# MatRad
# Treatment Planning Software

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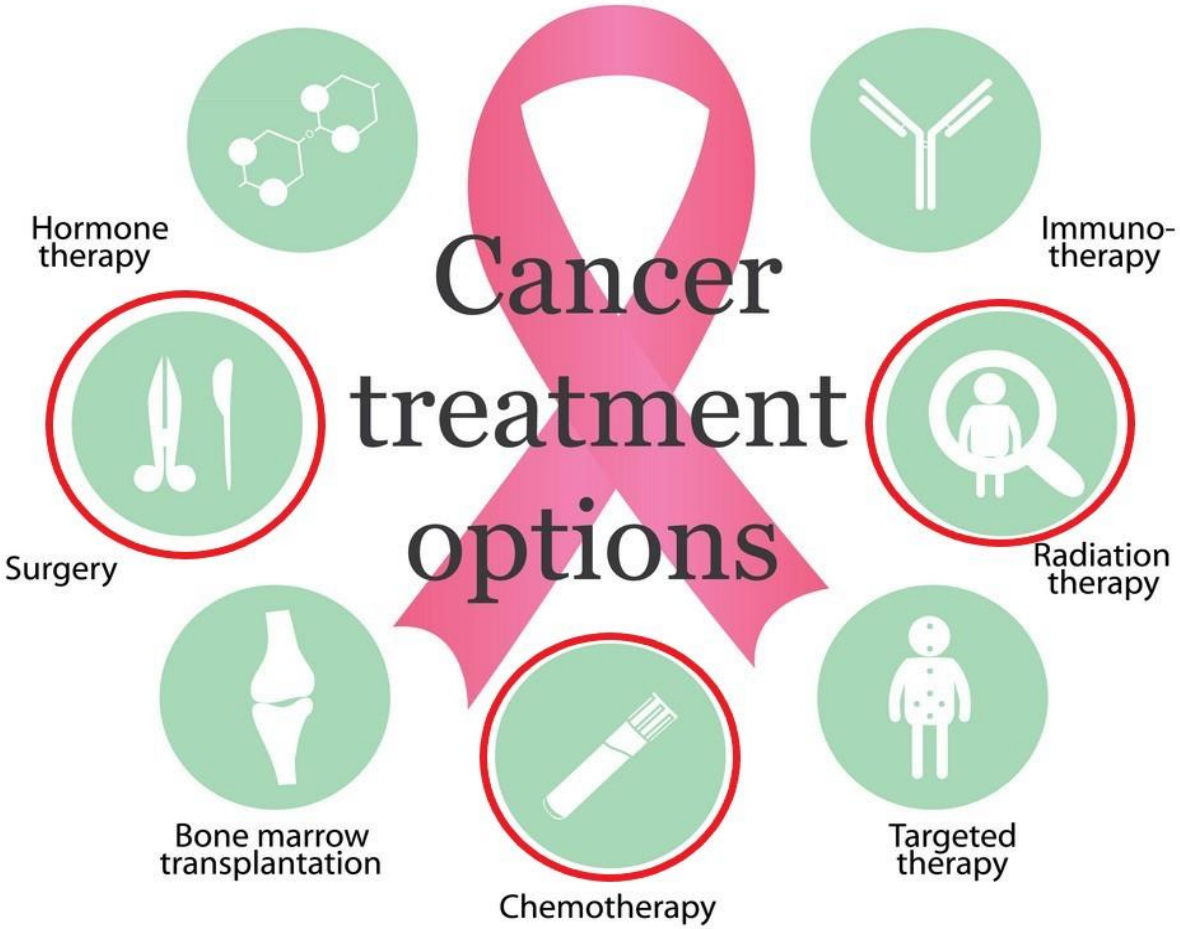
**Reference: Aristeidis Mamaras presentation**

