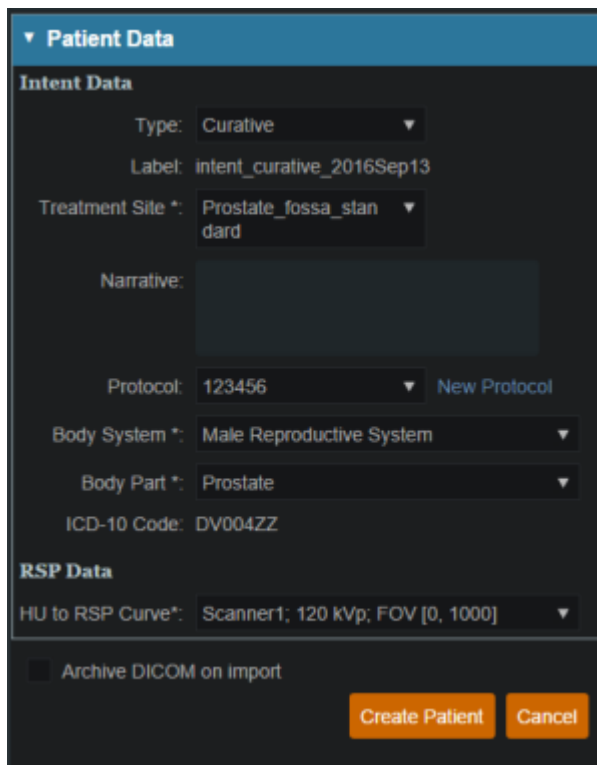


Prostate Plan Walkthrough

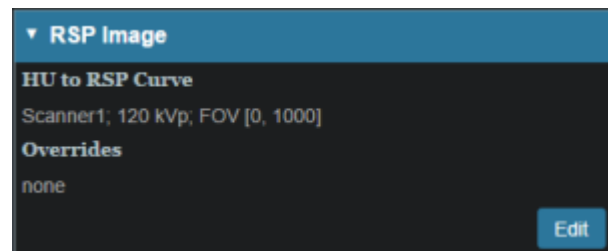
Patient Creation

1. Select the CT image set from the list of available files for import
2. Ensure that the MR is correct
 1. If MR needs to be changed you may edit it by choosing the *Edit* button to the left
3. Click the *Create New Patient* button to start the import process
4. Fill in the Patient Intent information and select the appropriate HU to RSP curve (as shown below)



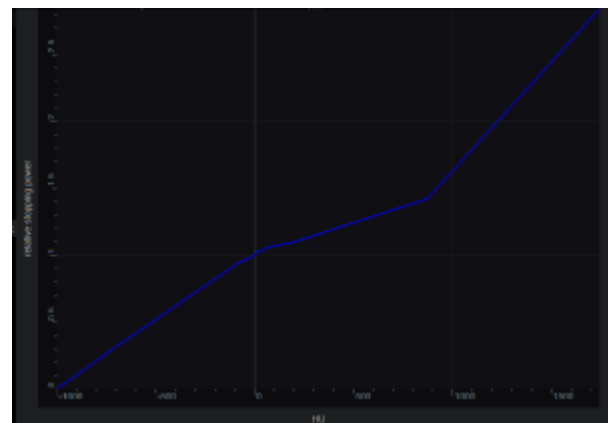
The screenshot shows the 'Patient Data' form with the following fields and values:

- Intent Data**
 - Type: Curative
 - Label: intent_curative_2016Sep13
 - Treatment Site *: Prostate_fossa_standard
 - Narrative: (empty text area)
 - Protocol: 123456 (with a 'New Protocol' link)
 - Body System *: Male Reproductive System
 - Body Part *: Prostate
 - ICD-10 Code: DV004ZZ
- RSP Data**
 - HU to RSP Curve*: Scanner1; 120 Kvp; FOV [0, 1000]
 - ☐ Archive DICOM on import
- Buttons: 'Create Patient' and 'Cancel'

