

RAYSTATION 11B

RayCommand 2B Instructions for Use



RayCommand

2B

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Workspace Main version a697
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Declaration of conformity




Complies with Medical Device Regulation (MDR) 2017/745. A copy of the corresponding Declaration of Conformity is available on request.

Safety notices

This user documentation contains WARNINGS concerning the safe use of the product. These must be followed.

WARNING!



The general warning sign informs you of a risk for bodily harm. In most cases the risk is related to mistreatment of the patient.

Note: *The note gives additional information concerning a specific topic, for example, things to consider when performing a certain step in an instruction.*

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1 INTRODUCTION

About RayCommand

The RayCommand application integrates with RayCare to allow the clinic to deliver plans created in RayStation as treatment sessions on treatment systems with a patient positioning system.

This manual describes the parts of the workflow that are directly related to the delivery of treatment plans and controlling the patient positioning system:

- Handling treatment appointments created in RayCare
- Preparation of the patient positioning system for imaging and delivery in RayCommand
- Performing treatment delivery in RayCommand
- Monitoring the treatment machine and patient positioning system using the RayCommand Machine monitor

About this manual

This document is an addition to *RSL-D-RS-11B-USM, RayStation 11B User Manual* and summarizes some of the most important features of the RayCommand application.

The document includes appendices that are also parts of *RSL-D-RS-11B-USM, RayStation 11B User Manual* and *RSL-D-RS-11B-RPHY, RayStation 11B RayPhysics Manual*, relevant for RayCommand users.

Study this manual and the *RSL-D-RS-11B-IFU, RayStation 11B Instructions for Use* carefully before using the RayCommand application. Proper functioning of the device can only be guaranteed if the instructions in these documents are adhered to.

Study the Release Notes in this manual as well as the *RSL-D-RS-11B-RN, RayStation 11B Release Notes* carefully. These notes provide final instructions on how to use the RayCommand application.

The RayStation 11B system is further described in the RayStation 11B product documentation.

Refer to the RayCare 5B product documentation for information about the RayCare 5B system.

2 PRODUCT INFORMATION

This chapter describes the RayCommand product label. For product information regarding the RayStation 11B system, refer to the *RSL-D-RS-11B-IFU, RayStation 11B Instructions for Use*.

The version number of an installed RayStation 11B system can be found by choosing **Help: About RayStation** in the RayCommand menu.

The following information can be identified:

- Product name = RayStation
- **产品型号: RayStation** (for the Chinese market only)
- Release version = **12.0**
- Marketing name = RayStation RayCommand 2B
- Software build number = **12.0.0.932**
- Clinical build = Indicates that the software is designed for clinical use.

Note: A clinical installation requires both a clinical build and a clinical license. Otherwise, 'Not for clinical use' will be displayed in the title bar.

- Product lifetime = The lifetime per market is one year after the next major release, but no less than three years
- Radiation Treatment Planning System Software = The generic name of the product

- **产品名称: 放射治疗计划系统软件** (for the Chinese market only)
- **MD** = Indicates that the product is a medical device
- **UDI** = Unique Device Identification number
- **CE 2862** = The CE mark and the notified body number
- **🏭** = Production date
- **📖** = Consult instructions for use
- **🏭** = The name and address of the manufacturer
- **@** = The support e-mail address



Figure 1. The **About RayCommand** dialog.

3 INFORMATION NEEDED FOR SAFE OPERATION

Adhere to the following warnings as well as the warnings described in *RSL-D-RS-11B-IFU, RayStation 11B Instructions for Use* for safe operation of the RayCommand application.

3.1 SAFETY PRECAUTIONS

3.1.1 General warnings

WARNING!



Ensure sufficient training. The user organization shall ensure that individuals authorized to perform treatment functions are appropriately trained for the functions they perform. Only individuals authorized to enter and accept machine setup or other patient treatment data should use this software. Carefully read all instructions prior to use. The user is responsible for proper clinical use and the prescribed radiation dose.

[334374]

WARNING!



Installation and reconfiguration testing. The correct functioning of RayCommand depends on configuration and external systems. Configuration changes in RayCommand, RayCare or RayStation require testing according to *RSL-D-RS-11B-RCMDITS, RayStation 11B RayCommand 2B Installation Test Specification*.

[334371]

WARNING!



Ensure unobstructed view of patient. Always ensure unobstructed view of the patient before and during irradiation or any other activity related to risk of patient safety.

(334373)

WARNING!



Only results from completed treatment sessions are displayed in RayCare. The results of the treatment sessions will not be displayed in RayCare until the session is completed. If it is not possible to complete the session, the result will not be displayed in RayCare.

(334370)

WARNING!



Safety when moving gantry and snout. When the patient is finally positioned for treatment, the gantry and snout positions must be verified before the last medical personnel leaves the treatment room.

(334391)

WARNING!



Safety when moving table top. When using the motion service in RayCommand to move the patient positioning device, the user operating the Operator Deadman's Switch (ODS) must be attentive during the complete range of movement. The ODS must be released immediately when there is a risk of collision or patient injury.

(334372)

WARNING!



Patient movement between imaging and completed treatment. Patient movement between imaging and completed treatment is not automatically detected. Patient movement after imaging may cause incorrect patient setup.

(334434)

WARNING!

Some state may not be persisted in services or drivers. If the RayCommand room driver is restarted, the driver's cache of the state of external systems is lost. After a restart, the state will be unknown until the external system is reset.

(334439)

WARNING!

Configuration of treatment room machine models. Only compatible machine models must be listed in the machine models list when configuring the treatment room. Incorrect configuration can cause failure of service or incorrect treatment delivery.

(342666)

WARNING!

Review automatic registration. Always ensure that the automatic registration between the setup images and the planning CT is properly done by manually reviewing the result.

(344618)

WARNING!

Imaging ring position. RayCommand does not detect if the imaging ring is blocking the beam. Before delivering the beam, always ensure that the imager source, detector and ring are in a safe position that does not block the beam path.

(344503)

WARNING!



Possible to approve/export plan with outdated setup instructions. In RayStation, the fixation devices in the setup instructions are cached when a patient is loaded in RayStation and remain unchanged as long as the patient is opened. Hence, warnings related to fixation devices at plan approval/export will operate on old data if the setup instructions have been changed elsewhere while the patient was opened in RayStation. A consequence is that any actions performed in RayStation that depend on setup instructions (e.g., creation of fixation device ROIs, performing a collision check, etc.) may be invalid.

[408999]

WARNING!



Possible to approve/export plan with collision based on outdated imaging device transformation. The RayStation collision check result is not invalidated if the imaging device transformation (IDT) vector for the treatment room is changed in Clinic Settings. It is the user's responsibility to ensure that the collision check is re-run for unapproved beam sets if the IDT is updated.

[409517]

WARNING!



Changing IDT requires re-assignment of beam sets to ongoing treatment courses. A changed IDT affects the calculated table top positions in the plan, thus the beam set to be used in subsequent sessions must be re-added to the Treatment Course via the Use plan in treatment course dialog to apply the updated IDT.

[410055]

WARNING!



Room view is an approximate representation of the treatment room and must not be used for determining patient setup or collisions. Room view is not sufficiently accurate for determining patient setup or collisions.

[410298]

WARNING!

Collision check not supported for gantry, snout or imager movements. Collision check is limited to table top movements. Extra caution must be taken when moving gantry and snout to avoid collision with equipment or patient and ensuring that imaging protocols are only executed when the table top is in a safe position.

(409667)

WARNING!

Ensure that the correct setup beam is used for imaging. In RayCommand there is no connection between the setup beams and the treatment beams. For plans with multiple isocenters, the user must be aware of the risk of using the wrong setup beam. If setup images are acquired based on the wrong imaging position, the patient displacement for the resulting registration may be unsuitable for the treatment beam. Always give the setup beam a unique and understandable name so that the correct setup beam is selected for image acquisition and registration before beam delivery. The body site for the setup beams can be used as a redundant indication of where the setup beam isocenter is positioned.

(410108, 410398)

4 RELEASE NOTES

This chapter contains important notes about the use of the RayCommand application. It contains information related to patient safety and lists new features, known issues and possible workarounds.

Every user of the RayCommand application must be familiar with these known issues as well as the known issues described in *RSL-D-RS-11B-RN, RayStation 11B Release Notes*. Contact the manufacturer for any questions about the content.

Note: *Beware that additional safety-related release notes may be distributed separately within a month of software installation.*

In this chapter

This chapter contains the following sections:

4.1	Known issues related to patient safety	p. 18
4.2	Other known issues	p. 19

4.1 KNOWN ISSUES RELATED TO PATIENT SAFETY

Possible to start session when setup instruction versions differ

The setup instructions in RayCommand may not be updated with the latest version of the setup instructions from RayCare. Verify that the setup instructions are up-to-date by comparing the instructions between RayCommand and RayCare.

[332782]

Confirm preparation state is not cleared when stopping a session

The *Confirm preparation* state is saved and persisted in a session and is not cleared when the session is stopped. Updating the patient setup instructions does not invalidate the state. Always check and redo all patient setup instructions, including fixation devices, when resuming a session.

[409600]

Patient weight and size are not retrieved from RayCare for image acquisition requests

The imaging acquisition request sent to MedPhoton Console does not use *Patient Weight* and *Patient Size* from RayCare. *Patient Weight* is taken from planning images (CT) or uses the default value 70 (kg). *Patient Size* is taken from planning images (CT) or uses default value 1.7 (m). Adjust the imaging energy as needed from the MedPhoton Console before initiating the imaging protocol.

[410401]

The continuation operation Next beam is not working

The continuation operation *Next beam* is not working. This applies both to in-session continuation (continuing from an interruption) and continuation sessions. An error is displayed during *Initiate beam line* with the following warning message: *Could not initiate beam line, driver reported 400: Severity: FailRequest, Continuation operation has not been specified*. A make-up plan must be created in RayStation and assigned to the treatment course if the remainder of the beam is less than the possible minimum with regards to energy layer and spot.

[410868]

Avatar and fixation devices not included in the path planning collision model

Path planning does not account for patient and fixation device structures in collision detection. RayStation Collision check must be executed to determine beam feasibility with regards to patient and fixation device geometries. Correction vectors outside the setup margins shall be interpreted as a collision even though the path planning is successful.

[411019]

4.2 OTHER KNOWN ISSUES

Check the status of previous offline image reviews in RayCare before starting a treatment session

There is no warning when starting a treatment session when there are rejected offline image reviews for the treatment course. The user must check in RayCare to see the status of previous offline image reviews.

(333534)

Verify that all tasks have been completed before completing session

It is possible to complete a session in RayCommand without having completed all the configured tasks from the RayCare workflow. The user must verify that all tasks are completed before completing the session.

(345098)

Site prescriptions cannot be delivered

Only ROI prescriptions can be used in RayCommand. Avoid creating plans with any other prescription type.

(344850)

Beamline name is not shown

The name of the beamline is not shown in the *Beam preparation* panel. Make sure that the correct beamline is selected when working in a room with several beamlines by looking at the gantry angle.

(335201)

Rotation point for patient displacement when geometry is missing in prescription ROI

The rotation point used for patient displacement in RayCommand is set to the geometrical center of the primary prescription ROI. If the primary prescription ROI does not have a geometry, the rotation point is set to 0,0,0 (Right-Left, Inf-Sup, Post-Ant).

(410343)

Plan specific tolerance table updates will not affect delivery

If a tolerance table for a beam set is updated using scripting, it will not be used for treatment. Only the template tolerance table will be used.

(406811)

PPS dialog: Memory leak may result in slow response from the system

The *Room navigator* allocates 150-200MB each time it is opened. When it is closed, the memory is not reclaimed. Restarting the main monitor will release the memory. If the system is responding slowly, try restarting the main monitor.

(398406)

The patient card for QA sessions does not show Case/Care plan

Verify that the correct plan is loaded when starting QA session.

[407612]

Entering Error mode does not fail ongoing sessions

The session should fail directly when system goes into Error mode. However, the result will incorrectly be indicated as Partially delivered. This only affects the treatment course overview.

[407793]

Room IR3 must define same nozzle elements as room IR2

The IR2 and IR3 rooms must be identically configured in Clinic Settings. The *Room navigator* in MedAustron room IR3 allows ad-hoc movements of vertical nozzle elements even though the room does not have a vertical nozzle. Using the command for moving the vertical nozzle elements in IR3 will result in an error message.

[407995]

Ensure correct room configuration

Ensure that the correct room is configured before moving any components in the room by using the *Room navigator* or the Delivery module. Use the *Room view* to verify the currently configured room of the motion service.

[410386]

Inconsistent treatment record data sent to PACS

Treatment records produced by RayCommand always contain the original values for Final Cumulative Meterset Weight (300A,010E) and Cumulative Meterset Weight (300A, 0134). Post processing of these files must use Scan spot Meterset Weights (300A,0396) to determine the delivered meterset for a given session.

[410594]

Confirm beam is not stored in audit log

The action *Confirm beam* is not stored as a separate action in the audit log.

[410696]

Incorrect spot map for first beam in continuation session

When opening or starting a continuation session, the first beam to be delivered will show an incorrect spot map until the continuation has been created by clicking the *Create continuation* button.

[410786]

Beamline for continuation session cannot be initiated

When using the *Next layer* option for an in-session continuation, the beam might not reach its planned meterset (within tolerance). If that is the case, the session cannot be used as base for a scheduled continuation session.

[410865]

Collapse gantry angle button is shown inconsistently

The *Collapse gantry angle* button is hidden in Physics/QA mode and shown as enabled in Clinical mode. Restart of RayCommand Main Monitor solves the issue.

(410951)

5 RAYCOMMAND

In this chapter

This chapter contains the following sections:

5.1	System overview	p. 24
5.2	Main monitor modules and workflow	p. 27
5.3	Machine monitor	p. 39
5.4	System health	p. 40
5.5	Patient positioning	p. 43
5.6	Physics mode	p. 46
5.7	Machine parameter verification	p. 49

5.1 SYSTEM OVERVIEW

The RayCommand 2B system consists of two different applications: *RayCommand Main monitor* and *RayCommand Machine monitor*. The applications are intended to be run on one monitor each. Together they constitute a dual screen control system for the treatment control room.

Information displayed on the two monitors is meant to supplement each other. To get the best experience, the Machine monitor should be placed adjacent to the right of the Main monitor in the control room.

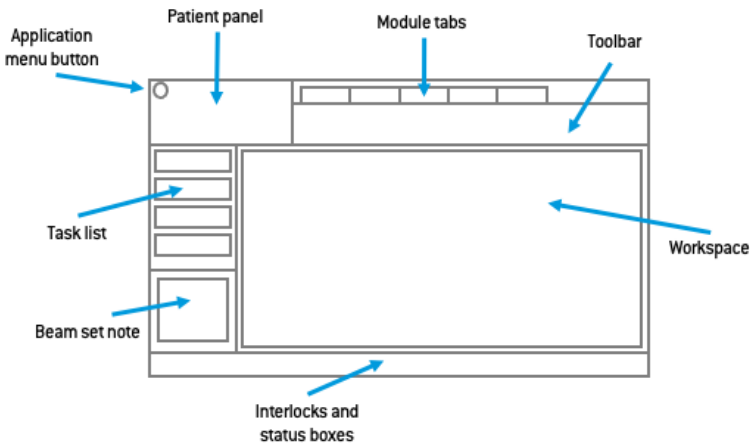
An additional RayCommand Main monitor application can also be run separately, for example inside the treatment room.

5.1.1 Main monitor

The Main monitor provides workflow support and provides the user with tools and information for managing and delivering a selected session.

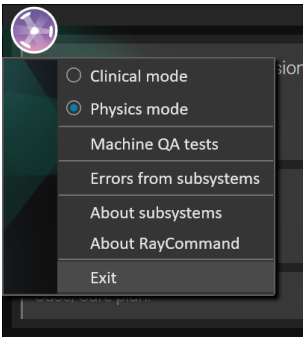
The list of tasks guides the user through the predefined activities to perform during the session. However, the user is always free to navigate to other parts of the interface.

The user interface in the Main monitor is divided into several areas:



Application menu

The application menu button opens a menu with general application functionality. The application menu is opened by clicking the RayCommand icon in the upper left corner.



- **Clinical mode** – Normal treatment of patients.
- **Physics mode** – Non-clinical task, see *section 5.6 Physics mode on page 46*.
- **Machine QA tests** – Used to perform machine QA tests. Only available in Physics mode. See *section 5.6.1 Machine QA tests on page 48*.
- **Errors from subsystems** – Shows errors received from external subsystems, for example MAPTA and Exacure.
- **About subsystems** – Shows information collected from external subsystems, for example configuration version.

Patient panel

The **Patient** panel shows information about the patient for the current session.

Module tabs

The RayCommand application is divided into different parts called *modules*, which represent well-defined treatment activities. A module is accessed by clicking its module tab. The module tabs are placed sequentially from left to right, according to a typical treatment delivery workflow.

The treatment activities are:

- **Schedule**
- **Preparation**
- **Imaging**
- **Delivery**
- **Results**

Toolbar

The toolbar contains tools and information related to the session and the selected module. Some content in the toolbar is available in several modules.

Delivery information

During irradiation the progress of the beam delivery (current layer of total layers) is displayed.

Session information

The session information shows information about the current session, the plan and beam set to be delivered, and the modality of the treatment.

Task list

The task list guides the user through the tasks that have been assigned to the patient for the current session. Tasks are defined in RayCare as a part of the patient's care plan.

The task list panel is available in all modules apart from the Schedule module as soon as a session has been started.

Click on a task in the task list to open the **Task properties** dialog. Here the task can be set to completed.

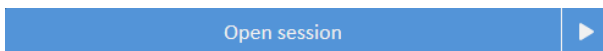
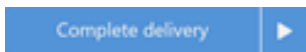
Beam set note

This note comes from the beam set note in **Treatment course**. If the note is edited and saved, the edited note will be visible in sessions using this beam set. All saved changes to the note are transferred to RayCare.

Workflow button

Click on the **Workflow** button to complete the main activity in the current module.

- Click on the button to complete the activity without moving to the next module.
- Click on the arrow to complete the activity and navigate to the next module.



Workspace area

The workspace area displays information and functionality that is specific for the selected module.

Interlock and system status

Along the bottom of the main monitor, interlock and system status is displayed. This information is helpful to get a quick overview of the current state. Tooltips about subsystems show detailed status. Clicking on **System status** opens up a detailed view of individual service health status, and detailed error information if system health is degraded.

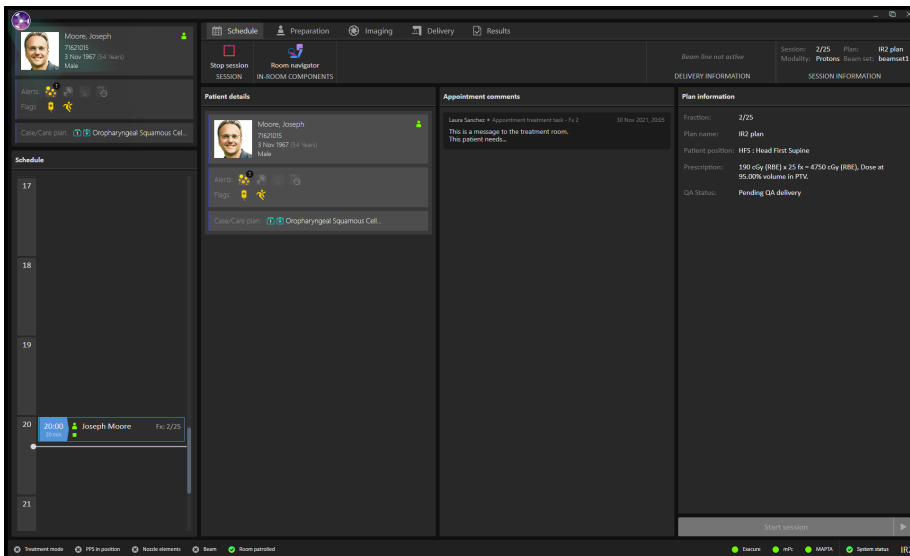
5.1.2 Machine monitor

The Machine monitor application complements the Main monitor with real time information from inside the treatment room and from the different devices included.

