MatRad
Treatment Planning Software

Ganesh Tambave

NISER, Bhubaneshwar

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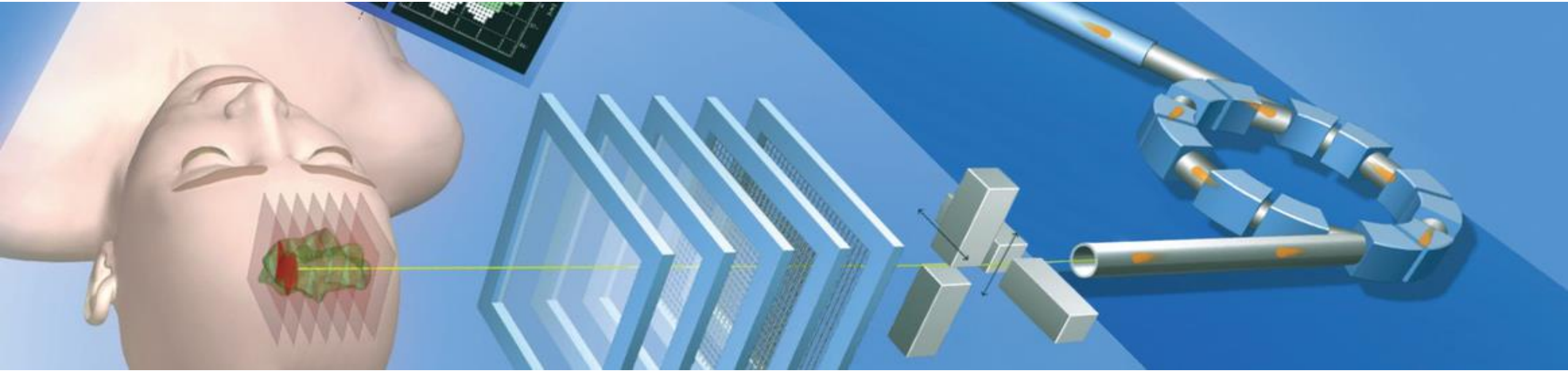
Reference: Aristeidis Mamaras presentation

How is a treatment plan designed?

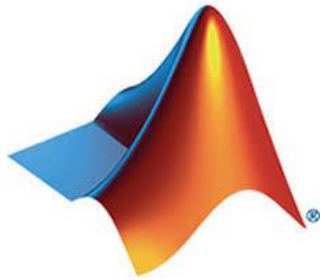


matRad

What is MatRad?

- MatRAD is an open source software tool for designing radiation therapy plans with a modulated beam of photons, protons and carbon ions.

- Its name derives from the combination of two words:



MatLab + Radiation = MatRad

Source: http://bit.ly/3sX756v

- Developed by scientists at the German Cancer Research Center, DKFZ in Darmstadt.

dkfz. GERMAN CANCER RESEARCH CENTER IN THE HELMHOLTZ ASSOCIATION

Source: **http://bit.ly/3uXfNDt**

- Use exclusively for research and educational purposes.

Where is MatRad used today?

+30 INSTITUTES

matRad – community

- ❑ With thousands of users worldwide.
- ❑ For more information visit the map at the following link:

Link: https://bit.ly/MatRadUsers

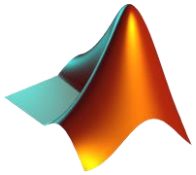
How can we use the software?

➢For research purposes:

- The program gives the possibility to use many parameters, for more realistic simulations.
- Uses the complete Mat Lab code for detailed analysis.
- Requires more computing power.

➢For educational purposes:

- For educational use, the simplified form of the software on Windows, Linux, Mac is recommended.
- Requires less storage space and computing power.



