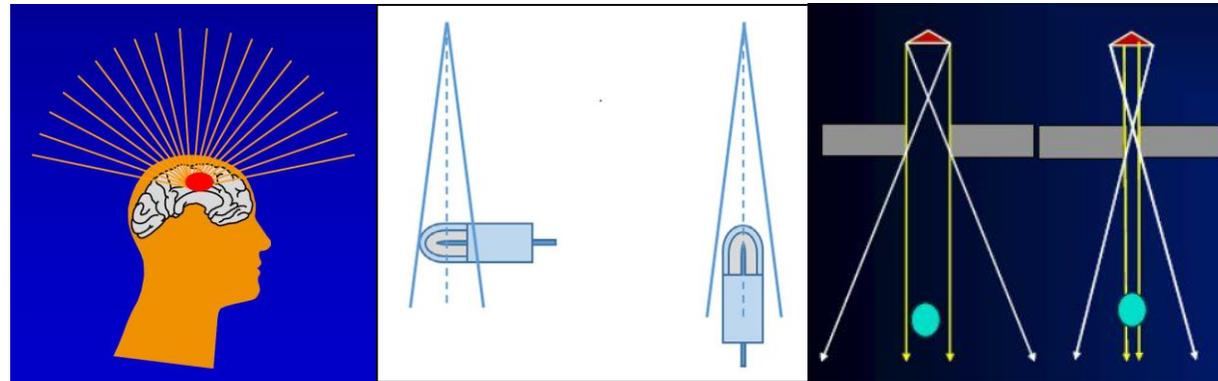


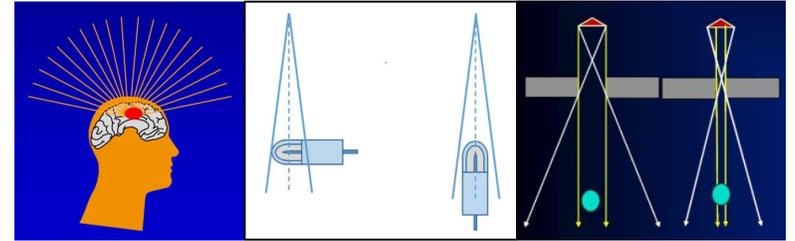
# Small photon field dosimetry: current status and challenges



Moderator: Hrvoje Hrsak

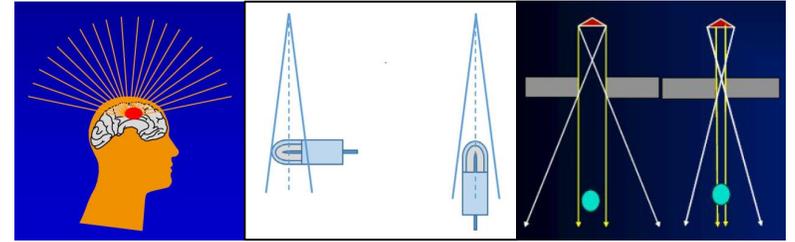
Presenters: Bozidar Casar

Josef Novotny



➤ **EURADOS WG9 (Radiation dosimetry in radiotherapy) activities:**

- Development and assessment of dosimetry techniques for non target patient doses in x ray and proton therapy,
- Determination of the total dose to the patient from therapy and imaging (in colab. with WG12)
- Specific developments in proton and neutron dosimetry
- In-phantom and ambient neutron dosimetry and spectrometry
- Foetal dose determination
- Monte Carlo simulation studies to support and enhance experimental programmes
- Identification of new and emerging dosimetric techniques and materials
- **Small field photon and proton beam dosimetry**



➤ **WG9 activities divided into Task Groups programmes:**

- **TG9.0 Photon radiotherapy programme:**

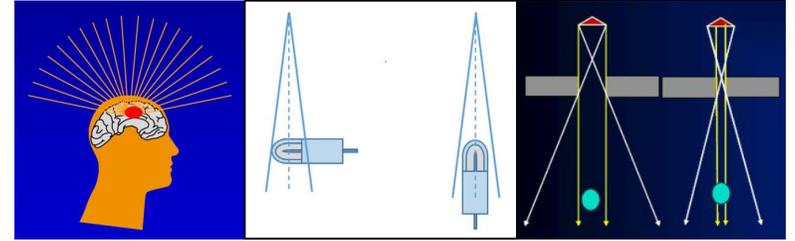
- > **Task 1: Small field photon beam dosimetry**
- > Task 2 : Out-of-field doses in brachytherapy

- **TG 9.1 Computational methods in medical physics**

- > Task 1: Dose to the fetus during radiotherapy
- > Task 2: Secondary radiation for superconducting synchrotron (Mevion S250i Hyperscan) - MC simulations
- > Task 3: Normalisation of secondary radiation doses in spot scanning proton radiotherapy – MC simulations

- **TG 9.2 Hadron radiotherapy programme**

- > Task 1: Dosimetry audit of active scanning proton beams
- > Task 2: Secondary radiation for superconducting synchrotron (Mevion S250i Hyperscan) (colab. with WG 11)
- > Task 3: Normalisation of secondary radiation doses in spot scanning proton radiotherapy



## Photon SFD programme:

- (i) Intercomparison of small field dosimeters characteristics/responses,
- (ii) comparison of published codes of practice and
- (iii) machine and detector specific mini-projects (now in focus):**

#1 „High resolution dose profile measurements for Leksell Gamma Knife using point detectors”

#2 „Angular dependence of detectors in small photon fields”

#3 „End-to-end test in stereotactic radiosurgery”

