

**Editorial for the Radiation Measurements/Physics Open Virtual Special Issue Radiation dosimetry
current challenges and future directions**

McKeever, Stephen W.S.; Bailiff, Ian; Bos, Adrie A.J.; Yukihiro, Eduardo G.

DOI

[10.1016/j.radmeas.2023.106909](https://doi.org/10.1016/j.radmeas.2023.106909)

Publication date

2023

Document Version

Final published version

Published in

Radiation Measurements

Citation (APA)

McKeever, S. W. S., Bailiff, I., Bos, A. A. J., & Yukihiro, E. G. (2023). Editorial for the Radiation Measurements/Physics Open Virtual Special Issue Radiation dosimetry: current challenges and future directions. *Radiation Measurements*, 161, Article 106909. <https://doi.org/10.1016/j.radmeas.2023.106909>

Important note

To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

Green Open Access added to TU Delft Institutional Repository

'You share, we take care!' - Taverne project

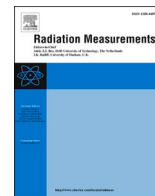
<https://www.openaccess.nl/en/you-share-we-take-care>

Otherwise as indicated in the copyright section: the publisher is the copyright holder of this work and the author uses the Dutch legislation to make this work public.



Contents lists available at ScienceDirect

Radiation Measurements

journal homepage: www.elsevier.com/locate/radmeas

Editorial for the Radiation Measurements/Physics Open Virtual Special Issue *Radiation dosimetry: current challenges and future directions*

This Virtual Special Issue (VSI) on *Radiation dosimetry: current challenges and future directions* is a collaboration between the journals *Radiation Measurements* and *Physics Open*. The goal is to review the status of radiation dosimetry and provide guidance toward future research and applications. The editors hope that by publishing jointly between the two journals we will provide authors and researchers alike with a greater range of publication choices, through print and open access options.

In many respects, radiation dosimetry can be considered, at least from the outside, as a stable and settled field. Over the years methods of radiation detection and measurement have been devised that have been outstandingly successful at providing critical quantitative data for the purposes of radiation protection of individuals in many areas of radiation protection. However, as knowledge of the microscopic interaction of radiation with matter (biological matter in particular) has increased, so the need to both understand and measure the microscopic deposition of dose in greater detail has increased correspondingly. For example, the medical treatment of patients with more precise radiation probes and with different varieties of energetic charged particles has presented challenges in dosimetry which have not yet been fully met for the optimum treatment of patients. The physics of microdosimetry continues to present significant challenges.

Methods for measuring and imaging radiation dose deposition at the microscale are also required, especially for ion beams, leading to the quest for not just new methods but also new materials, including new luminescence materials and luminescence methods. New materials and methods are also required in several other radiation dosimetry applications. Among these is included the very difficult challenge of neutron dosimetry. Dosimeters in general rely upon ionization effects to detect and measure the absorbed radiation dose, and this presents an obvious immediate difficulty with the dosimetry of neutrons.

Most dosimetry is “retrospective” in the sense that the dose is evaluated after the radiation event has occurred. The dosimeters used in these situations are “passive” and are analyzed post-irradiation, but there are more and more applications in which real-time dosimetry is needed using “active” dosimeters. Here, the dose is indicated immediately as the radiation is being absorbed. The development of these devices, and how they can meet the requirements of the accreditation agencies in comparison with established passive dosimeters, is a modern application topic of high relevance. Another retrospective dosimetry topic of grave concern in modern times is how to measure absorbed dose to large numbers of the general population when conventional dosimeters were not prospectively in place before the irradiation event occurred. Examples include nuclear power plant accidents and the release of radioactive contamination to which large numbers of the

general public may be exposed. A large current effort is underway to address how successful, or not, common-place materials may be in acting as surrogate passive dosimeters in these situations.

The eight papers in this VSI cover the range of dosimetry topics noted above. They are reflective of topics currently at the forefront of interest in both research and application in these varied fields of dosimetry. [Agosteo \(2022\)](#) addresses the challenges of devising microdosimeters to measure radiation quality in hadron fields at the cellular level during proton and carbon ion therapy. [Vedelago et al. \(2022\)](#) review the dosimetry of proton and light ion beams in ion therapy and discuss particularly the issues relating to the effects of magnetic fields on the detectors used.

