Catalan Clinical Audit
Network for Quality Improvement
in Radiotherapy

Dosimetry audit

Prof. Dr. Dirk Verellen

Co-funded by
the European Union

CAT·ClinART

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Objectives of the lecture

- Why do we need dosimetry audits?
- IAEA QUATRO approach
- B-QUATRO and BELdART
    - History of BELdART
    - Current situation
    - Regulations and Pitfalls

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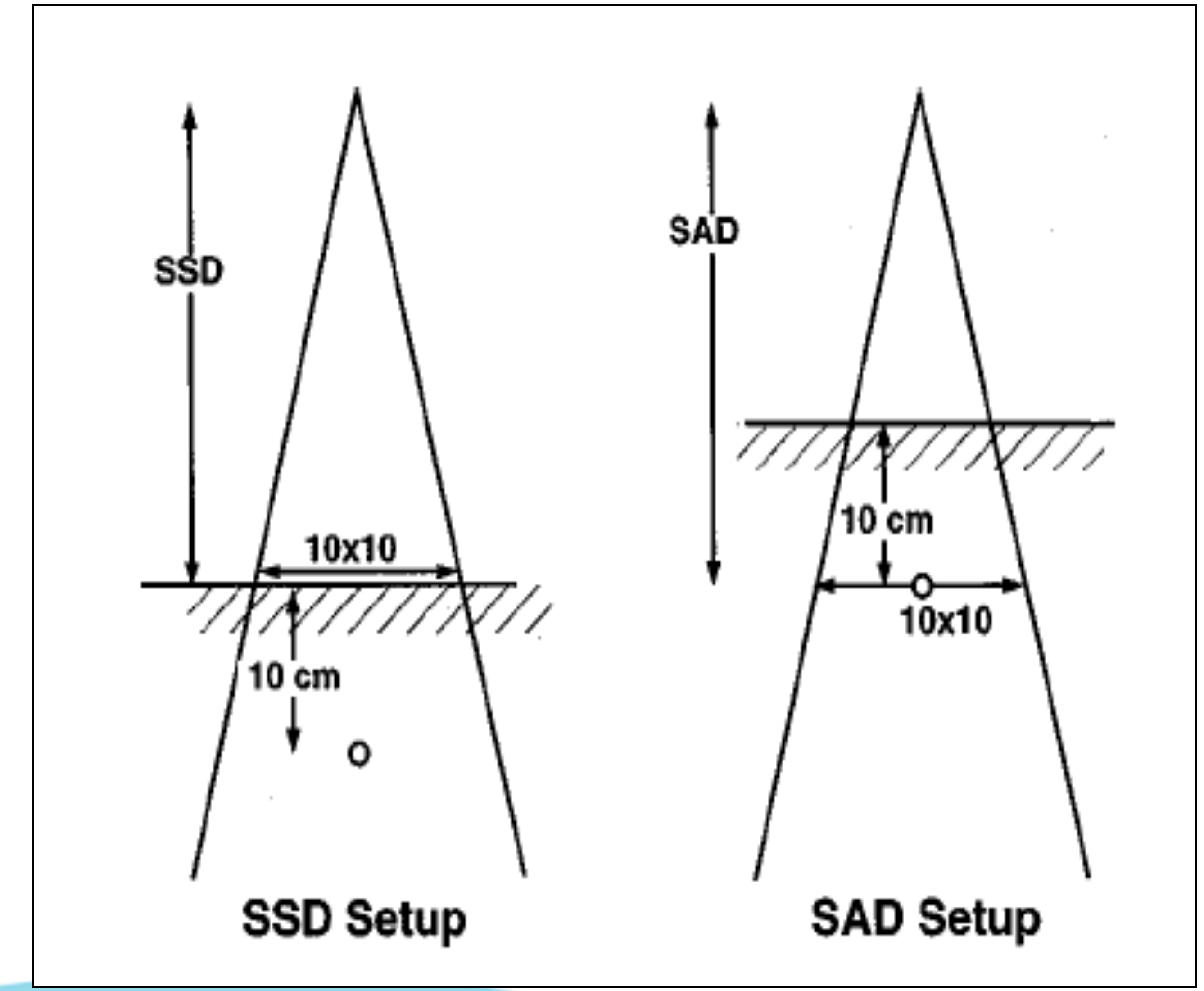
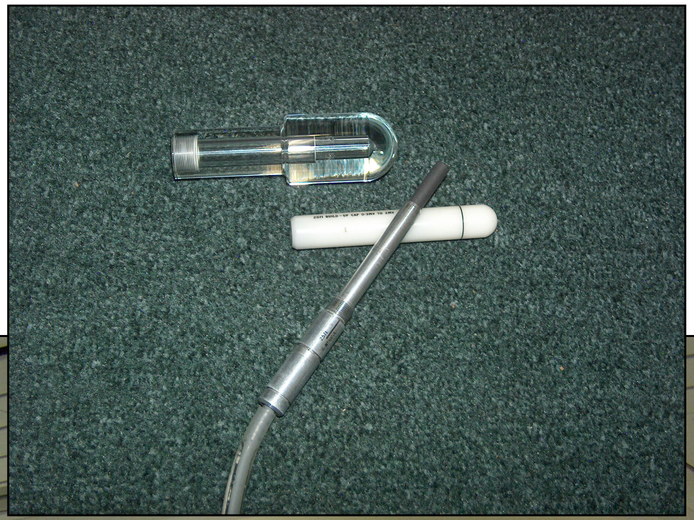
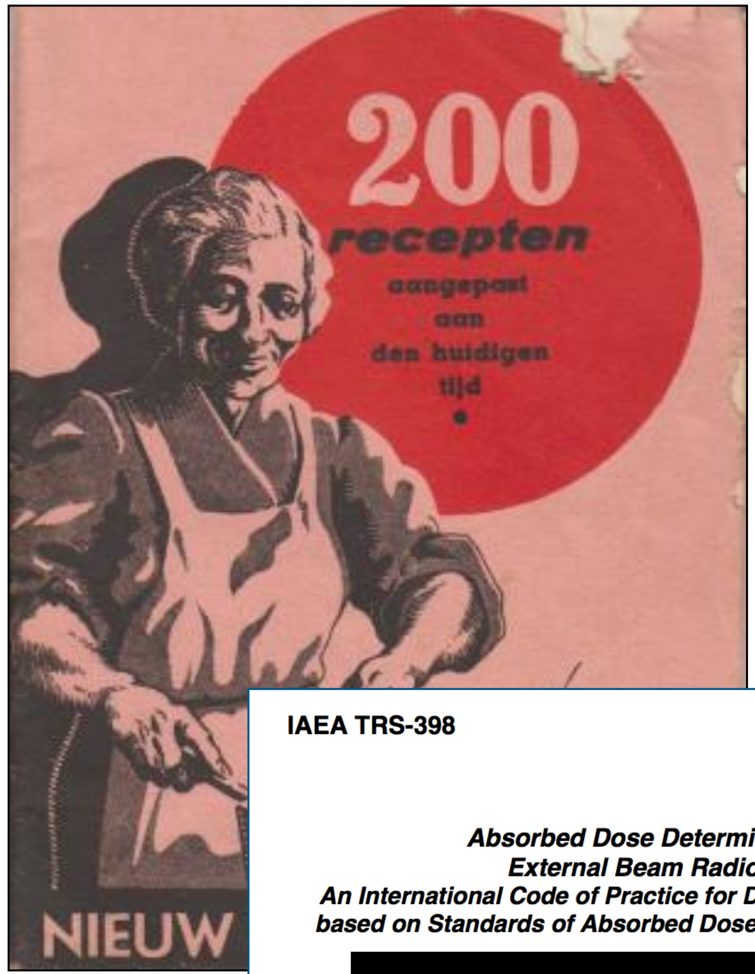
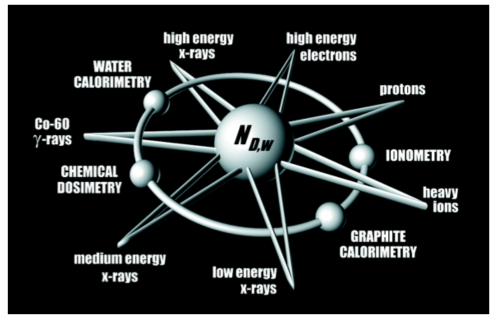
Dose calibration








IAEA TRS-398

Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry based on Standards of Absorbed Dose to Water

Pedro Andreo, Dosimetry and Medical Radiation Physics Section, IAEA
David T Burns, Bureau International des Poids et Measures (BIPM)
Klaus Hohlfeld, Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany
M Saiful Huq, Thomas Jefferson University, Philadelphia, USA
Tatsuaki Kanai, National Institute of Radiological Sciences (NIRS), Chiba, Japan
Fedele Laitano, Ente per le Nuove Tecnologie L'Energia e L'Ambiente (ENEA), Rome, Italy
Vere Smyth, National Radiation Laboratory (NRL), Christchurch, New Zealand
Stefaan Vynckier, Catholic University of Louvain (UCL), Brussels, Belgium

PUBLISHED BY THE IAEA ON BEHALF OF IAEA, WHO, PAHO, AND ESTRO

INTERNATIONAL ATOMIC ENERGY AGENCY IAEA

21 May 2001 (**V.10A**)

$$D_{w,Q_{msr}} = M_{corr,Q} . N_{D,w,Q_0} . k_{Q,Q_0}$$

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UK 1988, Exeter

- Calibration error of a new ^{60}Co-source
- 205 patients received 25% overdose
- Severe acute reactions

- The number of full-time physicists with specialist knowledge of radiation physics had previously been reduced to … 1!

EXETER HEALTH AUTHORITY

INCIDENT IN RADIOTHERAPY DEPARTMENT

THE REPORT

of the

COMMITTEE OF ENQUIRY

and

THE SUMMARY REPORT

by

PROFESSOR CHARLES JOSLIN

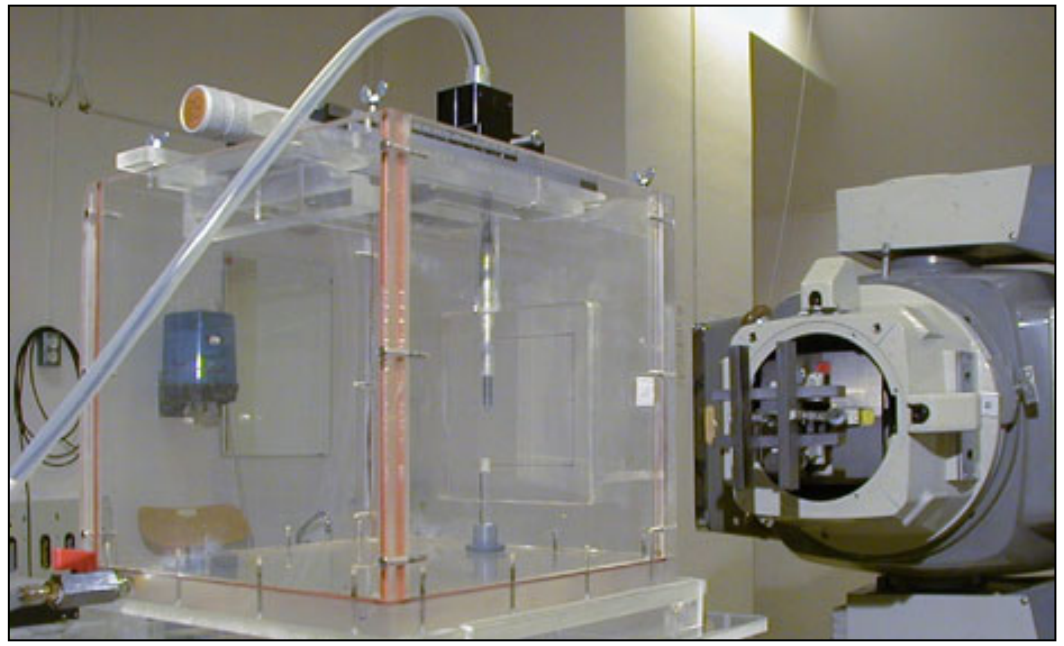
with a

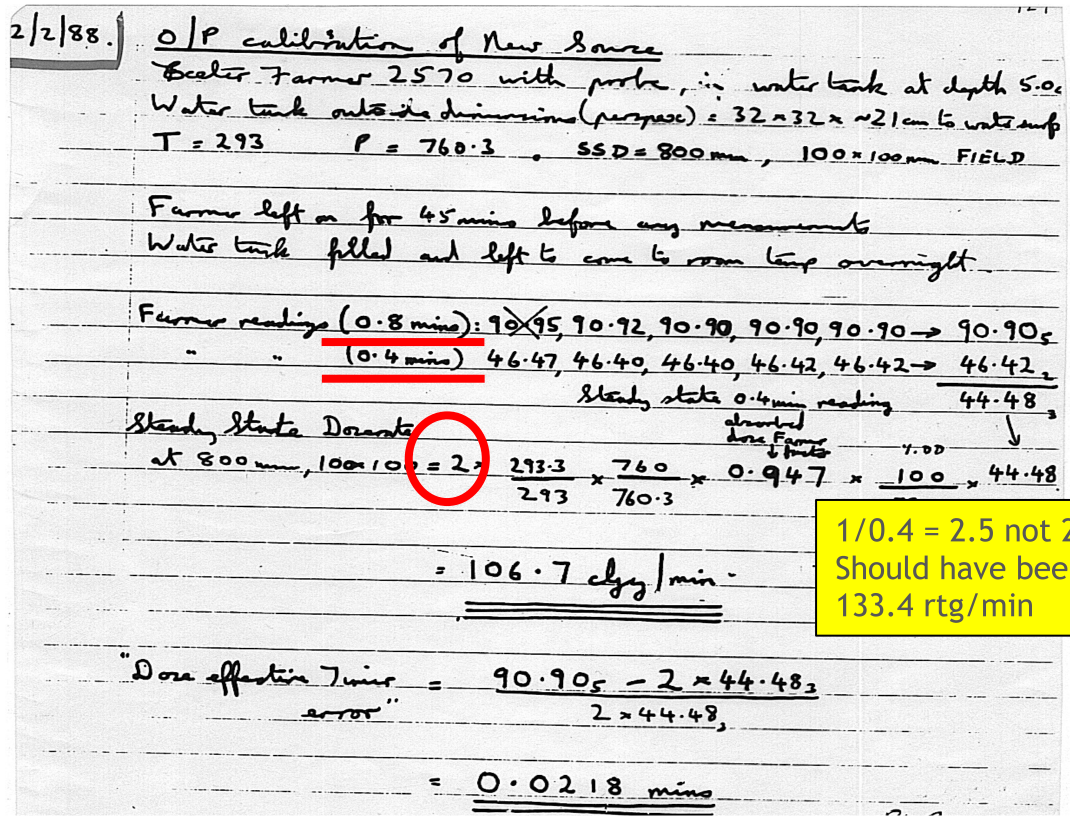
PREFACE

by the

Chairman of Exeter Health Authority

6th December, 1988





1/0.4 = 2.5 not 2 !!!
Should have been 133.4 rtg/min

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Atmospheric pressure

Atmospheric pressure was determined using data from nearby weather stations. The physicists concerned did not realize that these data were actually corrected to sea level. This happened at four institutions, and six physicists were involved.

In at least two of the treatment centres the same incorrect pressure was obtained redundantly. At three of the centres the overdose was 13–14% and at one centre the overdose was 21%. Many patients were treated at each institute. The 21% overdose by a ^{60}Co unit continued for about ten months until a different physicist calibrated the machine and informed the radiation oncologist of the miscalibration. The radiation oncologist chose to continue with the older and incorrect calibration.

Initiating event

— Incorrect calibration: The use of incorrect pressure values to correct for atmospheric pressure resulted in an incorrect beam output.

Contributing factors

— Shortage of instruments: The institutions did not have their own barometers.
— Insufficient awareness:
- Physicists relied on pressure data from an airport without knowing that the data referred to sea level (requesting both station pressure and pressure corrected to sea level should eliminate ambiguity).
- Physicists did not consider altitude as having a bearing on atmospheric pressure.

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Atmospheric pressure

Similar incident occurred in Switzerland, 2008

Physicist copied in-housed written “excel-file” for calibration (“values only” not “formula’s”), with chamber calibration factor acquired in standard conditions (i.e. sea level) ignoring correction for altitude.

- Standard air pressure: 1013 hP
- Pressure at 420m: 962 hPa
- 1013/962 = 1.05, i.e. 5% error in dose!!!!

