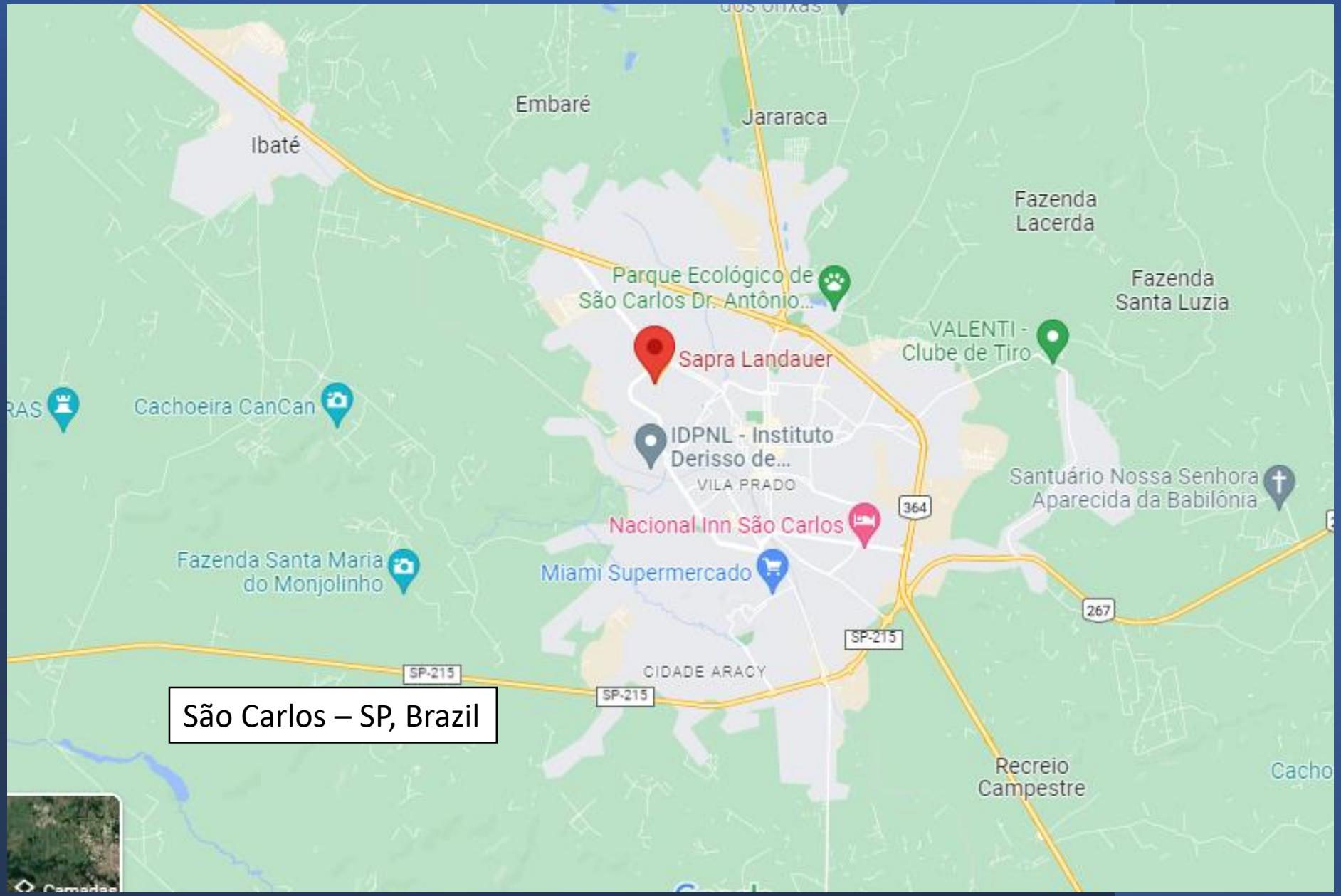
Overview on my work experiences

Guest Scientist: Dr. Daniel Villani



São Carlos – SP, Brazil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I started my journey within the radiation sciences and technology inspired by my sister's radiation therapy treatment back in 2010.

She was diagnosed with Hodking Lymphoma and went to Chemotherapy and Radiation Therapy and I was very motivated to know and learn about radiation applications and accelerators;

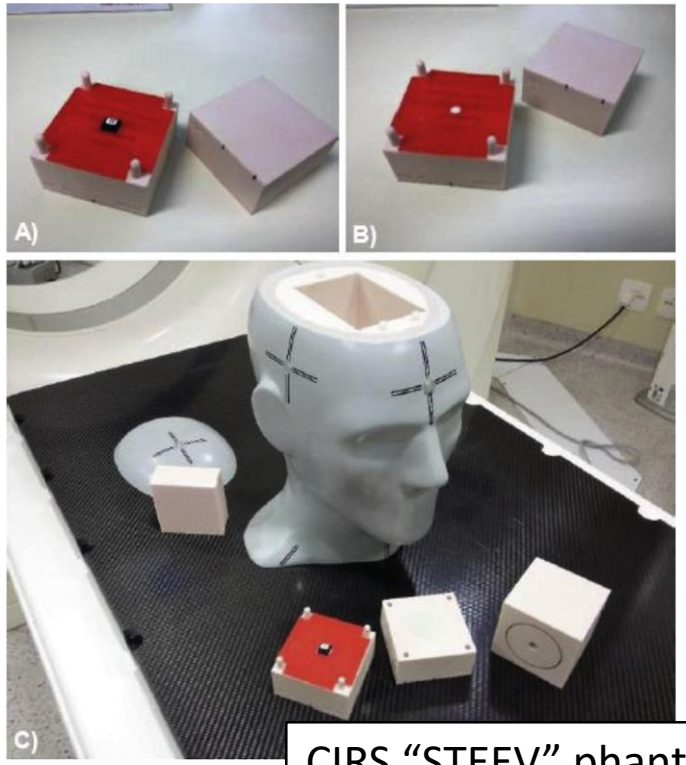
Started the Radiology Technology Graduation

As an undergrad student I worked as intern at Sapra Assessoria, whose activities involved consultancy in x-ray imaging equipment QA and dosimetry. In my senior year of undergrad studies, I had some short residency period at the Radiation Therapy Center of São Carlos.

