Ministero dell'Università e della Ricerca

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PIANO NAZIONALE DI RIPRESA E RESILIENZA

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Piano nazionale per gli investimenti complementari al PNRR
Ministero dell'Università e della Ricerca

Anthem
AdvaNced Technologies for Human-centEred Medicine

MIGHT

INFN
Istituto Nazionale di Fisica Nucleare

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AdvaNced Technologies for Human-centEred Medicine

14th October 2024

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Artificial Intelligence for BNCT: current applications and future prospects

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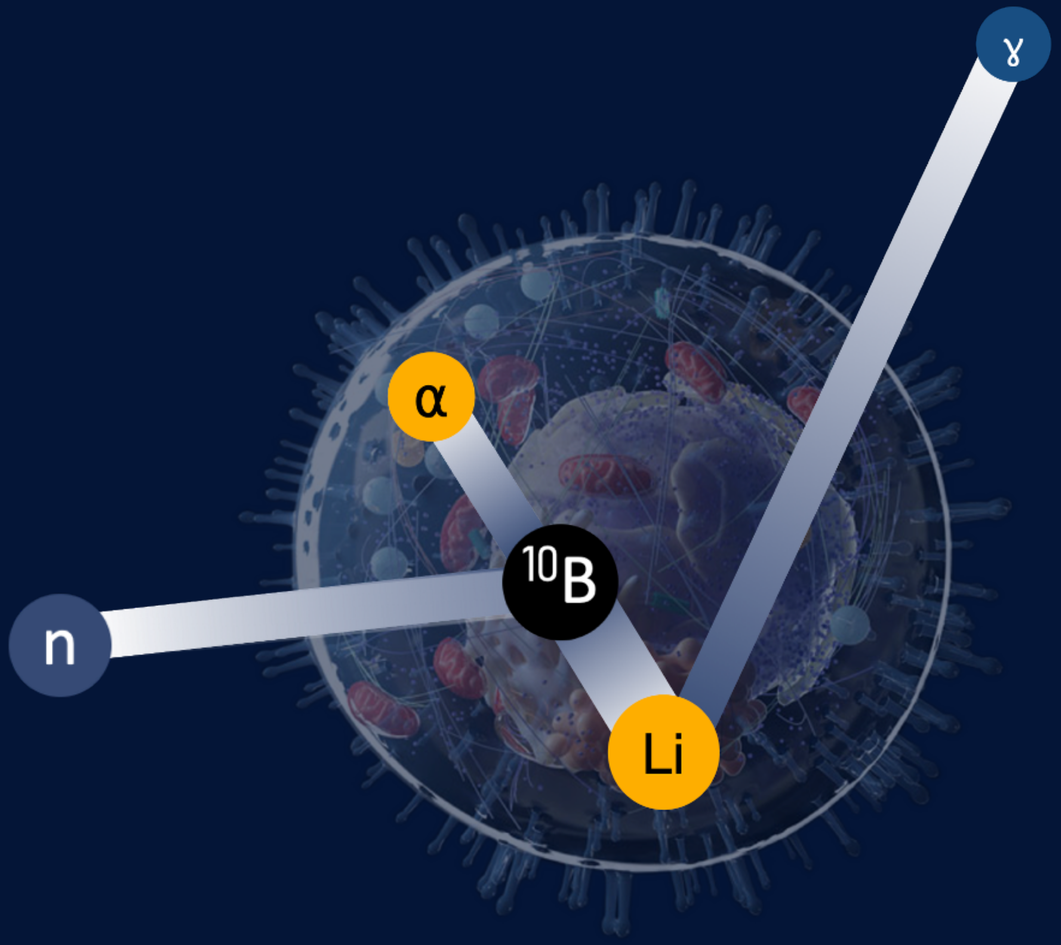
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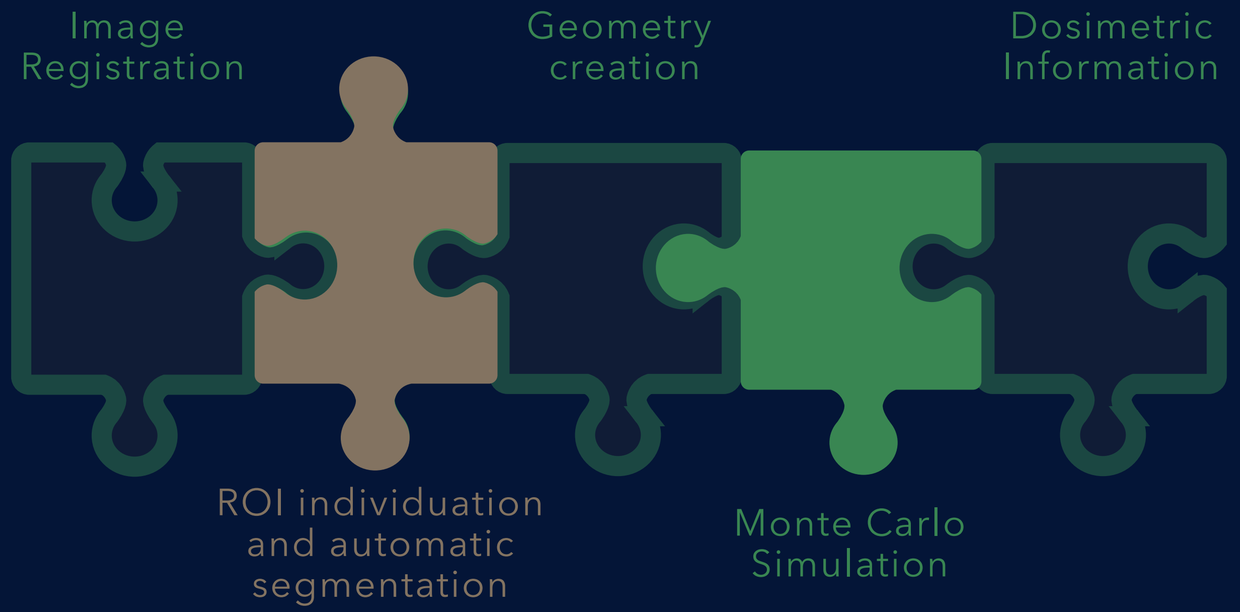
AI_MIGHT PROJECT