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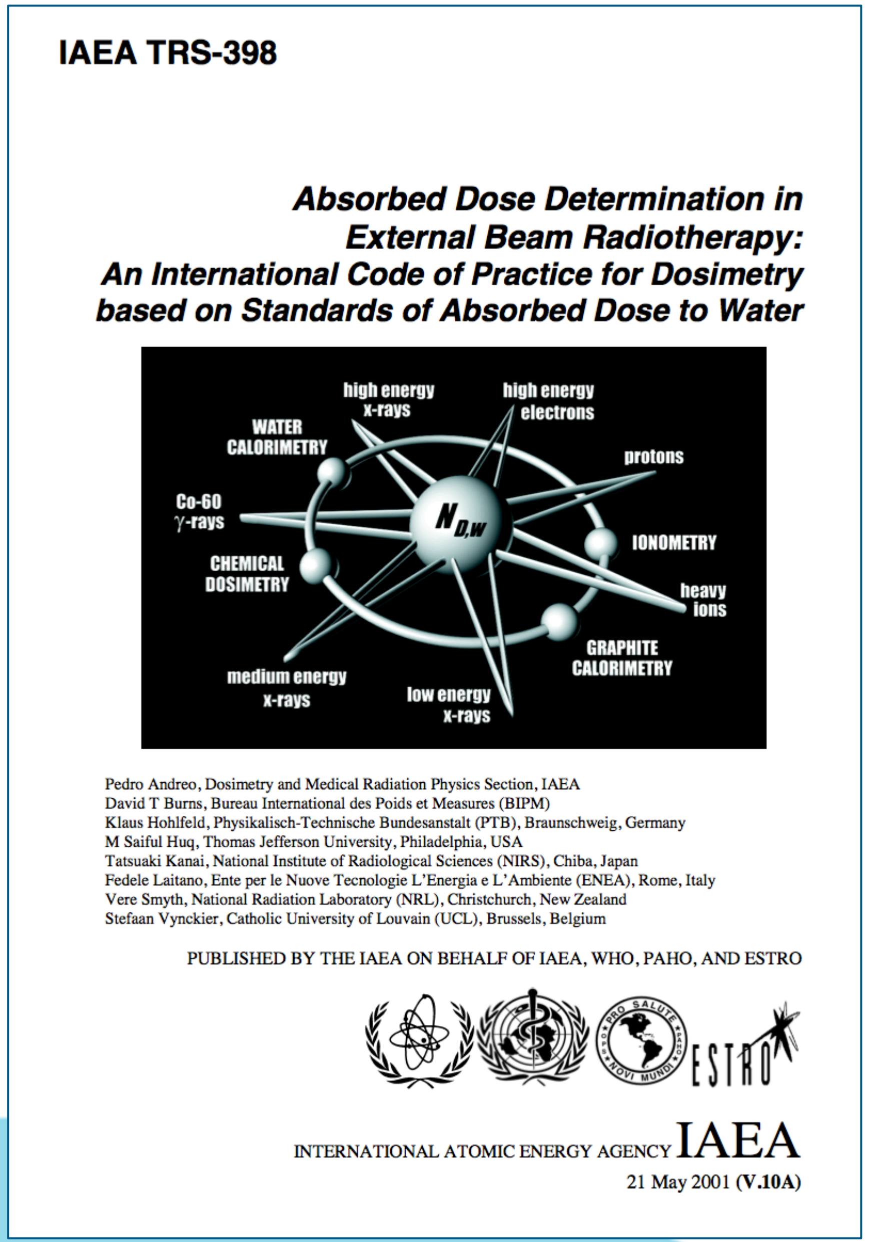
Not only “standard beams”: Non reference conditions!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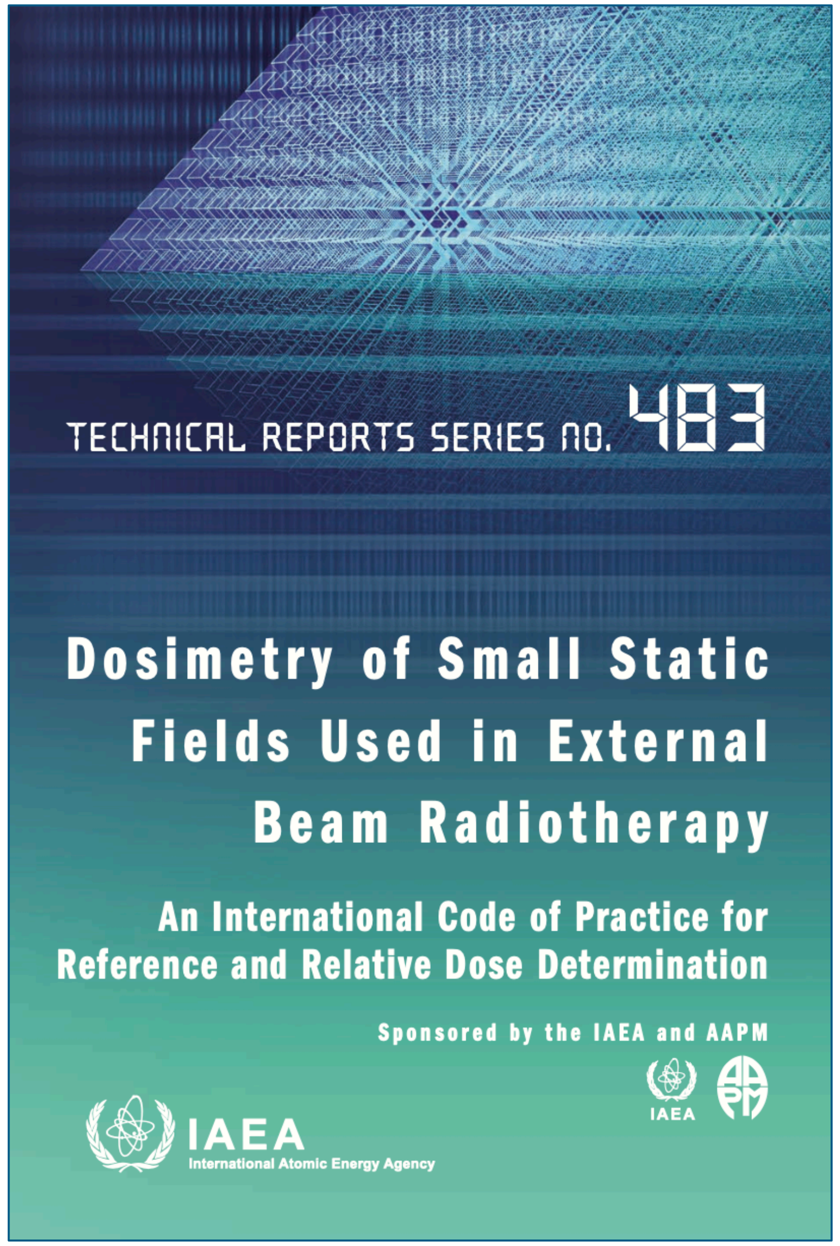
INTERNATIONAL ATOMIC ENERGY AGENCY IAEA
21 May 2001 (V.10A)



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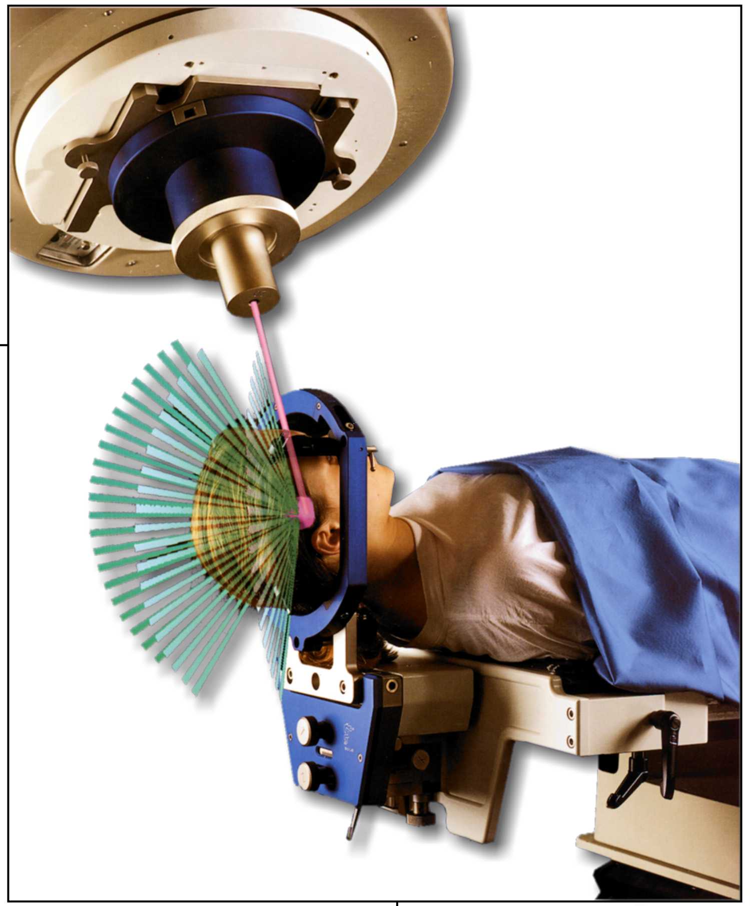
Toulouse: 2006-2007

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

L'ACCIDENT DE RADIOCHIRURGIE STEREOTAXIQUE AU CENTRE HOSPITALIER UNIVERSITAIRE DE TOULOUSE

Rapport d'expertise N°2

Evaluation dosimétrique et clinique
Analyse de risque



145 patients

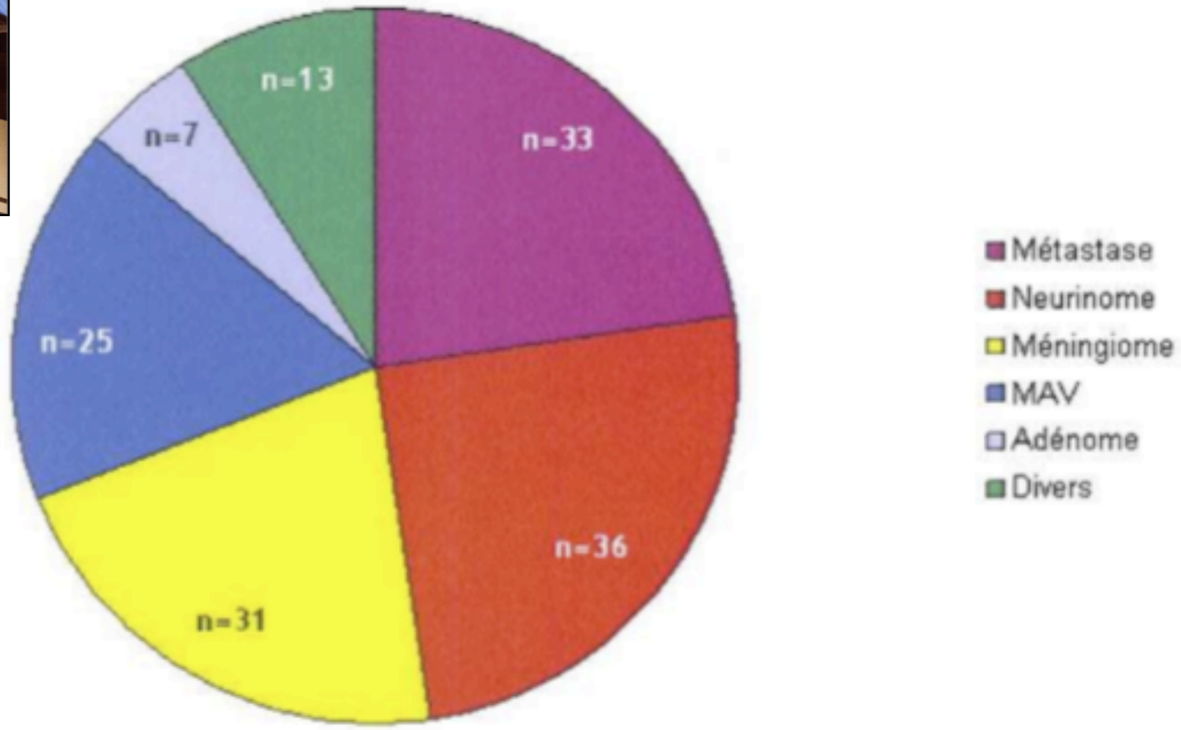


Figure 1 : *Répartition par pathologie des patients surexposés de la cohorte*

netwerk iridium
Topzorg in radiotherapie

Toulouse: 2006-2007

Les surdosages sont liés à une erreur initiale d'étalonnage de l'accélérateur Novalis en avril 2006 causée par l'utilisation d'un détecteur inapproprié, dont le volume sensible était trop grand devant les dimensions des faisceaux à étalonner. La procédure de Brainlab WOI 10-26, § 6.3.4 spécifie que les mesures de coefficients d'étalonnage[1] doivent être réalisées à l'aide d'une chambre d'ionisation de volume maximal 0,03 cm^3. Malgré ces spécifications, ces mesures ont été effectuées, en avril 2006, à l'aide d'une chambre d'ionisation « Farmer », de volume sensible 0,65 cm^3 (cylindre de longueur 23,1 mm et de diamètre 6,2 mm), 20 fois plus élevé que celui de la chambre recommandée.

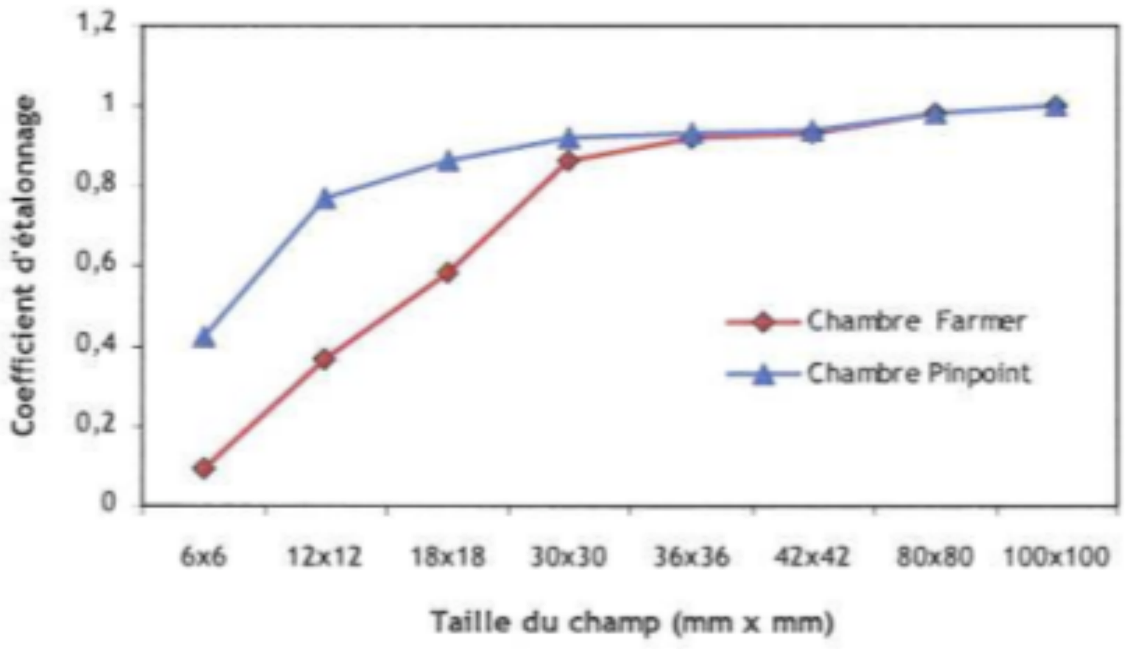
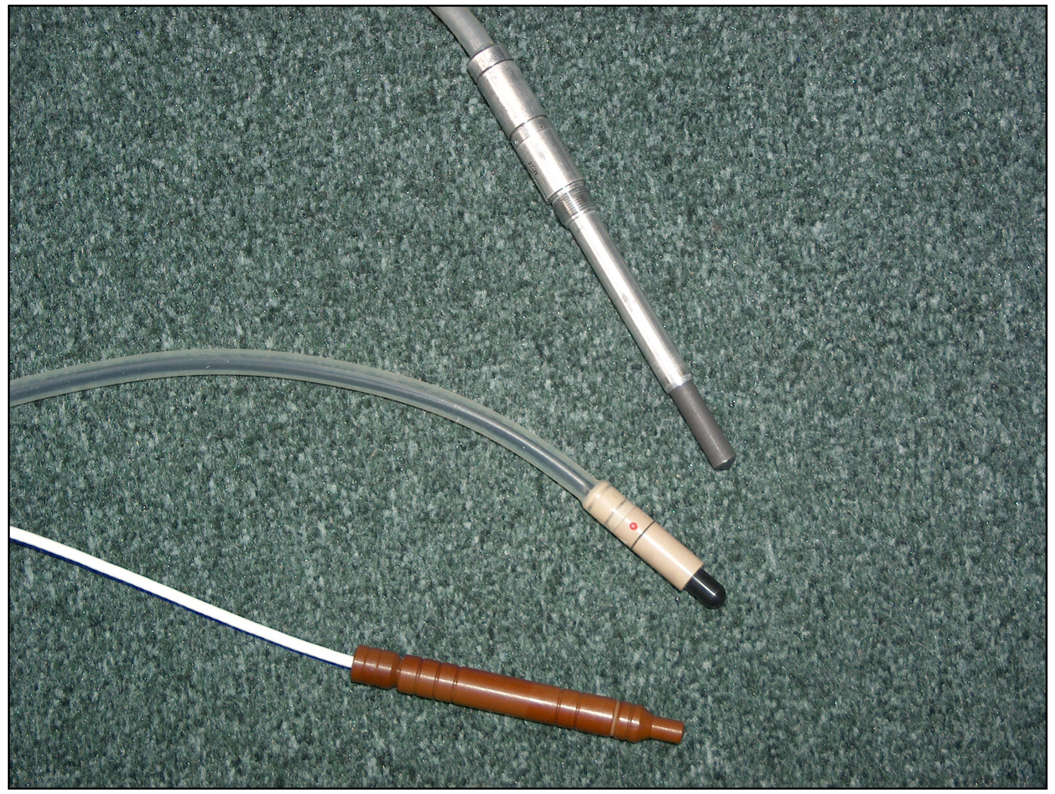
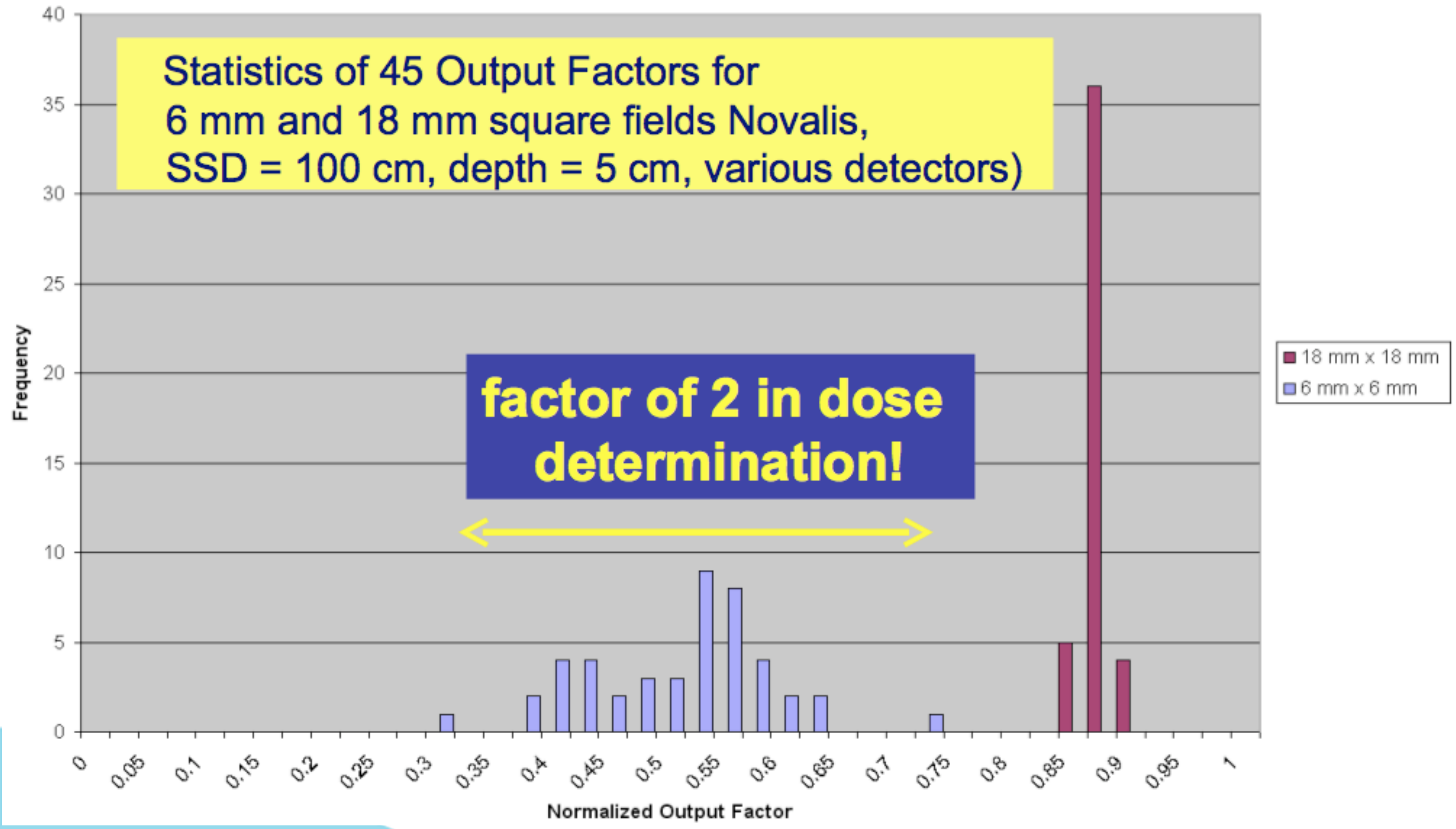


Figure 4 : *Coefficients d'étalonnage mesurés avec les chambres Farmer et Pinpoint pour différentes tailles de champ.*



Toulouse: 2006-2007



Courtesy BrainLAB

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External audits a necessity …

There has been a marked improvement in radiation dosimetry over the past three decades, and the RPC has been monitoring it through its auditing tools. Between 1970 and 1980, the compliance rate (±3%) for beam calibration increased from approximately 70% to 90%. Improvement since then has been gradual, with **compliance now near 98%, for both photons and electron beam calibrations**.

