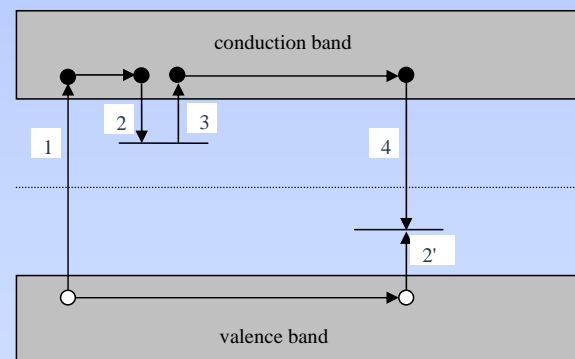


Validation of the Commissioning of an OSLD System for Remote Dosimetry

**F. Aguirre, P. Alvarez, C. Amador,
A. Taylor, D. Followill, G. Ibbott**

TL vs. OSL Processes

- OSL and TL processes are similar
- Dielectric crystals with trace amounts of impurities
- LiF:Mg for Harshaw TLD100 and $\text{Al}_2\text{O}_3:\text{C}$ for Landauer InLight nanoDot™
- TLD uses heat, OSLD uses light

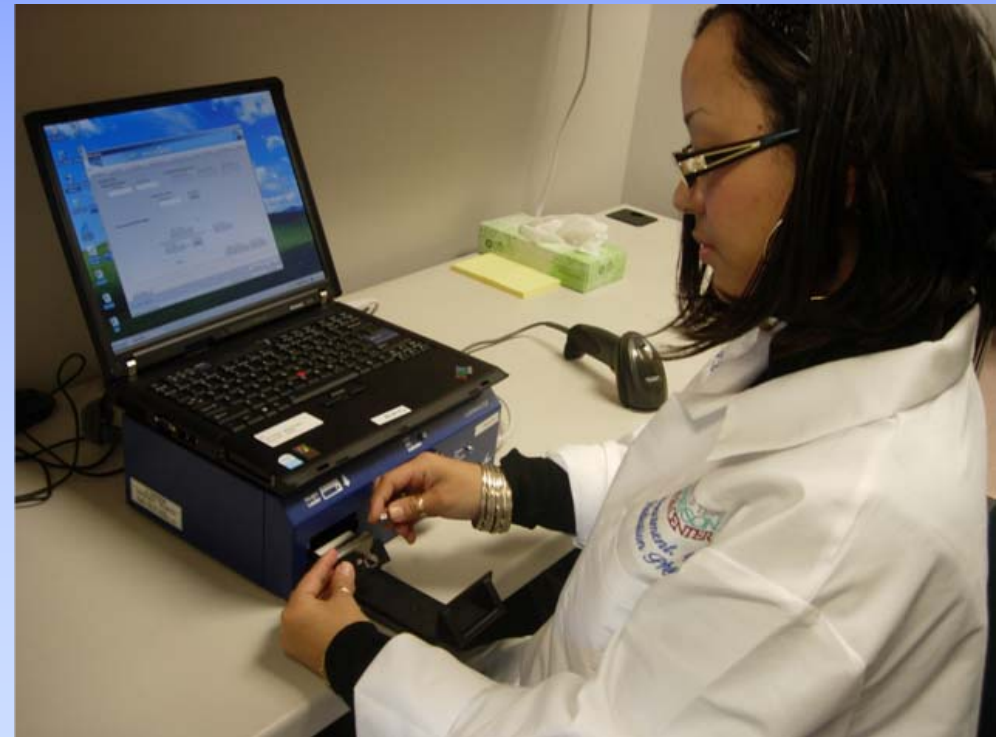


Equipment

TLD