#4 „2D radioluminescent sheet dosimetry for Leksell Gamma Knife”

Further planning:

„Small photon beam dosimetry audit”

## #1 „High resolution dose profile measurements for Leksell Gamma Knife using point detectors”

### - Motivation:

Dosimetry for GK radiosurgery beam profiles requires detectors with high spatial resolution – radiochromic film widely recommended  
 For GK dose profiles measurements no specific recommendations were given in the new IAEA TRS-483 CoP (AAPM TG 178 - Gamma Stereotactic Radiosurgery Dosimetry and Quality Assurance recently recommends film)

Comparing to point detectors radiochromic film has a high resolution and tissue equivalence, but it is **expensive, very noisy and requires complicated workflow (calibration, measurements, evaluation)**

### - Methodology:

We proposed a simple method for dose profiles scanning using different point detectors - in a non-reference geometry where spherical phantom with detector was moved from one measuring point to another

(already tested with exradin W1 detector)

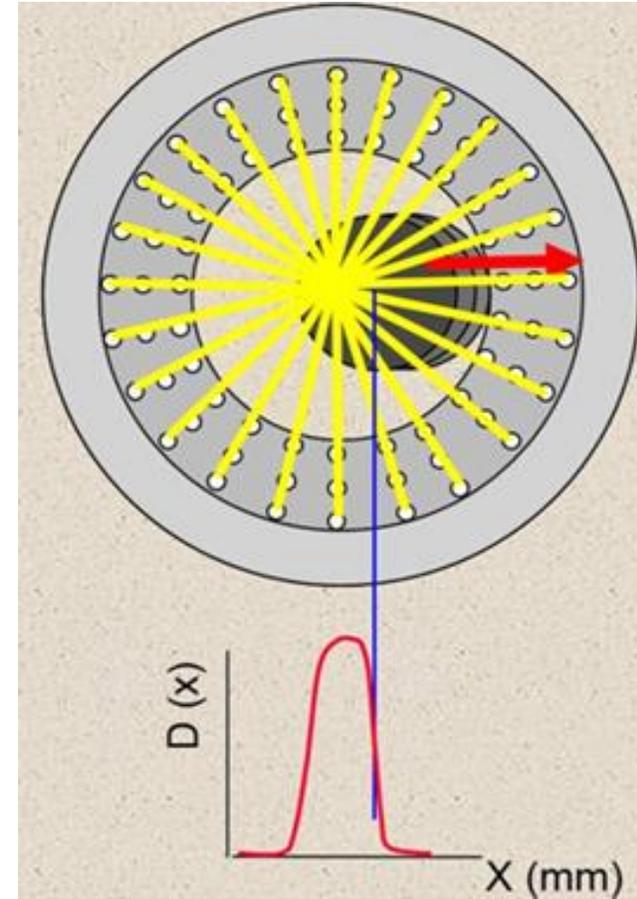
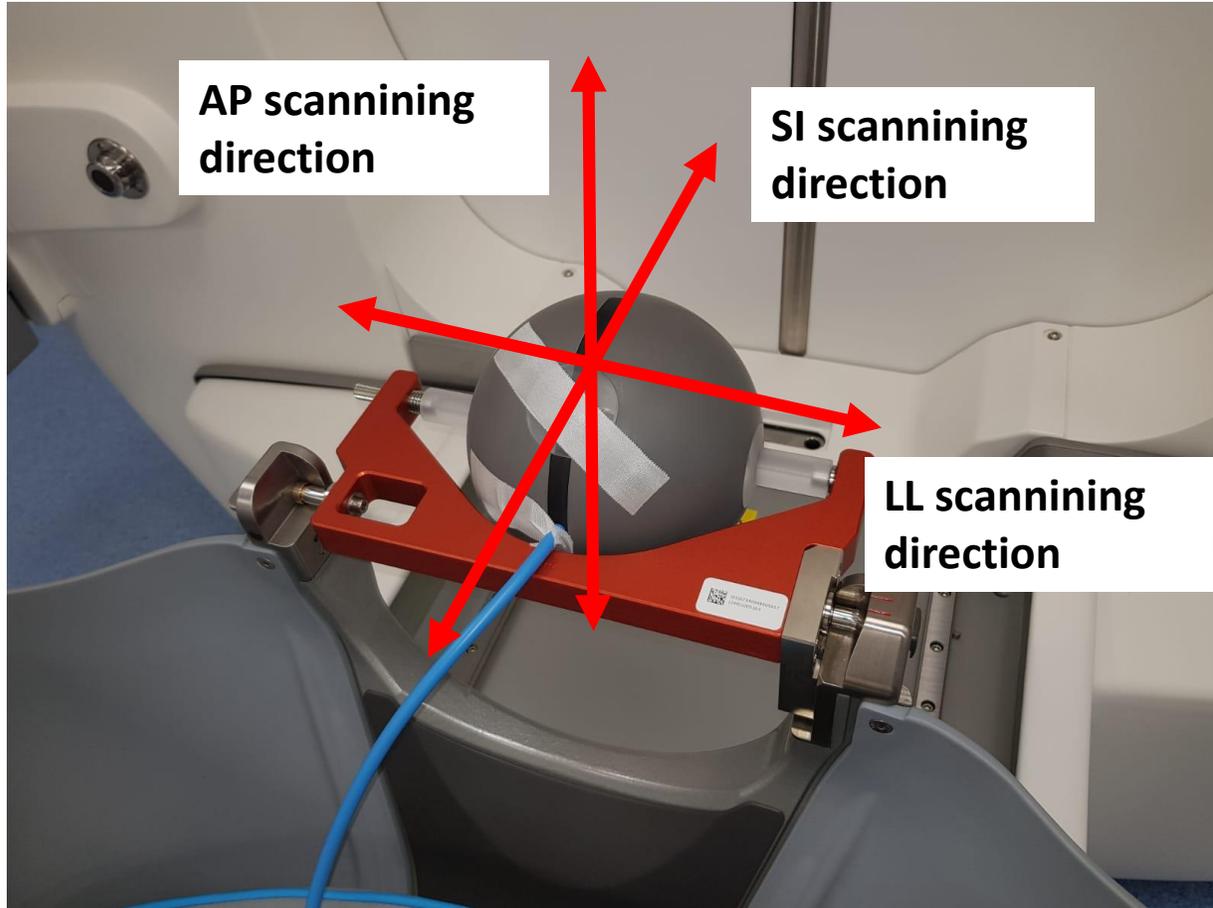
[Phys Med Biol. 2019 Nov 15;64\(22\):225007. doi: 10.1088/1361-6560/ab4ac3.](#)

