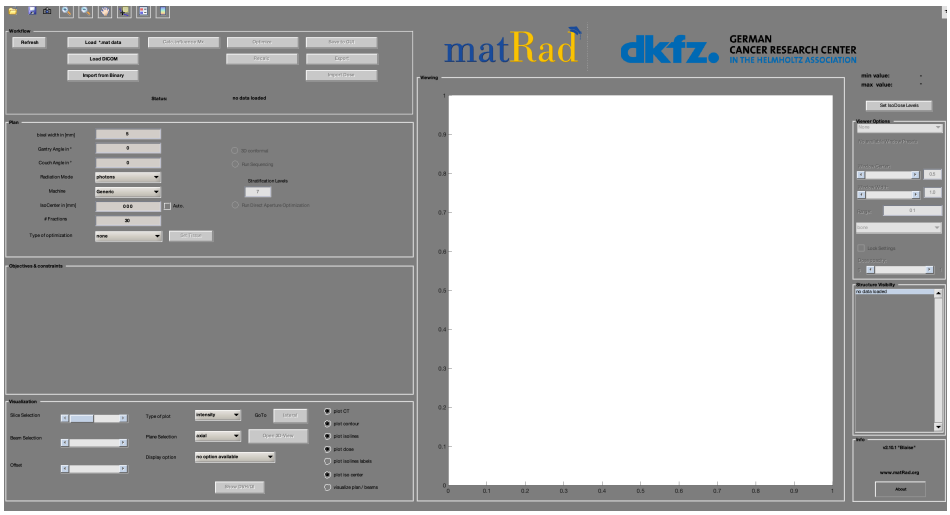
Hands-On Treatment Planning Basics: Hands-On Biological/Carbon Planning

20.05.2021

Task 1: Comparison between Protons and Carbon Ions

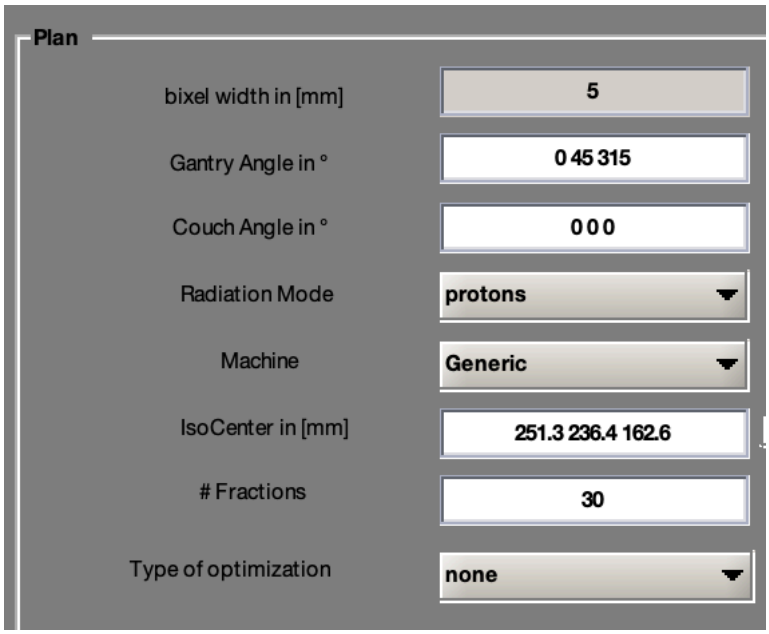
1.) Open the matrad User Interface



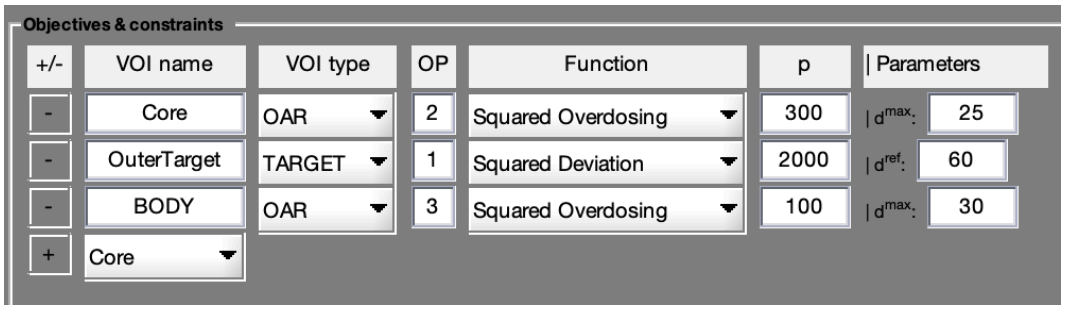
2.) Load *.mat data and choose TG119.mat

3.) Enable the visualization of the beam angles.

