Workshop #5: MBDCA

ACUROS Commission

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Table 1: Test case geometries for ACUROS® algorithm testing during AAPM summer school 2017

Test Case	Inner cube material 'Cube'	Outer cube material 'BgBOX'	Ir-192 source center location	Ir-192 source orientation	Applicator
1	H_2O	H_2O	(0, 0, 0) cm	+z	none
3	H_2O	air	(7, 0, 0) cm	+z	none

In Workshop #5, we plan to review imported Test Case 1 and 3 ACUROS dose distribution and the associated Monte Carlo (MC) reference dose distribution.

In this workshop, please do the following for Case 1 and Case 3 (already imported):

1. Calculate a dose distribution using ACUROS (TG-186).
2. Comparing the locally calculated ACUROS and reference MC dose distributions.

TEST CASE 1 and 3 have similar instructions:

For both Case 1 and 3, there are 3 plans already created: plan1 is TG-43 dose distribution for the TG-186 source in the center, plan 2 is ACUROS (calculated as shown below), and Plan 3 is the MCNP Monte Carlo imported dose grid for this case.

1. **Performing the ACUROS Dose Calculation**

The loaded 'ACUROS' plan will have dose defined already as this is a copy from the downloaded data set but now is calculated according to TG-43 formalism *(This dose will be overwritten by the local Acuros calculation)*.

- To perform an ACUROS dose calculation, click the button.
- The ACUROS dose calculation window will appear. Confirm that for the calculation medium the 'CT values' are used and click button to begin the ACUROS calculation.
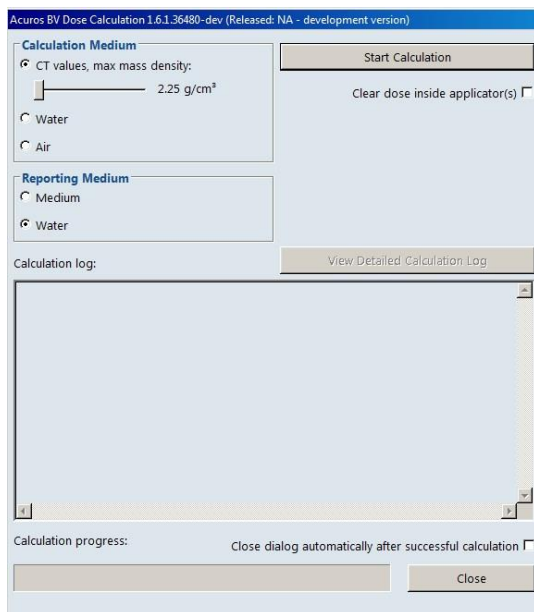
- When the calculation is completed, a warning message appears. Click .

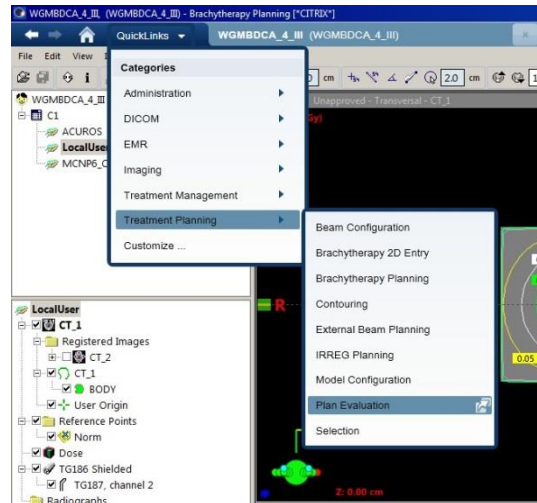Close the window. The display will be updated with isodoses for the ACUROS calculation. The display

will also specify the calculation algorithm 'Transport in medium. Dose to water'.

2   Dose Distribution Comparison (Ex given for Case 3)

A. Comparison Process Overview

- Open the Plan Evaluation Link.

- Select the 'TG-43' plan, right-click on it and select 'Drop to view → Left'.