**Quality assurance for Gamma Knife Perfexion using the Exradin W1 plastic scintillation detector and Lucy phantom**

Francois Therriault-Proulx<sup>1</sup>, Ramiro Pino, James N Yang, A Sam Beddar

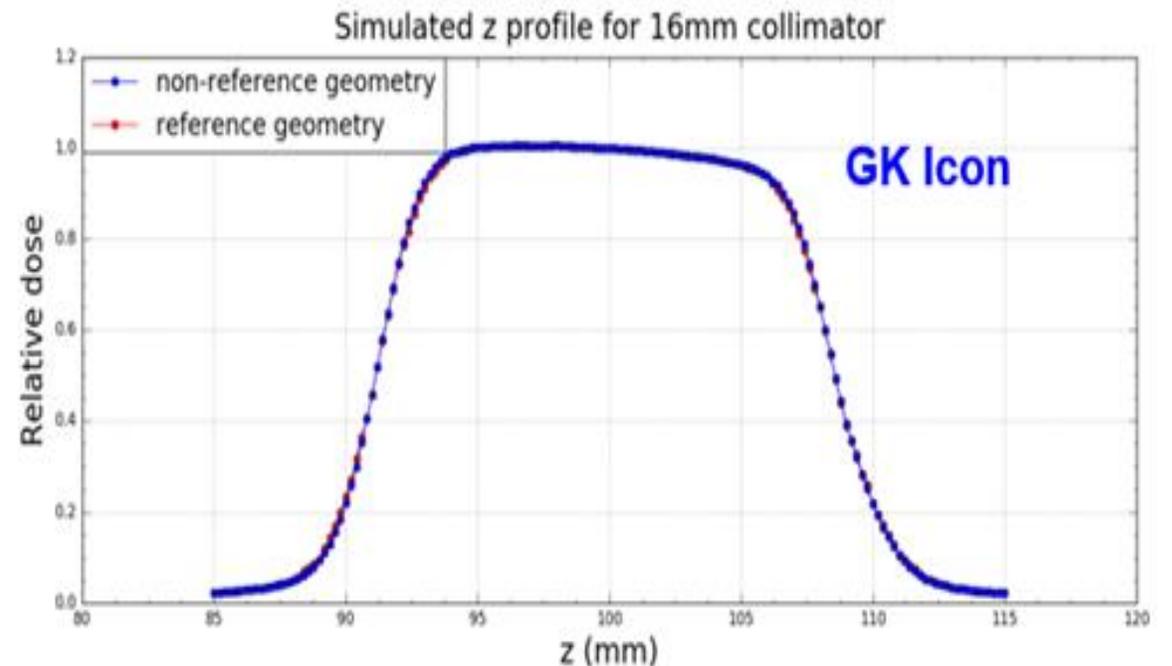
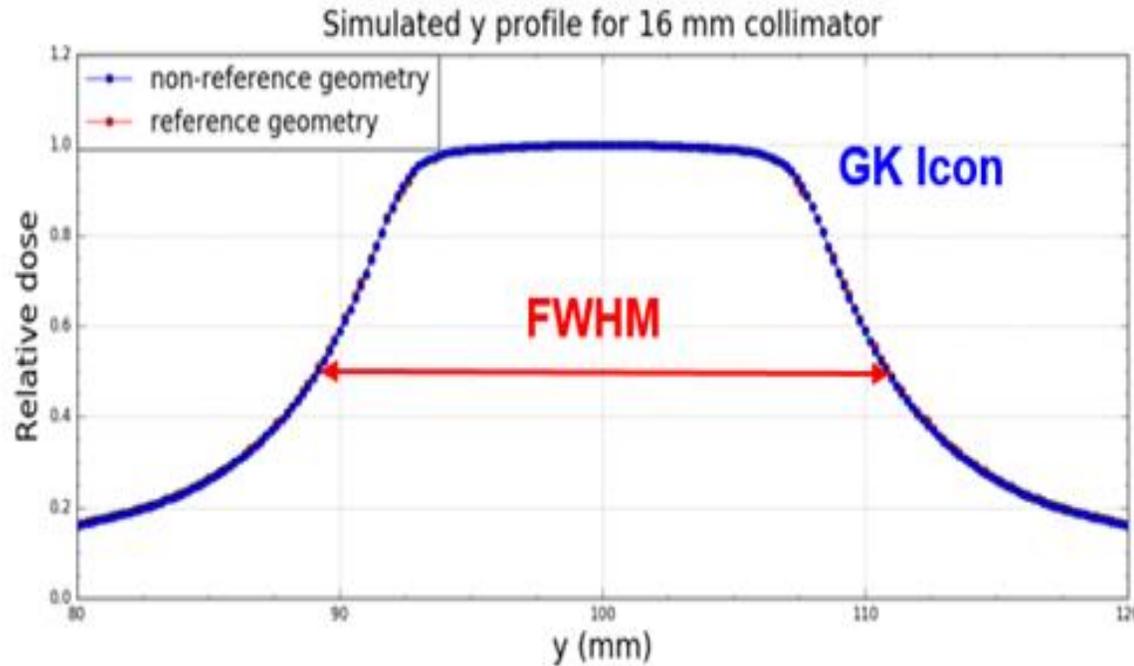
### - Results:

GK Icon profiles were scanned with the stereotactic PTW Diode SRS, microDiamond detector, PinPoint, PinPoint 3D chamber, IBA RAZOR, nanoRAZOR chamber, EFD and Razor diode compared with Elekta ref.profiles, profiles obtained with the EBT3 film and simulated with the TPS – **Excellent agreement was found for diode and microDiamond detectors for both vendors !!!**



Gamma Knife Icon measurement setup

TPS DVH simulation in ref. and non-ref. geometry



16 mm, 8 mm and 4 mm collimators show excellent agreement !

**How to accommodate detectors in phantom? – We need inserts !!**



**3D printed inserts**



	<b>ClearVue resin</b>	<b>Polyamide</b>
<b>rel.density</b>	<b>1.16</b>	<b>1.02</b>

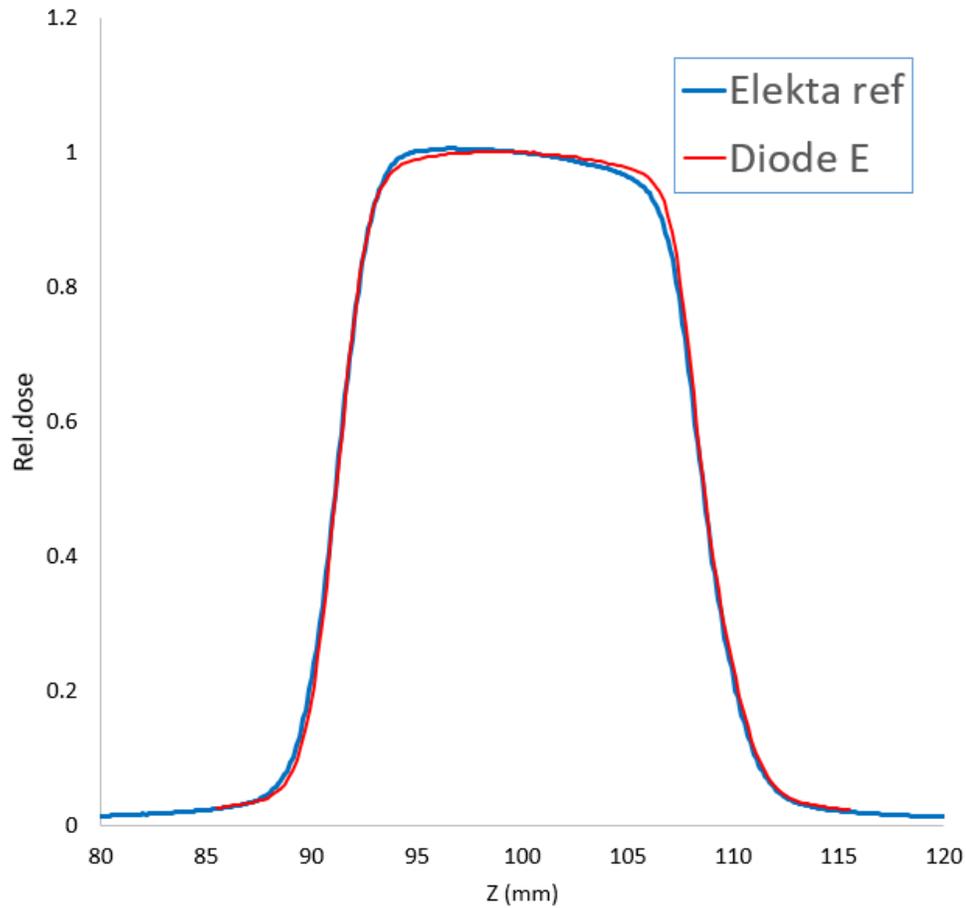


In collaboration with **Faculty of Mechanical Engineering and Naval Architecture in Zagreb**