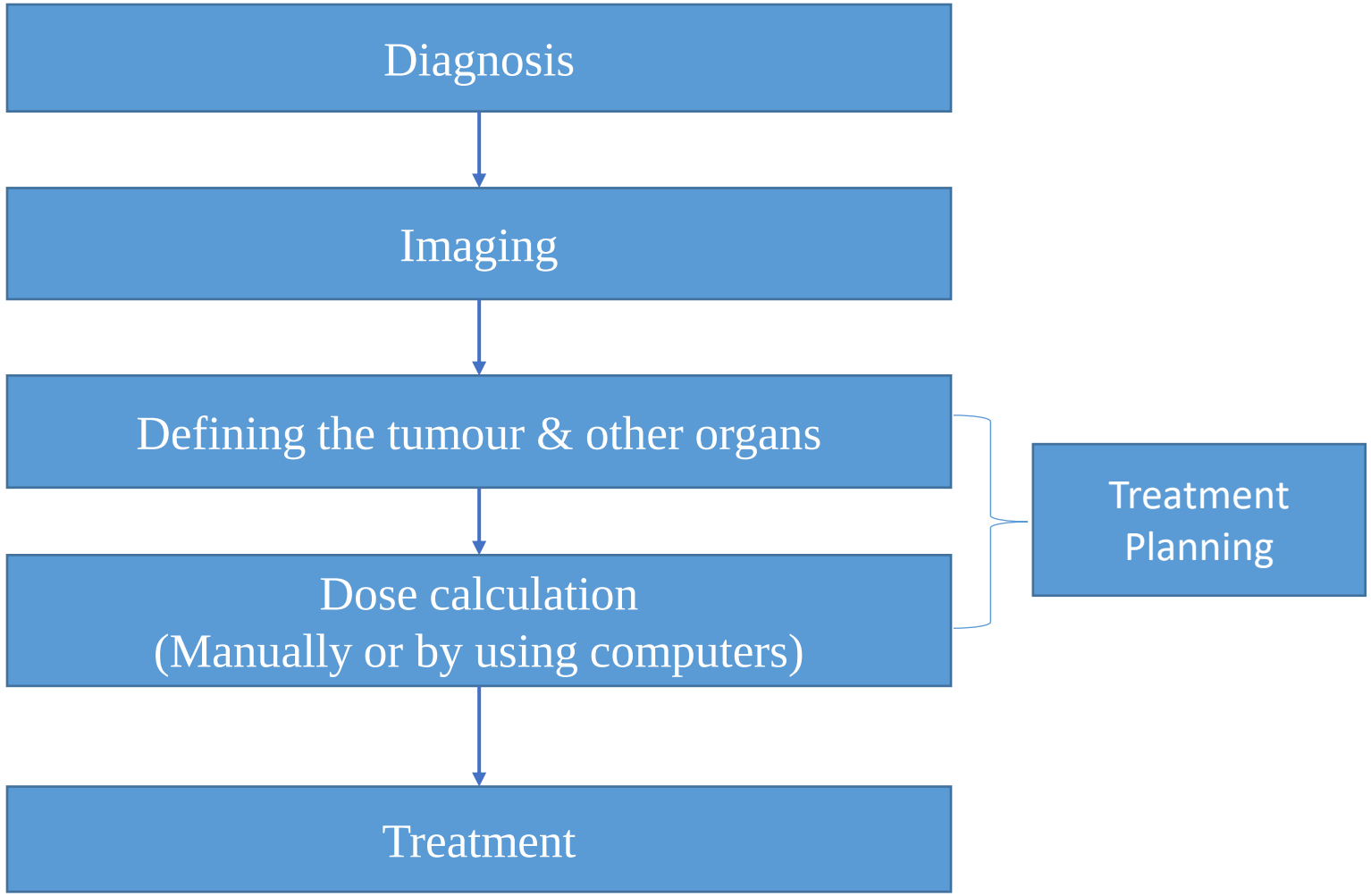
# Treatment of caner



# Radiation Therapy

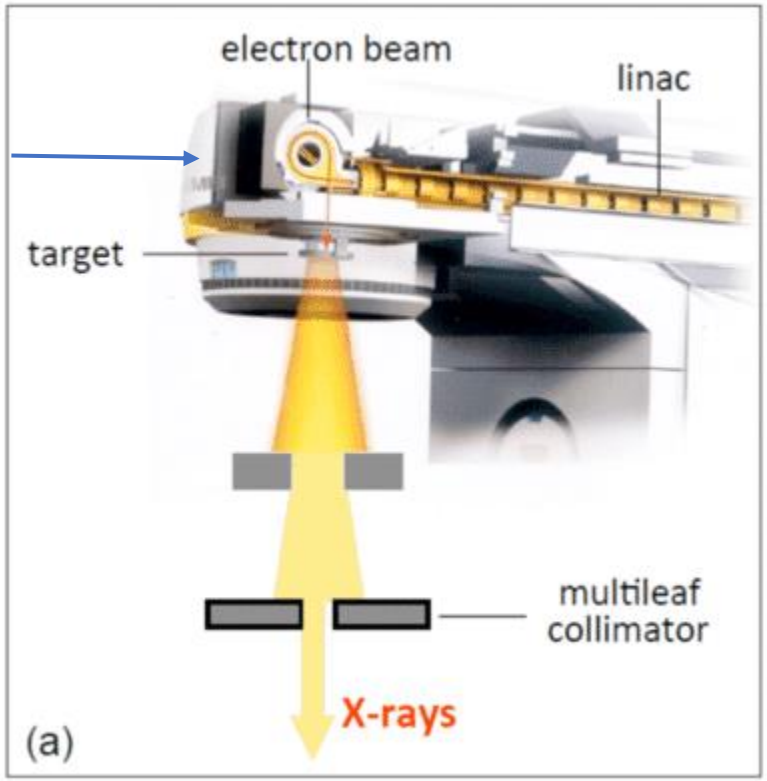
‘Treatment of cancer
By using
Ionising
Electromagnetic Radiation’