With the **complexity of therapy increasing**, discrepancies in other components of the treatment are more prevalent. Over the past four years, at approximately **45%** of the institutions reviewed by an on-site review, the RPC found at least one clinical situation where patients could be at risk to receive a dose more than **5% different** from that intended.

Radiological Physics Center

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External audits a necessity …

Phantom Results

Comparison between institution's plan and delivered dose.

Phantom	H&N	Prostate	Spine	Thorax	Liver
Irradiations	752	174	19	174	23
Pass	585	143	13	124	12
Fail	**167(22%)**	**31(18%)**	**6(32%)**	**50(29%)**	**11(49%)**
Criteria	**7%/4mm**	**7%/4mm**	**5%/3mm**	**5%/4mm**	**7%/4mm**
Year introduced	2001	2004	2009	2004	2005

Radiological Physics Center

netwerk iridium Topzorg in radiotherapie

External audits a necessity …

Phantom Results

Comparison between institution's plan and delivered dose.

Phantom	H&N	Prostate	Spine	Thorax	Liver
Irradiations	752	174	19	174	23
Pass	433	105	13	63	4
Fail	**319(43%)**	**69(40%)**	**6(32%)**	**111(64%)**	**19(83%)**
Criteria	**5%/3mm**	**5%/3mm**	**5%/3mm**	**5%/3mm**	**5%/3mm**
Year introduced	2001	2004	2009	2004	2005

Radiological Physics Center

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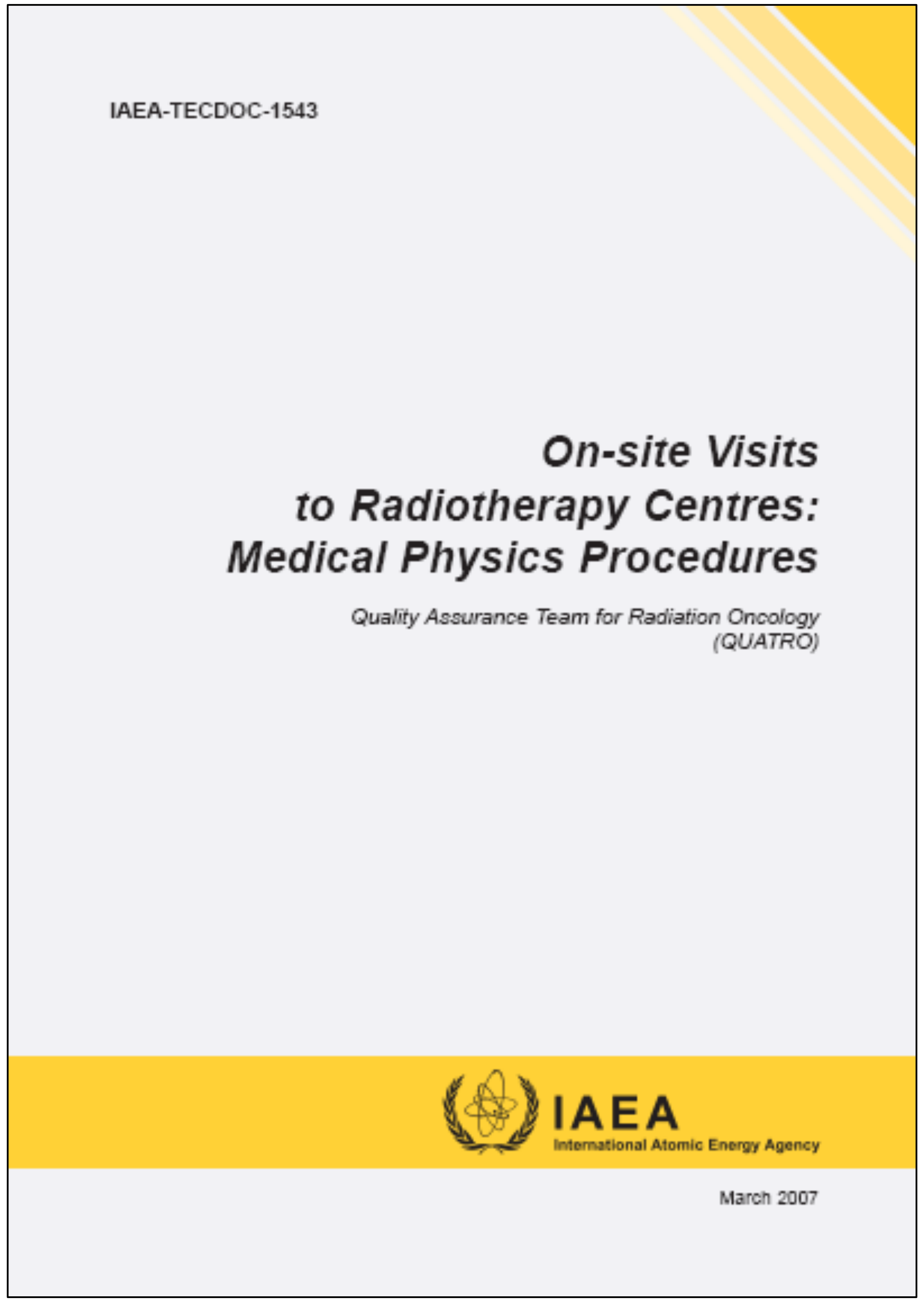
IEAE QUATRO: Physical measurements

- Physicist is required to perform physical measurements as part of the QUATRO audit
- Requires also practical tests
- Mostly performed by the medical physicist on **days 4 and 5** of the audit
- TECDOC 1543 is a useful resource


IAEA-TECDOC-1543

On-site Visits
to Radiotherapy Centres:
Medical Physics Procedures

Quality Assurance Team for Radiation Oncology
(QUATRO)

IAEA
International Atomic Energy Agency

March 2007

IEAE QUATRO: Physical measurements

QUATRO equipment test kit

TRS 398

- Electrometer
- Calibrated ionization chamber

… from TECDOC 1543

For photon beams, the clinical dosimetry tests will be done for a water phantom irradiated with a single field. The institution will calculate monitor units or time set to deliver 2 Gy for the beam geometries as follows:

(a) Field size 10 cm × 10 cm, depth 5 cm, with and without the most commonly used wedge;
(b) Field size 10 cm × 10 cm, depth 10 cm;
(c) Field size 7 cm × 15 cm, depth 5 cm, with and without the most commonly used wedge;
(d) Field size 7 cm × 15 cm, depth 10 cm.

If blocks are used at the institution, the expert and the local physicist will calculate monitor units or time set for a typical blocked field used at the institution.

For electron beams the clinical dosimetry tests will be done for a water phantom treated with a single field. The institution will calculate monitor units to deliver 2 Gy for the beam geometries as follows:

(a) Standard cone/field size (10 cm × 10 cm or 15 cm × 15 cm) at z_{90};
(b) Largest cone/field size available at z_{90}.

The ion chamber measurements of the basic electron and photon dosimetry parameters as described in section 13.2 will be used to verify the clinical dosimetry tests and calculations as outlined above. This procedure will be discussed with the institution's physicist.

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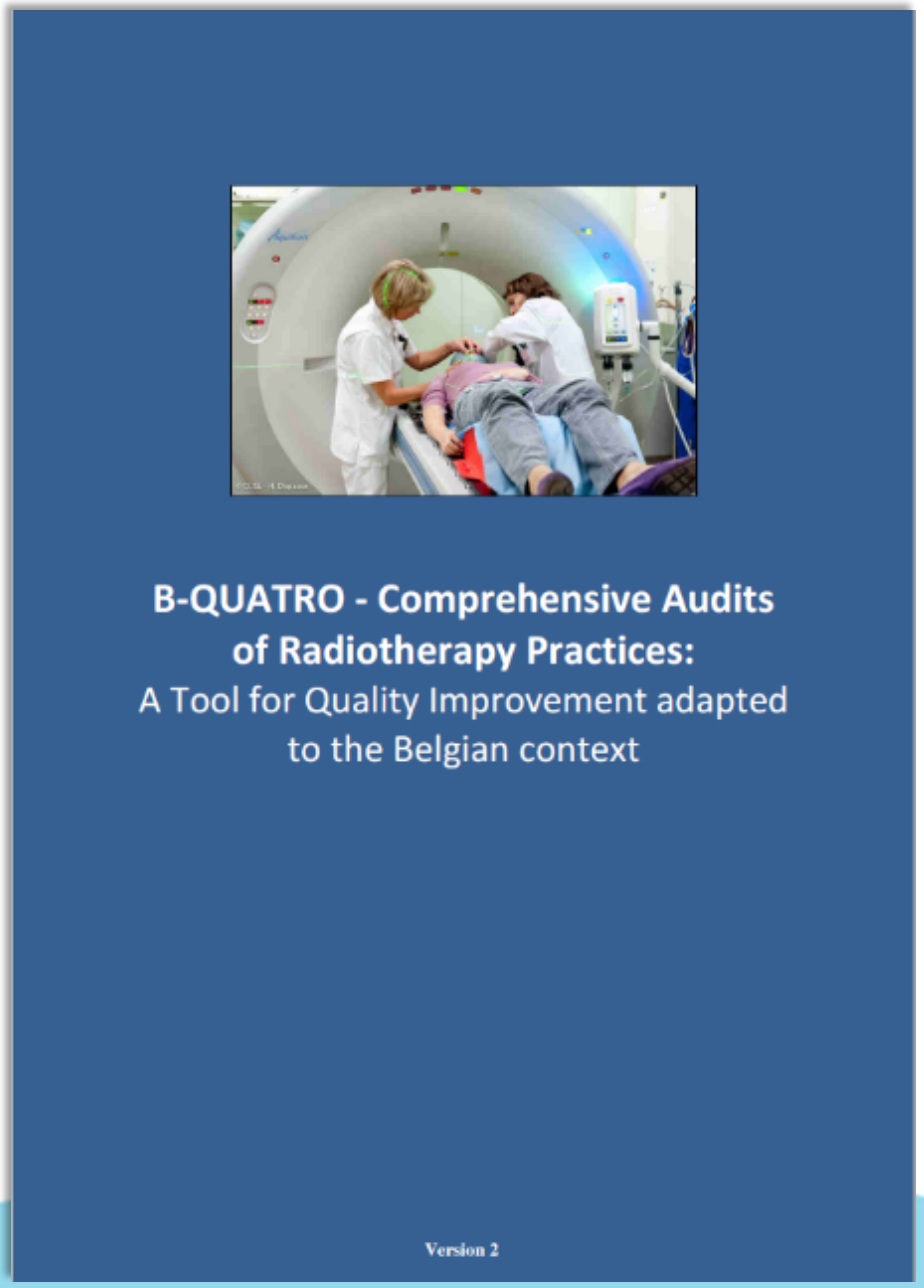
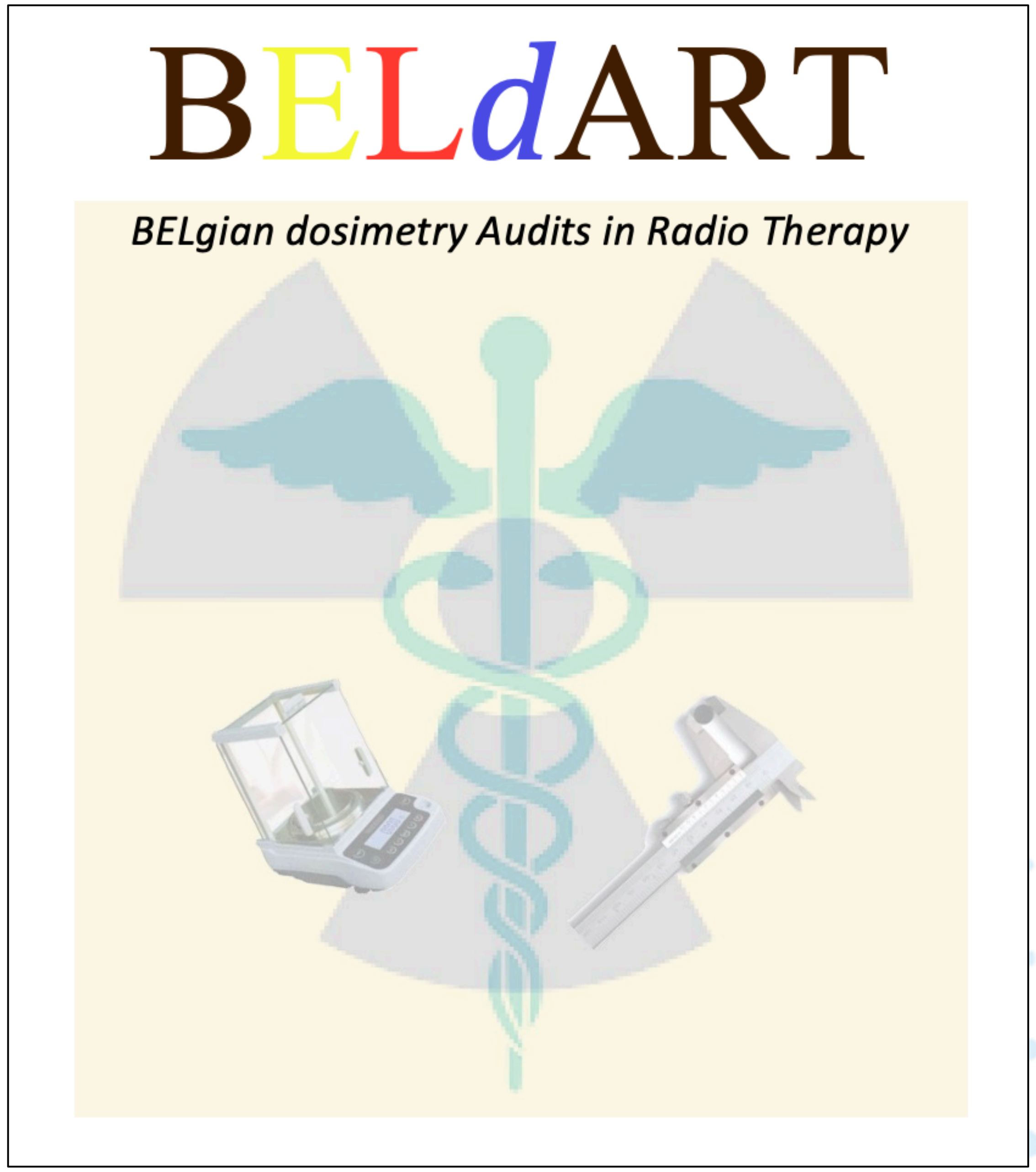
B-QUATRO: Dosimetry Audits