- Select the 'MCNP6_Case_3' plan, right-click on it and select 'Drop to view → Right'. Press the "lock" button circled in red and adjust zoom:
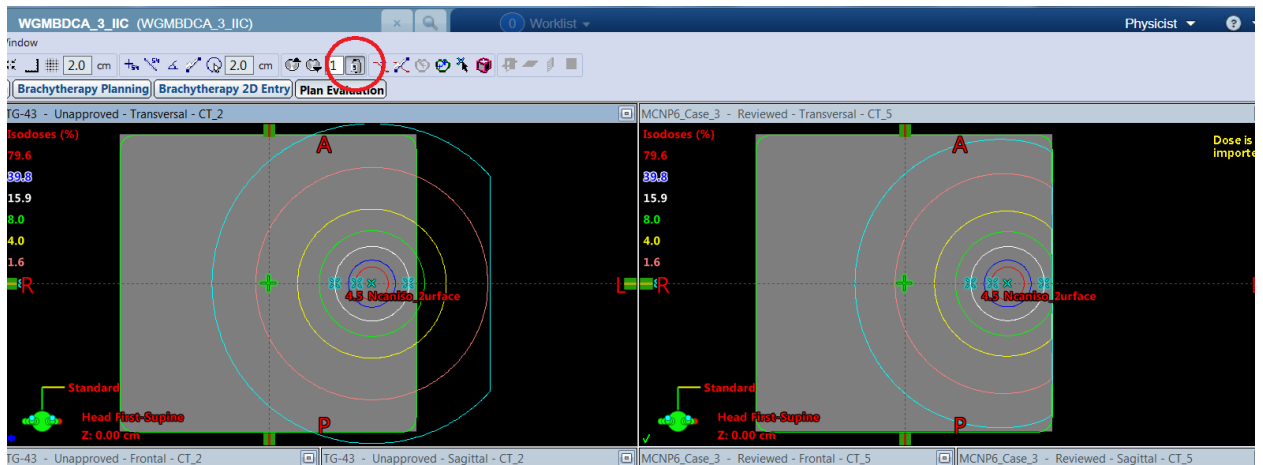

The comparison of 3D dose distributions is typically done at specified points, in selected planes (dose maps), or for defined volumes within the distributions. The comparison tools available within the BV treatment planning system are limited to those based on dose differences.

B. Doses at Specified Points

To perform a dose point check in the BrachyVision:

- Click the 'Point Dose' button and place the mouse at the point of interest. Repeat the same procedure in both plans and check the dose value.

- Alternatively, a series of reference points have been included in both plans at the same location for direct comparison. Students are encouraged to insert more (see screen shot below):
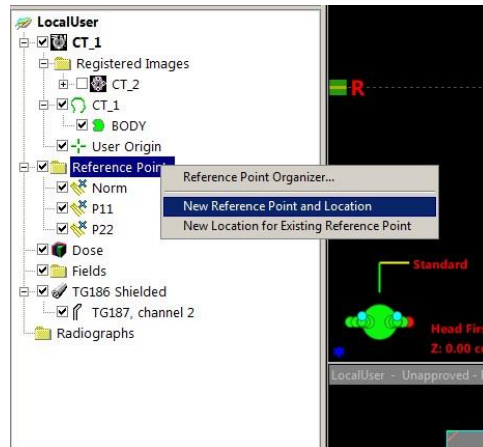

- Create a display grid using the grid definition tool in the toolbar. Click the button to facilitate the whole process.

C. 2D Dose Maps and 1D Dose Profiles

To set up a side-by-side display of a locally calculated and a reference dose distribution:

- Choose or define an appropriate set of isolines for dose display by selecting 'Planning → Isodose Levels' from the main menu.

- Click in the upper left panel of the display grid the buttons, and zoom/pan the image to show an area of dosimetric interest.