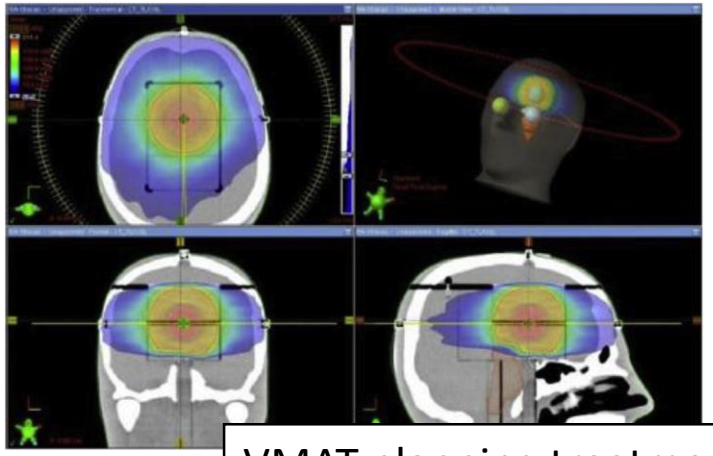
Both experiences together inspired my master's degree research project at University of São Paulo in the Applied Nuclear Technology postgraduate program.

ipen

In my master's I studied the application of TL and OSL dosimeters as tools for photons VMAT QA dosimetry measurements in partnership with Sirio Lebanese Hospital.

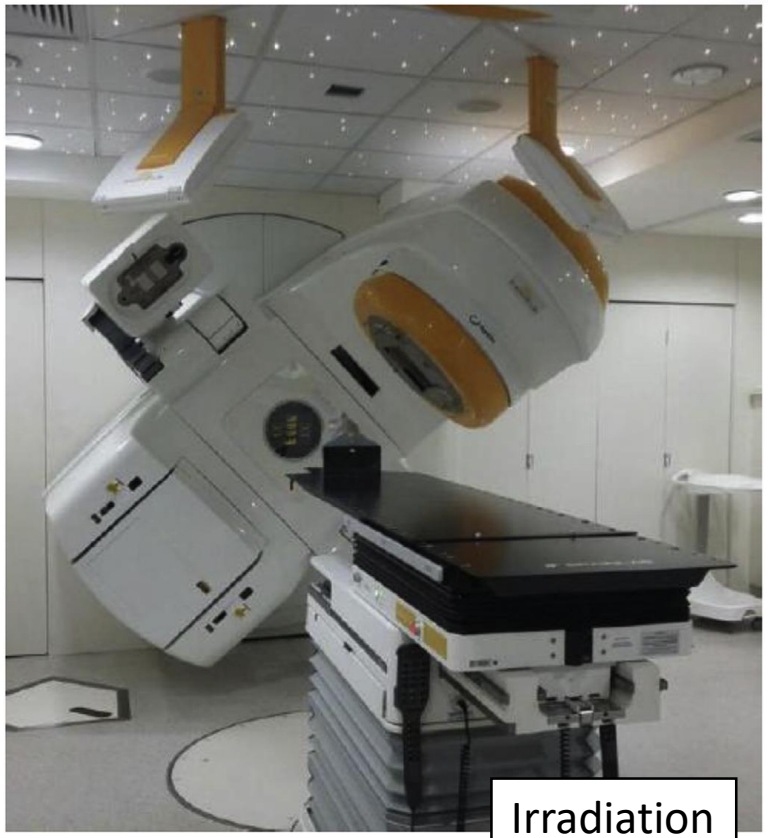


CIRS "STEEV" phantom



VMAT planning treatment

LiF:Mg,Ti (TLD-100)
$CaSO_4$:Dy (IPEN)
Al_2O_3:C (Landauer)



Irradiation

Villani, D.; Mancini, A.; Haddad, M. C. K.; Campos, L. L. Application of optically stimulated luminescence 'nanoDot' dosimeters for dose verification of VMAT treatment planning using an anthropomorphic stereotactic end-to-end verification phantom. RADIATION MEASUREMENTS. V.106, p. 321-325, 2017. *ttps://doi.org/10.1016/j.radmeas.2017.03.027*

Villani, D.; Mancini, A.; Haddad, C. M. K.; Campos, L. L. Comparative study of different $Al2O_3$:C dosimeters using OSL technique for dosimetry on volumetric modulates arc radiotherapy treatment (VMAT). REVISTA BRASILEIRA DE FÍSICA MÉDICA (ONLINE), v. 10, p. 7-11, 2016. *http://dx.doi.org/10.29384/rbfm.2016.v10.n2.p7-11*

Villani, D.; Almeida, S. B.; Campos, L. L. Caracterização de dosímetros de Al2O3:C para dosimetria de fótons utilizando a técnica OSL. BRAZILIAN JOURNAL OF RADIATION SCIENCES. V.5, p. 1-13, 2017. (Brazilian Portuguese) *http://dx.doi.org/10.15392/bjrs.v5i3.282.*

Meanwhile I have also collaborated with a college of my research group applying the same dosimeters for commissioning and QA dosimetry of electron clinical beams used in Total Skin Electron Beam treatments at Israelite Albert Einstein Hospital.

"Standford technique" set up

Measurements @ waist line and whole body

LiF:Mg,Ti (TLD-100)
Micro TLD-100
$CaSO_4$:Dy
Al_2O_3:C
DIODES

Almeida, S.B.; **Villani, D.**; Sakuraba, R.K.; Rezende, A.C.P.; Campos, L.L. Comparison between Al_2O_3:C pellets and diodes for TSEB *in vivo* dosimetry using an anthropomorphic phantom. RADIATION PHYSICS AND CHEMISTRY v. 167, p. 108171, 2020. *https://doi.org/10.1016/j.radphyschem.2019.02.030*

Almeida, S.B.; **Villani, D.**; Sakuraba, R.K.; Rezende, A.C.P.; Campos, L.L. Dosimetric evaluation employing and comparation of TL response OF LiF:Mg,Ti and μLiF:Mg,Ti in the clinical electron beams dosimetry applied to total skin irradiation (TSEB) treatments. RADIATION MEASUREMENTS. v. 125. p. 15-18. 2019. *https://doi.org/10.1016/j.radmeas.2019.03.007*