# Workflow of Radiation Therapy



# Treatment using Medical LINACS

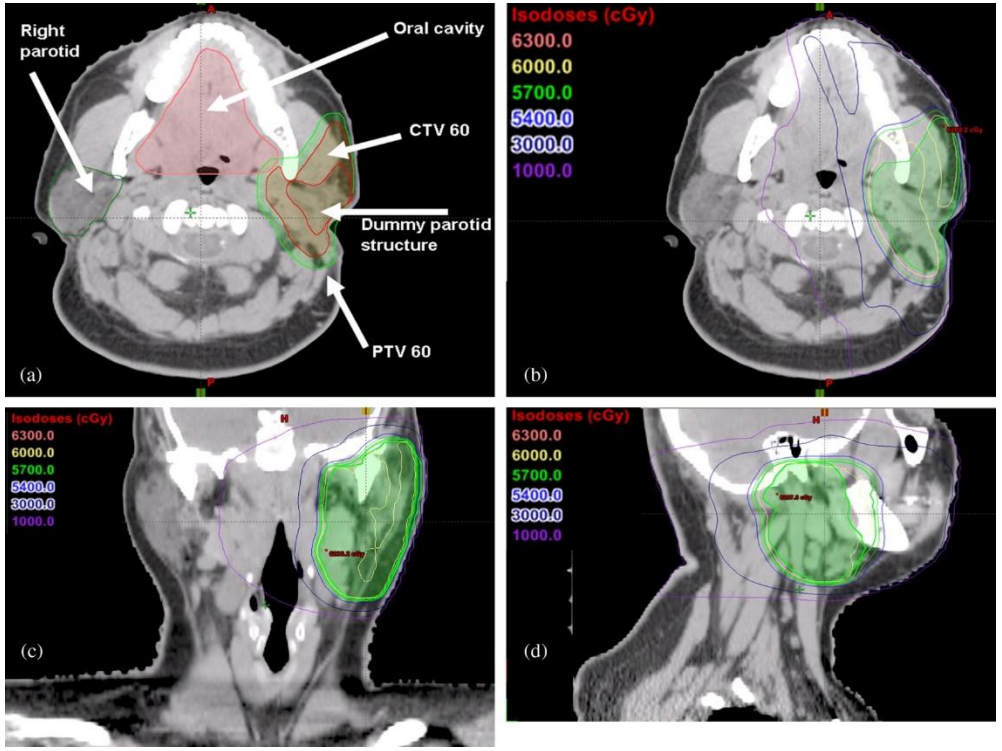
Gantry

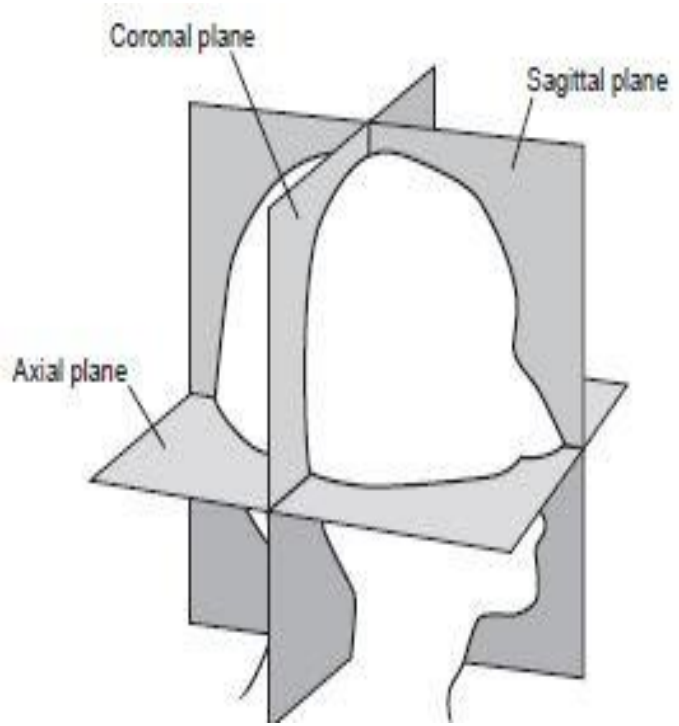




*Multi leaf collimator are the device used to get the radiation of desired area.
*By increasing the width of the gap between the multi leaf collimator we can get the beam of radiation of our desired area.

# Delineating Target & OARs




*Organs at Risk (OARs) : Other organs surrounding the tumour needed to be saved from the harmful effects of radiation

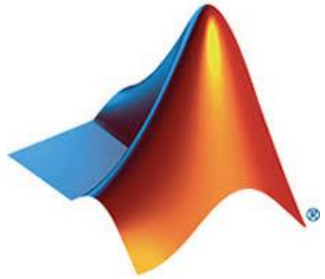
# Treatment planning

- The focus of Treatment Planning is ‘Give maximum dose to the target (tumor) and minimum dose to the surrounding normal tissues’.
- It Includes:
  - Imaging the patient
  - Setting the direction of the Radiation beam
  - Prescribing the dose to the target and the normal tissue
  - Calculating the dose in the patient image
  - Visualization of the Dose distribution inside the patient
  - Volumetric dose assessment
  - Plan approval by the Oncologist for treatment
- Treatment Planning is done by the computer software. (Here we will use **MatRad** software.

# What is MatRad?

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

- Its name derives from the combination of two words:



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

**MatLab + Radiation = MatRad**

- 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

- Used exclusively for research and educational purposes.

# Where is MatRad used today?

# +30 INSTITUTES

matRad – community




UNIVERSIDAD
COMPLUTENSE
MADRID





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

**Link**: https://bit.ly/MatRadUsers

# 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.)

**Enter the patient data**

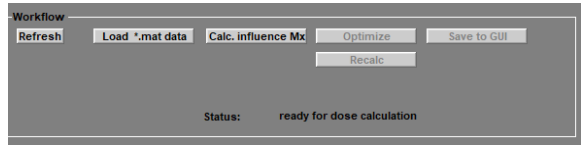
**We set the parameters of the treatment plan (Radiation geometry etc.)**