RESEARCH:
FAST TOOL TO CREATE A DATABASE FOR TPS IMPROVEMENT

CLINICAL:
SPEED UP & AID PHYSICIANS TO SEGMENT ROIS

IMAGE DATABASE

The Cancer Imaging Archive

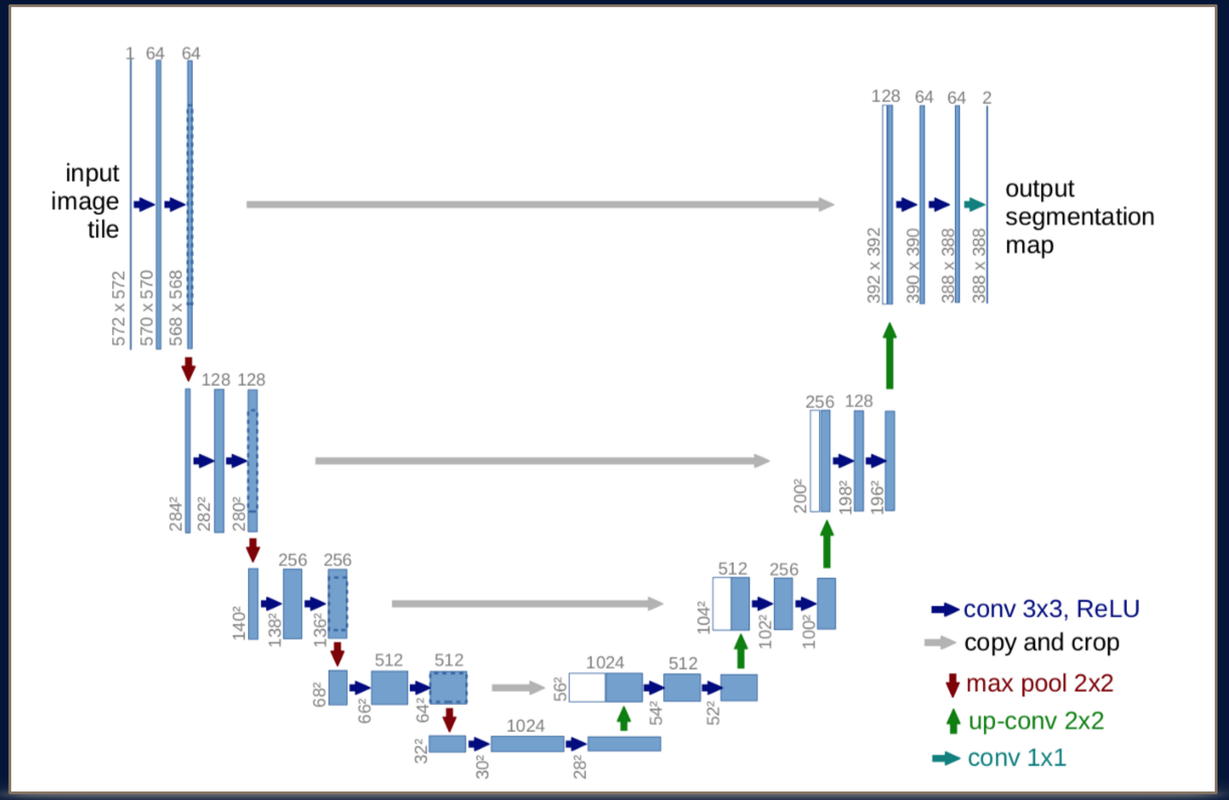
	GBM	H&N
CT	230	1934
MRI	$>10^3$	171

We chose the images with a corresponding RTSTRUCT

Francesco Morosato - Master Thesis @ UNIPV
16 December 2022

DEEP LEARNING MODEL

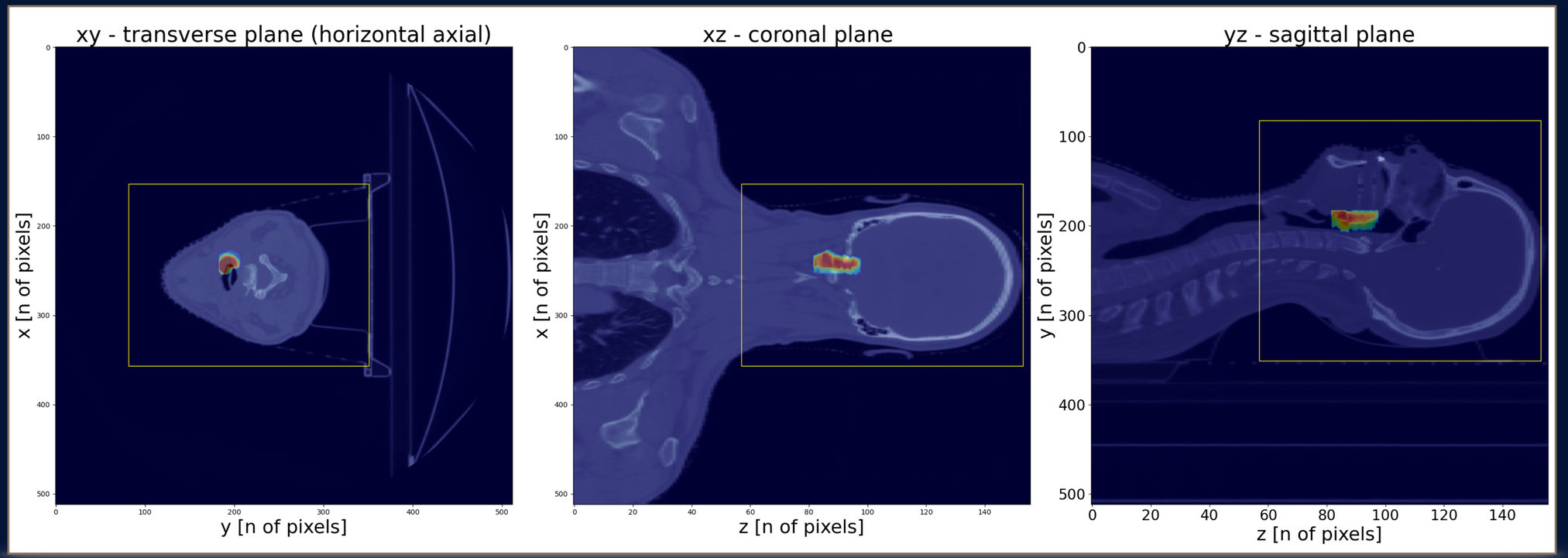
nnUNet



Isensee, F., Jaeger, P. F., Kohl, S. A., Petersen, J., & Maier-Hein, K. H. (2021). nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. Nature methods, 18(2), 203-211.