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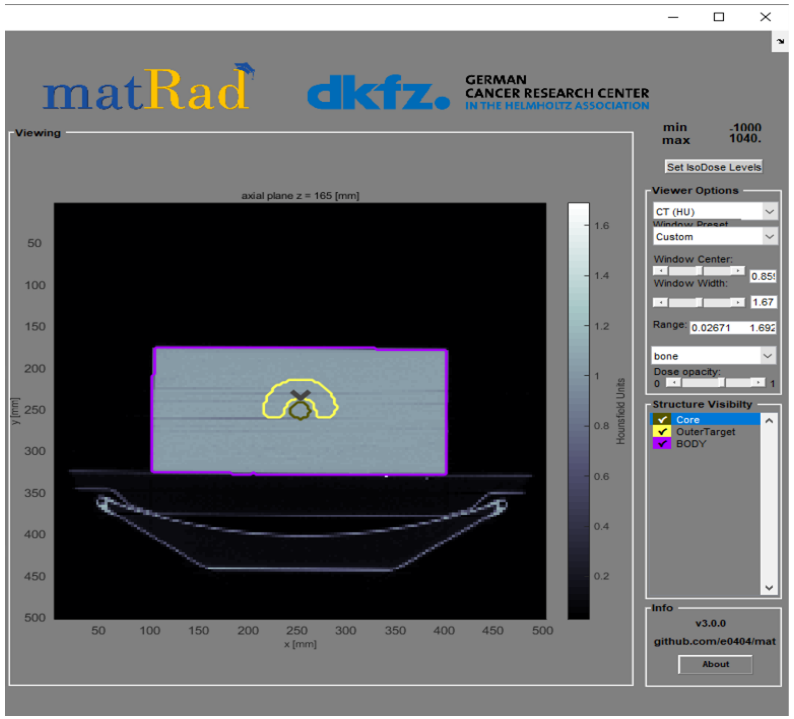
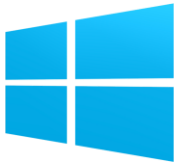
+Computing Power





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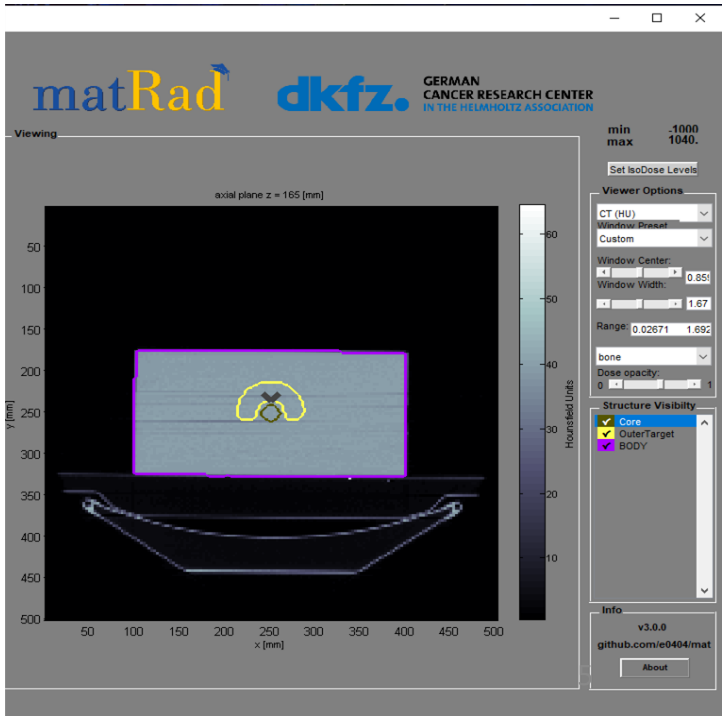
-Computing Power



How does MatRad work?

Data files:

I. Test Sample (C-phantom)
II. Liver
III. Head n Neck

Parameters:

I. Gantry angle
II. Couch angle
III. Radiation type (photon, proton, carbon ions etc.)

We enter the patient data

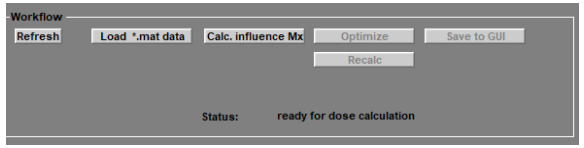
We set the parameters of the treatment plan (Radiation geometry etc.)

