Particle therapy Masterclass
INFN-CS group report

22 girls and 18 boys from the following high schools in Calabria and Basilicata:

Liceo Scientifico " Pitagora" Rende
Liceo Scientifico “G. Berto” VIbo Valentia
Liceo Scientifico “A. Volta” - Reggio Calabria
IIS IPSIA-ITI Acri
IIS " Lucrezia della Valle " Cosenza
Liceo Scientifico “Pietro Metastasio” - Scalea
Liceo statale “G. Galilei” – Paola
I.I.S “Ferrari” - Chiaravalle Centrale
IIS "Giovanni Paolo II" Maratea
Liceo Scientifico Filolao Crotone
Liceo Scientifico - Strongoli
Liceo Scientifico ”E. Fermi” Cosenza
Liceo Scientifico “Scorza" Cosenza
I.I.S. “L. Costanzo” - Decollatura
IISS di Amantea
Liceo Scientifico - “De Sarlo” – Lagonegro

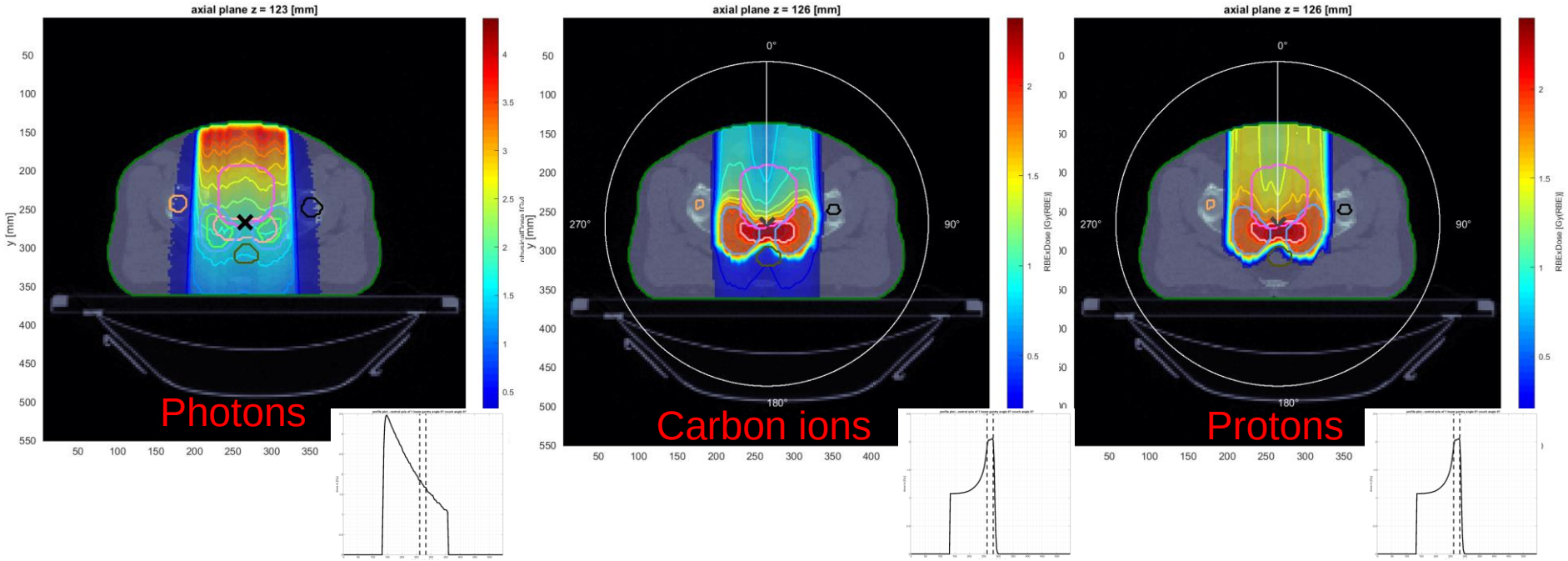
Hands-on session

20 groups of students to compare the different properties of the external beams of particles (photons, protons and carbon ions) and to evaluate how to optimize the maximum dose on cancer by protecting organs at risk.

This is the summary of our studies/observations.