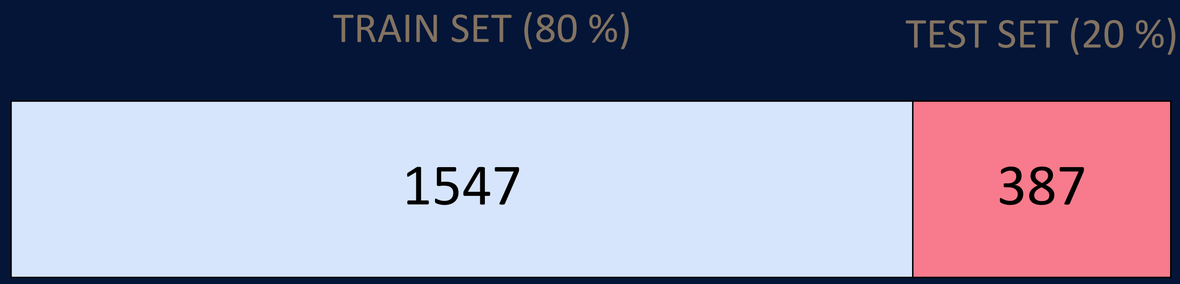
IMAGE PREPROCESSING

Bounding Box Algorithm

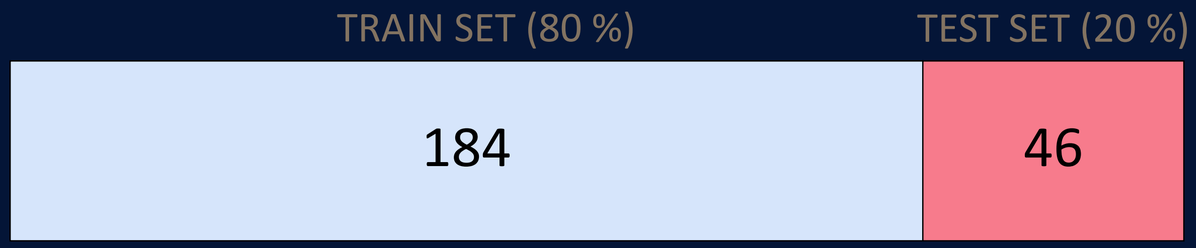


TRAINING & TESTING

HEAD & NECK

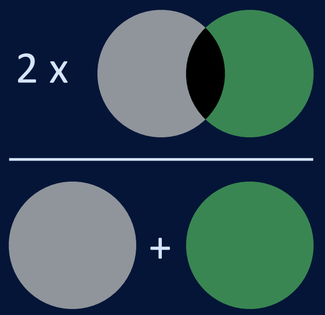


GLIOBLASTOMA MULTIFORME



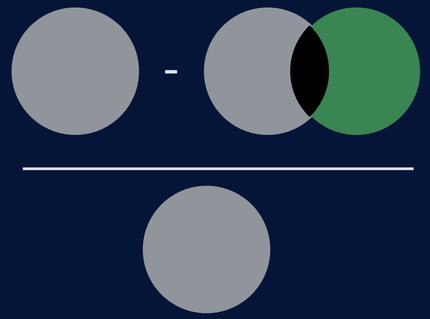
EVALUATION COEFFICIENTS

Dice Coefficient(Dc)



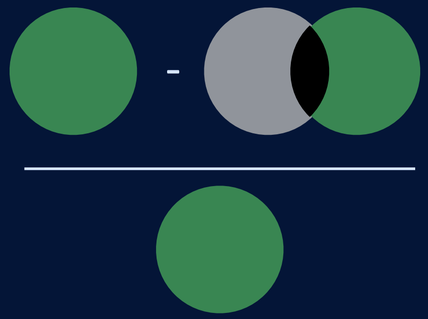
Volumes resemblance
(Best case DC =1)

Discordance Index (DI)



Fraction of the detected volume that is not part of the GT
(best case DI =0)

Geometrical Miss Index (GMI)



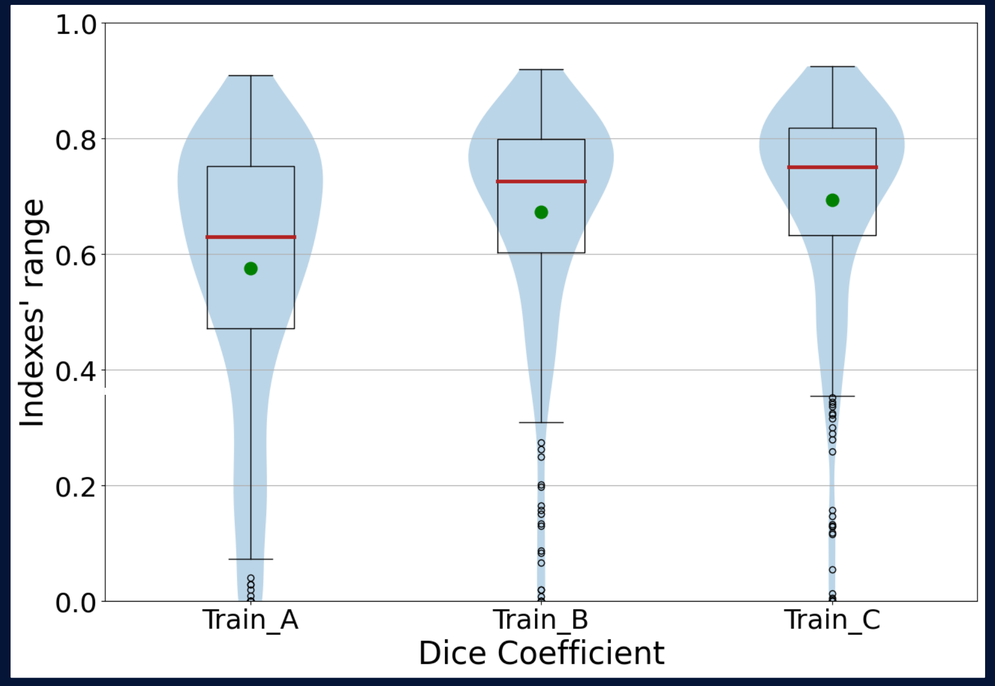
Fraction of the GT volume that was not predicted
(Best case GMI =0)

