

7th International Conference on 3D Radiation Dosimetry 2012

(IC3DDose)

Journal of Physics: Conference Series Volume 444

**Sydney, Australia
4-8 December 2012**

**ISBN: 978-1-62748-676-7
ISSN: 1742-6588**

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© by the Institute of Physics
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact the Institute of Physics
at the address below.

Institute of Physics
Dirac House, Temple Back
Bristol BS1 6BE UK

Phone: 44 1 17 929 7481
Fax: 44 1 17 920 0979

techtracking@iop.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

011001 [7th International Conference on 3D Radiation Dosimetry \(IC3DDose\)](#)
ACCESS David Thwaites and Clive Baldock

Papers

Refresher

012001 [Fundamentals of gel dosimeters](#) OPEN ACCESS K B McAuley and A T Nasr 1

012002 [Dosimetry in radiotherapy using a-Si EPIDs: Systems, methods, and applications focusing on 3D patient dose estimation](#) OPEN ACCESS B M C McCurdy 8

012003 [How to scan polymer gels with MRI?](#) OPEN ACCESS Y D Deene 15

012004 [How to perform an optical CT scan: an illustrated guide](#) OPEN ACCESS S J 24
Doran

012005 [Considerations for x-ray CT polymer gel dosimetry](#) OPEN ACCESS A Jirasek 30

012006 [Accuracy required and achievable in radiotherapy dosimetry: have modern technology and techniques changed our views?](#) OPEN ACCESS D Thwaites 37

Invited Review

012007 [Semi- and virtual 3D dosimetry in clinical practice](#) OPEN ACCESS S S 54
Korreman

012008 [Review of four novel dosimeters developed for use in radiotherapy](#) 62
ACCESS P Metcalfe, A Quinn, K Loo, M Lerch, M Petasecca, J Wong, N Hardcastle, M Carolan, J McNamara, D Cutajar, I Fuduli, A Espinoza, C Porumb and A Rosenfeld

012009 [Review of recent advances in non 3D dosimeters](#) OPEN ACCESS K Jordan 69

012010 [3D EPID based dosimetry for pre-treatment verification of VMAT – methods and challenges](#) OPEN ACCESS P B Greer 77

012011 [3D EPID-based *in vivo* dosimetry for IMRT and VMAT](#) OPEN ACCESS B 84
Mijnheer, I Olaciregui-Ruiz, R Rozendaal, J-J Sonke, H Spreeuw, R Tielenburg, M van Herk, R Vlijlbrieff and A Mans

012012 [Dosimetric quality assurance of highly conformal external beam treatments: from 2D phantom comparisons to 4D patient dose reconstruction](#) OPEN ACCESS V 91
Feygelman and B Nelms

012013 [Current status of scintillation dosimetry for megavoltage beams](#) 100
L Beaulieu, M Goulet, L Archambault and S Beddar

012014 [Dosimetry for audit and clinical trials: challenges and requirements](#) 111
ACCESS T Kron, A Haworth and I Williams

012015 [On the reliability of 3D gel dosimetry](#) OPEN ACCESS Y D Deene and J 118
Vandecasteele

012016 [Analysis and evaluation of planned and delivered dose distributions: practical concerns with \$\gamma\$ - and \$\chi\$ - Evaluations](#) OPEN ACCESS L J Schreiner, O Holmes and G 148
Salomons

012017 [Dosimetry of CBCT: methods, doses and clinical consequences](#) 157
J R Sykes, R Lindsay, G Iball and D I Thwaites