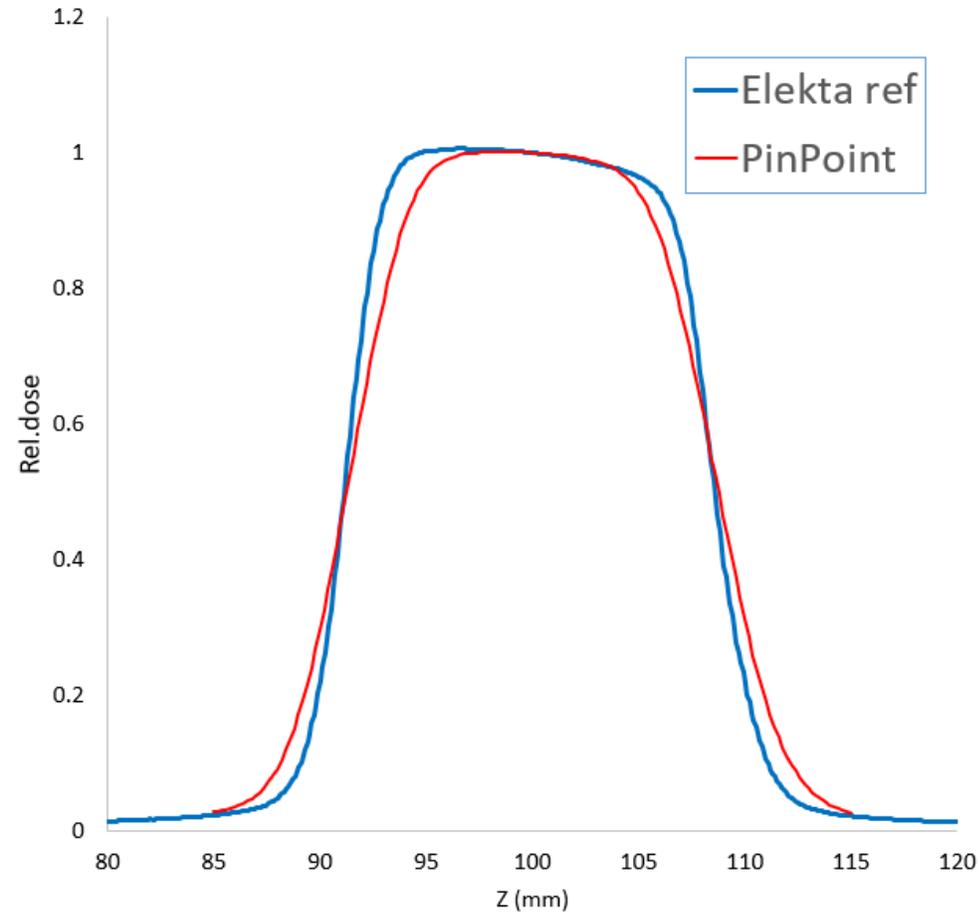
**EURADOS WG9 Webinar 12/4/2022**

**Profiles comparison:**

Elekta vs Diode E Z profile 16 mm coll.