COMPARISON BETWEEN PHOTON, PROTON AND ION BEAMS FOR PROSTATE (SAME ANGLE)

Objective: compare the various interaction-matter effects in relation to beam quality



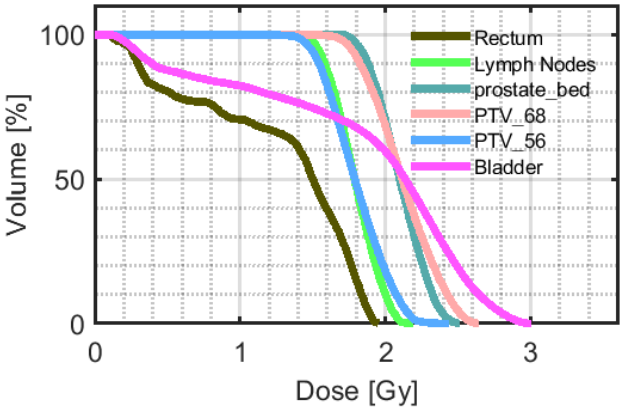
Observations:

OAR are better protected with a proton beam

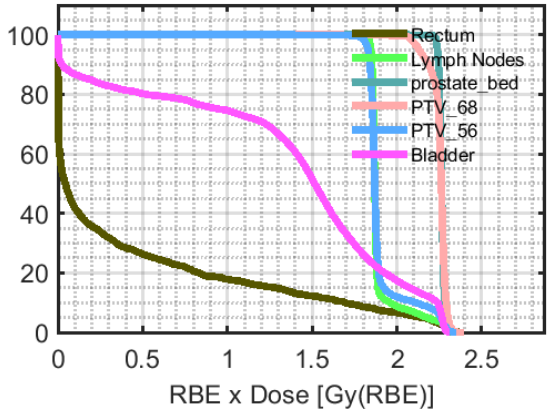
It is important to clearly define an OAR

PROSTATE DVH COMPARISON AT 0°

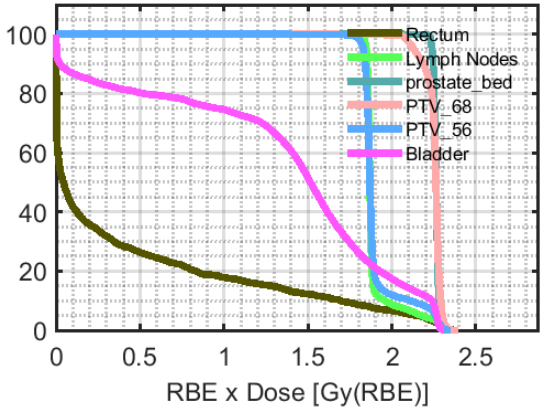
we focus on an important OAR: the rectum (dark green line)