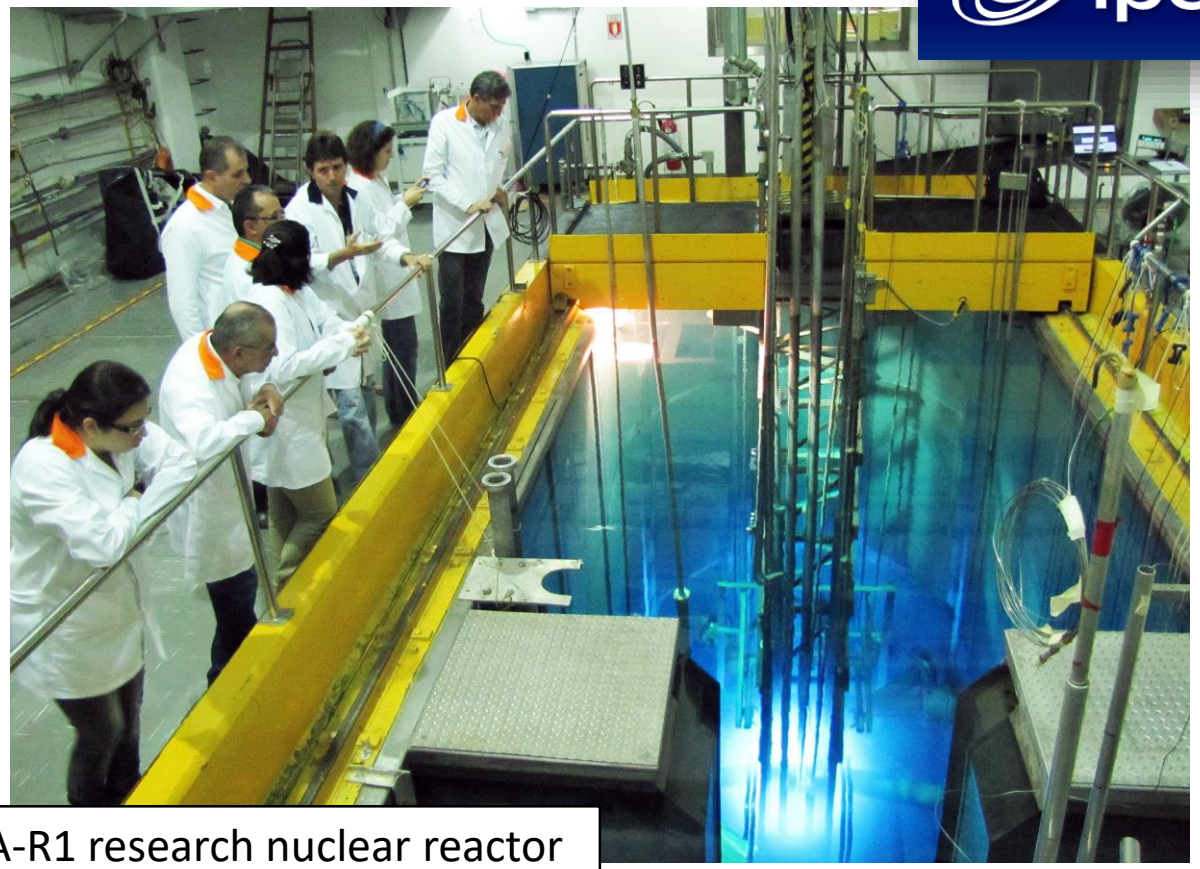
Almeida, S. B.; **Villani, D.**; Sakuraba, R. K.; Rezende, A. C. P.; Campos, L. L. TL and OSL dosimetric characterization of different luminescent materials for clinical electron beams application in TSEB treatments. JOURNAL OF LUMINESCENCE, v. 198C, p. 497-501, 2018. *https://doi.org/10.1016/j.jlumin.2018.02.065*

Almeida, S.B.; **Villani, D.**; Sakuraba, R.K.; Rezende, A.C.P.; Campos, L.L. Comparative study of the TL response of LiF:Mg,Ti and $CaSO_4$:Dy in the clinical electron beams dosimetry applied to Total Skin Irradiation (TSEB) treatments. RADIATION PHYSICS AND CHEMISTRY, v. 155, p. 121-126, 2018. *https://doi.org/10.1016/j.radphyschem.2018.05.025*

Almeida, S. B.; **Villani, D.**; Sakuraba, R. K.; Rezende, A. C. P.; Santos, S. C.; Campos, L. L. Dosimetric Evaluation Employing the Techniques of TL and OSL with Different Thermoluminescent Materials for Clinical Evaluation of Extremities Doses using Electrons Beams Applied to Total Irradiation of Skin Treatments. INTERNATIONAL JOURNAL OF MODERN PHYSICS: CONFERENCE SERIES, v. 48, p. 1860110, 2018. *http://dx.doi.org/10.1142/S2010194518601102*

The Nuclear Technology program from the University of São Paulo brought me broad knowledge on radiation applications, radiation detection, calibration of dosimetric systems and quality assurance of this procedures. It gave me also theoretical and observational experience in its nuclear reactors, radiation sources and particle accelerators.

IBA Cyclone 30

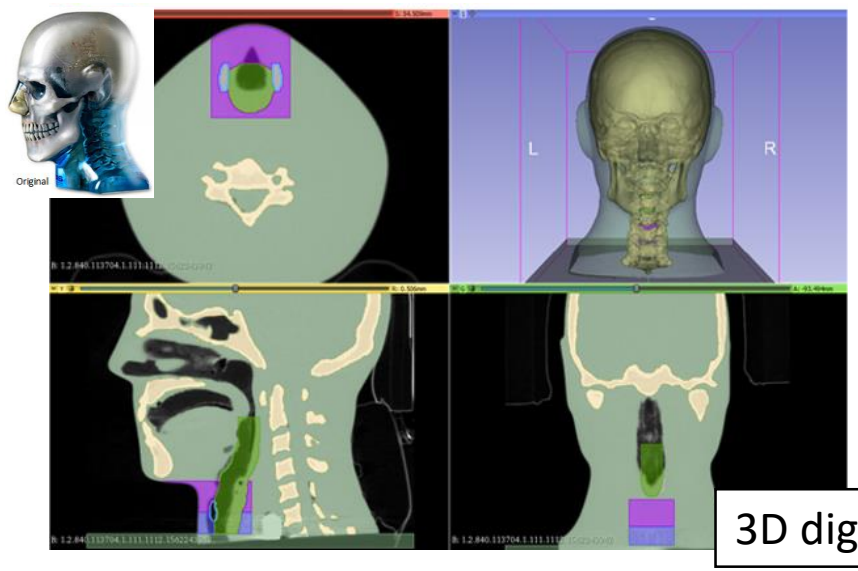


IEA-R1 research nuclear reactor

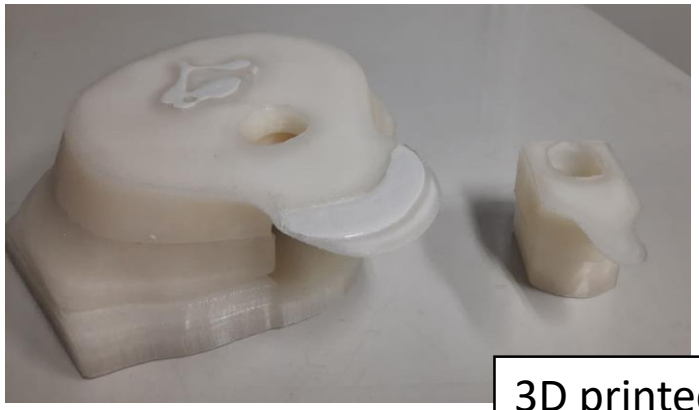
Main goals of these facilities: research and national radiotracer production

During my Ph.D I have developed a 3D printed neck-thyroid phantom characterized for multidisciplinary purposes:

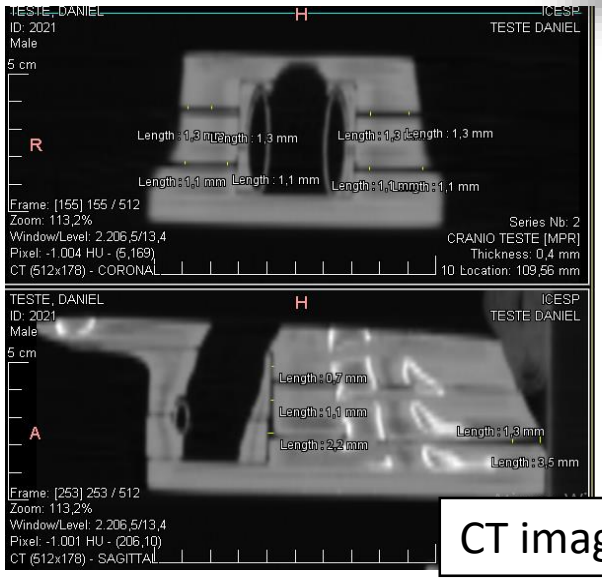
CT imaging quality assessment	Nuclear Medicine imaging quality assessment	Internal contamination dosimetry



3D digital model



3D printed



CT image

Villani, D.; Rodrigues Jr., O.; Campos, L. L. Dosimetric characterization of 3D printed phantoms at different infill percentages for diagnostic x-ray energy range. RADIATION PHYSICS AND CHEMISTRY. v. 172, p. 108728, 2020. *https://doi.org/10.1016/j.radphyschem.2020.108728*

Savi, M.; **Villani, D.**; Andrade, M.A.B.; Rodrigues Jr., O.; Potiens, M.P.A. Study on attenuation of 3D printing commercial filaments on standard X-ray beams for dosimetry and tissue equivalence. RADIATION PHYSICS AND CHEMISTRY, v. 182, p. 109365, 2021. *http://dx.doi.org/10.1016/j.radphyschem.2021.109365*

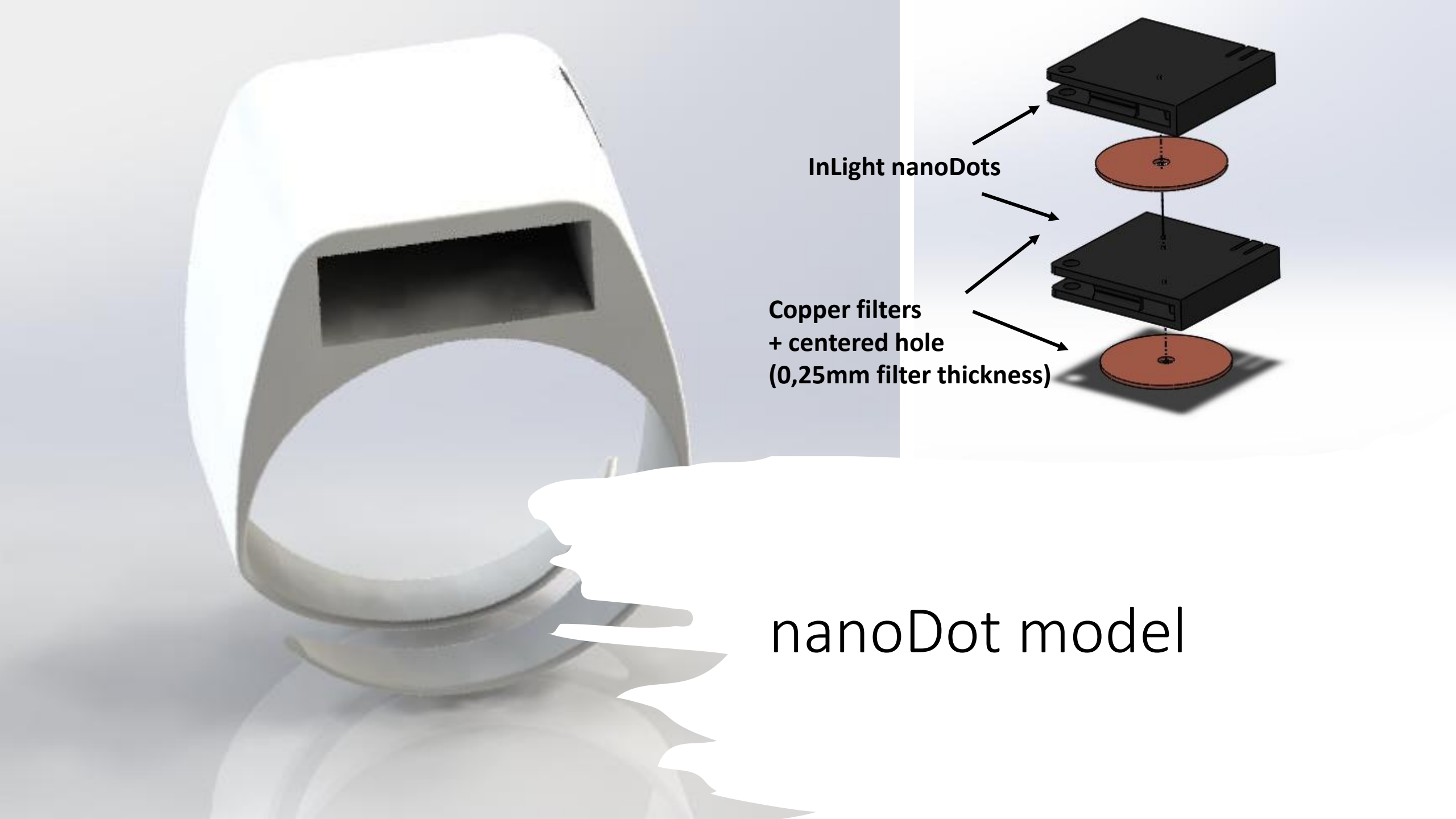
Savi, M.; Andrade, M. A. B.; **Villani, D.**; Rodrigues Jr., O.; Potiens, M. P. A. Development of radiopaque FFF filaments for bone and teeth representation in 3D printed radiological objects. BRAZILIAN JOURNAL OF RADIATION SCIENCES, v. 10, p. 1-22, 2022. *http://dx.doi.org/10.15392/bjrs.v10i1.1739*

Oliveira, M.; Savi, M.; Andrade, M. A. B.; **Villani, D.**; Potiens, M. P. A.; Stuani, H.; Ueba, C.; Mdeltshe, S. Attenuation properties of common 3D printed FFF plastics for mammographic applications. BRAZILIAN JOURNAL OF RADIATION SCIENCES, v. 10, p. 1-17, 2022. *http://dx.doi.org/10.15392/bjrs.v10i1.1732*