Predicted Volume

Ground Truth

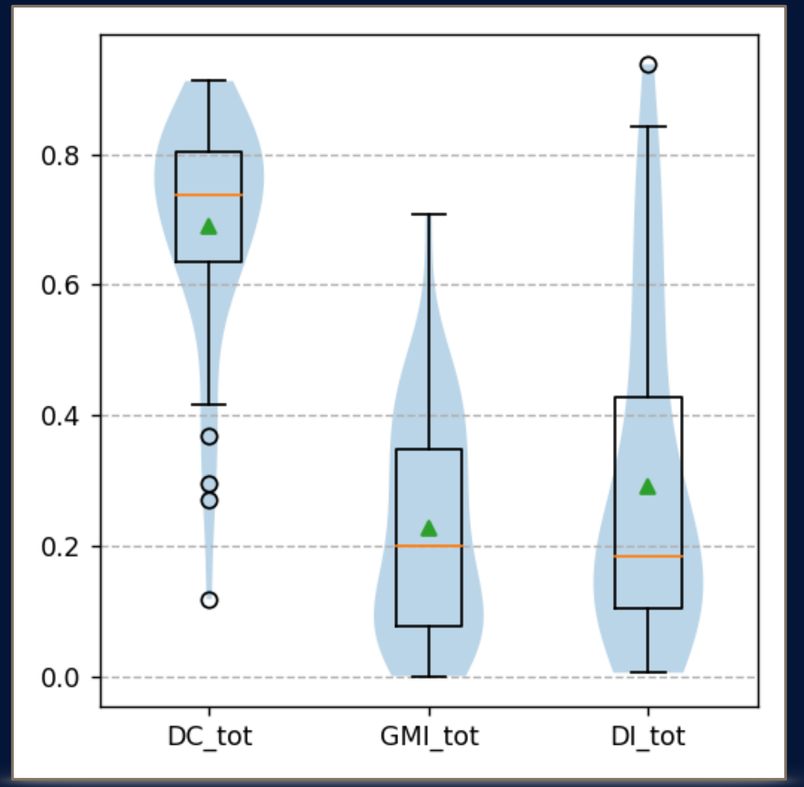
COEFFICIENTS RESULTS

HEAD & NECK



Train ID	Mean	Median	Low Median	High Median
Train_A	0.58 ± 0.23	0.63	0.47	0.75
Train_B	0.67 ± 0.19	0.73	0.60	0.80
Train_C	0.70 ± 0.19	0.75	0.63	0.82