4.) Choose the following plan parameters



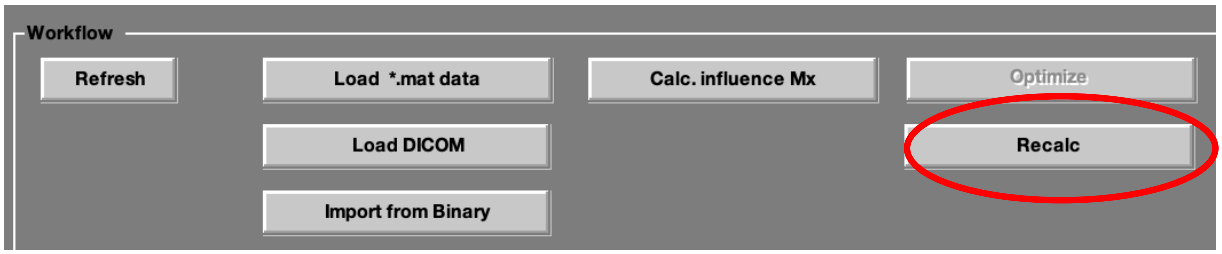
5.) Choose the following objectives



6.) Calculate the dose influence matrix by clicking Calc influence Matrix
7.) Then click Optimize
8.) Save your dose to the list with Save to GUI and choose a name (e.g. **proton3beamNone**). You can export an image using the screenshot button:

9.) Change the Type of optimization of 'none' to const_RBExD

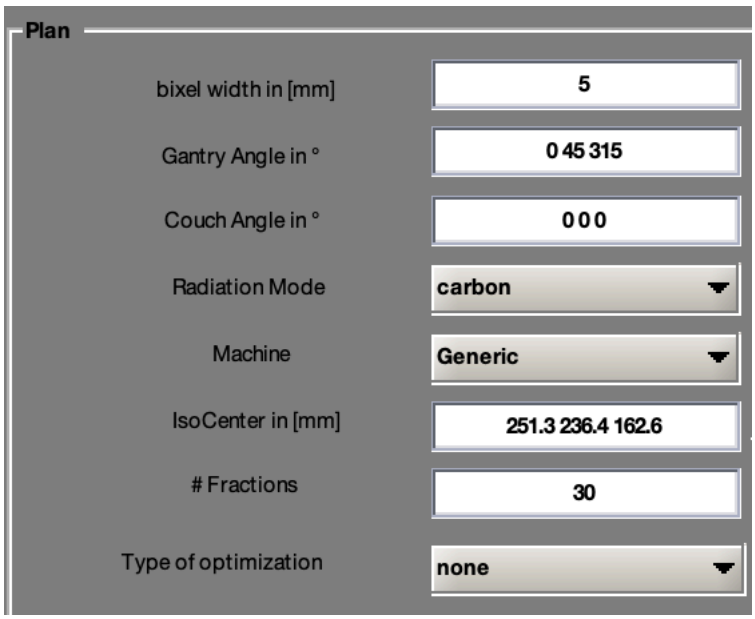
10.) And then recalculate the dose



11.) Save your dose to the list with Save to GUI and choose a name (e.g. **proton3beamConstRBE**).
12.) Go to the Display option and compare physicalDose and RBExD. What differences can be seen between these two distributions ?

13.) Compare the D95 dose and the DVH for the target and the core (OAR)for these two dose distributions

14.) Change the radiation mode to carbon and select type of optimization 'none', which indicates a physical dose optimization.



15.) Calculate the dose influence matrix by clicking Calc influence Matrix and the then click Optimize. This may take a while …

16.) Save the treatment plan Save to GUI (e.g. **carbon_physicalOpt**)

17.) What difference can you immediately observe in the dose distribution?