The main purpose of the Machine monitor application is to monitor the treatment devices. The interface is fixed, and all content is in the same place all the time. This provides users with current information and situational awareness.

5.2 MAIN MONITOR MODULES AND WORKFLOW

5.2.1 Schedule module



Schedule panel

The **Schedule** panel lists the appointments made for a treatment room. Appointments are scheduled in RayCare. An appointment is associated with a patient and a treatment session.

Select an appointment in the **Schedule** panel to get an overview of the patient and the associated treatment session in the **Patient details** panel.

Note: *The patient information shown in the Patient details panel is not necessarily the patient information for the patient in the currently active treatment session. The current patient is always displayed in the Patient panel (to the upper left in the user interface).*

Appointments



Treatment appointments are listed to the left in the **Schedule** workspace. Each appointment is summarized in a treatment appointment tile.










The treatment appointment tile contains the following information:

- Scheduled start time for the treatment appointment
- Estimated duration of the appointment
- Patient check-in status
- Session validation status
- Patient name
- Fraction number out of the total number of fractions. Fraction one is explicitly indicated by a grey background.

The patient check-in status can have the following states:

Patient status	Description
	Patient has not been checked in from RayCare
	Patient has been checked in from RayCare

The following session validation statuses exist:

Session status	Description
	Session has not been validated
	Session is being validated
	Session successfully validated and is ready for delivery
	Session has been canceled
	Session has been delivered and closed
	Session validated with a warning but can still be started
	Session validated with an error and cannot be started

The selected appointment is indicated with a blue frame in the schedule. Information about the patient in the selected appointment is displayed in the **Patient details** panel.

An appointment where a session has been started is indicated by a blue arrow in the left part of the treatment appointment tile:



The patient in the started session is displayed in the **Patient** panel.

Note: *It is possible to deliver a plan in all rooms in which the appointed machine model is possible to use for delivering a plan.*

Patient details panel

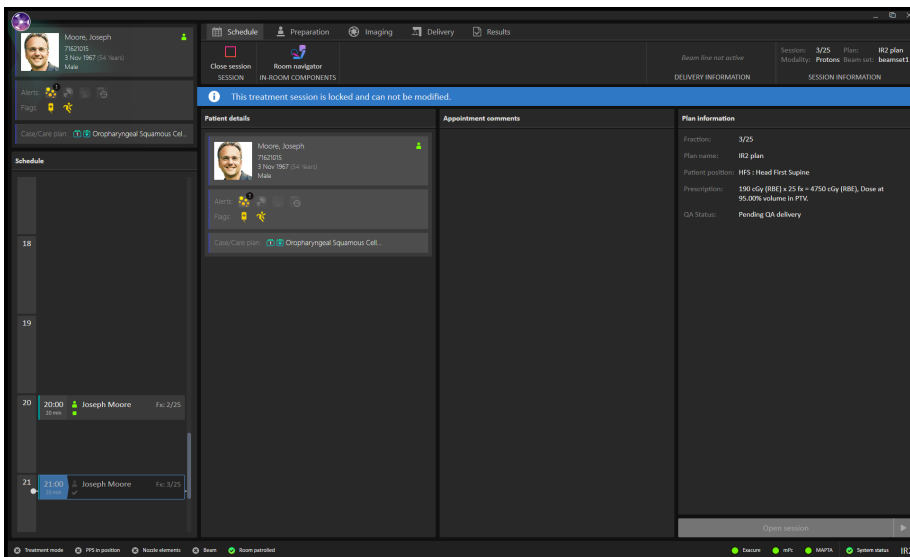
The **Patient details** panel displays information about the patient in the selected appointment.

Open session button

It is possible to open a session in read-only mode if the patient has not been checked-in or the treatment has been delivered.

Click the **Open session** button to view the treatment session selected in the appointment schedule, without navigating to the next module.

Click on the arrow to open the selected treatment session and navigate to the next module (**Preparation**).



Start session button

Click the **Start session** button to start the treatment session selected in the appointment schedule without navigating to the next module. Click on the arrow start the selected treatment session and navigate to the next module (**Preparation**).

Workflow – MedAustron

For a treatment session to start, the patient must be checked in from RayCare and the treatment session must be successfully validated. If the session is not successfully validated it is possible to right-click on the session to see why the validation did not pass, and also to restart the validation after the error has been fixed.

To start a session, select the appointment tile in the schedule and click the **Start session** button.

5.2.2 Preparation module



Setup note panel

The **Setup note** panel displays the setup notes created during setup in RayCare.

Fixation devices panel

The **Fixation devices** panel displays a checklist of all devices to be used for patient positioning, defined during setup in RayCare. When a fixation device has been applied, the corresponding checkbox must be selected. If all checkboxes are not selected the user must save a statement of why all fixation devices are not used.

Photos panel

The **Photos** panel displays the photos taken in RayCare during setup of the patient. If several photos are available, they are listed as thumbnails horizontally at the bottom. Select a thumbnail to display the photo in the panel.

Confirm preparation button

Click the **Confirm preparation** button to confirm that the patient setup has been performed as instructed. If all listed fixation devices have not been checked, a reason for this must be provided and signed before preparation can be confirmed.

Clicking the button will confirm the setup without navigating to the next module. Clicking on the arrow will confirm the patient setup and navigate to the next module (**Imaging**).

Confirm patient ID

Click the **Confirm patient ID** button after verifying that the identity of the patient in the room matches the patient for which the session is started. The patient ID must have been confirmed before setup images can be acquired.

Workflow – MedAustron

1. Verify the identity of the patient and then click the **Confirm patient ID** button.
2. Click the **Room navigator** button to open the **Room navigator** dialog.
3. Select the pre-defined target position for patient setup.
4. Click the buttons on the control console to execute the move of the patient positioner to the selected target position.
5. Apply the listed fixation devices. Verify the application of each device by selecting the corresponding checkbox.
6. Position the patient according to the photos and the setup instructions in the setup note.
7. Click the **Confirm preparation** button to confirm that the patient setup is correct.

5.2.3 Imaging module

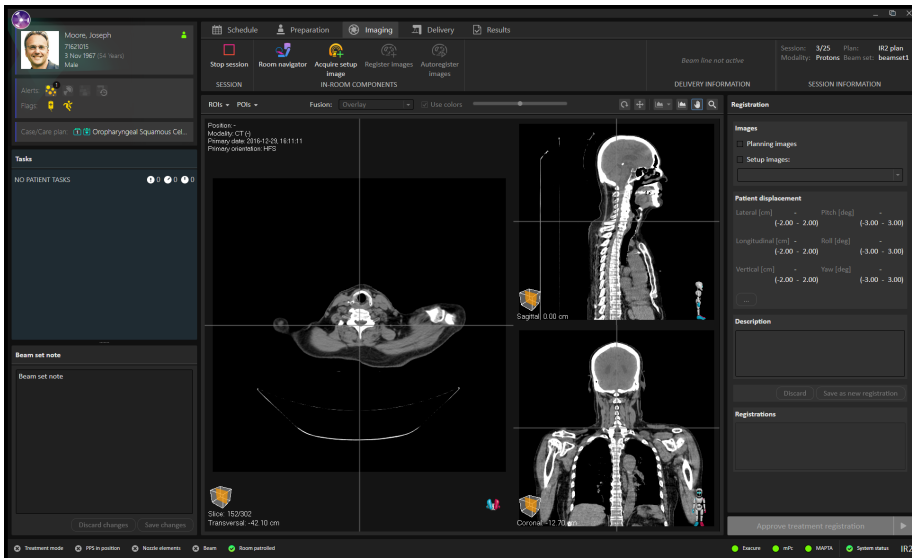
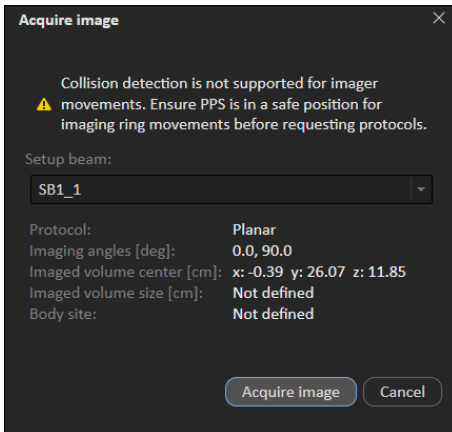


Image area

By default, the image area displays the planning CT image from the plan. When setup images have been acquired, and a registration between the planning images and the setup images has been performed, the fusion between the planning images and the setup images using the selected registration is displayed in the views.

When clicking the **Acquire image** button the settings for the setup image are shown, including information about the field-of-view and the body site selected in RayStation for the setup image.



Registration panel

The **Registration** panel manages images and registrations for the current session.

It is possible to select to show the ROIs and POIs for the plan, to make it easier to register the DRR against the daily setup image. The registration can be done by selecting rotation or translation icons and press the left mouse button. It is also possible to hold down the SHIFT keyboard button while dragging the mouse with the translation tool active, to only translate in one direction. It is possible to modify the roll angle on the registration by holding down the SHIFT keyboard button while dragging the mouse with the rotation tool active.

The correction vector will be shown in the section **Patient displacement** together with the setup margins read from RayStation.

To approve a registration, select an image and a registration object in the **Registration** panel and click **Save as new registration**. Then click the **Approve treatment registration** button.

Approve treatment registration button

Click the **Approve treatment registration** button to approve the selected registration without navigating to the next module. Click on the arrow to approve the registration and navigate to the next module (**Delivery**).

WARNING!



Review automatic registration. Always ensure that the automatic registration between the setup images and the planning CT is properly done by manually reviewing the result.

[344618]

Workflow - MedAustron

1. Click the **Room navigator** button to open the **Room navigator** dialog.
2. Select a pre-defined target position for imaging.
3. Use the control console to execute the move of the patient positioner to the selected target position.
4. Click the **Acquire setup image** button to request an image acquisition from the MedPhoton Controls system. If setup beams are available with an imaging device selected and an imaged volume defined, a protocol for the image acquisition can be selected from the list of setup beams. The angle offsets defined in the protocol are applied to the gantry angle of the setup beam to calculate the imaging angles, and the imaging volume corresponds to the volume of interest in the MedPhoton Controls system.
5. Perform imaging acquisition in the MedPhoton application.
6. Click the **Register Images** button.
7. [Optional] Select ROIs or POIs to be shown, to facilitate the registration.

8. If needed, manually adjust the registration by using the registration tools available in the image area.
9. Save the modified registration by clicking the **Save as new registration** button.
10. Add a description for the registration and confirm saving.
11. (Optional) Click the **Auto register images** button to get an automatic 2D-3D registration with the current registration as input.
12. Click the **Approve treatment registration** button to approve the registration for treatment.

5.2.4 Delivery module

No.	Name	Modality	Isocenter name	Gantry [deg]	Meterset	Delivered	Snout Name	Planned [cm]	Delivered [cm]	Status
1	Beam1	Protons	Isocenter1.1	90.00	3727955436.80 NP	0.00 NP		64.80	0.00	Not delivered

No.	Nominal energy [MeV/A]	Relative Weight [%]	No. of spots
10	162.60	1.56	8
11	168.50	1.08	6
12	158.80	0.99	6
13	156.30	0.91	7
..	154.70	0.91	7

Beams panel

The **Beams** panel displays a list of beams for the plan. When a beam has been successfully delivered it is marked with a green checkmark in the beam list.

The spot map shows the positions of the specified spots in the energy layer selected in the **Energy layers** table.

Beam preparation panel

The **Beam preparation** panel displays the beam and the devices that have been prepared for delivery of the beam.

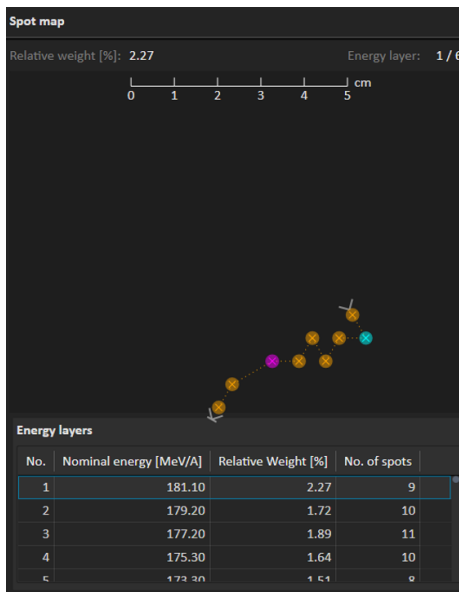
The **Gantry** and **Snout** boxes are only shown in a room that has a gantry and a movable snout.

Room view panel

The **Room view** panel displays the in-room components and their positions in the room.

Spot map panel

The **Spot map** panel displays spot positions for the selected energy layer. The current layer is marked with a blue box. The heaviest and lightest spots per layer are coloured with purple and blue. The direction of the spot delivery order is indicated with entrance and exit spot.



Complete delivery button

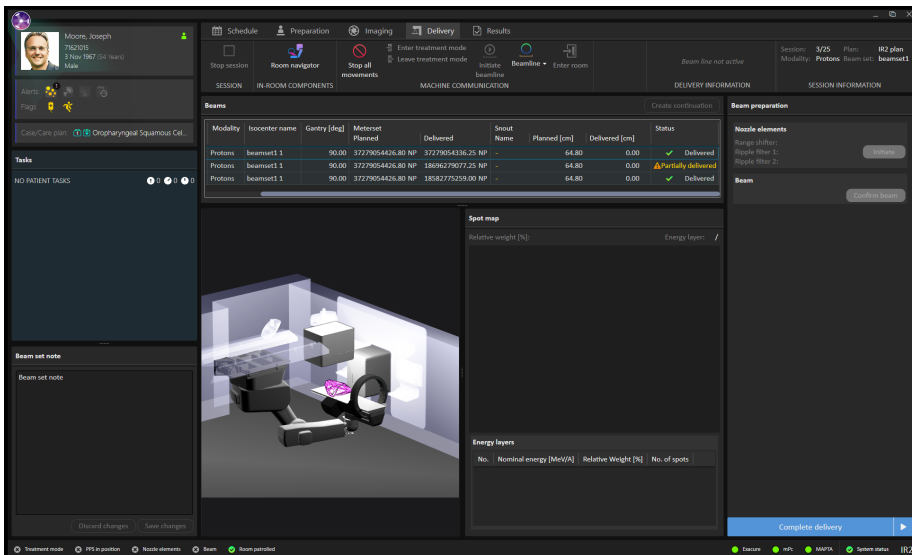
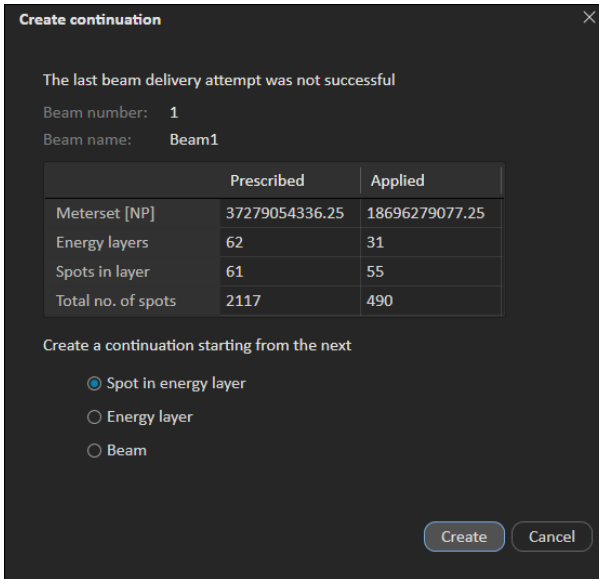
Click the **Complete delivery** button to complete the delivery and set the status for the treatment session to *delivered* without navigating to the next module. Click on the arrow to complete delivery and navigate to the next module (**Results**).

Continuation sessions

If a beam has been interrupted it is possible to continue the delivery, either in the current session or as a new session.

The continuation session can be planned to continue either from the next spot, from the next energy layer or from the next beam in the plan.

If the delivery can be continued within the current session, a continuation session is created by clicking on the **Create continuation** button above the beam list. The beamline then needs to be re-initiated, and the continuation can be started.



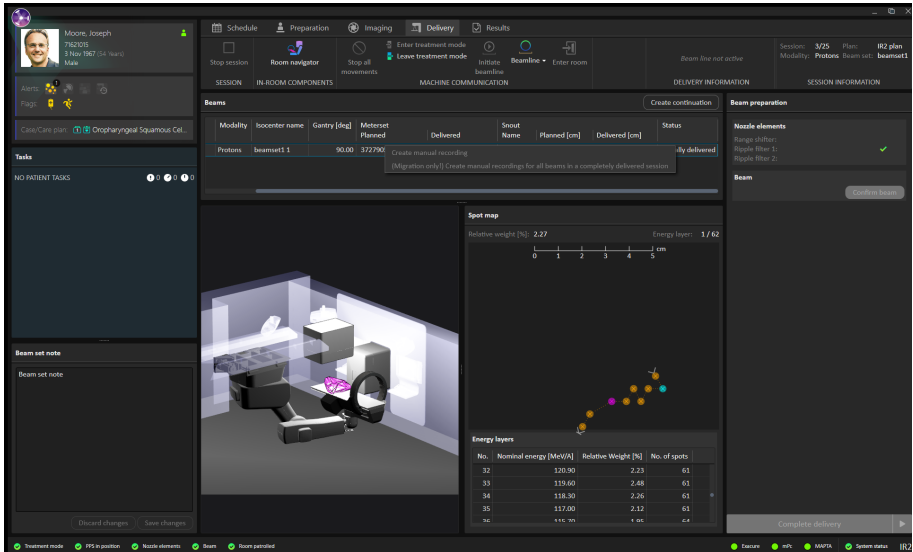
If the continuation of the delivery will be done in a new session, the user must first leave treatment mode and complete the delivery, then sign the session in the **Results** module. The checkmark indicates that the rest of the beam must be planned in a new session.

When the session has been scheduled in RayCare and later starts in RayCommand again, the user must select how to create the continuation session by clicking on the **Create continuation** button above the beam list.

Manual recording

In case the treatment record is not delivered from MAPTA, it is possible to manually record the delivered dose in RayCommand.

1. Right-click on the beam that has been delivered.



2. Enter the last delivered energy layer and spot. RayCommand will record the dose as 'delivered' according to the plan, up till the layer and spot.

Manual Recording ✕

Beam number:

Beam name:

Planned meterset for fraction:

Last energy layer:

Last spot:

Manually recorded:

Total recorded meterset for fraction:

If no treatment record is received after a delivery, RayCommand will be in 'degraded' mode until the treatment has been manually recorded.

