RAYSTATION 2023B

Release Notes

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CE 2862

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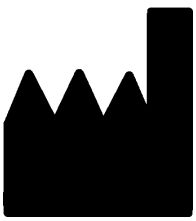
1 INTRODUCTION

1.1 ABOUT THIS DOCUMENT

This document contains important notes about the RayStation 2023B system. It contains information related to patient safety and lists new features, known issues and possible workarounds.

Every user of RayStation 2023B must be familiar with these known issues. Contact the manufacturer for any questions about the content.

1.2 MANUFACTURER CONTACT INFORMATION



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1.3 REPORTING OF INCIDENTS AND ERRORS IN SYSTEM OPERATION

Report incidents and errors to the RaySearch support email: support@raysearchlabs.com or to your local support organization via telephone.

Any serious incident that has occurred in relation to the device must be reported to the manufacturer.

Depending on applicable regulations, incidents may also need to be reported to national authorities. For the European Union, serious incidents must be reported to the competent authority of the European Union Member State in which the user and/or patient is established.

2 NEWS AND IMPROVEMENTS IN RAYSTATION 2023B

This chapter describes the news and improvements in RayStation 2023B compared to RayStation 12A.

2.1 HIGHLIGHTS

- Improved dose tracking and replanning workflow.
- Automatic field-in-field planning.
- Support for discrete proton arcs.
- LET optimization.

2.2 MACHINE LEARNING PLANNING

- Possibility to use organ motion image sets for robust optimization in Machine learning planning.

2.3 GENERAL SYSTEM IMPROVEMENTS

- New function *Localize isocenter* available in the *Beams* list, *Setup beams* list and right-click menu on 2D patient views will scroll the 2D patient views to the position of the beam's isocenter.
- Color table dialog always displays both absolute and relative values.
- Performance improvements that speed up the opening and closing of patients with a lot of data.
- Performance improvements that result in faster copy, delete and undo delete for ROIs.
- The error message showing if there are overlapping material ROIs has been improved. The message now shows the names of the overlapping ROIs.
- The content in most drop-down lists and other lists (e.g. when listing ROIs, POIs, imaging systems etc.) is now sorted alphabetically by default.
- The patient data management workspace user interface has been improved.
- For RayCare users, the beam set note is now displayed below the task list for the beam set selected in RayStation. The beam set note can be edited from RayStation.

- For patient data shared with RayCare, there is a new recovery function that makes it possible to resend all applicable patient data to RayCare.

2.4 PATIENT MODELING

- The *Simplify contours* dialog has been updated:
  - Pre-selected ROIs are displayed at the top of the list when the dialog is opened.
  - Counter is added to see how many ROIs are selected.
  - Confirmation is required when removing holes from fixation and support ROIs.
- Possibility to delete multiple contours has been added:
  - Contours in several slices for the selected ROI can be deleted, keeping contours in e.g. every 2nd, 3rd or 5th slice. Optionally, it is possible to define a limited range of image slices within which to do this.
- Possibility to delete multiple ROIs/POIs/geometries in *Structure definition* has been added, both in the toolbar and the ROI/POI list:
  - If multiple ROIs/POIs are selected in the ROI/POI list, it is possible to delete all of them or their geometry on the primary image set at the same time. This is done either by clicking the *Delete* button in the toolbar or by right-clicking in the ROI/POI list and selecting *Delete ROI(s)/Delete POI(s)/Delete geometries*.
  - The option to delete a geometry from the ROI/POI list is only available in the *Structure definition* module.
- The template material list has been updated:
  - The following materials have changed names:
    + *Aluminum 1* to *Aluminum [Al]*
    + *Aluminum 2* to *Aluminum +*
    + *Bone 1* to *Bone*
    + *Bone 2* to *Bone +*
    + *Gold* to *Gold [Au]*
    + *Iron* to *Iron [Fe]*
    + *Lead* to *Lead [Pb]*
    + *Silicon* to *Silicon [Si]*
    + *Silver* to *Silver [Ag]*
    + *Tantalum* to *Tantalum [Ta]*

+ *Titanium* to *Titanium [Ti]*

- The following template materials have been removed:
  - Carbon fiber
  - Cork
  - PMI foam
- It is now possible to filter both the A and B list of ROIs in the *ROI algebra* dialog.
- The functionality *Create controlling ROIs for biomechanical deformable registration* has been improved. If controlling ROIs are created for a set of ROIs, the controlling ROIs can be used directly in biomechanical deformable registration:
  - Conversion from geometry to triangle mesh representation has been adjusted to work better for biomechanical deformable registration.
  - Mesh separation is applied to overlapping triangle meshes based on user specified priority.
- It is now only possible to display Material for primary images. The option has been removed for secondary images.

2.5 BRACHYTHERAPY PLANNING

- Point based optimization: It is now possible to add objectives and constraints relating to the dose at points of interest.

2.6 AUTOMATIC BREAST PLANNING

- It is now possible to generate plans using the photon Monte Carlo dose engine.

2.7 PLAN SETUP

- It is now possible to edit adapted plans by using the standard *Edit plan* dialog.

2.8 VIRTUAL SIMULATION

- Setup beams and DRRs are now shown in the *Virtual Simulation* module. Note that DRRs will not be exported.

