Particle therapy (interes and knowledge)

SEEIIST
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Matjaž Vencelj

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Univerza v Ljubljani
Fakulteta za matematiko in fiziko

Onkološki inštitut
Institute of Oncology
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Areas of research:
Nuclear Medicine instrumentation
Development of new image analysis methods
Clinical research

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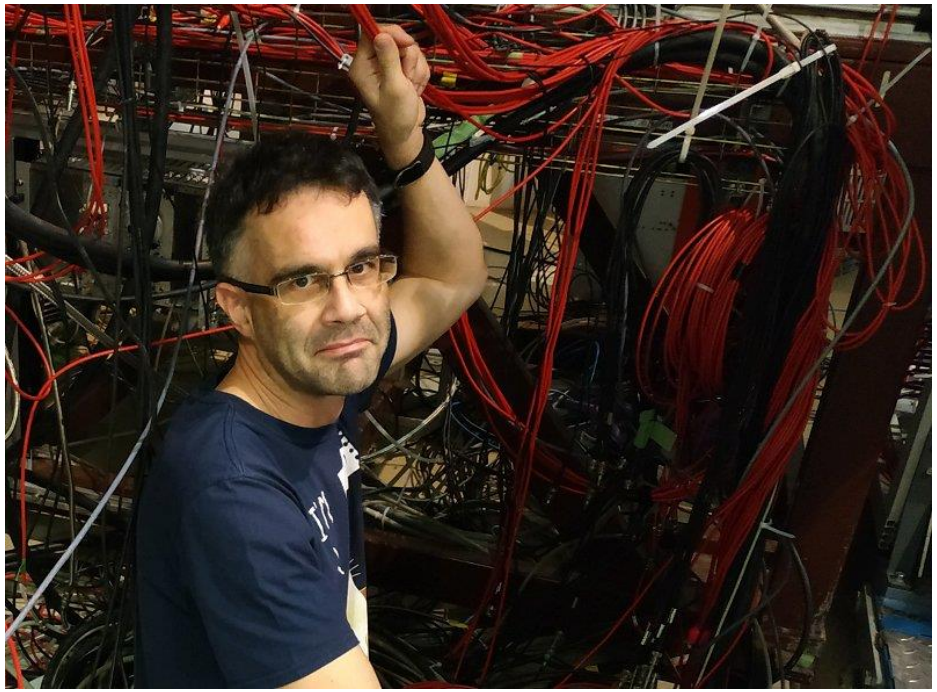
Areas of research:
Nuclear Medicine instrumentation, Atomic physics



Medical physics research group

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Medical physics research group

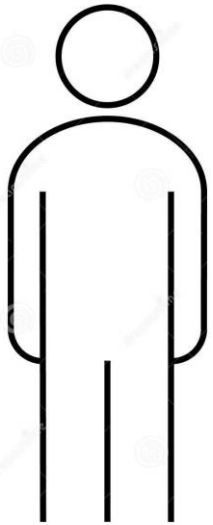
Focused on patient benefit

Modeling of diseases and treatment

Immunotherapy, prostate cancer

Personalized medicine

Breast screening,
Conformal radiotherapy



New instrumentation development

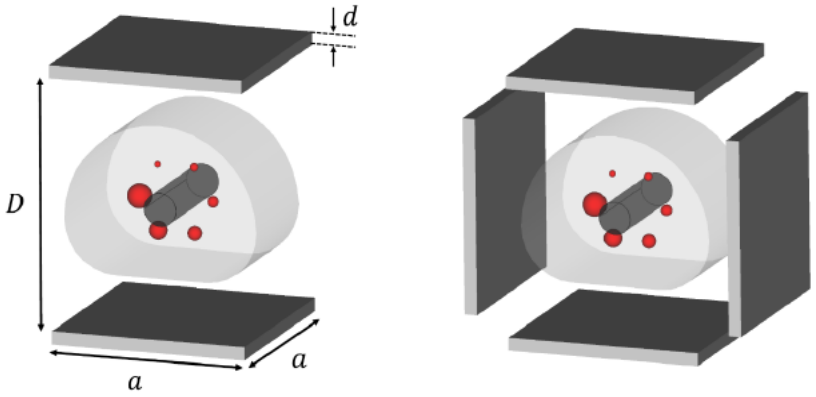
Bio-medical optical imaging group
PET instrumentation development