18.) Change the Type of Optimization to LEM_IV

19.) Press the Recalc Button to calculate the RBE weighted dose (=biological effective dose) for the previously physically optimized treatment plan. Save the treatment plan with plan Save to GUI (e.g. **carbon_recalcBioDose**)

20.) Inspect the resulting treatment plan and compare the two carbon ion dose distribution (physicalDose vs. RBExD) in the Viewing pane as well as with DVH and quality metrics.

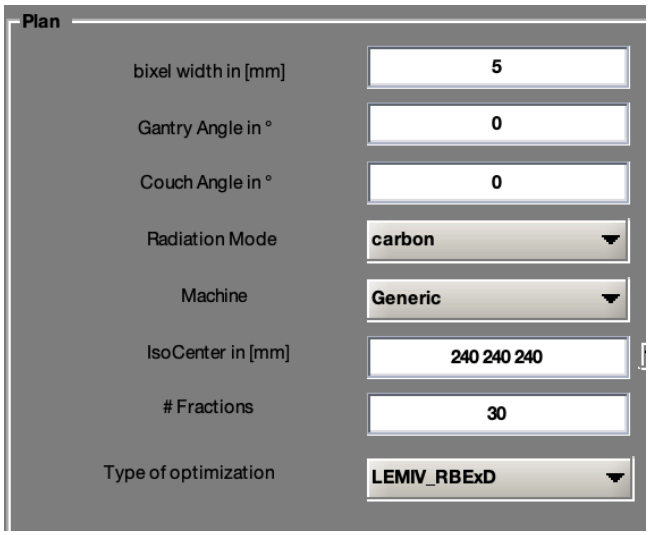
21.) Perform a full biological optimization for carbon ions by leaving the settings as they are (Type of Optimization: **LEMIV_effect**) and press the button Calc influence Matrix and the then click Optimize.

22.) Save the treatment plan with Save to GUI button (e.g. **carbon_bioOpt**) and compare the result to the previous result. Use the display option to switch between RBExD and physical dose.

23.) What did change in the physical dose when compared to the biological optimization result (LEMIV_effect).

Task 2: Boxphantom case -Different tissue type

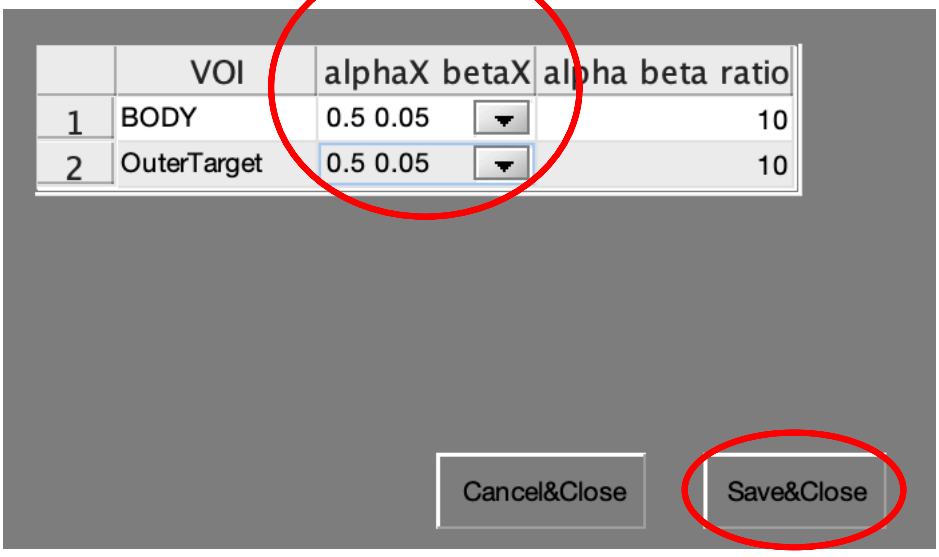
1.) Click on Load *.mat data and load the boxphantom.mat case and select the following settings:



2.) Save the treatment plan (e.g **carbon_ab2)**.