Clinical Challenges & Dosimetry Systems

- 012018 [Development and characterization of a three-dimensional film stack dosimeter](#) 170
OPEN ACCESS T J McCaw, J A Micka and L A DeWerd
- 012019 [Detecting VMAT delivery errors: A study on the sensitivity of the ArcCHECK-3D electronic dosimeter](#) 174
OPEN ACCESS S Arumugam, A Xing, G Goozee and L Holloway
- 012020 [Investigation of 3D dosimetry for an anthropomorphic spine phantom](#) 178
ACCESS R Grant, G Ibbott, J Yang, J Adamovics and D Followill
- 012021 [4D dosimetry and its applications to pre-treatment quality control and real-time *in vivo* dosimetry of VMAT treatments](#) 182
OPEN ACCESS F Nordström, S af Wetterstedt and S Å J Bäck
- 012022 [Evaluation of a clinically intuitive quality assurance method](#) SS H 187
Norris, A Thomas and M Oldham
- New Dosimetry Systems**
- 012023 [3D tomodosimetry using scintillating fibers: proof-of-concept](#) 191
M Goulet, L Gingras, L Beaulieu and L Archambault
- 012024 [Water equivalence of micelle gels for x-ray beams](#) OPEN ACCESS T Gorjiara, R 195
Hill, Z Kuncic, S Bosi and C Baldock
- 012025 [Enhancement of radiation effects by bismuth oxide nanoparticles for kilovoltage x-ray beams: A dosimetric study using a novel multi-compartment 3D radiochromic dosimeter](#) 200
OPEN ACCESS M Alqathami, A Blencowe, U J Yeo, R Franich, S Doran, G Qiao and M Geso
- 012026 [Low-density polymer gel dosimeters for 3D radiation dosimetry in the thoracic region: A preliminary study](#) 204
OPEN ACCESS Y D Deene, J Vandecasteele and T Vercauteren
- 012027 [Basic investigations on LCV micelle gel](#) OPEN ACCESS S B Ebenezer, M K 208
Rafic and P B Ravindran

012028 [New polymer gel dosimeters consisting of less toxic monomers with radiation-crosslinked gel matrix](#) OPEN ACCESS A Hiroki, S Yamashita, Y Sato, N Nagasawa and M Taguchi 213

Polymer Gel Dosimetry

012029 [Customising PRESAGE® for diverse applications](#) OPEN ACCESS T Juang, J 217 Newton, M Niebanck, R Benning, J Adamovics and M Oldham

012030 [NIPAM polymer gel dosimetry for IMRT four-field box irradiation using optical-CT scanner](#) OPEN ACCESS C H Yao, W T Hsu, S M Hsu, P Y L Ma, B T Hsieh and Y J Chang 222

012031 [Comparison between polymer gel dosimetry and calculated dose with small field in stereotactic irradiation](#) OPEN ACCESS H Kawamura, K Shinoda, H Fuse, T Terunuma, K Miyamoto, T Sakae and A Matsumura 226

012032 [Deformable gel dosimetry I: application to external beam radiotherapy and brachytherapy](#) OPEN ACCESS U J Yeo, M L Taylor, J R Supple, R L Smith, T Kron and R D Franich 231

012033 [Response of aqueous dichromate and nanoclay dichromate gel dosimeters to carbon ion irradiation](#) OPEN ACCESS T Maeyama, N Fukunishi, K L Ishikawa, K Fukasaku, T Furuta, S Takagi, S Noda, R Himeno and S Fukuda 235

012034 [An investigation into ultra-sensitive substituted leucomalachite dye derivatives for use in the PRESAGE® dosimeter](#) OPEN ACCESS M Alqathami, J Adamovics, R Benning and A Blencowe 239

Radiochromic and Other Novel Dosimetry

012035 [Measurements for dose distribution with a photo-stimulated luminescence dosimeter sheet](#) OPEN ACCESS C Kurokawa and A Urushiyama 244

012036 [Exploring the dose response of radiochromic dosimeters](#) OPEN ACCESS P S 248 Skyt, I Wahlstedt, E S Yates, L P Muren, J B B Petersen and P Balling

012037 [Photometric calibration of a radiochromic gel dosimeter](#) OPEN ACCESS J B 252
Davies, S G Bosi and C Baldock