- Click the button to create a dose profile for that area of the image. Use the cross-hair enabled to navigate through the Distance-Dose values of each plan.
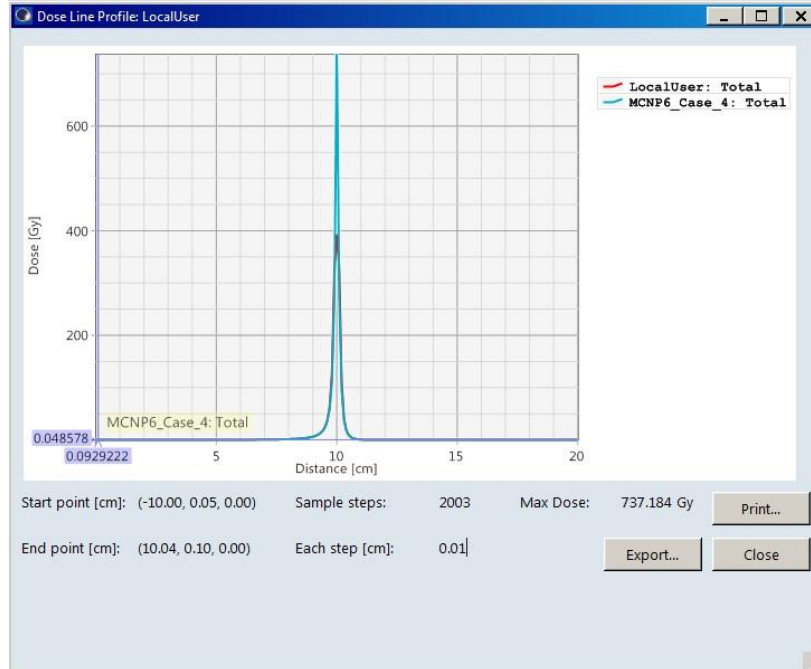
- Without closing the 'Dose Line Profiler' window, scroll through the slices to visually compare 2D doses and 1D dose profiles throughout the phantom.

- For the source centered geometry (Test Case 1), dose maps and "horizontal" dose profiles through the center of the source could be generated and recorded using screen capture software in planes $x = 0$ cm, $y = 0$ cm, and $z = 0$ cm.

- For the source displaced geometry (Test Case 3), dose maps and "horizontal" dose profiles through the center of the source could be created and recorded in planes $x = 7$ cm, $y = 0$ cm, and $z = 0$ cm.

D. 2D Dose Map Differences

To display differences between a locally calculated and a reference dose distribution:

- Click the 'Insert' tab and select 'New Plan Sum'.
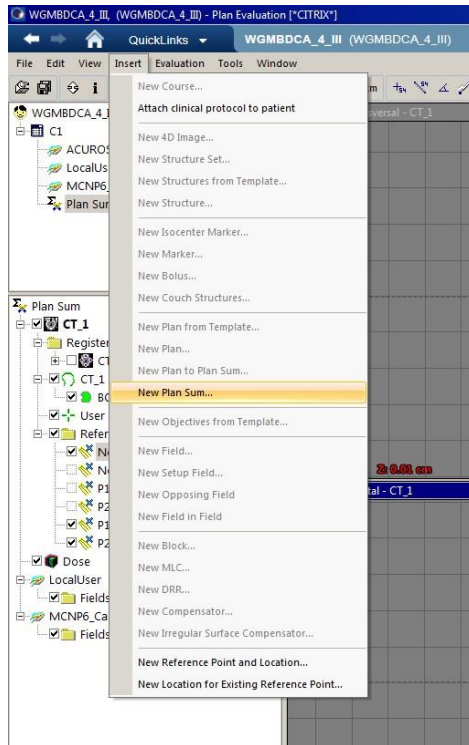
- Tick both plans of interest for comparison by checking the box for each plan ('TG-43' and 'MCNP6_Case_'No''). Set the 'Operation' for the reference plan to '−'; this yields the difference in the locally calculated dose distribution relative to the reference distribution. Click Ok.
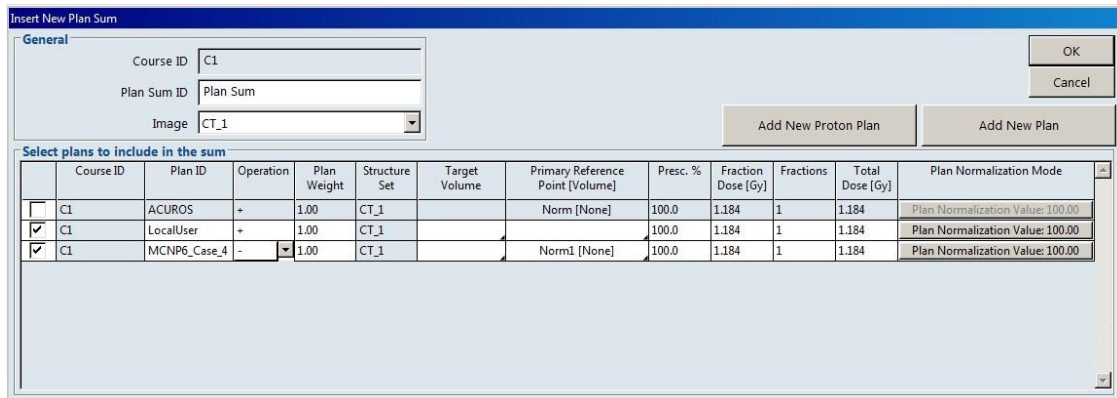
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  Choose or define an appropriate set of iso dose lines for dose display by selecting 'Planning →
  Isodose Levels' from the main menu.