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

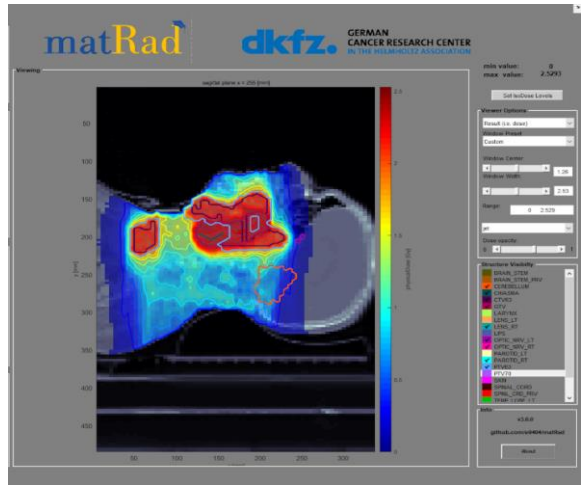
**Visualization of the plan**

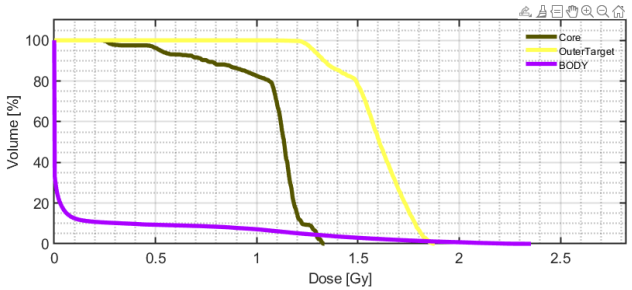
**Completion of Simulation**

Procedure

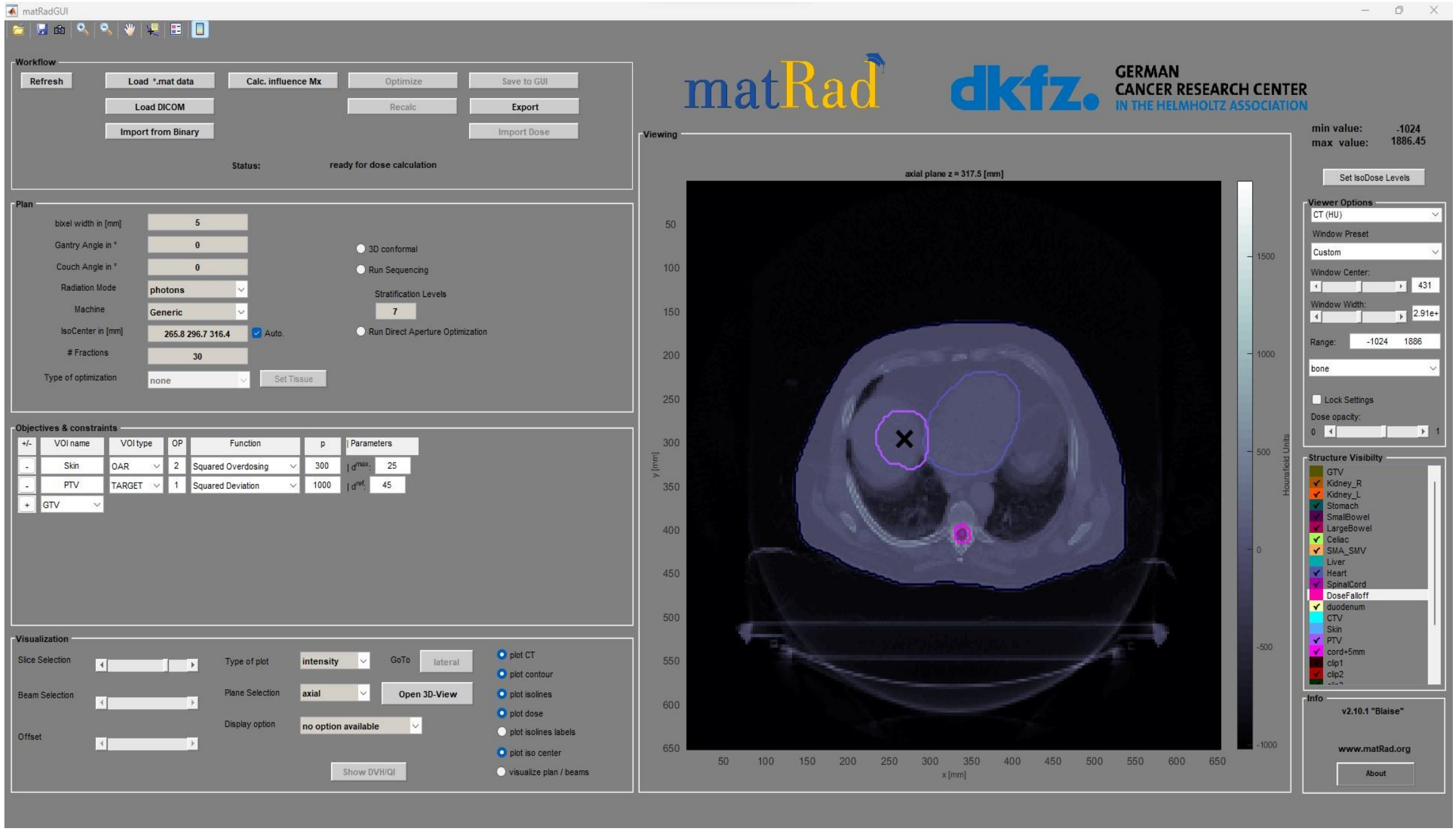




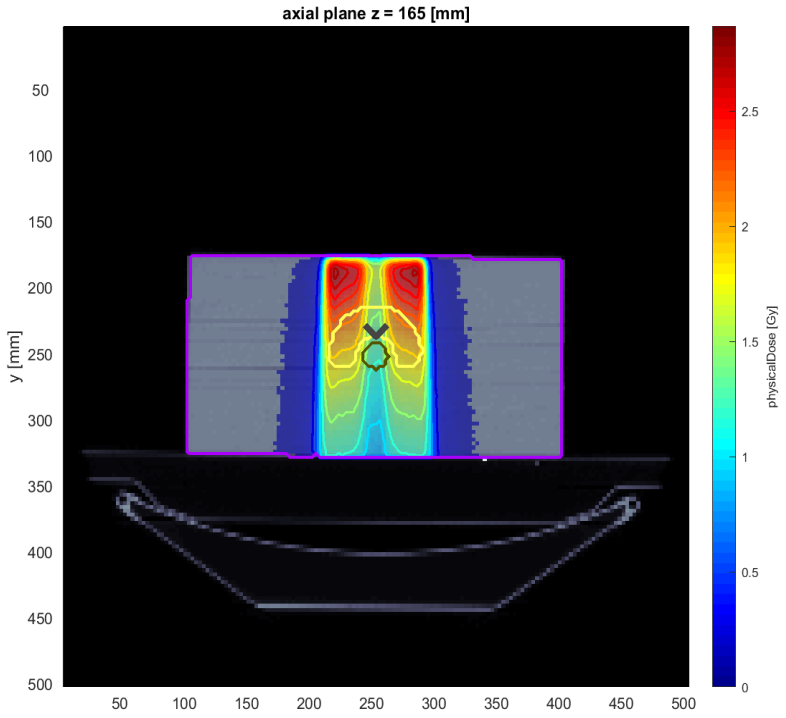


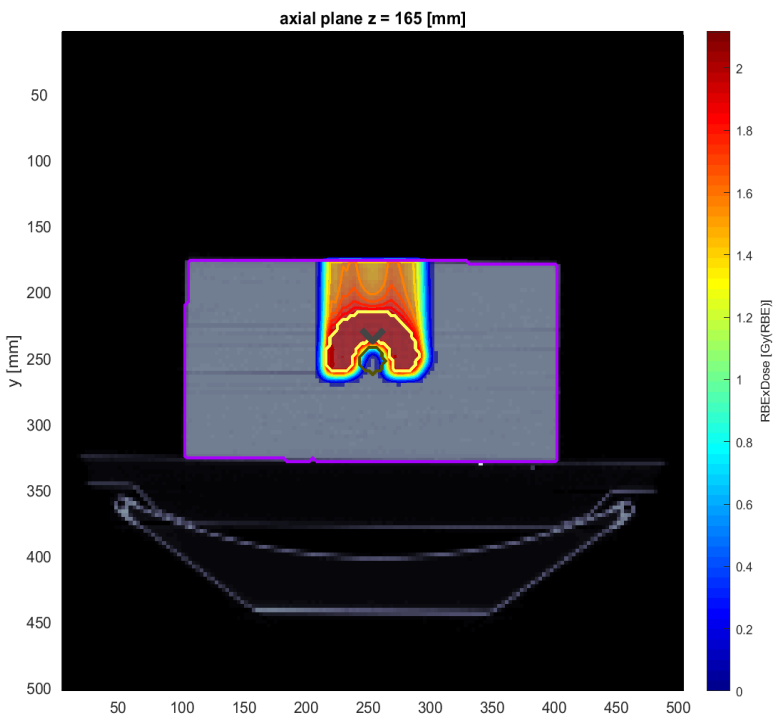

| | max | min | mean | std |
|---|---|---|---|---|
| Core | 1.3349 | 0.2372 | 1.0725 | 0.2146 |
| OuterTarget | 1.8801 | 1.0767 | 1.5918 | 0.1560 |
| BODY | 2.3556 | 0 | 0.1361 | 0.4030 |


matRadGUI
Workflow
Refresh
Load *.mat data
Calc. influence Mx
Optimize
Save to GUI
Load DICOM
Recalc
Export
Import from Binary
Import Dose
Status:
ready for dose calculation
matRad
dkfz.
GERMAN CANCER RESEARCH CENTER
IN THE HELMHOLTZ ASSOCIATION
Plan
bixel width in [mm]
5
Gantry Angle in °
0
Couch Angle in °
0
Radiation Mode
photons
Machine
Generic
IsoCenter in [mm]
265.8 296.7 316.4
Auto.
# Fractions
30
Type of optimization
none
Set Tissue
3D conformal