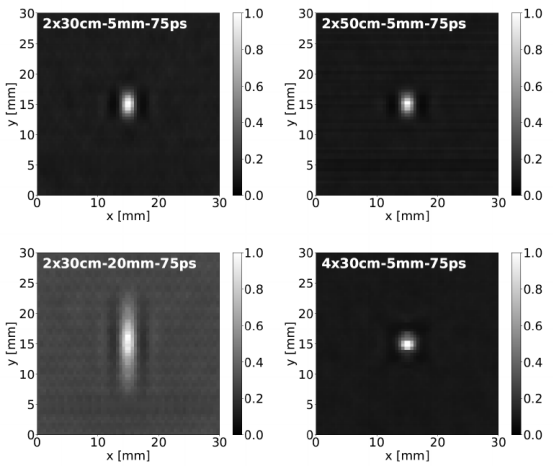
Development of new biomarkers

TECANT, somatostatin antagonist, quantitative imaging biomarkers (DORA, immunotherapy, cervical cancer)

Challenges – PET instrumentation

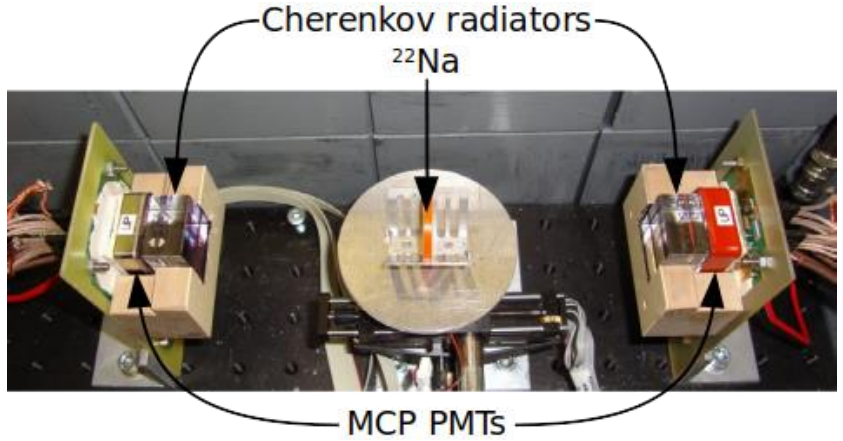
New geometries using TOF PET

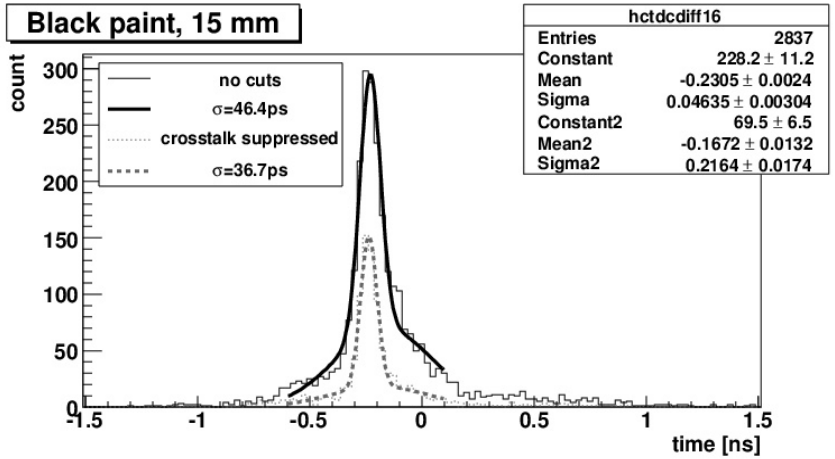




Partners:
FBK Trento, CNM Barcelona, Caltech, MGH

Cherenkov radiation provides excellent timing resolution for future PET imagers

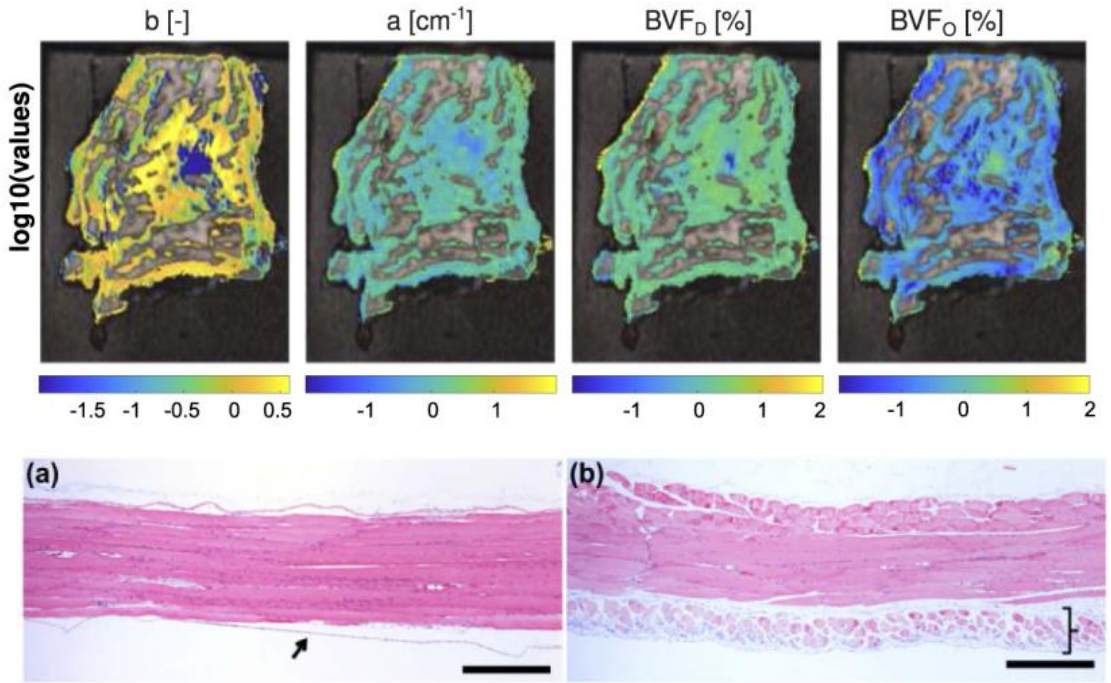




NIM A 654 (2011) p.532

Challenges – biomedical imaging

- Microscopy system
- Determination rf relevant microscopic and macroscopic tissue parameters