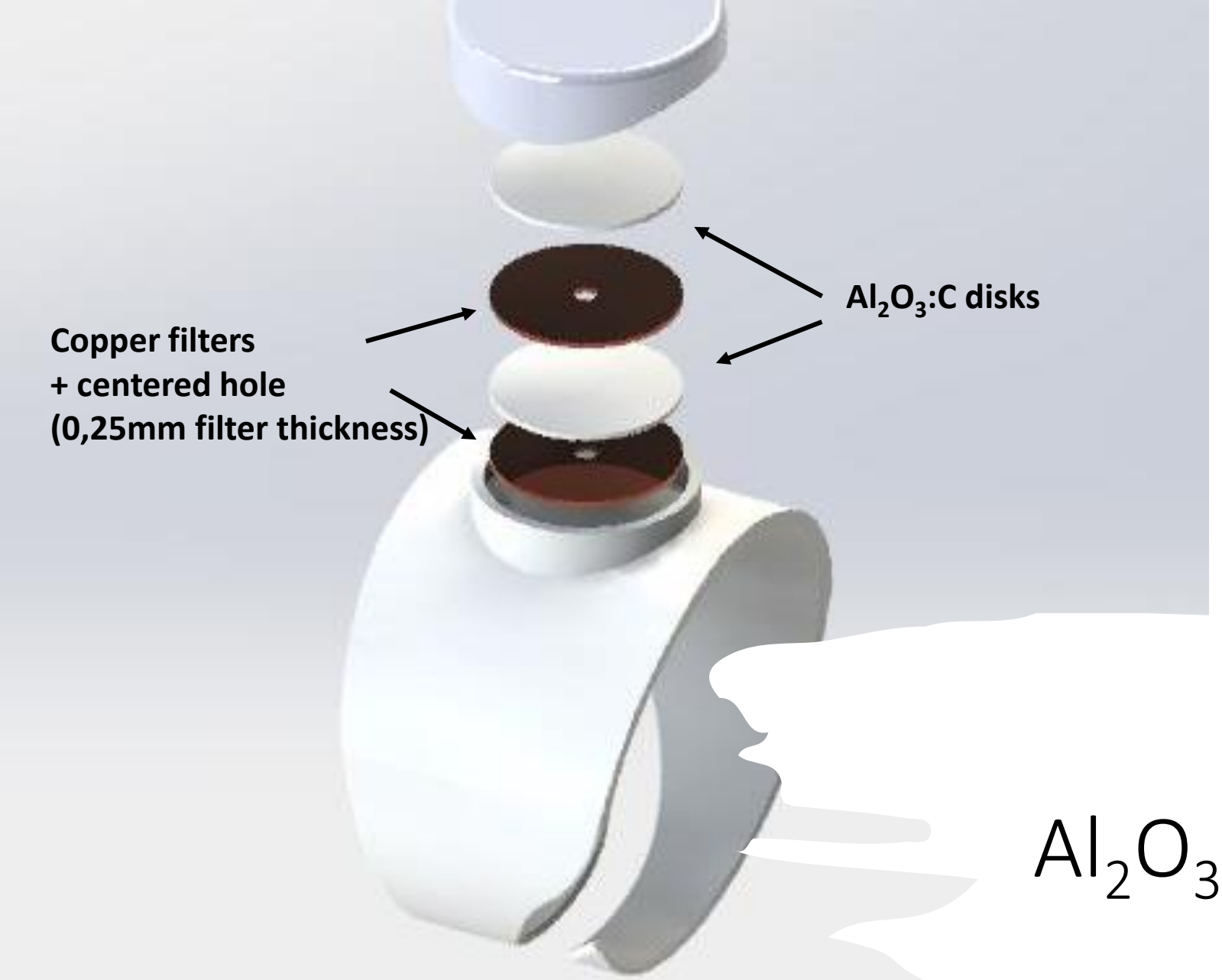
Villani, D.; Savi, M.; Andrade, M. A. B.; Campos, L.L.; Potiens, M. P. A. Characterization of ABS + W and ABS + Bi 3D printing filaments attenuation for different photon beams. JOURNAL OF PHYSICS. CONFERENCE SERIES (PRINT), v. 1826, p. 012037, 2021. http://dx.doi.org/10.1088/1742-6596/1826/1/012037

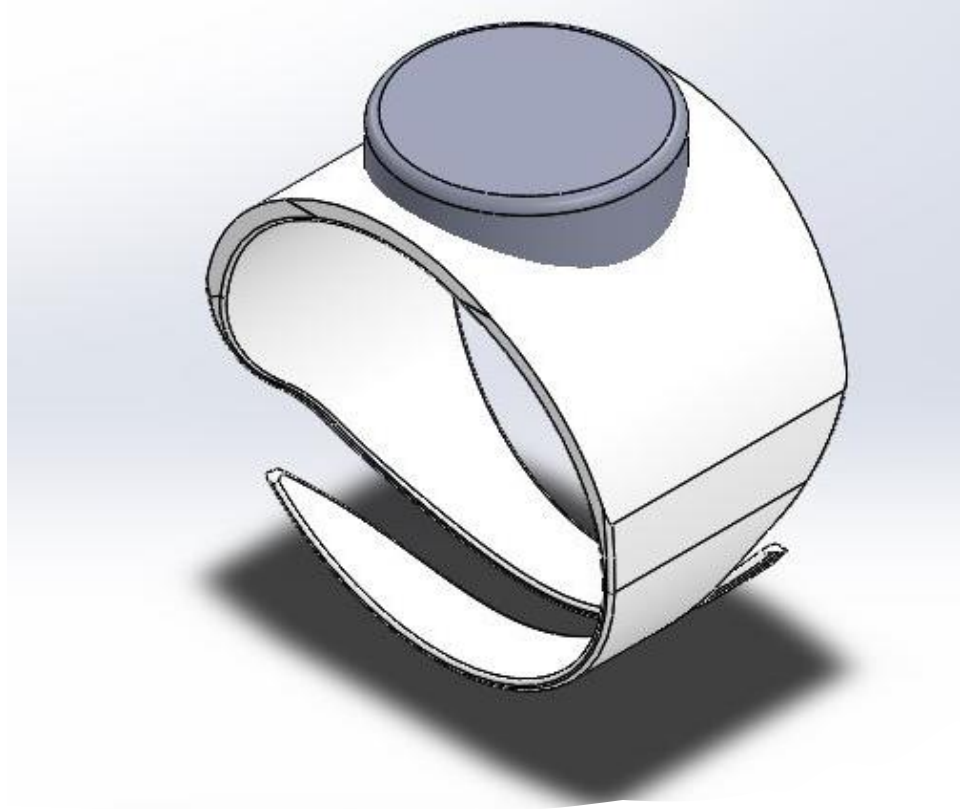
Villani, D.; Rodrigues Jr., O.; Mascarenhas, Y.M.; Campos, L. L. Study on electronic equilibrium of 137Cs gamma radiation for 3D printed phantoms using OSL dosimetry. JOURNAL OF PHYSICS. CONFERENCE SERIES (PRINT), v. 1826, p. 012057, 2021. *http://dx.doi.org/10.1088/1742-6596/1826/1/012057*

- In my latest experience I worked closely with health physics and radiation protection at Sapra-Landauer Individual Monitoring Service. I developed two models of ring OSL dosimeters to be applied as photons radiation monitor for individuals occupationally exposed to radiation. Both dosimeters met the performance requirements of the IEC 62387 formalism.