OSLD



Verification of Reference Calibration

- Photon and electron beams
- Same blocks and irradiation methodology

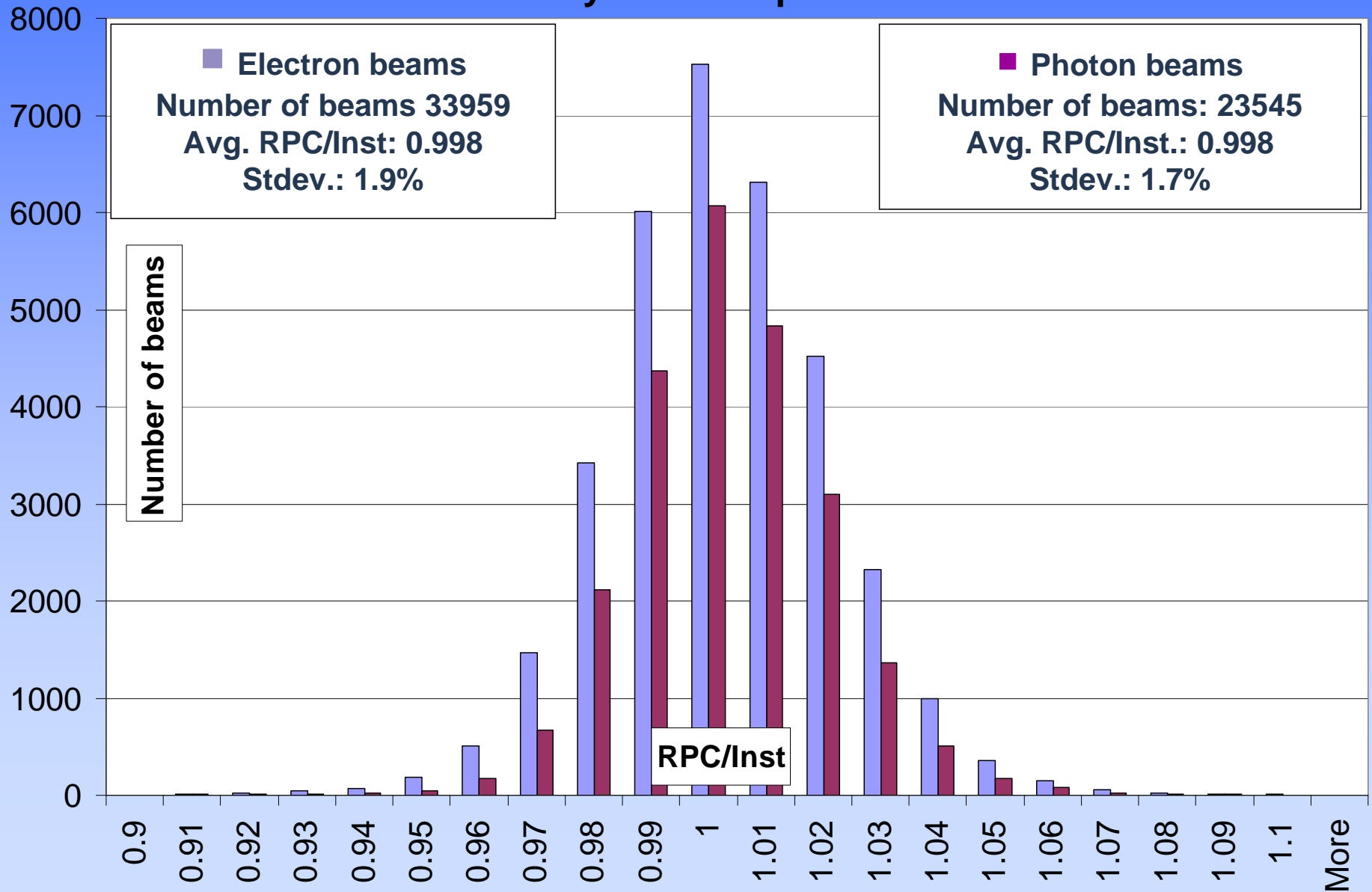


TLD vs OSLD

- **LiF:Mg,Ti (TLD-100)**
- **Disposable**
- **One reading**
- **Temperature and weight control**
- **3 dosimeters per point**
- **6 min reading time**
- **(Al₂O₃:C)**
- **Reusable (dose limit ~ 10Gy)**
- **Re-readable**
- **No temp/weight ctrl, light tightness**
- **2 dosimeters per point,**
- **~ 2 min reading time**