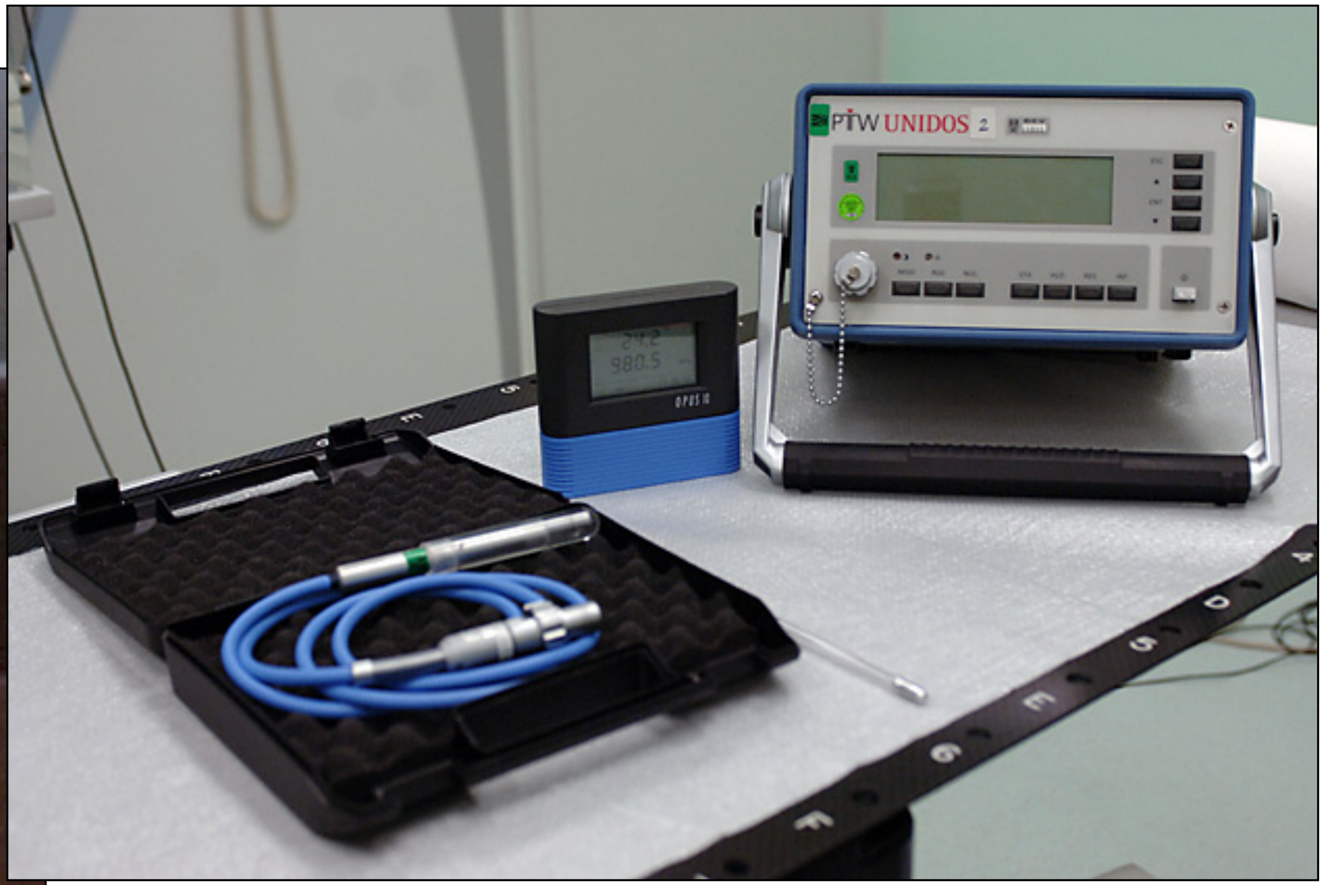


- As there is an established BELdART audit system in place, this part has been omitted from the B-QUATRO clinical audits
- However:
  - The new regulations require dosimetric audits before clinical implementation of new treatment machines and recommend dosimetric audits before clinical implementation of new treatment techniques
  - Assessment and discussion of the results from these dosimetric audits needs to be performed



About dosimetry audits

The radiotherapy community already has an established structure of dosimetry audits:



About dosimetry audits

The radiotherapy community already has an established structure of dosimetry audits:

ELSEVIER SCIENTIFIC PUBLISHERS IRELAND

Radiotherapy and Oncology 28 (1993) 37–43

RADIOTHERAPY & ONCOLOGY

A dosimetric quality audit of photon beams by the Belgian Hospital Physicist Association

M.Th. Hoornaert*[a], J. Van Dam[b], S. Vynckier[c] and A. Bo

[a]Hôpital de Jolimont, Haine-Saint-Paul, [b]KUL, U.H Sint Rafael, Leuven, [c]UCL, Cliniques Universitaires Saint-
La Louvière, Belgium

(Received 8 May 1992, revision received 4 January 1993; accepted 12 January 19

Abstract

Since 1987, a dosimetric standardization process has been started by the Belgian Hospital Physicist Association (BHPA). As part of this project, on-site visits were performed by a voluntary team, by request of the local physicist. They included mechanical checks on treatment machines and simulators and a dosimetric intercomparison of photon beams, following the EORTC methodology. Until now 16 centres have participated. Dose measurements were performed in order to evaluate the uniformity in dosimetry after the adoption by the BHPA members of the Nederlandse Commissie voor Stralingsdosimetrie (NCS) code of practice for photon beams [7,9]. Doses were measured with an ionization chamber in water under NCS reference conditions and under other conditions in 13 cobalt beams and 24 high energy X-ray beams from 4 to 25 MV. Under reference conditions, the mean ratio of measured to stated dose is 0.999 (± 0.010) and 1.006 (± 0.23) for cobalt and X-ray beams, respectively, with a difference between the extreme values (Δ) of 0.042 for cobalt beams and 0.084 for X-ray beams. In other conditions, the spread is a little larger for all beams. The results are comparable, but with a smaller dispersion, with those of other national and international similar dose intercomparisons and show the importance of applying a common protocol. The results of mechanical checks show some large deviations in digital displays and indicate the need for a systematic mechanical and beam alignment quality assurance programme.

Key words: Quality assurance in radiotherapy; Photon beams; Dose intercomparison; Quality audit; Dosimetry audit

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About dosimetry audits

The radiotherapy community already has an established structure of dosimetry audits:

Table 3
Dose intercomparison under reference conditions: X-ray beams

Study	Year	Visiting team protocol	*n*		M	SD	Δ
Scandinavia [6]	1982	NACP	50	PAT[a]	1.017	0.023	0.100
Europe [4]	1986	NACP	16	PAT	1.024	0.033	0.140
			16	COR[b]	1.013	0.022	0.090
The Netherlands [13]	1987	NCS	40	PAT	1.008	0.020	0.100
USA [1]	1991	AAPM	740	COR	1.008	0.019	0.140
UK [11]	1992	HPA	100	PAT	1.003	0.015	0.100
Belgium	1992	NCS	21	PAT	1.006	0.023	0.080
(this work)			21	COR	1.011	0.014	0.055

[a]PAT, 'Patient' value (see text).
[b]COR, 'Corrected' value (see text).

Hoornaert et al., Radiother Oncol, 1993

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BELdART … how it started

Radiotherapy and Oncology 99 (2011) 94–96

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

ELSEVIER

EPR dosimetry

Implementation of alanine/EPR as transfer dosimetry system in a radiotherapy audit programme in Belgium

B. Schaeken [a,b,*], R. Cuypers [a], S. Lelie [a,c], W. Schroeyers [a], S. Schreurs [a], H. Janssens [a], D. Verellen [c]

[a] *NuTeC-EMR dosimetry laboratory , Technologiecentrum, Diepenbeek, Belgium;* [b] *Department of Radiotherapy, ZNA-Middelheim, Antwerp, Belgium;* [c] *UZ-Brussel, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel (VUB), Brussels, Belgium*

A R T I C L E I N F O

Article history:
Received 11 December 2010
Received in revised form 25 January 2011
Accepted 31 January 2011

Keywords:
Quality assurance in radiotherapy
Alanine
EPR dosimetry
Mailed audits

A B S T R A C T

A measurement procedure based on alanine/electron paramagnetic resonance (EPR) dosimetry was implemented successfully providing simple, stable, and accurate dose-to-water (D_w) measurements. The correspondence between alanine and ionization chamber measurements in reference conditions was excellent. Alanine/EMR dosimetry might be a valuable alternative to thermoluminescent (TLD) and ionization chamber based measuring procedures in radiotherapy audits.

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BELdART … how it started

Table 1
Conditions and results for beam output measurements (# 407) at the beam axis: BEL*d*ART audit; MU for a 4 Gy delivery are calculated with the local treatment planning system for all tests.

Exp. Nr	Experiment	Depth (cm)	Irradiation distance	Field size	Accessory	D_{ala}/D_{centre} ± sd (min, max)
1	Ref. field	d_{ref}	ssd or sad	10 × 10 cm	No	1.001 ± 0.013 (0.974, 1.030)
2	Tray factor	D_{ref}	ssd or sad	10 × 10 cm	Tray	1.001 ± 0.014 (0.985, 1.032)
3	Energy open beam	10&20	ssd or sad	10 × 10 cm	No	1.000 ± 0.016 (0.962, 1.035)
4	Energy wedged beam	10&20	ssd or sad	10 × 10 cm	Wedge	0.996 ± 0.016 (0.958, 1.045)
5	Output factor1	8	ssd or sad	6 × 6 cm	No	1.003 ± 0.015 (0.969, 1.028)
6	Output factor2	8	ssd or sad	8 × 20 cm	No	1.000 ± 0.017 (0.963, 1.040)
7	Output factor3	8	ssd or sad	20 × 8 cm	No	1.000 ± 0.015 (0.966, 1.037)
8	Output factor4	8	sad or ssd	20 × 20 cm	No	1.002 ± 0.016 (0.964, 1.035)
9	"Irreg 1"	8	ssd or sad	6 cm circular	No	1.003 ± 0.017 (0.962, 1.034)
10	"Irreg 2"	8	ssd or sad	15 × 12 cm	No	0.996 ± 0.015 (0.953, 1.028)
11	"Irreg 3 + wedge"	8	ssd or sad	12 × 8 cm	Wedge	0.990 ± 0.015 (0.967, 1.019)

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BELdART … how it started

Physics and Imaging in Radiation Oncology 29 (2024) 100544

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Physics and Imaging in Radiation Oncology

journal homepage: www.sciencedirect.com/journal/physics-and-imaging-in-radiation-oncology

ELSEVIER

phiRO Physics and Imaging in Radiation Oncology ESTRO

Original Research Article

Early results of a remote dosimetry audit program for lung stereotactic body radiation therapy

Check for updates

Burak Yalvac *, Nathalie Reulens, Brigitte Reniers

Universiteit Hasselt, CMK, NuTeC, Diepenbeek, Belgium

A R T I C L E I N F O

Keywords:
SBRT
Dosimetry audit
Alanine/EPR dosimetry
Radiochromic film dosimetry

A B S T R A C T

Background and purpose: A dosimetry audit program based on alanine electron paramagnetic resonance (EPR) and radiochromic film dosimetry, may be a valuable tool for monitoring and improving the quality of lung stereotactic body radiotherapy (SBRT). The aim of this study was to report the initial, independent assessment of the dosimetric accuracy for lung SBRT practice using these dosimeters in combination with a novel phantom design.
Materials and Methods: The audit service was a remote audit program performed on a commercial lung phantom preloaded with film and alanine detectors. An alanine pellet was placed in the centre of the target simulated using silicone in a 3D-printed mould. Large film detectors were placed coronally through the target and the lung/tissue interface and analysed using gamma analysis. The beam output was always checked on the same day with alanine dosimetry in water. We audited 29 plans from 14 centres up to now.
Results: For the alanine results 28/29 plans were within 5 % with 19/29 plans being within 3 %. The passing rates were > 95 % for the film through the target for 27/29 plans and 17/29 plans for the film at the lung/tissue interface. For three plans the passing rate was < 90 % for the film on top of the lungs.
Conclusions: The preliminary results were very satisfactory for both detectors. The high passing rates for the film in the interface region indicate good performance of the treatment planning systems. The phantom design was robust and performed well on several treatment systems.

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BELdART

BELdART

BELdART audit results

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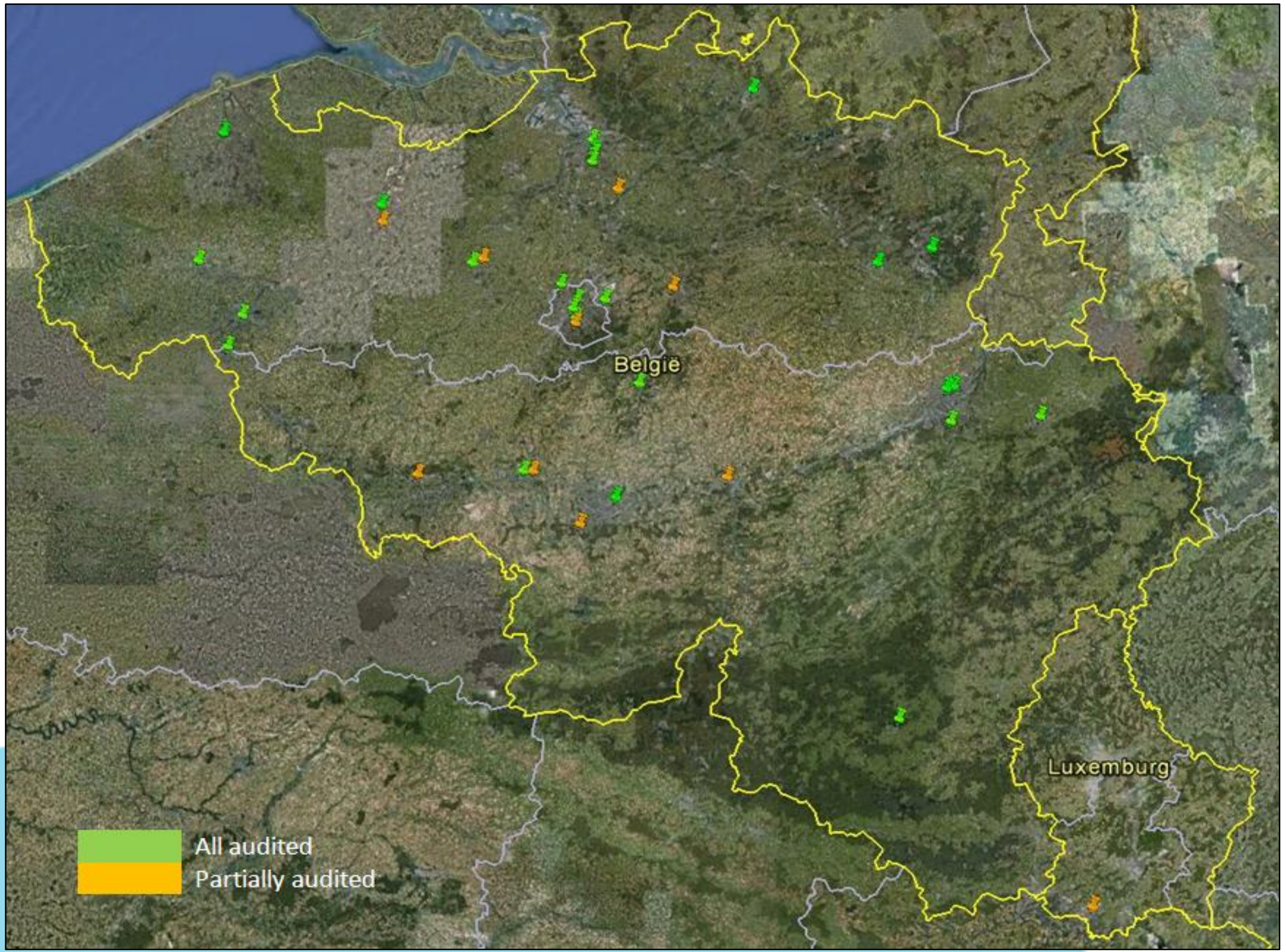
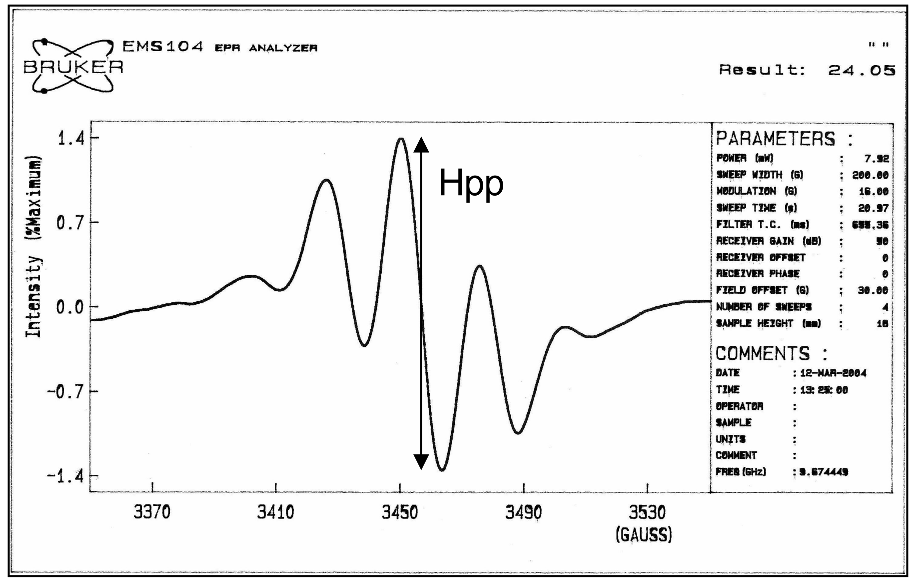
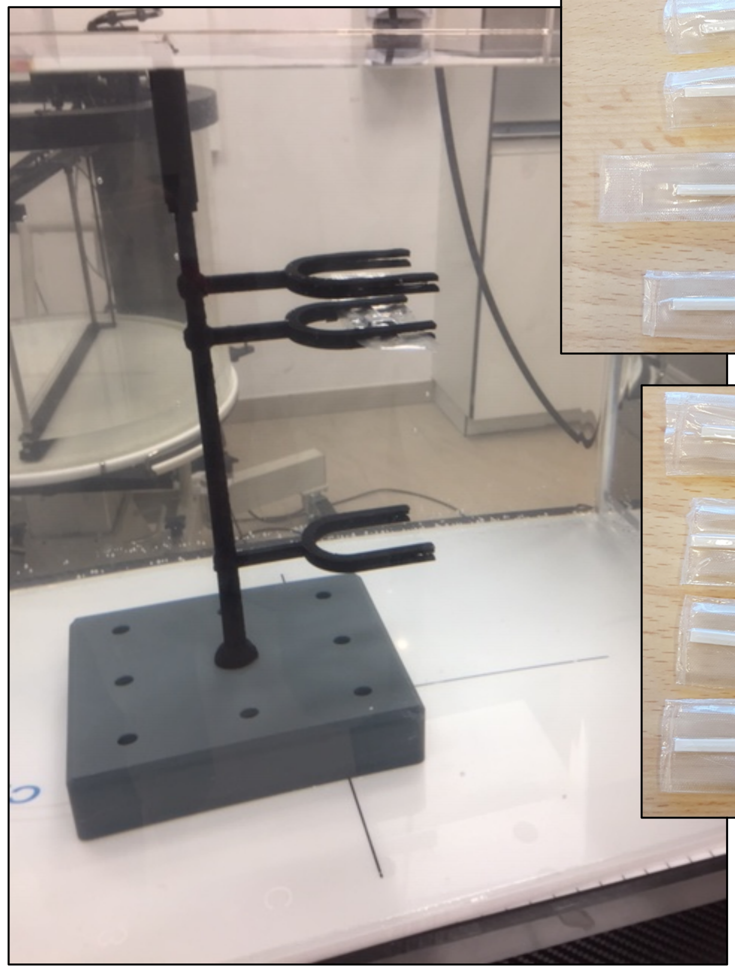
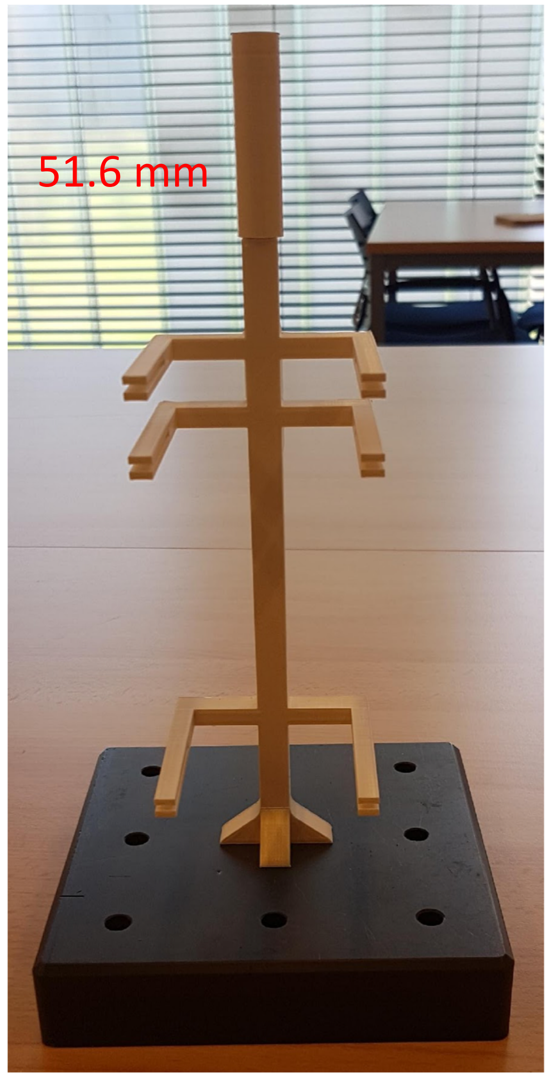
BELdART 1