3.) Click the Set Tissue button

4.) And change the alphaX betaX values of all structures to **0.5 0.05. AB ratio of 10** and click on Save&Close**.**

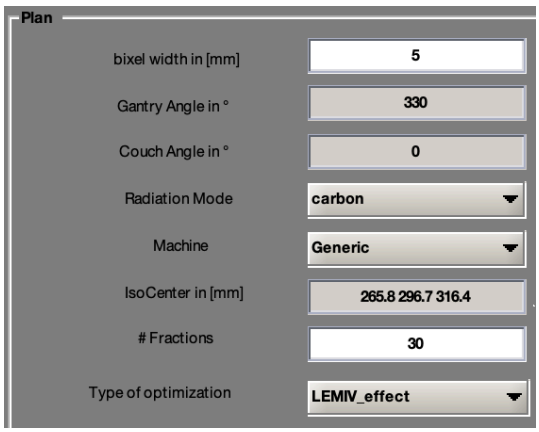


5.) Now perform a new biological optimization with a different reference tissue. Click on Calc influence Matrix and the then click Optimize.

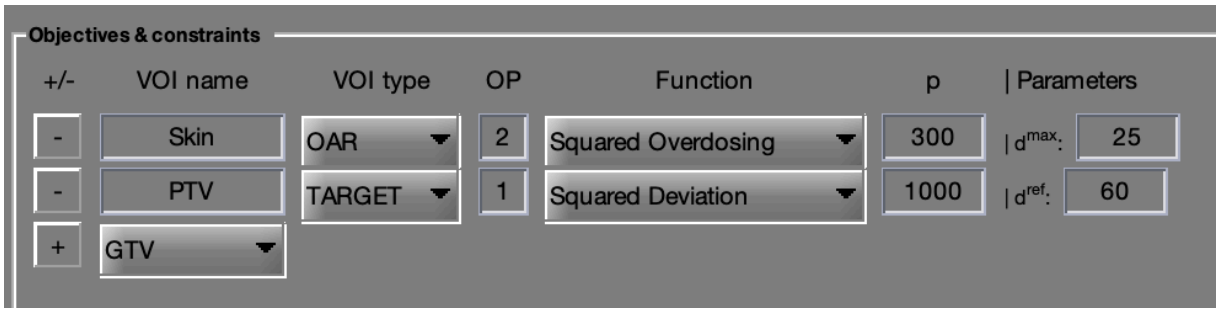
6.) Compare the two dose distributions. What differences can be observed, especially in the physical dose?

Task 3: LIVER case

7.) Click on Load *.mat data and load the LIVER.mat case and select the following settings:



8.) Select at least the following objective functions for optimization:

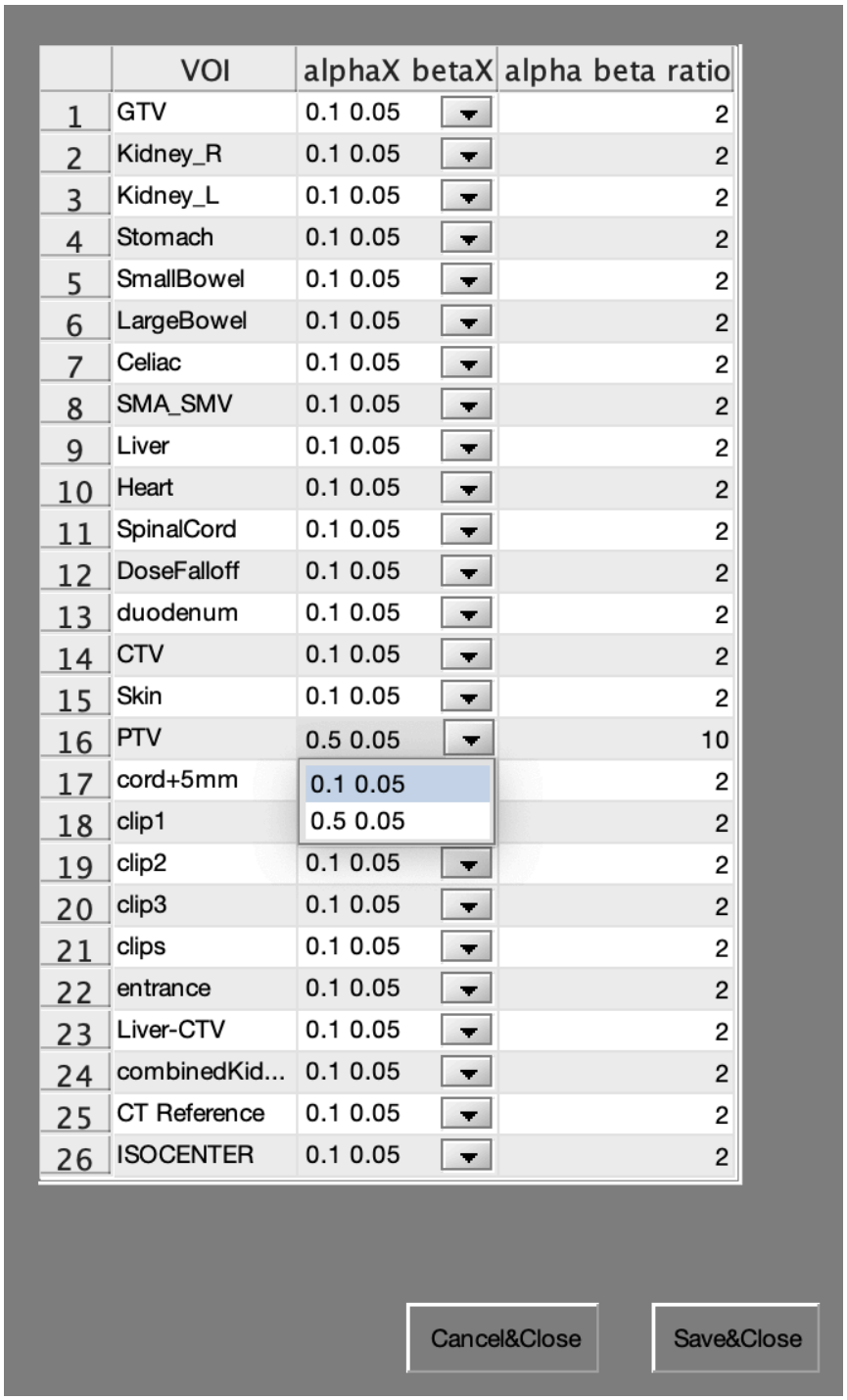


9.) Inspect the treatment plan using the Viewing pane, the display options and the DVH/QI button.

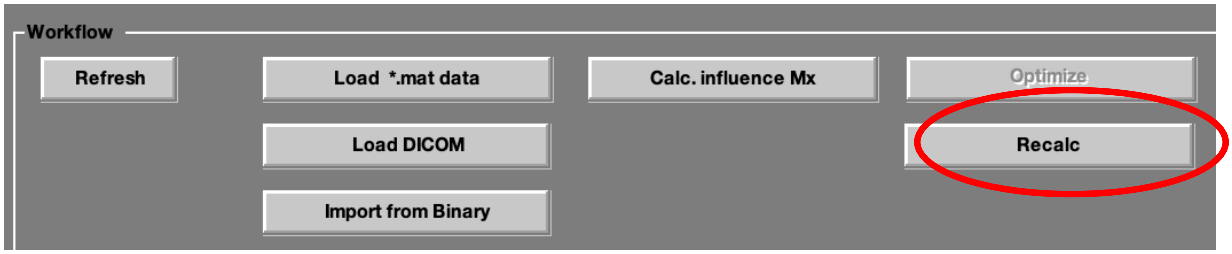
10.) Save the treatment plan using Save to GUI and give it a name like **carbon_1Beam_ab2**

11.) Click the Set Tissue button

12.) And change the alphaX betaX values for the PTV to **0.5 0.05. AB ratio of 10.** By this, the radio-sensitivity parameters of our tumor change.



13.) Recalculate the treatment plan and save using Save to GUI (e.g. **carbonab10**)



14.) Inspect the resulting treatment plan. What differences can be observed ?

15.) OPTIONAL: Uncheck the auto-box in the Plan pane and define manually a new shifted iso center and click on the Recalc button. By this you now additionally simulate a shifted patient geometry during treatment.