- Modelov developments that associate micro- and macroscopic tissue properties



Clinical challenges

Inflamatory diseases: phyisical and physiological properties
Arthrities (Clinic for arthriries, UMCL): GCA, animal inflamation models
Dermatology (Dermatology, UMCL; Chair of pathology, MF UL): skin infection, skin tumors
Oncology (OIL): human tumor models, DORA
Laser therapy (Fotona, Plastic surgery UMCL): laser epilation

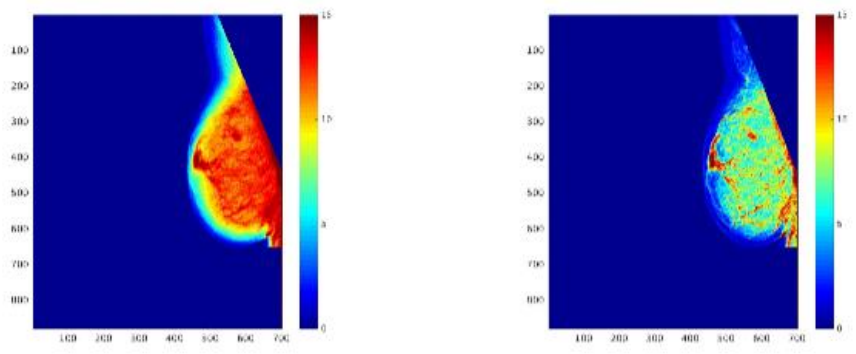
Challenges – breast screening

Dora
DRŽAVNI PRESEJALNI PROGRAM ZA RAKA DOJK

Personalized breast screening requires risk assessment.