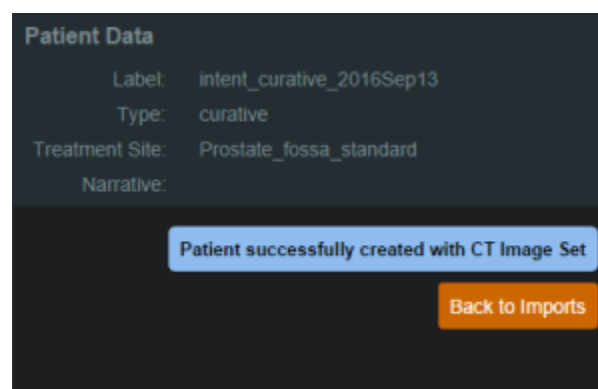


The screenshot shows the 'RSP Image' form with the following fields and values:

- HU to RSP Curve**
 - Scanner1; 120 Kvp; FOV [0, 1000]
 - Overrides: none
 - Button: 'Edit'



5. Click the *Create Patient* button and wait for the import to complete
6. Click the *Back to Imports* button



The screenshot shows the 'Patient Data' form with the following fields and values:

- Label: intent_curative_2016Sep13
- Type: curative
- Treatment Site: Prostate_fossa_standard
- Narrative: (empty text area)
- Message: 'Patient successfully created with CT Image Set' (in a blue box)
- Button: 'Back to Imports' (in an orange box)

7. Select the Structure Set file that is associated with this patient

1. Make sure Structure Set MR matches CT image set MR (make any edits to the MRN that are needed)
8. Click the *Import into Patient* button in the patient information window

The screenshot shows a software window titled 'cstrolid' with a 'planning' tab. On the left is a control pane with a search bar and filters. The main area is a table with the following columns: Modality, MRN, Name, Upload By, and Upload Date. The table contains 14 rows of data, mostly for 'CT' and 'MR' modalities, with upload dates ranging from 2016-10-10 to 2016-10-11.

Modality	MRN	Name	Upload By	Upload Date
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10
CT Image Set	111114-10	Imported CT16	Andrew Brown	2016-10-10 10:10:10

The screenshot shows two panels. The 'DICOM Information' panel displays: Patient Name: SBRT PROSTATE, MRN: 111114-10, Modality: Structure Set, Upload Date: 2016-10-10 11:29:57, Upload By: Health Module, and a 'Refresh' button. The 'Patient Information' panel displays: MRN: 111114 and an 'Import into patient' button.

1. In the control pane on the left hand side, the image snapshot will be automatically selected based on the structure set DICOM UID information, and then the *Import Structure* block will automatically expand.

► Snapshot Selection

Selected Snapshot: snapshot_2016Oct10

▼ Import Structures

Treatment Site: Prostate_Protocol

Patient Structure: Patient

Variant Label: variant_1_2016Oct10

► ☒ Prostate (matched)	Importing new structure
► ☒ PTV (matched)	Importing new structure
► ☒ Seminal Vesicles (custom)	Importing new structure
► ☒ Bladder (matched)	Importing new structure
► ☒ Rectum (matched)	Importing new structure
► ☒ Urethra (custom)	Importing new structure
► ☒ Bowel (custom)	Importing new structure
► ☒ Left Femoral Hea (custom)	Importing new structure
► ☒ Right Femoral He (custom)	Importing new structure
► ☒ Bladder neck (custom)	Importing new structure
► ☒ Testes (custom)	Importing new structure
► ☒ 2cm (custom)	Importing new structure
► ☒ Skin (matched)	Importing new structure
► ☒ penile bulb (custom)	Importing new structure
► ☒ Neurovascular Bu (custom)	Importing new structure
► ☒ Patient (matched)	Importing new structure

☐ Archive DICOM on import

Import Structures Cancel

2. You will see a list of the imported structures. Here you may choose whether or not to import each structure by checking or unchecking the box beside each structure name.
 1. For this case, we will import all available structures and there is nothing to change on this page
3. You also have the ability to assign or edit any structures that are shown as *custom*, which indicates the name did not exactly match a directive structure from the treatment site template list you specified during patient creation.
 1. Matched, Assigned, and Custom structures are designated with corresponding tags at the end of the structure name in the structure list.
 2. Assigning a custom structure to a defined directive structure will result in the imported structure inheriting all the predefined structure properties (e.g. name, type, color)
 3. For all custom structures the type is by default set to "Other" unless it contains the letters "TV" (as in PTV or CTV), in which case it is assigned the type of "Target"; this may be

changed here if needed

4. Once you have completed explored this feature, make sure all structures are back to their default states and click the orange “Import Structures” button (see above image)