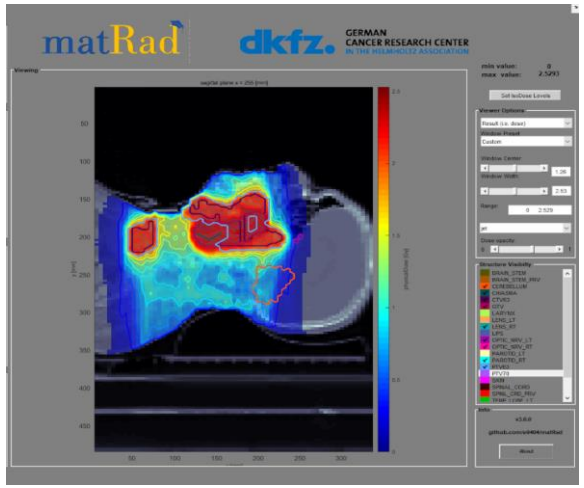
We calculate the dose of distribution to the cancerous tissue through algorithms

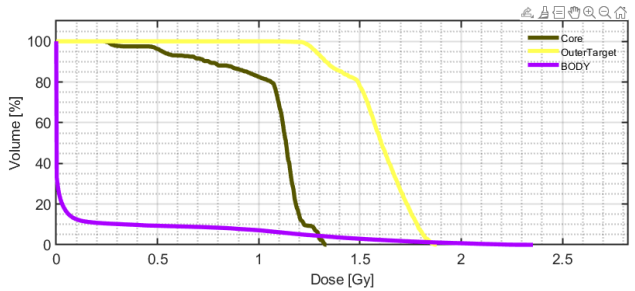
Visualization of the plan

Completion of Simulation

Procedure

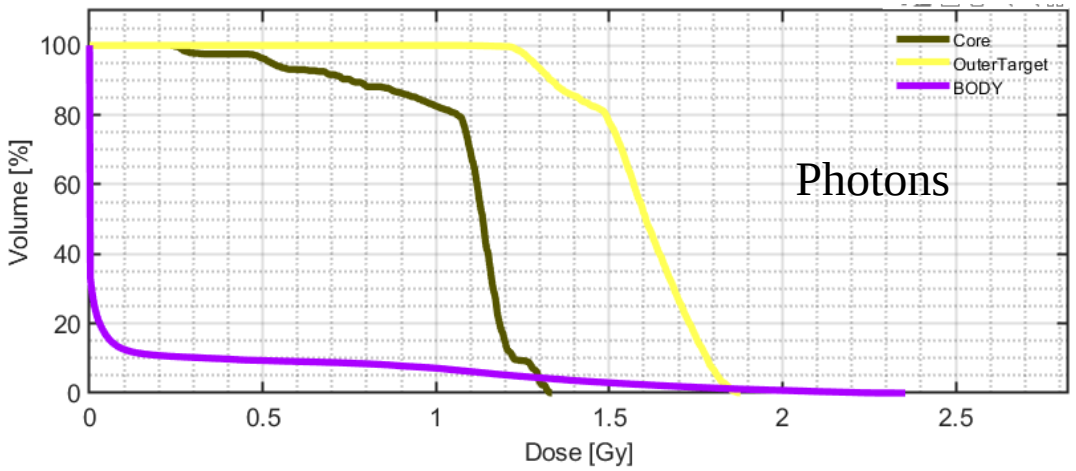


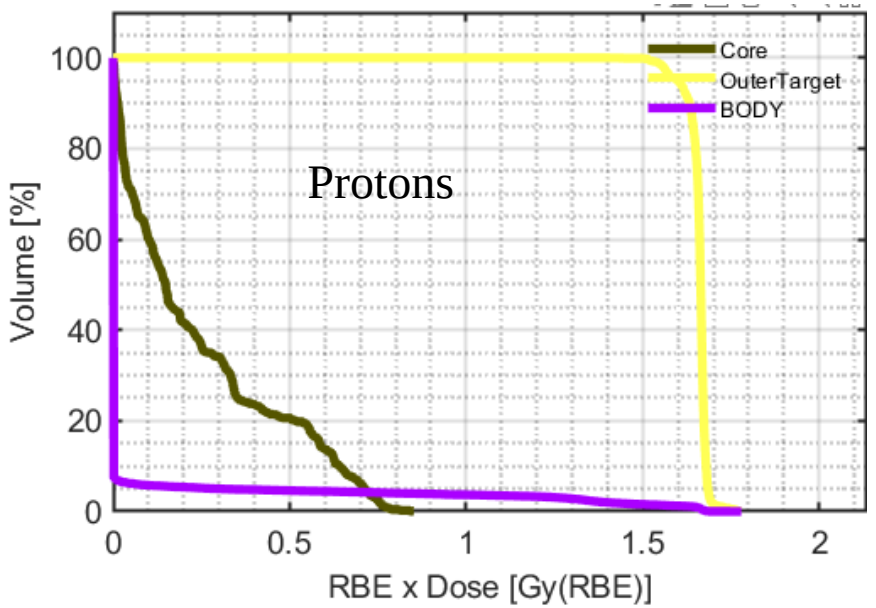


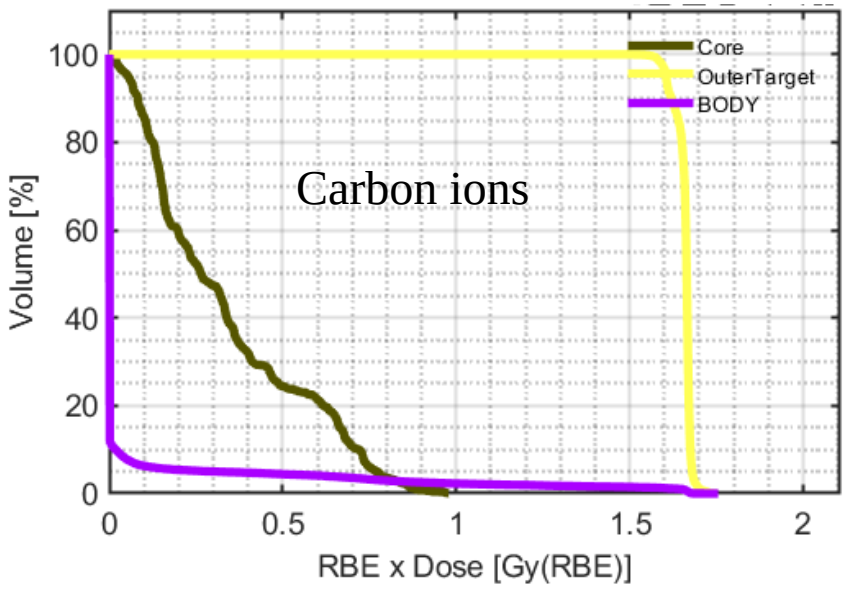


	max	min	mean	std
Core	1.3349	0.2372	1.0725	0.2146
OuterTarget	1.8801	1.0767	1.5918	0.1560
BODY	2.3556	0	0.1361	0.4030

Radiation type dose volume comparison (TG119)