012038 [Diffusion properties of a radiochromic hydrogel dosimeter](#) OPEN ACCESS P S 256
Skyt, T S Kinnari, I Wahlstedt, E S Yates, L P Muren, J B B Petersen and P Balling

012039 [Non-diffusing photochromic gel for optical computed tomography phantoms](#) 260
OPEN ACCESS K Jordan

012040 [Verification of a non-diffusing gel dosimeter](#) OPEN ACCESS J B Davies, S G 264
Bosi and C Baldock

012041 [Preliminary evaluation of diacetylene-based 3D micelle gel dosimeters](#) 268
ACCESS A Nasr, T Olding, L J Schreiner and K B McAuley

EPID Dosimetry and Verification of Complex Treatments

012042 [3D Dose reconstruction: Banding artefacts in cine mode EPID images during VMAT delivery](#) 273
OPEN ACCESS H C Woodruff and P B Greer

012043 [Clinical validation of an in-house EPID dosimetry system for IMRT QA at the Prince of Wales Hospital](#) 277
OPEN ACCESS M Tyler, P Vial, P Metcalfe and S Downes

012044 [3-D dose verification by cone-beam optical CT scanning of PRESAGE dosimeter](#) 281
OPEN ACCESS C-S Wu, S J Hoogcarspel, K Deh, W-Y Hsu and J Adamovics

012045 [Impact of patient rotational errors on target and critical structure dose in IMRT: A 3D simulation study](#) 285
OPEN ACCESS S Arumugam, A Xing, P Vial, A Scotti, R Stirton, G Goozee and Lois Holloway

012046 [Image guidance during breast radiotherapy: a phantom dosimetry and radiation-induced second cancer risk study](#) 289
OPEN ACCESS A Quinn, L Holloway and P Metcalfe

012047 [Experimental verification of the planned dose perturbation algorithm in an anthropomorphic phantom](#) OPEN ACCESS V Feygelman, D Opp, G Zhang, C Stevens and B Nelms 293

IMRT and IGRT

012048 [IMRT patient-specific QA using the Delta⁴ dosimetry system and evaluation based on ICRU 83 recommendations](#) OPEN ACCESS J Nilsson, A K Hauer and A Bäck 297

012049 [The effect of motion on IMRT – looking at interplay with 3D measurements](#) 301
OPEN ACCESS A Thomas, H Yan, M Oldham, T Juang, J Adamovics and F F Yin

012050 [Comprehensive quality assurance for base of skull IMRT](#) OPEN ACCESS A Thomas, J O'Daniel, J Adamovics, G Ibbott and M Oldham 305

012051 [Validation of an IMRT beam model using a secondary treatment planning system as a 3D dosimeter](#) OPEN ACCESS A Xing, S Arumugam, L Holloway and G Goozee 309

012052 [A multi-configurational cylindrical phantom based evaluation of patient-specific IMRT QA tools](#) OPEN ACCESS T Olding, T Halsall, L J Schreiner and A Kerr 313

012053 [Optical laser scanning of a leucodye micelle gel: preliminary results of a 3D dose verification of an IMRT treatment for a brain tumor](#) OPEN ACCESS J Vandecasteele and Y D Deene 317

2D versus 3D Dosimetry and 3D

012054 [High resolution dosimetry in monoenergetic proton beam therapy on a normoxic polymer gel: the importance of high spatial resolution for reduced Bragg-Peak-quenching](#) OPEN ACCESS A Berg, M Wieland, J Naumann and O Jaekel 321

012055 [Dosimetric assessment of the PRESAGE dosimeter for a proton pencil beam](#) 325
OPEN ACCESS C-S Wu, Y Xu, X Qian, J Adamovics, E Cascio and H-M Lu

012056 [Feasibility study of proton-based quality assurance of proton range compensator](#) 329
OPEN ACCESS S Park, C Jeong, B J Min, J Kwak, J Lee, S Cho, D Shin, Y K Lim, S Y Park and S B Lee