Results for TLD verifications

January 2005 to April 2010

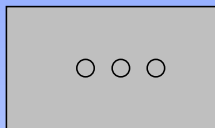


OSLD Studies at the RPC

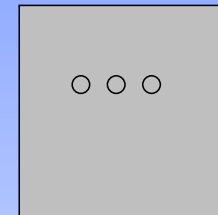
- **General characteristics of OSRD for radiotherapy doses**
- **Reliability and cost comparison OSRD/TLD**
- **Acceptance and commissioning of the OSRD system (dosimeters and reader)**
- **Design of irradiation, reading, calculation and quality assurance procedures for OSRD dosimetry**
- **Validation of the system**
- **Develop computerized calculation and archive procedures**

Methodology

cobalt



X-ray or e beam



Sensitivity (S) = Dose/unit signal

Dose = S x signal

Dose calculation

Dose to dosimeter

$$\text{Dose}_D = S \cdot \text{signal} \cdot \text{ECF} \cdot \text{DCF} \cdot K_L \cdot K_F \cdot K_E$$

- **ECF** = Nanodot element correction factor
- **DCF** = Depletion correction factor
- **KL** = Linearity correction
- **KL** = Linearity correction
- **KE** = Energy/block correction

Dose calculation

Dose to institution point

$$\text{Dose}_I = \text{Dose}_D \cdot \text{ISQ} \cdot \text{TMR} \cdot \text{BSF} \cdot \text{MC}$$

- **ISQ = Inverse square correction**
- **TMR = Tissue Maximum ratio**
- **BSF = Backscatter factor**
- **MC = Medium correction**

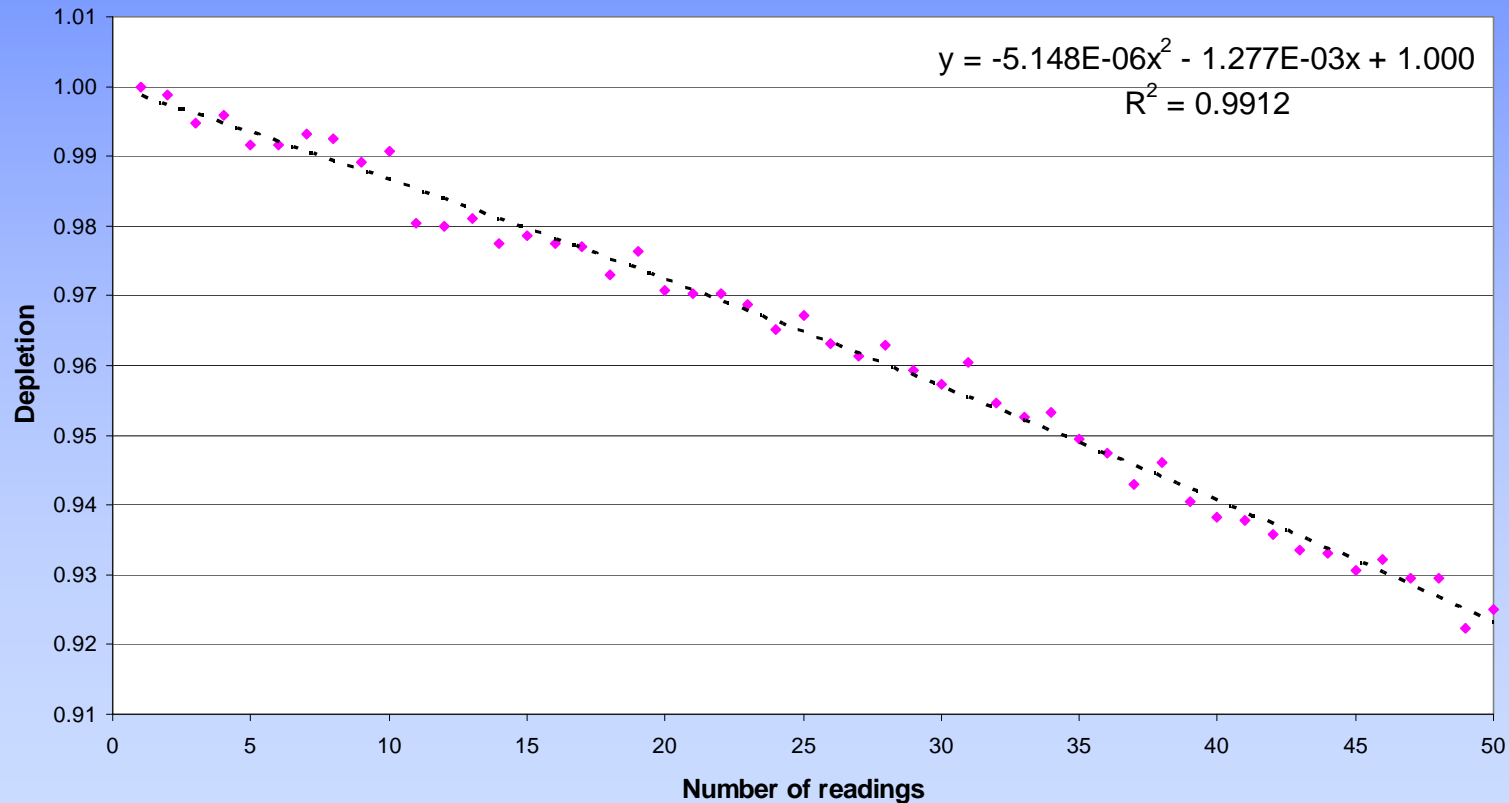
Element correction factor (ECF)