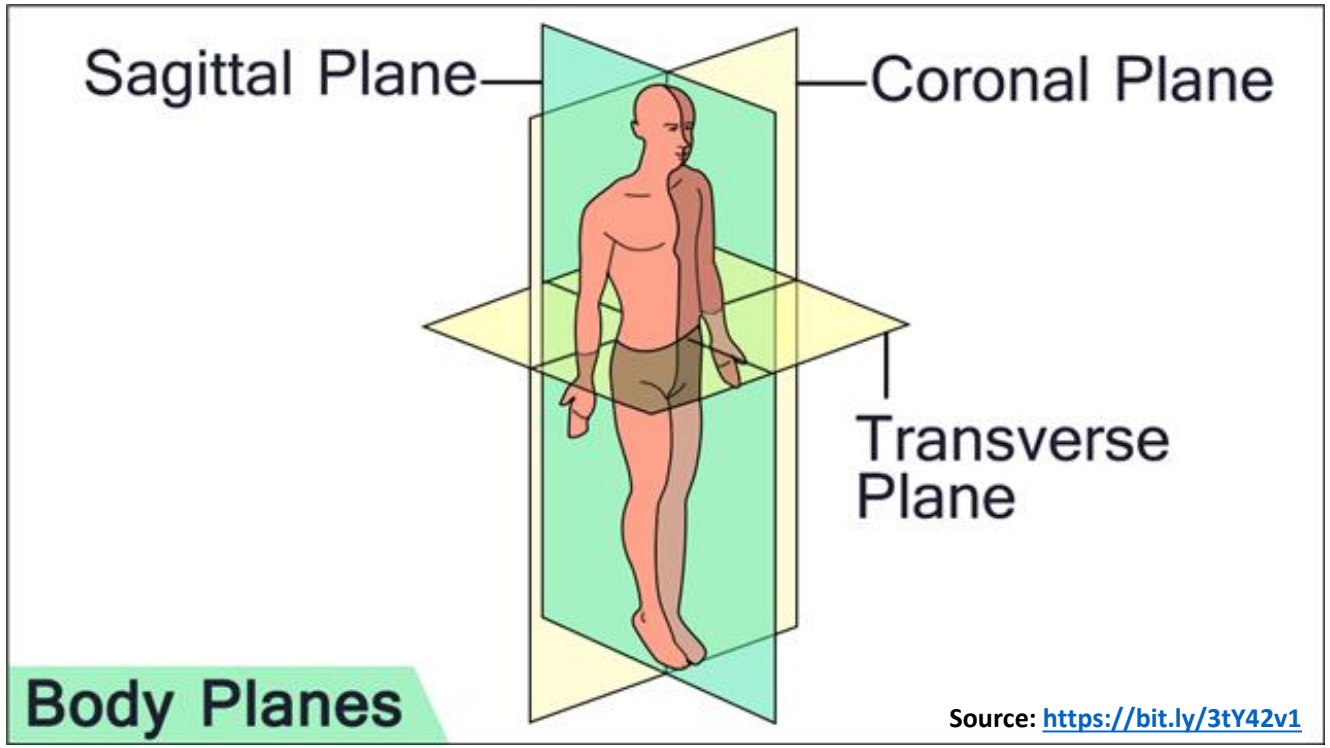


Photons	max	min	mean	std
Core	1.3349	0.2372	1.0725	0.2146
OuterTarget	1.8801	1.0767	1.5918	0.1560
BODY	2.3556	0	0.1361	0.4030

Protons	max	min	mean	std
Core	0.8525	1.1241e-09	0.2402	0.2380
