Integrating the Healthcare Enterprise

IHE Radiation Oncology
Technical Framework Supplement

Treatment Planning – Ion Plan Content (TPPC - ION)

For review and comment only.

DO NOT implement this public comment version.

Revision 1.0 – Draft for Public Comment

Date: May 6, 2021

Author: IHE Radiation Oncology Technical Committee

Email: ro@ihe.net

Please verify you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.

Foreword

This is a supplement to the IHE Radiation Oncology Technical Framework V2.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on May 6, 2021 for Public Comment. Comments are invited and can be submitted at https://www.ihe.net/Radiation_Oncology_Public_Comments. In order to be considered in development of the Trial Implementation version of the supplement, comments must be received by June 5, 2021.

This supplement describes changes to the existing technical framework documents.

"Boxed" instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend Section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text ~~**bold strikethrough**~~. When entire new sections are added, introduce with editor's instructions to "add new text" or similar, which for readability are not bolded or underlined.

General information about IHE can be found at https://www.ihe.net.

Information about the IHE Radiation Oncology domain can be found at https://www.ihe.net/ihe_domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at https://www.ihe.net/about_ihe/ihe_process and https://www.ihe.net/resources/profiles.

The current version of the IHE Radiation Oncology Technical Framework can be found at https://www.ihe.net/resources/technical_frameworks.

CONTENTS

Introduction to this Supplement

This integration profile involves the exchange of RT Ion Plan information between Treatment Planning Systems (TPS) and between Treatment Planning Systems and Treatment Management Systems (TMS). The emphasis for this profile is on reducing ambiguity involved in re-planning and incorporation of the planning information into the treatment management system in anticipation of transfer to a treatment delivery system. The transactions revolve around content rather than workflow.

This profile addresses a selection of "Beam Techniques" that exist in Modulated Ion Therapy. Other techniques such as Scattering, Uniform Scanning and Ocular will be addressed in later supplements. Rather than define actors that had broad involvement in many optional transactions, a large number of actors were defined which have specific mandatory/required transactions and a small number of optional transactions related to beam modifiers. The actors are either producers or consumers of a DICOM RT Ion Plan.

It is expected that the actual products commonly referred to as Treatment Planning Systems will implement one or more of the "producer" actors, and that the choice of which actors are implemented (for which adherence is claimed) will depend on the intended functionality (which is not defined by IHE-RO). A Treatment Planning System that is intended to be able to perform re-planning based on the output of another Treatment Planning System would be expected to adhere to one or more of the "consumer" actors.

It is expected that the actual products variously referred to as Oncology Information Systems, Oncology Information Management, or Electronic Medical Record for Oncology will implement the Treatment Management System Actor (TMS). While the profile does not dictate the functionality of the TMS, the TMS is responsible for providing an adequate view of the information provided to it (as a Beam Consumer) that in normal operating practice the appropriate user can ensure that the planning information has been properly consumed, associated with the correct patient, etc. As indicated in the table identifying actors and transactions, the TMS must be able to act as the consumer in all retrieve transactions, i.e., consume all Beam Techniques.

History

Date	Rev.	Author	Change Summary
2015-09-02	0.1	Ulrich Busch (ulrich.busch@varian.com)	Initial Version for startup: Setup of Document Structure and Chapter 7 Structure to provide a fast heads-up Actor granularity is a first guess Content: Text update by global replacement only DICOM Tables contain still the Conventional Beam tables
2015-09-24	0.2	Ulrich Busch (ulrich.busch@varian.com)	Some updates of Chapter 7 numbering because of further synchronization with other Profiles.

Date	Rev.	Author	Change Summary
2016-04-12	0.3	Ulrich Busch (ulrich.busch@varian.com)	Updated the draft to prepare it for the May 2016 WG-07 Ion Subgroup Meeting.
2016-09-30	0.6	R. Bruce Rakes (rbrakes@mevion.com)	Added recommendations from the IHE-RO Technical Committee and addressed some of Stuart Swerdloff's comments.
2017-07-07	0.8	David Wikler (david.wikler@iba-group.com)	Updated according to DICOM WG-07 Ion Subgroup work to prepare it for the August 2017 IHE-RO Meeting
2018-07-24	0.9	R. Bruce Rakes (rbrakes@mevion.com)	Updated according to the DICOM WG-07 Ion Subgroup Mtg on 2018-06-27. Also, merged Attributes with Excel Spreadsheet: profile RtIon Draft.v0.7.xlsx for the Basic Proton only.
2018-08-03	0.10	R. Bruce Rakes (rbrakes@mevion.com)	Updated according to the DICOM WG-07 Ion Subgroup Mtg on 2018-07-25 and from IHE-RO TC on 08-03-2018. Moved more Common Attributes to General RT Ion Attribute Specifications.
2018-10-26	0.11	R. Bruce Rakes (rbrakes@mevion.com)	Updated based on comments from WG-07 Ion Subgroup Mtg on 2018-08-15.
2019-04-04	0.12	R. Bruce Rakes (rbrakes@mevion.com)	Updated based on comments from DICOM WG-07 ION telecon on 2019-02-13 and IHE-RO TC telecon on 2019-03-21. Recommendation from IHE-RO TC is to simplify the Transactions by having a single Storage Transaction for all RT Ion Plans since the format of transactions is identical. This purpose of this document is content, transactions details will be defined by specific workflow profiles such as TDW-II. Instead, to make the actors easier, just made all the techniques a one-to-one simple C-Store transaction.
2019-06-10	0.13	R. Bruce Rakes (rbrakes@mevion.com)	Updated per recommendations of IHE-RO TC F2F in April 2019. Replaced 'Planned Pitch and Roll in Fixed Beam' with 'Fixed Beamline' Added text explaining that actors must be grouped with those from network or workflow profiles to be fully functional. Cleaned up wording on the transaction diagrams. Renamed Dynamic MLC to Variable Aperture MLC. Forced Meterset Weights to equal Metersets (1:1 ratio). Added Chair as an option for Fixed Beamline. Cleaned up and removed some display restrictions/requirements.
2019-07-19	0.14	R. Bruce Rakes (rbrakes@mevion.com)	At 2019-07-19 IHE-RO F2F, made changes to the Ion Block Modifier. Cleaned up minor syntactic/grammar errors or DICOM tags. Added comment questions inline for Public Comment.
2021-05-06	1.0	RO Technical Committee	Public Comment Release

Open Issues and Questions

#	Intr. in	Description
	0.13	Should metersets and metersets weights be forced to be the same, i.e., 1:1?
	0.14	Please see embedded comments for key decisions for Public Comment.

Closed Issues

#	Intr. in	Description

IHE Technical Frameworks General Introduction

The IHE Technical Framework General Introduction is shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to this document where appropriate.

9 Copyright Licenses

IHE International hereby grants to each Member Organization, and to any other user of these documents, an irrevocable, worldwide, perpetual, royalty-free, nontransferable, nonexclusive, non-sublicensable license under its copyrights in any IHE profiles and Technical Framework documents, as well as any additional copyrighted materials that will be owned by IHE International and will be made available for use by Member Organizations, to reproduce and distribute (in any and all print, electronic or other means of reproduction, storage or transmission) such IHE Technical Documents.

The licenses covered by this Copyright License are only to those copyrights owned or controlled by IHE International itself. If parts of the Technical Framework are included in products that also include materials owned or controlled by other parties, licenses to use those products are beyond the scope of this IHE document and would have to be obtained from that other party.

9.1 Copyright of Base Standards

IHE technical documents refer to and make use of a number of standards developed and published by several standards development organizations. All rights for their respective base standards are reserved by these organizations. This agreement does not supersede any copyright provisions applicable to such base standards. Copyright license information for frequently referenced base standards is provided below.

9.1.1 DICOM (Digital Imaging and Communications in Medicine)

DICOM® is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

9.1.2 HL7 (Health Level Seven)

HL7®, Health Level Seven®, CDA®, CCD®, and FHIR® are registered trademarks of Health Level Seven International.

Health Level Seven, Inc. has granted permission to IHE to reproduce tables from the HL7 standard. The HL7 tables in this document are copyrighted by Health Level Seven, Inc. All rights reserved. Material drawn from these documents is credited where used.

9.1.3 LOINC (Logical Observation Identifiers Names and Codes)

LOINC® is registered United States trademarks of Regenstrief Institute, Inc.

9.1.4 SNOMED CT (Systematized Nomenclature of Medicine -- Clinical Terms)

Some IHE Profiles incorporate SNOMED® CT, which is used by permission of the International Health Terminology Standards Development Organisation. SNOMED CT© was originally created by the College of American Pathologists. SNOMED CT is a registered trademark of the International Health Terminology Standards Development Organisation, all rights reserved.

10 Trademark

IHE® and the IHE logo are trademarks of the Healthcare Information Management Systems Society in the United States and trademarks of IHE Europe in the European Community. They may only be used with the written consent of the IHE International Board Operations Committee, which may be given to a Member Organization in broad terms for any use that is consistent with the IHE mission and operating principles.

Volume 1 – Profiles

Add the following to Section 1.7:

Copyright Licenses

No additions

Domain-specific additions

NA

Add Section 6

6 Treatment Planning – Plan Content Integration (TPPC-ION) Profile

This integration profile involves the exchange of RT Ion Plan information between treatment planning systems and between treatment planning systems and treatment management systems. The emphasis for this profile is on reducing ambiguity involved in re-planning and incorporation of the planning information in to the treatment management system in anticipation of transfer to a treatment delivery system. The transactions revolve around content rather than workflow.

This profile addresses a selection of "Beam Techniques" that exist in Modulated Ion Radiation Therapy. Other techniques such as Scattering, Uniform Scanning and Ocular are not addressed in this profile. Rather than define actors that had broad involvement in many optional transactions, a large number of actors were defined which have specific mandatory/required transactions and a small number of optional transactions related to beam modifiers. The actors are either producers or consumers of a DICOM RT Ion Plan.

6.1 TPPC-ION Actors, Transactions, and Content Modules

Figure 6.1-1 shows the actors directly involved in the TPPC-ION Profile and the relevant transactions between them. A product implementation using this profile must group actors from this profile with actors from a workflow or transport profile to be functional. Actors which have a mandatory grouping are shown in conjoined boxes.