2.9 3D-CRT BEAM DESIGN

- A new tool for field-in-field planning is available. The tool creates a field-in-field plan based on the prescription and a primary field. The tool automatically:
  - creates subfields based on low dose regions

- adjusts segment weights
- computes final dose and scales to prescription

2.10 PLAN OPTIMIZATION

- It is now possible to apply *OAR range margin* to several ROIs for ion PBS plans.
- The speed of VMAT optimization for machines without backup jaw in combination with protect ROIs or constraints has been improved. Such optimization may be many times faster than previously for some cases.
- Sliding window sequencing for VMAT has been changed to create segments where the MLC leaves conform more closely to the target volume than previously. Note that the segment-based mode in the MCO module is affected by this change as it always uses sliding window sequencing to create VMAT segments.
- It is now possible to run segment MU optimization and beam MU optimization using the photon Monte Carlo dose engine.

2.11 LET OPTIMIZATION

- Support for optimization on dose-averaged linear energy transfer (LETd) for protons and carbon ions has been added.
- Possibility to add Max LETd and Min LETd optimization functions in addition to standard dose optimization functions has been added.
- Possibility to set a dose threshold for max LETd functions has been added. The LETd is only penalized in voxels where the dose is higher than the threshold.

2.12 MULTI CRITERIA OPTIMIZATION (MCO)

See information about modification of the sliding window sequencing in Plan optimization above.

2.13 PLAN EXPLORER

- It is now possible to use the photon Monte Carlo dose engine in the *Plan explorer* module (not available when using High Performance Computing (HPC)).

2.14 TOMOTHERAPY PLANNING

- Better dose centering during delivery when using Motion Synchronization for Radixact treatment machines.

2.15 CYBERKNIFE PLANNING

- Optimization of cone and iris plans is now substantially faster. In the initial stage of the optimization, dose is computed with the fast SVD dose engine. In the later stage, the clinical dose engine is used.
- Optimization of a CyberKnife plan can now be continued, even if the plan does not reference the latest RAMP file, as long as it remains feasible for delivery.

2.16 PROTON PENCIL BEAM SCANNING PLANNING

- Beam scanning direction in the BEV is now shown in different colors depending on whether the beam is on or off when traveling to the spot. This makes it easier to identify spot islands for quasi-discrete PBS machines.

2.17 PROTON ARC PLANNING

- Support for discrete PBS Arcs has been added. Discrete PBS Arc optimization involves:
  - Many gantry angles per beam, where multiple energy layers are delivered per gantry angle.
  - No rotation during beam delivery.
  - Easy setup including air gap computation for collision avoidance.
  - Iterative reduction of energy layers during optimization to reduce delivery time.
  - PBS Arc plans can easily be converted to regular PBS plans which means that these plans can be delivered by all existing proton PBS treatment machines.

2.18 PROTON BROAD BEAM PLANNING

- *Compute beam SOBP* now traces through the actual shape of the compensator and ion wedge (if present).
- *Compute beam set parameters* takes ion wedge into account.
- RayOcular: The handling of multiple scattering in wedges has been improved, leading to an improved accuracy of the dose engine.

2.19 LIGHT ION PENCIL BEAM SCANNING PLANNING

- RBE model parameters can now be accessed using scripting.
- Nuclear interaction correction (NIC) has been introduced in the light ion pencil beam dose engine. This will improve physical dose calculation in non-water materials.

- Dose-averaged linear energy transfer (LETd) is computed using the trichrome fluence model, improving the accuracy significantly outside of the field, in penumbrae and for small fields.

2.20 BORON NEUTRON CAPTURE THERAPY (BNCT) PLANNING

- It is now possible to have more than two beams in a beam set.
- Maximum allowed value for cell type to blood boron concentration ratio in Standard BNCT RBE model is increased to 100.
- BNCT-specific scripting extension, *GetRoiNamePixelData*, is added which, for each dose grid voxel, returns the name of the ROI that has been associated with the dose grid voxel, as provided to the external BNCT dose engine.
- RBE model parameters can now be accessed using scripting.
- Material visualization view has been disabled for BNCT, since it is not applicable.
- A warning message is shown if the selected dose grid voxel size causes a material override ROI to be excluded from the computation. The warning may be shown when computing dose, during approval, in report and DICOM export.

2.21 ELECTRON PLANNING

- Support for dose computation using multiple GPUs has been added.

2.22 ROBUST EVALUATION

- It is now possible to evaluate the aggregate dose "voxelwise min" and "voxelwise max" on another image set than the nominal plan, as long as all scenarios are on the same image set.
- It is now possible to access the "voxelwise min" and "voxelwise max" through scripting, as well as evaluating clinical goals on these distributions. The number of passed scenarios per clinical goal can also be retrieved from the scripting interface.

2.23 DOSE TRACKING

- Initializing dose tracking is now done from the *Dose tracking* module. The previous *Use plan in treatment course* button is removed. When initializing dose tracking, the user selects a treatment plan that will be used to define the initial dose tracking treatment course.
- Selection of dose accumulation image set has been introduced. The user can choose any image set in the case to use for dose accumulation when initializing dose tracking.
- Support for editing the treatment course used in dose tracking has been added. Fractions can be added or removed, and it is possible to assign or clear beam set on planned fractions. Beam sets from any treatment plan in the case can be used in the same dose tracking treatment course.