Workflow (MedAustron)

1. Click the **Room navigator** button to open the **Room navigator** dialog.

2. Select the target position for the beam.
The motion planning bar shows the progress status.
3. Use the control console to move of the patient positioner to the selected target position.
4. Click the **Move gantry** button to rotate the gantry to the target position (if applicable).
5. Click the **Set nozzle elements** button to set the position of the nozzle elements to the planned position.
6. Click the **Move snout** button to prepare the snout and move it to the target position (if applicable).
7. Click the **Enter treatment mode** button in the toolbar to lock all devices and set them in treatment mode.
8. Click the **Confirm beam** button to prepare the beam for delivery. Use the treatment control console to deliver the beam. If machine parameter verification fails, a dialog will be shown with the status of all invalid parameters or required overrides.
9. When all beams are delivered, click the **Complete delivery** button to set the status for the treatment session to delivered.

Note: Resumption from interrupted delivery can be done after re-initiating gantry angle and snout position.

5.2.5 Results module

The screenshot displays the RayCommand Results module interface. The top navigation bar includes tabs for Schedule, Preparation, Imaging, Delivery, and Results. The main area is divided into several sections:

- Patient Profile:** Moore, Joseph, 71622015, 3 Nov 1987 (64 years), Male.
- Alerts:** No alerts shown.
- Case Case type:** Oropharyngeal Squamous Cel.
- Tasks:** NO PATIENT TASKS.
- Beams Table:**

No.	Name	Modality	Incenter name	Gantry [deg]	Isocenter Planned	Isocenter Delivered	Snout Name	Planned [cm]	Delivered [cm]	Status
1	Beam1	Protons	beams11	90.00	37279054426.80 NP	37279054438.25 NP		64.80	0.00	Delivered
	Beam1	Protons	beams11	90.00	37279054426.80 NP	18086279077.25 NP		64.80	0.00	Partially delivered
	Beam1	Protons	beams11	90.00	37279054426.80 NP	180842775259.00 NP		64.80	0.00	Delivered
- Spot map:** Relative weight [N]: 5.71. Energy layer: 31 / 31. The map shows a distribution of spots in a grid.
- Energy layers table:**

No.	Nominal energy [MeV/VA]	Relative Weight [N]	No. of spots
29	177.80	9.48	52
29	175.80	9.76	57
30	174.00	8.55	61
31	172.10	5.71	55

Beams panel

The **Beams** panel displays the list of beams that are to be delivered. Beams that have already been delivered are indicated by a green checkmark.

Spot map panel

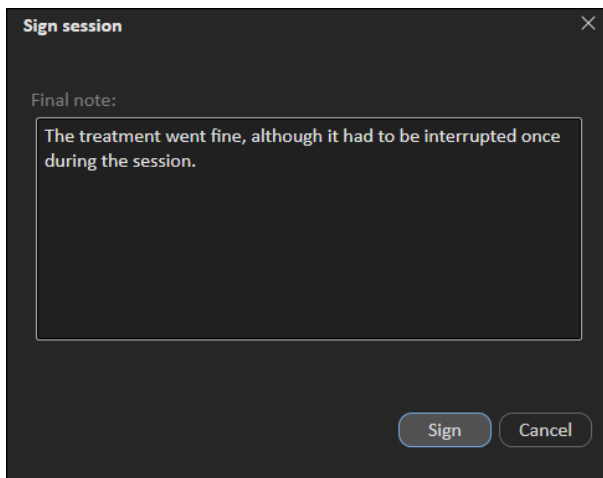
The **Spot map** panel displays delivered spots per energy layers.

Sign session button

Click the **Sign session** button to complete the treatment session without navigating to the next module. Click on the arrow to complete the treatment session and navigate back to the first module (**Schedule**).

It is possible to enter a final note for the session. This note will also be shown in RayCare.

It is also possible to select if a continuation session should be created if the session was not fully delivered. The session needs to be scheduled in RayCare.



Sign session ✕

Final note:

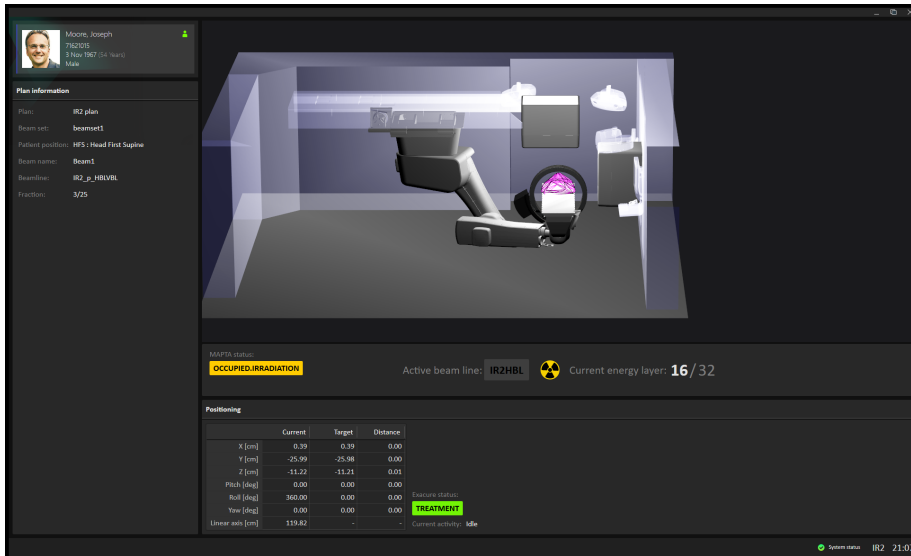
The treatment went fine, although it had to be interrupted once during the session.

Sign Cancel

5.3 MACHINE MONITOR

The content on the Machine monitor complements the information on the Main monitor, with real time information from inside the treatment room.

The Machine monitor requires no interaction from the user but is used for viewing information only.



5.3.1 Patient information panel

The **Patient information** panel displays information about the patient associated with the current session.

Irradiation status

The **Irradiation status** panel shows the current status of the irradiation system and which beamline that occupied the synchrotron.

During the irradiation the 'Radiation on' icon is active, and the progress of the beam (delivery of the energy layer information) is shown.

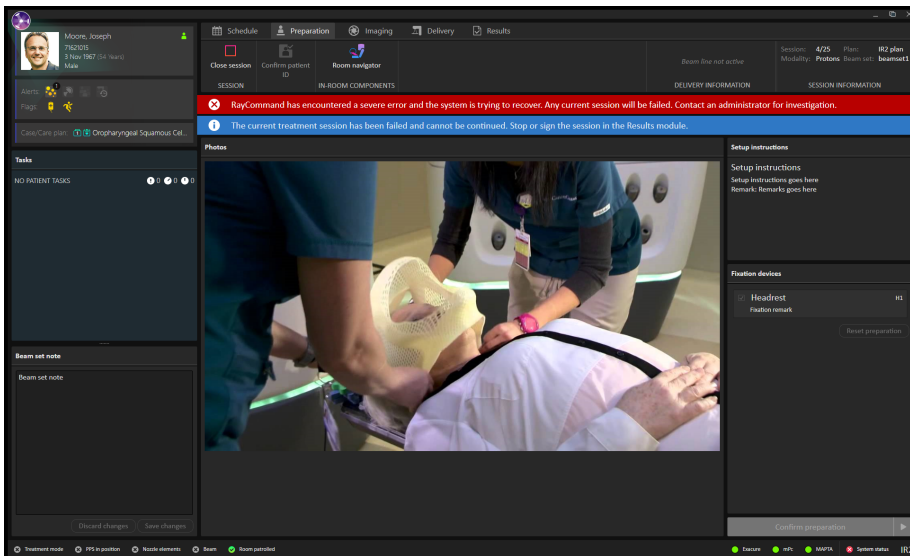
5.3.2 Patient positioning system

The coordinates for the patient positioner show the current position of the patient positioner, the target position and the estimated distance between them.

Note: *The actual distance may differ from the estimated distance if the calculated trajectory is not straight due to collision detection.*

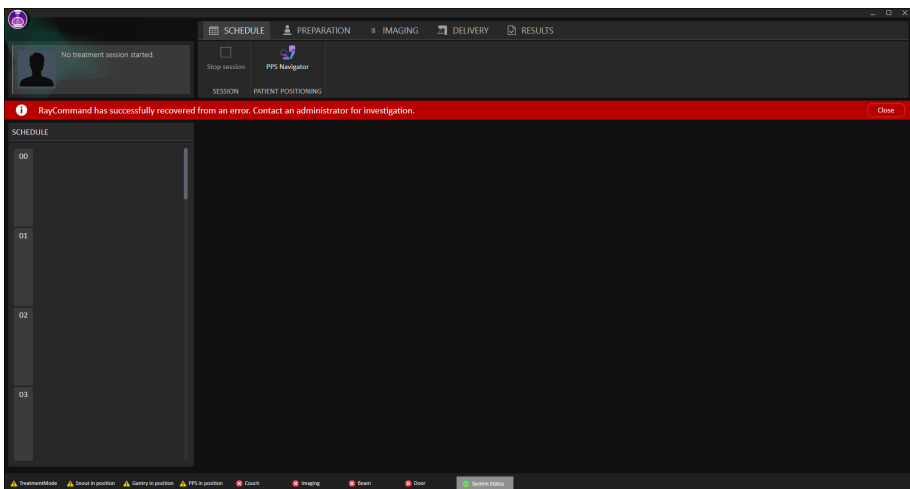
5.4 SYSTEM HEALTH

If some part of RayCommand has experienced a severe error, RayCommand will enter Error mode. A banner will be displayed at the top of the monitors:

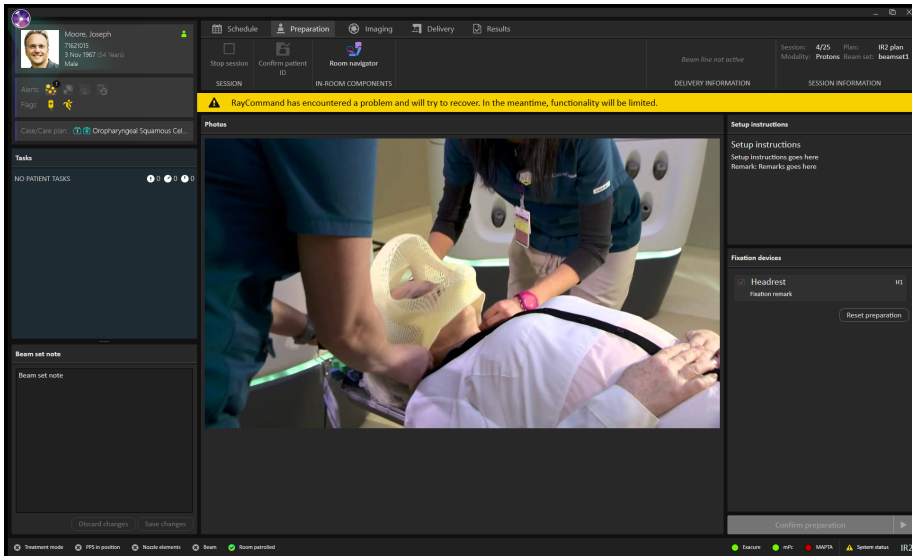


Interaction with a currently open session in the Main monitor will be limited, and the session state will be set to failed. An additional banner will be shown until the session has been stopped or completed.

Once the error has been resolved, the Main monitor will again allow full interaction and the banner with the error message can be closed:



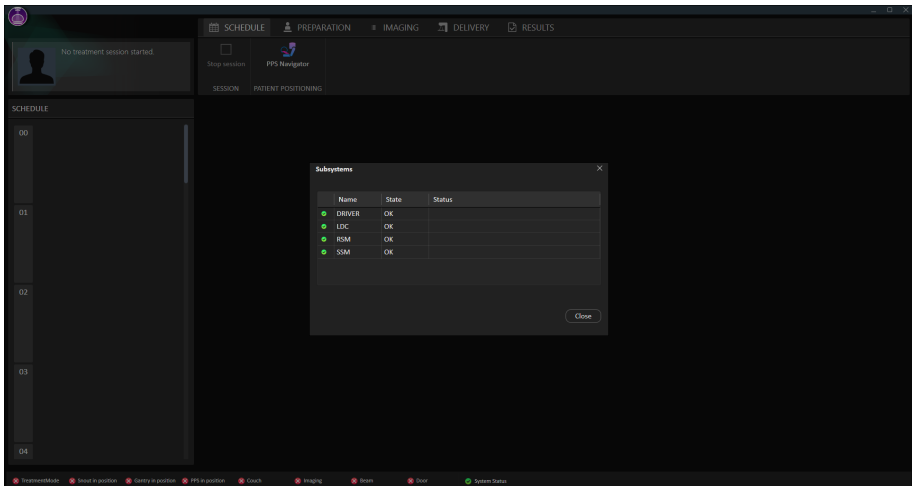
When an external system is faulty, RayCommand will enter Degraded mode. A banner with a different message is displayed:



Interaction in Degraded mode is as normal, but confirming beams and interaction with external systems in faulty state will not be possible.

Along the bottom of the main monitor, interlock and system status is displayed. This information is helpful to get a quick overview of the current state. Tooltips about subsystems show detailed status.

To see the status of each subsystem, the user can access the **Subsystems** dialog from the status bar. A list of any current errors per subsystem can also be viewed here.

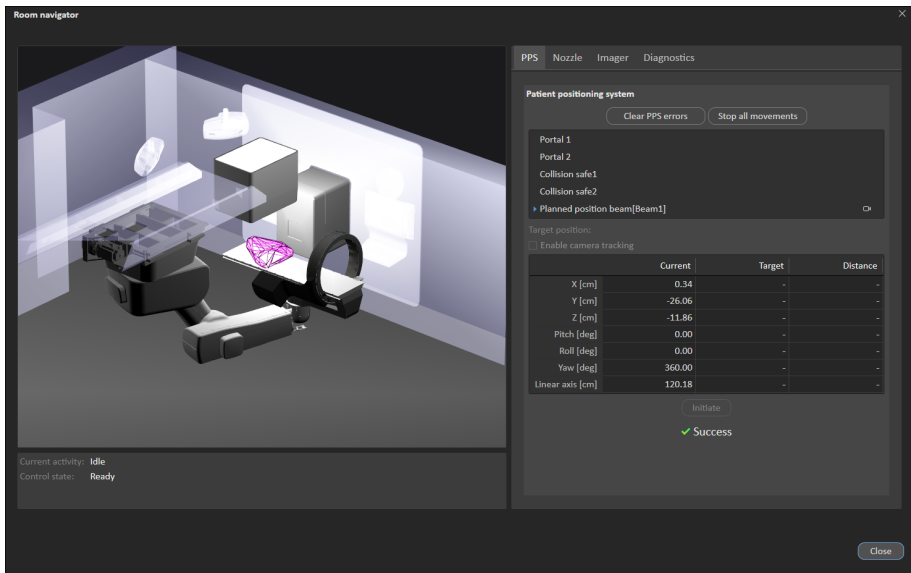


5.5 PATIENT POSITIONING

The patient positioning tools are located to the right of the toolbar and are available from all modules. Use these tools to control the position of the patient positioner.

5.5.1 Couch setup (MedAustron)

Click the **Room navigator** button in the toolbar to open the **Room navigator** dialog.



PPS tab

Available positions for the Patient Position System are either predefined at system setup or created based on the beams in the current plan. It is also possible to enter an ad hoc position in the target column for moving the PPS.

To move the Patient Positioning System (PPS) to a new position:

1. Select a position in the list of target positions, or enter an ad hoc position in the target column.
2. Press **Initiate**. The motion planning bar shows the progress status.
3. Use the control console to execute the move.

Coordinates for the patient positioner are shown in a table: current position, target position and the estimated distance between them. The same table is also displayed on the Machine monitor.

Note: *The displayed distance from the start to target may increase and decrease several times before finally converging to the target. This is because the calculated trajectory may not be a straight line in the room.*

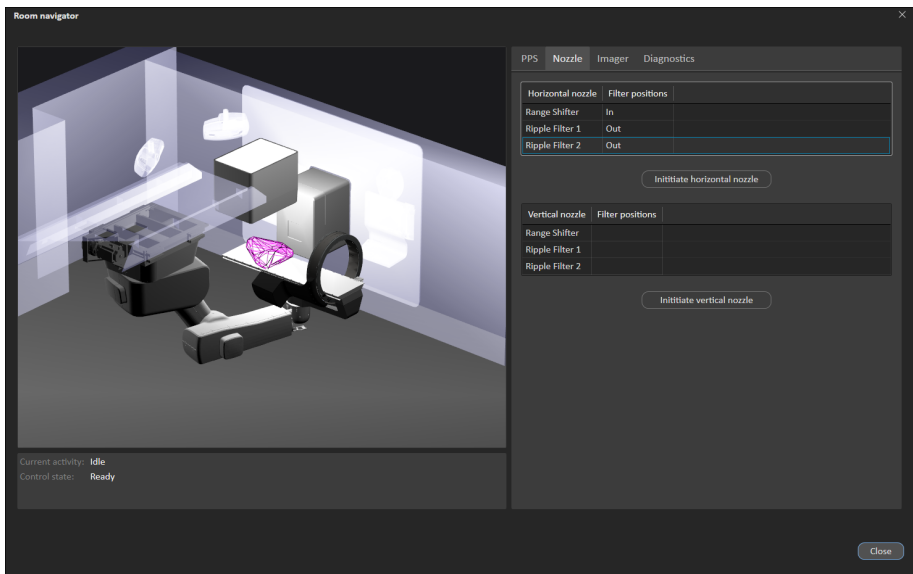
Gantry/Snout

Positions for the gantry and snout are available for irradiation rooms with a gantry and movable snout. There are predefined parking positions and a possibility to enter ad hoc positions for the gantry angle and snout extension.

The gantry/snout will move to the initiated position when the control console is used for executing the move.

Nozzle

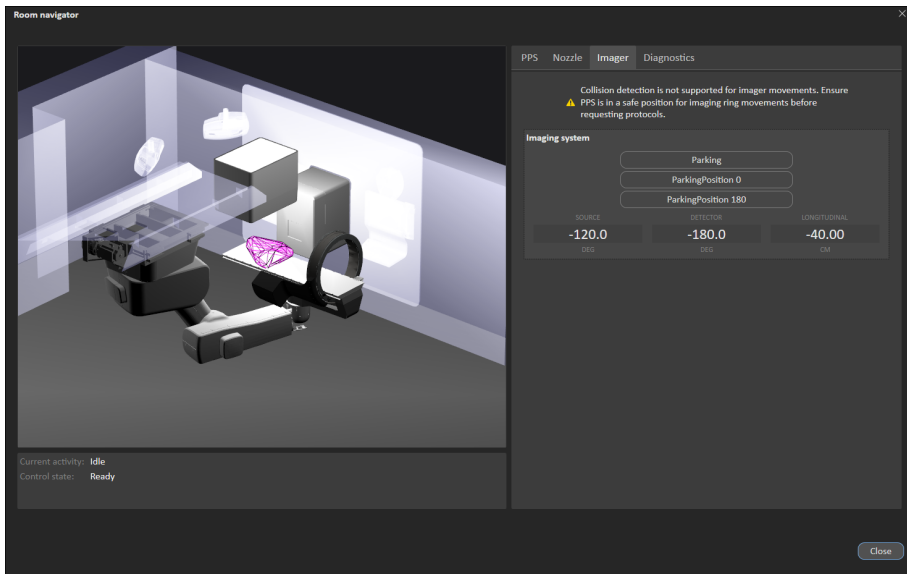
Available positions for the nozzle filters (In or Out) can be set, and the positions initiated ad hoc.