external AUDIT of Belgian centres (2009-2012)







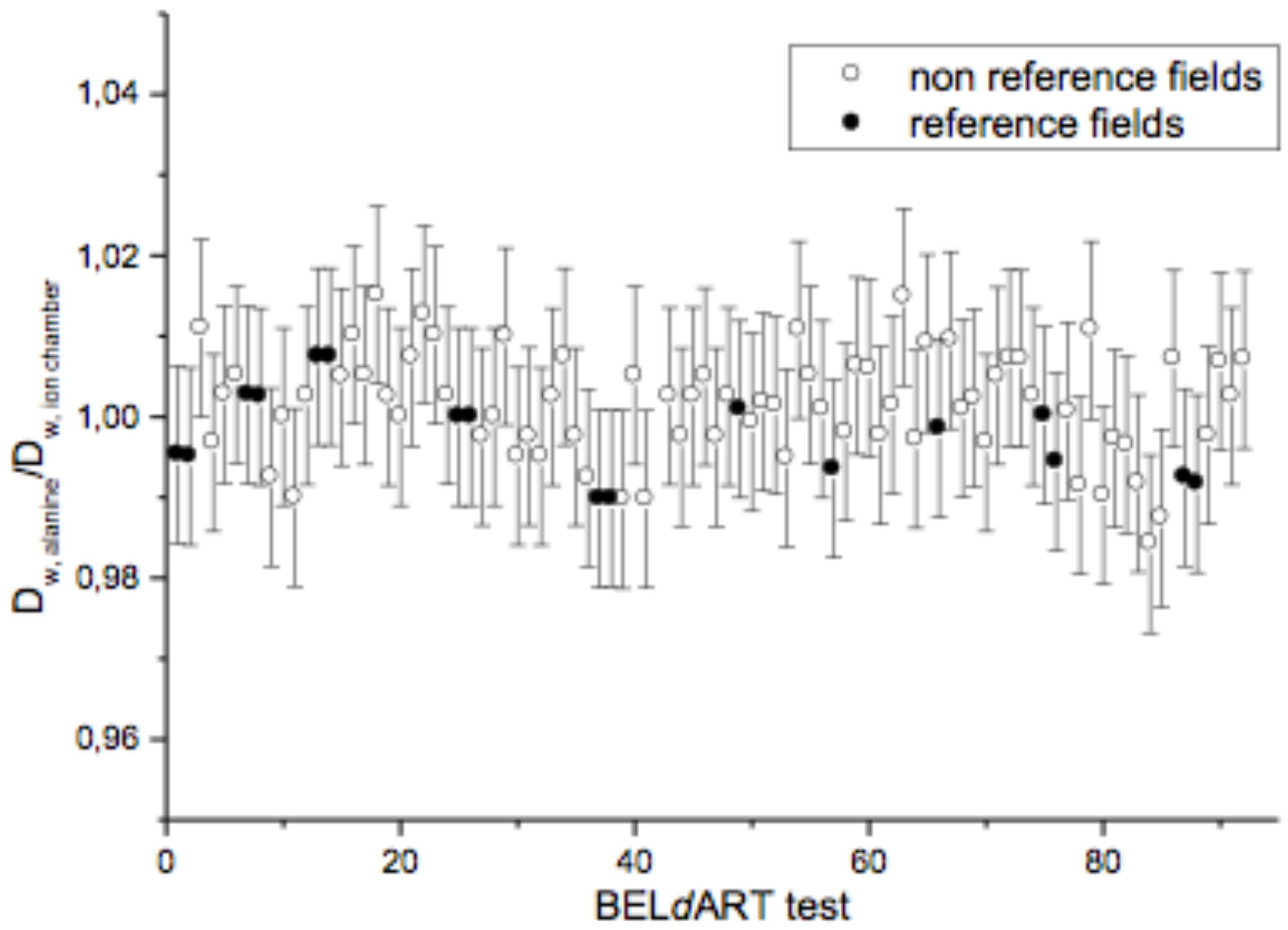


BELdART 1

external AUDIT of Belgian centres (2009-2012)

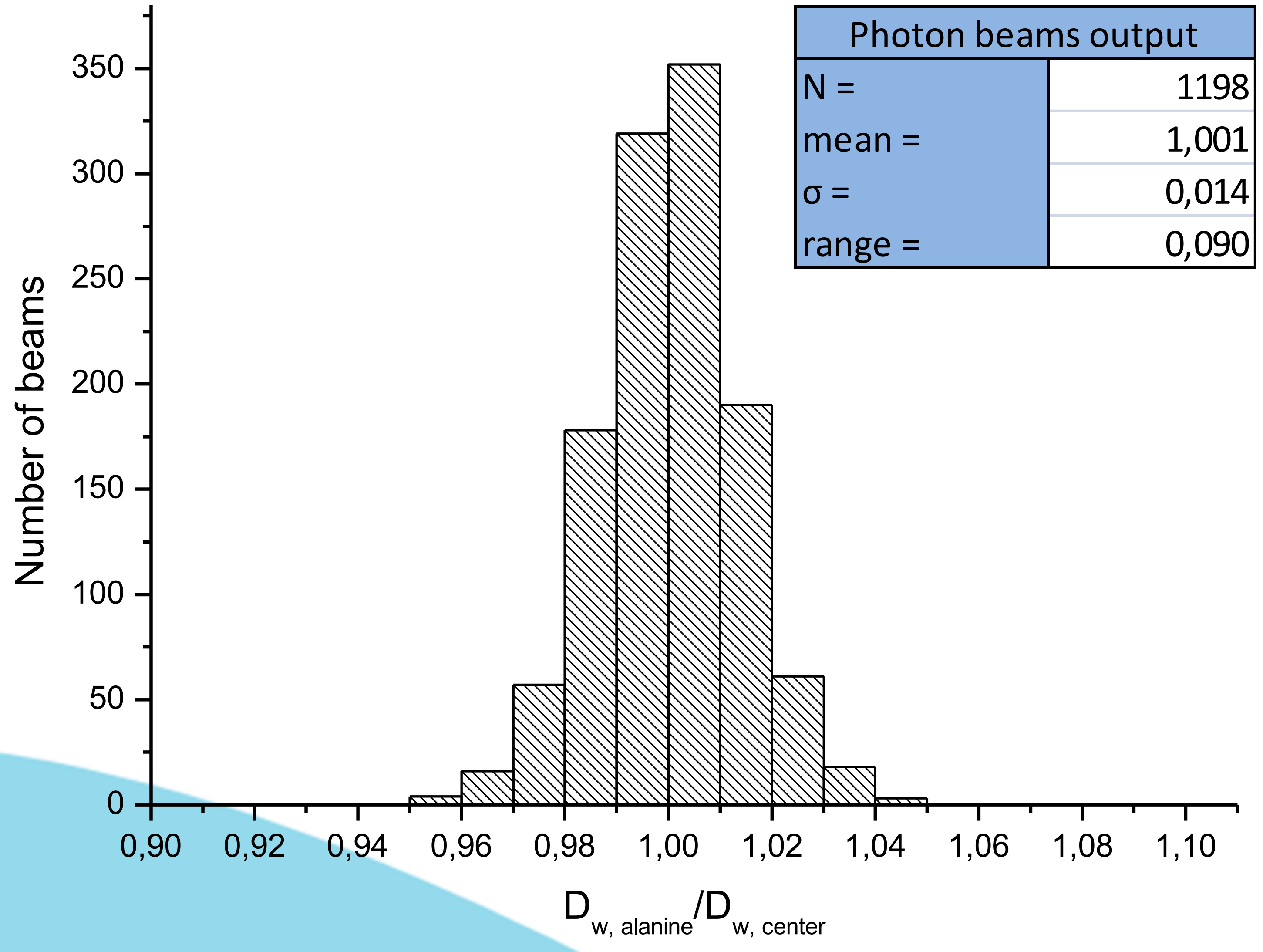
Dose ratio of alanine- to Farmer chamber measurements for the set of BELdART tests in sequential order (open circles) in 6, 15, 18 MV photon beams.

The average ratio of alanine to IC measurements was 1.001, s = 0.006; N = 92



BELdART 1

external AUDIT of Belgian centres (2009-2012)

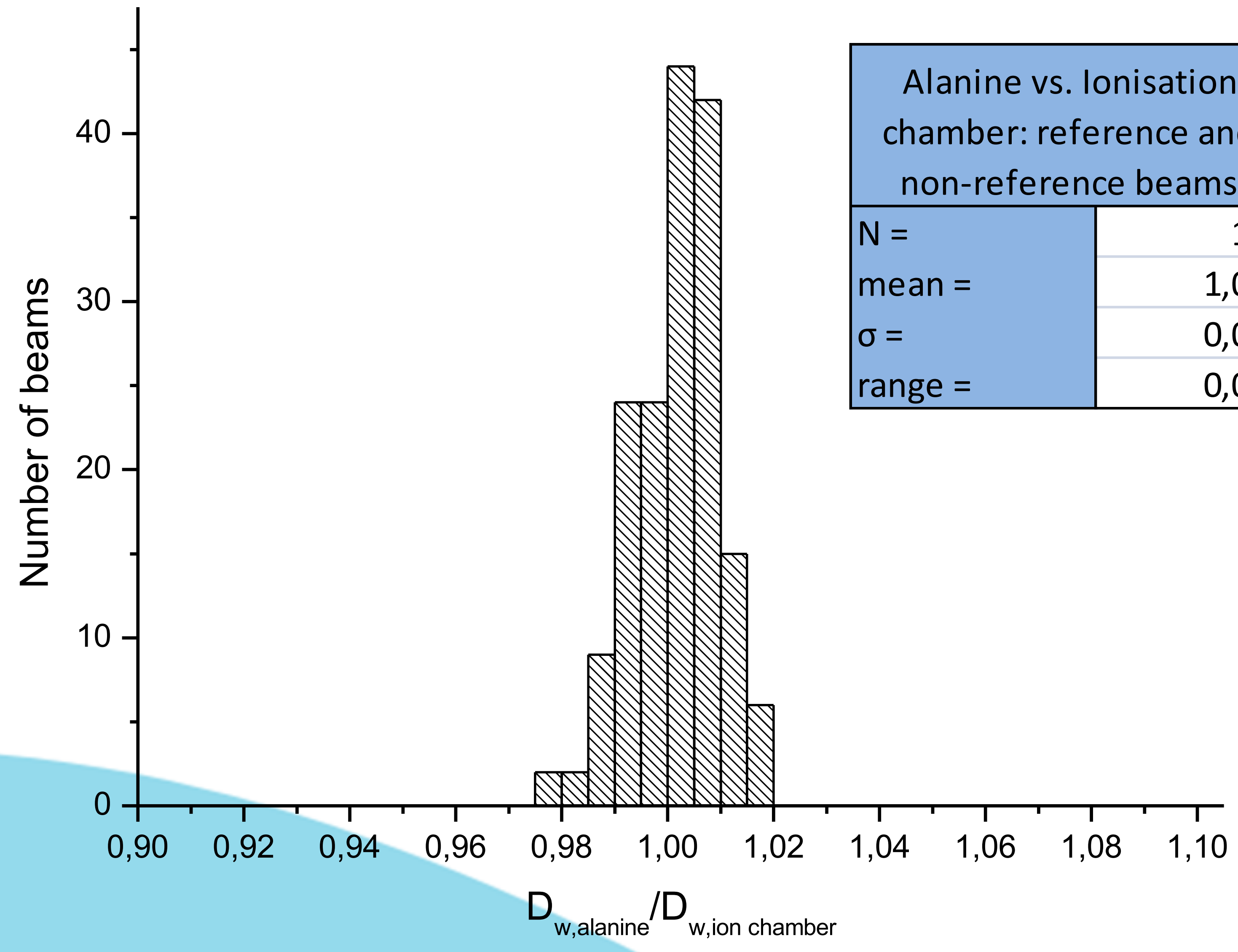


Photon beams output	
N =	1198
mean =	1,001
σ =	0,014
range =	0,090

Previous results	
N =	1074
mean =	1,000
σ =	0,013
range =	0,090

BELdART 1

external AUDIT of Belgian centres (2009-2012)

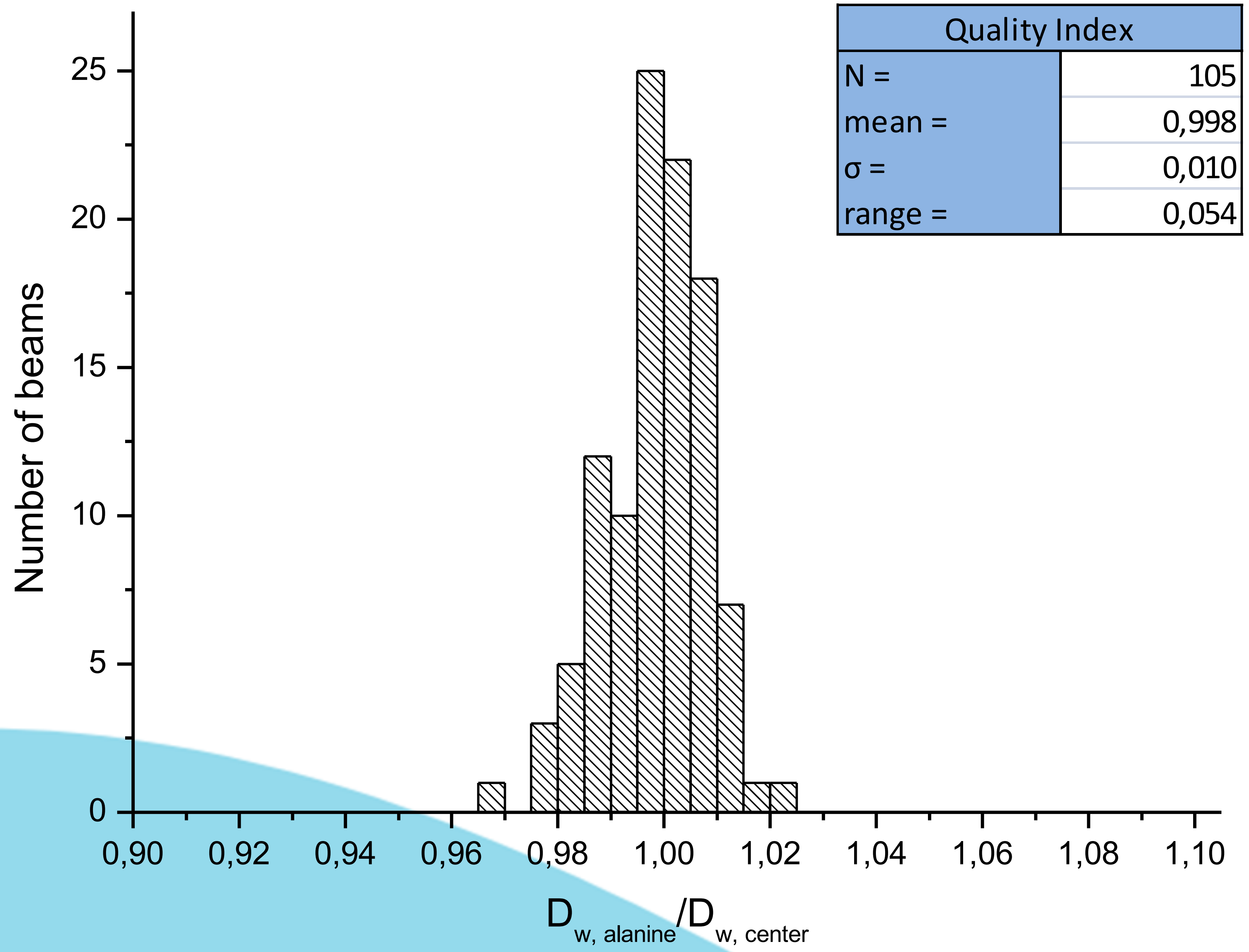


Alanine vs. Ionisation chamber: reference and non-reference beams	
N =	168
mean =	1,002
σ =	0,008
range =	0,039