Prescription

1. The patient is now created and all available data has been imported, so it is time to proceed with entering the prescription information
2. Click on the *Back to Import* button
3. Click the *Planning* task
4. Click the entry from the table of patients that corresponds to your newly imported patient
5. Prescription information is stored in the *Directive*
6. Click *Open* under the *Directive* entry in the patient overview tree
7. Under *General* fill in *Goals*
 1. In this example we will set a minimum dose to the PTV7920 at 79.2Gy and the maximum dose at 85.5Gy as shown below

The screenshot shows a software interface for setting goals. The 'General' tab is selected. Under 'Goals', the 'PTV_7920' goal is defined with a minimum dose of 79.2 Gy(RBE) and a maximum dose of 85.5 Gy(RBE). There are buttons to add more goals for min mean, max mean, min DVH, and max DVH. At the bottom, there are dropdowns for 'Add Structure' and 'Add Point', and 'OK' and 'Cancel' buttons.

8. Next proceed to *Phases* and fill in *Fractions* and *Prescription*
 1. For this example the dose will be 79.2Gy in 44 fractions to the PTV7920

2. *Label* and *Description* are free text fields that allow you to “name” each Phase and provide any description or notes necessary to distinguish between each phase in the case of multiple phases. You are free to enter your own values in these fields for this walkthrough
9. Click *Create* to complete the phase
10. Click *Done* to complete the *Directive* editing and return to the Patient Overview tree

Plan Creation

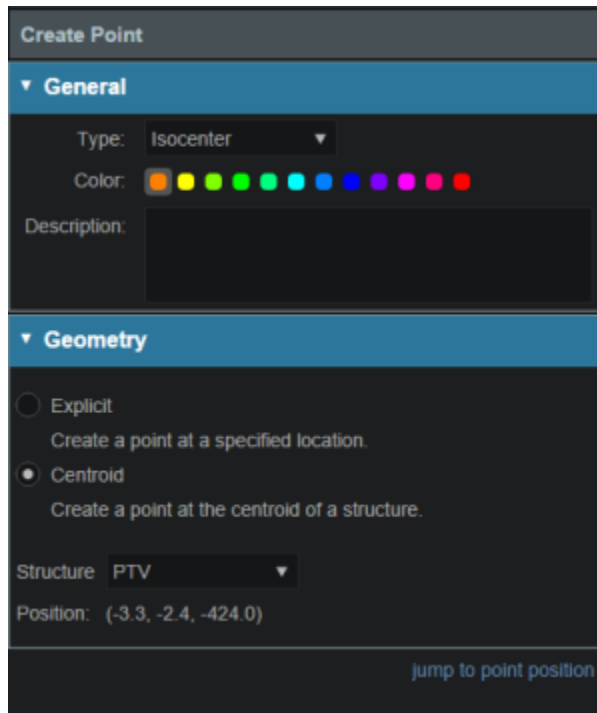
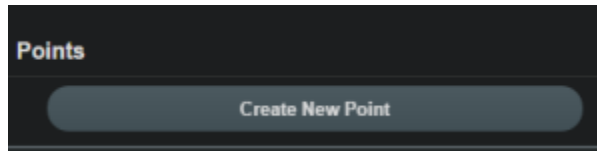
1. The required *Intent*, *Course*, and *Snapshot* information was selected during import, so now we can move to creation of a *Request* and *Plan*
2. From the Patient Overview tree, click the *Add Request* button
 1. If a plan will only fulfill a portion of the prescription, then the *Request* should be edited to reflect this, otherwise just proceed to adding a plan
 2. In this case, we will be fulfilling the entire prescription with a single plan, so no editing of the *Request* is needed
3. Now click the *Add Plan* button under the newly created Request entry
 1. Name the plan and click *Save*
4. Now open the new plan by clicking the *Open* button under the new plan entry in the Patient Overview tree