- It is now possible to clear fractions that have already been dose tracked. This allows the user to change which image is used for fraction dose evaluation.
- Total dose comparison view is updated to include the planned fraction dose as contribution for undelivered fractions in the predicted total dose.
- For RayCare users, the dose tracking treatment course can be synced with the treatment course in RayCare. A button will be shown when the dose tracking treatment course is out of sync and allows the user to quickly get up to date with the current RayCare treatment course.
- Dose evaluation on converted CBCT images for protons and other light ions.
    - A converted CBCT cannot be used as the primary planning image, due to high sensitivity to range uncertainty for protons and other light ions. The functionality should primarily be used to assess whether a repeat CT and replanning are needed.

2.24 ADAPTIVE REPLANNING

- The dialog for creating adapted plans is updated and simplified. It is now possible to create adapted plans without taking any background dose into account. This allows a quick and simple replanning workflow where a base plan is quickly adapted to the daily patient geometry.
- Background dose accumulation has changed to only include direct dose deformations. When creating an adapted plan based on dose tracking, all fraction contributions will be mapped directly from the dose accumulation image set. When creating an adapted plan based on planned dose, all fraction contributions will be mapped directly from the plan image set.
- It is now possible to edit adapted plans using the standard *Edit plan* dialog. The previous *Edit adapted plan* dialog has been removed.

2.25 DICOM

- The issues described in FSN 109886 regarding Virtual Simulation export and import have been fixed.
- The DICOM filter *RSL-D-61-450 Remove Pixel Intensity Relationship and Sign* is no longer needed. A checkbox configuration in RayPhysics replaces the filter.
- It is now possible to define a default value for the *Delete after successful import* selection in the import dialogs for Storage SCP.
- It is now possible to set both default import source and default export target in Clinic Settings. This configures which source/target is pre-selected when opening the import/export dialogs in RayStation.
- Export of nominal dose rate for each control point for VMAT and Conformal Arc plans is now supported. There is a checkbox configuration in RayPhysics for this.

- It is now possible to export symmetrical jaw positions with values X/Y for plans where the jaw positions are symmetrical for all segments in all beams. There is a checkbox configuration in RayPhysics for this.
- It is now possible to omit MLC from export for cone plans with fully retracted MLC. There is a checkbox configuration in RayPhysics for this.
- The sorting order of studies and series in the import dialog has been updated to show the newest study/series first.
- When doing Query/Retrieve from a PACS system, where only a single patient was returned by the query, RayStation will now only automatically query for studies within the patient (not for all series in all studies).

2.26 PLAN REPORTS

- It is now possible to define a default folder where generated reports will be stored. The folder is defined in Clinic settings.
- In the plan report, there is a new table for each beam set displaying the used support and fixation ROIs and their material properties. The *ROI properties* table for *Plan* will no longer contain material information for fixation and support ROIs. Make sure that the new *Fixation & support ROIs* table becomes included in a suitable location when updating existing report templates. (In the Report designer, the table is displayed in *Data modules*: *Tables* > *Beam set* > *Fixation & support ROIs*. It requires scope *Beam set*).

2.27 RAYPHYSICS

Photon beam commissioning

- It is now possible to see dose difference curves together with measured and computed curves in the dose curve graph. It is also possible to export the dose difference curves.
- It is now possible to see gamma curves together with measured and computed curves in the dose curve graph. It is also possible to export the gamma curves.
- Two additional MLC parameters have been introduced: leaf tip transmission and corner transmission. This will allow improved modeling of the MLC leaf tip region for MLCs with tilted surface between the leaves, for example the Elekta Agility MLC. The new parameters have default values set which will result in equivalent computed dose as in previous RayStation versions.
- Template machines have been updated.
- It is now possible to set several machine parameters per energy: maximum DMLC dose rate, minimum and maximum static arc dose rate, minimum MU per leaf travel distance, minimum and maximum MU per gantry degree, minimum MU per arc segment.

- It is now possible to commission machines which have only the backup jaw fixed. This is done by setting the minimum and maximum backup jaw limit to the same value.
- It is now possible to use different phantom size in x, y and depth directions for dose curve calculations in RayPhysics.
- It is now possible to have a maximum field size larger than 40 cm for machines (up to 64 cm).

Electron beam commissioning

- It is now possible to see dose difference curves together with measured and computed curves in the dose curve graph. It is also possible to export the dose difference curves.
- It is now possible to see gamma curves together with measured and computed curves in the dose curve graph. It is also possible to export the gamma curves.
- It is now possible to select different shapes (rounded or focused) for MLC leaf/jaw tips. Previously, focused was always used. Setting rounded collimators makes the modeling better for machines with such collimator shape.
- It is now possible to select the additional materials Zinc-Aluminum and Lead for applicator scraper layers.
- Template applicators for Varian and Elekta have been updated.
- Template machines have been updated.

Ion beam commissioning

- Possibility to commission a proton Pencil Beam Scanning machine with support for discrete PBS Arc planning has been added.
- ABS Resin has been added to the available materials for range shifters and ion wedges.