Correction for the difference in single dosimeter response compared to the average response of the whole population

- **Defined for groups of 100 dosimeters**
- **Range between 0.90 to 1.10**
- **Determined at dose level of 25 cGy**
- **Verified for different dose levels**
- **Verified to reproduce after annealing of the dosimeters for cumulative doses of up to 1000 cGy (Average ECF vs. first time ECF within 0.6%)**
- **Verified for the whole population of 4000.**

Depletion correction

Correction for changes in signal based on the number of readings performed

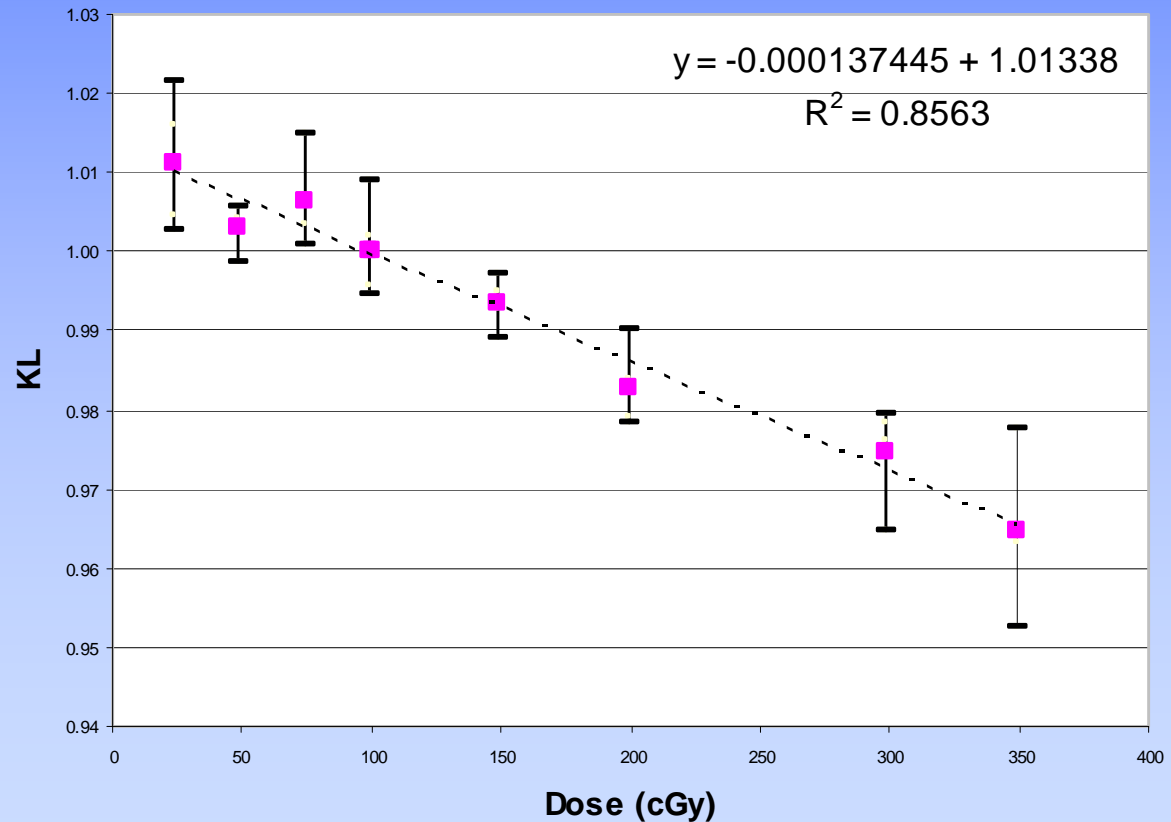


Reader dependent

**Batch dependence
under analysis**

Linearity correction

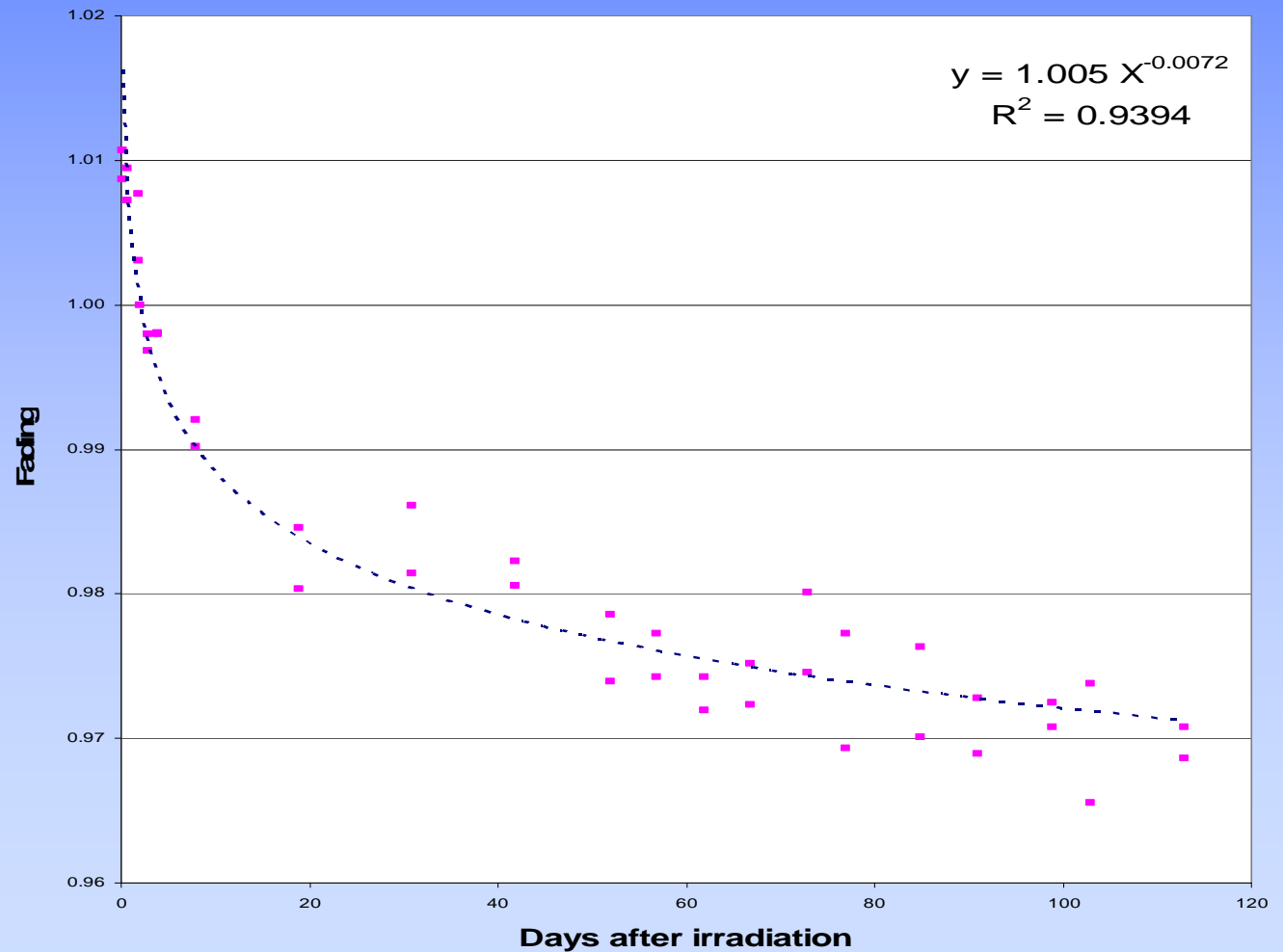
Correction for difference from the linearity response at different dose levels