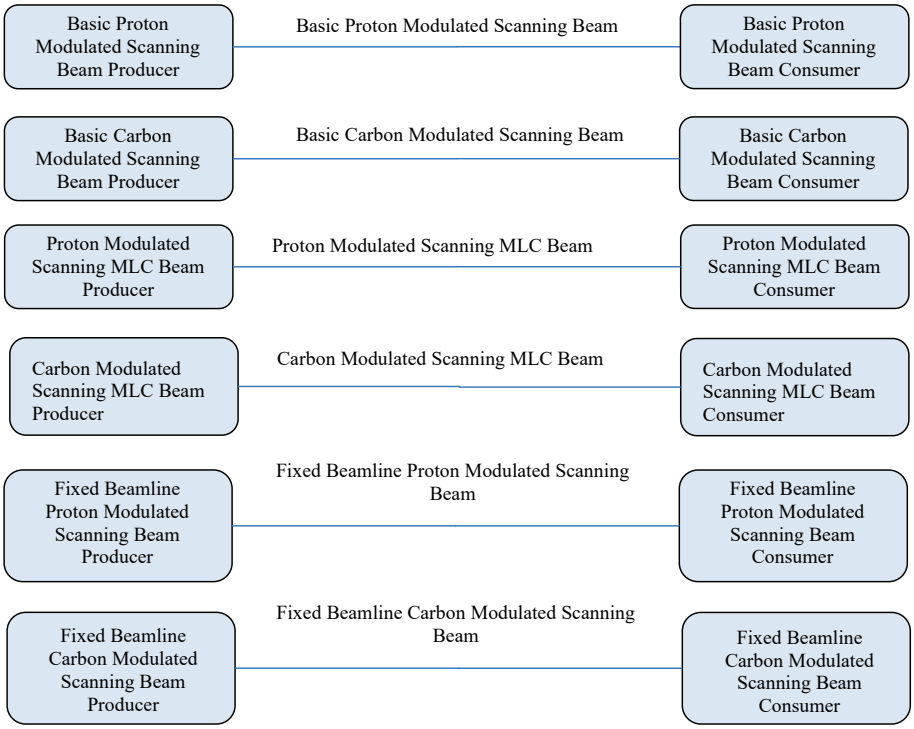


Figure 6.1-1: TPPC-ION Actor Diagram

Table 6.1-1 lists the transactions for each actor directly involved in the TPPC-ION Profile. In order to claim support of this Profile, an implementation of an actor must perform the required transactions (labeled "R") and may support the optional transactions (labeled "O"). Actor groupings are further described in Section 6.3.

Table 6.1-1: TPPC-ION Profile - Actors and Transactions

Actors	Transactions	Optionality	Section in Vol. 2
Treatment Management System (TMS)	Basic Proton Modulated Scanning Beam Storage	O	TPPC-ION-1

Actors	Transactions	Optionality	Section in Vol. 2
(See Note Below)	Basic Carbon Modulated Scanning Beam Storage	O	TPPC-ION-2
	Proton Modulated Scanning MLC Beam Storage	O	TPPC-ION-3
	Carbon Modulated Scanning LC Beam Storage	O	TPPC-ION-4
	Fixed Beamline Proton Modulated Scanning Beam Storage	O	TPPC-ION-5
	Fixed Beamline Carbon Modulated Scanning Beam Storage	O	TPPC-ION-6
Basic Proton Modulated Scanning Beam Consumer	Basic Proton Modulated Scanning Beam Storage	R	TPPC-ION-1
Basic Carbon Modulated Scanning Beam Consumer	Basic Carbon Modulated Scanning Beam Storage	R	TPPC-ION-2
Proton Modulated Scanning MLC Beam Consumer	Proton Modulated Scanning MLC Beam Storage	R	TPPC-ION-3
Carbon Modulated Scanning MLC Beam Consumer	Carbon Modulated Scanning MLC Beam Storage	R	TPPC-ION-4
Fixed Beamline Proton Modulated Scanning Beam Consumer	Fixed Beamline Proton Modulated Scanning Beam Storage	R	TPPC-ION-5
Fixed Beamline Carbon Modulated Scanning Beam Consumer	Fixed Beamline Carbon Modulated Scanning Beam Storage	R	TPPC-ION-6

Note: The TMS Integration Statement will indicate which transactions it is capable of supporting. In general, these will be grouped according to the overall functionality of the TMS. For example, a general TMS would likely support all 12 transactions, while a Proton only TMS may only support the proton beams. In addition, for cases where there are insufficient actors for complete testing of the TMS, the TMS can pass the Connectathon by claiming those transactions it successfully completed.

6.1.1 Actor Descriptions and Actor Profile Requirements

Normative requirements are typically documented in Volume 2 (Transactions) and Volume 3 (Content Modules). Some Integration Profiles, however, contain requirements which link transactions, data, and/or behavior. Those Profile requirements are documented in this section as normative requirements ("shall").

6.2 TPPC-ION Transaction Options

Options that may be selected for this profile are listed in the Table 6.2-1 along with the transactions to which they apply. In Table 6.1-1, each * Beam Producer has exactly one transaction, * Beam Storage. Similarly, each * Beam Consumer has exactly one transaction, * Beam Retrieval. For each of these, there are additional content options as noted in Table 5.2-1 from the set of {Bolus, Block, Compensator, Variable Aperture MLC}. One or more of these

content additions can be added to the base transaction based on the Integration Statement for the application. The TMS must implement all options of all Retrieval transactions. Dependencies between options when applicable are specified in notes.

275 **Table 6.2-1. TPPC-ION - Transaction Options**

Transactions	Options	Optionality	Section in Vol 2
Basic Proton Modulated Scanning Beam Storage	Bolus Beam Modifier	O	3.Y1
	Ion Block Beam Modifier	O	3.Y1
	Ion Range Compensator Beam Modifier	O	3.Y1
Basic Carbon Modulated Scanning Beam Storage	Bolus Beam Modifier	O	3.Y2
	Ion Block Beam Modifier	O	3.Y2
	Ion Range Compensator Beam Modifier	O	3.Y2
Proton Modulated Scanning MLC Beam Storage	Bolus Beam Modifier	O	3.Y3
	Ion Range Compensator Beam Modifier	O	3.Y3
	Variable Aperture MLC Beam Modifier	O	3.Y3
Carbon Modulated Scanning MLC Beam Storage	Bolus Beam Modifier	O	3.Y4
	Ion Range Compensator Beam Modifier	O	3.Y4
	Variable Aperture MLC Beam Modifier	O	3.Y4
Fixed Beamline Proton Modulated Scanning Beam Storage	Bolus Beam Modifier	O	3.Y5
	Ion Block Beam Modifier	O	3.Y5
	Ion Range Compensator Beam Modifier	O	3.Y5
	Chair Patient Support Type Modifier	O	3.Y5
Fixed Beamline Carbon Modulated Scanning Beam Storage	Bolus Beam Modifier	O	3.Y6
	Ion Block Beam Modifier	O	3.Y6
	Ion Range Compensator Beam Modifier	O	3.Y6
	Chair Patient Support Type Modifier	O	3.Y6

6.3 TPPC-ION Actor Required Groupings

There is no required actor grouping.

6.4 TPPC-ION Document Content Module

Not applicable.

6.5 TPPC-ION Overview

This integration profile involves the exchange of RT Ion Plan information between treatment planning systems and between treatment planning systems and treatment management systems. The emphasis for this profile is on reducing ambiguity involved in re-planning and incorporation of the planning information in to the treatment management system in anticipation of transfer to a treatment delivery system.

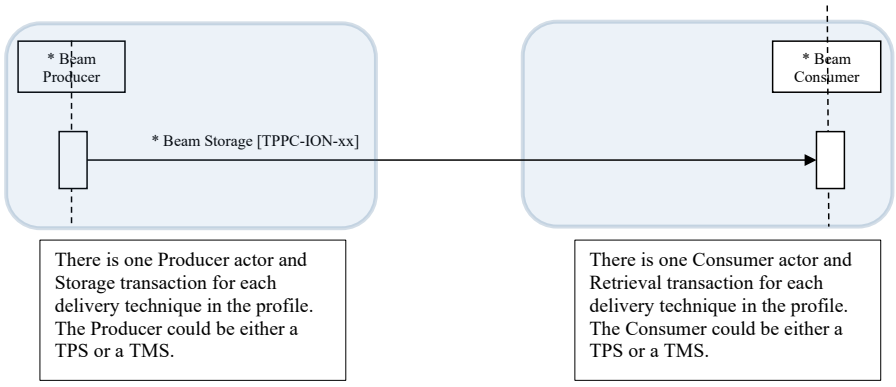


Figure 6.5-1: Overall Process Flow in TPPC-ION Profile

6.5.1 Concepts

This integration profile involves the exchange of RT Ion Plan information between treatment planning systems and between treatment planning systems and treatment management systems. The emphasis for this profile is on reducing ambiguity involved in re-planning and incorporation of the planning information in to the treatment management system in anticipation of transfer to a treatment delivery system. The transactions revolve around content rather than workflow.

This profile addresses a selection of "Beam Techniques" that exist in Modulated Ion Radiation Therapy. Rather than define actors that have broad involvement in many optional transactions, a large number of actors were defined which each have specific mandatory/required transactions and a small number of optional transactions related to beam modifiers. The actors are either producers or consumers of a DICOM RT Ion Plan.

It is expected that the actual products commonly referred to as Treatment Planning Systems will implement one or more of the "producer" actors, and that the choice of which actors are implemented (for which adherence is claimed) will depend on the intended functionality (which is not defined by IHE-RO). A Treatment Planning System that is intended to be able to perform re-planning based on the output of another Treatment Planning System would be expected to adhere to one or more of the "consumer" actors.

It is expected that the actual products variously referred to as Oncology Information Systems, Oncology Information Management, or Electronic Medical Record for Oncology will implement the Treatment Management System (TMS). While the profile does not dictate the functionality of the TMS, the TMS is responsible for providing an adequate view of the information provided to it (as a Beam Consumer) such that, in normal operating practice, the appropriate user can ensure that the planning information has been properly consumed, associated with the correct patient, etc. No transactions have been defined between the TMS in this profile and the TMS in other profiles, and any necessary interface is considered private (in the same way that an Image Manager and an Image Archive are related in the Radiology Domain Scheduled Workflow profile). In practice, it is expected that once a TMS has consumed the information provided to it by a Beam Producer, the system incorporating the TMS will then be able to act as the TMS in delivery-oriented profiles and provide that information to a Treatment Delivery System in that profile. It is not expected that a TMS for this profile from one vendor will interoperate with a TMS for other delivery profiles from another vendor. As indicated in the table identifying actors and transactions, the TMS can support retrieval of any of the beam types (all transactions are optional). The TMS shall indicate in its Integration Statement the scope of its capabilities (i.e., which beam types it supports). It is expected that a TMS will support most, if not all, beam types. However, there may be beam types for which full testing is not possible due to limitations on the number of producers of a specific beam type, hence the optional transaction list.