Ion treatment machines room view model

- A new *Room view model* for RayStation, called *Ion gantry* in RayPhysics, has been added for ion machines with rotating gantry, as an alternative to *Only couch* model.
- Existing ion treatment machines that support at least 359 degrees gantry rotation will use the new *Ion gantry* room view model by default (no re-commissioning needed).

2.28 DOSE ENGINE UPDATES

The changes to the dose engines for RayStation 2023B are listed below.

The dose effect refers to the effect when recommissioning of the machine is not performed. After successful recommissioning the dose changes should be minor (except for the Light Ion Pencil Beam dose engine, where differences can be seen in non-water materials due to the introduction of the Nuclear Interaction Correction (NIC)).

Dose engine	Version 12A SP1	Version 2023B	Dose effect	Comment
All	-	-	-	New voxel volume algorithm version due to an update of the conversion algorithm used when converting an ROI from mesh representation to voxel representation. When ROIs are modified, the resulting ROI volumes might be slightly different compared to the same operation in previous versions of RayStation.
Photon Collapsed Cone	5.7	5.8	Minor	Adjustment to the MLC transmission map has been made: The leaf tip region now has a separate, user editable, transmission and a new region called the corner region with a separate transmission has been added. Existing machine models are automatically updated to give the same transmission regions as before. Minor additional improvements and adjustments have been made to the transmission map to improve performance. For example, Elekta Motorized Wedge fluence is minimally reduced: Only the open region is now considered, compared to all MLC regions from RayStation 12A and earlier. Changes at the level of 0.3% have been seen for 1 cm x 1 cm2 square fields due to the transmission map changes (size of output change depends on beam model). The changes are small enough so that recommissioning is not required.

Dose engine	Version 12A SP1	Version 2023B	Dose effect	Comment
Photon Monte Carlo	2.0	3.0	Major	Improved handling of positron physics. For external beam treatment energies, the difference is small. The most noticeable difference is changed output for large field sizes. Improved handling of multiple coulomb scattering. The same fluence map updates as described above for Collapsed Cone are also introduced for Photon Monte Carlo. Existing machine models need to be re-commissioned.
Electron Monte Carlo	4.0	5.0	Major	Improved handling of positron physics. Improved handling of scatter electrons from scraper layers. Improved handling of multiple coulomb scattering. Existing machine models need to be re-commissioned.
Proton PBS Monte Carlo	5.4	5.5	Minor	Improved handling of multiple coulomb scattering. Existing machine models do not need to be re-commissioned.
Proton PBS Pencil Beam	6.4	6.5	Negligible	Existing machine models do not need to be re-commissioned.
Proton US/DS/Wobbling Pencil Beam	4.9	4.10	Minor	RayOcular: Improved handling of multiple scattering in wedges. The algorithm that subtracts WET from IDD:s for MELCO US and RayOcular is slightly modified. Existing machine models do not need to be re-commissioned.

Dose engine	Version 12A SP1	Version 2023B	Dose effect	Comment
Carbon PBS Pencil Beam	5.0	6.0	Major	Nuclear interaction correction (NIC). Noticeable differences for dose reported in non-water materials. New physics base data (depth dose kernels and particle energy spectra) generated in new FLUKA-version. LETd computed using the trichrome approximation. Existing machine models need to be re-commissioned.
Brachy TG43	1.3	1.4	Negligible	No relevant changes to the dose computation algorithm in brachytherapy plans.

2.29 CBCT CONVERSION ALGORITHM UPDATES

The changes to the CBCT conversion algorithms for RayStation 2023B are listed below.

Conversion algorithm	Version 12A SP1	Version 2023B	Dose effect	Comment
Corrected CBCT	1.1	1.2	Minor	Algorithm updated to handle HU-to-SPR tables (only applicable for ions).
Virtual CT	1.1	1.2	Minor	Algorithm updated to handle HU-to-SPR tables (only applicable for ions).

2.30 DEFORMABLE REGISTRATION ALGORITHM UPDATES

The changes to the Hybrid intensity and structure based deformable registration (ANACONDA) for RayStation 2023B are listed below.

Deformable registration algorithm	Version 12A SP1	Version 2023B	Comment
ANACONDA	3.1	3.2	When using controlling ROIs, a new term is included in addition to the chamfer-matching technique used in the original ANACONDA version. This new term measures the image similarity between the target and deformed ROI. This improves the performance for cases with large deformations and makes the algorithm more robust. However, it slows down the speed when many controlling ROIs are selected for computing the registration.