General Plan Parameters

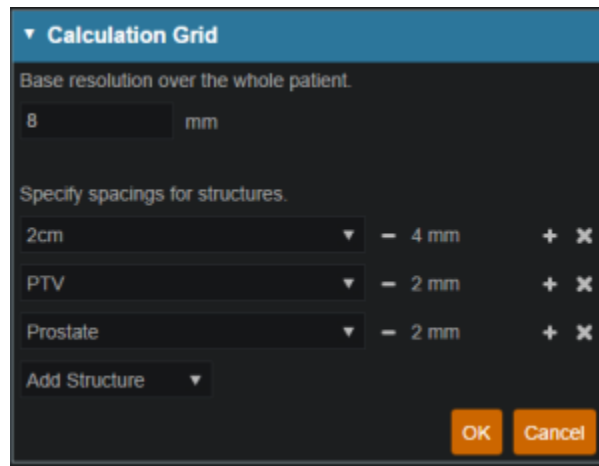
1. Creating our plan will begin in the *Patient Geometry* block, where we will create any points or planning structures that are needed (if not created in contouring software), such as a combination of the left and right femoral heads (see [Structure Geometry](#) for details on how to Create structures)
 1. We will create a point to use for the isocenter (note this step is done for illustration purposes

and is not necessary for most plans)

1. Select a type of isocenter and create the point at the centroid of the prostate



2. Next we will move on to defining the HU to Proton Relative Stopping Power (RSP) conversion
3. Click to open the *RSP Image* block
 1. If any density overrides are needed they are entered here in the *RSP Image* block
 2. If the HU to RSP curve was not chosen upon patient import the user may do so at this point
 3. We do have any density overrides to apply for this case and the proper HU curve has already been selected, so we can move past this block for this example, so click *Cancel* to close this block
4. We are now ready to define the dose calculation grid (see [Defining the Dose Grid](#) for a detailed explanation)
5. Click to open the *Calculation Grid* block
 1. Create a grid by performing the following steps:
 1. Set the base grid resolution to 8 mm
 2. Click *Add Structure* and select the "2cm" structure
 1. Set the size to 4 mm
 3. Add the PTV and the Prostate each in the same manner and set their sizes to 2 mm



Calculation Grid

Base resolution over the whole patient.

8 mm

Specify spacings for structures.

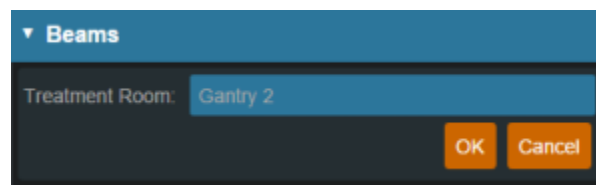
2cm	-	4 mm	+	×
PTV	-	2 mm	+	×
Prostate	-	2 mm	+	×

Add Structure

OK Cancel

Beams

1. We are now ready to begin defining the treatment beams
2. Click to expand the *Beams* block (see [Creating a New Beam](#) for detailed explanation)
 1. Before defining individual beams, we will first set some shared beam properties
 2. Set the *Treatment Room* by choosing "Gantry 2" from the dropdown

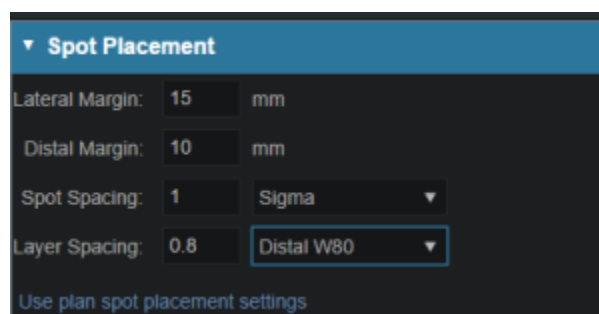


Beams

Treatment Room: Gantry 2

OK Cancel

3. Expand the *Spot Placement* sub-block and set the following values (note these are the plan level spot placement parameters, so it will apply to all our beams, unless we specifically override the values within an individual beam)
 1. Lateral margin- 15 mm
 2. Distal margin- 10 mm
 3. Spot spacing- 1 sigma
 4. Layer spacing- .8 Distal 80