It should also be noted that Section 7 in this supplement's Volume 3 specifies content that is mandatory across all transactions.

6.6 TPPC-ION Security Considerations

Not applicable

6.7 TPPC-ION Cross Profile Considerations

Not applicable

IHE General Introduction Appendices

Actor Summary Definitions

Add the following terms to the IHE Technical Framework General Introduction Appendix A:

Basic Proton Modulated Scanning Beam Producer

A Treatment Planning System (TPS) capable of producing a proton radiation therapy treatment plan with non-MLC, modulated scanned proton treatment beams.

Basic Proton Modulated Scanning Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Management System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan with static, non-MLC, modulated scanned proton treatment beams.

Basic Carbon Modulated Scanning Beam Producer

A Treatment Planning System (TPS) capable of producing an carbon radiation therapy treatment plan with non-MLC, modulated scanned carbon ion treatment beams.

Basic Carbon Modulated Scanning Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Planning System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan with non-MLC, modulated scanned carbon ion treatment beams.

Proton Modulated Scanning MLC Beam Producer

A Treatment Planning System (TPS) capable of producing a radiation therapy treatment plan with MLC, modulated scanned proton treatment beams.

Proton Modulated Scanning MLC Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Planning System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan with MLC, modulated scanned proton treatment beams.

Carbon Modulated Scanning MLC Beam Producer

A Treatment Planning System (TPS) capable of producing a radiation therapy treatment plan with MLC, modulated scanned carbon treatment beams.

Carbon Modulated Scanning MLC Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Planning System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan with MLC, modulated scanned carbon treatment beams.

Fixed Beamline Proton Modulated Scanning Beam Producer

A Treatment Planning System (TPS) capable of producing a radiation therapy treatment plan without MLC, using planned table pitch and roll, modulated scanned proton treatment beams.

Fixed Beamline Proton Modulated Scanning Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Planning System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan without MLC, using planned table pitch and roll, modulated scanned proton treatment beams.

Fixed Beamline Carbon Modulated Scanning Beam Producer

A Treatment Planning System (TPS) capable of producing a radiation therapy treatment plan without MLC, using planned table pitch and roll, modulated scanned carbon treatment beams.

Fixed Beamline Carbon Modulated Scanning Beam Consumer

A system like a Treatment Planning System (TPS), Treatment Planning System (TMS) or Treatment Delivery System (TDS) capable of consuming a radiation therapy treatment plan without MLC, using planned table pitch and roll, modulated scanned carbon treatment beams.

Treatment Management System (TMS) – An application providing radiation oncology management services and capable of consuming and producing proton treatment plans with any of the above treatment techniques.

Transaction Summary Definitions

Add the following terms to the IHE Technical Framework General Introduction Appendix B:

TPPC-ION-01: Basic Proton Modulated Scanning Beam Storage

In the Basic Proton Modulated Scanning Beam Storage transaction, a ***Basic Proton Modulated Scanning Beam Producer*** stores a treatment plan to a ***Consumer***. The treatment plan shall contain only non-MLC, modulated scanned proton treatment beams.

TPPC-ION-02: Basic Carbon Modulated Scanning Beam Storage

In the Basic Carbon Modulated Scanning Beam Storage transaction, a ***Basic Carbon Modulated Scanning Beam Producer*** stores a treatment plan to a ***Consumer.*** The treatment plan shall contain only non-MLC, modulated scanned carbon ion treatment beams.

TPPC-ION-03: Proton Modulated Scanning MLC Beam Storage

In the Proton Modulated Scanning Beam MLC Storage transaction, a ***Proton Modulated Scanning MLC Beam Producer*** stores a treatment plan to a ***Consumer***. The treatment plan shall contain only MLC, modulated scanned proton treatment beams.

TPPC-ION-04: Carbon Modulated Scanning MLC Beam Storage

In the Proton Modulated Scanning Beam MLC Storage transaction, a ***Carbon Modulated Scanning MLC Beam Producer*** stores a treatment plan to a ***Consumer***. The treatment plan shall contain only dynamic, MLC, modulated scanned proton treatment beams.

TPPC-ION-5: Fixed Beamline Proton Modulated Scanning Beam Storage

In the Fixed Beamline Proton Modulated Scanning Beam Storage transaction, *a* ***Fixed Beamline Proton Modulated Scanning Beam Producer*** stores a treatment plan to a ***Consumer***. The treatment plan shall contain only non-MLC, using planned table pitch and roll, modulated scanned proton treatment beams.

TPPC-ION-6: Fixed Beamline Carbon Modulated Scanning Beam Storage

In the Fixed Beamline Carbon Modulated Scanning Beam Storage transaction, *a* ***Fixed Beamline Carbon Modulated Scanning Beam Producer*** stores a treatment plan to a ***Consumer***. The treatment plan shall contain only non-MLC, using planned table pitch and roll, modulated scanned carbon treatment beams.

Glossary

Add the following terms to the IHE Technical Frameworks General Introduction Glossary:

No new Glossary terms

Volume 2 – Transactions

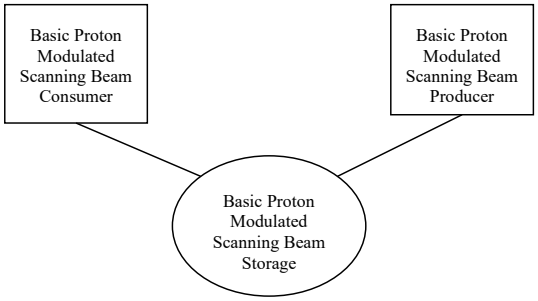
Add the following new sections (3.Y1 through 3.Y6)

3.Y1 Basic Proton Modulated Scanning Beam Storage [TPPC-ION-01]

3.Y1.1 Scope

In the Basic Proton Modulated Scanning Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in TPPC-ION-01: Basic Proton Modulated Scanning Beam Storage stores the plan to a Consumer such as a TMS.

3.Y1.2 Use Case Roles



Actor:	Basic Proton Modulated Scanning Beam Producer
Role:	Creates Basic Proton Modulated Scanning Beam RT Ion Plan and stores plan to a Basic Proton Modulated Scanning Beam Consumer
Actor:	Basic Proton Modulated Scanning Beam Consumer
Role:	Accept and store RT Ion Plan from Basic Proton Modulated Scanning Beam Producer

3.Y1.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y1.4 Messages

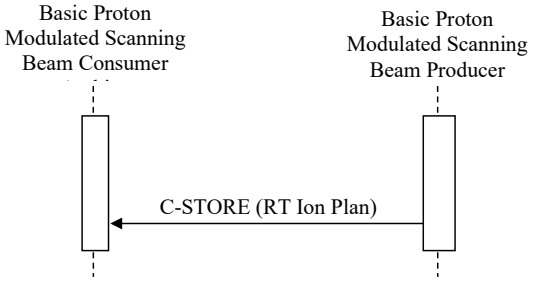


Figure 3.Y1.4-1: Interaction Diagram

3.Y1.4.1 Basic Proton Modulated Scanning Beam Storage

3.Y1.4.1.1 Trigger Events

The Basic Proton Modulated Scanning Beam Producer transfers the plan to the Basic Proton Modulated Scanning Beam Consumer once the plan is created and the dose calculation is finished.

3.Y1.4.1.2 Message Semantics

The Basic Proton Modulated Scanning Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Basic Proton Modulated Scanning Beam Producer is the DICOM Storage SCU and the Basic Proton Modulated Scanning Beam Consumer is the DICOM Storage SCP.

The Basic Proton Modulated Scanning Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y1.4.1.2.1 Storage of RT Ion Plan containing a Basic Proton Modulated Scanning Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y1.4.1.2.2 Optional Modifiers

The Basic Proton Modulated Scanning Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	7.4.4.9.1
Ion Block Beam	7.4.4.9.2
Ion Range Compensator Beam Modifier	7.4.4.9.3

3.Y1.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y1.5 Security Considerations

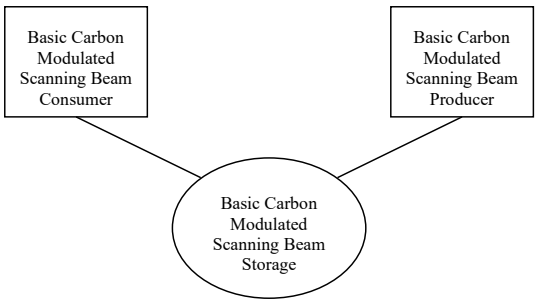
There are no specific security considerations.

3.Y2 Basic Carbon Modulated Scanning Beam Storage [TPPC-ION-02]

3.Y2.1 Scope

In the Basic Carbon Modulated Scanning Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in TPPC-ION-02: Basic Carbon Modulated Scanning Beam Storage stores the plan to the Basic Carbon Modulated Scanning Beam Consumer.

3.Y2.2 Use Case Roles



Actor:	Basic Carbon Modulated Scanning Beam Producer
Role:	Creates Basic Carbon Modulated Scanning Beam RT Ion Plan and stores plan to an Basic Carbon Modulated Scanning Beam Consumer
Actor:	Basic Carbon Modulated Scanning Beam Consumer
Role:	Accept and store RT Ion Plan from Basic Carbon Modulated Scanning Beam Producer

3.Y2.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y2.4 Messages

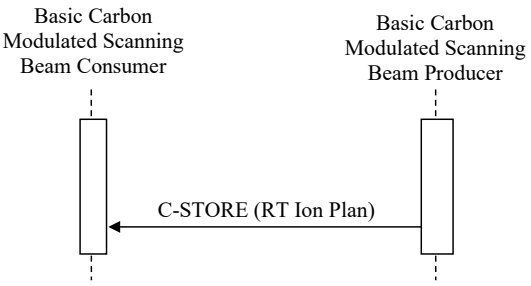


Figure 3.Y2.4-1: Interaction Diagram

3.Y2.4.1 Basic Carbon Modulated Scanning Beam Storage

3.Y2.4.1.1 Trigger Events

The Basic Carbon Modulated Scanning Beam Producer transfers the plan to the Basic Modulated Scanning Beam Consumer once the plan is created and the dose calculation is finished.