GLIOBLASTOMA MULTIFORME



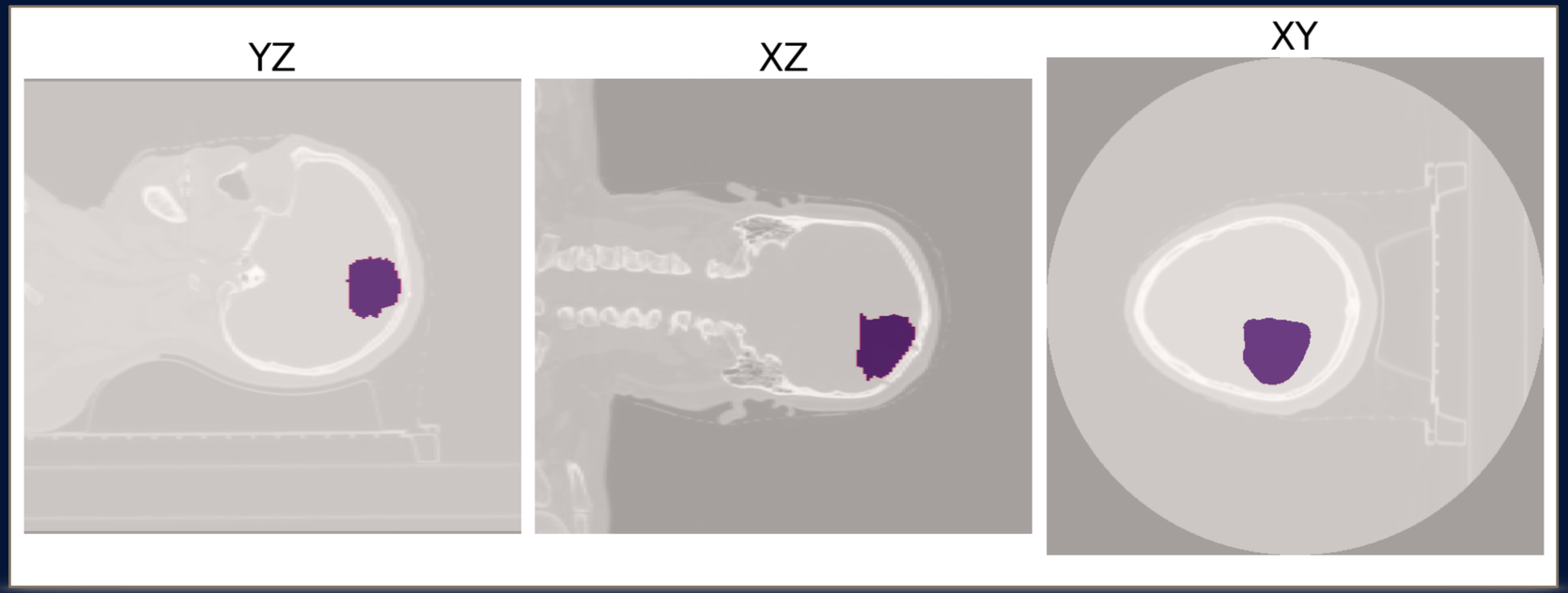
TREATMENT PLANNING SYSTEM

INPUT:
SEGMENTED ROIS

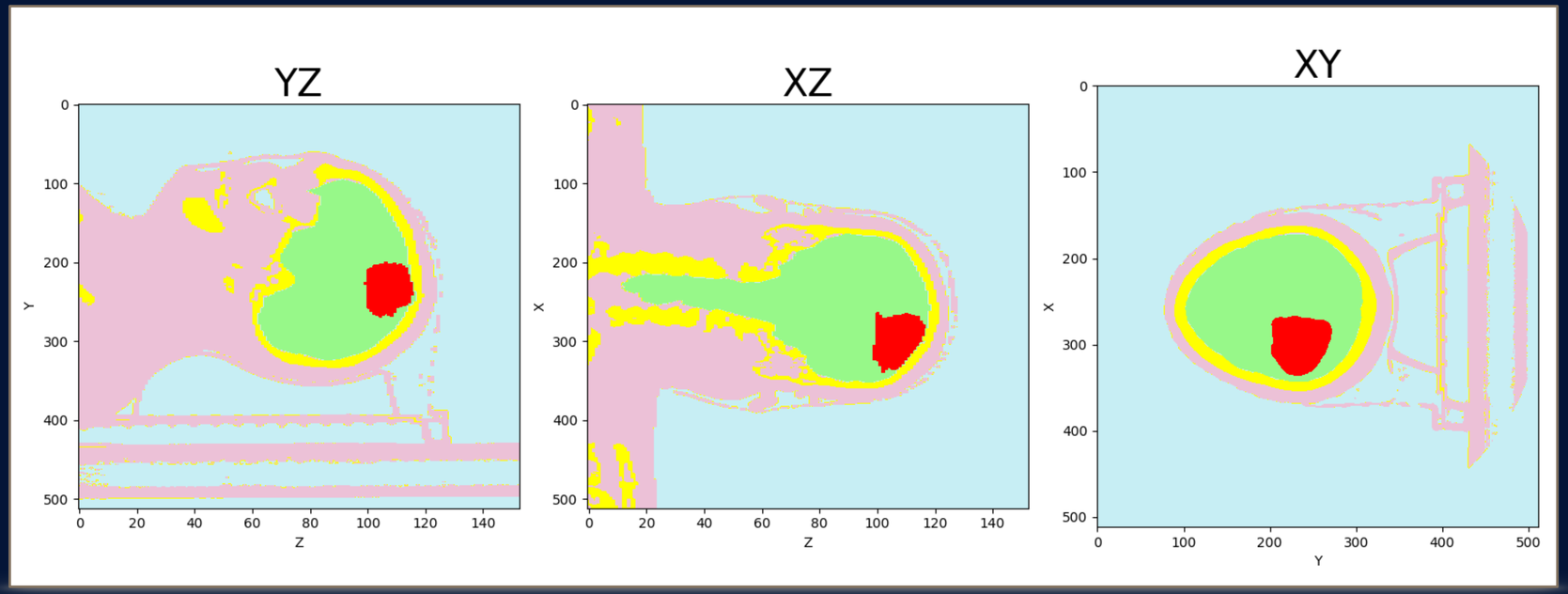
OUTPUT:
DOSIMETRIC CALCULATION

GLIOBLASTOMA MULTIFORME

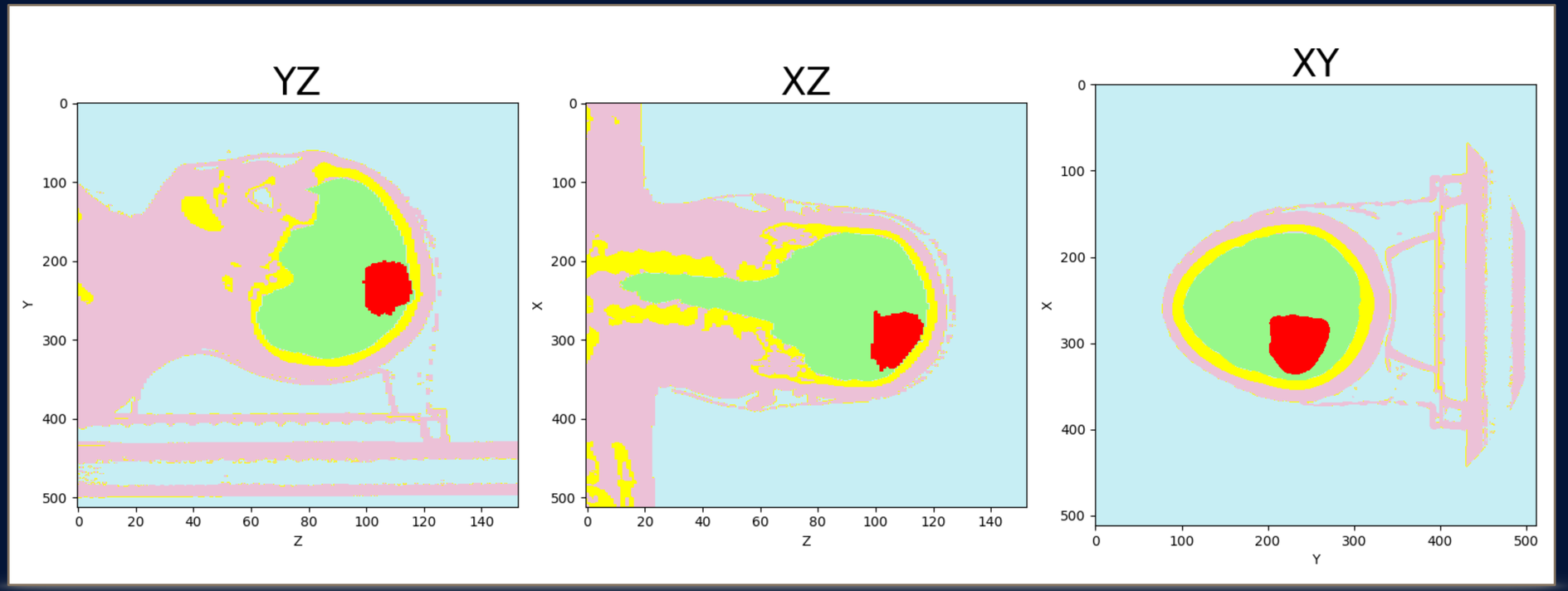
CT+GTV



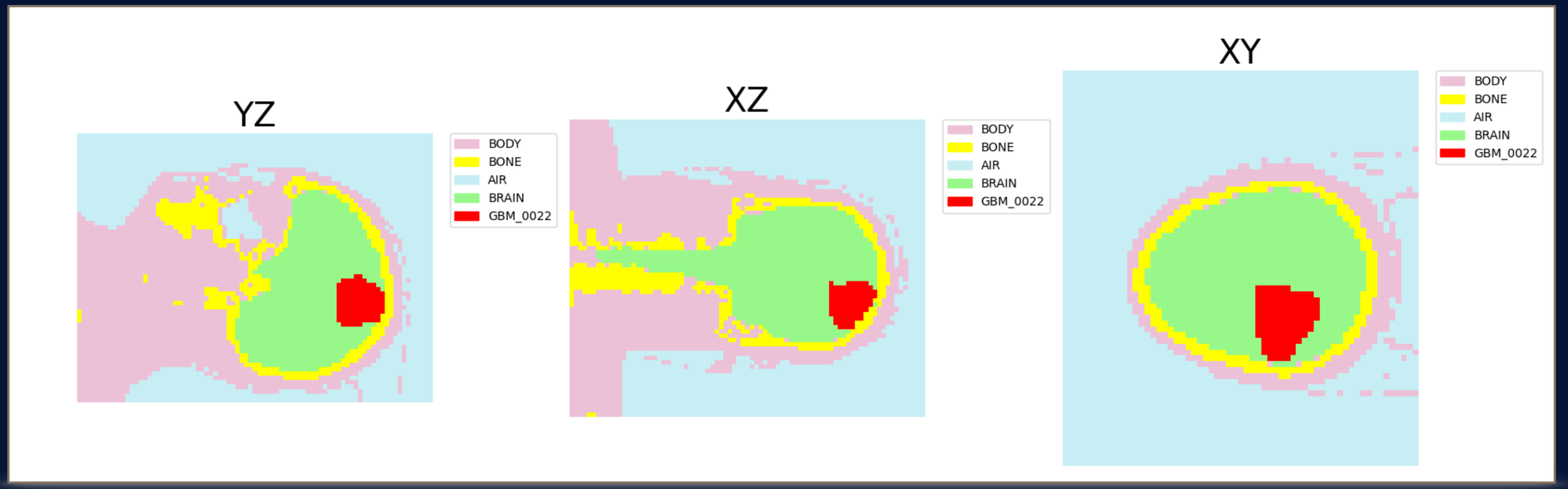
BODY+GTV+OAR

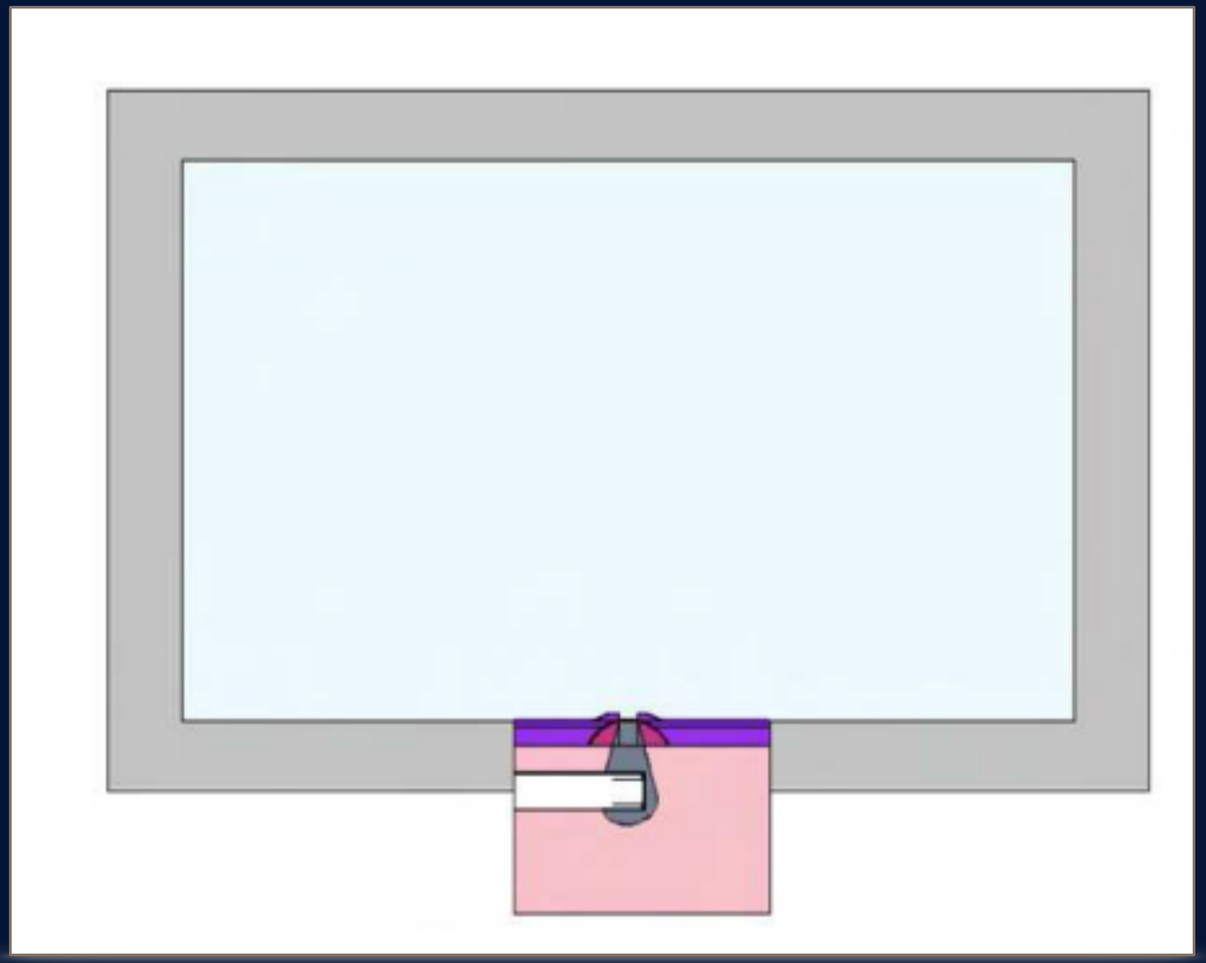


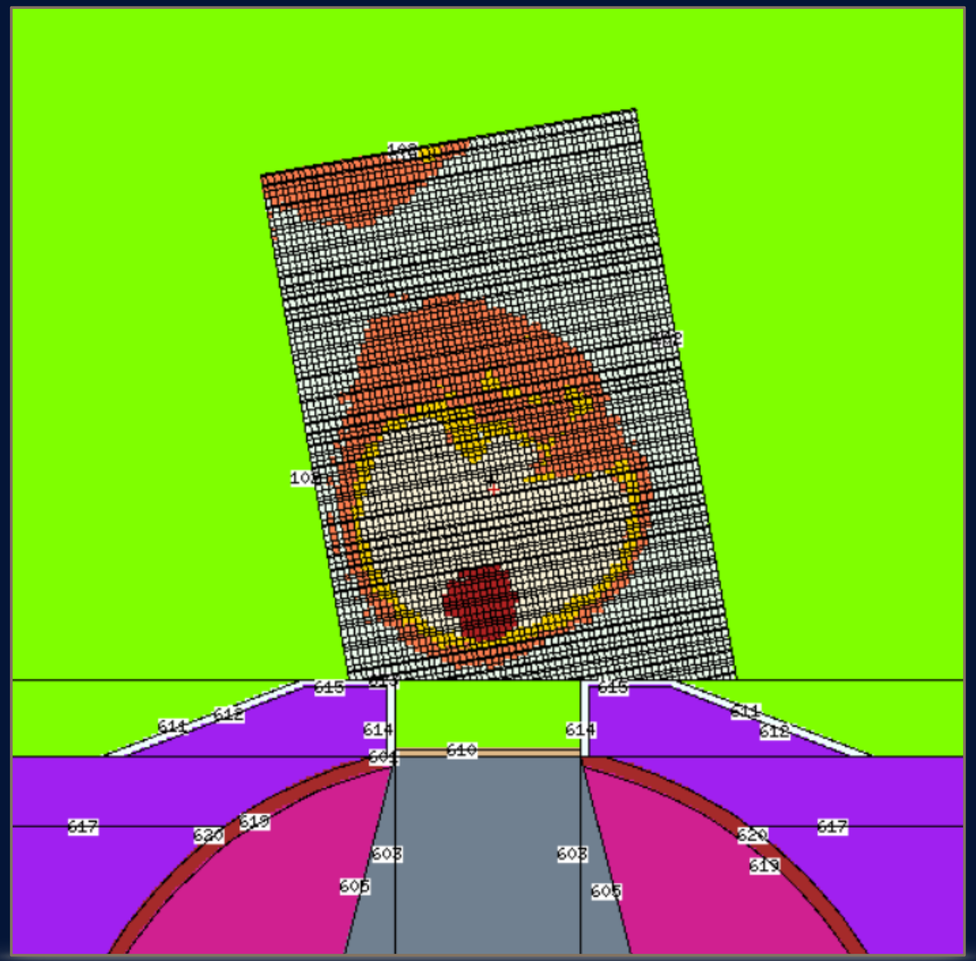
CT + GTV + OAR