Spot Placement

Lateral Margin: 15 mm

Distal Margin: 10 mm

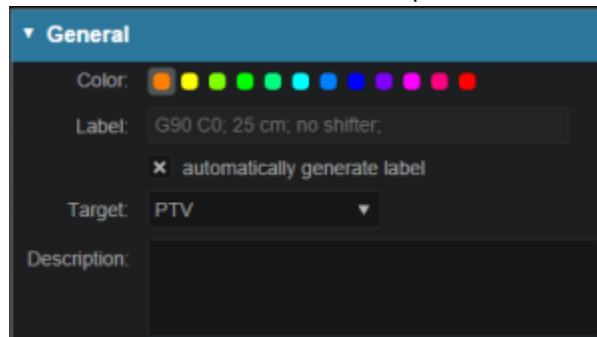
Spot Spacing: 1 Sigma

Layer Spacing: 0.8 Distal W80

Use plan spot placement settings

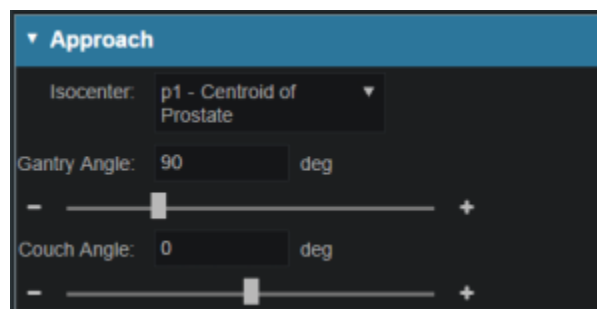
4. Now we are ready to make our beams
5. Start by clicking *Create New Beam*
 1. Enter the following for each beam
 1. General
 1. Select the PTV as the target and if desired, enter a description for the

beam, for other selections leave the defaults (see [Structure Geometry](#))



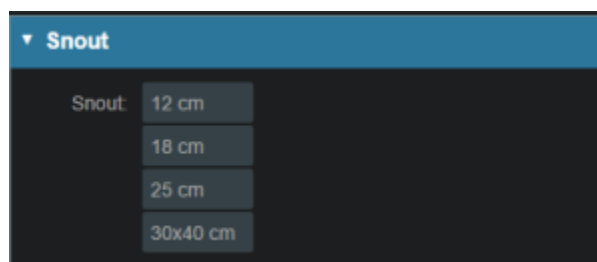
2. Approach

1. At this point the user will specify the geometry of the beam by setting the isocenter as well as the gantry and couch angles
2. Two beams at gantry angles of 90 and 270, respectively, will be used here, which is typical (± 5 degrees) for standard prostate plans such as this example
3. Couch angle of 0 is used here for each beam
 1. You may use the sliders, the $\pm$ buttons, or simply type in the values to adjust these angles



3. Snout

1. Depending on the size of the prostate a 10-12cm snout should be adequate, in this example select the 12cm Snout option
2. If the pelvic nodes need to be included, the user may need to increase the snout size to the 18 or 25cm snout

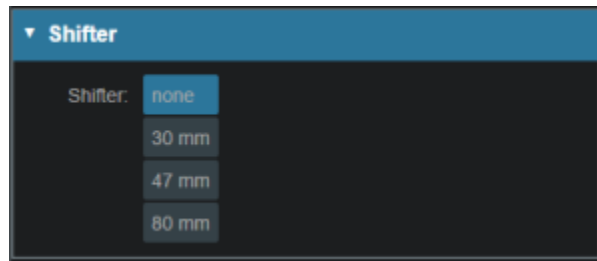


4. Aperture (if desired)

1. If there is the need to use an Aperture for sharper penumbra the user can do so at this time (see [Creating an Aperture](#))
2. Note that Astroid has the ability to utilize an Aperture with pencil beam scanning for both SFO and IMPT plans
3. For this plan, no apertures are necessary

5. Shifter

1. Simply choose a shifter from the list if one is needed
2. For this plan, no shifters are necessary



6. Air gap

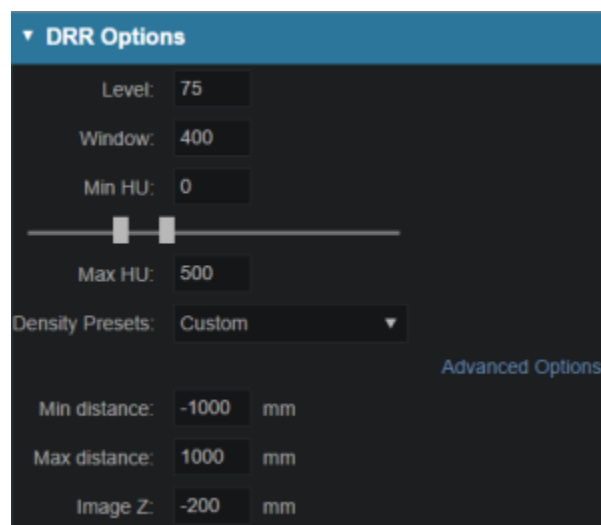
1. The air gap is specified as the distance from the final beamline device (aperture or shifter) or the snout end if no devices are present)
2. The view automatically shifts to the 3D view when entering this sub-block and you can adjust the air gap to ensure patient collisions are avoided
3. The default air gap of 30 mm is sufficient for both beams in this example