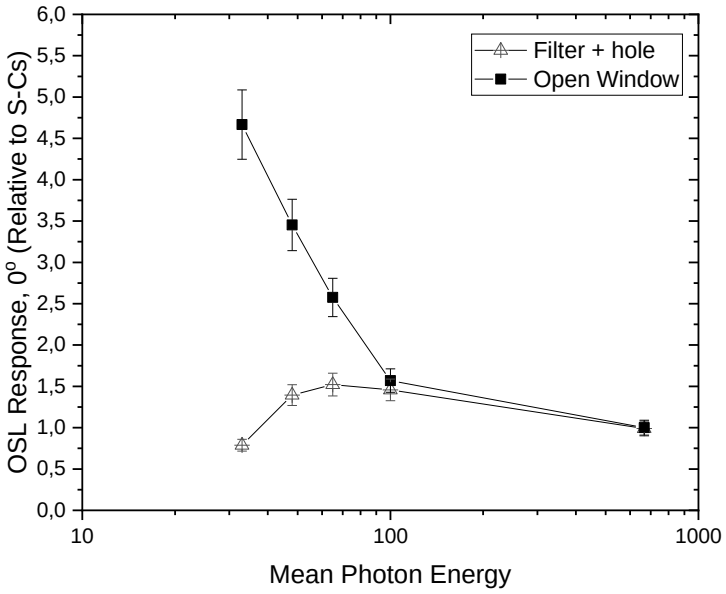
nanoDot model

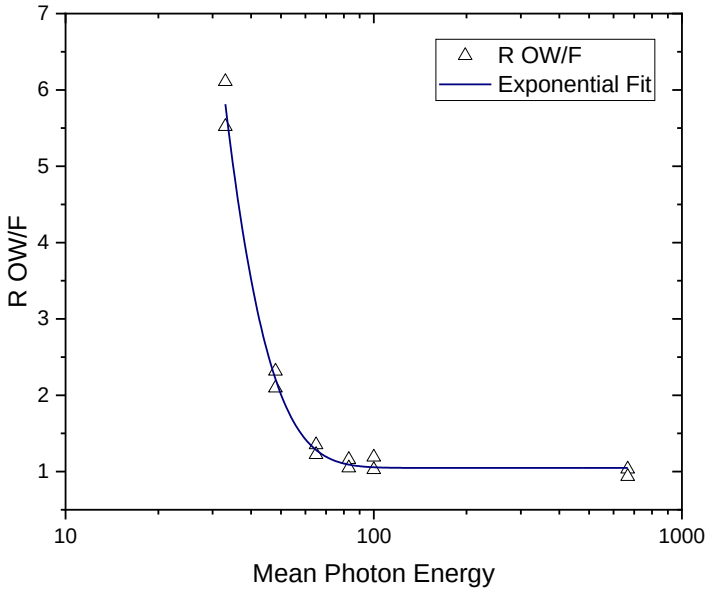


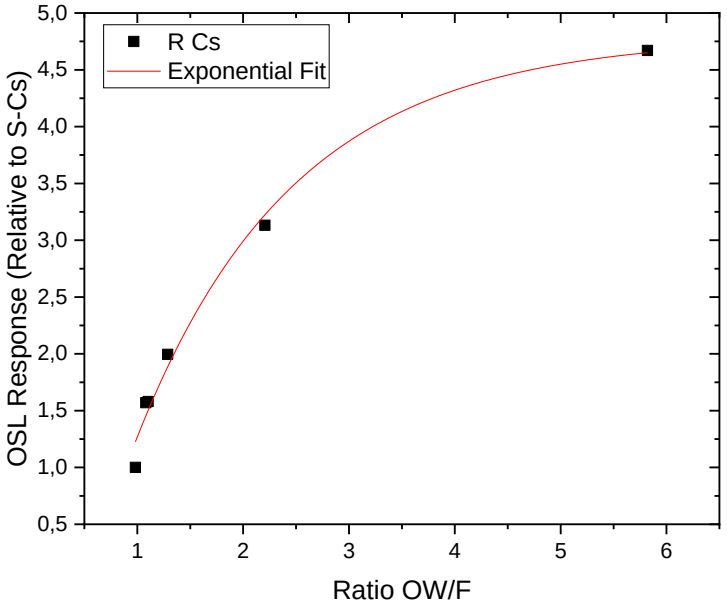


Al_2O_3:C open elements

Both of the rings work with the same tandem funtion for correction of Al_2O_3:C beam energy dependence, as well as the same dose calculation algorithm.