OuterTarget	1.7802	1.4057	1.6581	0.0300
BODY	1.7802	0	0.0638	0.2840

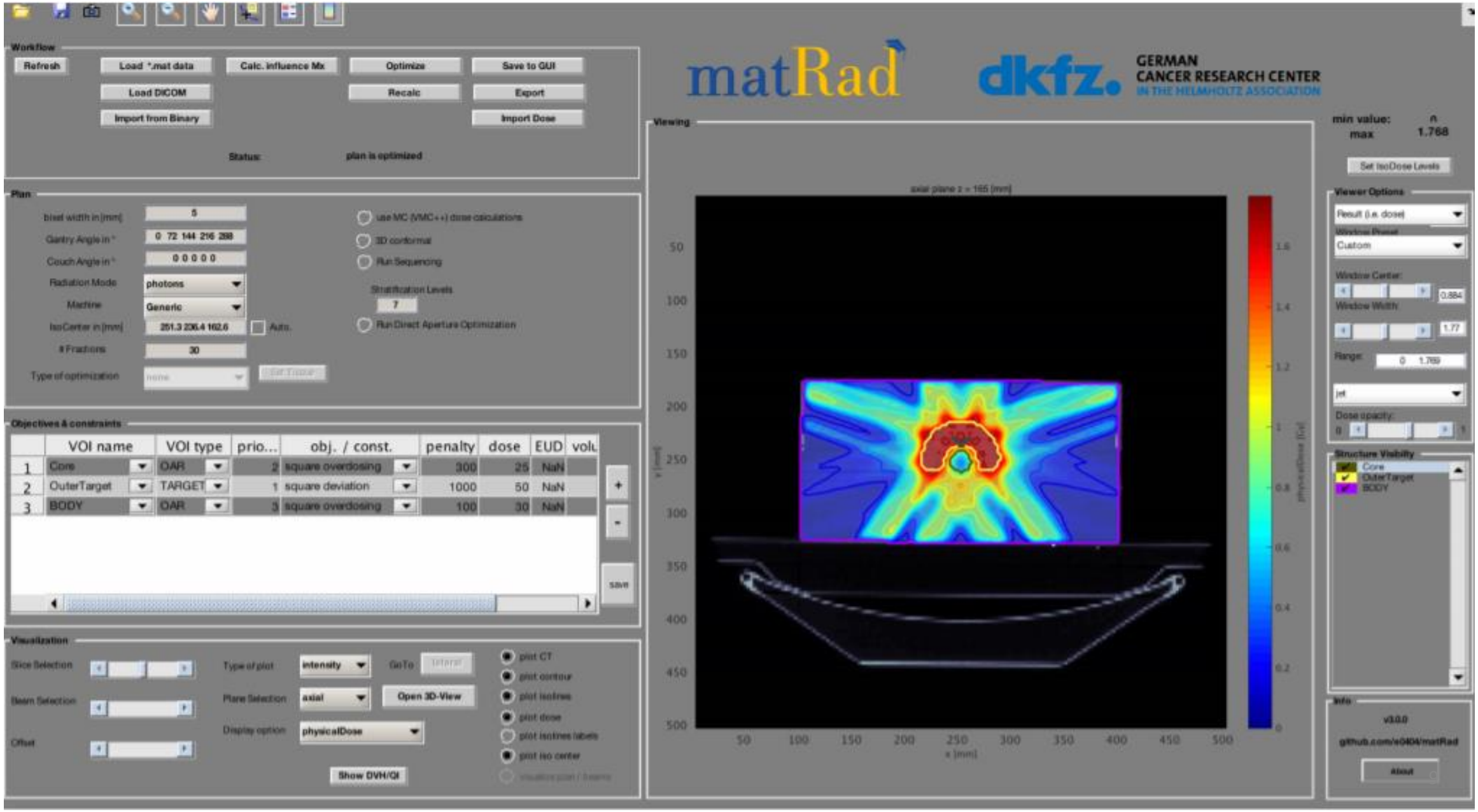
Carbon ions	max	min	mean	std
Core	0.9793	0.0048	0.3344	0.2405
OuterTarget	1.7564	1.4947	1.6580	0.0235
BODY	1.7564	0	0.0564	0.2496

