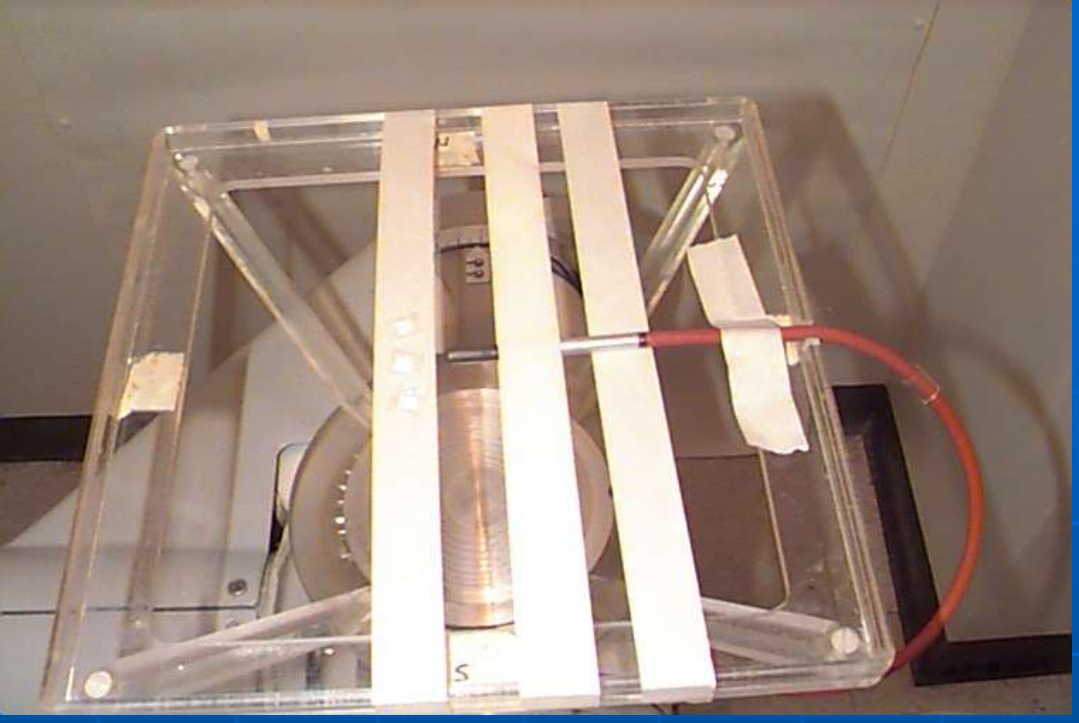
Additional Comments about Calibration of Orthovoltage



Pantak 300 Calibration and Constancy

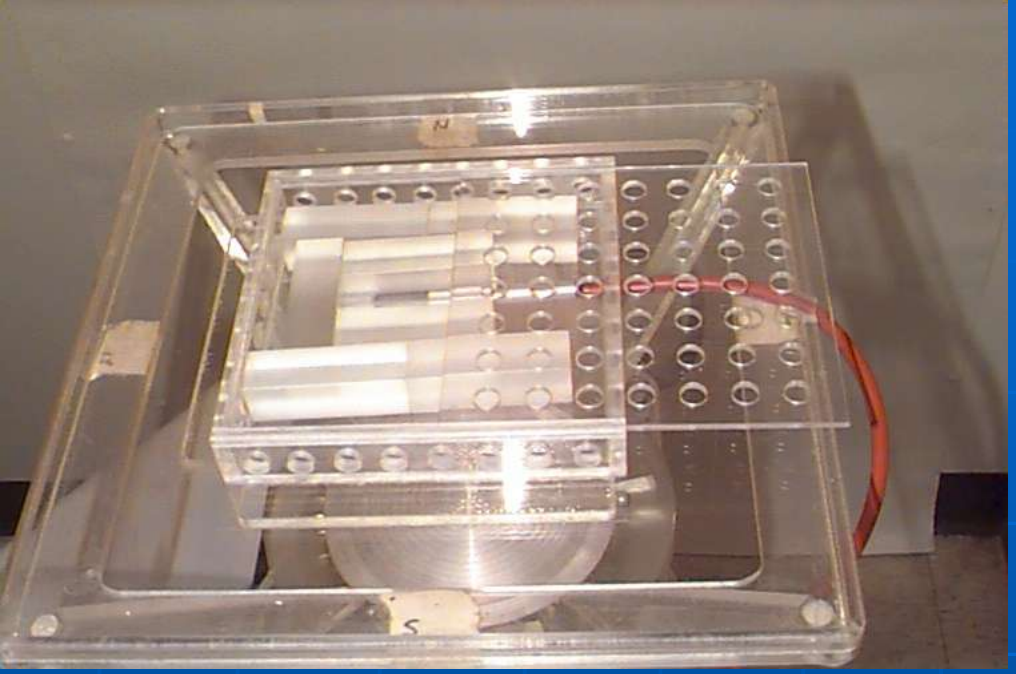
Calibration in-air small volume thimble chamber