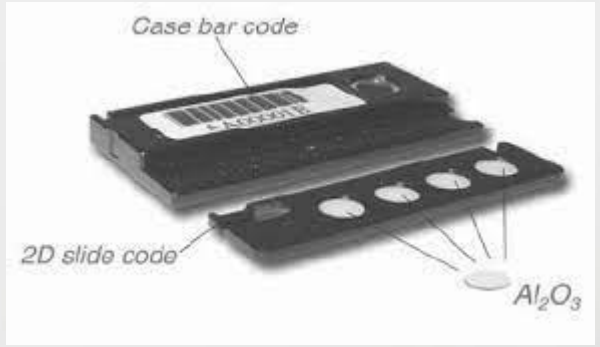




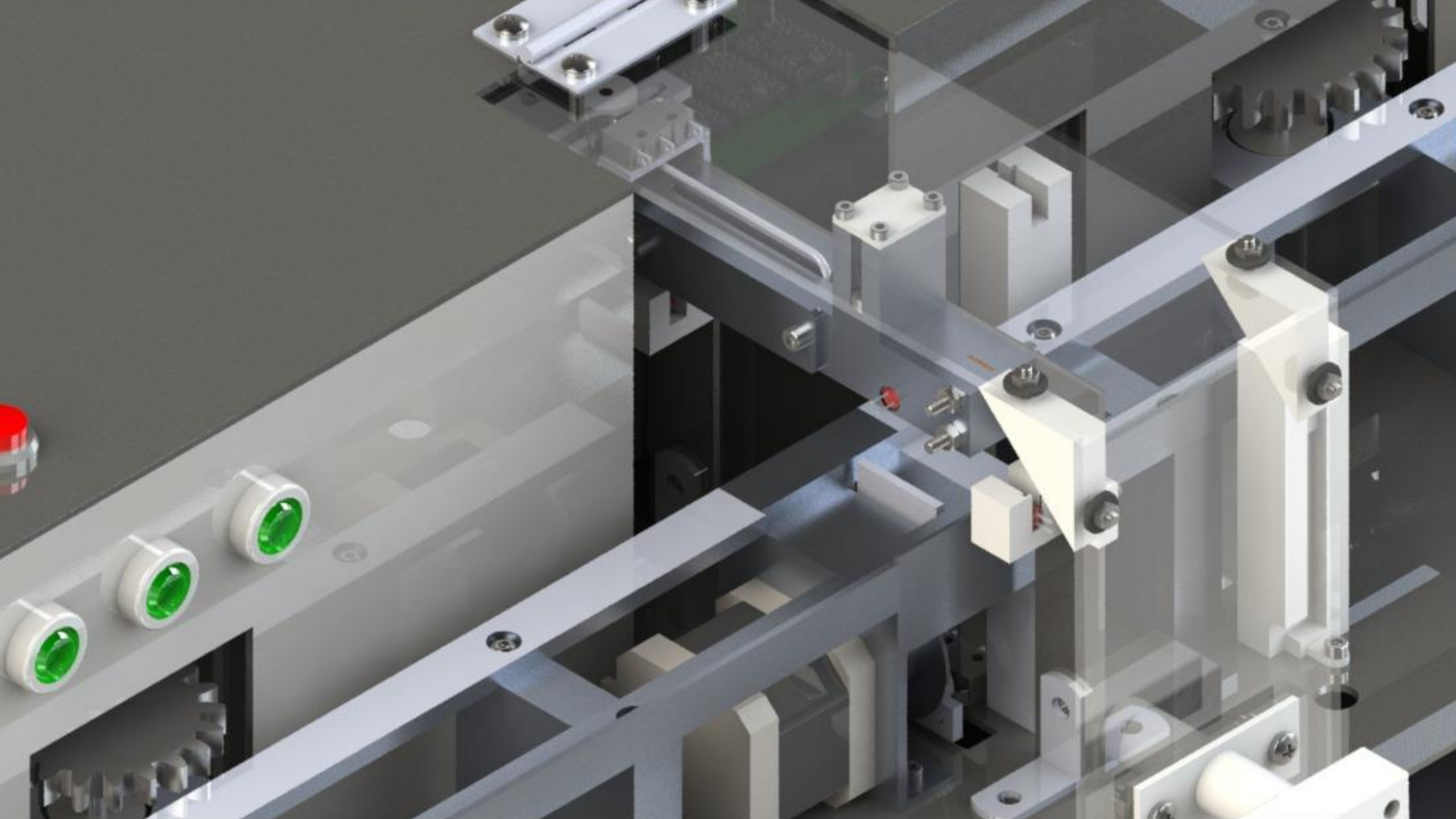
$$D = \frac{Counts}{K_{cal} \cdot K_s \cdot K_E}$$

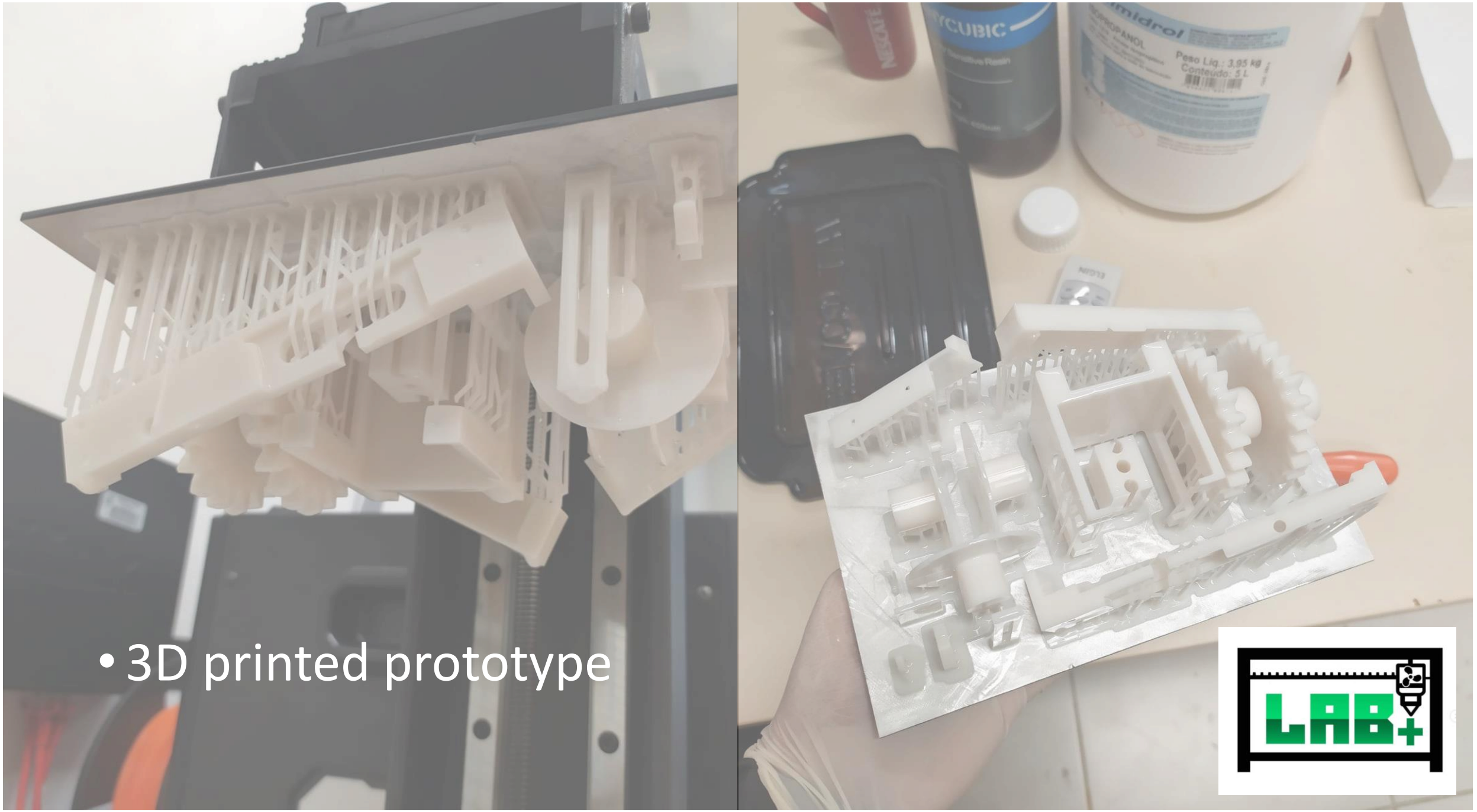
Results have not been published due to attempt to make a patent from them

- I supervised two engineering undergrad students in their collaboration with the Project on the development of an automated OSL Annealer