Planes in visualization



- **Sagittal plane:** It separates the body equally in left and right parts.
- **Coronal plane:** It separates the body into two parts, anterior (front) and posterior (back).
- **Transverse/Axial/Horizontal plane:** It separates the body at the upper and bottom parts.

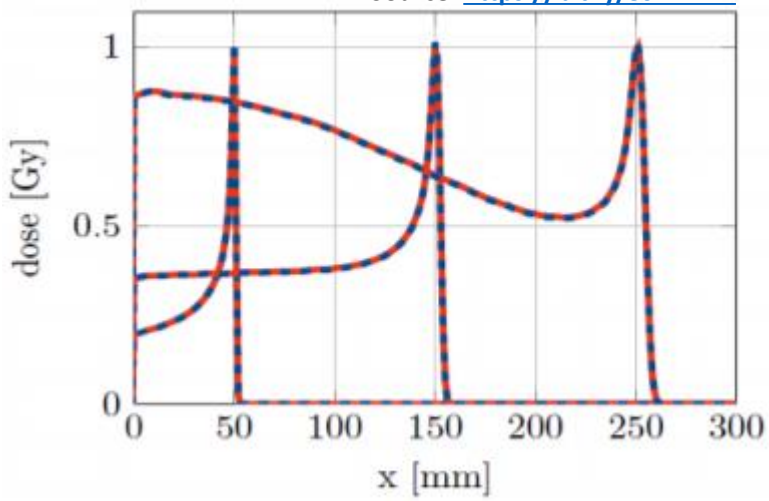
The graphical interface of MatRad



Comparison of MatRad with Syngo clinical software

- Syngo software is used clinically in Heidelberg (HIT).
- Display of the dose in Gray (Gy) as a function of the depth of the beam in human tissue in millimeters (mm).
- The results are almost identical !!!
- MatRad is not used in clinic, it is designed for research and educational purpose.

