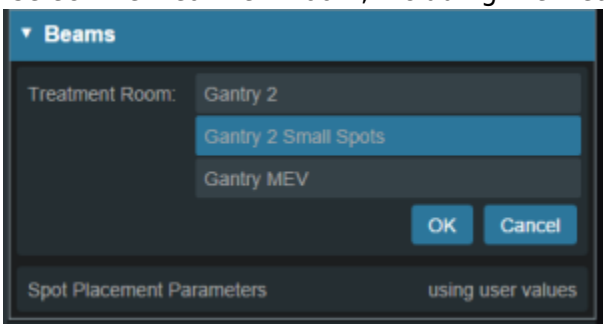
Proton Beams

Defining treatment beams will be one of the most important tasks within the Astroid planning system. Defining appropriate beams will require users to use their knowledge and experience to properly select many of the parameters that define a treatment beam. These parameters include the target, geometry (isocenter, gantry and couch angles), beamline devices, air gap, and spot placement options. The *Beam* task utilizes a series of blocks to organize the beam creation process into a common step-by-step sequence. Several blocks are optional as not all beams will use all features. Additionally, it is important to point out that the treatment room & default spot placement parameters are set outside of the individual beam creation tasks as these apply to all beams (however, spot placement parameters can be overridden within each beam if desired). An example of constructing a lateral beam, with the isocenter at the centroid of the PTV is given below to illustrate the features available when defining a beam.

Treatment Room & Mode Type (SOBP or PBS)

1. Within the *Plan Overview* select the *Beams* block
2. From this interface you can select the treatment room, including the treatment mode



3. If the treatment mode is PBS you can then select and define the plan level PBS *Spot Placement Parameters*. Edit these parameters to define the spot placement grid for each beam in the plan, noting that individual beams can override these values during beam creation if you so desire

Beam Creation

- The next step is to create the beam by clicking the:
  - *Create New PBS Beam* button for use in PBS treatment rooms
  - *Create New SOBP Beam* button for use in SOBP treatment rooms
- Now we will proceed step-by-step through the various “blocks” to create a complete beam as shown below:

General Settings

The ***General*** block is used to set general beam details including:

- Color, Beam Label (or select *automatically generate label*) and Description

PBS specific

- ***Geometric Target*** is used for approach and device creation. You may choose an existing target or create a new structure. For this example we chose the PTV_7920 as the geometric target. The geometric target will be used to define the extents of the aperture (if used) and will be linked to the isocenter position (if target centroid is selected in the approach block).
- ***Spot Target*** is used to define the extent of the PBS spot placements for the beam. The spot target can either match the geometric target, or the user can choose to use the target for the fraction group in which the beam is used (useful for allowing the same geometric beam to be used in multiple fraction groups by simply recomputing the spot positions based on the fraction group target).

SOBP specific

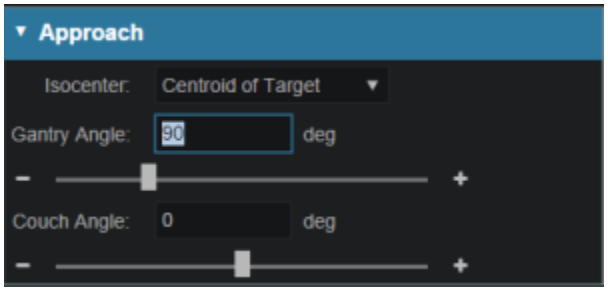
- ***Target*** is used for approach and device creation, and it can be either a structure or an existing beam.

- If the target selected is an existing beam, the new beam becomes a ***Patch beam*** or ***field***. Thus, the targeted beam becomes a parent thru-beam of the current patch beam (child).
    - The patch dose field box is then enabled, allowing users to enter a dose value amount. This value will identify areas of the thru-beam's targeted volume that received less than then the entered dose amount.

- The patch beam will become the portion of the parent thru-beam's target that is less than the dose value entered. This patch target can be viewed in the Display UI and toggled on and off in the right hand side beam controls.
- To create a patch beam of an existing patch beam, select the desired patch beam as the target.
- Once a beam is designated as a patch and added to a fraction group, it cannot change back to a standard non-patch beam. Thus, a new SOBP beam must be created.

Beam Approach

In the *Approach* block specify the desired isocenter from the dropdown. You may choose to use the centroid of the Geometric Target (as shown below) or you can select or create a new point to define the location for the isocenter. The gantry angle and couch angles are also entered here as well. Editing these values can be done by typing directly in the provided fields or by using the sliders. The patient in this example is feet first so we will use 90 for the *Gantry* angle and 0 for the *Couch Angle* to create a left lateral beam.



Snout

In the snout block a list of snouts associated with the specified treatment room will be available to choose from. Selecting a snout can change what beamline devices are available based on the facility model in the site info.

Apertures

An option to add an aperture can be found within the *Aperture* block. An *Aperture* was not chosen in the PBS beam example. Although selecting an aperture is optional for PBS beam plans, selecting an aperture is **required for SOBP beam** plans.

- Refer to Creating a New Aperture for detailed instruction

Shifters (PBS)

The Range Shifter block is only available for PBS treatment modes.

- If desired, select the range *Shifter* to use based on the ones available for the selected snout. If no

Shifter is needed as in the example given, the user may go to the next step

Air Gap

Once the beam line devices are defined, we can move to specify the *Air Gap* distance. The valid air gap range will be listed based on the selected snout. The user may choose any value in this range. 30mm was chosen in the below example.

Beam Spot Placements (PBS)

The Spot Placement block is only available for PBS treatment modes.

- With the beam positioned and any beamline devices put in place, the user is ready view the PBS Spots and adjust the *Spot Placement* values if needed. The *Spot Placement* box, if chosen, will allow the user to set new parameters, overriding the spot placement parameters for this one beam if desired. The example below illustrates the message shown when using the spot placement values from the plan level.

Proton DRRs

Proton DRRs do not impact the beam and are used purely for visualization purposes so that you can set the DRR Options to levels that generate appropriate anatomy visualizations. An example DRR is shown below. Note that Astroid allows you to define 2 distinct DRRs and then blend them together using a simple weight factor to create a single DRR image on the screen. This gives users the freedom to create high contrast, high quality DRR visualizations. A single image was used in the example below as the second set of DRR options has the weight set to 0.