TLD as redundant check

Constancy Jig using same ion chamber

Very reproducible set up - quick

Flattening filter can be seen

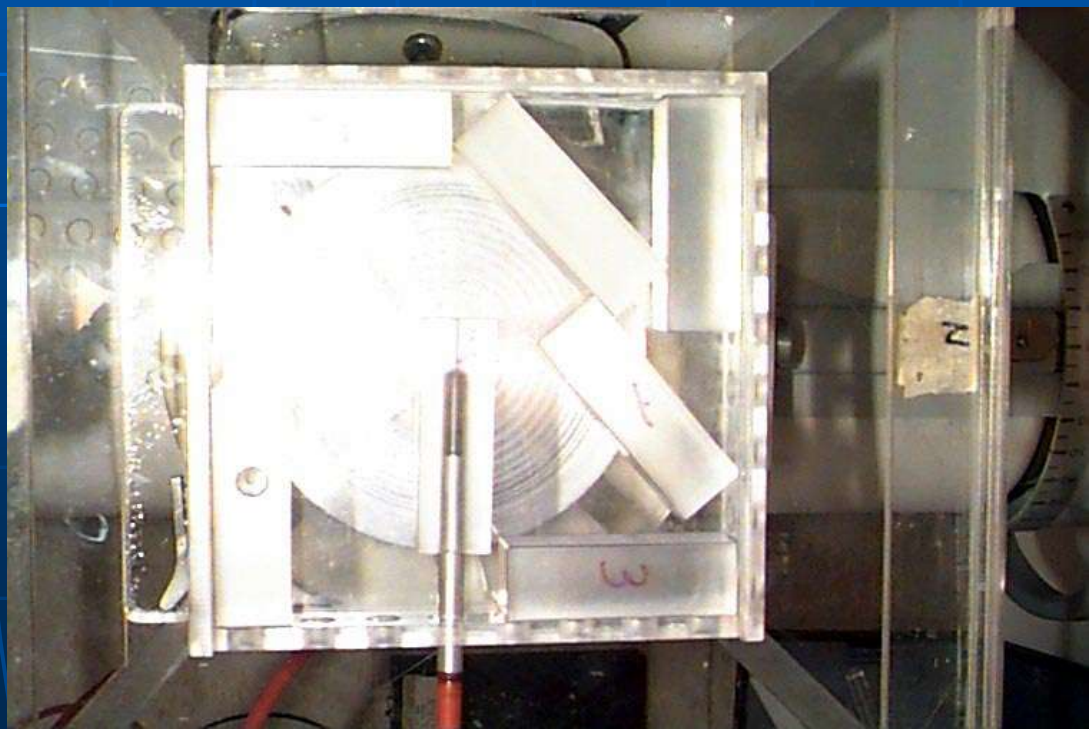


300 KV Pantak:
Determine jig factor for whole body mouse irradiation

8 mice ordered

7 mice random

Constancy irradiation



Dose in various media

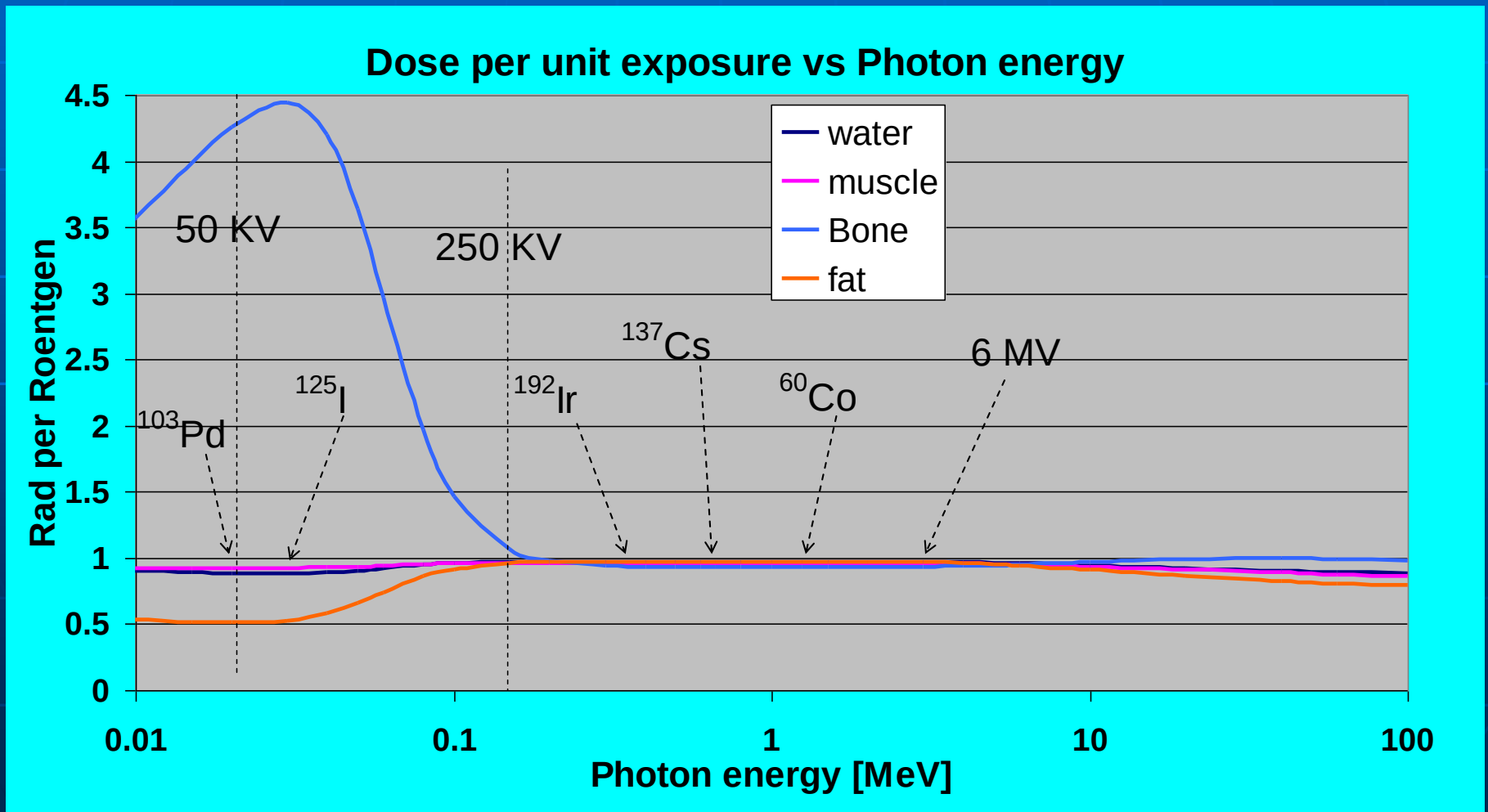
- TG-61 provides procedures and data for calibrating conventional x ray units in various phantoms. Not appropriate to discuss here – make sure physicist does it.
- TG-61 also provides procedures and data for calculating dose to various tissues
- The important thing is to appreciate how important this is at conventional x ray energies. The following graph shows why.
- You probably remember f_{med} used to calculate dose/exposure in old formalisms.
  - f_{med} = dose to the medium/R, TG-21 uses dose to med/dose to water - same concept.