Estimating breast density as an independent risk factor in DORA (> 100k mammography scans anually):

- 50k annotated images used as input



comparison of density score for raw and processed image

	Correct estimates	
	Raw	Processed
BIRADS1	77.5 ± 1.8	76.0 ± 1.9
BIRADS2	44.2 ± 1.7	49.8 ± 2.4
BIRADS3	58.2 ± 2.2	62.2 ± 2.1
BIRADS4	84.2 ± 7.7	86.8 ± 6.5

Of particular importance is the **BIRADS4 group** with significant increase in risk.

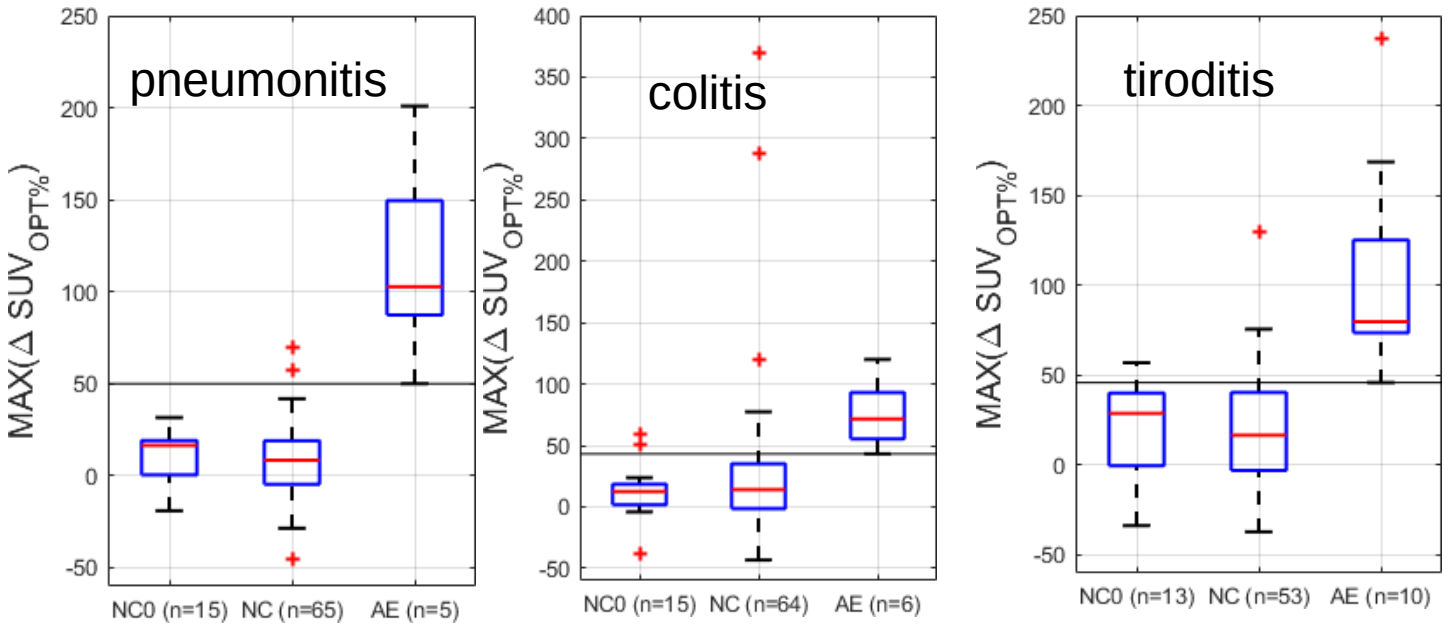
Partners: OIL, KU Leuven

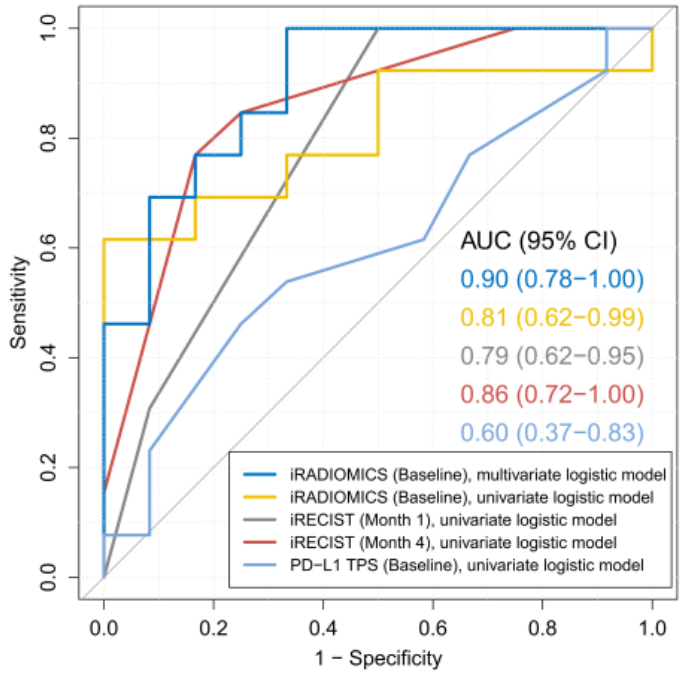
Challenges - Immunotherapy

Adverse effect in metastatic melanoma
Quantitative analysis of change in tissue uptake on sequential images