Batch dependent

Fading Correction

A correction for the loss of signal based on the number of days between irradiation and reading date



Batch dependence
under analysis

Energy/block correction

Correction for changes in signal because of type and energy beam

Energy (photons)	K_E	Energy (electrons)	K_E
Cobalt 60	1.000	5e	1.027
4MV	1.000	6e	1.044
6 MV	1.011	7e	1.035
10 MV	1.051	8e	1.042
15 MV	1.045	9e	1.033
18 MV	1.054	10e	1.038
23 MV	1.058	12e	1.029
		14e	1.024
		15e	1.025
		16e	1.027
		18e	1.047
		20e	1.032
		21e	1.035

Defined for the
RPC system

Batch dependent

Validation of the system

- Institutional comparison **OSLD/TLD**

- 11 institutions
- 2 photon beams and 5 electron beams per institution

PER ENERGY
0.989 – 1.015

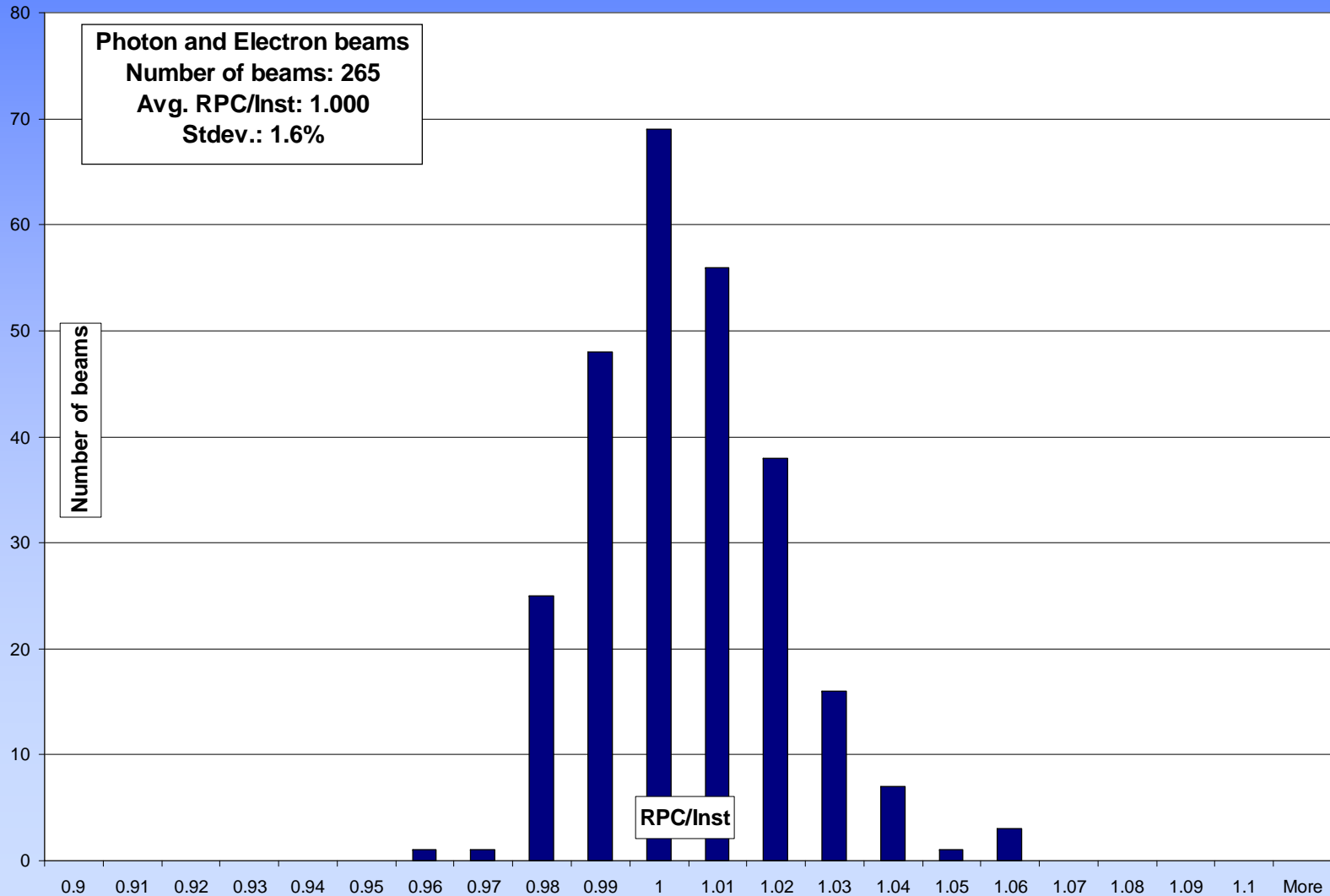
PER INSTITUTION
0.993 – 1.011

PER ENERGY	
6e	1.004
8e	0.989
9e	1.002
12e	0.996
15e	0.999
16e	1.004
18e	1.016
20e	1.007
21e	1.015
4x	1.024
6x	0.996
10x	1.006
15x	1.000
18x	0.993
23x	0.993
AVG	1.003

PER INSTITUTION	
1	1.004
2	1.011
3	0.994
4	0.998
5	0.999
6	1.001
7	1.011
8	1.002
9	0.993
10	1.001
11	0.999
AVG	1.001

Results for OSLD verifications

July 1 – 15, 2010



Quality of the Results

**Agreement between measured dose and Institution stated dose
1.5%**

- **Uncertainty in dose measurement under controlled cobalt 60 irradiation conditions
0.6%**

Conclusions

- **TLD and OSLD are comparable tools for remote dosimetry**
- **OSLD allows the RPC to increase efficiency without losing accuracy**
- **The RPC is ready and has migrated to OSLD as of June 1st 2010**



Thank you

OSLD Studies at the RPC

READER

Stability

Reading cycle

DOSIMETER

Depletion rate

Dependence of depletion rate with reader

Cumulative dose limit

Number of readings per dosimeter

Relative dose response or element correction factor (ECF)

Variability of ECF with reader

Variability of ECF with dose

Dose linearity correction

Signal fading correction

Energy/block correction

ANNEALING

Optimal annealing time and recommended instrumentation.

Variability of ECF with annealing