2.31 CHANGED BEHAVIOR OF PREVIOUSLY RELEASED FUNCTIONALITY

- Organ motion: The user can no longer change the imaging system for images generated via *Simulate organ motion*. The imaging system of a simulated organ motion image will always match the imaging system of the original image and will be automatically updated if the imaging system of the original image is changed.
- A bolus is no longer visualized in 3D views if not used in the currently selected beam set.
- A new limitation for maximum ring rotation between consecutive control points has been introduced for WaveArc beams. For some WaveArc templates, only arc gantry angle spacing of 2 degrees will be possible to use.
- Ions: Range shifter tray, block aperture tray and ion wedge tray can now be placed downstream of the isocenter.
- Note that RayStation 11A introduced some changes regarding prescriptions. This information is important if upgrading from a RayStation version earlier than 11A:
    - Prescriptions will always prescribe dose for each beam set separately. Prescriptions defined in RayStation versions prior to 11A relating to beam set + background dose are obsolete. Beam sets with such prescriptions cannot be approved and the prescription will not be included when the beam set is DICOM exported.
    - Prescriptions that are set using a plan generation protocol will now always relate to the beam set dose only. Make sure to review existing plan generation protocols when upgrading.
    - Prescription percentage is no longer included in exported prescription dose levels. In RayStation versions prior to 11A, the Prescription percentage defined in RayStation was included in the exported Target Prescription Dose. This has been changed so that only the Prescribed dose defined in RayStation is exported as Target Prescription Dose. This change also affects exported nominal dose contributions.
    - In RayStation versions prior to 11A, the Dose Reference UID exported in RayStation plans was based on the SOP Instance UID of the RT Plan/RT Ion Plan. This has been changed so that different prescriptions can have the same Dose Reference UID. Because of this change, the Dose Reference UID of plans exported prior to 11A has been updated so that if the plan is re-exported a different value will be used.
- Note that RayStation 11A introduced some changes regarding Setup imaging systems. This information is important if upgrading from a RayStation version earlier than 11A:
    - A Setup imaging system (in earlier versions called Setup imaging device) can now have one or several Setup imagers. This enables multiple setup DRRs for treatment beams as well as a separate identifier name per setup imager.
        + Setup imagers can be gantry-mounted or fixed.

    + Each setup imager has a unique name which is shown in its corresponding DRR view and is exported as a DICOM-RT Image.
    + A beam using a setup imaging system with multiple imagers will get multiple DRRs, one for each imager. This is available for both setup beams and treatment beams.

- Note that RayStation 8B introduced handling of effective dose (RBE dose) for protons. This information is important for proton users if upgrading from a RayStation version earlier than 8B:
    - Existing proton machines in the system will be converted to RBE type, that is, it is assumed that a constant factor of 1.1 has been used. Contact RaySearch if this is not valid for any machine in the database.
    - Import of RayStation RT Ion Plan and RT Dose of modality proton and with dose type PHYSICAL that was exported from RayStation versions earlier than 8B will be treated as RBE level if the machine name in the RT Ion Plan refers to an existing RBE machine.
    - RT Dose of dose type PHYSICAL from other systems or from RayStation versions earlier than 8B with a machine that does not have the RBE included in the beam model will be imported as in earlier versions and will not be displayed as RBE dose in RayStation. The same applies if the referenced machine does not exist in the database. It is the responsibility of the user to know if the dose should be treated as physical or as RBE/photon equivalent. However, if such a dose is used as background dose in subsequent planning, it will be treated as an effective dose.

    For more details, refer to *Appendix A Effective dose for protons*.
- Note that RayStation 11B introduced changes in the dose statistics calculations. This means that small differences in evaluated dose statistics are expected when comparing to a prior version.

    This affects:

    - DVHs
    - Dose statistics
    - Clinical goals
    - Prescription evaluation
    - Optimization objective values
    - Fetching dose statistics measures via scripting

    This change also applies to approved beam sets and plans, meaning that, for example, prescription and clinical goals fulfillment may change when opening a previously approved beam set or plan from a RayStation version prior to 11B.

The dose statistics accuracy improvement is more noticeable with increasing dose range (difference between minimum and maximum dose within an ROI), and only minor differences are expected for ROIs with dose ranges smaller than 100 Gy. The updated dose statistics no longer interpolates values for Dose at volume, $D(v)$, and Volume at dose, $V(d)$. For $D(v)$, the minimum dose received by the accumulated volume v is instead returned. For $V(d)$, the accumulated volume that receives at least the dose d is returned. When the number of voxels within an ROI is small, the discretization of the volume will become apparent in the resulting dose statistics. Multiple dose statistics measures (e.g., D5 and D2) may get the same value when there are steep dose gradients within the ROI, and similarly, the dose ranges lacking volume will appear as horizontal steps in the DVH.

3 KNOWN ISSUES RELATED TO PATIENT SAFETY

There are no known issues related to patient safety in RayStation 2023B.

Note: *Additional release notes may potentially be distributed shortly after installation.*

4 OTHER KNOWN ISSUES

4.1 GENERAL

The auto recovery feature does not handle all types of crashes

The auto recovery feature does not handle all types of crashes and sometimes when trying to recover from a crash RayStation will show an error message with the text "Unfortunately auto recovery does not work for this case yet". If RayStation crashes during auto recovery, the auto recovery screen will pop up next time RayStation is started. If this is the case, discard the changes or try to apply a limited number of actions to prevent RayStation from crashing.