Imager

Available positions for the imager are predefined at system setup. The position is sent directly to the imager system when a parking position is selected.

The imager will move to the selected position when the control console is used for executing the move.



Diagnostics

The **Diagnostics** tab contains information nodes from Exacure, to provide access to OPC directly from RayCommand without the need of other tools. Values are updated without unnecessary delay.

5.5.2 Automatic motion planning

MedAustron installations of RayCommand provide support for *automatic motion planning*.

Without automatic motion planning, the PPS would take a direct path from start to target positions. When executed without supervision, the direct movement can result in physical contact between components such as in the following examples:

- Patient and nozzle
- Table Top with the nozzle
- Imager with the nozzle
- Imager C-arm with the robot arm

With the automatic motion planning feature enabled, when a target position is selected in the **Room navigator**, RayCommand automatically computes a collision-free PPS movement from the start position to the target position.

In both cases, the user must maintain visual contact of the PPS and anticipate collisions while executing the movement with the control console. See *chapter 3 Information needed for safe operation* for relevant safety precautions.

Considerations for automatic motion planning

There are some important considerations for automatic motion planning.

Determinism

The motion planner does not produce a deterministic solution. This means that if RayCommand plans a motion from position A to position B and later plans another motion from A to B, the second motion can be different than the first.

Since it is important for rehearsed movements to be repeatable after the patient mounts the table, RayCommand caches the motion within a treatment session so that all executions of the motion from A to B are the same. However, in a different treatment session, the motion from A to B from the previous session is not recalled and is instead recalculated.

Timeouts

The planner is not guaranteed to produce a solution. RayCommand imposes a configurable timeout on the planning time, typically 10 seconds. The more constrained the physical space, the more likely this timeout will be reached. If this occurs, it is recommended to try again. If multiple timeouts occur, try changing the start or target position or opening up the physical space, such as by retracting the nozzle or parking the imager.

Contact margins

Motion planning performance is sensitive to the preconfigured contact margins, which specify how close objects can get and in what context. For example, when the PPS is moving, in a suggested configuration, the table top may only approach to 10 cm from the nozzle, but when the nozzle is moving, the nozzle could approach to 0.5 cm from the table top. The contact margins may differ by mode (Service, Physics, Clinical). For Clinical mode, they are locked after customer acceptance. Contact RaySearch if you wish to customize the contact margins for Clinical mode.

Handedness

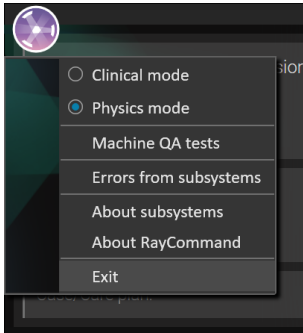
In some positions, the PPS robot arm can take a 'left' or 'right' handed configuration. Due to technical limitations, RayCommand cannot control which handedness the robot takes. As a rule of thumb, the system attempts to preserve the current handedness unless it is not physically feasible.

5.6 PHYSICS MODE

In Physics mode the user can perform the same activities as in Clinical mode, but the rules in Clinical mode do not apply in Physics mode (e.g., the user can perform activities in any order).

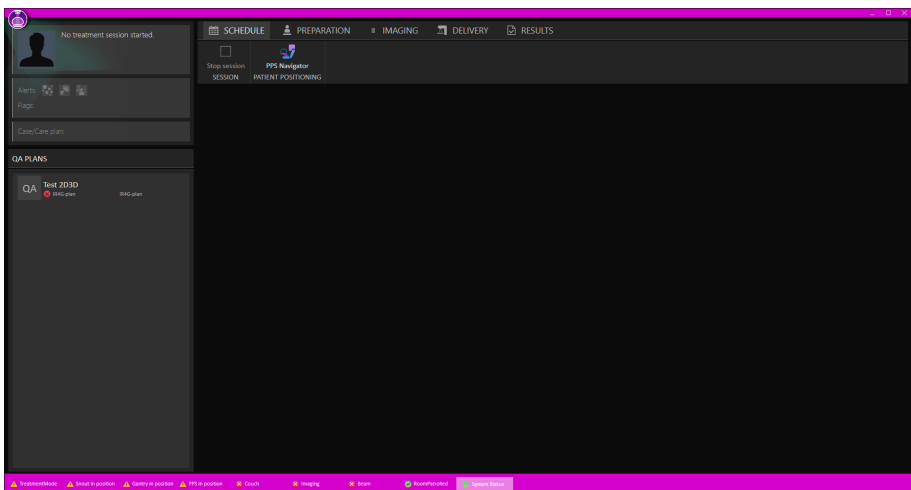
To perform quality assurance on scheduled plans:

1. Select **Physics mode** from the application menu.



RayCommand will now enter Physics mode. A colored frame is displayed as an indication of the Physics mode.

The schedule will be replaced with a list of scheduled plans for which quality assurance has not yet been performed.



2. Select a plan and click **Start session**. A QA session is created and started.

Treatment **Imaging** and **Delivery** can now proceed as normal, with the exception that the user needs to confirm that no patient is present on the table before delivering a beam.

In Physics mode, the beams delivered will not contribute to nominal dose, and unapproved treatment courses can be delivered.

To be able to exit Physics mode, the session must first be stopped or completed.

Collapse gantry angle

When a room has a gantry, there is a possibility to collapse the gantry angles to 0 and 90 degrees for QA deliveries. All beams can then be delivered from the same gantry angle for the QA delivery.

The screenshot shows the 'Beams' section of the RayCommand interface. A table lists two beams, both with a planned gantry angle of 90.00 degrees. A dialog box titled 'Choose an angle to collapse gantry to' is open, allowing the user to select between 0° and 90°. The 0° option is currently selected. The dialog also includes 'OK' and 'Cancel' buttons and a small diagram of the gantry mechanism.

No.	Name	Modality	Isocenter name	Gantry [deg]	Meterset Planned	Meterset Delivered	Snout Name	Planned [cm]	Delivered [cm]	Status
1	beam 1	Protons	Anonymized 2	0.00	1020818447.89 NP	0.00 NP		31.00	0.00	Not delivered
2	beam 2	Protons	Anonymized 2	90.00	1120126071.48 NP	0.00 NP		31.00	0.00	Not delivered

5.6.1 Machine QA tests

The following options are available for machine QA tests:

- **Start QA test** – Starts a QA test of the Exacure system.
- **Start camera measurement** – Starts camera tracking.
- **Stop all movements** – Stops any ongoing Exacure request.
- **Clear PPS errors** – Clears any PPS errors.

One of these texts will be shown, depending on current Exacure status:

- **QA test is required**
- **QA test is NOT required**

The screenshot shows the 'Machine QA tests' dialog box. It contains five buttons: 'Start QA test', 'Start camera measurement', 'Stop all movements', 'Clear PPS errors', and 'QA test is required'. The 'QA test is required' button is highlighted in a darker color, indicating it is the current status. A 'Close' button is located at the bottom right of the dialog.

5.7 MACHINE PARAMETER VERIFICATION

The machine parameter verification compares planned and current values, and checks interlock status.

Interlocks are considered only unlocked or locked, and cannot be overridden. Values such as positions and angles have a hard tolerance that cannot be overridden. Hard tolerances always have precedence over user-defined tolerances.

The table below shows a complete list of verified machine parameters.

Machine parameter	Hard tolerance	Soft tolerance	Description
Interlocks	—	—	All relevant interlocks.
Machine name	—	—	Verifies the machine model name.
Range shifters	—	—	Verifies inserted accessories.
Range modulators	—	—	
Total Meterset	—	—	Verifies the total delivered meterset of the fraction accounting the specified meterset.
Planned Meterset	—	User-defined	Verifies the planned meterset using absolute and relative tolerances.
Gantry angle	0.5 degrees	User-defined	Verifies current gantry angle.
Snout position	1 mm	User-defined	Verifies current snout position.
Table top vertical position	1 mm	User-defined	Verifies current table top position.
Table top longitudinal position	1 mm	User-defined	
Table top lateral position	1 mm	User-defined	
Table top pitch angle	0.5 degrees	User-defined	
Table top roll angle	0.5 degrees	User-defined	
Table top yaw angle	0.5 degrees	User-defined	

A CLINIC SETTINGS CONFIGURATION FOR RAYCOMMAND

In order to use RayCommand, configuration of the treatment settings in the Clinic settings application is needed. Most of the settings are configured at installation and are therefore described in the RayCommand installation documents. This section describes some important things to keep in mind for the user.

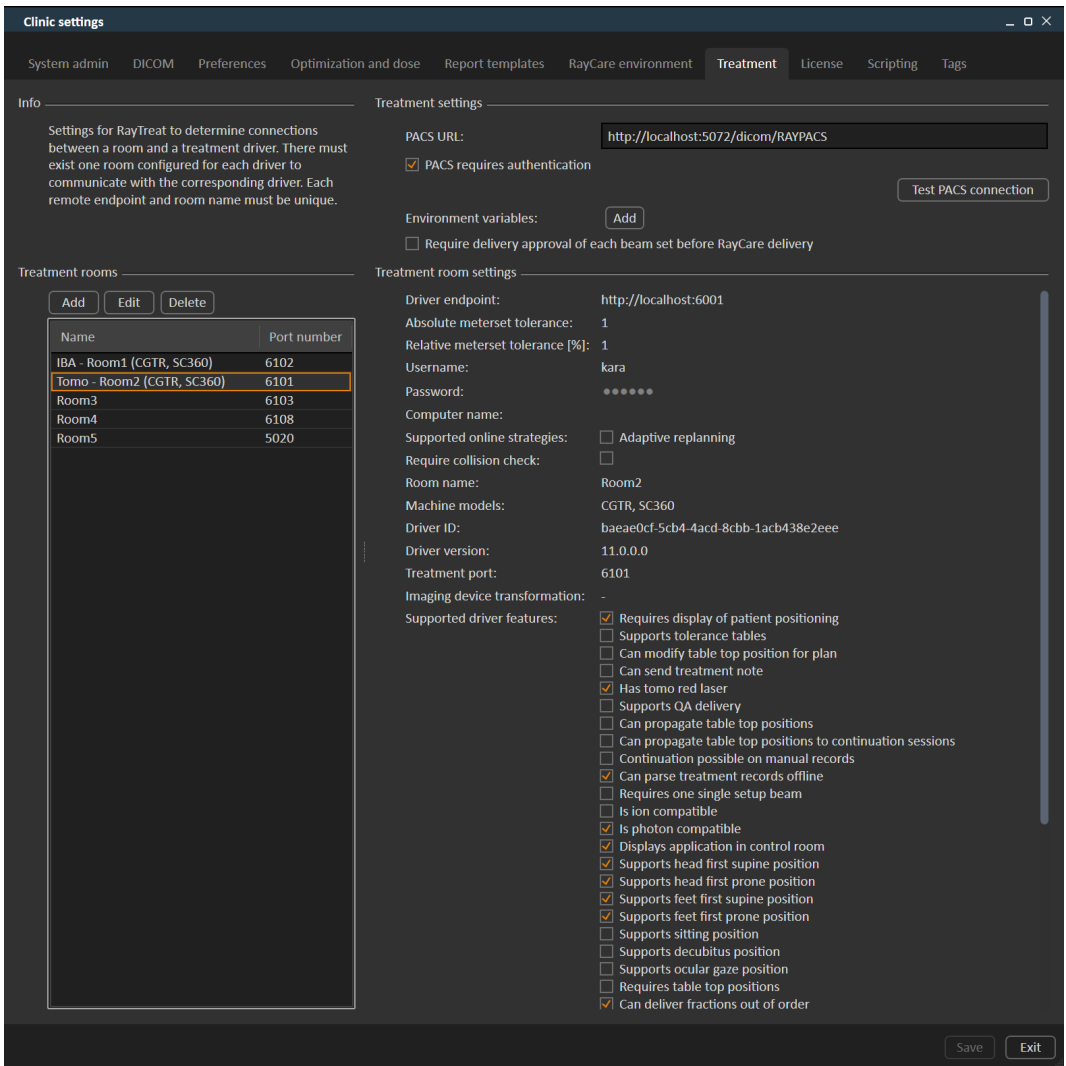


Figure 2. The **Treatment** tab in **Clinic settings**.

The configuration has a list of rooms. These reflect the rooms that the user can schedule an appointment for in RayCare. Each room also has a list of machine models. These reflect the models of the machine setup in RayPhysics and are used when creating a beam set in RayStation. The same machine model can be referenced in multiple rooms. It is also possible to let a single room support multiple machine models.

WARNING!

Machine models. The user who configures which machine models are supported in which rooms shall have a very clear understanding of the clinic and its rooms and machine models. It is strongly discouraged to remove or rename any machine model in the configuration of a room. Instead it is recommended to deprecate the machine in RayPhysics if a machine model is not to be used anymore. It is still possible to add new machine models to a room.

[341177]

To edit treatment room settings, click the **Edit** button. This opens the **Edit treatment room settings** dialog.

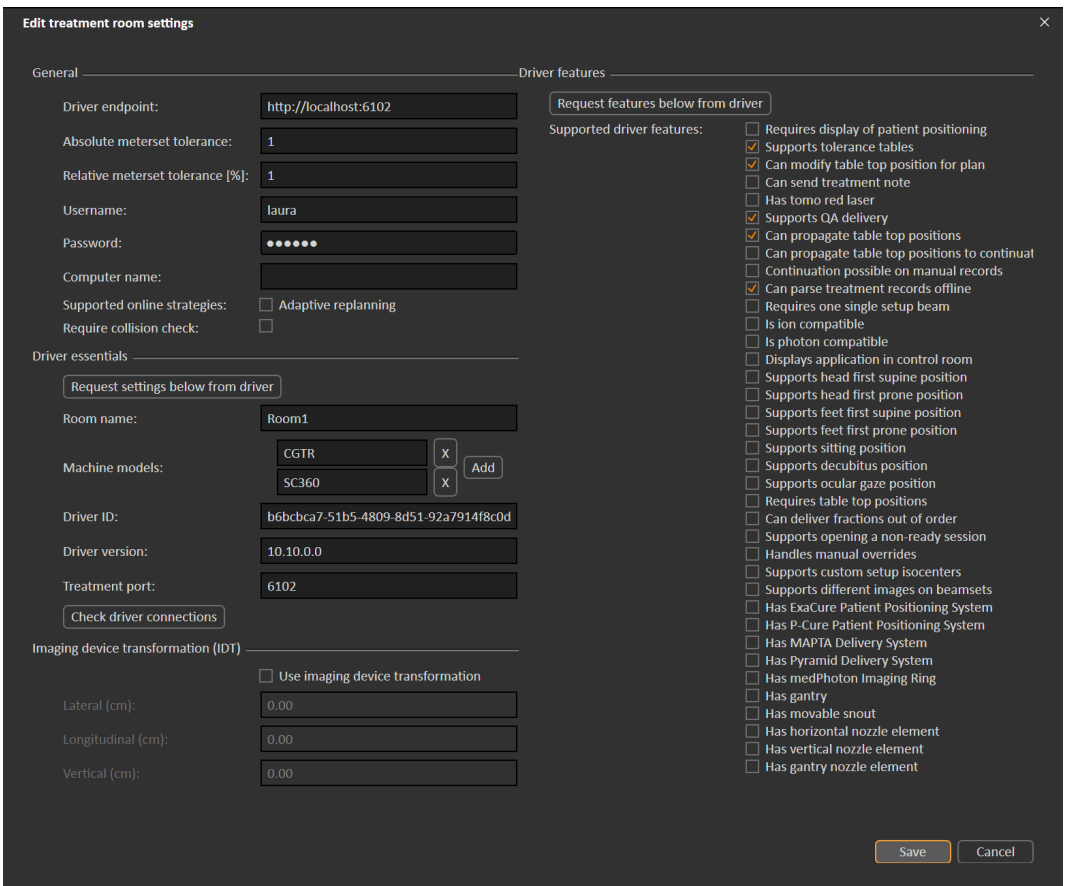


Figure 3. The **Edit treatment room settings** dialog.

Absolute meterset tolerance and **Relative meterset tolerance** can be configured to indicate how much of the delivered meterset can be missing while the system still considers the delivery completed. When the system considers the delivery completed, a checkmark is shown on the session/fraction/beam, and no more continuation can be delivered.

Absolute meterset tolerance takes the unit into account. For example, a machine of a vendor using MU, NP (number of particles) and Minutes as the meterset unit shall all have very different absolute meterset tolerances defined.

It is possible to specify only one of the tolerances. When having both absolute and relative tolerances set, the delivery is considered complete if any of the tolerances is a pass.

In **Imaging device system** it is possible to enter an imaging device transformation in case the patient coordinate system and the imaging device do not match. If IDT is set to 0,0,0 the coordinate system for the patient and the imaging system is coinciding.

A.1 CONFIGURE BEAM SET DELIVERY APPROVAL IN CLINIC SETTINGS

It is possible to configure Clinic settings to require an additional approval step before a specific beam set can be delivered.

The screenshot shows a dark-themed window titled "Treatment settings". It contains the following elements:

- PACS URL:** A text input field containing "https://test.com:0001".
- PACS requires authentication:** A checkbox that is currently unchecked.
- Test PACS connection:** A button located to the right of the checkbox.
- Environment variables:** A section with an "Add" button.
- Require delivery approval of each beam set before RayCare delivery:** A checkbox that is checked.

Figure 4. The **Treatment settings** in **Clinic settings**.

When **Require delivery approval of each beam set before RayCare delivery** is selected, all beam sets added to a treatment course will require delivery approval and it will not be possible to check in a patient for a session or to validate the session for delivery in RayCommand. It will not apply for beam sets already part of a treatment course when the setting is enabled. For further information see section *D.9 Beam set delivery approval in treatment course on page 89*.

Note: *This feature is only applicable for RayCare treatments.*

A.2 CONFIGURE ENVIRONMENT VARIABLES FOR MAPTA

MAPTA is the beam delivery system at MedAustron. The valid MAPTA version, Configuration ID and Operation Mode are entered as environment variables by the clinicians. These values are compared to the values of the beam delivery system before the irradiation is performed.

Example:

MAPTAVersion = V1.02.019.010

ConfigurationID = C000000001125

OperationMode = CLINICAL

Environment variables:	MAPTAVersion	=	1.0.0.45	X	
	ConfigurationID	=	1234	X	Add
	OperationMode	=	CLINICAL	X	

B DEFINING SETUP IMAGING PARAMETERS IN RAYSTATION

This section describes the workflow in RayStation for configuring setup beams and imaging parameters for the medPhoton specific patient setup and imaging procedures performed by RayCommand.

In this chapter

This chapter contains the following sections:

B.1	Commission an Ion Treatment Machine to support workflows for medPhoton imaging procedures	p. 57
B.2	Create a beam set including imaging parameters	p. 59
B.3	Edit setup beam properties in the setup beam list	p. 60
B.4	Select parameters for imaging	p. 61

B.1 COMMISSION AN ION TREATMENT MACHINE TO SUPPORT WORKFLOWS FOR MEDPHOTON IMAGING PROCEDURES

To support the patient setup and imaging procedures required for medPhoton delivery, the Ion treatment machine needs to be configured with the appropriate type of motion synchronization support.