Source: https://bit.ly/3sWzzwT



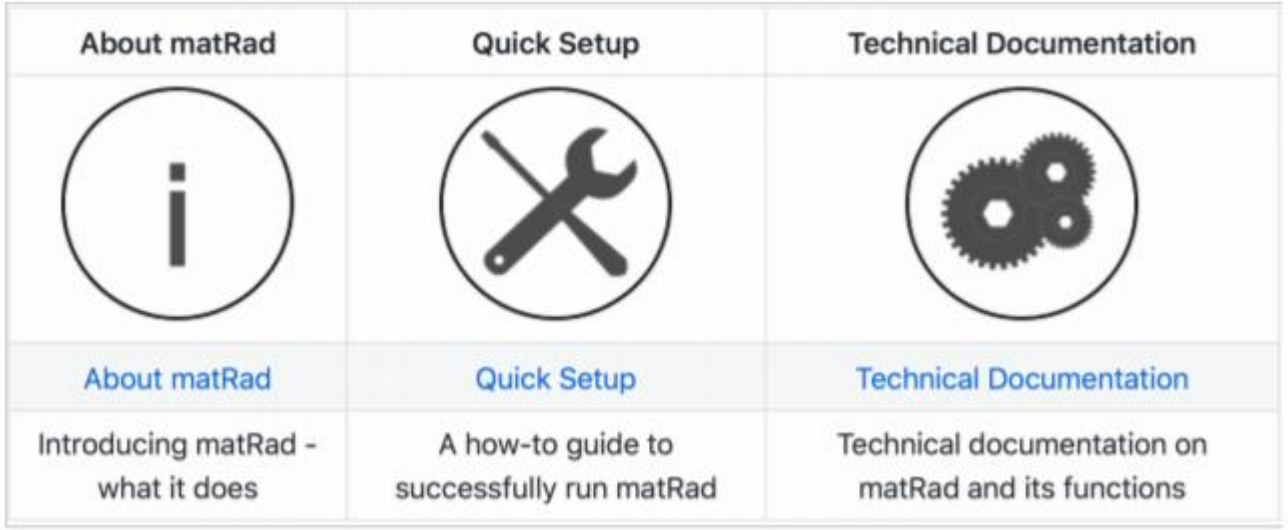
MatRad features

- Open source software and access to real life patient data.
  Widespread use in the Medical Physics community.
- Standalone (matRad.exe) can be used without permission.
- User friendly and provides easy data visualization functions.
- Convenient and fast debugging.
- Simple syntax compared to more abstract programming languages (e.g. C ++).

More information about the software

- Many functional examples of the software are available as well as enough educational material.

- 29 pages available at Wiki: https://github.com/e0404/matRad/wiki



- The official page of the software is given at the following link: https://e0404.github.io/matRad/

Thank you
Lets work together in the hands on session!

Some definitions used by MatRad

- **GTV** (Gross Tumor Volume) is defined as the target tumor and is the exact location of the malignancy (cancer), as evidenced by imaging methods.

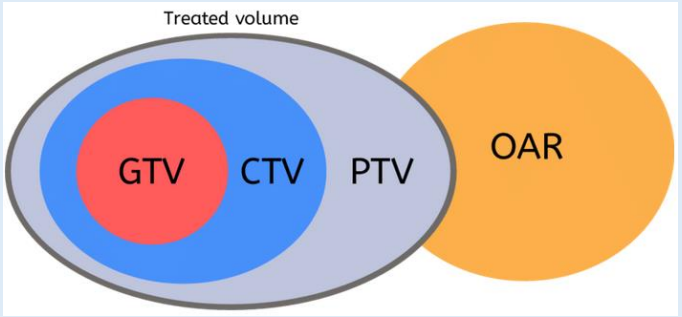
- **CTV** (Clinical Target Volume) is defined as the target clinical tumor (where the radio physicist assumes that cancerous tissue is still present). It is designed with the requirement that cancer cells should not be located outside its region.

- **PTV** (Planning Target Volume) is defined as the target volume for design. Includes CTV with an internal margin (IM) and an additional margin for placement (setup margin (SM)), which refers to patient movement and placement error.

- **OAR** (Organs At Risk): Organs that are more sensitive compared to healthy tissue. Organs in danger need adequate protection. Once the endangered organs are identified, an extra safety margin should be added to include their movement.

- **Gray** (Gy) is the measure of the energy deposited in matter by ionizing radiation per unit mass

  Is equal to absorbed dose of 1 Joule/kilogram



Target Volume and Organ At Risk