Dosimetry methods which may not be so affected by magnetic fields include traditional methods of luminescence dosimetry including thermoluminescence (TL), optically stimulated luminescence (OSL) and radiophotoluminescence (RPL). Two papers address new materials for applications of TL and OSL ([Yukihara et al., 2022](#)) and of RPL ([Yanagida et al., 2022](#)) including highly ionizing, charged particle and neutron beam irradiation. Yukihara et al. call for a systematic, guided approach for the development of new TL and OSL materials using past experience to guide future efforts, while Yanagida et al. outline a potential exciting future for RPL by highlighting new RPL materials, as yet unexploited in dosimetry.

The ever-challenging issue of neutron dosimetry is discussed in two papers, by [Bolzonella et al. \(2022\)](#) and by [Gómez-Ros et al. \(2023\)](#). The former discuss the fundamentals and current best practices while the latter illustrate new directions using a wide variety of dosimetry techniques.

The state of the art in passive, active and hybrid personal dosimetry is reviewed by [Vanhavere and Van Hoey \(2022\)](#), who also examine the potential of computational dosimetry, artificial intelligence and machine learning to address some of the dosimetry challenges in the future.

Finally, the state of the art in retrospective dosimetry for radiation emergencies, including the challenges of dosimetry of a large population of potentially exposed people, are addressed in a thoughtful discussion by [Fattibene et al. \(2023\)](#). The paper provides an excellent guide to future research on this very difficult topic.

Although the list of topics covered in this VSI is not exhaustive, in the continually progressing field of radiation dosimetry, the editors hope that the papers included will provide researchers across the field with much useful information and will act as an illuminating guide to at least some of the exciting ways forward for future research in this forever challenging field.

<https://doi.org/10.1016/j.radmeas.2023.106909>

Available online 18 January 2023

1350-4487/© 2023 Elsevier Ltd. All rights reserved.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Agosteo, S., 2022. Detectors for measurement of microdosimetric quantities. *Radiat. Meas.* 156, 106807.
- Bolzonella, M., Ambrožová, I., Caresana, M., Gibbens, N., Gilvin, P., Mariotti, F., Savary, A., Stabilini, A., Vittoria, F.A., Yukihara, E.G., Chevallier, M.-A., 2022. Neutron personal dosimetry using polyallyl diglycol carbonate (PADC): Current status, best practices and proposed research. *Phys. Open* 12, 100114.
- Fattibene, P., Trompier, F., Bassinet, C., Ciesielski, B., Discher, M., Eakins, J., Gonzales, C.A.B., Huet, C., Romanyukha, A., Woda, C., Juniewicz, M., Kim, H., Lee, J., Marciniak, A., Sholom, S., Yasuda, H., 2023. Reflections on the future developments of research in retrospective physical dosimetry. *Phys. Open* 14, 100132.
- Gómez-Ros, J.M., Bedogni, R., Domingo, C., 2023. Personal neutron dosimetry: State-of-the-art and new technologies. *Radiat. Meas.* 161, 106908.
- Vanhavere, F., Van Hoey, O., 2022. Advances in personal dosimetry towards real-time dosimetry. *Radiat. Meas.* 158, 106862.
- Vedelago, J., Karger, C.P., Jäkel, O., 2022. A review on reference dosimetry in radiation therapy with proton and light ion beams: status and impact of new developments. *Radiat. Meas.* 157, 106844.
- Yanagida, T., Okada, G., Kato, T., Nakauchi, D., Kawaguichi, N., 2022. A review and future of RPL dosimetry. *Radiat. Meas.* 158, 106847.
- Yukihara, E.G., Bos, A.J.J., Bilski, P., McKeever, S.W.S., 2022. The quest for new thermoluminescence and optically stimulated luminescence materials: Needs, strategies and pitfalls. *Radiat. Meas.* 158, 106846.

Stephen W.S. McKeever^a, Ian Bailiff^b, Adrie A.J. Bos^c, Eduardo G. Yukihara^{d,*}

^a Radiation Dosimetry Group, Department of Physics, Oklahoma State University, Stillwater, OK, USA

^b Luminescence Research Laboratory, Department of Archaeology, Durham University, Durham, UK

^c Department of Radiation and Technology, Faculty of Applied Sciences, Delft University of Technology, Delft, Netherlands

^d Department of Radiation Safety and Security, Paul Scherrer Institute, Villigen, Switzerland

* Corresponding author.

E-mail address: eduardo.yukihara@psi.ch (E.G. Yukihara).