Photons



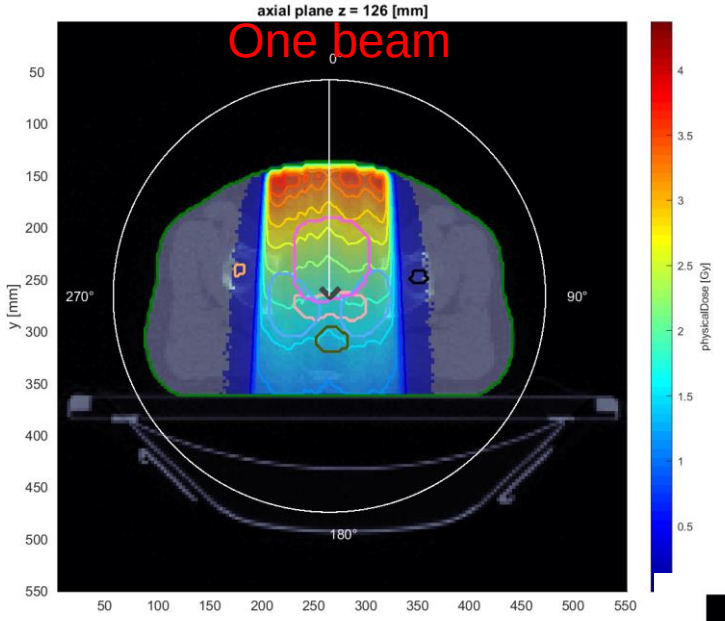
Protons

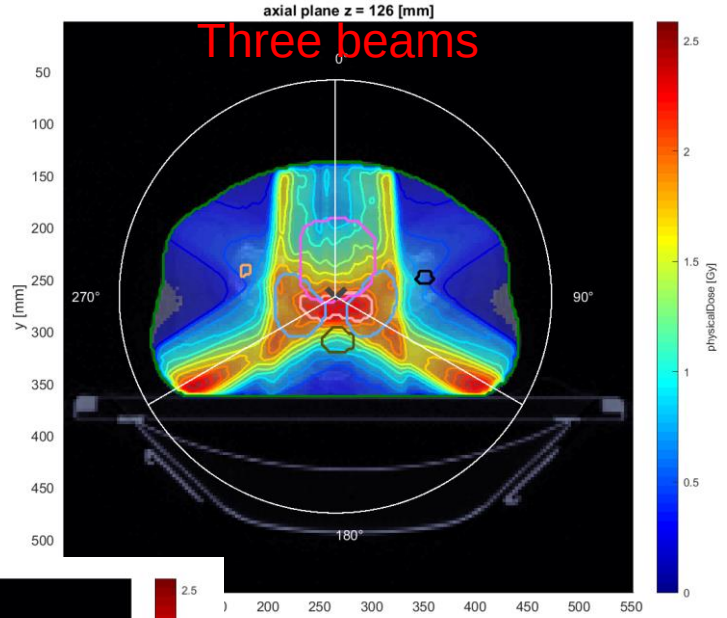


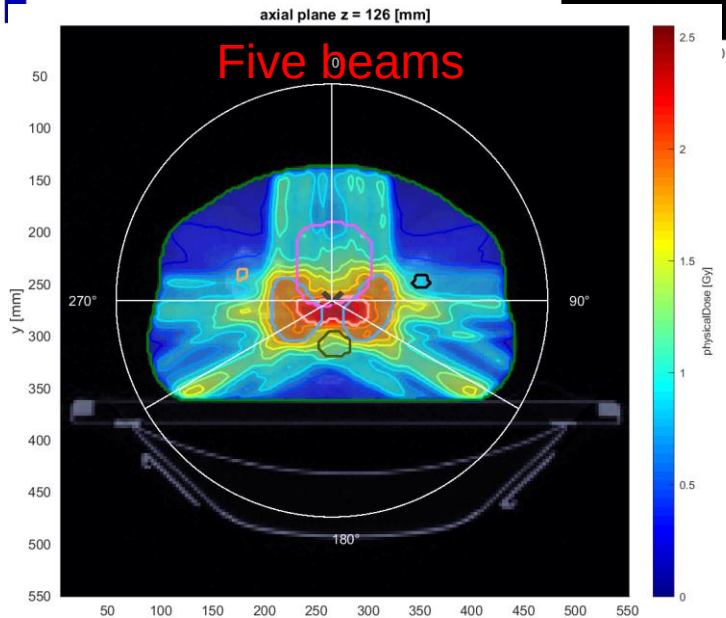
Carbon ions

It is clearly visible from the DVH plots that we have a better treatment plan with protons or carbon ions.
Should we avoid photon treatment?

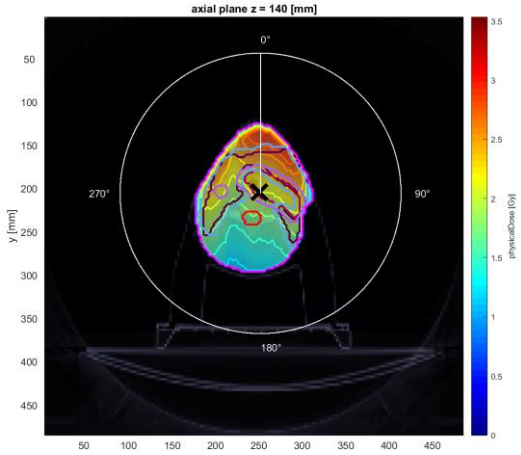
NO, A BETTER RESULT WITH PHOTONS CAN BE OBTAINED USING MULTIPLE BEAMS AND CHOOSING THE BEST ANGULAR DISTRIBUTION