3.Y2.4.1.2 Message Semantics

The Basic Carbon Modulated Scanning Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Basic Carbon Modulated Scanning Beam Producer is the DICOM Storage SCU and the Basic Carbon Modulated Scanning Beam Consumer is the DICOM Storage SCP.

The Basic Carbon Modulated Scanning Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y2.4.1.2.1 Storage of RT Ion Plan containing a Basic Carbon Modulated Scanning Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y2.4.1.2.2 Optional Modifiers

The Basic Carbon Modulated Scanning Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Ion Range Compensator Beam Modifier	7.4.4.9.3
Bolus Beam Modifier	7.4.4.9.1
Ion Block Beam Modifier	7.4.4.9.2

3.Y2.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y2.5 Security Considerations

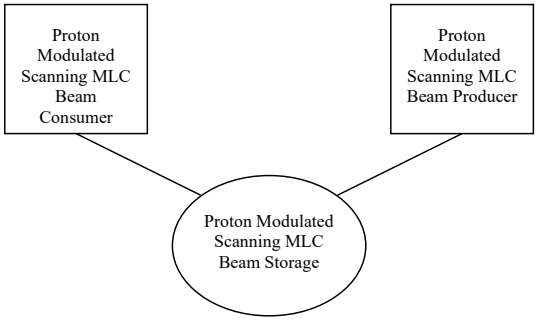
There are no specific security considerations.

3.Y3 Proton Modulated Scanning MLC Beam Storage [TPPC-ION-03]

3.Y3.1 Scope

In the Proton Modulated Scanning MLC Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in TPPC-ION-03: Proton Modulated Scanning MLC Beam Storage stores the plan to the Proton Modulated Scanning MLC Beam Consumer.

3.Y3.2 Use Case Roles



Actor:	Proton Modulated Scanning MLC Beam Producer
Role:	Creates Proton Modulated Scanning MLC Beam RT Ion Plan and stores plan to a Proton Modulated Scanning MLC Beam Consumer
Actor:	Proton Modulated Scanning MLC Beam Consumer
Role:	Accept and store RT Ion Plan from Proton Modulated Scanning MLC Beam Producer

515

3.Y3.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y3.4 Messages

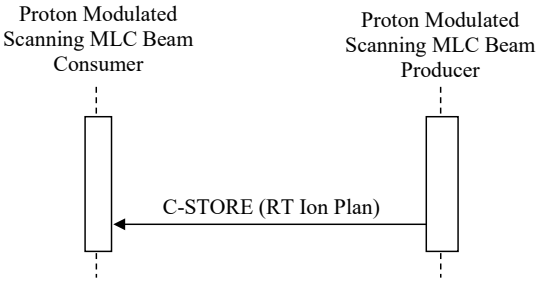


Figure 3.Y3.4-1: Interaction Diagram

3.Y3.4.1 Proton Modulated Scanning MLC Beam Storage

3.Y3.4.1.1 Trigger Events

The Proton Modulated Scanning MLC Beam Producer transfers the plan to the Proton Modulated Scanning MLC Beam Consumer once the plan is created and the dose calculation is finished.

3.Y3.4.1.2 Message Semantics

The Proton Modulated Scanning MLC Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Proton Modulated Scanning MLC Beam Producer is the DICOM Storage SCU and the Proton Modulated Scanning MLC Beam Consumer is the DICOM Storage SCP.

The Proton Modulated Scanning MLC Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y3.4.1.2.1 Storage of RT Ion Plan containing a Proton Modulated Scanning MLC Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y3.4.1.2.2 Optional Modifiers

The Proton Modulated Scanning MLC Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	7.4.4.9.1
Ion Range Compensator Beam Modifier	7.4.4.9.3

3.Y3.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y3.5 Security Considerations

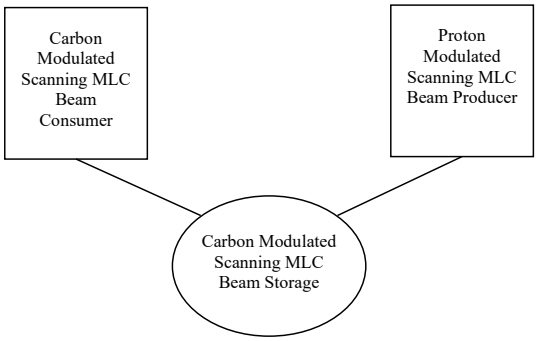
There are no specific security considerations.

3.Y4 Carbon Modulated Scanning MLC Beam Storage [TPPC-ION-04]

3.Y4.1 Scope

In the Carbon Modulated Scanning MLC Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in TPPC-ION-04: Carbon Modulated Scanning MLC Beam Storage stores the plan to the Carbon Modulated Scanning MLC Beam Consumer.

3.Y4.2 Use Case Roles



Actor:	Carbon Modulated Scanning MLC Beam Producer
Role:	Creates Carbon Modulated Scanning MLC Beam RT Ion Plan and stores plan to a Carbon Modulated Scanning MLC Beam Consumer
Actor:	Carbon Modulated Scanning MLC Beam Consumer
Role:	Accept and store RT Ion Plan from Proton Modulated Scanning MLC Beam Producer

3.Y4.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y4.4 Messages

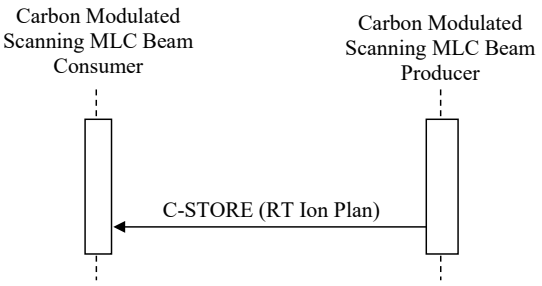


Figure 3.Y4.4-1: Interaction Diagram

3.Y4.4.1 Carbon Modulated Scanning MLC Beam Storage

3.Y4.4.1.1 Trigger Events

The Carbon Modulated Scanning MLC Beam Producer transfers the plan to the Carbon Modulated Scanning MLC Beam Consumer once the plan is created and the dose calculation is finished.

3.Y4.4.1.2 Message Semantics

The Carbon Modulated Scanning MLC Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Carbon Modulated Scanning MLC Beam Producer is the DICOM Storage SCU and the Carbon Modulated Scanning MLC Beam Consumer is the DICOM Storage SCP.

The Carbon Modulated Scanning MLC Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y4.4.1.2.1 Storage of RT Ion Plan containing a Carbon Modulated Scanning MLC Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y4.4.1.2.2 Optional Modifiers

The Proton Modulated Scanning Variable Aperture MLC Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Ion Range Compensator Beam Modifier	7.4.4.9.3
Bolus Beam Modifier	7.4.4.9.1
Variable Aperture MLC Modifier	7.4.4.9.4

3.Y4.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y4.5 Security Considerations

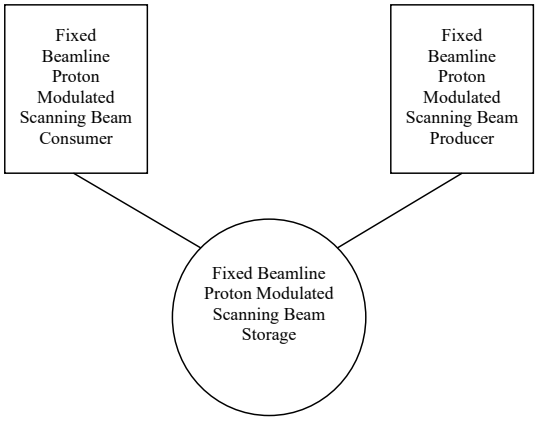
There are no specific security considerations.

3.Y5 Fixed Beamline Proton Modulated Scanning Beam Storage [TPPC-ION-05]

3.Y5.1 Scope

In the Fixed Beamline Proton Modulated Scanning Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in TPPC-ION-5: Fixed Beamline Proton Modulated Scanning Beam Storage stores the plan to the Fixed Beamline Proton Modulated Scanning Beam Consumer.

3.Y5.2 Use Case Roles



605

Actor:	Fixed Beamline Proton Modulated Scanning Beam Producer
Role:	Creates Fixed Beamline Proton Modulated Scanning Beam RT Ion Plan and stores plan to a Fixed Beamline Proton Modulated Scanning Beam Consumer
Actor:	Fixed Beamline Proton Modulated Scanning Beam Consumer
Role:	Accept and store RT Ion Plan from Fixed Beamline Proton Modulated Scanning Beam Producer

3.Y5.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y5.4 Messages

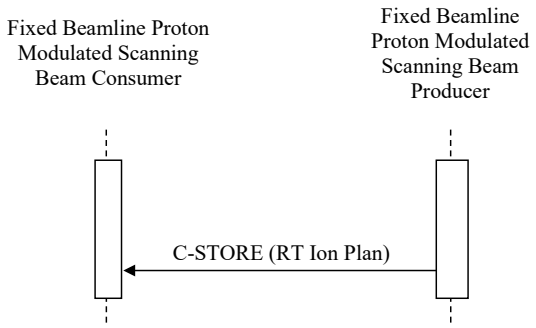


Figure 3.Y5.4-1: Interaction Diagram

3.Y5.4.1 Fixed Beamline Proton Modulated Scanning Beam Storage

3.Y5.4.1.1 Trigger Events

The Fixed Beamline Proton Modulated Scanning Beam Producer transfers the plan to a Fixed Beamline Proton Modulated Scanning Beam Consumer once the plan is created and the dose calculation is finished.

3.Y5.4.1.2 Message Semantics

The Fixed Beamline Proton Modulated Scanning Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Fixed Beamline Proton Modulated Scanning Beam Producer is the DICOM Storage SCU and the Fixed Beamline Proton Modulated Scanning Beam Consumer is the DICOM Storage SCP.