How to configure motion synchronization.

1. Open the Add synchronization technique dialog in the **Motion synchronization** tab, see *Motion synchronization* in the *RSL-D-RS-11B-RPHY, RayStation 11B RayPhysics Manual*.

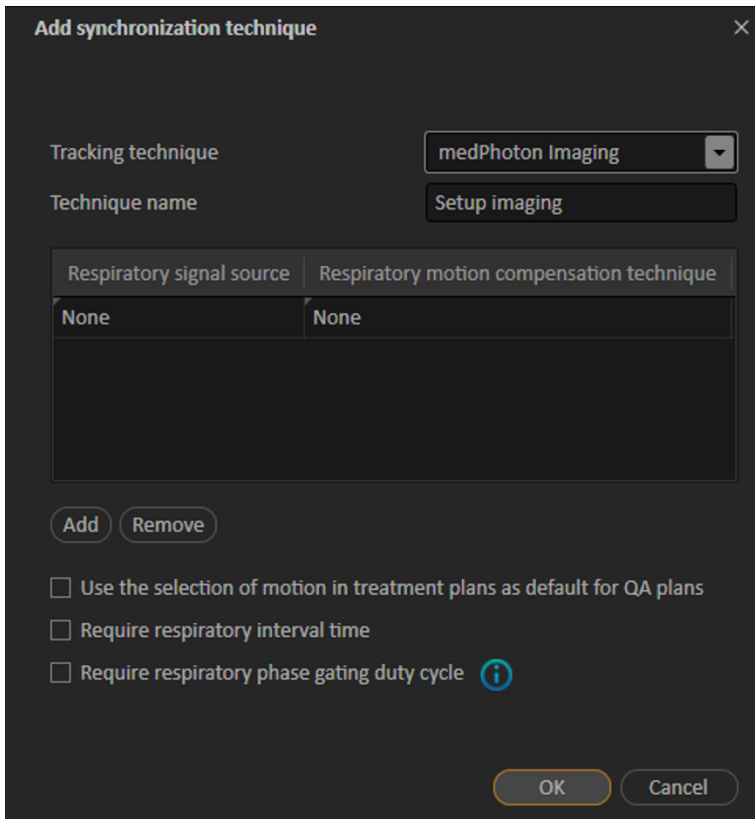
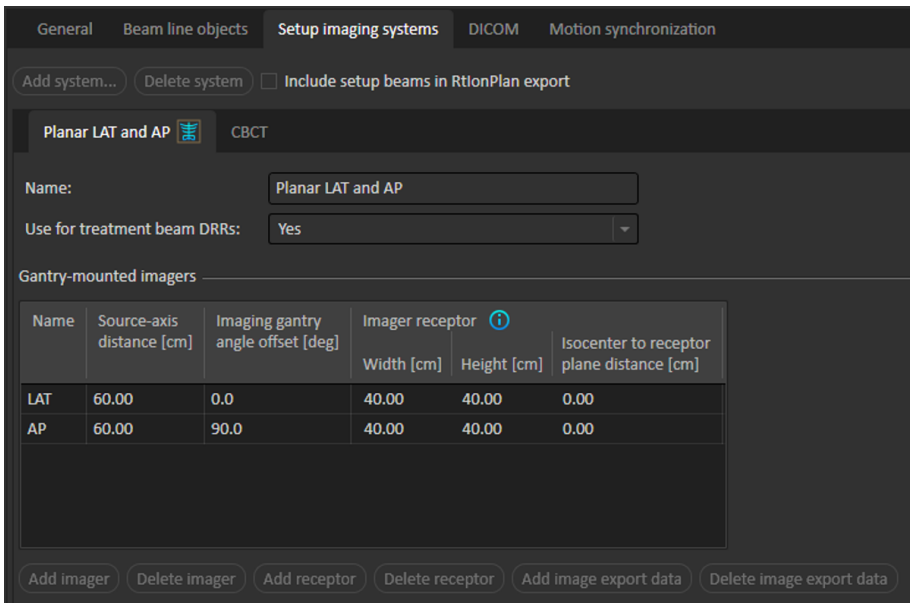


Figure 5. Add synchronization technique with support for medPhoton imaging procedures.

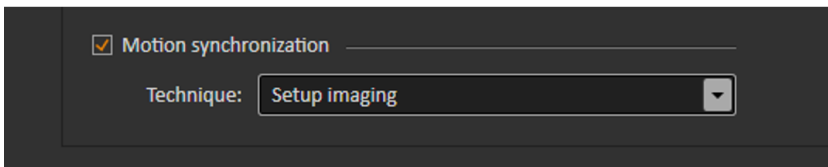
2. Add a motion synchronization technique with the Tracking technique selected as 'medPhoton Imaging'.
3. Add a name for the Tracking technique.

The other available properties in the **Motion synchronization** tab will not affect the standardized medPhoton patient setup and imaging flow.



B.2 CREATE A BEAM SET INCLUDING IMAGING PARAMETERS

In the Add/Edit beam set dialog, select a motion synchronization technique with Tracking technique 'medPhoton' to enable the medPhoton flow for imaging and patient setup. For more information on how to define the technique, see *Commission an Ion Treatment Machine to support workflows for medPhoton imaging procedures on how such a technique is defined*.



When a motion synchronization technique of type 'medPhoton imaging' is selected, it will have the following consequences for that beam set.

- Setup beams with custom imaging isocenter will automatically be used.
 - Note that as a consequence the section for setup beam creation and setup beam isocenter selection will be hidden.
 - Setup beams will be created according to standard RayStation rules for gantry mounted and fixed imagers.
- Additional custom imaging isocenters for the setup beams are allowed to be created.
- A selected Tracked ROI is required per imaging isocenter.

- A selected Body site is required per imaging isocenter.
- An Imaged volume representation will be created, which can be edited.

B.3 EDIT SETUP BEAM PROPERTIES IN THE SETUP BEAM LIST

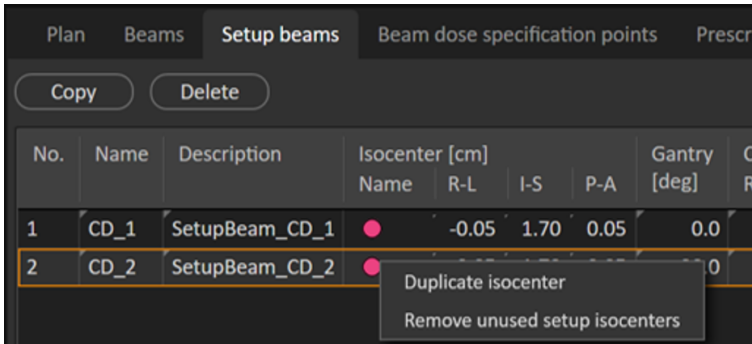
The setup beams and imaging parameters are configured from the **Setup beams** tab. For further information, see *Setup beams* in the *RSL-D-RS-11B-USM, RayStation 11B User Manual*.

No.	Name	Description	Isocenter [cm]			Gantry [deg]	Couch [deg] Rotation	Imaging system	Tracked ROI	Imaged volume Width [cm]	Imaged volume Height [cm]	Imaged volume Aspect ratio	Body site	
			Name	R-L	I-S									P-A
1	CD1_1	SetupBeam_CD(1)_1	●	-0.06	-37.35	-7.84	0.0	0.0	Planar LAT and AP	PTV	4.00	7.00	1.75	Abdomen
2	CD1_2	SetupBeam_CD(1)_2	●	-0.06	-37.35	-7.84	90.0	0.0	CBCT	PTV	4.00	7.00	1.75	Abdomen

Figure 6. The setup beam list when using medPhoton imaging.

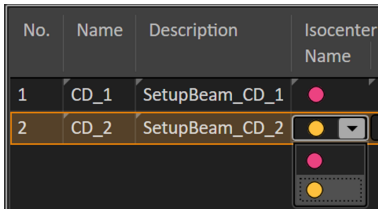
Assign a separate isocenter for a setup beam

Define a new separate isocenter for the beam by right-clicking on an existing isocenter in the setup beam list and select **Duplicate isocenter**.



Select another isocenter for a setup beam

Select another existing isocenter for a setup beam by right-clicking on the isocenter in the setup beam list and select another isocenter from the drop-down list.



Remove unused isocenters

If undesired and unused isocenters exist in the beam sets, select **Clear unused isocenters**. All isocenters in the beam set that are not used by a beam will be deleted.

Note that the imaging isocenters do not have a name. Setup beam isocenters are marked in the patient views as 'Setup iso'.

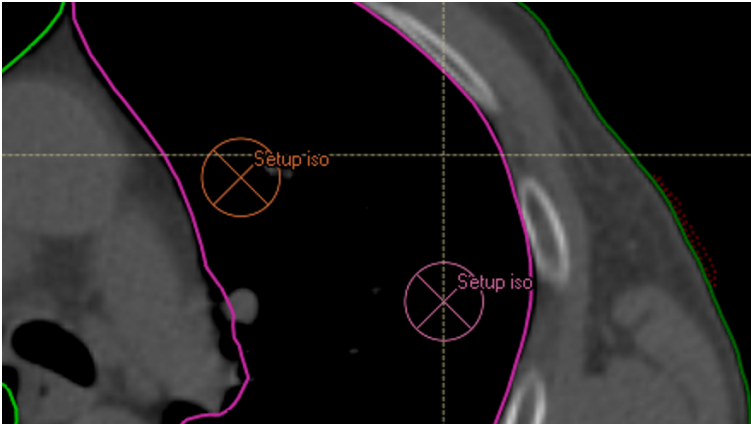


Figure 7. Setup isocenters in the patient view.

B.4 SELECT PARAMETERS FOR IMAGING

For standard editing of setup beam parameters, see *Setup beams for proton plans and light ion plans* in the *RSL-D-RS-11B-USM, RayStation 11B User Manual*.

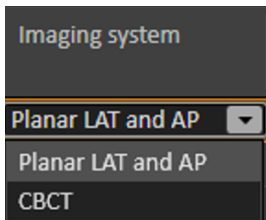
Setup beams															
No.	Name	Description	Isocenter [cm]			Gantry [deg]	Couch [deg]	Imaging system	Tracked ROI	Imaged volume Width [cm]	Imaged volume Height [cm]	Imaged volume Aspect ratio	Body site		
			Name	R-L	I-S	P-A	[deg]	Rotation							
1	CD_1	SetupBeam_CD_1	●	-0.06	-37.35	-7.84	0.0	0.0	Planar LAT and CT	●	PTV	4.00	7.00	1.75	Abdomen
2	CD_2	SetupBeam_CD_2	●	-2.51	-37.35	-5.67	90.0	0.0	CBCT	●	PTV	4.00	7.00	1.75	Abdomen
3	CD_3	SetupBeam_CD_3	●	-2.51	-37.35	-5.67	90.0	0.0	CBCT	●	PTV	4.00	7.00	1.75	Abdomen

Figure 8. The setup beam list for medPhoton imaging

The setup beam list will, in addition to present information for each setup beam, also display information that is defined per imaging isocenter. When editing properties related to the imaging isocenter, the information will be updated in all rows containing setup beams sharing that same imaging isocenter.

Imaging system

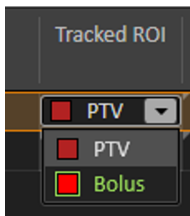
The user can select which imaging protocol to use per setup beam. The protocol includes the definition of the angles to use for setup imaging performed by that setup beam. If selecting an imaging system with multiple imagers with different offsets, setup imaging with RayCommand will be performed from all angles defined as the setup beam angle + the imager offset.



Tracked ROI

A **Tracked ROI** is required to select per imaging isocenter. Select the appropriate ROI from the drop-down list that is populated with all ROIs which are not of **Organ at risk** type.

The selected ROI will be used in RayCommand as the default focus ROI for registrations of images acquired at that setup beam isocenter.



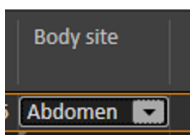
Width, height and aspect ratio of Imaged volume

The width, height and aspect ratio of the volume to be imaged can be edited in the setup beam list as well as interactively changed from the DRR views. The relationship (height = aspect ratio * width) is always preserved when editing.

Body site

A **Body site** is required to select per imaging isocenter. The **Body site** will be forwarded from RayCommand to the imaging system to define imaging parameters, to give optimal image quality of the body site imaged at this imaging isocenter.

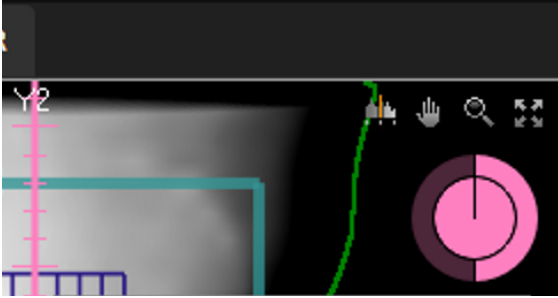
The available body sites to select from is defined in Clinic Settings, see *Preferences* in the *RSL-D-RS-11B-USM, RayStation 11B User Manual*.



DRR view

For more information regarding what is displayed in the DRR views, see *DRR views and Settings* and *Setup beams* in the *RSL-D-RS-11B-USM, RayStation 11B User Manual*.

When looking at the setup DRR for a setup beam, DRRs for the different imaging angles will be possible to select in the different sections in the pie diagram in the upper right corner of the workspace. Change the selected imaging angle by clicking in the pie diagram or use arrow right/arrow left keys.

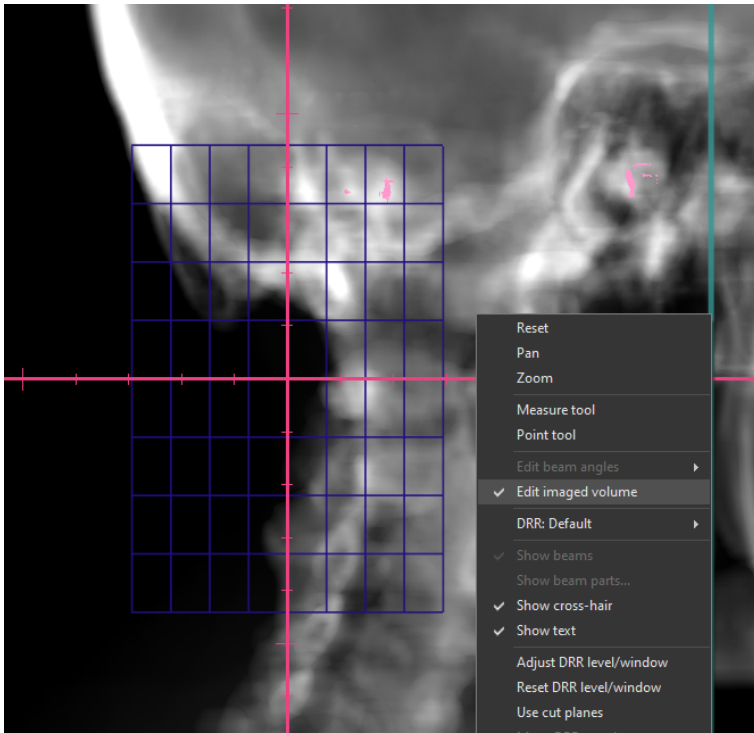


In the DRR, the imaged area is visualized as a grid, centered at the setup beam isocenter.

By right-clicking in the **Setup DRR** view and selecting the **Edit imaged volume** tool, it is possible to move and resize the imaged volume.

By using the **Edit imaged volume** tool, the isocenter of the setup beam can be moved in the DRR view by clicking and dragging in the central part of the grid. The isocenter is moved with the grid following.

To change the size of the imaged volume, for the isocenter of the selected setup beam, click and drag on the border of the grid. Interactive resizing is possible only with a fixed aspect ratio.



C COLLISION CHECK IN RAYSTATION

C.1 INTRODUCTION

The Collision check functionality in RayStation consists of tools designed for predicting collisions in the treatment room already in the planning phase, to avoid the discovery that a plan is non-deliverable when the patient is positioned on the treatment table and is ready for treatment.

In addition to the geometries of the treatment room, delivery system and robotic couch, the Collision check also enables the insert of a patient avatar whose shape is specified by the user in RayStation, and that is automatically positioned in the patient image stack. The Collision check also includes the modeling of fixation devices whose ID and position on the table top are defined in RayCare prior to planning.

The Collision check can be performed with the table top in its nominal position, as well as for a multitude of table top correction scenarios which are sampled by user-defined setup margins in all 6 degrees of freedom of the robotic couch. At plan approval, the user is not allowed to proceed if the Collision check has not been executed and a warning is shown if a collision has been detected.

The setup margins are exported to RayCommand along with the plan and structures representing the fixation devices and patient avatar. The setup margins and collision status are also included in the plan report.

C.2 ADD FIXATION DEVICES

The fixation devices are created in RayStation as regular ROIs. These ROIs will also be used in the collision check of the robotic motion tracking algorithm in RayCommand.

The fixation device IDs and table top positions (indices) used for the planning image data set are defined in RayCare and are automatically pushed to RayStation prior to planning. The geometry of each available fixation device is stored in a structure template in RayStation. The devices used for the current plan are positioned in the image stack according to the table top position (index). The position and shapes of the fixation devices may be adjusted manually after being placed in the patient, for example to compensate for potential couch sag. The creation of the fixation ROIs in the patient is triggered from a script in RayStation.

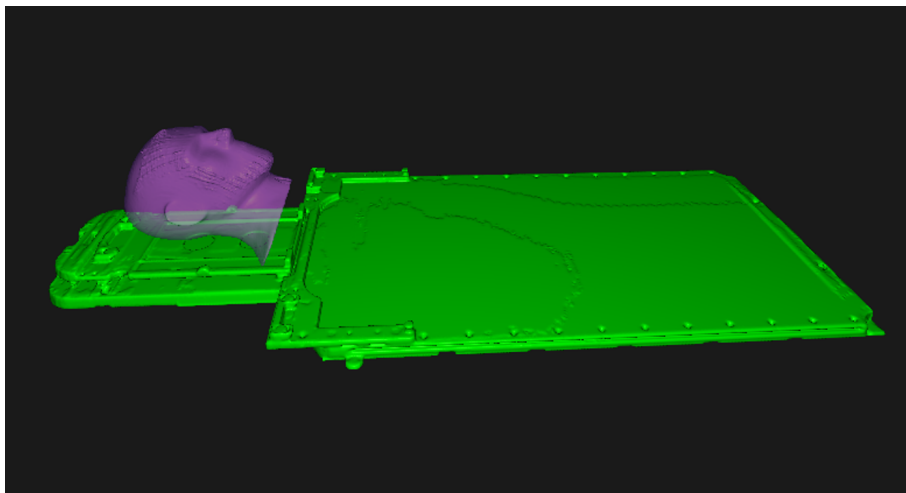
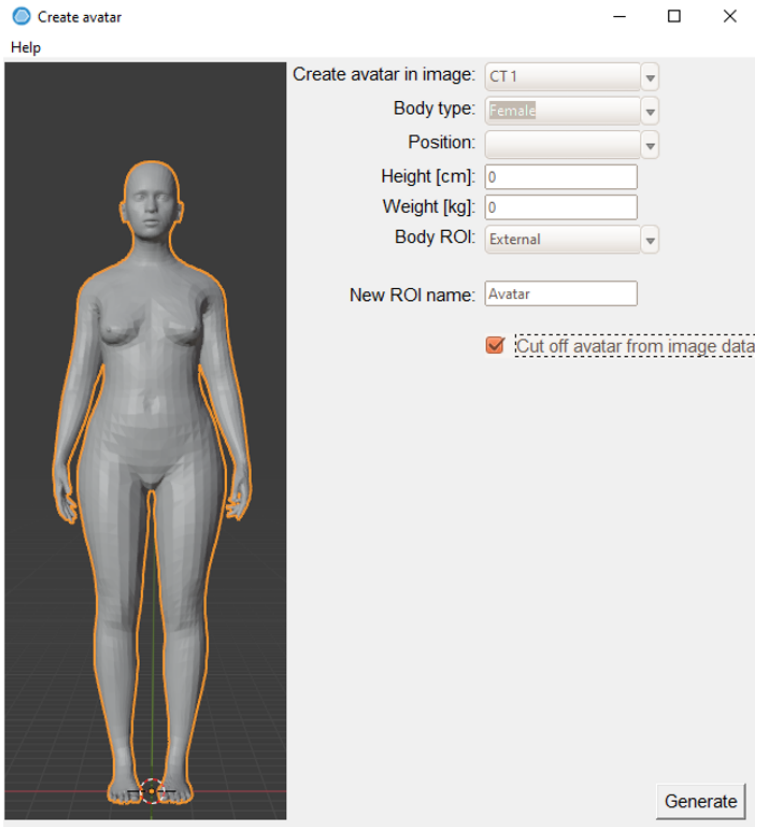


Figure 9. Example where the fixation device 'HeadStep' has been added to the patient.