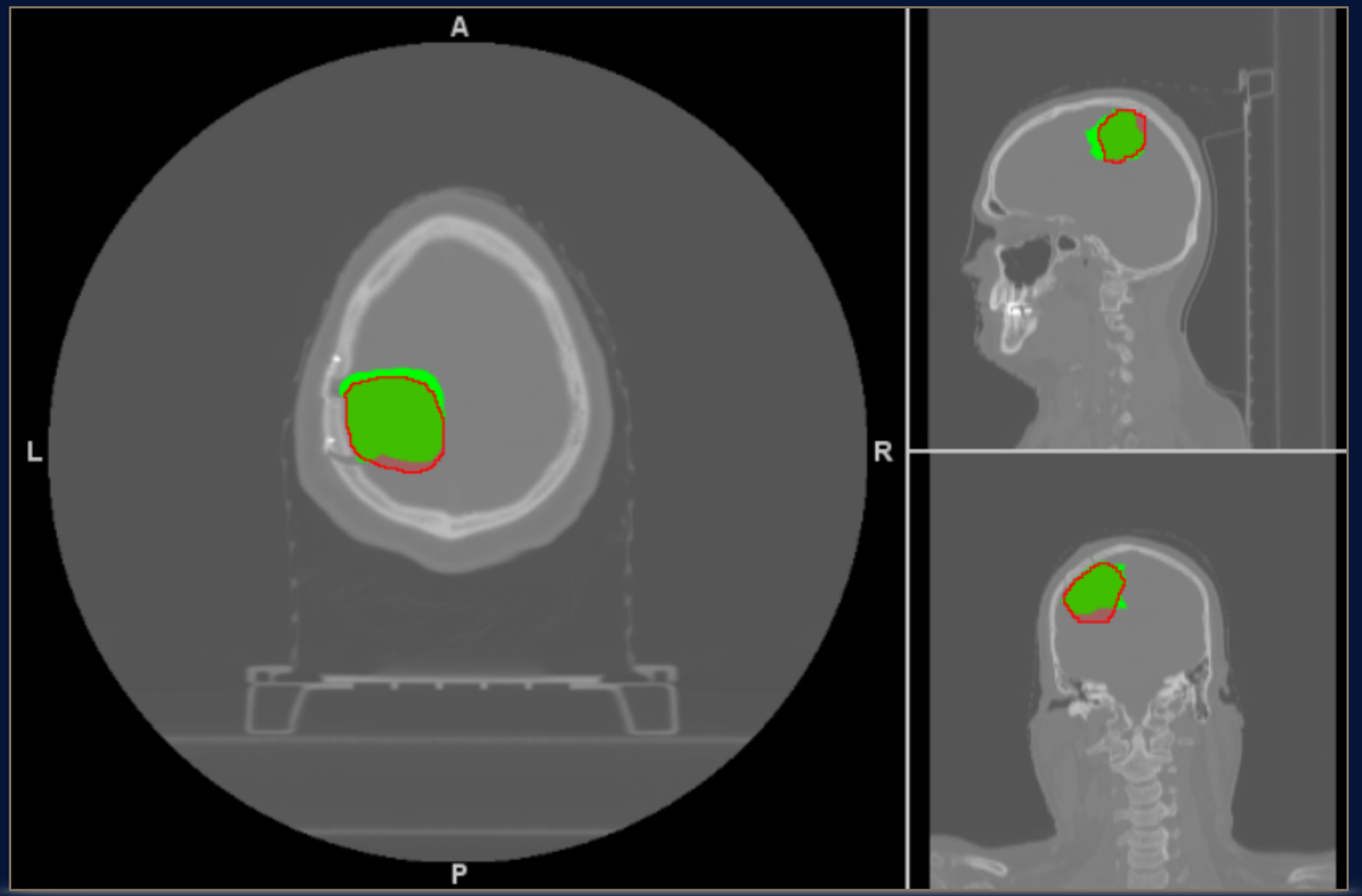
MCNP Voxelized Geometry







18 cases of GBM tumours studied with the TPS

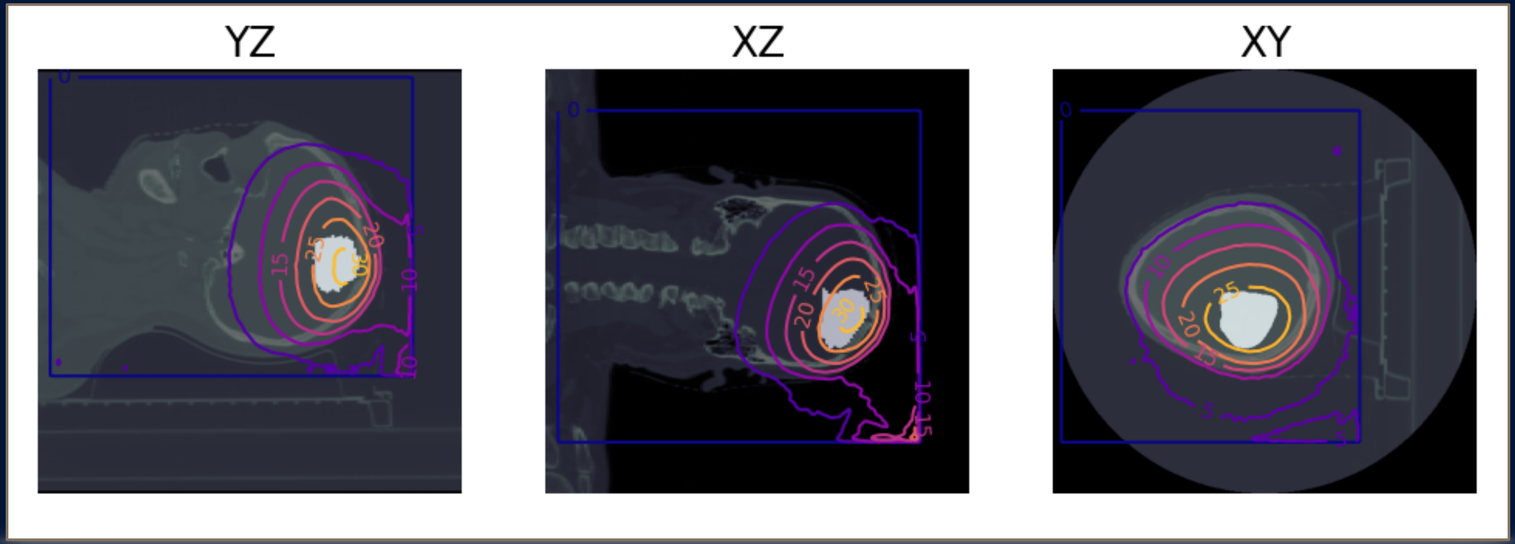


DC=0.82
GMI=0.198,
DI=0.152

Ground Truth

Predicted Volume

ISODOSE CURVES GROUND TRUTH

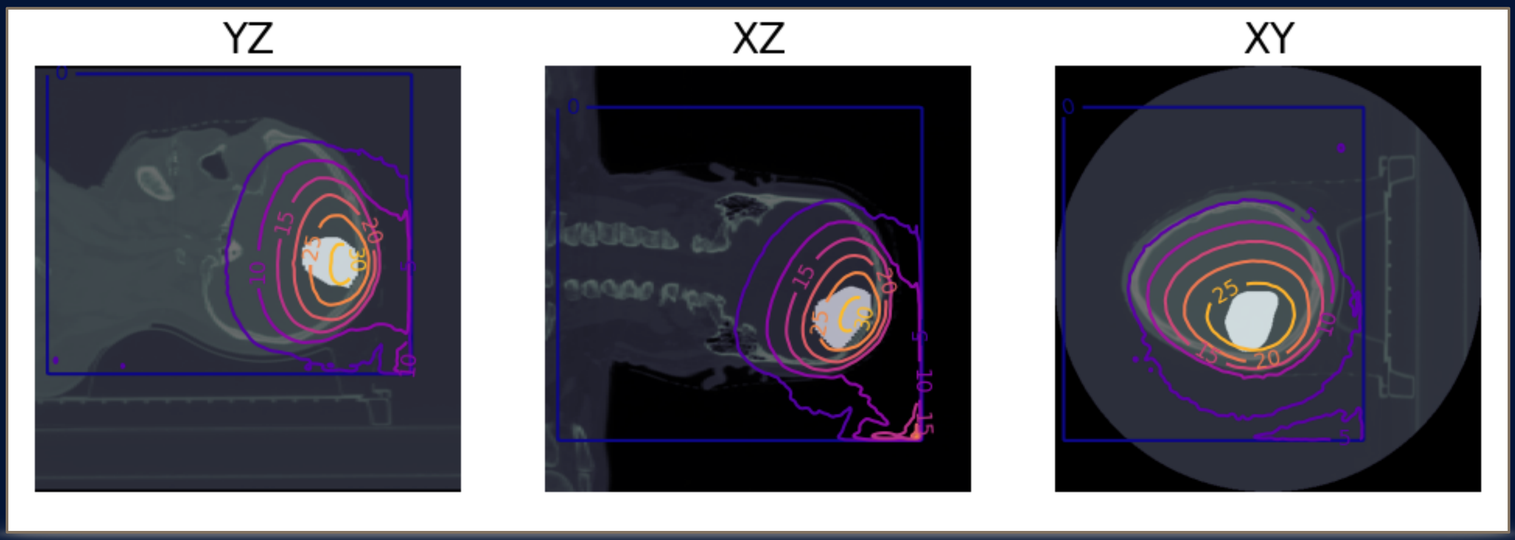


Isoeffective dose model

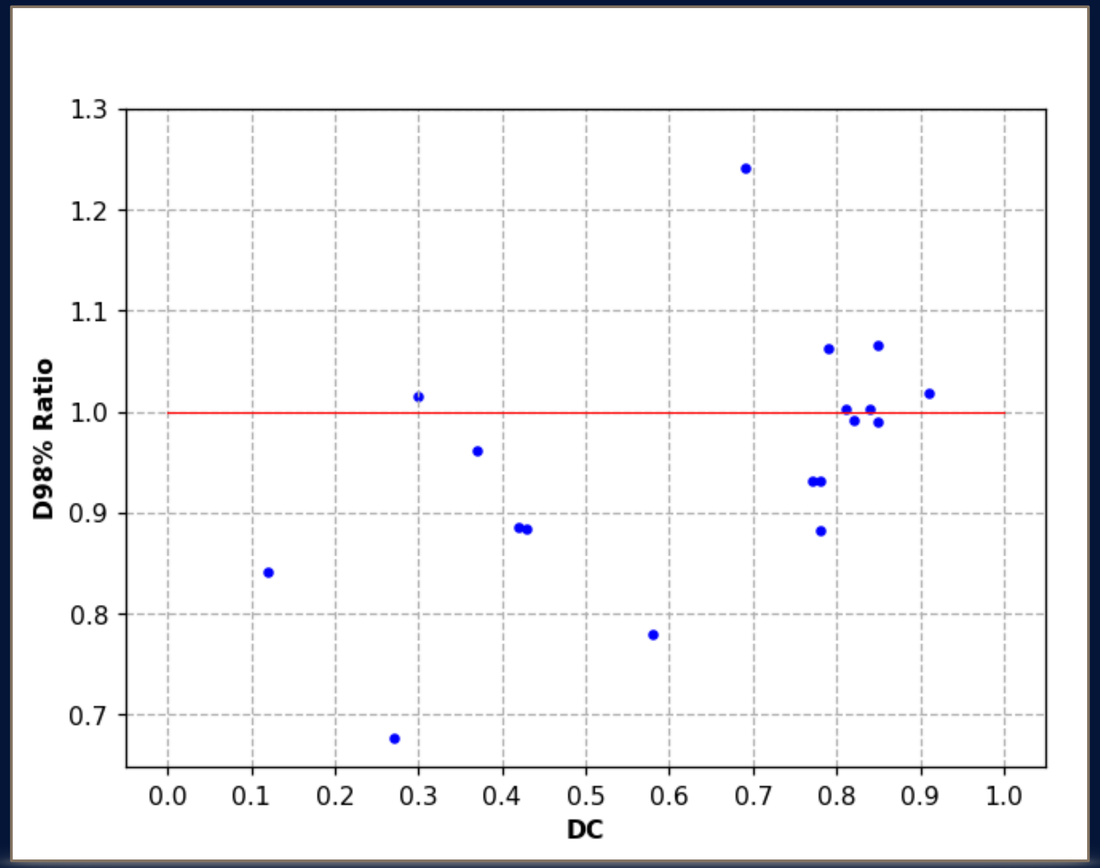
González, S.J. and Cruz, G.A.S., 2012. The photon-isoeffective dose in boron neutron capture therapy. Radiation research, 178(6), pp.609-621.

	Manual Segmentation	AI Segmentation
Minimum Dose [Gy]	23.33	23.12
Mean Dose [Gy]	28.03	28.39
Maximum Dose [Gy]	30.74	31.10

ISODOSE CURVES NN_SEGMENTATION



18 cases of GBM tumours studied with the TPS



Ongoing: evaluation of the TCP as a figure of merit to compare the results of the dosimetric calculations on the “True” segmentation and on the NN segmentation

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In synergy with PNC_PNRR_ANTHEM:

we opened a collaboration with Università della Campania Luigi Vanvitelli Radiation Oncology Department

we are focusing on AI for the optimisation of the moderation system and for boron imaging

we are studying AI for image reconstruction for a real time imaging during treatment

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