The Fixed Beamline Proton Modulated Scanning Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y5.4.1.2.1 Storage of RT Ion Plan containing a Fixed Beamline Proton Modulated Scanning Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements

build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y5.4.1.2.2 Optional Modifiers

The Fixed Beamline Proton Modulated Scanning Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Ion Range Compensator Beam Modifier	7.4.4.9.3
Bolus Beam Modifier	7.4.4.9.1
Ion Block Beam Modifier	7.4.4.9.2
Chair Patient Support Type Modifier	7.4.4.9.5

3.Y5.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y5.5 Security Considerations

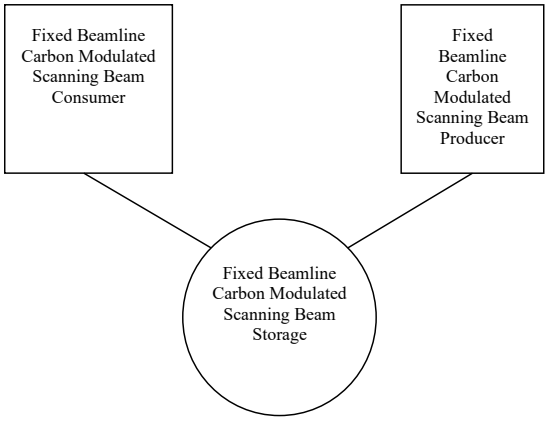
There are no specific security considerations.

3.Y6 Fixed Beamline Carbon Modulated Scanning Beam Storage [TPPC-ION-06]

3.Y6.1 Scope

In the Fixed Beamline Carbon Modulated Scanning Beam Storage transaction, a Producer of an RT Ion Plan that incorporates the beam technique identified in Fixed Beamline Carbon Modulated Scanning Beam Storage stores the plan to the Fixed Beamline Carbon Modulated Scanning Beam Consumer.

3.Y6.2 Use Case Roles



Actor:	Fixed Beamline Carbon Modulated Scanning Beam Producer
Role:	Creates Fixed Beamline Carbon Modulated Scanning Beam RT Ion Plan and stores plan to a Fixed Beamline Carbon Modulated Scanning Beam Consumer
Actor:	Fixed Beamline Carbon Modulated Scanning Beam Consumer
Role:	Accept and store RT Ion Plan from Fixed Beamline Carbon Modulated Scanning Beam Producer

3.Y6.3 Referenced Standards

DICOM 2019b, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y6.4 Messages

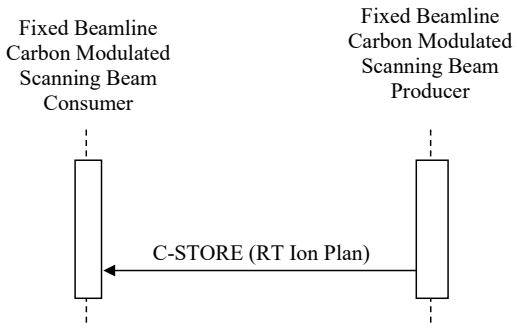


Figure 3.Y6.4-1: Interaction Diagram

3.Y6.4.1 Fixed Beamline Carbon Modulated Scanning Beam Storage

3.Y6.4.1.1 Trigger Events

The Fixed Beamline Carbon Modulated Scanning Beam Producer transfers the plan to a Fixed Beamline Carbon Modulated Scanning Beam Consumer once the plan is created and the dose calculation is finished.

3.Y6.4.1.2 Message Semantics

The Fixed Beamline Carbon Modulated Scanning Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Fixed Beamline Carbon Modulated Scanning Beam Producer is the DICOM Storage SCU and the Fixed Beamline Carbon Modulated Scanning Beam Consumer is the DICOM Storage SCP.

The Fixed Beamline Carbon Modulated Scanning Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.Y6.4.1.2.1 Storage of RT Ion Plan containing a Fixed Beamline Carbon Modulated Scanning Beam

Systems supporting the Treatment Planning - Ion Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements

build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

The definition of the IOD content and the references to the Module content definition are specified in Section 7.3.2.1.4.

3.Y6.4.1.2.2 Optional Modifiers

The Fixed Beamline Carbon Modulated Scanning Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Ion Range Compensator Beam Modifier	7.4.4.9.3
Bolus Beam Modifier	7.4.4.9.1
Ion Block Beam Modifier	7.4.4.9.2
Chair Patient Support Type Modifier	7.4.4.9.5

3.Y6.4.1.3 Expected Actions

The Producer stores the RT Ion Plan.

3.Y6.5 Security Considerations

There are no specific security considerations.

Volume 3 – Content Modules

5 Namespaces and Vocabularies

No Namespaces and Vocabularies defined.

6 Content Modules

No Content Modules defined.

7 DICOM Content Definition

7.1 Conventions

No change to Framework.

7.2 General Definitions

No change to Framework.

7.3 IOD Definitions

This section defines each DICOM IOD used in the IHE Radiation Oncology domain in detail, specifying the standards used and the information defined.

7.3.1 Prescription IODs

This section is present only to convey the envisioned section numbering.

7.3.2 Plan IODs

7.3.2.1 RT Ion Plan IODs

7.3.2.1.1 RT Plan IOD for Photon External Beam in Planning State

This section is present only to convey the envisioned section numbering.

7.3.2.1.2 RT Plan IOD for Photon External Beam in Delivery State

This section is present only to convey the envisioned section numbering.

7.3.2.1.3 RT Plan for Brachytherapy

This section is present only to convey the envisioned section numbering.

7.3.2.1.4 RT Ion Plan

This section is present only to convey the envisioned section numbering.

7.3.2.1.4.1 Referenced Standards

DICOM 2019b PS 3.3

7.3.2.1.4.2 IOD Definition

IE	Module	Reference	Usage	IHE-RO Usage
Patient	Patient	C.7.1.1	M	M See Section 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See Section 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See Section 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Frame of Reference	Frame of Reference	C.7.4.1	U - See Note.	R See Section 7.4.1.7.1
Equipment	General Equipment	C.7.5.1	M	M See Section 7.4.1.5.1
Plan	RT General Plan	C.8.8.9	M	M See Section 7.4.3.1.1
	RT Prescription	C.8.8.10	U	R See Section 7.4.3.2.1
	RT Ion Tolerance Tables	C.8.8.24	U	U
	RT Patient Setup	C.8.8.12	U	R See Section 7.4.3.4.1
	RT Fraction Scheme	C.8.8.13	U	R See Section 7.4.3.3.4
	RT Ion Beams	C.8.8.25	C - Required if RT Fraction Scheme Module exists and Number of Beams (300A,0080) is greater than zero for one or more fraction groups	R Definitions see below
	Approval	C.8.8.16	U	R
	SOP Common	C.12.1	M	M See Section 7.4.1.6.1

RT Ion Beams Module is defined as follows:

Beam Content Type	Section
Basic Proton Modulated Scanning Beam	7.4.4.7.1
Basic Carbon Modulated Scanning Beam	7.4.4.7.2

Beam Content Type	Section
Proton Modulated Scanning MLC Beam	7.4.4.7.3
Carbon Modulated Scanning MLC Beam	7.4.4.7.4
Fixed Beamline Proton Modulated Scanning Beam	7.4.4.7.5
Fixed Beamline Carbon Modulated Scanning Beam	7.4.4.7.6

The Module definition defined in the specification above only applies to beams with Treatment Delivery Type TREATMENT. Beams with other Treatment Delivery Type may be present but their content is not specified.

7.4 Module Definitions

This section defines each DICOM Module used in the IHE Radiation Oncology domain in detail, specifying the standards used and the information defined.

7.4.1 General Modules

This section is present only to convey the envisioned section numbering.

7.4.2 Workflow-Related Modules

This section is present only to convey the envisioned section numbering.

7.4.3 General Plan-Related Modules

This section is present only to convey the envisioned section numbering.

7.4.3.1 General Plan Module

This section is present only to convey the envisioned section numbering.

7.4.3.2 Prescription Module

This section is present only to convey the envisioned section numbering.

7.4.3.3 RT Fraction Scheme Module

This section is present only to convey the envisioned section numbering.

7.4.3.4 RT Patient Setup Module

7.4.3.4.1 RT Patient Setup Module Base Content

This section is present only to convey the envisioned section numbering.

7.4.3.4.2 RT Patient Setup Module Feet First

This section is present only to convey the envisioned section numbering.

7.4.3.4.3 RT Patient Setup Module Reoriented

This section is present only to convey the envisioned section numbering.

7.4.3.4.4 RT Patient Setup Module Decubitus

This section is present only to convey the envisioned section numbering.

7.4.3.4.5 RT Patient Setup Module Sitting

This section is present only to convey the envisioned section numbering.

7.4.3.4.5.1 Referenced Standards

This section is present only to convey the envisioned section numbering.

7.4.3.4.5.2 Module Definition

Attribute	Tag	Type	Attribute Note
Patient Setup Sequence	(300A,0180)	R+*	An actor must not rely on the presence of: Fixation Device Sequence Shielding Device Sequence Setup Device Sequence within the Patient Setup Sequence for proper operation.
>Patient Position	(0018,5100)	R+	Shall be SITTING
>Setup Technique	(300A,01B0)	R+*	
>Table Top Vertical Setup Displacement	(300A,01D2)	O+*	If present, shall be consistent with Isocenter position. See note below
>Table Top Longitudinal Setup Displacement	(300A,01D4)	O+*	If present, shall be consistent with Isocenter position. See note below
>Table Top Longitudinal Setup Displacement	(300A,01D6)	O+*	If present, shall be consistent with Isocenter position. See note below

7.4.4 Plan-Related Modules in Planning

7.4.4.1 RT Beams

This section is present only to convey the envisioned section numbering.

7.4.4.2 General RT Beams Option Specifications

This section is present only to convey the envisioned section numbering.

7.4.4.3 RT Beams Option Specifications

This section is present only to convey the envisioned section numbering.

7.4.4.4 Other Beam Module Definitions

This section is present only to convey the envisioned section numbering.

7.4.4.5 (Future Use)

This section is present only to convey the envisioned section numbering.

7.4.4.6 RT Brachy Application Setups

This section is present only to convey the envisioned section numbering.

7.4.4.7 RT Ion Beams

Editorial Note (to be removed later):

Column "Presence":

This column allows to specify IHE requirements on presence of attributes, which go beyond the requirements of the DICOM Standard. For example,. an attribute with DICOM Type 3 (optional) maybe required by IHE.

Definitions are (excerpt of IHE_RO BRTO II):

R	The attribute is required and is not an IHE extension of the DICOM requirements; i.e., it is already Type 1 in DICOM, but additional constraints are placed by IHE, for example on the value set that may be used for the attribute.
R+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present, i.e., is Type 1, whereas the DICOM requirement may be Type 2 or 3.