C.3 ADD A PATIENT AVATAR

The patient avatar is composed of regular RayStation ROIs of type 'Avatar'. The avatar is constructed by a series of ROIs (torso, two arms, two legs and head & neck) so that individual body components may be manually adjusted if needed. The external ROI is also considered by the Collision check.



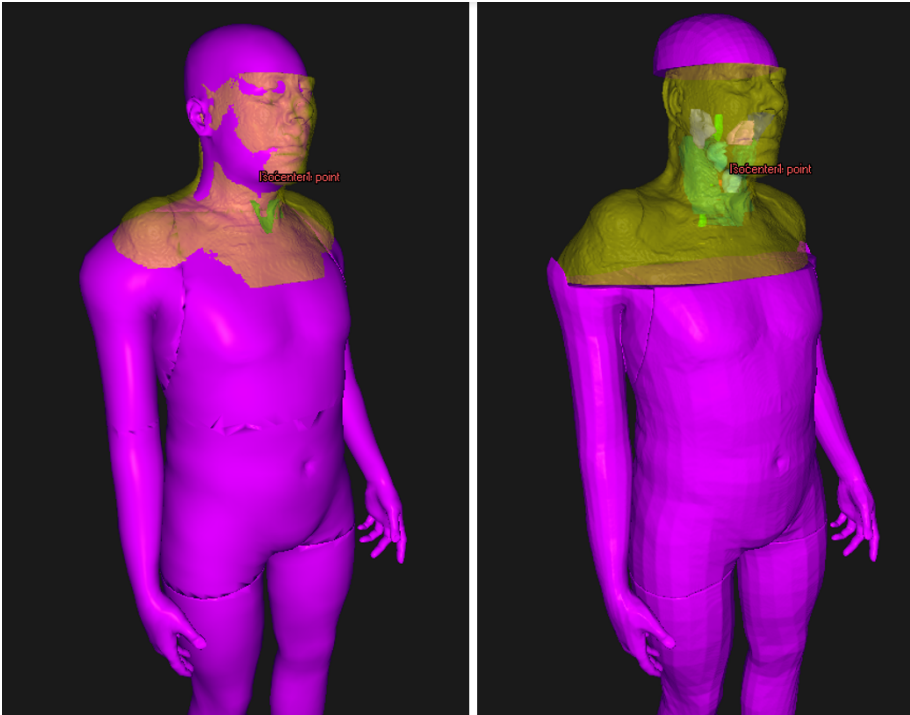
The creation of the avatar is handled by a RayStation script (script UI is shown above). If more than one CT is available, the CT image to be used is selected first in the script. The shape of the avatar is then defined by the following:

- Length
- Weight
- Body type (woman/man/child)
- Body position (arms down, arms up etc.).

The length and weight are populated automatically by data from RayCare. The body type is determined from the patient's sex and age according to the following:

- Man \geq 13 years -> Man body type
- Man < 13 year -> Child body type
- Woman \geq 11 year -> Woman body type
- Woman < 11 year -> Child body type

This data may be overridden in the avatar user interface. The avatar ROIs are automatically positioned in the patient coordinate system by a rigid registration to the external ROI, but the positions may be subsequently manually adjusted. Since the External ROI is included in the Collision check and often is the best representation of the true patient outline, the volume covered by the image data stack can optionally be subtracted from the avatar ROI (via the **Cut off Avatar by image data** checkbox). The effect of this function is exemplified below, where the **Cut off Avatar by image data** checkbox was selected for the avatar to the right.



C.4 COLLISION CHECK TAB

The **Collision check** tab is the main workspace for the Collision check in RayStation, and is included in the **Plan design** and **Plan optimization** modules. The **Collision check** tab includes:

- Collision check execution buttons
- Collision status table
- Setup margins table
- List of rooms that the Collision check is performed for
- Room view execution button
- Planning parameters beams list

Objectives/constraints															Beams		Energy layers		Beam computation settings		Beam weighting		Beam dose specification points		Prescriptions		IDCAS collision avoidance		Collision check	
Beam collision status															Nominal check		Within margins check		Room view...		Setup margins									
Rooms: IR2															Reset margins															
No.	Name	Collision status		Lateral [cm]		Longitudinal [cm]		Vertical [cm]		Pitch [deg]		Roll [deg]		Yaw [deg]																
		Nominal	Within setup margins	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper															
1	HBL	Pass	Fail	-2.00	2.00	-2.00	2.00	-2.00	2.00	-3.00	3.00	-3.00	3.00	-3.00	3.00															
2	VBL	Pass	Pass																											
Beams																														
No.	Name	Description	Isocenter [cm]	R-L	I-S	P-A	Machine	Snout Name	Position [cm]	Air gap [cm]	Gantry	Couch [deg]	Range shifter	Spot tune ID	10° NP/fx															
			Name							Min	CAX	[deg]																		
1	HBL	2FL test 1_moved 1	-33.99	18.55	-5.68	IR2_p_11A	HBL_Nozzle	64.80	20.00	23.83	90.0	0.0	RS3cmR1	4.0	29894.2576															
2	VBL	2FL test 2_moved 1	-0.21	18.55	-49.09	IR2_p_11A	VBL_Nozzle	64.23	10.00	10.60	0.0	0.0	RS3cmR1	4.0	28495.0474															

C.5 COLLISION CHECK FUNCTIONS

The Collision check can be performed with the patient in its nominal position (**Nominal check**), and for collisions considering the 6D movement of the table within the given setup margins (**Within margins check**). The result of these two tests is presented in the **Beam collision status** table. The status is one of the following:

- **Unknown** (if no check has been executed for the given setup)
- **Pass**
- **Fail**

Within margins check is performed for all possible scenarios combining the setup margin limits plus the nominal scenario (=65 scenarios). The setup margins are shown in the **Setup margins** table, with separate values for positive and negative margins. The setup margins are editable in the table, with default values of 2 cm for spatial margins and 3 degrees for angular margins. The default values are brought back by clicking the **Reset margins** button. The rotational center of the table top correction is by default taken as the center-of-mass of the primary prescription ROI.

The values of the setup margins do not refer to margins relative to the table top, but rather to the displacement of the body that leads to a counter movement of the table. For example, the scenario including a Lateral margin of +2 cm will investigate the scenario where the table is positioned at a Lateral position of -2 cm [see section C.7 Room view on page 70].

The treatment room which is used for the Collision check is identified by the beam model of the beam set and the treatment room settings as given in Clinic Settings. If the beam model of the current beam set serves more than one room, the Collision check is performed for all the rooms. This means that the so-called imaging device transformation (IDT) vector, which is needed for positioning the fixation devices and avatar correctly on the treatment table top and is stored per treatment room in Clinic settings, is required to be equal for the rooms that are included in a Collision check. This is verified by the Collision check algorithm. The names of the treatment rooms used in the Collision check are displayed in the **Collision check** tab.

A collision is noted if the convex hulls of the geometries of the model are within a specified contact margin. In RayStation 11B, these margins are by default set to 3 cm for collisions with snout or nozzle and is otherwise 1 cm. To change these values, contact RaySearch support.

C.6 COLLISION STATUS INVALIDATION

The collision status is invalidated upon any change to:

- Patient plan
- Patient avatar ROIs
- Fixation ROIs
- External ROI
- Setup margin values (only Margin Collision check status)
- Plan prescription (only Margin Collision check status)

Note that the collision status is not invalidated in the following scenarios:

- The setup instructions (fixation devices and positions) have been updated in RayCare since the patient was last opened in RayStation.
- The IDT vector for a room is changed after a Collision check has been executed.

C.7 ROOM VIEW

Room view is a dialog that is opened from the **Collision check** tab.

The dialog shows a 3D rendition of the treatment room, displaying all the geometries included in the Collision check for the selected beam (**Beam** drop-down list) of the current beam set. For beam sets with a beam model that is supported by more than one room, the room to be visualized is selected by the **Room** drop-down list.

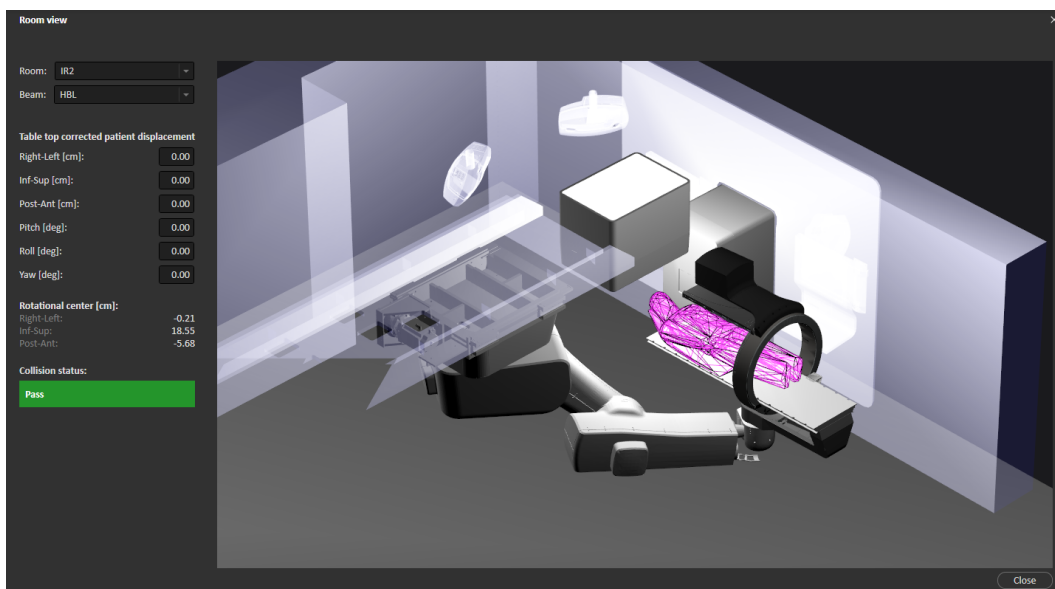
Besides investigating the nominal patient position, the **Room view** dialog also supports the possibility to study the effect of a 6D couch correction. It should be noted that the setup correction values entered in the user interface refer to the displacement of the patient and only implicitly the correction of the table since the patient displacement will generate a counter motion of the table top. However, in RayStation 11B the patient avatar will remain in its nominal position on the table top. The relation of the table top motion to the input patient displacement parameters is further explained in the table below.

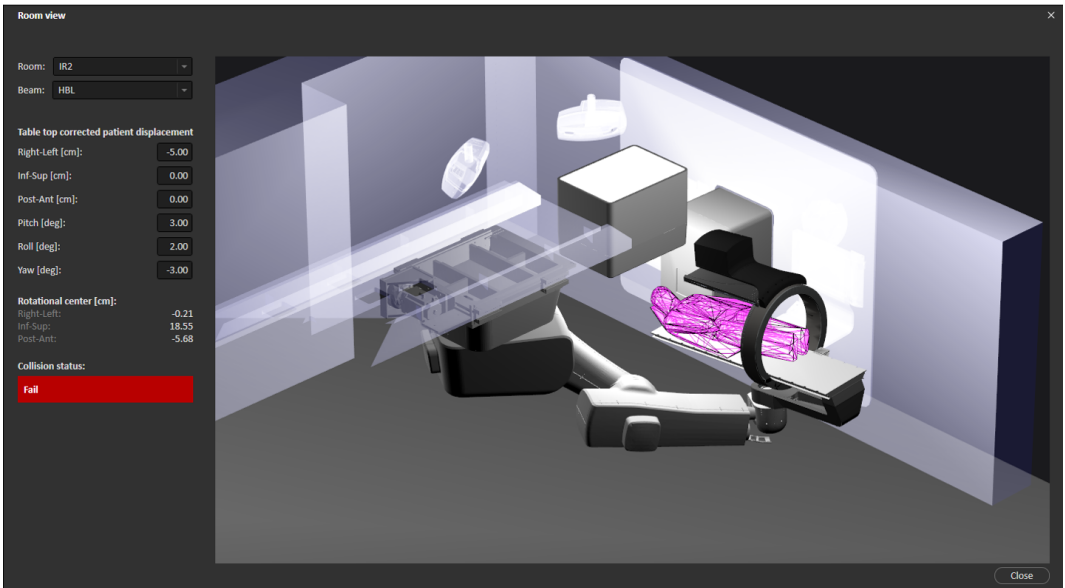
Right-Left	HFS reference: Positive (negative) values indicate couch movement in patient's right (left) direction.
Inf-Sup	HFS reference: Positive (negative) values indicate couch movement in patient's inferior (superior) direction.
Post-Ant	HFS reference: Positive (negative) values indicate couch movement in patient's posterior (anterior) direction.
Pitch	HFS reference: Positive (negative) values indicate counterclockwise (clockwise) rotation as seen from patient's right side. Patient's head lowers (elevates).

Roll	HFS reference: Positive (negative) values indicate clockwise (counterclockwise) couch rotation as seen from patient's head. Patient's right hand lowers (elevates).
Yaw	HFS reference: Positive (negative) values indicate clockwise (counterclockwise) couch rotation as seen from above. Head moves to patient's left (right).

The **Room view** dialog further indicates the collision status for the current room/beam/patient displacement. The possible states are:

- **Pass** (green)
- **Fail** (red)
- **Unreachable position** (red). Indicates that the couch robot cannot bring the table to the desired position.





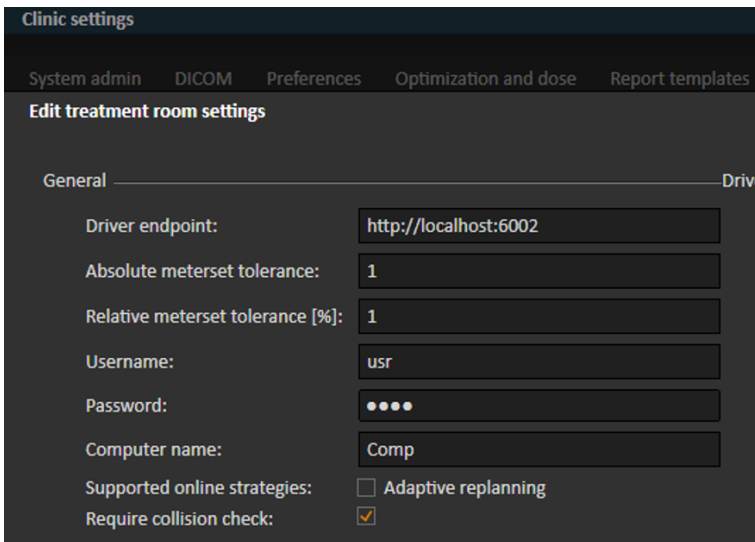
The information in the **Room view** is controlled via the mouse and keyboard as summarized in the table below.

Key	Function	Description
Left mouse button	Rotate camera	Rotates the camera to view the room from different angles.
Mouse wheel	Zoom in/out	Zooms in/out to get a closer or a more distant view of the room.
Space	Camera reset	Sets the camera to its default position.
C	Show lines	Closest points of collision between objects.
F	Show frames	Frame-of-reference of various components and their origin and rotational direction relative the reference coordinate system.
G	Show grid	Grid of isocentric planes.
1	Show collision models	Shows the convex hull geometries that are used in the Collision check.

Key	Function	Description
2	Show spheres	Linear Axis Heuristic (LAH) spheres depicting the permissible minimum and maximum positions of the linear sliding overhead rail.

C.8 PLAN APPROVAL

The user may select whether a Collision check (**Nominal** and **Within margins check**) must have been executed to allow plan approval. This is defined per treatment room and is controlled by the **Require collision check** checkbox in Clinic Settings.



At plan approval, the user will get a warning if any collision has been detected, but plan approval is not prohibited.

C.9 PLAN REPORT

The setup margins and collision status tables are included in the plan report (see example below). If the **Require collision check** checkbox is selected in Clinic Settings (see section C.8 Plan approval on page 73), a Collision check must have been executed to allow plan report generation.

Lateral [cm]		Longitudinal [cm]		Vertical [cm]		Yaw [deg]		Pitch [deg]		Roll [deg]	
Low-er	Up-per	Low-er	Up-per	Low-er	Up-per	Low-er	Up-per	Low-er	Up-per	Low-er	Up-per
-2.0	1.0	-2.0	2.0	-1.00	2.0	-3.0	3.0	-3.0	3.0	-1.00	3.0

Beam collision status

Beam #	Beam name	Collision status	
		Nominal	Within setup margins
1	HBL	Pass	Pass
2	B2	Pass	Fail

C.10 SCRIPTABLE FUNCTIONS

The following are the Collision check related actions available via scripting:

NominalCollisionCheck()	Same as the Nominal check in the Collision check tab.
WithinMarginsCollisionCheck()	Same as the Within margins check in the Collision check tab.
ReadOnlyNominalCollisionCheckForBeam(..)	Performs the Nominal check for a given beam without affecting the collision status.
ReadOnlyWithinMarginsCollisionCheckForBeam(..)	Performs the Within margins check for a given beam without affecting the collision status.

C.11 SCRIPTABLE PROPERTIES

The following are the Collision check related properties available via scripting:

```

PatientSetup.CollisionProperties
    BeamCollisionStatus -> ScriptCollection
    SetupMargins -> ScriptObject
BeamCollisionStatus
    Nominal (get)
    WithinSetupMargins (get)
SetupMargins
    LateralLowerMargin (get/set)
    LateralUpperMargin (get/set)
    LongitudinalLowerMargin (get/set)
    LongitudinalUpperMargin (get/set)
    PitchLowerMargin (get/set)
    PitchUpperMargin (get/set)
    RollLowerMargin (get/set)
    RollUpperMargin (get/set)
    VerticalLowerMargin (get/set)
    VerticalUpperMargin (get/set)
    YawLowerMargin (get/set)

```

YawUpperMargin (get/set)

D TREATMENT MANAGEMENT IN RAYSTATION

D.1 OVERVIEW

Before an approved treatment plan from RayStation can be used for delivery in RayCommand, it is necessary to specify which plans and beam sets to use for a specific fraction in the treatment course. An overview of the treatment course can be found in the **Treatment course** tool panel to the left.