012057 [Application of a PAGAT/MgCl₂ gel for dose measurements in a 150 MeV proton beam](#) 333
OPEN ACCESS T Tominaga, S Hayashi, S Usui, H Kawamura and K Katahira

012058 [Preliminary characterization of PRESAGE® for 3D dosimetry of 62 MeV proton beam](#) 337
OPEN ACCESS T Gorjiara, A Kacperek, Z Kuncic, C Baldock and S Doran

012059 [Investigation of photon and proton overlapping fields in PRESAGE® dosimeters](#) 341
OPEN ACCESS M Carroll, G Ibbott, R Grant, M Gillin and J Adamovics

Optical Dosimetry I

012060 [Laser CT evaluation on normoxic PAGAT gel dosimeter](#) OPEN ACCESS D S 344
Kumar, E J J Samuel and Y Watanabe

012061 [Array of square waveguides for scintillation dosimetry in external radiotherapy](#) 348
OPEN ACCESS P Naseri, D R McKenzie, P Liu, S Fleming and N Suchowerska

012062 [Laser cone beam computed tomography scanner geometry for large volume 3D dosimetry](#) 353
OPEN ACCESS K J Jordan, D Turnbull and J J Batista

012063 [Effect of refraction on dose reconstruction in optical-CT gel dosimetry](#) 357
ACCESS L Florescu, G Ambartsoumian and C-S Wu

012064 [Characterization of a cone beam optical scanner](#) OPEN ACCESS P B Ravindran 361
and H M Thomas

012065 [How effective can optical-CT 3D dosimetry be without refractive fluid matching?](#) OPEN ACCESS L Rankine and Oldham 366

012066 [Recent developments with a prototype fan-beam optical CT scanner](#) 370
ACCESS W G Campbell, A Jirasek and D Wells

012067 [A study on the reproducibility and spatial uniformity of N-isopropylacrylamide polymer gel dosimetry using a commercial 10X fast optical-computed tomography scanner](#) OPEN ACCESS Y J Chang, J Q Lin, B T Hsieh and C H Chen 375

012068 [Dosimetric characteristics of N-vinylpyrrolidone based polymer gels: utilization depending on dose range](#) OPEN ACCESS M-V Papoutsaki, E Pappas, A E Papadakis, C Varveris, J Damilakis and T G Maris 379

012069 [A novel optical calorimetry dosimetry approach applied to an HDR Brachytherapy source](#) OPEN ACCESS A Cavan and J Meyer 383

Dosimetry for Audit, SRS/SBRT and Small Fields

012070 [How accurate is image guided radiation therapy \(IGRT\) delivered with a micro-irradiator?](#) OPEN ACCESS M Oldham, J Newton, L Rankine, J Adamovics, D Kirsch and S Das 387

012071 [Potential dosimetric benefit of dose-warping based 4D planning compared to conventional 3D planning in liver stereotactic body radiotherapy \(SBRT\)](#) 391
ACCESS U J Yeo, M L Taylor, T Kron, D Pham, S Siva and R D Franich

012072 [Investigating the reproducibility of a complex multifocal radiosurgery treatment](#) 395
OPEN ACCESS M Niebanck, T Juang, J Newton, J Adamovics, Z Wang and M Oldham

012073 [Stereotactic body radiation therapy delivery validation](#) OPEN ACCESS T Olding, L Garcia, K Alexander, L J Schreiner and C Joshi 399

012074 [Ultra-high resolution optical CT dosimetry for the visualisation of synchrotron microbeam therapy doses](#) OPEN ACCESS S J Doran, A T A Rahman, E Bräuer-Krisch, T Brochard and J Adamovics 404