Previous results	
N =	146
mean =	1,001
σ =	0,008
range =	0,039

BELdART 1

external AUDIT of Belgian centres (2009-2012)

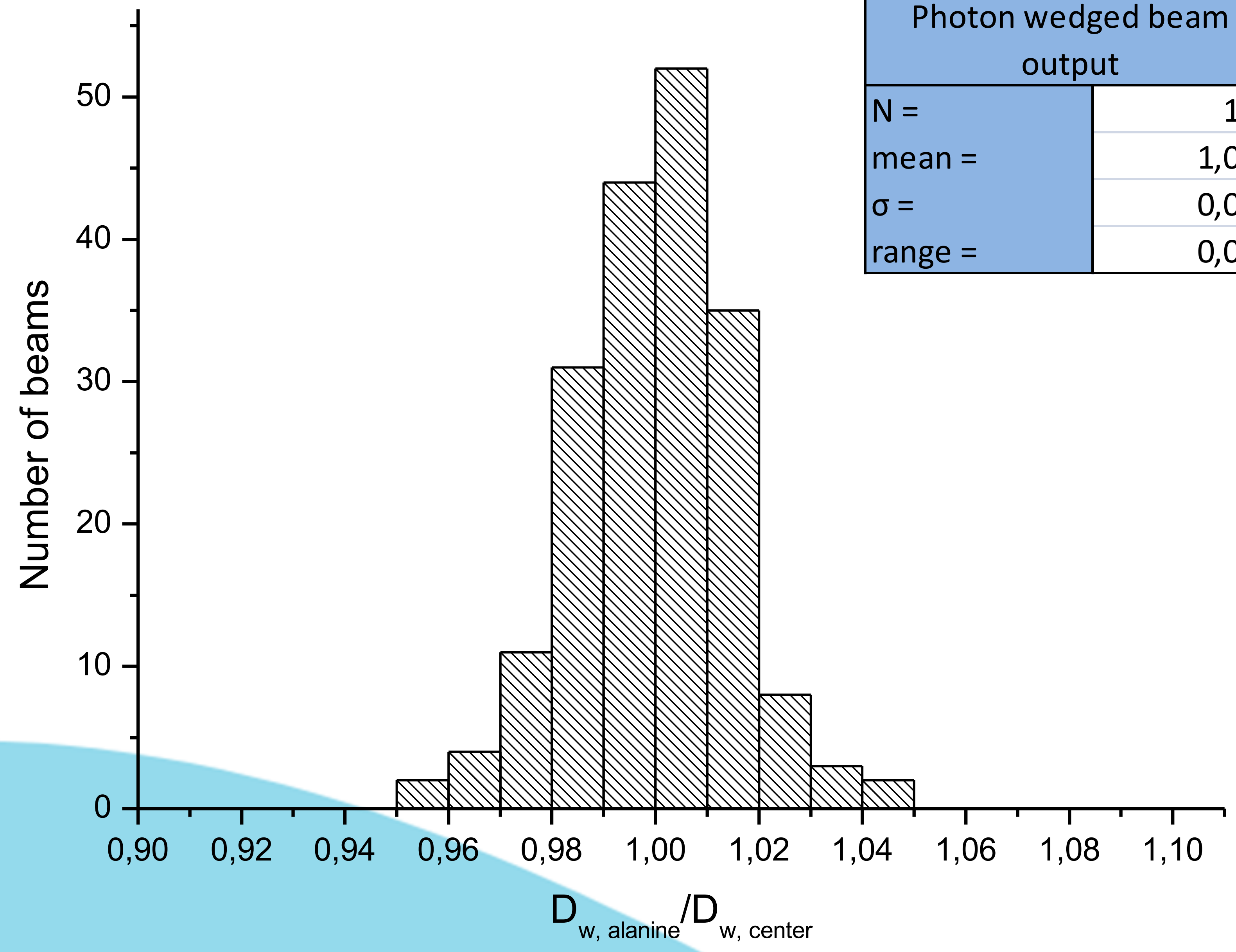


Quality Index	
N =	105
mean =	0,998
σ =	0,010
range =	0,054

Previous results	
N =	93
mean =	0,998
σ =	0,009
range =	0,051

BELdART 1

external AUDIT of Belgian centres (2009-2012)

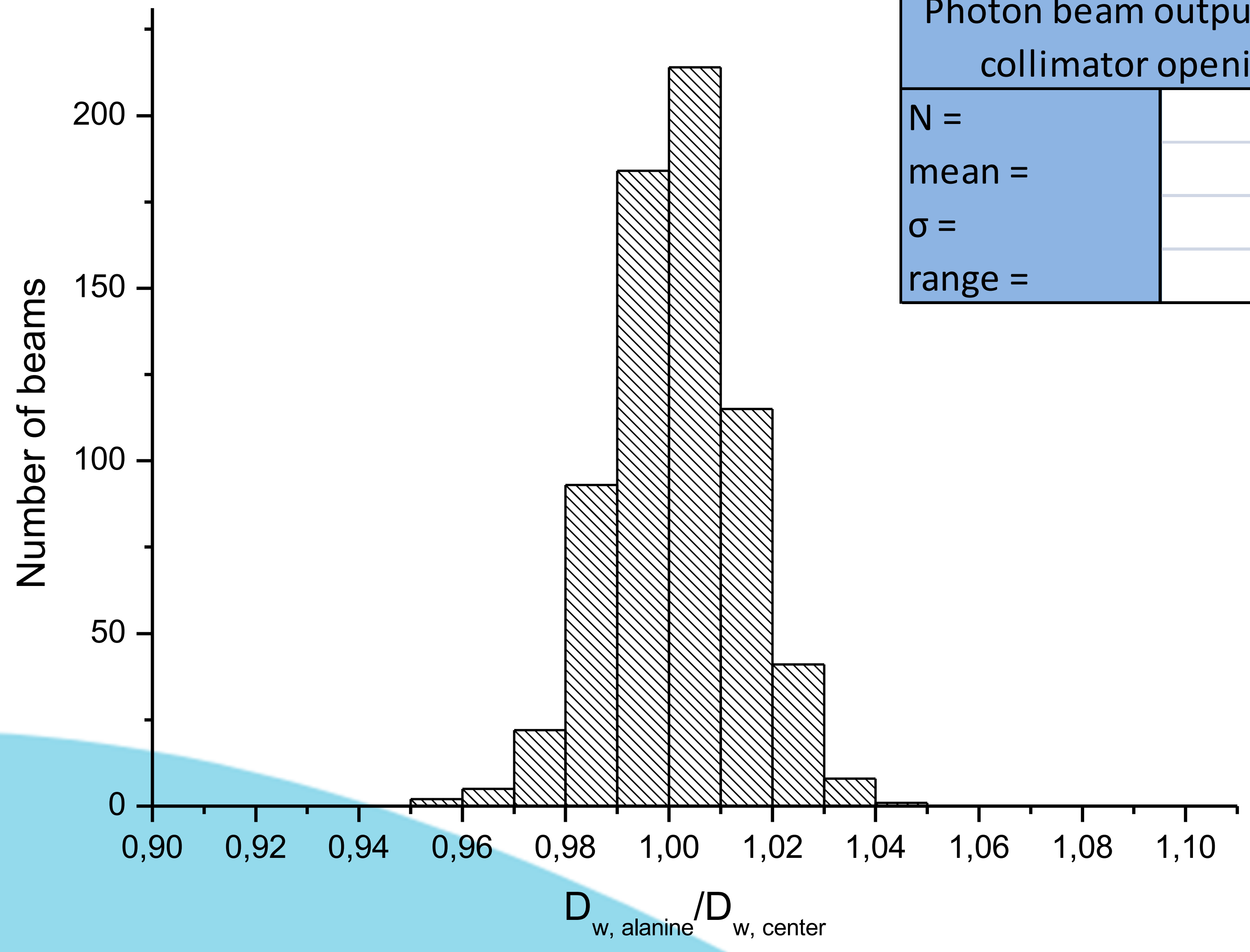


Photon wedged beam output	
N =	192
mean =	1,000
σ =	0,015
range =	0,090

Previous results	
N =	168
mean =	0,999
σ =	0,015
range =	0,090

BELdART 1

external AUDIT of Belgian centres (2009-2012)



Photon beam output with collimator opening	
N =	685
mean =	1,002
σ =	0,013
range =	0,084

Previous results	
N =	601
mean =	1,001
σ =	0,013
range =	0,081

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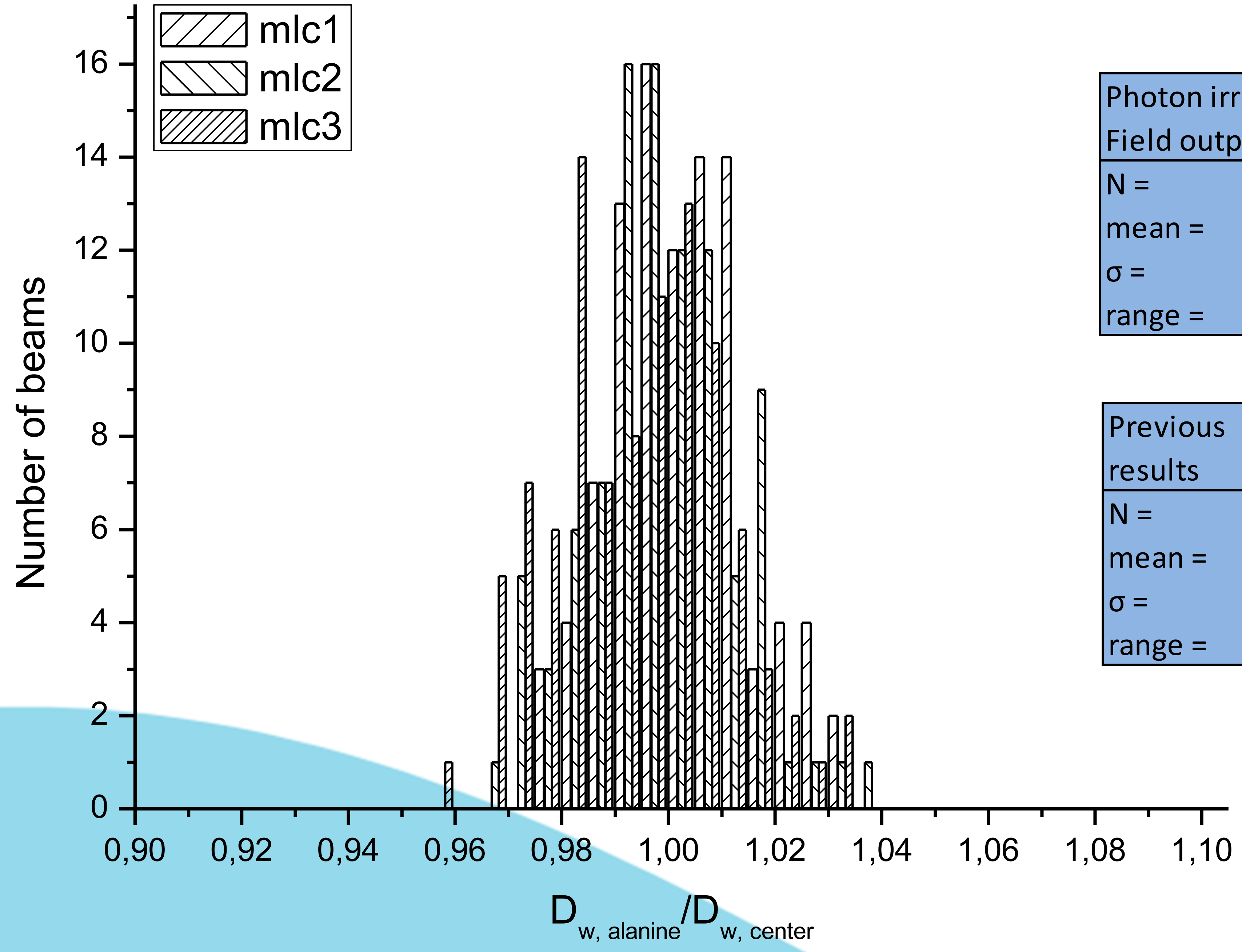
BELdART 1

external AUDIT of Belgian centres (2009-2012)

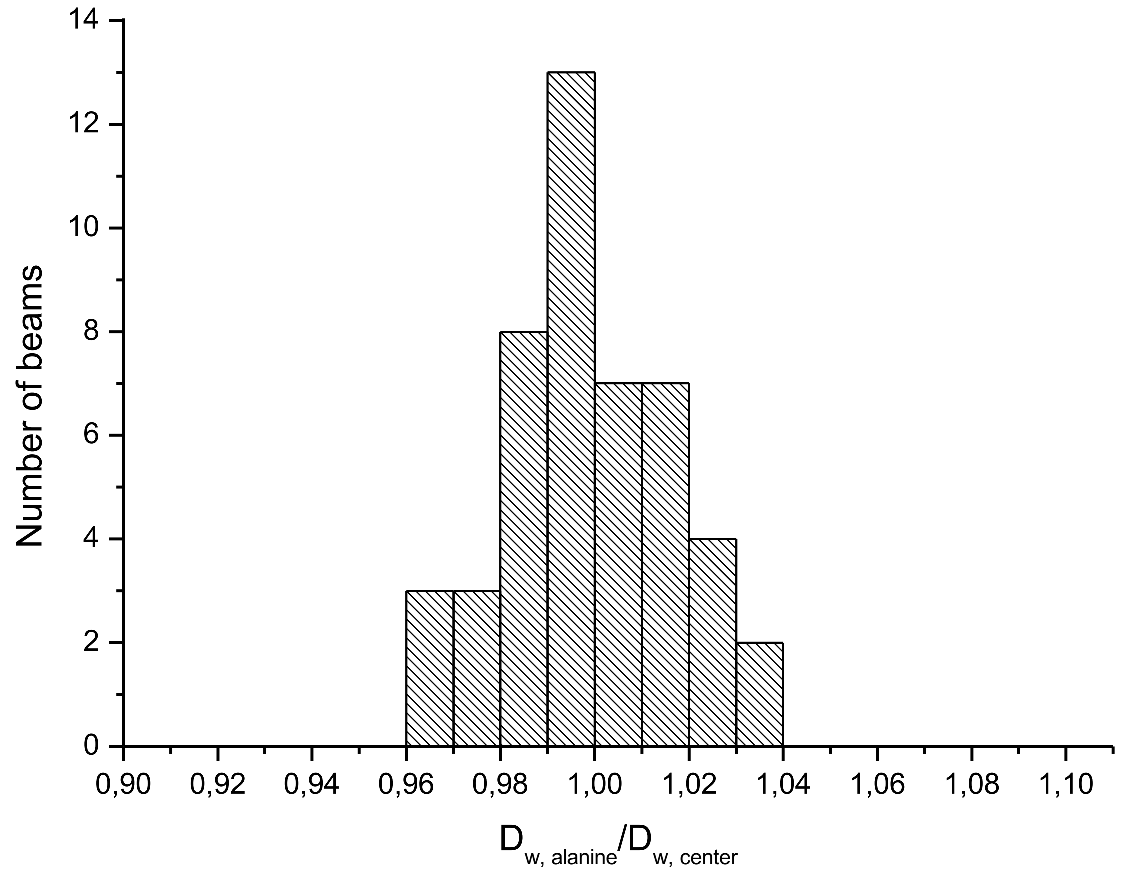


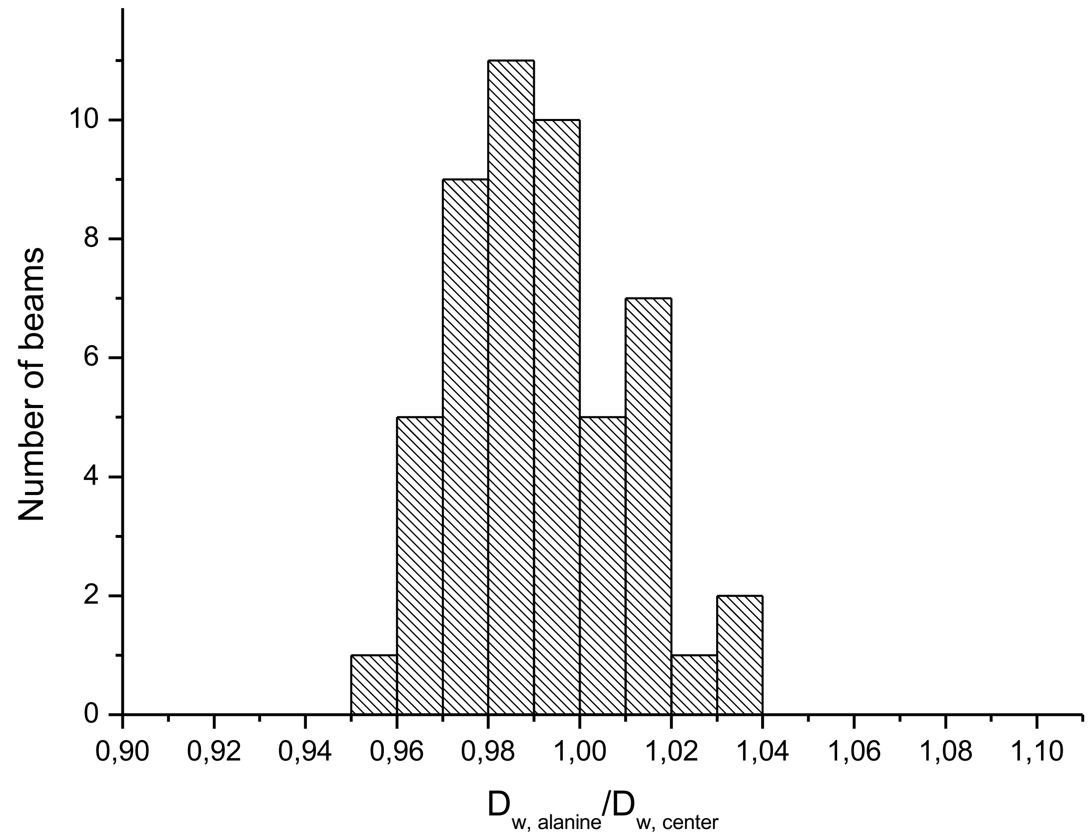
Photon irr. Field output	MLC1	MLC2	MLC3
N =	96	96	96
mean =	1,003	0,999	0,994
σ =	0,013	0,014	0,016
range =	0,058	0,070	0,075