7. Spot placement

1. Since we want both beams to use the same spot settings, we have those at the plan level and there is no need to edit the spot placements here for the beams

8. DRR options

1. The Proton DRRs shown in the *Beam* task are generally used to help determine appropriate treatment angles
2. In cases such as these, appropriate angles are readily determined and there is no need to utilize the DRR sub-task
 1. If you wish to explore this feature however, you may choose one of the preset *Density Presets* from the drop down or manually set the *level*, *window*, *min HU* and *max HU* or go into *Advanced Options* for additional control of the DRR's
 2. These proton DRRs are used only for visualization purposes and will have no effect on the plan construction process



2. Click *Create* to complete the first beam
3. After creating the first beam (at gantry angle 90) it is recommended that you *Clone* it and simply change new beam's gantry angle to save time in creating the second beam (the *Clone* button is available under a beam when it is selected for viewing from the list of beams) **FIXM** : Add an image of the clone button
 1. Note for more complex plans, there are often additional parameters to change (such as the aperture and the air gap) when creating additional beams via the *Clone* option

Optimization

1. With the two beams completely defined, we can now move on organizing our treatment fraction groups and specifying the constraints and objectives for the treatment
2. Open the *Optimization* block (see [Astroid Optimization](#) for a detailed explanation of *Optimization*, *Feasibility* and *Constraints*, as well as *Running the Optimizer*)

Fraction Group

1. *Create a New Fraction Group* under the *Fraction Group* block (See [Fraction Groups](#) for a more detailed explanation)
 1. Enter a Fraction Count of 44
 2. Add a new Target to the *Target List* by clicking *Add Another Target*
 1. Set the Target to the PTV
 2. Add the following *Beam Set*
 1. In this case we will use an IMPT approach so add both the G90 and G270 beams in this same beam set
 3. Constraints associated with this target
 1. Click the *Add Structure* drop down and choose the PTV
 2. Add a min dose constraint of 79.2 Gy (1.8 Gy per fx)
 3. Add a max dose constraint of 87 Gy
 4. At this point your *Fraction Group* should appear as shown below

3. Click *Create* to complete the Target entry and then *Create* again to complete the *Fraction Group*

Constraints and Objectives

1. This is our only Fraction Group for this plan, so we'll move on to the plan level constraints and objectives
2. Open the *Plan Constraints/Objectives* block
 1. First we'll enter the *Constraints* for the planning (target) volumes
 1. Remember these are the "hard stops/non negotiables" for the plan
 2. These doses will be decided per the users' department protocols
 3. For this case do the following:
 1. Click *Add Structure* and select the Prostate
 1. Add a min set to 79.2 Gy
 2. Add a max set to 87 Gy
 2. Click *Add Structure* and select the PTV
 1. Add a min set to 75.2 Gy

2. Add a max set to 87 Gy



After the target constraints have been entered, it's generally good practice to test the plan feasibility. The Feasibility calculation is run by clicking *calculate* in the Feasibility block at the bottom of the *Plan Constraints/Objectives* sub-block. The Feasibility calculation is based solely on the constraints and it should be used to ensure there is a possible solution (plan) that can meet the specified constraints. The Feasibility calculation may be an iterative processes in order to get appropriate constraints established for a particular plan. In other words, the user may need to enter a constraint, check the feasibility, then progressively tighten the constraint and check the feasibility until the plan is no longer feasible. It is recommended practice to start by obtaining a feasible plan utilizing only target constraints then add OAR constraints as desired. Remember, using a narrow range of constraints can improve the optimizer performance and improve the resolution of the Pareto surface navigation.