012075 [Scintillators for 3D and 4D dosimetry: current status and future potential for clinical translation](#) OPEN ACCESS N Suchaworska, P Z Y Liu, A Ralston, P Naseri, P Abolfathi, J Lee, K Warrener and D R McKenzie 408

Optical Dosimetry II

012076 [Optical computed tomography liquid calibration phantom](#) OPEN ACCESS K Jordan 412

012077 [Revealing the impact of radiation-induced refractive index changes in polymer gel dosimeters](#) OPEN ACCESS W G Campbell, A Jirasek and D Wells 416

012078 [Laser beam optical CT scanner for in-air gel readout: imaging artefacts](#) 420
ACCESS D Ramm

012079 [Feasibility study using MRI and two optical CT scanners for readout of polymer gel and PresageTM](#) OPEN ACCESS H Svensson, P S Skyt, S Ceberg, S Doran, L P Muren, P Balling, J B B Petersen and S Å J Bäck 424

012080 [Preliminary investigation and application of a novel deformable PRESAGE[®] dosimeter](#) OPEN ACCESS T Juang, J Newton, S Das, J Adamovics and M Oldham 428

012081 [Performance of latex balloons for optical computed tomography](#) OPEN ACCESS 432
K Jordan, A Walsh, M Peng and J Battista

3D Analysis and Ultrasound Evaluation of Gels

012082 [A note on the interpretation of the gamma evaluation index](#) OPEN ACCESS C Ceberg 436

012083 [Measurement of a PAGAT gel dosimeter by ultrasound computed tomography](#) 440
OPEN ACCESS S Khoei, J V Trapp and C M Langton

012084 [Quantitative evaluation of polymer gel dosimeters by broadband ultrasound attenuation](#) 444
OPEN ACCESS S Khoei, J V Trapp and C M Langton

012085 [A potential modification of the \$\gamma\$ -evaluation: mapping dose disagreements using \$\gamma\$ -vector fields](#) 448
OPEN ACCESS O Holmes, J Darko, T Olding and L J Schreiner

012086 [Real-world examples of sensitivity failures of the 3%/3mm pass rate metric and published action levels when used in IMRT/VMAT system commissioning](#) 452
ACCESS B Nelms, G Jarry, M Chan, C Hampton, Y Watanabe and V Feygelman

012087 [A software tool for 3D dose verification and analysis](#) OPEN ACCESS M A Sa'd, 457
J Graham and G P Liney

CBCT Dosimetry; Radiological Properties of Gels, X-ray CT, MRI

012088 [Polymer gel dosimetry utilizing a 2D \(SE\) and a 2D \(HASTE\) multiple echo sequences](#) 461
OPEN ACCESS M-V Papoutsaki, E Pappas, A E Papadakis, C Varveris, J Damilakis and T G Maris

012089 [Dose-response measurement in gel dosimeter using various imaging modalities](#) 465
OPEN ACCESS T Fujibuchi, H Kawamura, K Yamanashi, A Hiroki, S Yamashita, M Taguchi, Y Sato, K Mimura, H Ushiba and T Okihara

012090 [Monte Carlo water-equivalence study of two PRESAGE[®] formulations for proton beam dosimetry](#) 469
OPEN ACCESS T Gorjiara, Z Kuncic, J Adamovics and C Baldoock

012091 [Reconstructing 3D x-ray CT images of polymer gel dosimeters using the zero-scan method](#) 474
OPEN ACCESS M B Kakakhel, T Kairn, J Kenny and J V Trapp

012092 [Characterization of the essential dosimetric properties of cosolvent-free polymer gel dosimeters: Recent progress in x-ray CT based normoxic polymer gel dosimetry](#) 478
OPEN ACCESS H Johnston, M Hilts, J Carrick and A Jirasek

012093 [Influence of preparation and calibration method of PAGAT dosimeter on TSE MR readout results](#) 482
OPEN ACCESS K Vávrů, P Dvořák, J Tintěra and V Spěváček