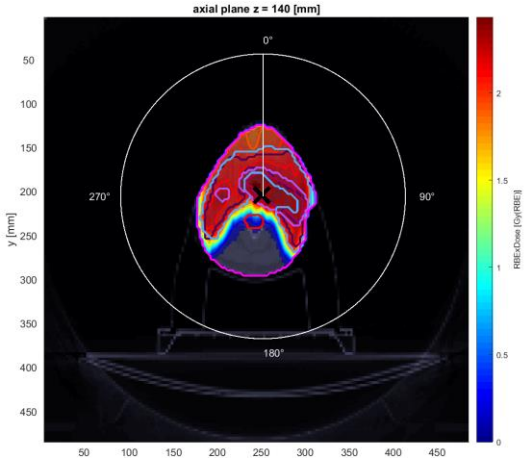






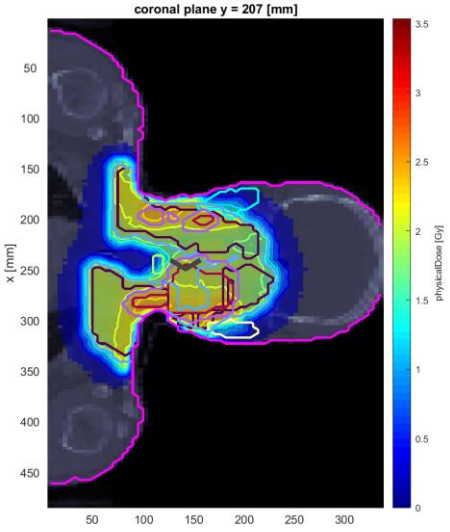
COMPARISON PHOTONS-PROTONS IN THE CASE OF HEAD CANCER

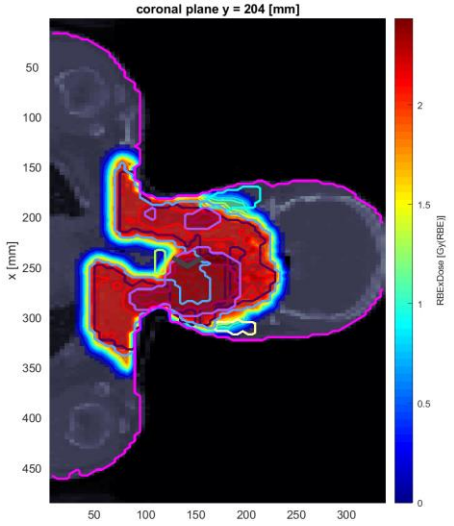




Protons

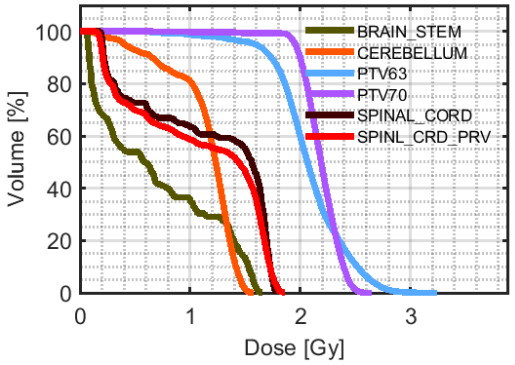
Photons





In the head there are various OAR, it may be useful to use multiple beams (even in the case of protons)

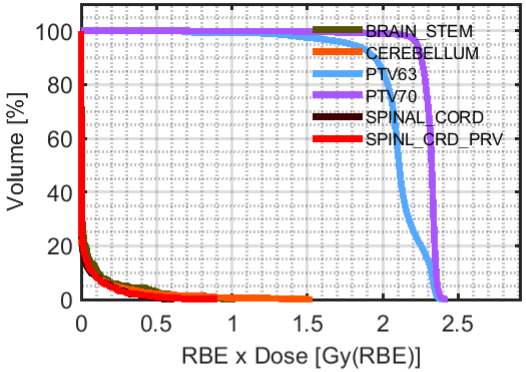
COMPARISON PHOTONS-PROTONS IN THE CASE OF HEAD CANCER



Photons

Spinal cord mean dose 1,16 RBExGy and max 1,8

	max	min	mean
BRAIN_STEM	1.6605	0.0535	0.6994
CEREBELLUM	1.5759	0.0944	1.1413
PTV63	3.2433	0.3398	2.0817
PTV70	2.6477	0.6653	2.1895
SPINAL_CORD	1.7876	0.1857	1.1643
SPINL_CRD_PRV	1.8630	0.1460	1.0938