Partners: OIL, UW Madison

Patient selection in NSCLC
Quantitative image analysis prior or during treatment





Z. Klaneček, D. Huff, N. Hribernik, M. Reberšak et al.

D. Valentinuzzi et al. Rad and Onc. 2020

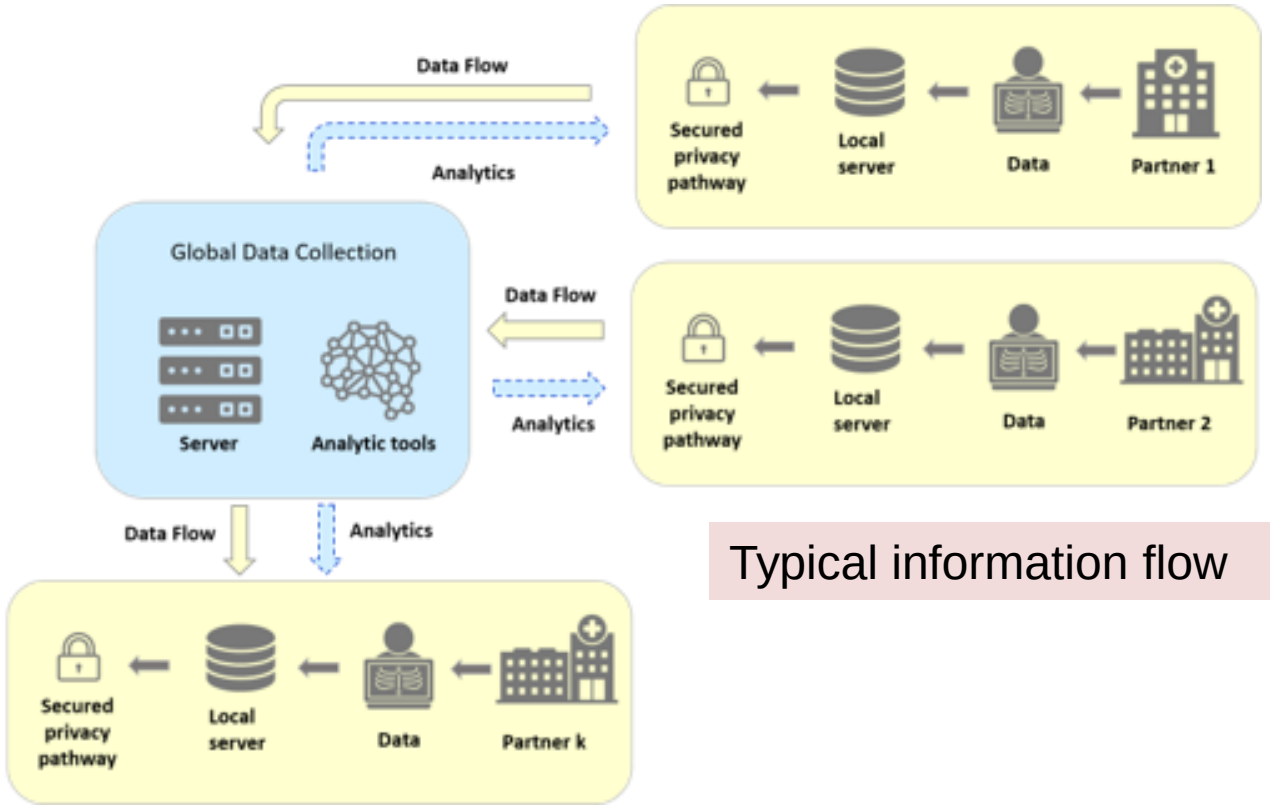
Challenges – data management

Network of excellence in imaging (NIX, nix-alliance.org) promotes harmonized collection, management and global sharing of data

Medical data is very sensitive - NIX provides strategies for mitigating international security concerns.