RC+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present when the condition is satisfied, i.e., is Type 1C, whereas the DICOM requirement may be Type 2 or 3. If the condition is not fulfilled, the DICOM definitions apply. Note, that this means that the attribute may be present / have a value also in case the condition does not apply.
O	The attribute or its value is optional, i.e., in DICOM it is Type 2 or 3.
O+	The attribute is optional, but additional constraints have been added. Note: The specification approach does not force a Type 2 or Type 3 value to become a Type 1 by stating R+.
D	The requirements of DICOM apply unchanged, but the attribute needs to be displayed if content is not null. E.g., if a value of a Type 2 is null, the empty content does not need to be displayed but if content is present this content shall be displayed
X	This attribute shall be empty if Type 2 and not present if Type 3.
-	No IHE extension of the DICOM requirements is defined. The attribute is listed for better readability or similar purpose.

Column "Specific Rules":

This column allows to specify IHE requirements on the content of attributes, which narrows down the requirement of the DICOM Standard.

For example, although DICOM allows for many values for a treatment plan, for the profile technique, IHE only allows the specified values.

7.4.4.7.1 RT Ion Beams Module for Basic Proton Modulated Scanning Beam

7.4.4.7.1.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.7.1.2 Module Definition

Attribute	Tag	Beam Technique Basic Proton Modulated Scanning	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	R+*	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+	Shall be PROTON.
>Radiation Mass Number	(300A,0302)	O+*	If present, shall be 1
>Radiation Atomic Number	(300A,0304)	O+*	If present, shall be 1
>Radiation Charge State	(300A,0306)	O+*	If present, shall be 1
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.
>Modulated Scan Mode Type	(300A,0309)	R+*	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	X	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT
>Referenced Dose Sequence	(300C,0080)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0.
>Number of Compensators	(300A,00E0)	R+*	Shall be 0 unless Ion Range Compensator Beam Modifier Option is supported. See Section 7.4.4.9.3
>Number of Boli	(300A,00ED)	R+*	Shall be 0 unless Bolus Beam Modifier Option is supported. See Section 7.4.4.9.1
>>Referenced ROI Number	(3006,0084)	-	
>>Accessory Code	(300A,00F9)	-	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0 unless Ion Block Beam Modifier Option is supported. See Section 7.4.4.9.2
>Applicator Sequence	(300A,0107)	X	

Attribute	Tag	Beam Technique Basic Proton Modulated Scanning	
		Presence	Specific Rules
>General Accessory Sequence	(300A,0420)	X	
>Number of Range Shifters	(300A,0312)	R+*	Shall be 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	-	
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)	-	
>>Lateral Spreading Device Number	(300A,0334)	-	
>>Lateral Spreading Device ID	(300A,0336)	-	
>>Accessory Code	(300A,00F9)	-	
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.
>>Lateral Spreading Device Description	(300A,033A)	-	
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall be >= 1.
>>Range Modulator ID	(300A,0346)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Modulator Type	(300A,0348)	R+*	Shall be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.
>>Beam Current Modulation ID	(300A,034C)	-	

Commented [BR1]: This is to accommodate Ripple Filters, etc. which are sometimes used with Scanning techniques.

Attribute	Tag	Beam Technique Basic Proton Modulated Scanning	
		Presence	Specific Rules
>Patient Support Type	(300A,0350)	R+	Shall be TABLE.
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	
>Ion Control Point Sequence	(300A,03A8)	-	
>>Ion Wedge Position Sequence	(300A,03AC)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type (300A,0320) is BINARY, shall be specified as a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.
>>Lateral Spreading Device Settings Sequence	(300A,0370)	-	
>>>Referenced Lateral Spreading Device Number	(300C,0102)	-	
>>>Lateral Spreading Device Setting	(300A,0372)	-	
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)	-	
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)	-	
>>>Referenced Range Modulator Number	(300C,0104)	-	

Commented [BR2]: Is this acceptable?

Attribute	Tag	Beam Technique Basic Proton Modulated Scanning	
		Presence	Specific Rules
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Beam Limiting Device Angle	(300A,0120)	R+*	Shall be 0.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	
>>Scan Spot Meterset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS but always reported in the Treatment Record.
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be 0.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be 0.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	

Commented [BR3]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

Commented [BR4]: Acceptable? Allowing this to be >1 created so many problems especially since Treatment Records don't even record it! There are other better and more modern ways to accomplish re-painting.

Attribute	Tag	Beam Technique Basic Proton Modulated Scanning	
		Presence	Specific Rules
>>Chair Head Frame Position	(300A,0151)	X	

7.4.4.7.2 RT Ion Beams Module for Basic Carbon Modulated Scanning Beam

795 **7.4.4.7.2.1 Referenced Standards**

DICOM 2019b Edition PS 3.3

7.4.4.7.2.2 Module Definition

Attribute	Tag	Beam Technique Basic Carbon Modulated Scanning	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	-	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+*	Shall be ION.
>Radiation Mass Number	(300A,0302)	R+	Shall be 12.
>Radiation Atomic Number	(300A,0304)	R+	Shall be 6.
>Radiation Charge State	(300A,0306)	R+*	Shall be 6.
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.
>Modulated Scan Mode Type	(300A,0309)	R+*	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	X	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT.
>Referenced Dose Sequence	(300C,0080)	-	

Attribute	Tag	Beam Technique Basic Carbon Modulated Scanning	
		Presence	Specific Rules
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0.
>Number of Compensators	(300A,00E0)	R+*	Shall be 0 unless Ion Range Compensator Beam Modifier Option is supported. See Section 7.4.4.9.3
>Number of Boli	(300A,00ED)	R+*	Shall be 0 unless Bolus Beam Modifier Option is supported. See Section 7.4.4.9.1
>>Referenced ROI Number	(3006,0084)	-	
>>Accessory Code	(300A,00F9)	-	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0 unless Ion Block Beam Modifier Option is supported. See Section 7.4.4.9.2
>Applicator Sequence	(300A,0107)	X	
>General Accessory Sequence	(300A,0420)	X	
>Number of Range Shifters	(300A,0312)	R+*	Shall be 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	R+*	Shall only be ANALOG or BINARY.
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)		
>>Lateral Spreading Device Number	(300A,0334)		
>>Lateral Spreading Device ID	(300A,0336)		
>>Accessory Code	(300A,00F9)		
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.
>>Lateral Spreading Device Description	(300A,033A)		

Attribute	Tag	Beam Technique Basic Carbon Modulated Scanning	
		Presence	Specific Rules
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall >= 1.
>>Range Modulator ID	(300A,0346)	D	This is to be used as a unique identifier to select the device. No other attribute shall be used for this purpose.
>>Accessory Code	(300A,00F9)	-	
>>Range Modulator Type	(300A,0348)	R+	Shall only be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.
>>Beam Current Modulation ID	(300A,034C)	-	
>Patient Support Type	(300A,0350)	R+	Shall be TABLE.
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	
>Ion Control Point Sequence	(300A,03A8)	-	
>>Control Point Index	(300A,0112)	-	
>>Nominal Beam Energy	(300A,0114)	R+	Shall be present.
>>KVP	(0018,0060)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type is BINARY, this shall be a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.

Attribute	Tag	Beam Technique Basic Carbon Modulated Scanning	
		Presence	Specific Rules
>>Lateral Spreading Device Settings Sequence	(300A,0370)		
>>>Referenced Lateral Spreading Device Number	(300C,0102)		
>>>Lateral Spreading Device Setting	(300A,0372)		
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)		
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)		
>>>Referenced Range Modulator Number	(300C,0104)		
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Beam Limiting Device Angle	(300A,0120)	R+*	Shall be 0.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	

Attribute	Tag	Beam Technique Basic Carbon Modulated Scanning	
		Presence	Specific Rules
>>Scan Spot Meterset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS and reported in the Treatment Record.
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be 0.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be 0.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	
>>Chair Head Frame Position	(300A,0151)	X	

Commented [BR5]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

7.4.4.7.3 RT Ion Beams Module for Proton Modulated Scanning MLC Beam

7.4.4.7.3.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.7.3.2 Module Definition

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	-	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+	Shall be PROTON.
>Radiation Mass Number	(300A,0302)	O+*	If present, shall be 1.
>Radiation Atomic Number	(300A,0304)	O+*	If present, shall be 1.
>Radiation Charge State	(300A,0306)	O+*	If present, shall be 1
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
>Modulated Scan Mode Type	(300A,0309)	R+*	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	R+*	Only one item shall be present.
>>RT Beam Limiting Device Type	(300A,00B8)	R+*	Shall be MLCX or MLCY.
>>Isocenter to Beam Limiting Device Distance	(300A,00BB)	-	
>>Number of Leaf/Jaw Pairs	(300A,00BC)	-	
>>Leaf Position Boundaries	(300A,00BE)	-	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT
>Referenced Dose Sequence	(300C,0080)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0
>Number of Compensators	(300A,00E0)	R+*	Shall be 0 unless Ion Range Compensator Beam Modifier Option is supported. See Section 7.4.4.9.3
>Number of Boli	(300A,00ED)	R+*	Shall be 0 unless Bolus Beam Modifier Option is supported. See Section 7.4.4.9.1.2
>>Referenced ROI Number	(3006,0084)	-	
>>Accessory Code	(300A,00F9)	-	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0.
>Total Block Tray Water-Equivalent Thickness	(300A,00F3)	X	
>Ion Block Sequence	(300A,03A6)	X	
>Applicator Sequence	(300A,0107)	X	

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
>General Accessory Sequence	(300A,0420)	X	
>Number of Range Shifters	(300A,0312)	-	Shall 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	R+*	Shall only be ANALOG or BINARY.
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)		
>>Lateral Spreading Device Number	(300A,0334)		
>>Lateral Spreading Device ID	(300A,0336)		
>>Accessory Code	(300A,00F9)		
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.
>>Lateral Spreading Device Description	(300A,033A)		
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall be >= 1.
>>Range Modulator ID	(300A,0346)	D	This is to be used as a unique identifier to select the device. No other attribute shall be used for this purpose.
>>Accessory Code	(300A,00F9)	-	
>>Range Modulator Type	(300A,0348)	R+	Shall only be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
>>Beam Current Modulation ID	(300A,034C)	-	
>Patient Support Type	(300A,0350)	R+	Shall be TABLE.
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	
>Ion Control Point Sequence	(300A,03A8)	-	
>>Ion Wedge Position Sequence	(300A,03AC)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type is BINARY, this shall be a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.
>>Lateral Spreading Device Settings Sequence	(300A,0370)		
>>>Referenced Lateral Spreading Device Number	(300C,0102)		
>>>Lateral Spreading Device Setting	(300A,0372)		
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)		
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)		

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
>>>Referenced Range Modulator Number	(300C,0104)		
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Beam Limiting Device Position Sequence	(300A,011A)	R+*	Shall be consistent with the Beam Limiting Device Sequence (300A,00B6). Shall only exist for the first Control Point unless option Variable Aperture MLC Beam Modifier is chosen, see 7.4.4.9.4.
>>>RT Beam Limiting Device Type	(300A,00B8)	R+*	Shall be MLCX or MLCY
>>>Leaf/Jaw Positions	(300A,011C)	D	
>>Beam Limiting Device Angle	(300A,0120)	R+	Shall be constant within a beam.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	
>>Scan Spot Meterset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS and reported in the Treatment Record.