(144699)

Limitations when using RayStation with large image set

RayStation now supports import of large image sets (>2GB), but some functionality will be slow or cause crashes when using such large image sets:

- Smart brush/Smart contour/2D region growing are slow when a new slice is loaded
- Hybrid deformable registration might run out of memory for large image sets
- Biomechanical deformable registration might crash for large image sets
- Automated Breast Planning does not work with large image sets
- Creating large ROIs with gray-level thresholding might cause a crash

(144212)

Limitations when using multiple image sets in a treatment plan

Plan total dose is not available for plans with multiple beam sets that have different planning image sets. Without plan dose it is not possible to:

- Approve the plan
- Generate plan report
- Enable the plan for dose tracking
- Use the plan in adaptive replanning

(341059)

Slight inconsistency in dose display

The following applies to all patient views where dose can be viewed on a patient image slice. If a slice is positioned exactly on the border between two voxels, and dose interpolation is disabled, the dose value presented in the view by the "Dose: XX Gy" annotation can differ from the actual presented color, with regards to the dose color table.

This is caused by the text value and the rendered dose color being fetched from different voxels. Both values are essentially correct, but they are not consistent.

The same can occur in the dose difference view, where the difference might seem larger than it actually is, because of neighboring voxels being compared.

(284619)

Cut plane indicators are not displayed in 2D patient views

The cut planes, used to limit the CT data used for computing a DRR, are not visualized in regular 2D patient views. To be able to view and use cut planes, use the DRR settings window.

(146375)

Fixation and Support ROIs added after beam set approval will have no effect when computing evaluation dose for the beam set

It is possible to add Fixation and Support ROIs to a case with approved plans or beam sets. Geometries for such ROIs cannot be added to the image set used for the approved beam set, but can be added to other image sets. Dose computation on other image sets (in the Plan evaluation module and in the Dose tracking module) will only consider the Fixation and Support ROIs that existed at the time of beam set approval. Density values for new Fixation and Support ROIs will not be taken into account. Fixation and support ROIs not included in the dose computation are indicated by a dashed line in the patient views. The material view will show that the excluded Fixation and Support ROIs have no effect on the density considered for dose computation.

Note: Geometries added on additional image sets for a Fixation or Support ROI that existed at the time of beam set approval will be included in dose computation for the evaluation dose.

(726053)

The patient image view incorrectly shows the name of the original CBCT imaging system for converted CBCT images

For converted CBCT images, the patient image view shows the name of the original CBCT imaging system rather than the name of the imaging system from where the HU-to-mass-density or SPR conversion table is taken. The user can still get the full information about the conversion table by opening the *Image set properties* dialog for the corresponding converted CBCT image.

(721528)

No warning is given when deleting a case containing approved plans

When a patient containing an approved plan is selected for deletion, the user will be notified and given the opportunity to cancel the deletion. However, if a case containing an approved plan is

selected for deletion for a patient with multiple cases, no warning will be given to the user that an approved plan is about to be deleted.

(770318)

4.2 IMPORT, EXPORT AND PLAN REPORTS

Import of approved plan causes all existing ROIs to be approved

When importing an approved plan to a patient with existing unapproved ROIs, the existing ROIs can become automatically approved. If this occurs, a UI message is given at import stating that the plan approval status will be transferred to the RTStruct. If importing via scripting, this information is given in the import log.

336266

Laser export not possible for decubitus patients

Using the laser export functionality in the Virtual simulation module with a decubitus patient causes RayStation to crash.

(331880)

RayStation sometimes reports a successful TomoTherapy plan export as failed

When sending a RayStation TomoTherapy plan to iDMS via RayGateway, there is a timeout in the connection between RayStation and RayGateway after 10 minutes. If the transfer is still ongoing when the timeout starts, RayStation will report a failed plan export even though the transfer is still in progress.

If this happens, review the RayGateway log to determine if the transfer was successful or not.

338918

Report Templates must be upgraded after upgrade to RayStation 2023B

The upgrade to RayStation 2023B requires upgrade of all Report Templates. Also note that if a Report Template from an older version is added using Clinic Settings, this template must be upgraded to be used for report generation.

Report Templates are upgraded using the Report Designer. Export the Report Template from Clinic Settings and open it in the Report Designer. Save the upgraded Report Template and add it in Clinic Settings. Do not forget to delete the old version of the Report Template.

(138338)

4.3 PATIENT MODELING

Memory crashes can occur when running large hybrid deformable registration computations on GPU

GPU computation of deformable registration on large cases can result in memory related crashes when using the highest grid resolution. The occurrence depends on the GPU specification and the grid size.

(69150)

Floating view in Image registration module

The floating view in the Image registration module is now a fusion view that only displays the secondary image set and contours. The change of the view type has changed how the view works/displays information. The following have changed:

- It is not possible to edit the PET color table from the floating view. The PET color table in the Secondary image set can be changed via Fusion tab instead.
- Scrolling in the floating view is limited to the Primary image set, e.g., if the Secondary image set is larger or does not overlap the Primary in the fusion views it will not be possible to scroll through all slices.
- Position, Direction (transversal/sagittal/coronal), Patient direction letters, Imaging system name and Slice number are no longer displayed in the floating view.
- Image value in the floating view is not displayed if there is no registration between the Primary and Secondary image sets.

(409518)

4.4 BRACHYTHERAPY PLANNING

Mismatch of planned number of fractions and prescription between RayStation and SagiNova

There is a mismatch in the interpretation of the DICOM RT Plan attributes *Planned number of fractions* (300A, 0078) and *Target prescription dose* (300A,0026) in RayStation compared to the brachytherapy afterloading system SagiNova. This applies specifically to SagiNova versions 2.1.4.0 or earlier. If the clinic is using a version later that 2.1.4.0, contact customer support to verify whether the issue persists.