012094 [Comparison of the influence of inorganic salts on the NMR dose sensitivity of polyacrylamide-based gel dosimeter](#) 486
OPEN ACCESS S-I Hayashi, H Kawamura, S Usui and T Tominaga

012095 [The effect of chemical stability on the NIPAM gel dosimeter using \$^1\text{H}\$ -NMR](#) 490
OPEN ACCESS Y-R Huang, L-L Hsieh, Y-J Chang and B-T Hsieh

012096 [Monomer consumption in MAGIC-type polymer gels in the Bragg-peak of proton beams observed by volume selective \$^1\text{H}\$ MR-spectroscopy \(MRS\): proof of principle for high resolution MRS-methodology with a sensitive rf-detector](#) 494
OPEN ACCESS A I Schmid, E Laistler, J Sieg, B Dymerska, M Wieland, J Naumann, O Jaekel and A Berg

Motion, Brachytherapy, Heterogeneity and Miscellaneous

012097 [A novel method for 4D measurement-guided planned dose perturbation to estimate patient dose/DVH changes due to interplay](#) 498
OPEN ACCESS B Nelms and V Feygelman

012098 [Evaluation of breathing interplay effects during VMAT by using 3D gel measurements](#) 503
OPEN ACCESS S Ceberg, C Ceberg, M Falk, P M af Rosenschöld and S Å J Bäck

012099 [The effect of systematic set-up deviations on the absorbed dose distribution for left-sided breast cancer treated with respiratory gating](#) 507
OPEN ACCESS A Edvardsson and S Ceberg

012100 [Towards comprehensive characterization of Cs-137 Seeds using PRESAGE® dosimetry with optical tomography](#) 511
OPEN ACCESS J Adamson, Y Yang, L Rankine, J Newton, J Adamovics, O Craciunescu and M Oldham

012101 [Semi-3D dosimetry of high dose rate brachytherapy using a novel Gafchromic EBT3 film-array water phantom](#) OPEN ACCESS A L Palmer, A Nisbet and D A Bradley 515

012102 [ROPS eye plaque dosimetry: commissioning and verification of an ophthalmic brachytherapy treatment planning system](#) OPEN ACCESS J Poder, N Annabell, M Geso, M Alqathami and S Corde 519

012103 [Application of MAGAT polymer gel dosimetry in breast balloon](#) 523
ACCESS N Govi, P Gueye and S Avery

012104 [Polymer gel dosimetry of an electron beam in the presence of a magnetic field](#) 527
OPEN ACCESS J Vandecasteele and Y D Deene

012105 [The effect of mixed dopants on the stability of Fricke gel dosimeters](#) 532
ACCESS K Penev and K Mequanint

012106 [Preliminary dosimetry investigation of Tc-99m diagnostic radionuclide by NIPAM gel dosimeter](#) OPEN ACCESS Y-R Huang, Y-J Chang, L-L Hsieh, B-W Yu, C-H Chu and B-T Hsieh 536

012107 [Deformable gel dosimetry II: experimental validation of DIR-based dose-warping](#) 539
OPEN ACCESS U J Yeo, M L Taylor, J R Supple, R L Smith, T Kron and R D Franich

012108 [Dosimetric effects of a high-density spinal implant](#) OPEN ACCESS T Kairn, S B Crowe, J Kenny, J Mitchell, M Burke, D Schlect and J V Trapp 543

Poster

012109 [The study of N-isopropylacrylamide gel dosimeter doped iodinated contrast agents](#) 547
OPEN ACCESS Y J Chang, L L Hsieh, M H Liu, J S Liu and B T Hsieh

012110 [Radiological characteristics of charged particle interactions in the first clay-nanoparticle dichromate gel dosimeter](#) 551
OPEN ACCESS M L Taylor, T Maeyama, N Fukunishi, K L Ishikawa, K Fukasaku, T Furuta, S Takagi, S Noda, R Himeno and S Fukuda