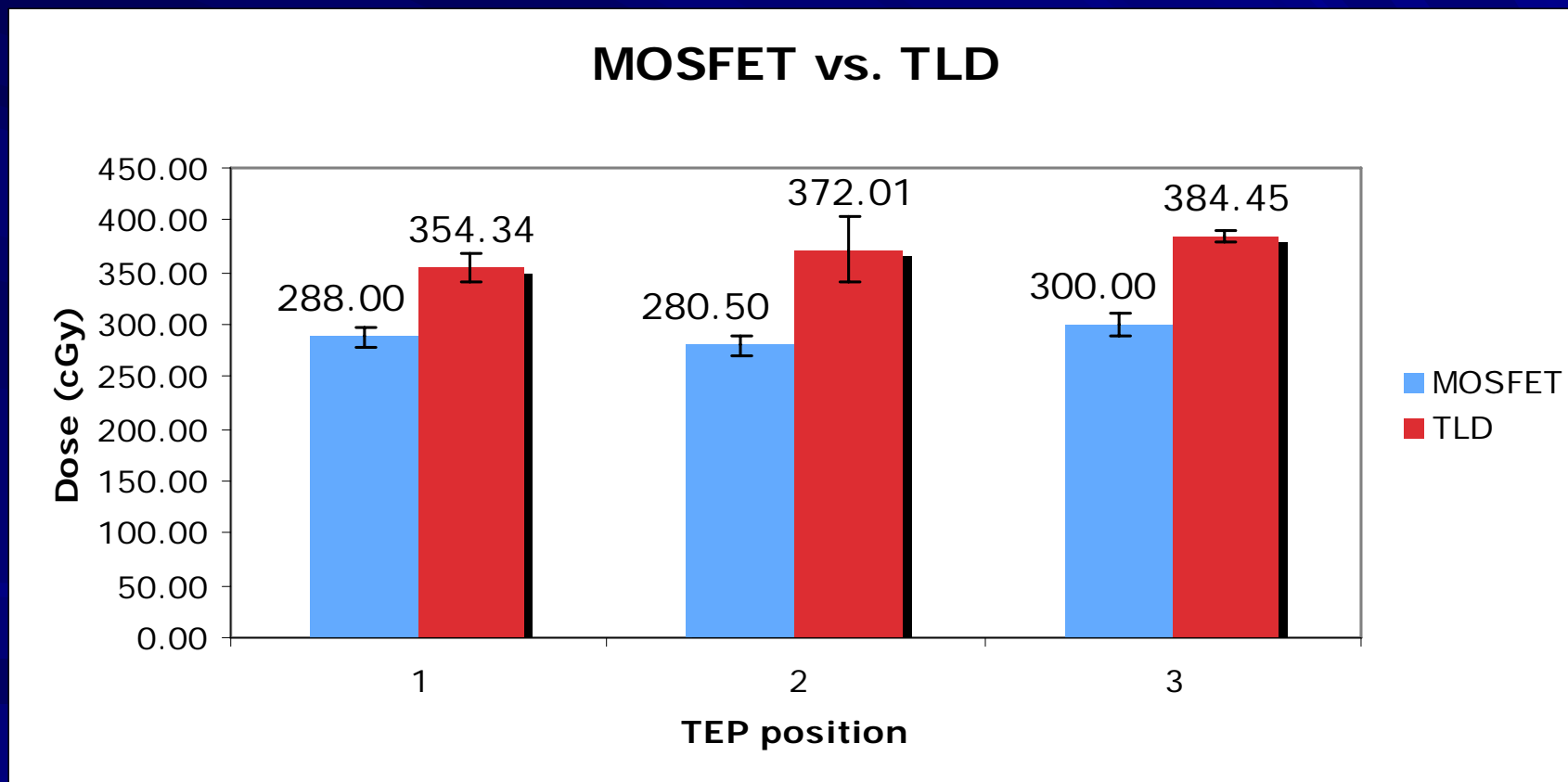


X-ray beam

Additional Angular Dependency Results



- long-axis of detector surface parallel to the beam



Conclusion

- MOSFET showed good agreement with TLD
- MOSFET advantages:
 - Small size
 - Immediate readout
- MOSFET disadvantages
 - Energy dependence
 - Costly (> \$22k for small animal dosimetry)
- MOSFET provides alternative to labor-intensive TLD method

Acknowledgments

- Beverly Steffey
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