Run Sequencing
Stratification Levels
7
Run Direct Aperture Optimization
Objectives & constraints
+/-
VOI name
VOI type
OP
Function
p
Parameters
Skin
OAR
2
Squared Overdosing
300
d^max: 25
PTV
TARGET
1
Squared Deviation
1000
d^ref: 45
GTV
Visualization
Slice Selection
Beam Selection
Offset
Type of plot
intensity
GoTo
lateral
Plane Selection
axial
Open 3D-View
Display option
no option available
Show DVH/QI
plot CT
plot contour
plot isolines
plot dose
plot isolines labels
plot iso center
visualize plan / beams
Viewing
axial plane z = 317.5 [mm]
y [mm]
x [mm]
Hounsfield Units
min value: -1024
max value: 1886.45
Set IsoDose Levels
Viewer Options
CT (HU)
Window Preset
Custom
Window Center:
431
Window Width:
2.91e+
Range:
-1024
1886
bone
Lock Settings
Dose opacity:
Structure Visibilty
GTV
Kidney_R
Kidney_L
Stomach
SmallBowel
LargeBowel
Celiac
SMA_SMV
Liver
Heart
SpinalCord
DoseFalloff
duodenum
CTV
Skin
PTV
cord+5mm
clip1
clip2
Info
v2.10.1 "Blaise"
www.matRad.org
About