Fx	Plan	Beam set	Acquired images	Dose
1	✓	Beam set A1	-	
2	✓	Beam set A1	-	
3	✓	Beam set A1	-	
4	✓	Beam set A1	-	
5	✓	Beam set A1	-	
6	✓	Beam set A1	-	
7	✓	Beam set A1	-	
8	✓	Beam set A1	-	
9	✓	Beam set A1	-	
10	✓	Beam set A1	-	
11	✓	Beam set A2	-	
12	✓	Beam set A2	-	
13	✓	Beam set A2	-	

Figure 10. Treatment course tool panel.

Management of the treatment course prior to delivery can either be done by right-clicking on selected fractions in the panel, or in the **Approval** tab in the **Plan evaluation** module.

Additional information regarding fractions included in the treatment course is available in the tooltip.

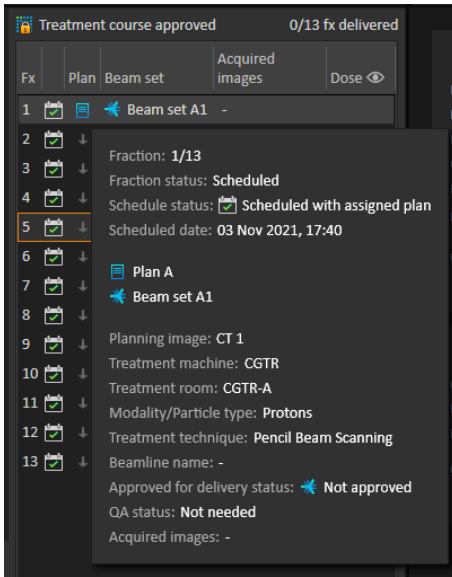


Figure 11. Tooltip with information about a fraction.

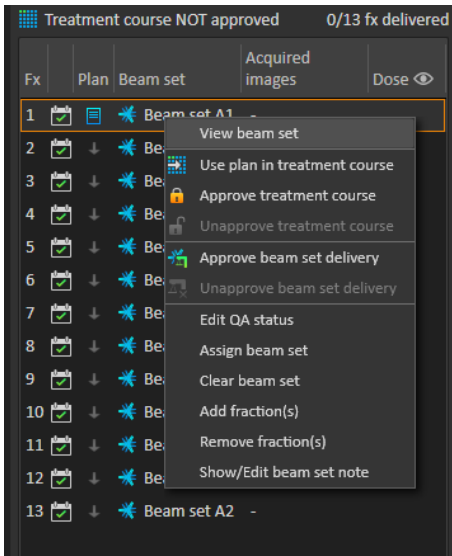


Figure 12. Treatment course tool panel menu.

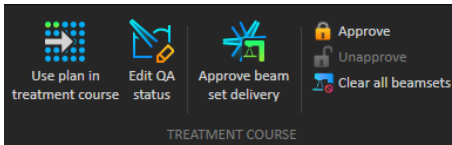


Figure 13. Treatment course management in the **Approval** tab.

In the **Patient data** management module in RayStation, the treatment delivery overview displays the available plans to deliver, as well as the number of delivered fractions.

The treatment delivery overview shows all beam sets that can be used for upcoming delivery. The name, machine and assigned fractions are displayed.

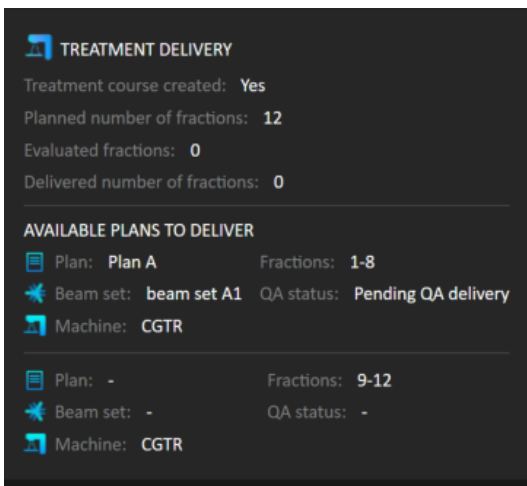


Figure 14. Treatment delivery overview in **Patient data** management.

If any fractions are scheduled in RayCare, for a room with no plan assigned for a machine model corresponding to one that the room supports for delivery, the plan and beam set will be displayed as - .

When having alternative plans, the same fraction may occur for multiple beam sets. This indicates that these fractions can be delivered by either of the machines specified.

Different actions to manage the treatment course are described below.

D.2 USE PLAN IN TREATMENT COURSE

Assigning plans for treatment is done in the **Use plan in treatment course** dialog in RayStation. The dialog is accessed by clicking the **Use plan in treatment course** button.

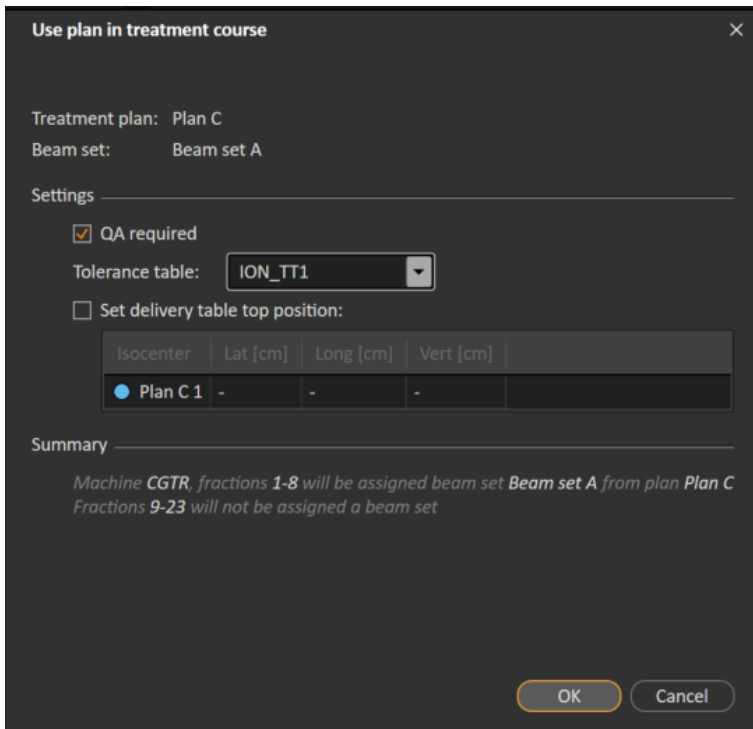


Figure 15. The **Use plan in treatment course** dialog in RayStation. The dialog may look different depending on the machine model.

The **Use plan in treatment course** dialog shows the currently open plan, all approved beam sets and to which fractions each beam set will be assigned. The assignment depends on the current plan's fractionation schedule and the fractions that have already been delivered.

To be able to assign a beam set for treatment, the following is required:

- The machine used in the plan must have a corresponding machine model configured in a treatment room in the **Treatment** section of the Clinic Settings application (for more information, see *Appendix A Clinic Settings configuration for RayCommand*).
- The approved plan must have a dose computed with the current dose engine version and the latest, not deprecated, treatment machine model version.
- Each beam set in the plan needs to have a primary prescription.

Note: For IBA, there must be exactly one single setup beam in the list.

Note: In RayTreat, the beam sets will be displayed with both their plan and beam set name. Make sure to use unique beam set names.

WARNING!

Make sure that the intended plan is used. All plans can be included in the treatment course, regardless of the prescription or the planned number of fractions. Exercise caution when assigning different plans to different fractions.

[7190]

Typically, when treatment planning has been completed for a patient, the approved plan is assigned to be delivered for all fractions in the treatment course. This can be accomplished by opening the **Use plan in treatment course** dialog, and verifying that the selected beam set will be used for all expected fractions. If the treatment machine for the plan requires a tolerance table to be selected for a plan, that must also be selected in the **Tolerance table** drop-down menu.

If fractions do not have an approved beam set, they will be left unassigned. They can later be assigned by opening the same dialog again, or by manually editing the treatment course. For more information, see *section D.7 Modify treatment course on page 87*.

If the plan needs to be replaced during the treatment course (e.g., if a replanned treatment plan, adapted treatment plan or fallback plan needs to be used instead of the original plan), the new plan will be used according to its fractionation schedule. The user is responsible for verifying that the new plan is assigned to the correct fractions in the **Use plan in treatment course** dialog.

Note: *When the patient has been checked in to a treatment session, the plan for the corresponding fraction cannot be changed.*

Set delivery table top position

If the machine is set to support modifying table top positions, it is possible to set the default absolute table top position for the plan in the **Use plan in treatment course** dialog.

Once the table top positions are set and the plan has been assigned for treatment, it is possible to open the **Use plan in Treatment Course** dialog again to edit the table top position values but it is not possible to clear the values.

Alternative plans

When using a plan for treatment it is possible to include alternative plans for different rooms, if needed. Having alternative plans does not increase the number of fractions. However, it will be useful when having several treatment rooms, and to easily be able to reschedule a fraction for another room which does not share a common machine model. It adds a backup if any of the machines needs maintenance, for example.

There are a number of requirements that need to be fulfilled in order for a plan to be considered as an alternative plan:

- It must have been planned on the same image set as the original plan.
- It must use the same approved structure set as the original plan.

- It must have exactly the same prescriptions as the original plan.
- There must be a localization point and it must be the same localization point as the original plan.
- It must have the same fractionation schedule as the original plan.
- It must be for a different machine model than the original plan.
- The plan must not be deliverable in the same room as the original plan.

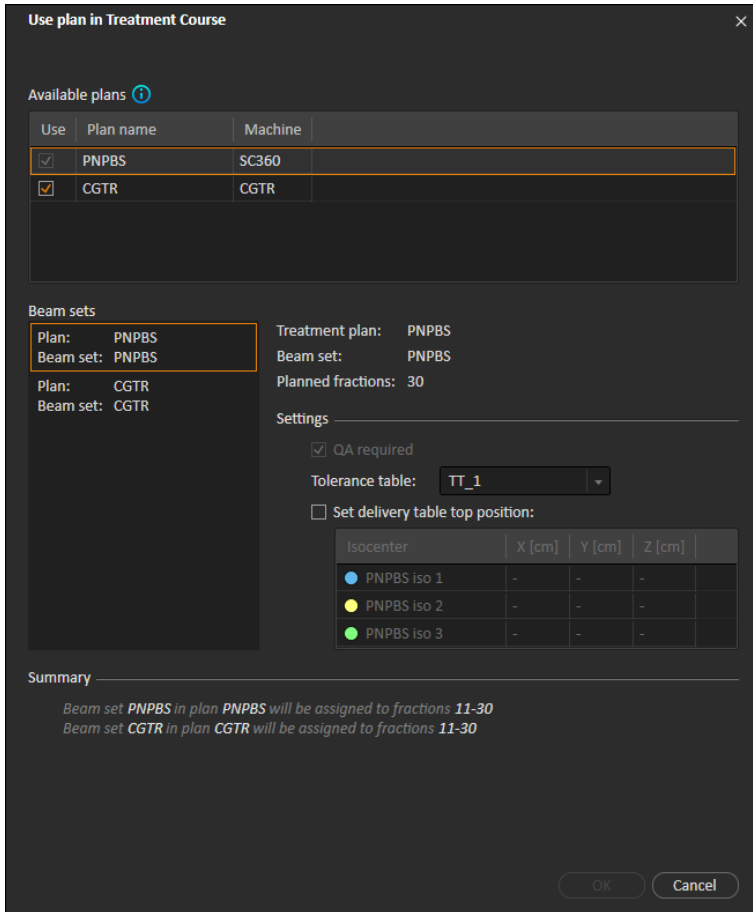


Figure 16. The **Use plan in treatment course** dialog, with alternative plans.

Any alternative plans are displayed in the **Available plans** list in the **Use plan in treatment course** dialog. When using alternative plans, each beam set needs to be prepared by configuring its **Settings** in the **Use plan in treatment course** dialog.

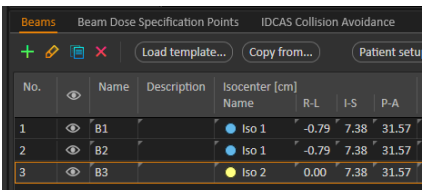
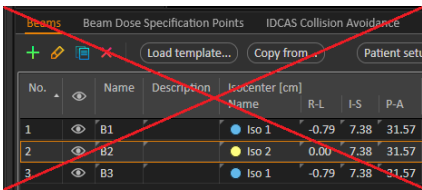
Note: When selecting an alternative plan, other plans for the same machine may be disabled. This happens if selecting them would cause any fraction to get alternative beam sets for the same machine.

Note: It is not possible to reschedule a continuation session for a machine other than the one for which the fraction was originally scheduled.

Plans with multiple isocenters

For plans with multiple isocenters, table top positions for all treatment isocenters are shown. Note that there are some specific requirements for plans with multiple isocenters:

- There must be a POI of type “Localization point”.
- Isocenters must only be used for a consecutive set of beams and not be used in multiple beams with non-consecutive beam numbers. This means that a previously used isocenter cannot be repeated after another isocenter has been used.

This is OK		This is NOT OK																																																							
 <table border="1"> <thead> <tr> <th>No.</th> <th>Name</th> <th>Description</th> <th>Isocenter [cm]</th> <th>R-L</th> <th>I-S</th> <th>P-A</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>B1</td> <td></td> <td>Iso 1</td> <td>-0.79</td> <td>7.38</td> <td>31.57</td> </tr> <tr> <td>2</td> <td>B2</td> <td></td> <td>Iso 1</td> <td>-0.79</td> <td>7.38</td> <td>31.57</td> </tr> <tr> <td>3</td> <td>B3</td> <td></td> <td>Iso 2</td> <td>0.00</td> <td>7.38</td> <td>31.57</td> </tr> </tbody> </table> <p>Beam 1 - Iso 1 Beam 2 - Iso 1 Beam 3 - Iso 2</p>	No.	Name	Description	Isocenter [cm]	R-L	I-S	P-A	1	B1		Iso 1	-0.79	7.38	31.57	2	B2		Iso 1	-0.79	7.38	31.57	3	B3		Iso 2	0.00	7.38	31.57	 <table border="1"> <thead> <tr> <th>No.</th> <th>Name</th> <th>Description</th> <th>Isocenter [cm]</th> <th>R-L</th> <th>I-S</th> <th>P-A</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>B1</td> <td></td> <td>Iso 1</td> <td>-0.79</td> <td>7.38</td> <td>31.57</td> </tr> <tr> <td>2</td> <td>B2</td> <td></td> <td>Iso 2</td> <td>0.00</td> <td>7.38</td> <td>31.57</td> </tr> <tr> <td>3</td> <td>B3</td> <td></td> <td>Iso 1</td> <td>-0.79</td> <td>7.38</td> <td>31.57</td> </tr> </tbody> </table> <p>Beam 1 - Iso 1 Beam 2 - Iso 2 Beam 3 - Iso 1</p>	No.	Name	Description	Isocenter [cm]	R-L	I-S	P-A	1	B1		Iso 1	-0.79	7.38	31.57	2	B2		Iso 2	0.00	7.38	31.57	3	B3		Iso 1	-0.79	7.38	31.57
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- Delivery table top positions must be specified in the **Use plan in treatment course** dialog.
- Validated plans with treatment patient position **HFS** (Head First Supine), **HFP** (Head First Prone), **FFS** (Feet First Supine) and **FFP** (Feet First Prone) are supported.

Only the table top position for the first isocenter can be edited – the other table top positions are automatically calculated based on the relative positions of the isocenters.

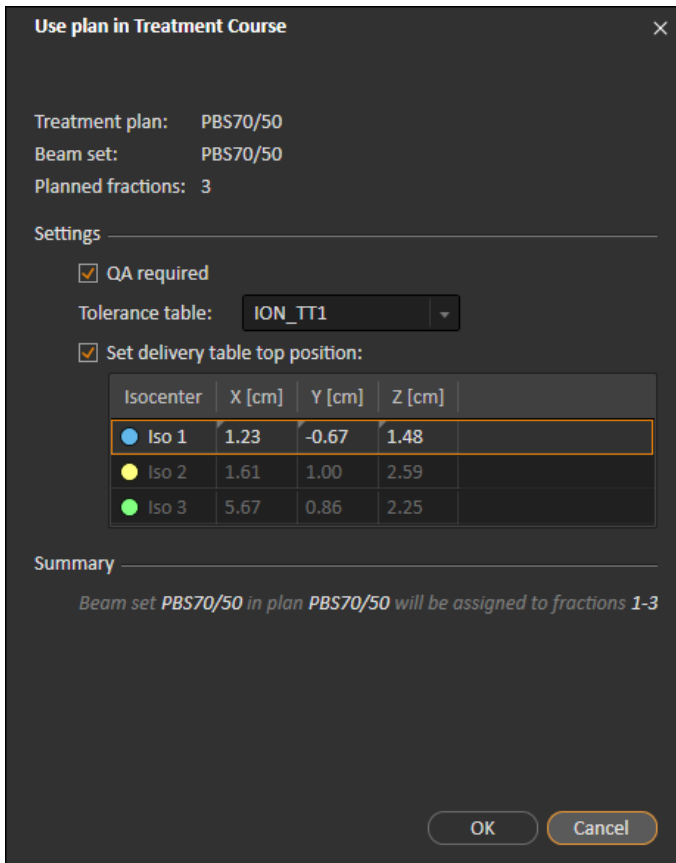


Figure 17. The **Use plan in treatment course** dialog for multiple beams at separate isocenters. The dialog may look different depending on the machine model.

D.3 CLEAR ALL BEAM SETS

This button will clear all existing fractions which have not been delivered of their existing assigned beam sets. Similar functionality for individual fractions is found in the **Treatment course** tool panel. The treatment course must be unapproved to allow any removal of beam sets from fractions. A warning is displayed where the user can choose to verify the action to remove all plans from undelivered fractions.

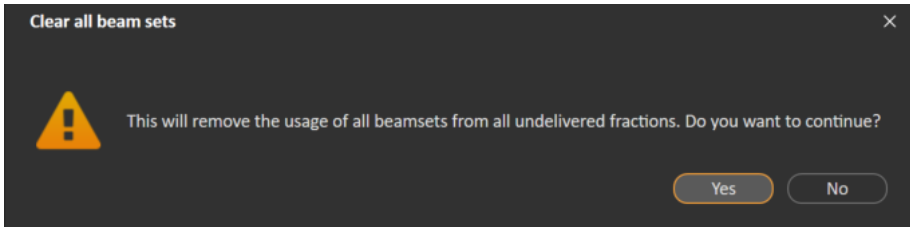


Figure 18. Warning dialog displayed when clearing all beam sets.

D.4 EDIT QA STATUS

In the **Use plan in Treatment Course** dialog, it is possible to define whether or not the beam set will require QA delivery. Note that only treatment plans, as opposed to QA plans, will be used for delivery in this RayTreat version, both for treatment and QA delivery. When QA delivery is performed, or if the requirement of QA delivery changes, it is possible to edit the QA status by clicking the **Edit QA status** button.