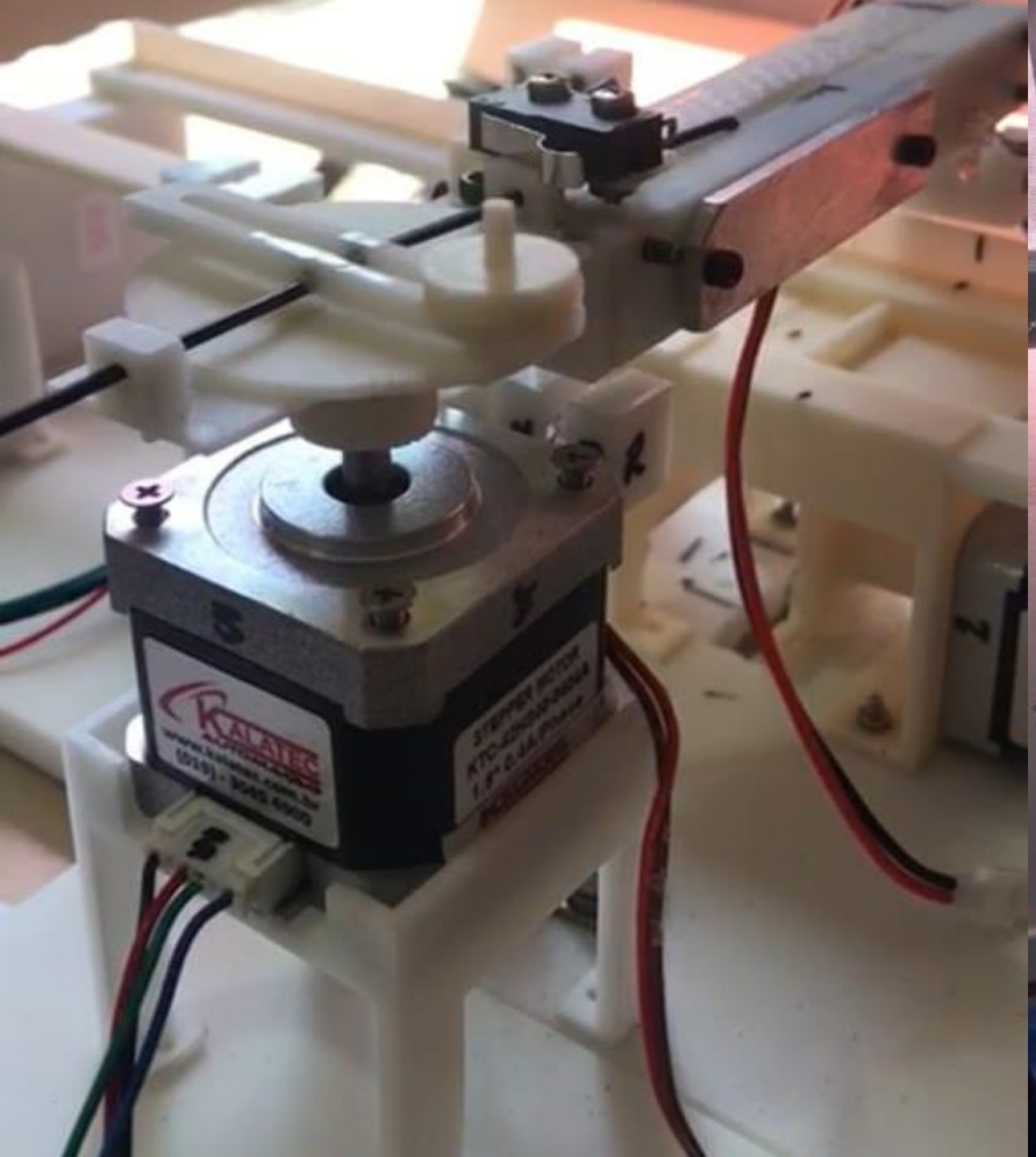


To be used in the laboratory routine





- 3D printed prototype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Protocol determination for OSL *in vivo* measurements of absorbed dose in the oral mucosa in oral cancer patients: A pilot study

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[b] Dental Oncology Service, Instituto do Câncer do Estado de São Paulo (ICESP), Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brasil
[c] Division of Radiation Oncology, Department of Radiology and Oncology, Instituto do Câncer do Estado de São Paulo, Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brasil
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OSL dosimetry
Radiation-induced oral mucositis (RIOM)
Al_2O_3:C

ABSTRACT

Radiation-induced oral mucositis (RIOM) is one of the major oral complications caused by radiotherapy (RT), and can lead a negative impact on patients' quality of life. Considering that there is no specific radiation therapy dose constraint for oral mucosa, the need to study the correlation between absorbed dose and effect in this area is crucial. This pilot study aims to report *in vivo* OSL dosimetry protocol to investigate the dose distribution in the oral mucosa in patients with oral cancer using Intraoral customised Stent (IOS). For measurements, aluminium oxide nanoDot dosimeters and a microStar ii OSL reader from Landauer Inc. were used. The OSL dosimetry system was calibrated with a 6 MV photon beam using an Elekta Synergy linear accelerator and solid water phantoms following the recommendations of the AAPM TG 191 protocol. The dose distribution in the oral mucosa using seven OSL dosimeters fixed on the intraoral stent was evaluated and compared with the dose distribution available from the RT planning for the patient. Our experimental results showed the expected linearity response of the nanoDot dosimeters from 20 to 200 cGy. The repeatability of readings was better than 1.0% in all commissioning measurements. The uncertainty budget of the commissioning analysis resulted in an overall type An uncertainty of ~3.4% at the 1-sigma level for dose calculation, compatible with the TG 191 protocol. The dose distribution in the oral mucosa was assessed and dose deviations up to 35% can be found in high dose gradient regions of the treatment planning. This type of deviation may impact on the development and progression of RIOM, as analysed in this protocol. It is feasible to establish this procedure in *vivo* dosimetry for a patient undergoing RT using a multidisciplinary approach. Additionally, intraoral customised stents can decrease radiation doses in the oral mucosa, and the understanding of the dose distribution in the oral mucosa may help to minimise damages from radiation.

Volunteer collab

I`ve participated in a volunteer collaboration between Sapra-Landauer and the State of Sao Paulo Cancer Institute by helping to find a dosimetry protocol to perform *in vivo* measurements in the oral mucosa of oral cancer patients.

Villani, D.; FARIA, K.M.; KAUARK-FONTES, E.; RIBEIRO, C.T.M.; MASCARENHAS, Y.M.; RIBEIRO, A.C.P.; VECHIATO-FILHO, A.J.; MENEGUSSI, G.; VASCONCELOS, K.G.M.C.; SANTOS-SILVA, A.R.; BRANDÃO, T.B. Protocol determination for OSL in vivo measurements of absorbed dose in the oral mucosa in oral cancer patients: A pilot study. RADIATION PHYSICS AND CHEMISTRY, v. 205, p. 110729, 2023. *http://dx.doi.org/10.1016/j.radphyschem.2022.110729*.

What I bring to PITZ:

- I am a multidisciplinary professional that passed throughout a variety of radiation applications;
- I can adapt to new environments;
- I have strong experience in radiation detection, x-ray imaging systems, calibration protocols, 3D printing and radiation dosimetry;
- I have close contact with clinical linear accelerators and medical imaging equipment from the medical institutions I have collaborated with;
- Knowledge in MCNP6.2 computational simulations;
- Will to learn new things.

Thank you!

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