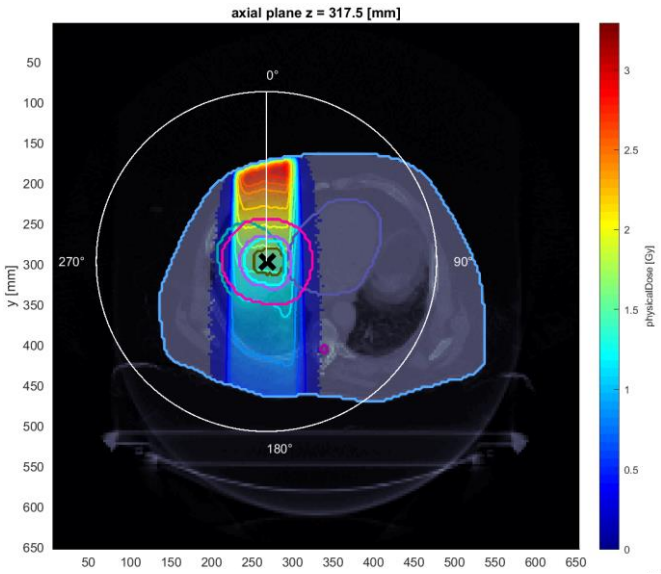
Protons

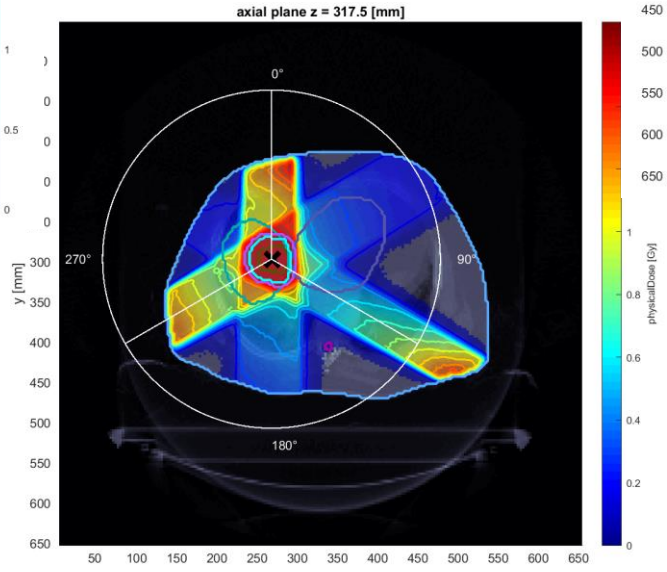
Spinal cord mean dose 0,03 RBExGy and max 0,6

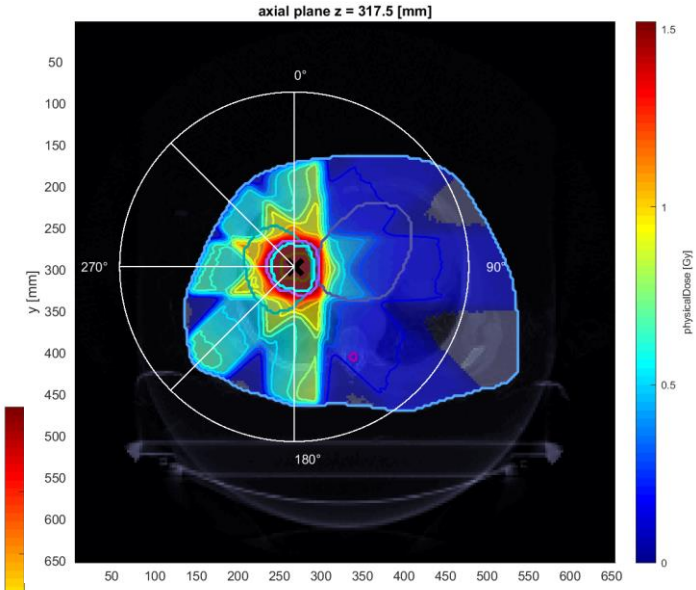
	max	min	mean
BRAIN_STEM	1.0273	0	0.0458
CEREBELLUM	1.5369	0	0.0380
PTV63	2.4316	0.3396	2.1005
PTV70	2.4316	0.7272	2.3077
SPINAL_CORD	0.6174	0	0.0263
SPINL_CRD_PRV	0.9056	0	0.0286

It is not easy to plan a treatment to the head, despite the high symmetry among important organs

LIVER TP: COMPARISON BETWEEN SINGLE PHOTON BEAM AND MULTIPLE PHOTON BEAMS (0,180,225,270,315) AND (0,120,240)