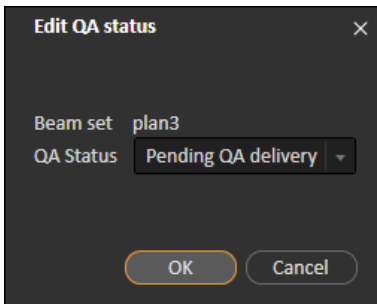


Figure 19. The **Edit QA status** dialog.

The available QA statuses are listed in the following table.

Table D.1: List of the available QA statuses.

QA status	Meaning
Pending QA delivery	The plan is expected to be delivered and measured for plan-specific QA and analyzed prior to use for patient treatment delivery.
Pending QA analysis	The plan has been delivered for plan-specific QA, but the results have not been analyzed yet.
Not needed	The plan is of a type that either does not require plan-specific QA before patient treatment delivery, or the QA status of treatment plans is managed in another system.

QA status	Meaning
Pass	The plan has been delivered and measured for plan-specific QA, and the results have been analyzed and are acceptable for patient treatment delivery.
Failed measurements	The plan has been delivered and measured for plan-specific QA, and the results have been analyzed but are unacceptable for patient treatment delivery. The reason is likely that the plan is correct but the measurement procedure has failed. Repeated QA delivery and measurement is recommended.
Failed plan	The plan has been delivered and measured for plan-specific QA, and the results have been analyzed but are unacceptable for patient treatment delivery. The reason is likely to be a problem with the plan. Therefore, it shall not be used and replanning is required.
-	QA status is unknown.

D.5 APPROVE TREATMENT COURSE

Before a treatment course can be used for delivery, approval is needed. This is done by clicking the **Approve** button, available both in the right-click menu in the **Treatment course** tool panel and in the **Approval** tab (see section D.1 Overview on page ??). A table shows all the prescriptions of the treatment course and the total prescribed contribution of all fractions to each prescription.

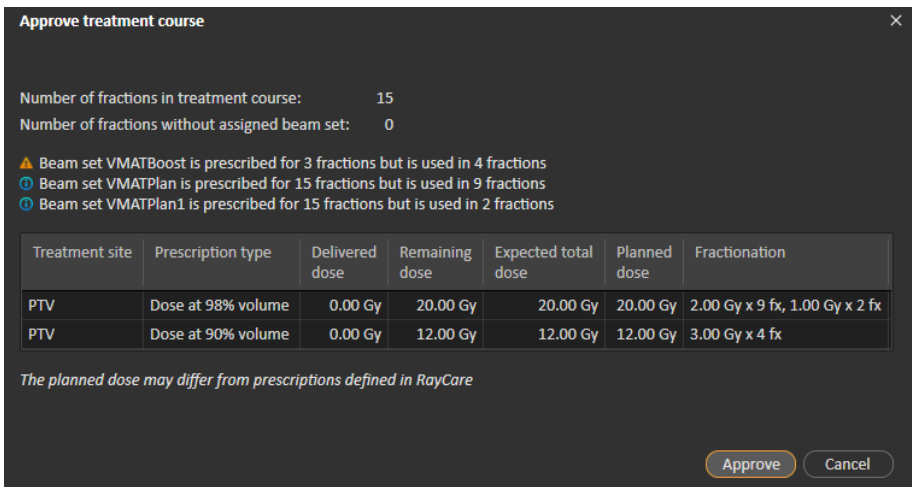


Figure 20. The **Approve treatment course** dialog.

By clicking the **Approve** button the user confirms that the prescribed dose of the total treatment course is as expected. Only patients with a treatment course approved for delivery will be possible to treat in RayTreat. QA delivery is still possible without approval.

WARNING!

Prescription in Approve treatment course dialog. The planned prescribed nominal dose shown in the *Approve treatment course* dialog is the sum of the nominal dose contributions for all fractions in the treatment course. The prescription is not automatically synchronized between RayStation and RayCare. The user is responsible for making sure that the prescription in the *Approve treatment course* dialog corresponds to the prescription in RayCare.

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D.6 UNAPPROVE TREATMENT COURSE

By clicking the **Unapprove treatment course** button, the treatment course becomes unapproved for delivery. When a treatment course is unapproved the user can make modifications, such as assigning or clearing the beam set on fractions. A patient with an unapproved treatment course can be scheduled for treatment. However, RayTreat will not allow any delivery to be made, and the patient cannot be checked in from RayCare. For details about how a patient with an unapproved treatment course is handled in RayTreat.

Unapproving the treatment course can only be done when no session is checked in. Only a fraction with no recorded delivery can be modified.

D.7 MODIFY TREATMENT COURSE

The following actions can be found in the **Treatment course** tool panel menu. Some actions are only available for an unapproved treatment course.

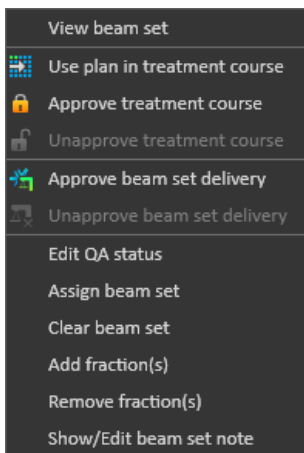


Figure 21. Menu displayed when right-clicking in the **Treatment course** tool panel.

- **View beam set:** Changes the current viewed beam set in RayStation.

- **Use plan in treatment course:** Assigns the current selected plan in RayStation for the entire treatment course. For more information, see *section D.2 Use plan in treatment course on page 79*.
- **Approve treatment course:** Approves treatment course for delivery. For more information, see *section D.5 Approve treatment course on page 86*.
- **Unapprove treatment course:** Unapproves treatment course for delivery. For more information, see *section D.6 Unapprove treatment course on page 87*.
- **Edit QA status:** Edits the beam set QA status. For more information, see *section D.4 Edit QA status on page 85*.
- **Assign beam set:** Updates the beam set to be delivered on a fraction. Any approved beam set from any plan can be assigned to any undelivered fraction. Assigning a beam set to fractions opens a dialog similar to the **Use plan in treatment course** dialog, where tolerance table, QA status and table top positions can be reassigned.

Note: *The tolerance table, QA status and table top positions will be modified for all upcoming fractions using the same beam set.*

- **Clear beam set:** Clears the selected fractions of their assigned beam sets. If the beam set for a fraction needs to be reassigned but the intended new beam set is not approved or decided yet, the fraction can be cleared of its current beam set.
- **Add fraction(s):** Extends the treatment course with a number of desired fractions. The fractions are always added at the end of the treatment course.
- **Remove fraction(s):** Removes selected fractions to shorten the treatment course. Fractions are removed from the end of the treatment course, and only fractions without any delivery can be removed.

Note: *Some of the above actions will alter the treatment course nominal contributions to the defined prescriptions. These will, thus, require the user to first unapprove and then re-approve the treatment course.*

D.8 SHOW/EDIT BEAM SET NOTE

It is possible to edit the beam set note for a plan. The edited note will be saved for the plan in the treatment course. The note can also be edited from the started session.

If the beam set has a beam set note there is a speech bubble in all rows for this beam set in the treatment course list.

To show/edit a note, right-click on the fraction in the treatment course and select **Show/Edit beam set note**.

D.9 BEAM SET DELIVERY APPROVAL IN TREATMENT COURSE

When Clinic settings is configured to require beam set delivery approval, an additional approval step is required before the scheduled beam set can be delivered. For further information, see *section A.1 Configure beam set delivery approval in Clinic settings on page 54*.

The **Approve beam set delivery** option is accessible by right-clicking on a fraction in the treatment course list. The delivery approval will apply to the beam set that is shown for the fraction.

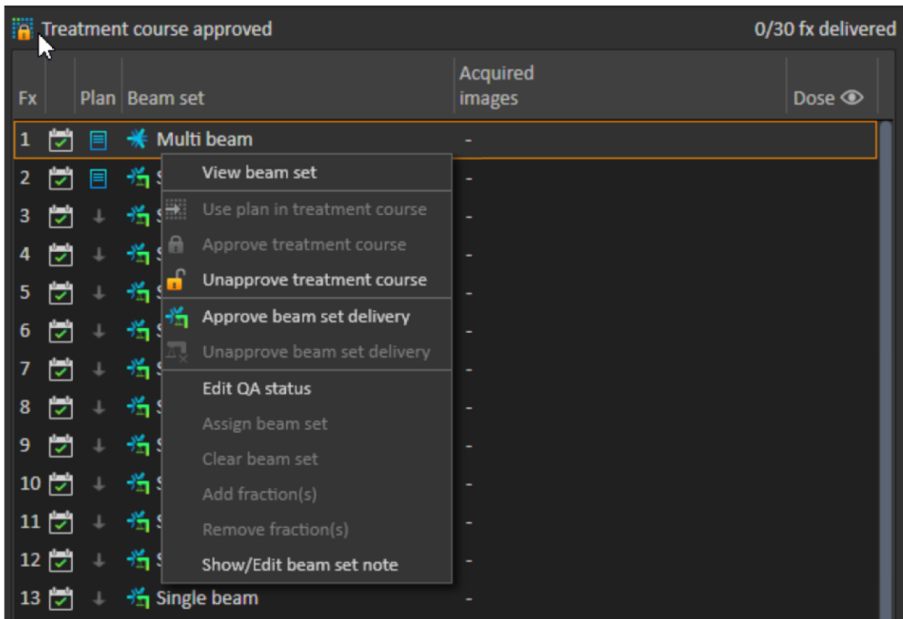
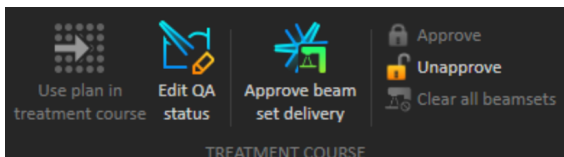


Figure 22. The **Approve beam set delivery** option in Treatment course.

Delivery approval can also be set for the currently selected beam set by clicking the **Approve beam set delivery** button in the top tool bar. This also allows approving beam sets not currently shown in the treatment course list (alternative beam sets).



Beam set delivery approval requires authentication by a user with treatment administration rights.

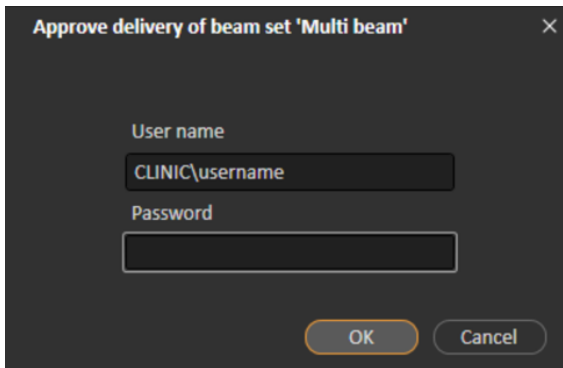
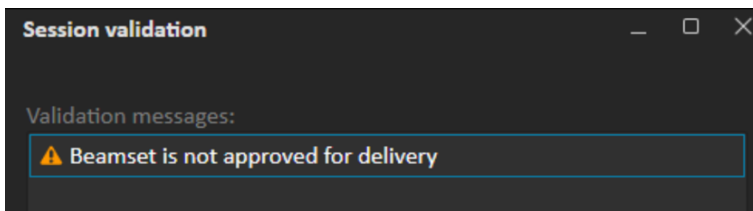


Figure 23. The Beam set delivery approval authentication dialog.

If the scheduled beam set is missing delivery approval, it will not be possible to check in the patient for the session.

RayCommand will also validate beam set delivery approval before the beam set can be delivered.



Once a beam set delivery is approved it is possible to undo the approval by unapproving it. This also requires treatment administration rights. Removing a beam set completely from the treatment course will unapprove the delivery and if a previously approved beam set is re-added to the treatment course, its delivery will have to be approved again.

It is possible to see the delivery approval status in the treatment course list as well as in the session tooltip. An approved beam set delivery is indicated by a beam set icon with a green treatment unit. The delivery approval status is also shared with RayCare and its state shows up as a treatment alert for a specific session.

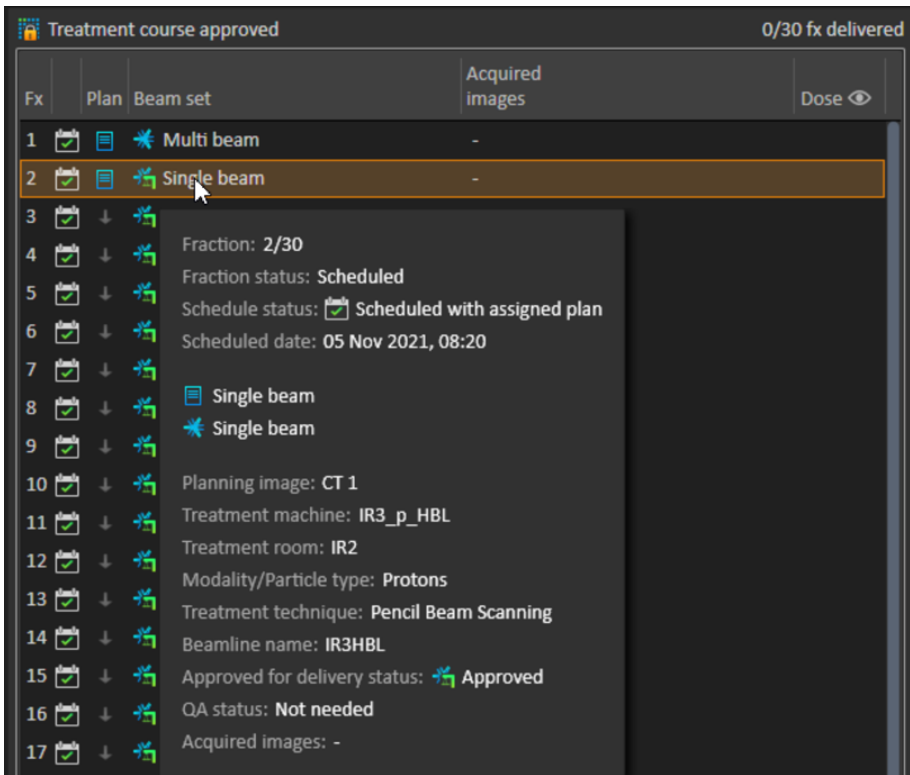


Figure 24. The delivery approval status in Treatment course.

When Clinic settings is set to require beam set delivery approval, but the scheduled beam set does not require delivery approval (i.e., if the beam set was added to the treatment course before selecting the delivery approval option in Clinic settings), the delivery approval buttons will be visible but disabled. To require delivery approval for such beam sets they need to be removed and re-added to the treatment course.

Note: *This feature is only applicable for RayCare treatments.*

E TREATMENT RESULTS IN RAYSTATION

After the treatment delivery has been performed, it is possible to examine the results of the delivery in RayStation. The delivery results are presented in the **Result** workspace layout in the Dose Tracking module in RayStation. Delivery results such as beam delivery result status, couch positions, couch angles and online couch correction can be examined for each delivered treatment session.

The screenshot shows the RayStation software interface in the 'Result' workspace layout. The top left panel displays patient information for Joseph Moore, including an anonymized ID and date of birth. The main workspace is divided into several sections:

- Beam delivery result:** A table showing the results for two beams (b1 and b2) across two fractions. The table includes columns for Beam #, Beam name, Planned MU, Delivered MU, Gantry angle (Planned and Delivered), Status, and Snout (Planned and Delivered).
- Online couch correction:** A table showing couch positions and angles for the two beams. The table includes columns for Beam #, Beam name, Isocenter name, and couch angles (Lat, Long, Vert, Rotation, Pitch, Roll).
- Final note:** A text area for recording final notes.

Beam #	Beam name	Planned	Delivered	Gantry angle [deg]		Status	Snout [cm]		
				Planned	Delivered		Name	Planned	Delivered
1	b1	60.57 MU	60.57 MU	90.00	90.00	Delivered	SnoutM	32.30	32.30
2	b2	66.10 MU	66.10 MU	325.00	325.00	Delivered	SnoutM	32.30	32.30

Beam #	Beam name	Isocenter name	Couch positions [cm]			Couch angles [deg]		
			Lat	Long	Vert	Rotation	Pitch	Roll
1	b1	Beam set A1 1	-	-	-	-	-	-
2	b2	Beam set A1 1	-	-	-	-	-	-

Figure 25. The **Result** workspace layout in the Dose Tracking module in RayStation.

It is possible to edit results or compensate for any mistakes done in RayTreat. It is also possible to cancel and record any treatment sessions delivered outside of RayTreat, so that the results may still be used for dose tracking or when displaying the results of the treatment course in RayCare

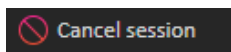
and RayStation. Editing results and recording of treatment sessions are not available when using RayCommand.

Note: *Modifications done in this workspace cannot be undone. Any changes here require that no previous unsaved modifications exist. All changes also require user authentication to be performed before completion.*

Note: *The treatment course needs to be approved in order to modify delivery or cancel a session.*

E.1 CANCEL SESSION

To cancel a treatment session that has not yet been started, click the **Cancel session** button in the Dose Tracking module in RayStation.



It is not possible to cancel a session that has already started, or has been checked-in through RayCare. Such a session will still have to be canceled through RayTreat.

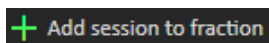
Note: *It is always preferred to cancel a session through RayTreat before canceling it through RayStation, if the session is scheduled for delivery on the same day.*

When canceling a session in RayStation, the user has to confirm the cancellation and complete the empty session. Once a session has been canceled it is still possible to modify the delivery through the **Modify delivery** button.

E.2 ADD SESSION TO FRACTION

Add an additional treatment session to the selected fraction by clicking the **Add session to fraction** button. That is, if the last session is completed, and there is still more to be delivered on that fraction.

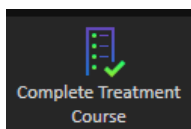
Note: *Treatment course needs to be unapproved before session can be added to fraction.*



The new session that is added will then have to be scheduled manually through RayCare.

E.3 COMPLETE TREATMENT COURSE

When all fractions have been delivered and completed, it is possible to complete the entire treatment course by clicking the **Complete Treatment Course** button. A completed treatment course will be locked from further delivery.



F DEFINITIONS

Term	Meaning
GPU	Graphics Processing Unit
BEV	Beam's Eye View
Control point	Position of the PPS in the treatment room according to IEC 61217: Yaw (IEC theta, Rz), X (table top lateral), Y (table top longitude), Z (vertical), Pitch (IEC psi, Rx), Roll (IEC phi, Ry)
DVH	Dose Volume Histogram
deg	When the term deg is seen in RayStation this refers to degrees.
DRR	Digitally Reconstructed Radiograph
External ROI	The ROI used to define the outline of the patient in the dose computation. The ROI used to define the outline of the patient in the dose computation.
GUI	Graphical User Interface
MU	Monitor Units
ROI	Region of Interest
Path	A sequence of control points.
Patient positioner	Collective name for the device used to place the patient on. This can typically be a treatment couch, or a chair mounted on a positioning device.

Term	Meaning
Trajectory	PPS speeds and accelerations through a path, calculated for the comfort of the patient, stability of the ROI, and protection of the PPS, with respect to mechanical limits and IEC standards.
Control console	The physical control panel provided by the manufacturer of the patient positioning system or the treatment machine.
PPS	Patient Positioning System



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