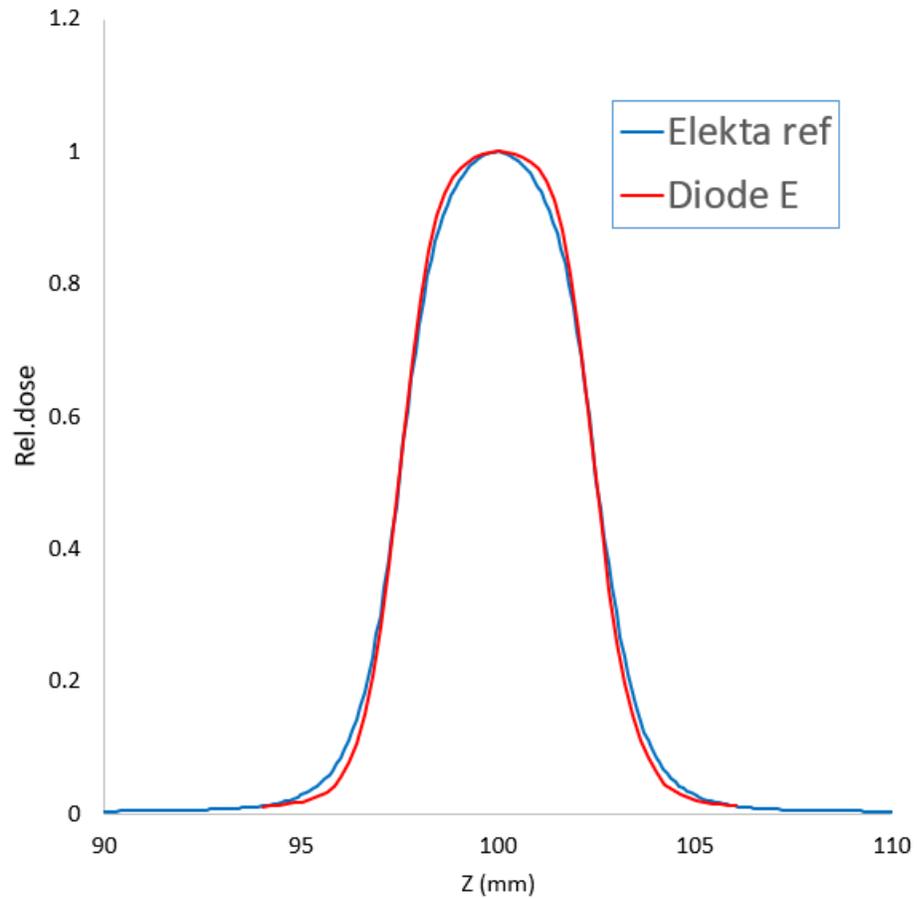


Elekta vs PinPoint Z profile 16 mm coll

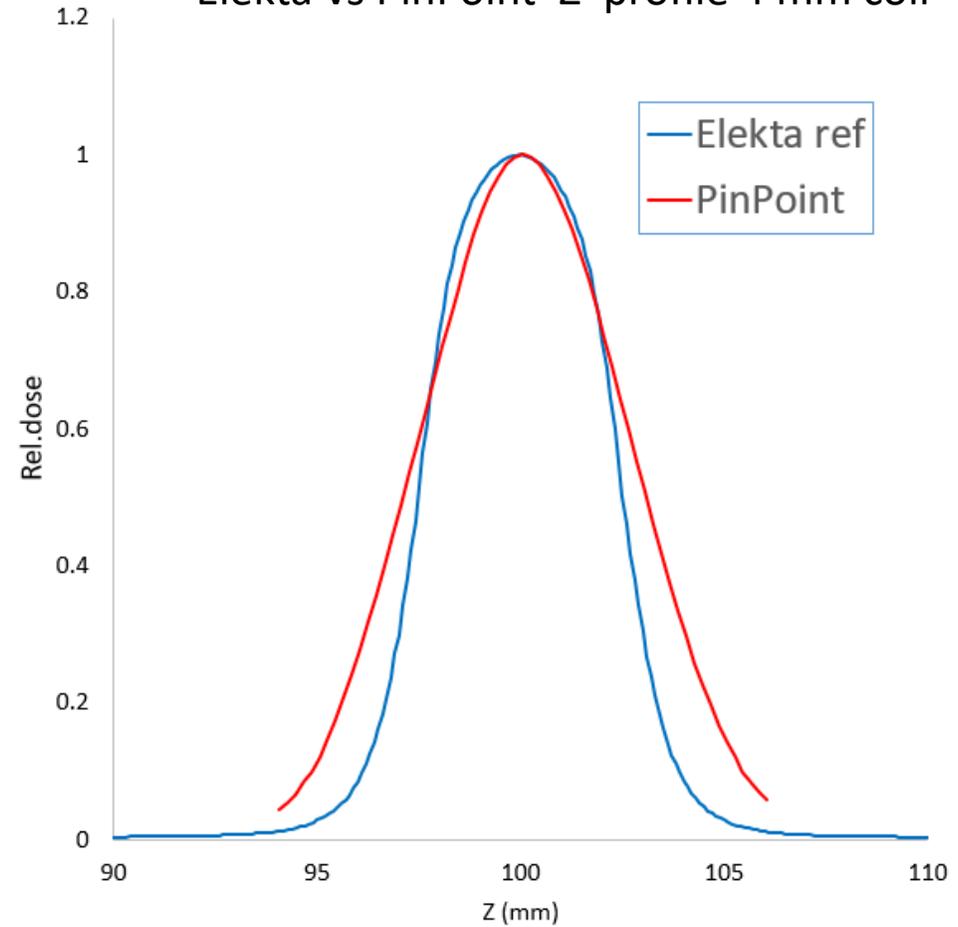