When exporting plans from RayStation:

- The target prescription dose is exported as the prescription dose per fraction multiplied by the number of fractions of the beam set.
- The planned number of fractions is exported as the number of fractions for the beam set.

When importing plans into SagiNova for treatment delivery:

- The prescription is interpreted as the prescription dose per fraction.
- The number of fractions is interpreted as the total number of fractions, including fractions for any previously delivered plans.

Possible consequences are:

- At treatment delivery, what is displayed as prescription per fraction on the SagiNova console is actually the total prescription dose for all fractions.
- It might not be possible to deliver more than one plan for each patient.

Consult with SagiNova application specialists for appropriate solutions.

(285641)

4.5 PLAN DESIGN AND 3D-CRT BEAM DESIGN

Center beam in field and collimator rotation may not keep the desired beam openings for certain MLCs

Center beam in field and collimator rotation in combination with "Keep edited opening" might expand the opening. Review apertures after use and if possible use a collimator rotation state with "Auto conform".

(144701)

4.6 PLAN OPTIMIZATION

No feasibility check of max leaf speed performed for DMLC beams after dose scaling

DMLC plans that result from an optimization are feasible with respect to all machine constraints. However, manual rescaling of dose (MU) after optimization may result in violation of the maximum leaf speed depending on the dose rate used during treatment delivery.

(138830)

4.7 PROTON PLANNING

Beam names may be truncated by OIS

When converting a PBS arc plan to a regular multi-beam PBS plan, each beam will have its gantry angle appended to its name. Some OIS truncate beam names to 5 characters. It is recommended that the user reviews and adjusts beam names of the converted plan (for example via scripting) to conform to the expectations of the OIS prior to plan export.

(770331)

4.8 PLAN EVALUATION

Material view in Approval window

There are no tabs to select to display the material view in the Approval window. The material view can be selected instead by clicking on the image set name in a view and then selecting material in the drop-down that appears.

(409734)

4.9 CYBERKNIFE PLANNING

Verifying deliverability of CyberKnife plans

CyberKnife plans created in RayStation may, for about 1% of the cases, fail the deliverability validation. Such plans will not be deliverable. The affected beam angles will be identified by the deliverability checks that are run at plan approval and plan export.

To check if a plan is affected by this issue before approval, the script method `beam_set.CheckCyberKnifeDeliverability()` can be run. The affected segments can be manually removed before running a continued optimization for the last adjustments.

(344672)

4.10 TREATMENT DELIVERY

Mixed beam sets in plan fraction schedule

For plans with multiple beam sets where the plan fraction schedule has been manually edited for a subsequent beam set, a change to the number of fractions for a preceding beam set will result in a faulty fraction schedule where beam sets are no longer planned in sequence. This can lead to issues in dose tracking and adaptive replanning. To prevent this, always reset the plan fraction schedule to default before changing number of fractions for beam sets in a multi beam set plan after the fractionation pattern has been manually edited.

(331775)

4.11 AUTOMATED PLANNING

Incorrect Beam on interval might be set back without notification

In the Plan Explorer Edit Exploration Plan dialog, when editing the Beam on interval value in the Beam Optimization Settings tab, the value will change back to the previous value without notice if the entered value is out of range. This could easily be missed, for example if the dialog is closed directly after entering an incorrect value. The Beam on interval value is only applicable for VMAT treatment machines commissioned for burst mode (mArc).

(144086)

4.12 BIOLOGICAL EVALUATION AND OPTIMIZATION

Biological evaluation of fractionation schedule can lead to crash when creating new adapted plan

If the fractionation schedule is edited from the Biological Evaluation module, the system will crash when creating an adapted plan. To perform biological evaluation, copy the plan and do the fractionation schedule changes on the copy.

(138535)

Undo/redo invalidates response curves in the Biological Evaluation module

In the Biological Evaluation module, the response curves are removed on undo/redo. Recompute the function values to restore the response curves.

(138536)

Biological function values not invalidated when modifying the fractionation scheme for plans with more than one beam set

Modifying the fractionation schedule for a beam set other than the first one does not invalidate the *Biological Progress* graph or the evaluation function values in the Biological Evaluation module. Always recompute function values manually after moving fractions in plans with more than one beam set.

(48314)

Limitation when evaluating biological clinical goals with time dependent effects in the Dose tracking module

The Dose tracking module supports evaluation of biological clinical goals with time dependent effects (repair and repopulation). Input to this evaluation is the time of treatment of the fractions in the dose tracking treatment course. However, the time of treatment for the fractions is not displayed in the Dose tracking module which makes it difficult for the user to know exactly what the basis for the evaluation is. When initializing dose tracking from a treatment plan, the time of treatment is copied from the plan to the dose tracking treatment course. However, when manually adding or removing fractions the time of treatment might be different from the intended fractionation. Time of treatment for the dose tracking fraction is currently only accessible via scripting. The user must be aware of this limitation when evaluating biological clinical goals with time dependent effects in the Dose tracking module.