Previous results	MLC1	MLC2	MLC3
N =	84	84	84
mean =	1,003	0,999	0,994
σ =	0,013	0,014	0,016
range =	0,058	0,070	0,075

BELdART 1

external AUDIT of Belgian centres (2009-2012)



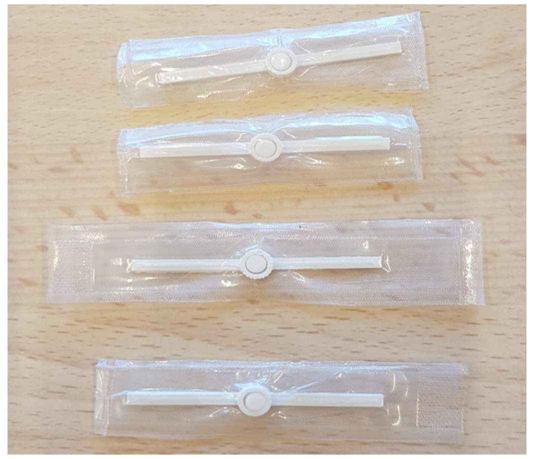


Low energy electron beams	
N =	47
mean =	0,999
σ =	0,018
range =	0,074

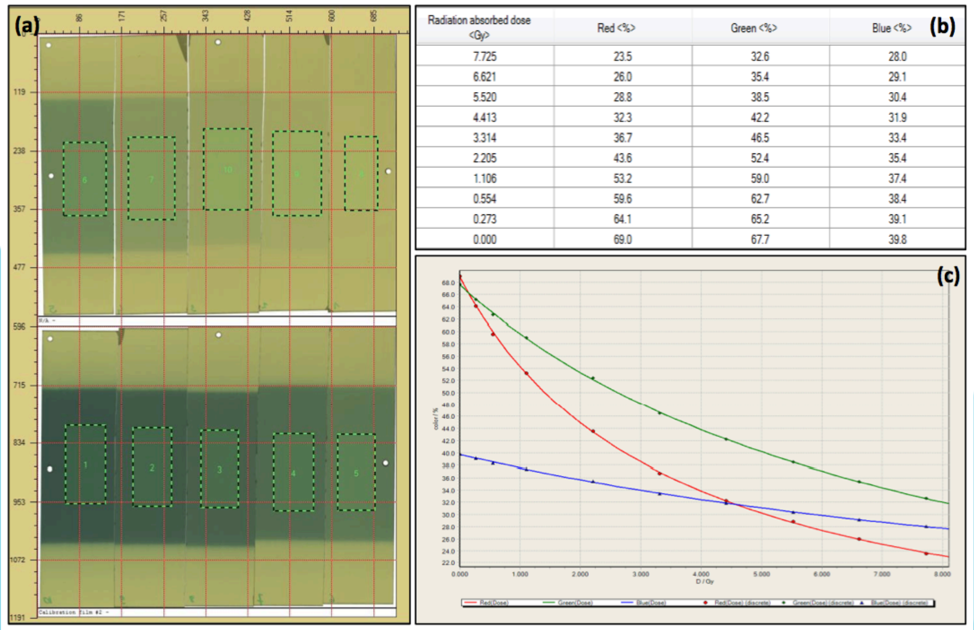
High energy electron beams	
N =	51
mean =	0,991
σ =	0,019
range =	0,086

BELdART Today

Alanine EPR

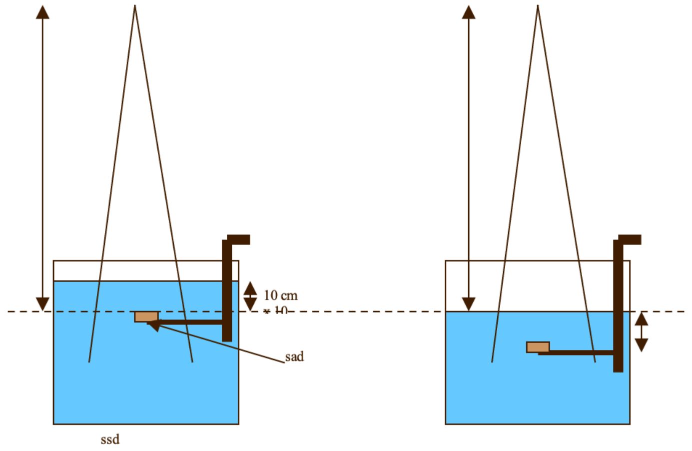


Radiochromic film

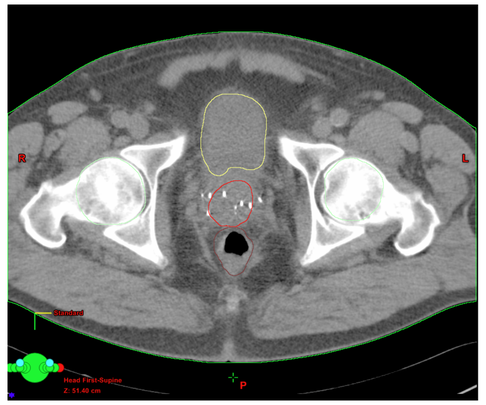


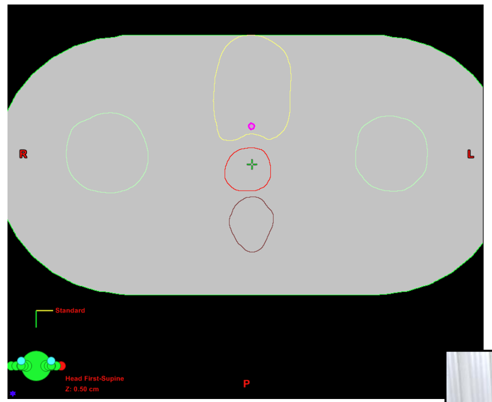
Radiation absorbed dose <Gy>	Red <%>	Green <%>	Blue <%>
7.725	23.5	32.6	28.0
6.621	26.0	35.4	29.1
5.520	28.8	38.5	30.4
4.413	32.3	42.2	31.9
3.314	36.7	46.5	33.4
2.205	43.6	52.4	35.4
1.106	53.2	59.0	37.4
0.554	59.6	62.7	38.4
0.273	64.1	65.2	39.1
0.000	69.0	67.7	39.8

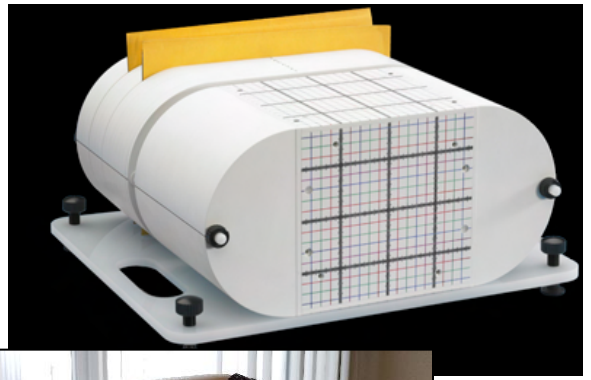
- Standard beams



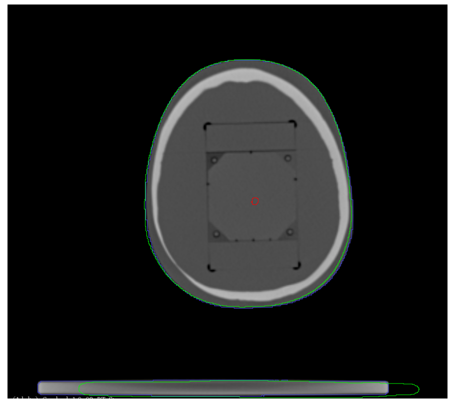
- Prostate IMRT

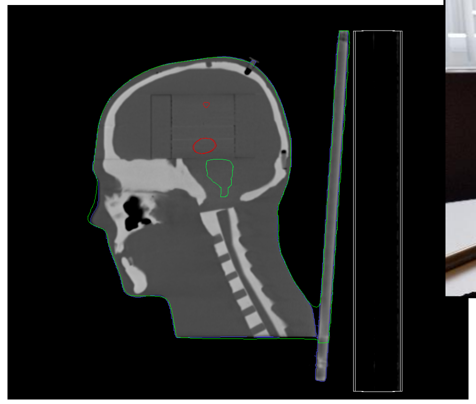


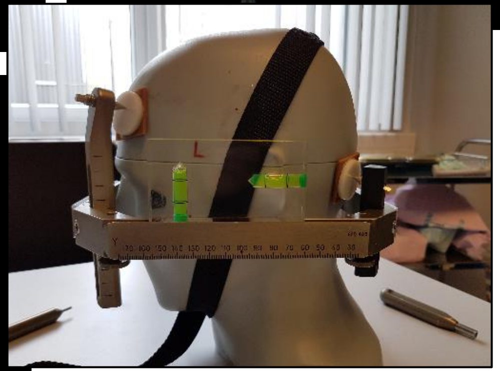




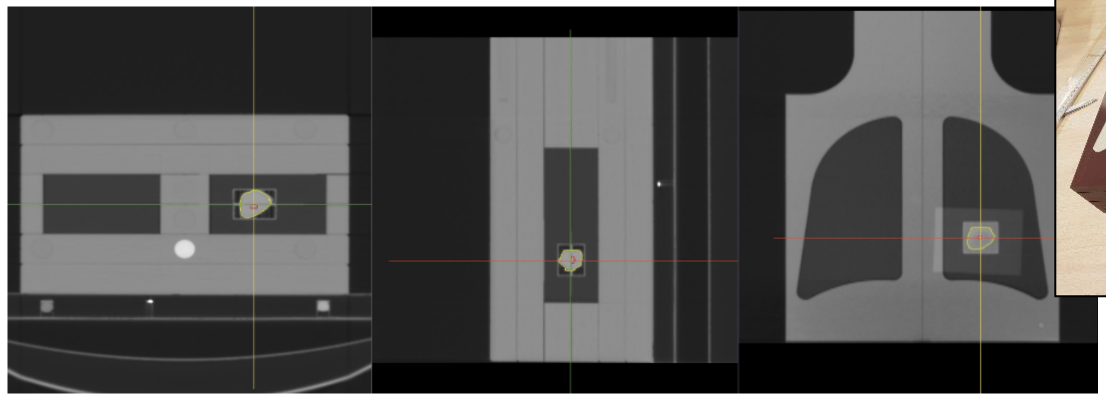
- Cranial SRS







- Lung SBRT



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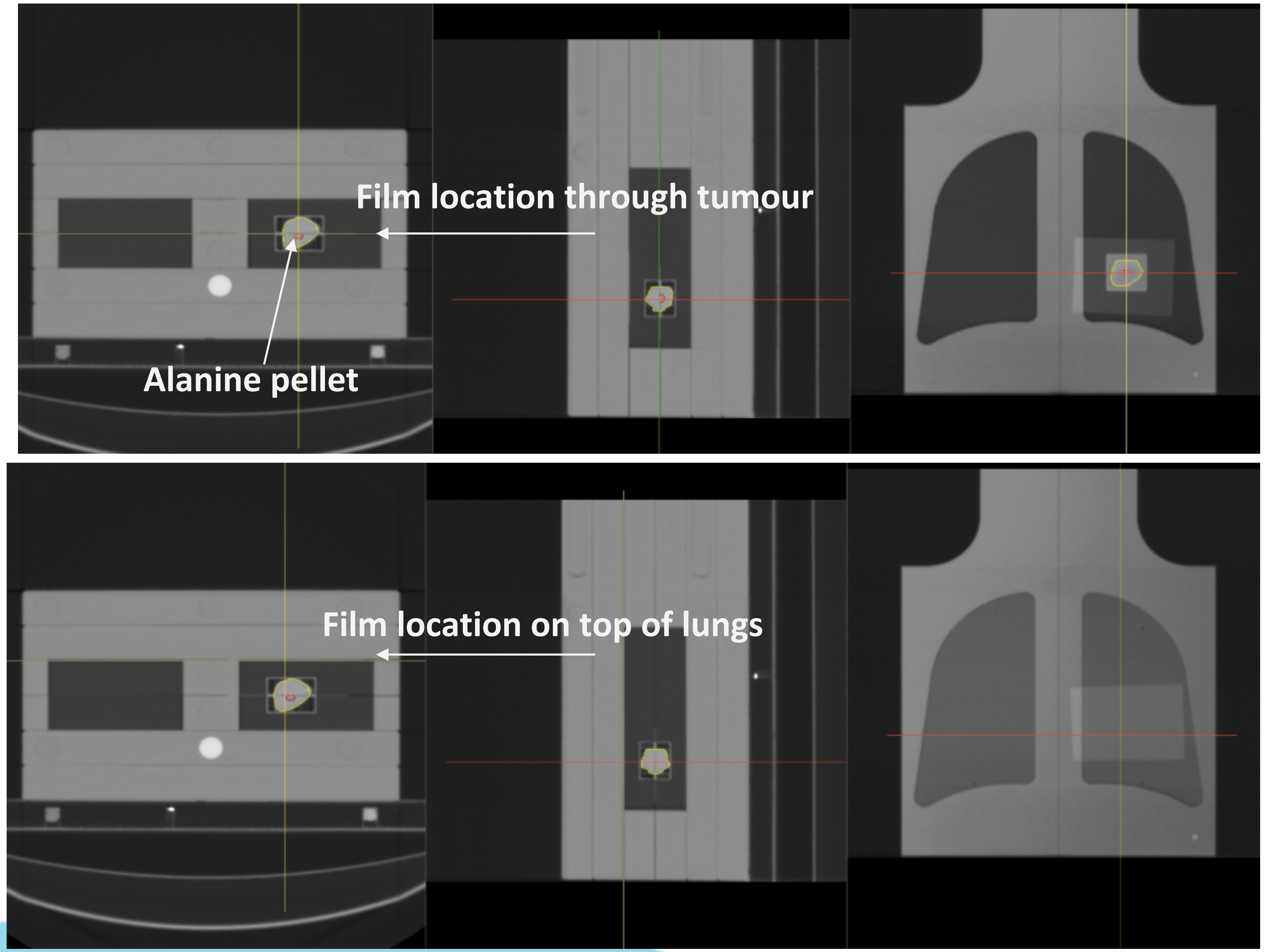
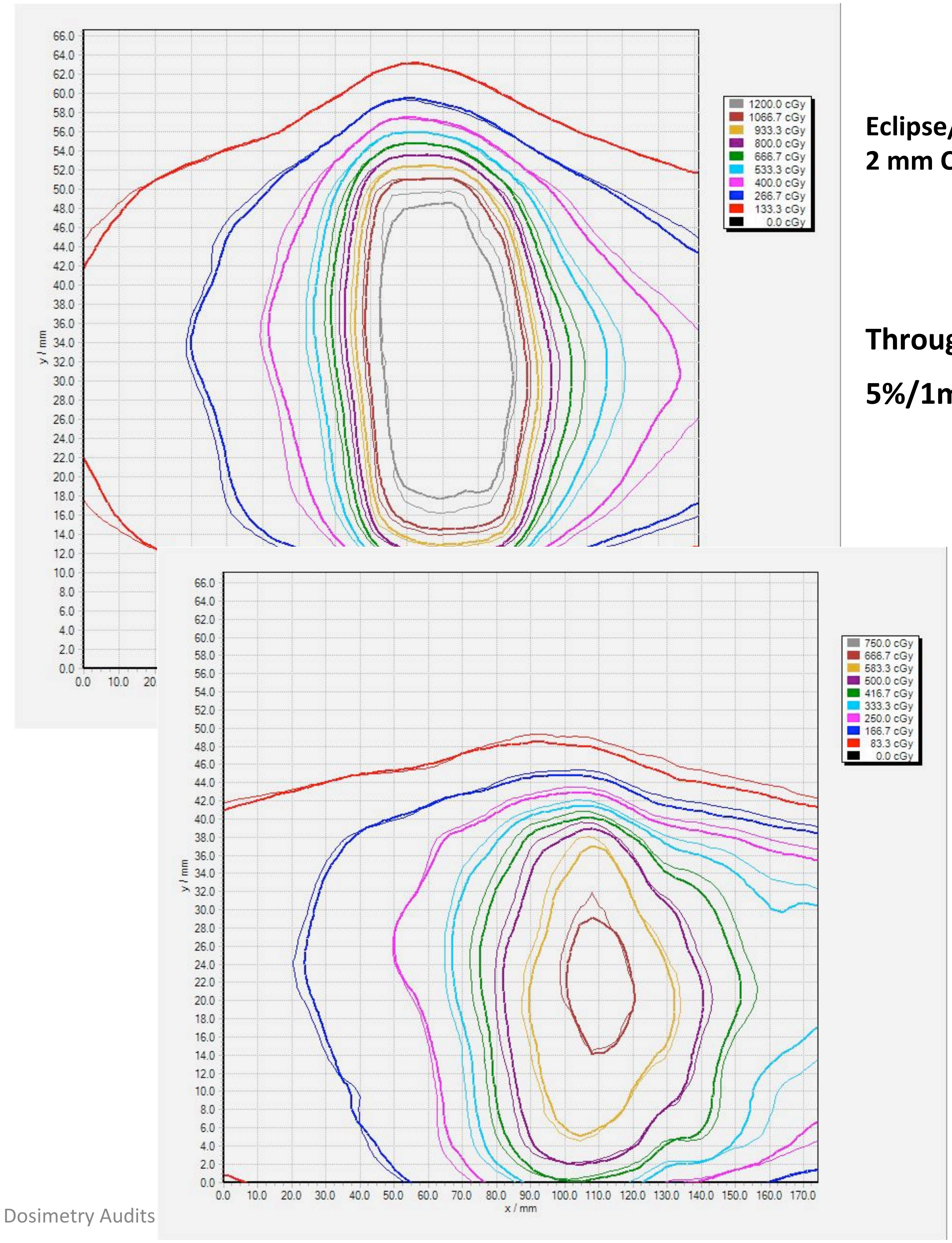
CAT ClinART

BELdART Today





Eclipse/AAA
2 mm CT slice thickness

Through target

5%/1mm: 99.9%

Eclipse/AAA
2 mm CT slice thickness

Top of lungs

3%/2mm: 95.3%

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CAT ClinART

BELdART Today

Standard Beams

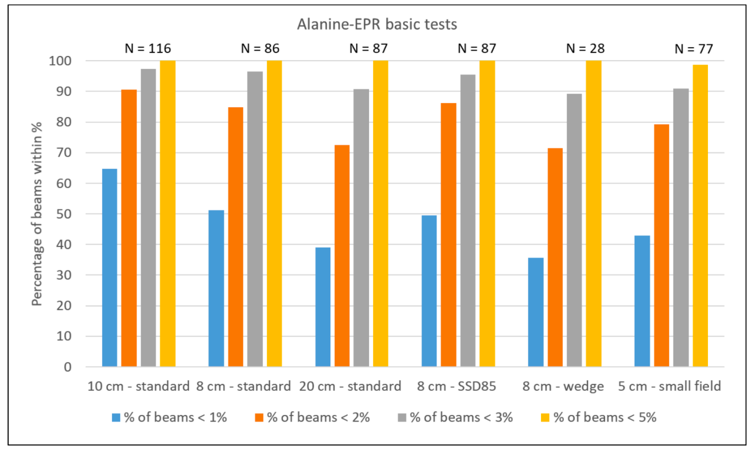


Figure 1-1: Summary of the results of the basic tests. The number of beams per test is indicated by the labels above.