**Profiles comparison:**

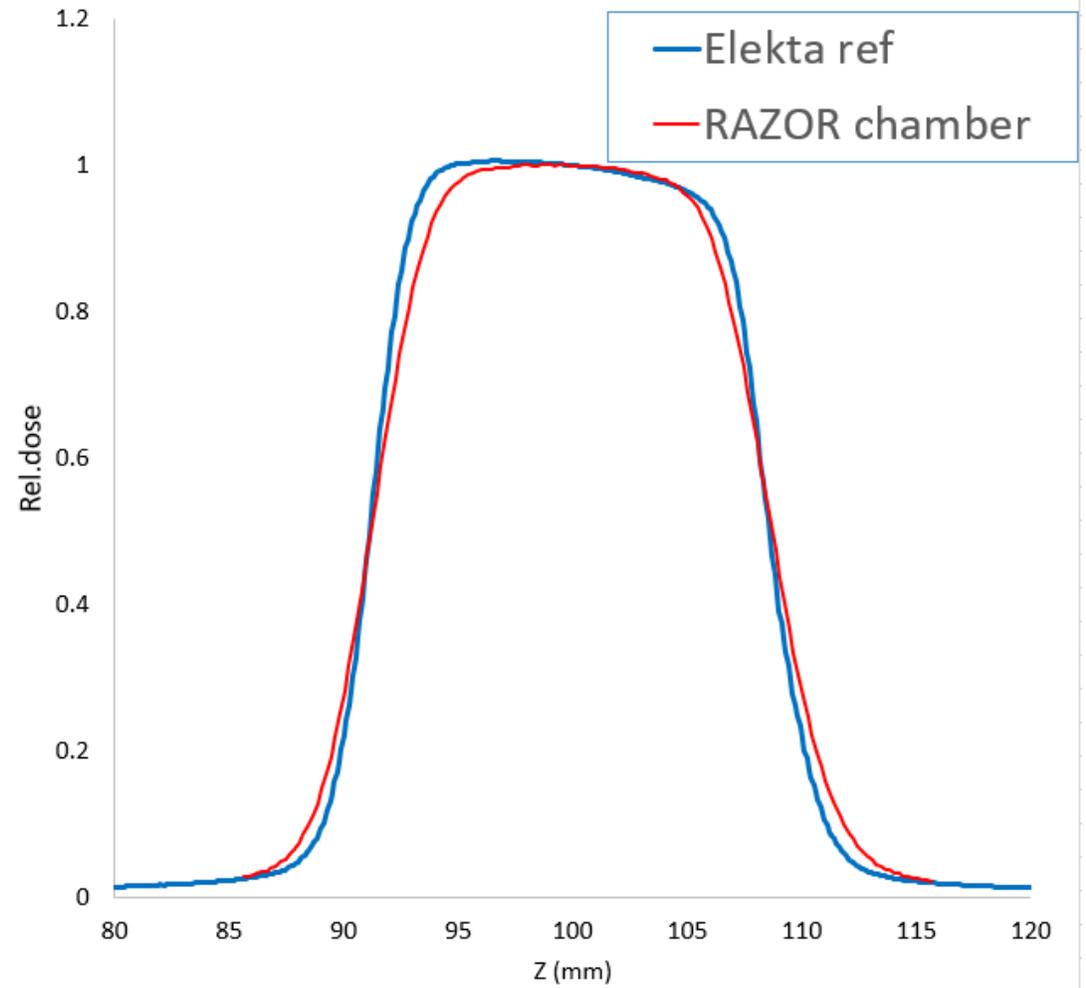
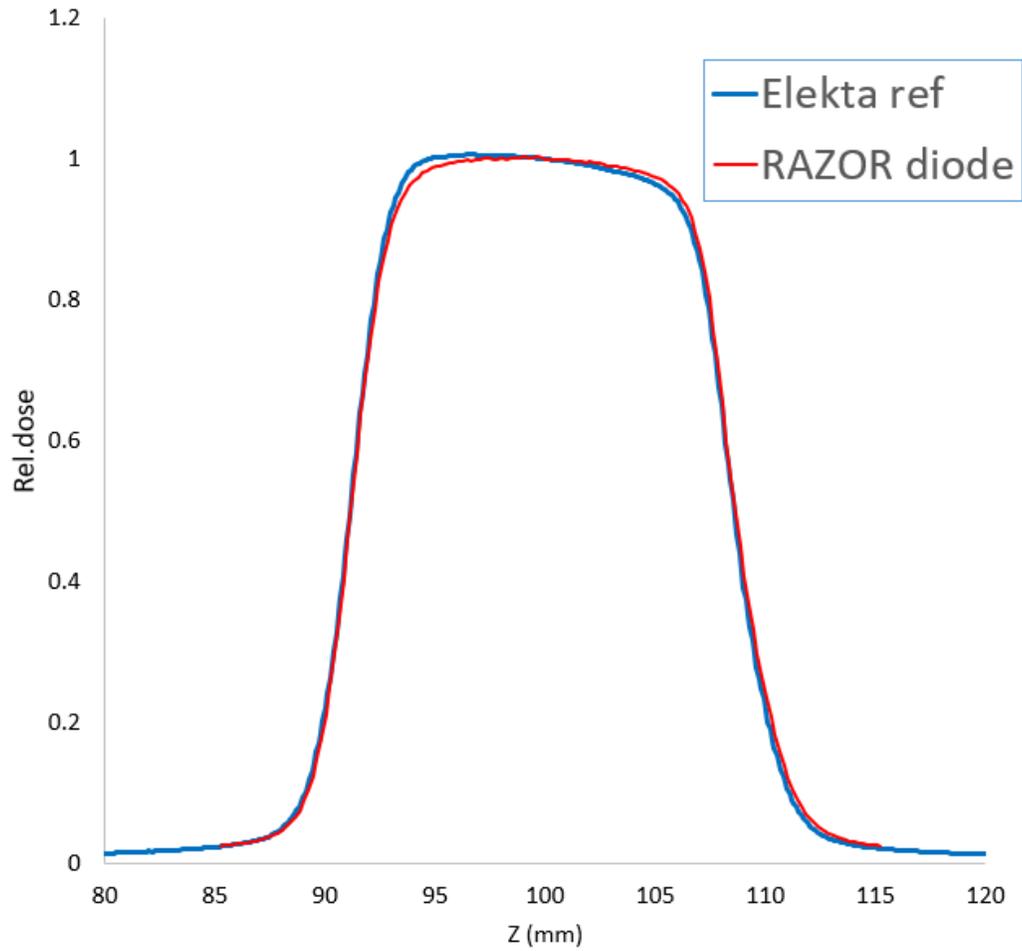
Elekta vs Diode E Z profile 4 mm coll.