Commented [BR6]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

Attribute	Tag	Beam Technique Proton Modulated Scanning MLC	
		Presence	Specific Rules
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be 0.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be 0.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	
>>Chair Head Frame Position	(300A,0151)	X	

7.4.4.7.4 RT Ion Beams Module for Carbon Modulated Scanning MLC Beam

7.4.4.7.4.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.7.4.2 Module Definition

Attribute	Tag	Beam Technique Carbon Modulated Scanning MLC	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	-	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+*	Shall be ION.
>Radiation Mass Number	(300A,0302)	R+	Shall be 12.
>Radiation Atomic Number	(300A,0304)	R+	Shall be 6.
>Radiation Charge State	(300A,0306)	R+*	Shall be 6.
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.
>Modulated Scan Mode Type	(300A,0309)	R+*	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	R+*	Only one item shall be present.

Attribute	Tag	Beam Technique Carbon Modulated Scanning MLC	
		Presence	Specific Rules
>>RT Beam Limiting Device Type	(300A,00B8)	R+*	Shall be MLCX or MLCY.
>>Isocenter to Beam Limiting Device Distance	(300A,00BB)	-	
>>Number of Leaf/Jaw Pairs	(300A,00BC)	-	
>>Leaf Position Boundaries	(300A,00BE)	-	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT.
>Referenced Dose Sequence	(300C,0080)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0.
>Total Wedge Tray Water-Equivalent Thickness	(300A,00D7)	X	-
>Ion Wedge Sequence	(300A,03AA)	X	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0.
>Total Block Tray Water-Equivalent Thickness	(300A,00F3)	X	
>Ion Block Sequence	(300A,03A6)	X	
>Applicator Sequence	(300A,0107)	X	
>General Accessory Sequence	(300A,0420)	X	
>Number of Range Shifters	(300A,0312)	-	Shall be 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	R+*	Shall only be ANALOG or BINARY.

Attribute	Tag	Beam Technique Carbon Modulated Scanning MLC	
		Presence	Specific Rules
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)		
>>Lateral Spreading Device Number	(300A,0334)		
>>Lateral Spreading Device ID	(300A,0336)	-	
>>Accessory Code	(300A,00F9)		
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.
>>Lateral Spreading Device Description	(300A,033A)		
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall be >= 1.
>>Range Modulator ID	(300A,0346)	D	This is to be used as a unique identifier to select the device. No other attribute shall be used for this purpose.
>>Accessory Code	(300A,00F9)	-	
>>Range Modulator Type	(300A,0348)	R+	Shall only be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.
>>Beam Current Modulation ID	(300A,034C)	-	
>Patient Support Type	(300A,0350)	R+	Shall be TABLE.
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	

Attribute	Tag	Beam Technique Carbon Modulated Scanning MLC	
		Presence	Specific Rules
>Ion Control Point Sequence	(300A,03A8)	-	
>>Ion Wedge Position Sequence	(300A,03AC)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type is BINARY, this shall be a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.
>>Lateral Spreading Device Settings Sequence	(300A,0370)		
>>>Referenced Lateral Spreading Device Number	(300C,0102)		
>>>Lateral Spreading Device Setting	(300A,0372)		
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)		
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)		
>>>Referenced Range Modulator Number	(300C,0104)		
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	

Attribute	Tag	Beam Technique Carbon Modulated Scanning MLC	
		Presence	Specific Rules
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Beam Limiting Device Position Sequence	(300A,011A)	R+*	Shall be consistent with the Beam Limiting Device Sequence (300A,00B6). Shall only exist for the first Control Point unless option Variable Aperture MLC Beam Modifier is chosen, see 7.4.4.9.4.
>>>RT Beam Limiting Device Type	(300A,00B8)	R+*	Shall be MLCX or MLCY.
>>>Leaf/Jaw Positions	(300A,011C)	D	
>>Beam Limiting Device Angle	(300A,0120)	R+	Shall be constant within a beam.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	
>>Scan Spot Meterset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS and reported in the Treatment Record.
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be 0.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be 0.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	
>>Chair Head Frame Position	(300A,0151)	X	

Commented [BR7]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

7.4.4.7.5 RT Ion Beams Module for Fixed Beamline Proton Modulated Scanning Beam

7.4.4.7.5.1 Referenced Standards

DICOM 2019b Edition PS 3.3

In particular, see Sections **C.8.8.25.6.1 Fixed Beam Line** for handling of Coordinate Systems and **C.8.8.25.6.3 Seated Treatments** for CHAIR based treatments if the CHAIR option is chosen.

7.4.4.7.5.2 Module Definition

Attribute	Tag	Beam Technique	
		Fixed Beamline Proton Modulated Scanning	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	-	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+	Shall be PROTON.
>Radiation Mass Number	(300A,0302)	O+*	If present, shall be 1
>Radiation Atomic Number	(300A,0304)	O+*	If present, shall be 1
>Radiation Charge State	(300A,0306)	O+*	If present, shall be 1
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.
>Modulated Scan Mode Type	(300A,0309)	R+	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	X	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT.
>Referenced Dose Sequence	(300C,0080)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0.

Attribute	Tag	Beam Technique Fixed Beamline Proton Modulated Scanning	
		Presence	Specific Rules
>Total Wedge Tray Water-Equivalent Thickness	(300A,00D7)	-	-
>Ion Wedge Sequence	(300A,03AA)	X	
>Number of Compensators	(300A,00E0)	R+*	Shall be 0 unless Ion Range Compensator Beam Modifier Option is supported. See Section 7.4.4.9.3
>Number of Boli	(300A,00ED)	R+*	Shall be 0 unless Bolus Beam Modifier Option is supported. See Section 7.4.4.9.1
>>Referenced ROI Number	(3006,0084)	-	
>>Accessory Code	(300A,00F9)	-	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0 unless Ion Block Beam Modifier Option is supported. See Section 7.4.4.9.2
>Applicator Sequence	(300A,0107)	X	
>General Accessory Sequence	(300A,0420)	X	
>>Source to General Accessory Distance	(300A,0425)		
>Number of Range Shifters	(300A,0312)	-	Shall be 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	R+*	Shall only be ANALOG or BINARY.
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)		
>>Lateral Spreading Device Number	(300A,0334)		
>>Lateral Spreading Device ID	(300A,0336)		
>>Accessory Code	(300A,00F9)		
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.

Attribute	Tag	Beam Technique Fixed Beamline Proton Modulated Scanning	
		Presence	Specific Rules
>>Lateral Spreading Device Description	(300A,033A)		
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall be >= 1.
>>Range Modulator ID	(300A,0346)	D	This is to be used as a unique identifier to select the device. No other attribute shall be used for this purpose.
>>Accessory Code	(300A,00F9)	-	
>>Range Modulator Type	(300A,0348)	R+	Shall only be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.
>>Beam Current Modulation ID	(300A,034C)	-	
>Patient Support Type	(300A,0350)	R+	Shall be TABLE unless Chair Patient Support Type Option is supported. See Section 7.4.4.9.5
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	
>Ion Control Point Sequence	(300A,03A8)	-	
>>Ion Wedge Position Sequence	(300A,03AC)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type is BINARY, this shall be a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	

Attribute	Tag	Beam Technique Fixed Beamline Proton Modulated Scanning	
		Presence	Specific Rules
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.
>>Lateral Spreading Device Settings Sequence	(300A,0370)		
>>>Referenced Lateral Spreading Device Number	(300C,0102)		
>>>Lateral Spreading Device Setting	(300A,0372)		
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)		
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)		
>>>Referenced Range Modulator Number	(300C,0104)		
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Include Table C.8.8.27-1 “Beam Limiting Device Position Macro Attributes”			Shall be consistent with the Beam Limiting Device Sequence (300A,00B6).
>>Beam Limiting Device Angle	(300A,0120)	R+*	Shall be 0.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.

Attribute	Tag	Beam Technique Fixed Beamline Proton Modulated Scanning	
		Presence	Specific Rules
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	
>>Scan Spot Meterset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS and reported in the Treatment Record.
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be present at first Control Point and shall not change.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be present at first Control Point and shall not change.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	
>>Chair Head Frame Position	(300A,0151)	X	

Commented [BR8]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

7.4.4.7.6 RT Ion Beams Module for Fixed Beamline Carbon Modulated Scanning Beam

7.4.4.7.6.1 Referenced Standards

820 DICOM 2019b Edition PS 3.3

In particular, see Sections **C.8.8.25.6.1 Fixed Beam Line** for handling of Coordinate Systems and **C.8.8.25.6.3 Seated Treatments** for CHAIR based treatments if the CHAIR option is chosen.