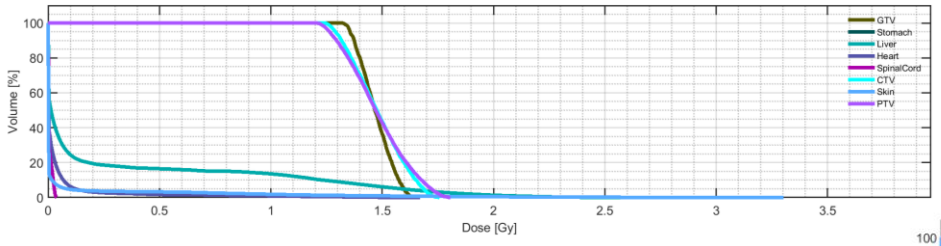






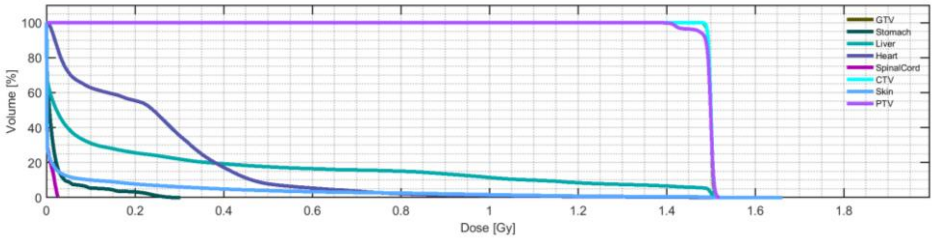
Unlike the head, here there is no particular symmetry.
The choice of multiple beams is preferable

LIVER TP: COMPARISON BETWEEN SINGLE PHOTON BEAM AND MULTIPLE PHOTON BEAMS (0,180,225,270,315) AND (0,120,240)



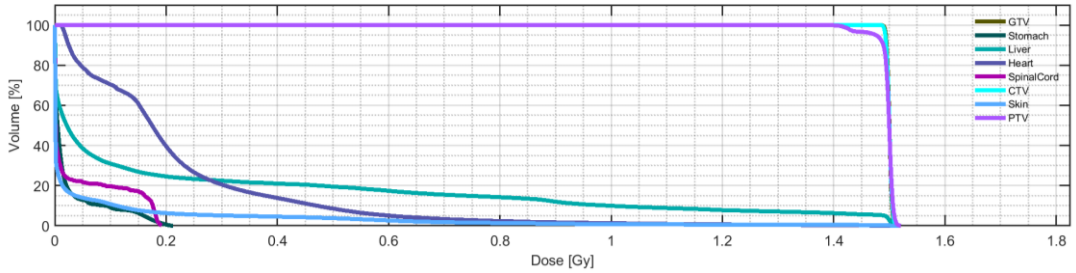
0°

	max	min	mean	std
GTV	1.6406	1.3221	1.4716	0.0744
Stomach	0	0	0	0
Liver	2.6562	0	0.2549	0.5303
Heart	1.6725	0	0.0371	0.1443
SpinalCord	0.0383	0	0.0054	0.0096
CTV	1.7576	1.2454	1.4802	0.1219
Skin	3.3048	0	0.0464	0.2479
PTV	1.8082	1.2028	1.4790	0.1388



0°,120°,240°

	max	min	mean	std
GTV	1.5133	1.4806	1.4997	0.0047
Stomach	0.3023	0	0.0218	0.0479
Liver	1.5207	0	0.2494	0.4504
Heart	1.5028	0	0.2389	0.2165
SpinalCord	0.0267	0	0.0041	0.0074
CTV	1.5201	1.4806	1.5000	0.0049
Skin	1.9823	0	0.0575	0.2030
PTV	1.5213	1.3726	1.4959	0.0167



0°,180°,225°,270°,315°

	max	min	mean	std
GTV	1.5117	1.4855	1.5001	0.0039
Stomach	0.2132	0	0.0232	0.0469
Liver	1.5216	0	0.2462	0.4418
Heart	1.5037	0.0086	0.2161	0.2070
SpinalCord	0.1922	0	0.0371	0.0671
CTV	1.5141	1.4855	1.5000	0.0044
Skin	1.5216	0	0.0499	0.1732
PTV	1.5216	1.3946	1.4967	0.0156

We can obtain a better treatment plan by choosing multiple beams

A beautiful day,thanks!