Within NIXLJU, Ljubljana node, four sub-nodes are in place at partner institutions (UMCL, OI, labkey-public and merlin) and are vital in providing data and analysis for science projects.

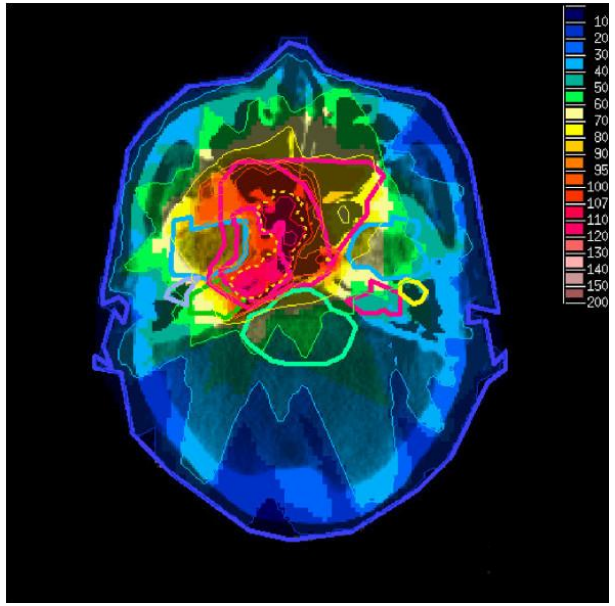
Partners: Universidad Sao Paolo, UWA Perth, UW Madison, Hospital San Raffaele, Hospital de la Santa Creu i de Sant Pau Barcelona,...



Typical information flow

Challenges – conformal radiotherapy

Dose painting doesn't fit GTV/CTV/PTV paradigm.
Highly personalized approach to treatment.