1. Run the *Feasibility* by clicking the *calculate* link



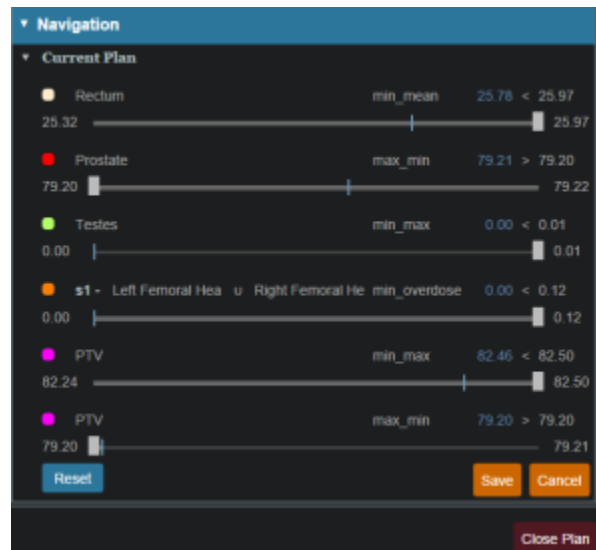
1. The feasibility should return as passing, if not, please confirm your plan parameters match those shown throughout this walkthrough and try again
2. Now with the target constraints set, we'll move on to our OAR's
 1. Again these will be set per department protocol
 2. For this example create the following OAR constraints:
 1. Rectum max mean 60 Gy
 2. Bladder max mean 60 Gy
 3. Skin max 82.5 Gy
 4. Skin max mean 50 Gy
3. Run *Feasibility* again
 1. The feasibility should return as passing again, if not, please confirm your plan parameters match those shown throughout this walkthrough and try again
4. With narrow constraints set and feasibility established, we will now turn our attention to *Objectives*
 1. *Objectives* are the goals that you would like to achieve and these will be the driving forces for the optimizer
 2. Click *Edit* under the *Objectives* section
 3. For this example we will use the following objectives:
 1. Rectum min_mean (Minimize the mean dose to the Rectum)
 2. Prostate max_min (Maximize the minimum Prostate dose)
 3. Testes min_max (Minimize the maximum dose to the Testes)
 4. Left & Right Femur min_overdose 45 Gy (Minimize the amount of the structure the receives dose above 45 Gy)
 5. PTV min_max (Minimize the maximum dose within the PTV)
 6. PTV max_min (Maximize the minimum dose within the PTV)

Plan Constraints / Objectives			
Constraints			
structure	type	dose	objectives
• Prostate	max	87	
• Prostate	min	79.2	
• PTV	max	87	
• PTV	min	75.24	
• Rectum	max_mean	60	
• Bladder	max_mean	60	
• Skin	max	82.5	
• Skin	max_mean	50	
Edit			
Objectives			
structure	type	dose	objectives
• Rectum	min_mean	—	
• Prostate	max_min	—	
• Testes	min_max	—	
• s1 - Left Femoral Head - u Right Femoral He	min overdose	45	
• PTV	min_max	—	
• PTV	max_min	—	
Edit			
Advanced			
Feasibility			
Status: completed			

5. Click *Done* to complete the *Objectives*
6. We are now ready to run the MCO, by opening the *Navigation* sub-block and clicking the *calculate* link
 1. This may take up to 20 minutes for this plan depending upon your available cloud services resources
 2. Keep in mind that even though this process may take some time the planner will be able to make adjustments easily in the *Navigation* without running a new plan

Navigation

1. Once the MCO has been completed, you can adjust the relative importance of the objectives using the slider bars in the *Navigation* block (see [Astroid Optimization Navigating the Solutions](#) for a detailed explanation of using the slider bars)
 1. Adjust the slider bars in the *Navigation* block to find what you feel is the optimal plan for this case
 1. Note: All of these adjustments are made without having to run a new plan
 2. If you find a plan that you like, but wish to continue exploring further, you can click the *Save* button to save the current slider state and then continue exploring
 3. You may return to the last saved state at any time by clicking the *Reset* button
 4. The *Cancel* button will close the navigation block, reverting back to the last *Saved* state



2. The plan is ready for physician review at this point
 1. Physicians often find it useful to Navigate the solution and explore trade-offs in real time, which can often alter the traditional physician approval process into an interactive, real-time trade-off analysis and on the spot plan approval
3. After the physician has decided on a treatment plan the user may then proceed to export the chosen plan to the EMR
 1. Note that these standard (non-plan specific) features are covered in other guides and not repeated herein

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