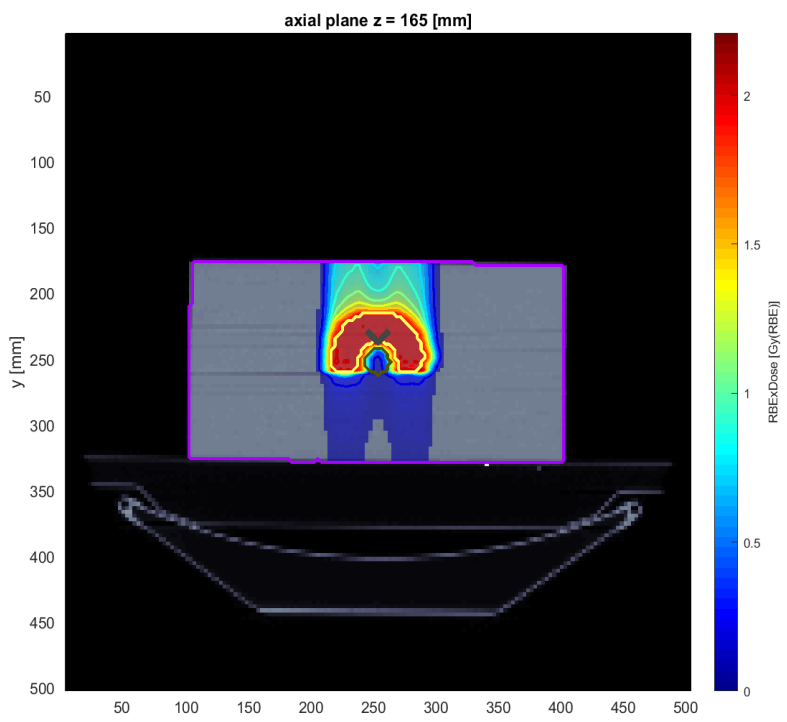
# Treatment Plan Single Beam




Photons

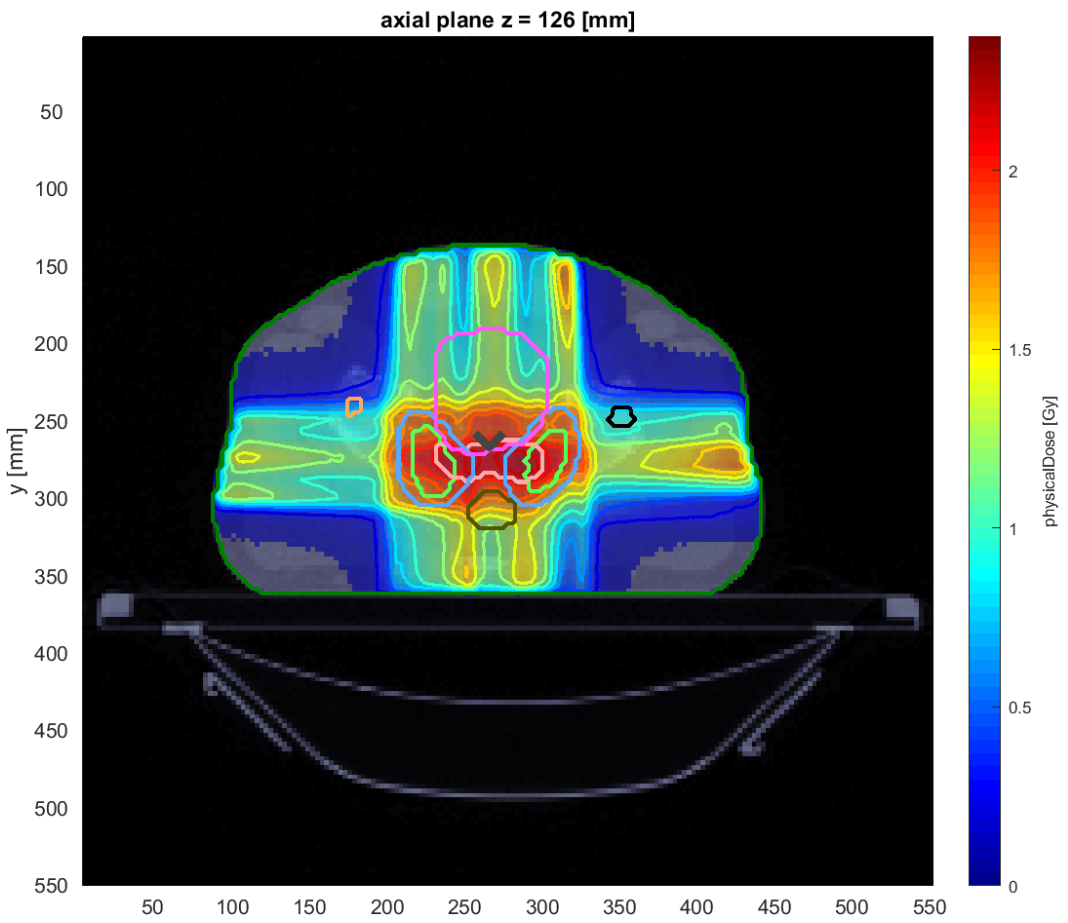



Protons

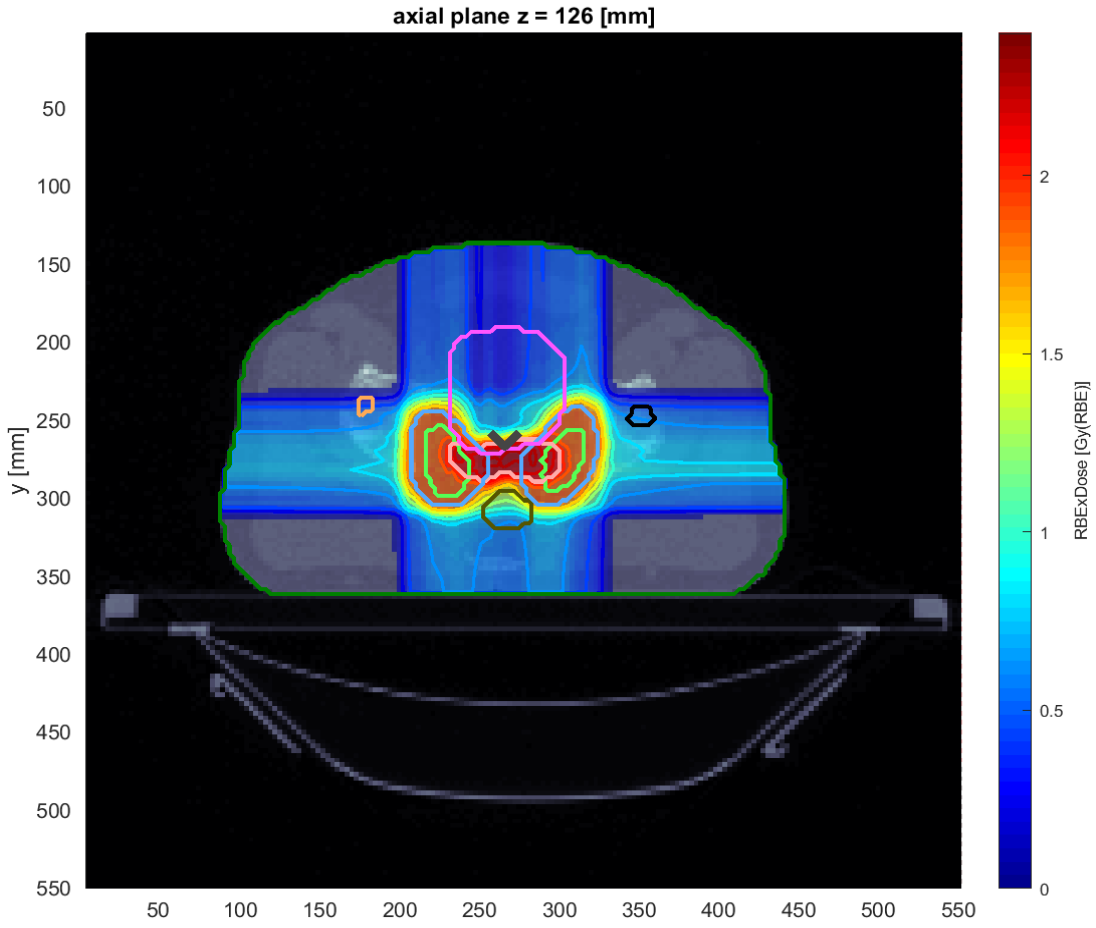



Carbon Ions

# Treatment Plan : Multi-Beam

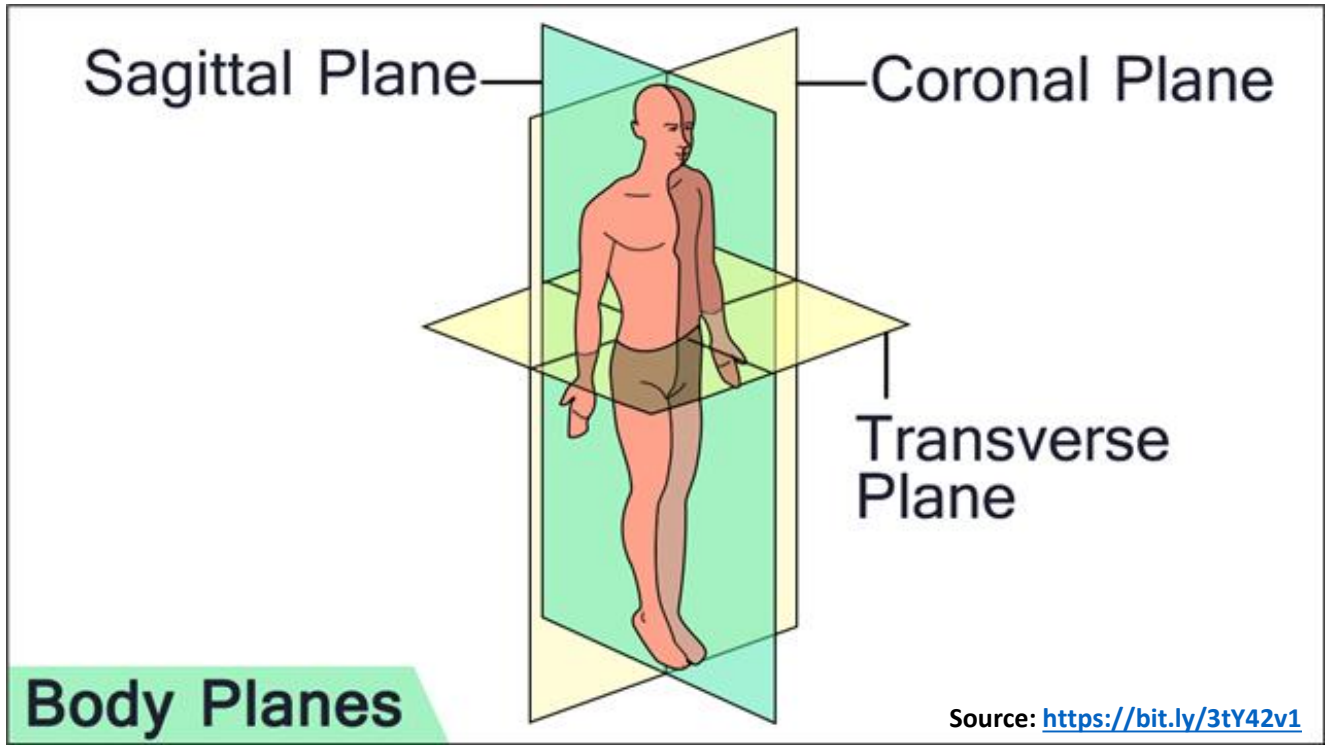



Photons



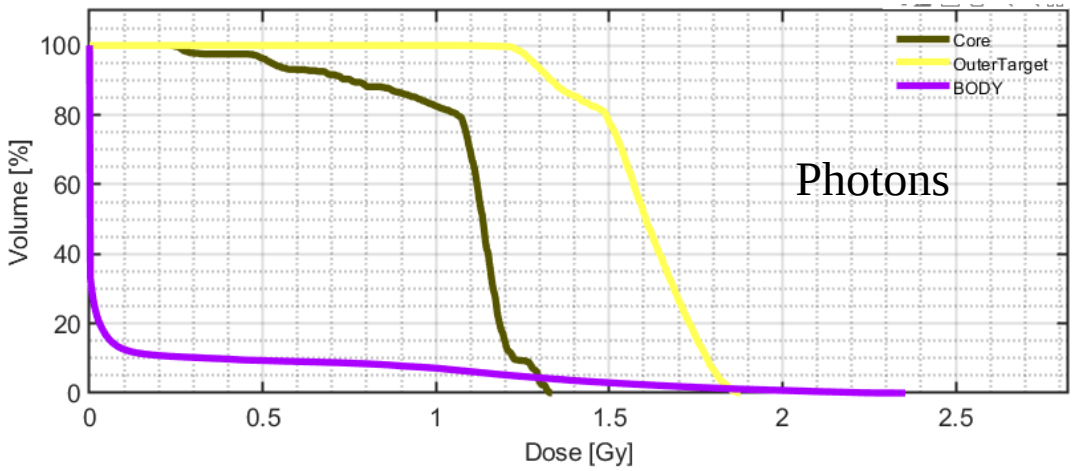

Protons

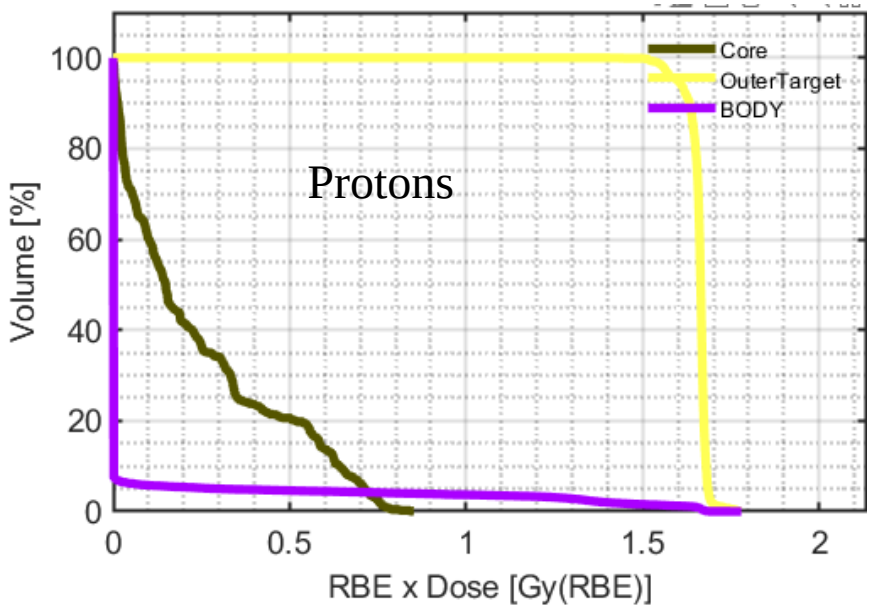
# Planes in visualization

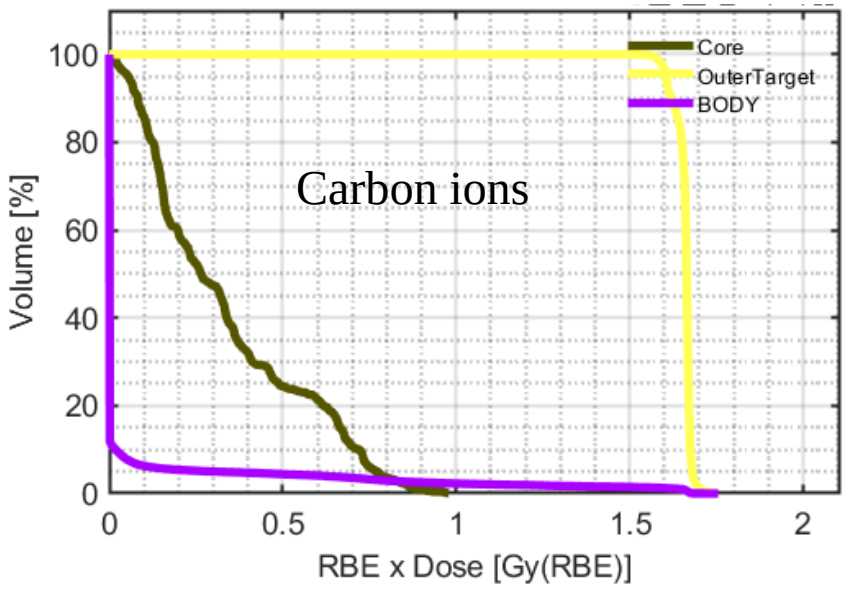



- **Sagittal plane:** It separates the body equally in left and right parts.
- **Coronal plane:** It separates the body into two parts, anterior (front) and posterior (back).
- **Transverse/Axial/Horizontal plane:** It separates the body at the upper and bottom parts.