Influence of Z dependence on Dose to medium

Dose to Muscle and Dose to water close over whole energy range

Conventional x ray region strong dependence of Dose on z -- PE effect

- 1/2 the dose to fat as that to muscle
- 4 times the dose to bone as that to muscle



Quality Audit of Radiotherapy Dosimetry by the Radiological Physics Center

Work for Radiobiology?

Will Hanson

Retired Director of the

Radiological Physics Center, RPC

THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center

Radiological Physics Center (RPC)

Responsible for standardizing radiotherapy physics and dosimetry at all institutions that participate in cooperative cancer clinical trials, involving radiotherapy, funded by the US National Cancer Institute:

Radiological Physics Center

- Funded by NCI continuously since in 1968
- Criteria for calibration of Therapy units
  - within 3% of RPC
- Criteria for delivery of radiation dose
  - within 5% of reported dose.
  - within 5% of trial Protocol.
- Currently > 1800 Megavoltage therapy facilities are monitored by the RPC.

Traditional RPC Methods

- Mailed Dosimeters for both photon and electron beam calibrations
  - TLD "in air" phantoms for photons
  - TLD in minimal phantom (10 cm cube) for electrons
- On site dosimetry review by RPC Physicist.
  - Machine calibration
  - Participation in clinical trials
  - Patient dose calculation techniques
- Review of treatment records of patients entered onto clinical trials

"NEW" RPC Methods

- Mailed Dosimeters for both photon and electron beam calibrations
  - OSLD, Optically Stimulated Luminescent Dosimeters - for more than a year.
- Test Case:
  - Questionnaire of how institution treats patients on a specific trial.
  - Dry lab - Plan the treatment for a "Paper patient"
- Anatomical Phantoms
  - Image a phantom with imageable lesion
  - Treat phantom as prescribed in the clinical trial
  - RPC evaluate absolute dose and dose distribution:
    - TLD
    - Film
    - Radio sensitive Gels 3-D distribution

⟨Pseudo 3 - D distribution

Other Quality Audit Programs

- Radiation Dosimetry Services, RDS
  - Marilyn Stovall, Ph.D. MDACC
    - Calibration of megavoltage radiotherapy
    - Calibration of orthovoltage
    - Calibration and dose distribution - Blood Irradiators
  - TLD powder
- IAEA:
  - Calibration of megavoltage radiotherapy
  - Calibration of Food Irradiators
  - Calibration of Ion chambers
- EQUAL: Similar to RPC for Estro
- Other national organizations forming
- U of Wisc: Diagnostic – TLD rods

Messages:

- National Quality Audit can be done
- Audit of calibration of units is reasonably inexpensive.
- Other activities are more expensive
- Essential to have some way to resolve discrepancies -- visit by an expert?
- It is effective: All Quality Audit systems identify problems on the order of 5% – 15% and some big errors.
- Participation in a quality audit improves attitude of the receiver, and therefore his quality.

Redundancy is Essential

- Recommendation in Radiotherapy
  - Perform redundant calibration
    - Another instrument
    - Another operator
    - Different software (Will Hanson recommends)
  - Obtain External Audit

Role of Anthropomorphic Phantoms

- Has been shown to be effective in radiotherapy.
- Different concerns in Radiobiology
  - Energy
  - Irradiation Geometry
  - Local immobilization techniques
  - No standard dosimetry for small fields, Can we learn from IMRT and Gamma knife?