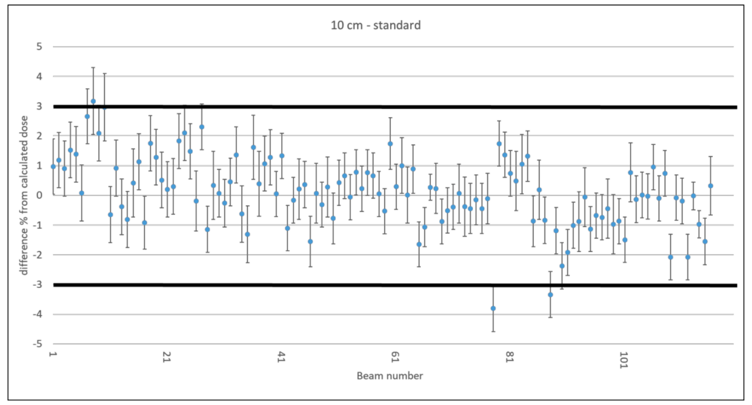


Figure 1-2: Results of the measured beam output in reference conditions with alanine/EPR dosimetry for each beam individually. The error bars show the uncertainty on the alanine reading.

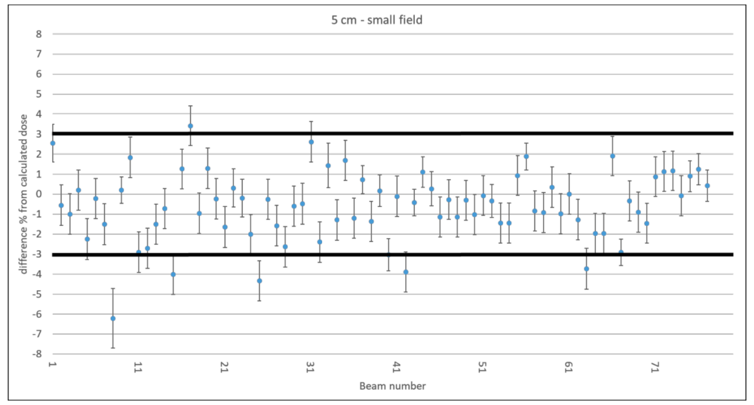


Figure 1-7: Results of the measured beam output at 5 cm depth and small fields up to 2x2 cm² or smallest one commissioned with alanine/EPR dosimetry for each beam individually. The error bars show the uncertainty on the alanine reading.

Prostate

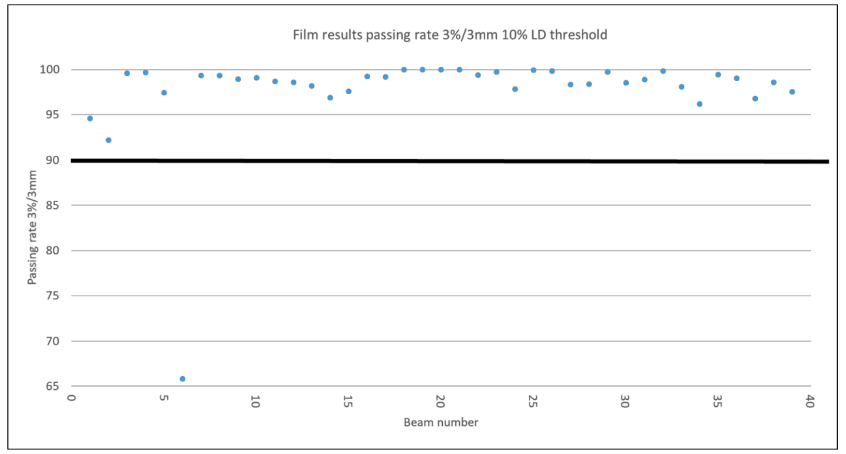


Figure 2-2: Film dosimetry results for the E2E test for the IMRT prostate case for each beam individually.

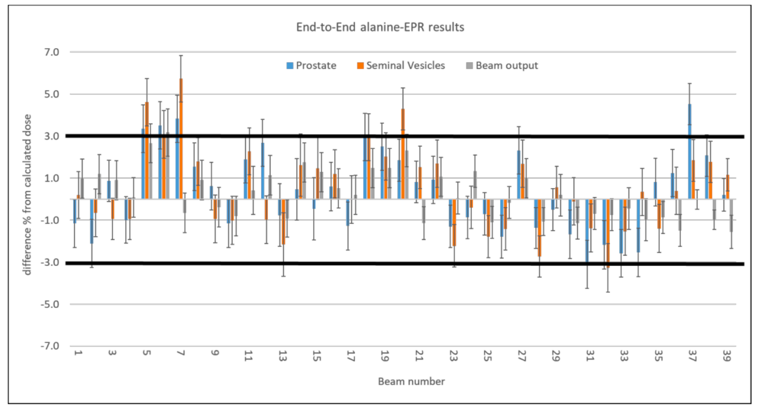


Figure 2-1: Alanine/EPR dosimetry results for the E2E test for the IMRT prostate case for each beam individually. The beam output that is measured on the same day as the E2E test is plotted together. The error bars show the uncertainty on the alanine reading.

SRS cranial

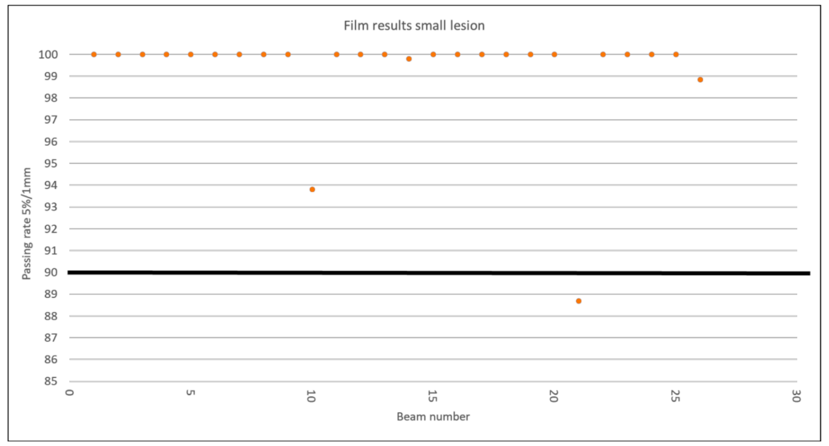


Figure 2-5: Film dosimetry results for the E2E test for the intracranial SRS case for the small lesion for each beam individually.

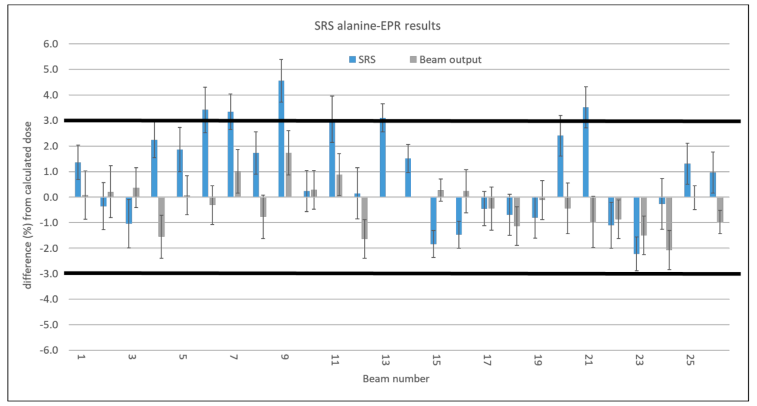


Figure 2-3: Alanine/EPR dosimetry results for the E2E test for the intracranial SRS case for each beam individually. The beam output that is measured on the same day as the E2E test is plotted together. The error bars show the uncertainty on the alanine reading.

SBRT lung

Figure 2-8: Film dosimetry results for the E2E test for the lung SBRT case for the film on top of the lungs for each beam individually.

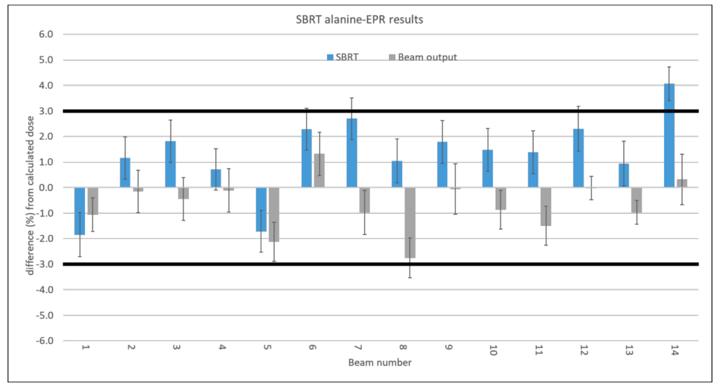


Figure 2-6: Alanine/EPR dosimetry results for the E2E test for the lung SBRT case for each beam individually. The beam output that is measured on the same day as the E2E test is plotted together. The error bars show the uncertainty on the alanine reading.

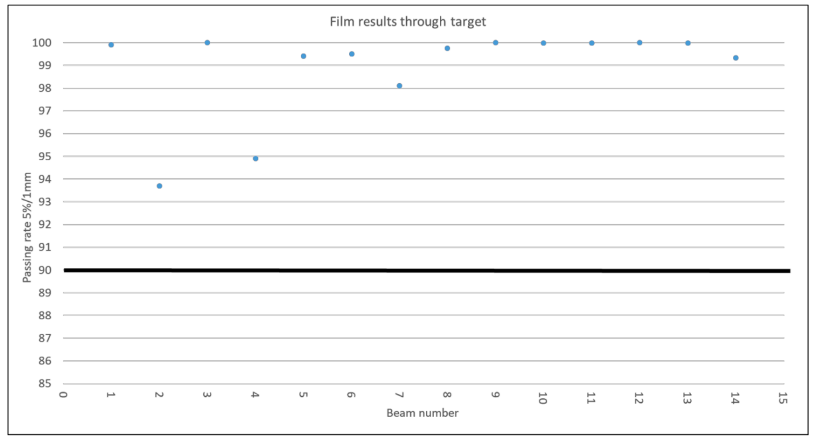


Figure 2-7: Film dosimetry results for the E2E test for the lung SBRT case for the film through the target for each beam individually.

Objectives of the lecture

- Why do we need dosimetry audits?
- IAEA QUATRO approach
- B-QUATRO and BELdART
  - History of BELdART
  - Current situation
  - Regulations and Pitfalls

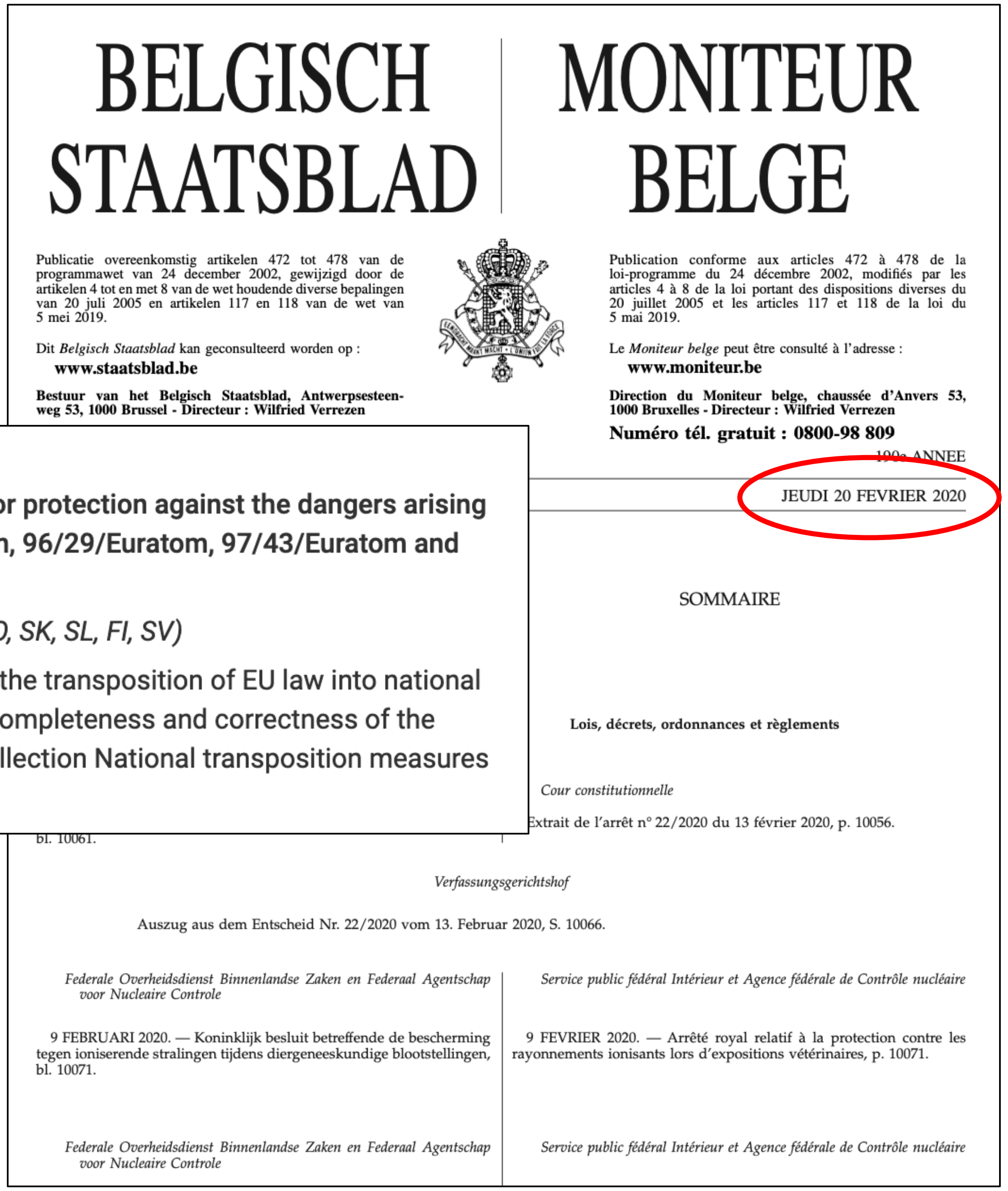
Regulations and pitfalls

National transposition measures communicated by the Member States concerning:

Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

OJ L 13, 17.1.2014, p. 1–73 (BG, ES, CS, DA, DE, ET, EL, EN, FR, HR, IT, LV, LT, HU, MT, NL, PL, PT, RO, SK, SL, FI, SV)

The member states bear sole responsibility for all information on this site provided by them on the transposition of EU law into national law. This does not, however, prejudice the results of the verification by the Commission of the completeness and correctness of the transposition of EU law into national law as formally notified to it by the member states. The collection National transposition measures is updated weekly.


BELGISCH STAATSBLAD | MONITEUR BELGE

Publicatie overeenkomstig artikelen 472 tot 478 van de programmawet van 24 december 2002, gewijzigd door de artikelen 4 tot en met 8 van de wet houdende diverse bepalingen van 20 juli 2005 en artikelen 117 en 118 van de wet van 5 mei 2019.

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190e ANNEE

JEUDI 20 FEVRIER 2020

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Federale Overheidsdienst Binnenlandse Zaken en Federaal Agentschap voor Nucleaire Controle

9 FEBRUARI 2020. — Koninklijk besluit betreffende de bescherming tegen ioniserende stralingen tijdens diergeneeskundige blootstellingen, bl. 10071.

Service public fédéral Intérieur et Agence fédérale de Contrôle nucléaire

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Federale Overheidsdienst Binnenlandse Zaken en Federaal Agentschap voor Nucleaire Controle

Service public fédéral Intérieur et Agence fédérale de Contrôle nucléaire

Regulations and pitfalls

So, the KB/RA had the great idea to make this an **obligation** …

- "An **external dosimetry audit** is mandatory **PRIOR** to clinical implementation of a linac"

Some issues that were not considered properly …:

- Only one audit centre in Belgium, with limited capacity -> waiting times ~ months
- What are the tolerances, who decides on these tolerances?
- Basic dosimetry audit or complex techniques?
- What if audit fails for, let's say 1 electron energy only?
- What in case of dispute, experimental set-up errors?

- This requirement will result in delay of clinical implementation of replacement/new linacs:
  - double shifts on remaining machines … increased risk in incidents?
  - increased waiting times … quality?

See presentation on "How to maintain a permanent audit service"

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