- Choose from the 'Window' tab the desired views. Click 'Window → Orthogonal Views and BEV'.
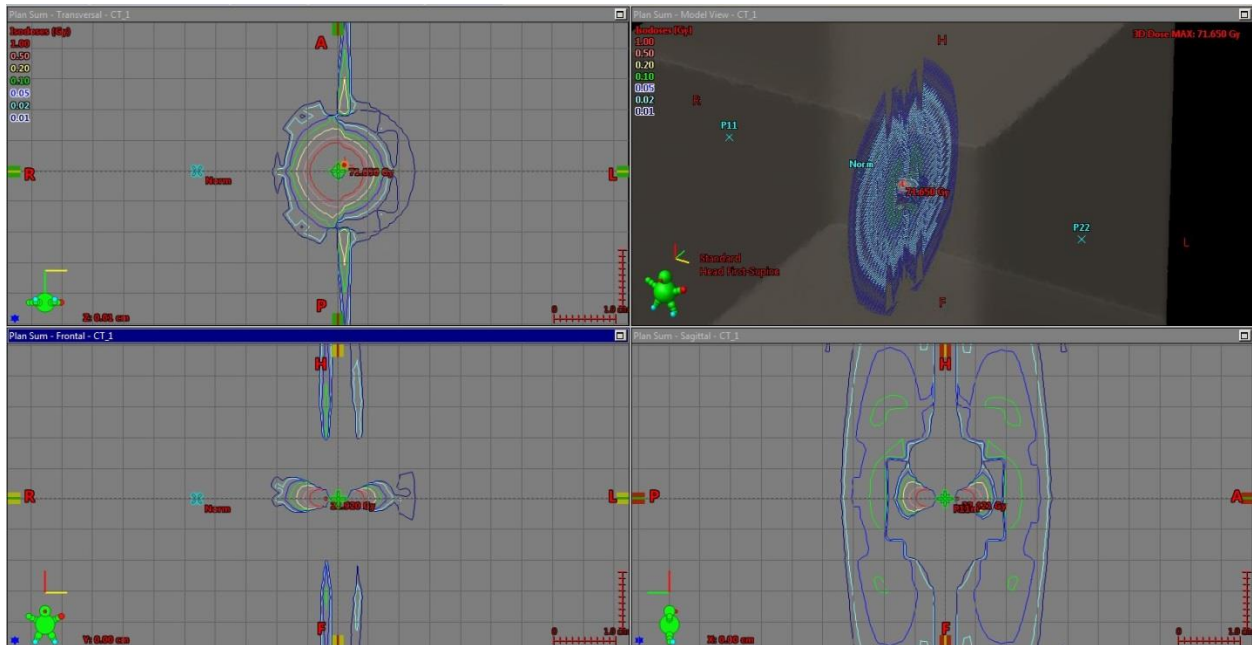
- Scroll through the slices to inspect 2D dose differences throughout the phantom.

- For the source centered geometry (Test Case 1), dose difference maps through the center of the source could be generated and recorded using screen capture software on planes x = 0 cm, y = 0 cm, and z = 0 cm.

- For the source displaced geometry (Test Case 3), dose difference maps through the center of the source could be created and recorded on planes x = 7 cm, y = 0 cm, and z = 0 cm.

Note:

Creating a generic HDR Ir-192 virtual WG-MBDCA source model in the BV TPS

Depending on BV TPS version (v. 13 or higher) a source model for the generic WG source might have to be created before proceeding with test case import and dose calculations. Users should follow the BV reference guide instructions. In short, users can create a new radioactive source model with the ID "TG-186" in RT Administration. It is imperative that the above mentioned ID is used as it is used to link the source to the correct source model in the Acuros BV dose calculation algorithm. Since the source model is non-clinical, the status of the source model must be kept as "Commissioning" to ensure that it is not used in treatments. Users can then create a new brachytherapy treatment unit and add the new radioactive source model to the created treatment unit.