Report Committee 32 on Dose Prescription, Reporting and Recording in Advanced Optimization Strategies: Application to Dose Painting and Robust Planning

TERMS OF REFERENCE

Commission Sponsors

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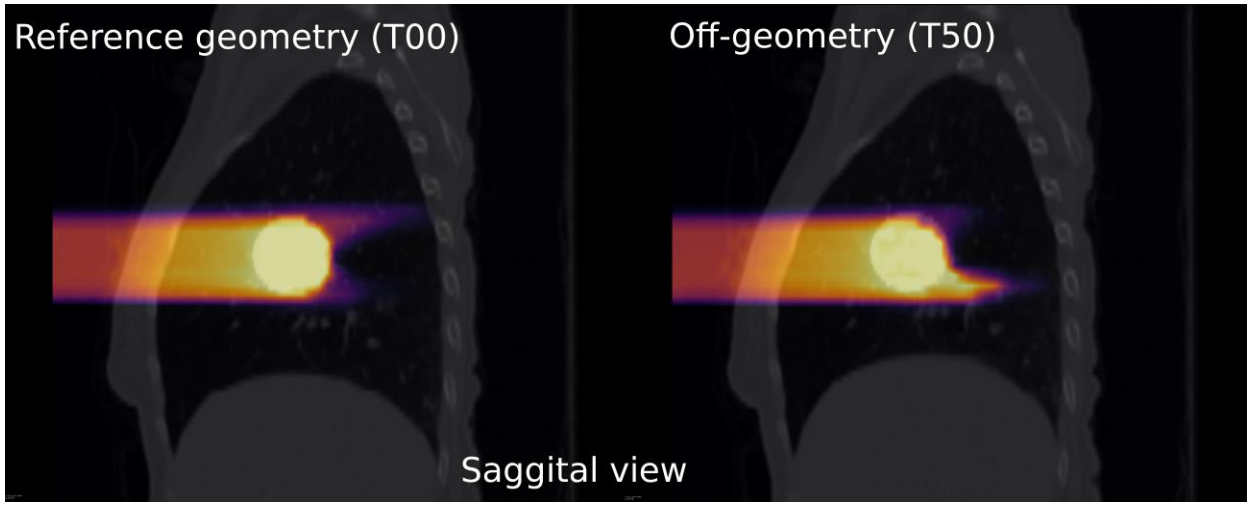
New committee formed to answer the needs

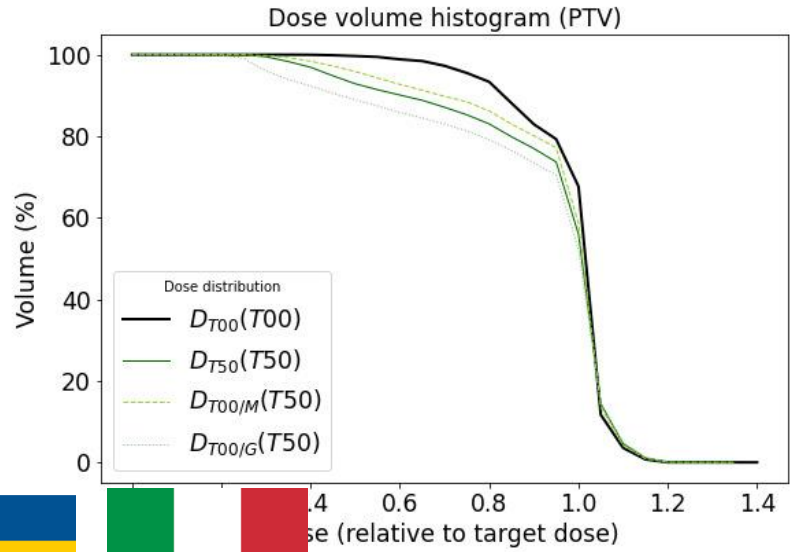
Adaptive treatment

G. Razdevšek et al. ANIMA 2019

Is adaptive treatment required?

- a naïve motion-less approach to proton irradiation.
- Plan dose on the inhale phase.
- Simulate actual dose (MCNP).
- Compare on-reference and off-reference dose.





Significant deviation in dose delivery that violates standards seen.

Slovenian researches initiators of the **RAPTOR collaboration**, funded by the EC 2020 MSC/ETN call, with collaborators from leading HR centers.

Future studies

Medical physics group
is building a puzzle of advanced diagnostic and therapy monitoring procedures and algorithms.

New facilities (such as RC-Advance) add important pieces and contribute to our overall goal of patient benefit.