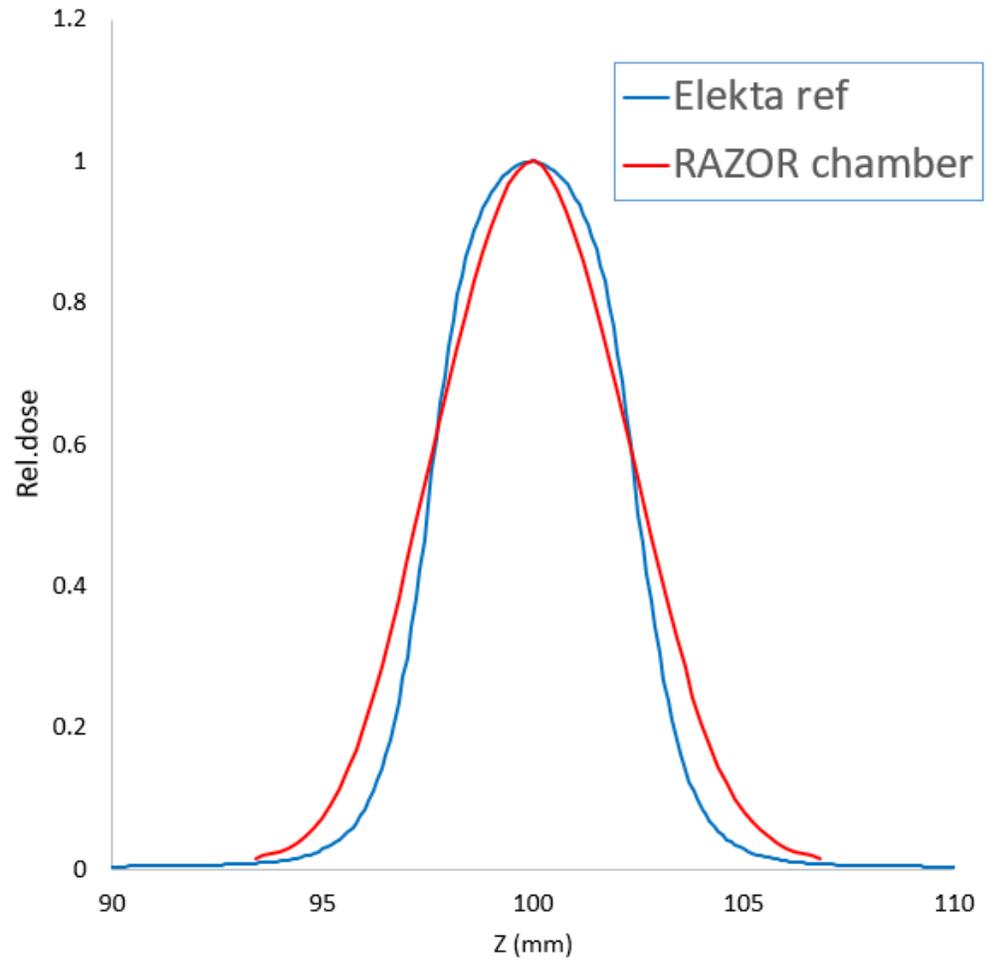
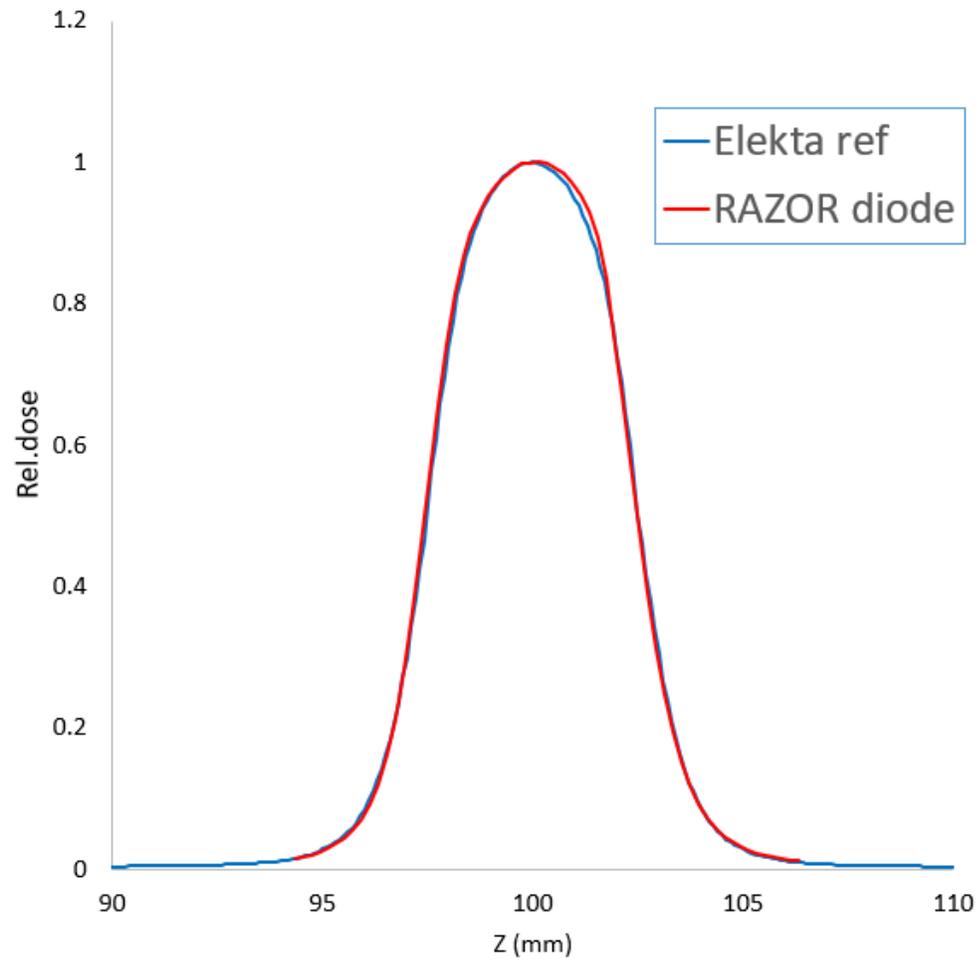
Elekta vs PinPoint Z profile 4 mm coll



Profiles comparison:



**Profiles comparison:**



**Summary of minitask #1:**

- **72 profiles were determined GK Icon (In total 8 point detectors used IBA + PTW)**
- **Less noise in a measured signal, reusability and simpler pre/post processing represent advantage of PTW and IBA Diode detectors and PTW MicroDiamond over the EBT3**
- **Non-reference geometry proved to be good method for profiles measurements during commissioning and QC of Gamma Knife**
- **Because of very small sensitive volumes of these detectors, which make volume averaging negligible, point detectors represent a good alternative to EBT3 for the Gamma Knife dose profile measurement**
- **Profiles measured with the ionization detectors show volume averaging of measured signal, resulting in higher values of penumbra**
- **Results are being prepared for the publishing**

## Presentations of the webinar:

1. **Assist. Prof. Božidar Casar** (Department for Dosimetry and Quality of Radiological Procedures, Institute of Oncology Ljubljana, Slovenia)

»Small field dosimetry on linear accelerators«

2. **Josef Novotny** (Department of Medical Physics, Na Homolce Hospital, Prague, Czech Republic)

»Implementation of IAEA TRS 483 in small field dosimetry of

Leksell Gamma Knife Icon – transition from IAEA TRS 398 to IAEA TRS 483«

## Please:

- Answer Poll questions !
- Q&A at the end of the presentations
- Use the Q&A box to write your questions

# Enjoy the webinar!

***EURADOS WG9 Webinar 12/4/2022***