(722865)

Biological clinical goals and optimization functions are sometimes not added from templates and protocols

Biological clinical goals and optimization functions in templates and protocols will not be added if no matching biological function is found in the RayBiology function library. This will happen if the biological functions have been updated after the templates and protocols have been created, or if the function is associated with an ROI with another tissue when loading the template. No warning will appear when loading the template or adding the protocol. It is the user's responsibility to ensure that all expected functions have been added after loading a template or running a protocol.

(725140)

4.13 RAYPHYSICS

Updated recommendations for detector height usage

Between RayStation 11A and RayStation 11B, recommendations on the usage of detector height and depth offset for depth dose curves have been updated. If the previous recommendations were followed, the modeling of the build-up region for photon beam models could lead to surface dose overestimation in computed 3D dose. When upgrading to a RayStation version newer than 11A, it is recommended to review and, if needed, update photon beam models with respect to the new recommendations. Refer to section *Detector height and depth offset* in *RSL-D-RS-2023B-REF, RayStation 2023B Reference Manual*, section *Depth offset and detector height* in *RSL-D-RS-2023B-RPHY, RayStation 2023B RayPhysics Manual* and *RSL-D-RS-2023B-BCDS,*

RayStation 2023B Beam Commissioning Data Specification for information about the new recommendations.

(410561)

4.14 SCRIPTING

Limitations regarding scripted reference functions

It is not possible to approve a beam set that includes a scripted reference dose function referencing an unlocked dose. This will lead to a crash. Also, approving a beam set that includes a scripted reference dose function referencing a locked dose, and consecutively unlocking the referenced dose will lead to a crash.

If a scripted reference dose function refers to an unlocked dose, there will be no notifications if the referenced dose is changed or removed. Finally, there is no guarantee when upgrading to new versions of RayStation that upgrades of optimization problems including scripted reference dose functions will retain the dose references.

(285544)

A EFFECTIVE DOSE FOR PROTONS

A.1 BACKGROUND

Starting with RayStation 8B the effective dose of proton treatments is treated explicitly, either by including a constant factor in the absolute dosimetry in the machine model or by combining a machine model based on physical dose in the absolute dosimetry with a constant factor RBE model. When upgrading from a RayStation version prior to RayStation 8B to RayStation 8B or later, all existing machine models in the database will be assumed to have been modeled with a constant factor of 1.1 in the absolute dosimetry to take the relative biological effects of protons into account. Contact RaySearch support if this is not valid for any machine in the database.

A.2 DESCRIPTION

- The RBE factor can either be included in the machine model (as was the standard workflow in RayStation versions prior to 8B) or be set in an RBE model.
  - If the RBE factor is included in the machine model, it is assumed to be 1.1. These machines are referred to as 'RBE'.
  - A clinical RBE model with factor 1.1 is included in every proton RayStation package. This is to be combined with machine models based on physical dose. These machines are referred to as 'PHY'.
  - For other constant factors than 1.1, the user needs to specify and commission a new RBE model in RayBiology. This option can only be used for PHY machines.
- **All existing proton machines in the system will be converted to dose type RBE, where it is assumed that a constant factor of 1.1 has been used to scale absolute dosimetry measurements. Correspondingly, the dose in all existing plans will be converted to RBE dose.**
- Display of RBE/PHY for PHY machine in the RayStation modules Plan design, Plan optimization and Plan evaluation.
  - Possible to toggle between physical and RBE dose in these modules.
  - Possible to view the RBE factor in the Difference view in Plan evaluation.
- For RBE machines, the only existing dose object is RBE dose. For PHY machines, RBE dose is the primary dose in all modules with the following exceptions:

  - Display of Beam Dose Specification Points (BDSP) will be in physical dose.
  - All doses in the QA preparation module will be in physical dose.

- DICOM import:
  - Import of RayStation RtIonPlan and RtDose of modality proton and with dose type PHYSICAL from earlier versions of RayStation than RayStation 8B will be treated as RBE dose if the machine name in the RtIonPlan refers to an existing machine with RBE included in the model.
  - RtDose of dose type PHYSICAL from other systems or from RayStation versions prior to 8B with a machine that does not have the RBE included in the beam model will be imported as in earlier versions and will not be displayed as RBE dose in RayStation. The same applies if the referenced machine does not exist in the database. It is the responsibility of the user to know if the dose should be treated as physical or RBE/photon equivalent. However, if such a dose is used as background dose in subsequent planning, it will be treated as an effective dose.

  Note: *Plans for machines from Mitsubishi Electric Co follow different rules and the behavior has not been changed from versions prior to RayStation 8B.*

- DICOM export:
  - Treatment plans and QA plans for proton machines with dose type RBE (changed behavior compared to RayStation versions prior to 8B where all proton doses were exported as PHYSICAL):
    + Only EFFECTIVE RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as EFFECTIVE.
  - Treatment plans for machines with dose type PHY:
    + Both EFFECTIVE and PHYSICAL RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as PHYSICAL.
  - QA plans for machines with dose type PHY:
    + Only PHYSICAL RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as PHYSICAL.

  Note: *Plans for machines from Mitsubishi Electric Co follow different rules and the behavior has not been changed from versions prior to RayStation 8B.*

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