# Dose Volume Histogram (DVH) comparison




| Photons | max | min | mean | std |
|---|---|---|---|---|
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| OuterTarget | 1.8801 | 1.0767 | 1.5918 | 0.1560 |
| BODY | 2.3556 | 0 | 0.1361 | 0.4030 |

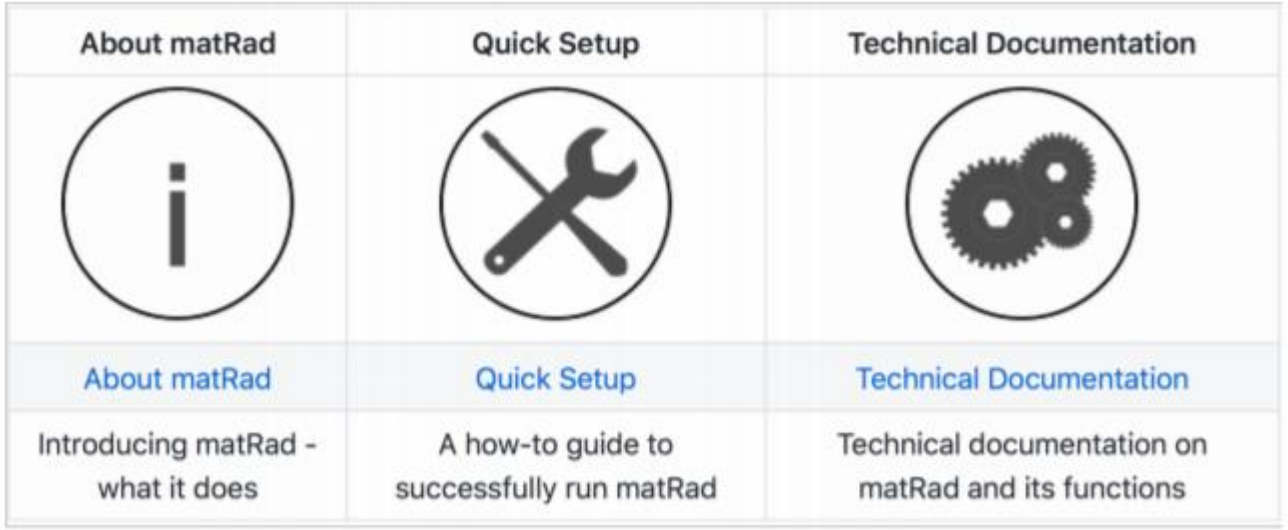
| Protons | max | min | mean | std |
|---|---|---|---|---|
| Core | 0.8525 | 1.1241e-09 | 0.2402 | 0.2380 |
| OuterTarget | 1.7802 | 1.4057 | 1.6581 | 0.0300 |
| BODY | 1.7802 | 0 | 0.0638 | 0.2840 |

| 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 |

# 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

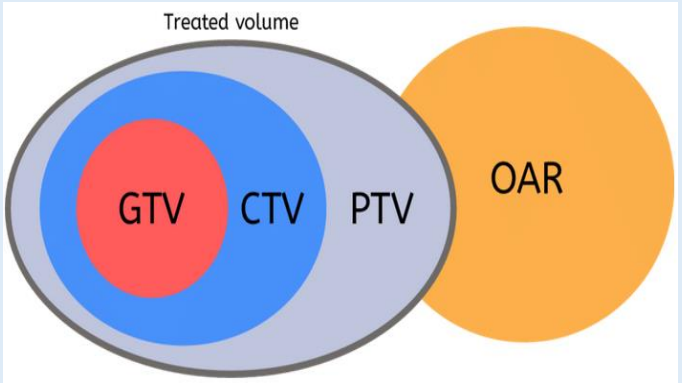
- **GTV** (Gross Tumor Volume) includes the total tumor as evidenced by imaging methods.

- **CTV** (Clinical Target Volume) includes the GTV and some microscopic extension that are not visible in the imaging.

- **PTV** (Planning Target Volume) includes the CTV with an internal margin (IM) and an additional margins related to patient setup uncertainties, patient movement and placement error etc.

- **OAR** (Organs At Risk): Organs that are more sensitive compared to healthy tissue surrounding/near the tumor volume. They need to be saved from the radiation.

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




Target Volume and Organ At Risk