7.4.4.7.6.2 Module Definition

Attribute	Tag	Beam Technique Fixed Beamline Carbon Modulated Scanning	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	-	
>Beam Type	(300A,00C4)	R+*	Shall be STATIC.
>Radiation Type	(300A,00C6)	R+*	Shall be ION.
>Radiation Mass Number	(300A,0302)	R+	Shall be 12
>Radiation Atomic Number	(300A,0304)	R+	Shall be 6
>Radiation Charge State	(300A,0306)	R+*	Shall be 6
>Scan Mode	(300A,0308)	R+*	Shall be MODULATED_SPEC.
>Modulated Scan Mode Type	(300A,0309)	R+*	Shall be STATIONARY or LEAPING.
>Device Serial Number	(0018,1000)	-	
>Depth Dose Parameters Sequence	(300A,0505)	X	
>Ion Beam Limiting Device Sequence	(300A,03A4)	X	
>Referenced Reference Image Sequence	(300C,0042)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reference Image Number	(300A,00C8)	-	
>Treatment Delivery Type	(300A,00CE)	R+	Shall be TREATMENT.
>Referenced Dose Sequence	(300C,0080)	-	
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Number of Wedges	(300A,00D0)	R+*	Shall be 0.
>Total Wedge Tray Water-Equivalent Thickness	(300A,00D7)	-	-
>Ion Wedge Sequence	(300A,03AA)	X	
>Number of Compensators	(300A,00E0)	R+*	Shall be 0 unless Ion Range Compensator Beam Modifier Option is supported. See Section 7.4.4.9.3.
>Number of Boli	(300A,00ED)	R+*	Shall be 0 unless Bolus Beam Modifier Option is supported. See Section 7.4.4.9.1.
>>Referenced ROI Number	(3006,0084)	-	

Attribute	Tag	Beam Technique Fixed Beamline Carbon Modulated Scanning	
		Presence	Specific Rules
>>Accessory Code	(300A,00F9)	-	
>Number of Blocks	(300A,00F0)	R+*	Shall be 0 unless Ion Block Beam Modifier Option is supported. See Section 7.4.4.9.2.
>Applicator Sequence	(300A,0107)	X	
>General Accessory Sequence	(300A,0420)	X	
>Number of Range Shifters	(300A,0312)	-	Shall be 0 or 1.
>Range Shifter Sequence	(300A,0314)	-	
>>Range Shifter Number	(300A,0316)	-	
>>Range Shifter ID	(300A,0318)	D	
>>Accessory Code	(300A,00F9)	-	
>>Range Shifter Type	(300A,0320)	R+*	Shall only be ANALOG or BINARY.
>>Range Shifter Description	(300A,0322)	-	
>Number of Lateral Spreading Devices	(300A,0330)	R+*	Shall be 0 or 1. If value is 1, then the Lateral Spreading Device shall only be used for adjusting spot size.
>Lateral Spreading Device Sequence	(300A,0332)		
>>Lateral Spreading Device Number	(300A,0334)		
>>Lateral Spreading Device ID	(300A,0336)		
>>Accessory Code	(300A,00F9)		
>>Lateral Spreading Device Type	(300A,0338)	R+*	Shall be SCATTERER or MAGNET.
>>Lateral Spreading Device Description	(300A,033A)		
>Number of Range Modulators	(300A,0340)	-	
>Range Modulator Sequence	(300A,0342)	-	
>>Range Modulator Number	(300A,0344)	R+*	Shall be >= 1.
>>Range Modulator ID	(300A,0346)	D	This is to be used as a unique identifier to select the device. No other attribute shall be used for this purpose.
>>Accessory Code	(300A,00F9)	-	

Attribute	Tag	Beam Technique Fixed Beamline Carbon Modulated Scanning	
		Presence	Specific Rules
>>Range Modulator Type	(300A,0348)	R+	Shall only be FIXED.
>>Range Modulator Description	(300A,034A)	O+	Not to be used as an identifier.
>>Beam Current Modulation ID	(300A,034C)	-	
>Patient Support Type	(300A,0350)	R+	Shall be TABLE unless Chair Patient Support Type Option is supported. See Section 7.4.4.9.5.
>Patient Support ID	(300A,0352)	O+*	Shall be preserved if present.
>Fixation Light Azimuthal Angle	(300A,0356)	X	
>Fixation Light Polar Angle	(300A,0358)	X	
>Fixation Eye	(300A,0150)	X	
>Number of Control Points	(300A,0110)	-	
>Ion Control Point Sequence	(300A,03A8)	-	
>>Ion Wedge Position Sequence	(300A,03AC)	X	
>>Range Shifter Settings Sequence	(300A,0360)	-	
>>>Referenced Range Shifter Number	(300C,0100)	-	
>>>Range Shifter Setting	(300A,0362)	R+	If Range Shifter Type is BINARY, this shall be a string of 1s and 0s.
>>>Isocenter to Range Shifter Distance	(300A,0364)	-	
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	O+*	Informational only. Shall not be relied on.
>>Lateral Spreading Device Settings Sequence	(300A,0370)		
>>>Referenced Lateral Spreading Device Number	(300C,0102)		
>>>Lateral Spreading Device Setting	(300A,0372)		
>>>Isocenter to Lateral Spreading Device Distance	(300A,0374)		

Attribute	Tag	Beam Technique Fixed Beamline Carbon Modulated Scanning	
		Presence	Specific Rules
>>>Lateral Spreading Device Water Equivalent Thickness	(300A,033C)	O+*	Informational only. Shall not be relied on.
>>Range Modulator Settings Sequence	(300A,0380)		
>>>Referenced Range Modulator Number	(300C,0104)		
>>>Range Modulator Gating Start Value	(300A,0382)	X	
>>>Range Modulator Gating Stop Value	(300A,0384)	X	
>>>Range Modulator Gating Start Water Equivalent Thickness	(300A,0386)	X	
>>>Range Modulator Gating Stop Water Equivalent Thickness	(300A,0388)	X	
>>>Isocenter to Range Modulator Distance	(300A,038A)	-	
>>Include Table C.8.8.27-1 "Beam Limiting Device Position Macro Attributes"			Shall be consistent with the Beam Limiting Device Sequence (300A,00B6).
>>Beam Limiting Device Angle	(300A,0120)	R+*	Shall be 0.
>>Beam Limiting Device Rotation Direction	(300A,0121)	R+*	Shall be NONE.
>>Scan Spot Tune ID	(300A,0390)	-	
>>Scan Spot Reordering Allowed	(300A,0395)	R+*	Shall be present.
>>Number of Scan Spot Positions	(300A,0392)	-	
>>Scan Spot Position Map	(300A,0394)	-	
>>Scan Spot Metersset Weights	(300A,0396)	R+*	Shall be absolute metersets based on the Primary Dosimeter Unit (300A,00B3).
>>Scanning Spot Size	(300A,0398)	O+*	Informational only. Shall not be relied on.
>>Number of Paintings	(300A,039A)	R+*	Shall be 1. If Re-paints are desired, they can be handled either by the TPS using repeated spots or Control Points or by the TDS and reported in the Treatment Record.

Commented [BR9]: TO BE DISCUSSED IN PUBLIC COMMENTS!!

Attribute	Tag	Beam Technique Fixed Beamline Carbon Modulated Scanning	
		Presence	Specific Rules
>>Table Top Pitch Angle	(300A,0140)	R+	Shall be present.
>>Table Top Pitch Rotation Direction	(300A,0142)	R+*	Shall be NONE.
>>Table Top Roll Angle	(300A,0144)	R+	Shall be present.
>>Table Top Roll Rotation Direction	(300A,0146)	R+*	Shall be NONE.
>>Head Fixation Angle	(300A,0148)	X	
>>Chair Head Frame Position	(300A,0151)	X	

Commented [BR10]: If Chair Option is chosen, be sure to include these as Presence D in the Option parameters.

825

7.4.4.8 General RT Ion Beams Attribute Specifications

7.4.4.8.1 Control Point Fixed Attribute List Base Content

7.4.4.8.1.1 Referenced Standards

DICOM 2019b Edition PS 3.3

830 ##### 7.4.4.8.1.2 Required Attributes

The list of attributes and requirements below shall be included in all TPPC-ION transactions as noted in the RT Ion Beam Module specification associated with those transactions.

Attribute Name	Tag	Presence	IHE Specific Rules
Ion Beam Sequence	(300A,03A2)	R+*	
>Beam Number	(300A,00C0)	R+*	Shall be >= 1.
>Beam Name	(300A,00C2)	R+	Shall be unique within the plan.
>Beam Description	(300A,00C3)	D	
>Treatment Machine Name	(300A,00B2)	R+	Shall be the same for all treatment beams in the plan.
>Manufacturer	(0008,0070)	R+	
>Manufacturer's Model Name	(0008,1090)	R+	
>Primary Dosimeter Unit	(300A,00B3)	D	
>Referenced Tolerance Table Number	(300C,00A0)	-	
>Referenced Patient Setup Number	(300C,006A)	R+*	Shall be >=1.

Attribute Name	Tag	Presence	IHE Specific Rules
>Snout Sequence	(300A,030C)	O+*	Shall be preserved if present.
>>Snout ID	(300A,030F)	D	
>>Accessory Code	(300A,00F9)	O+*	Shall be preserved if present.
>Final Cumulative Meterset Weight	(300A,010E)	R+*	Shall be present. Value shall equal the Beam Meterset (300A,0086).
>Ion Control Point Sequence	(300A,03A8)	R+*	
>>Control Point Index	(300A,0112)	-	
>>Nominal Beam Energy	(300A,0114)	R+	Shall be present
>>KVP	(0018,0060)	X	
>>Cumulative Meterset Weight	(300A,0134)	R+	Shall be present.
>>Referenced Dose Reference Sequence	(300C,0050)	-	
>>Meterset Rate	(300A,035A)	O+*	Shall be preserved if present.
>>Gantry Angle	(300A,011E)	R+	Shall be constant.
>>Gantry Rotation Direction	(300A,011F)	R+*	Shall be NONE.
>>Gantry Pitch Angle	(300A,014A)	R+*	Shall be 0 for the first control point and not present for subsequent control points.
>>Gantry Pitch Rotation Direction	(300A,014C)	R+*	Shall be NONE for the first control point and not present for subsequent control points.
>>Patient Support Angle	(300A,0122)	R+	Shall be constant.
>> Patient Support Rotation Direction	(300A,0123)	R+*	Shall be NONE.
>> Table Top Vertical Position	(300A,0128)	O+	If value is present, shall be constant.
>> Table Top Longitudinal Position	(300A,0129)	O+	If value is present, shall be constant.
>> Table Top Lateral Position	(300A,012A)	O+	If value is present, shall be constant.
>>Snout Position	(300A,030D)	R+	Shall be constant.
>>Isocenter Position	(300A,012C)	R+	Shall be constant.
>>Surface Entry Point	(300A,012E)	O+*	Informational only. Shall not be relied on.
>>External Contour Entry Point	(300A,0133)	O+*	Informational only. Shall not be relied on.

Commented [BR11]: Point out for PUBLIC COMMENTS

7.4.4.9 RT Ion Beam Option Specifications

7.4.4.9.1 Bolus Beam Modifier Base Content

7.4.4.9.1.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.9.1.2 Required Attributes

One or more Boli may be optionally included in any of the Treatment Planning - Ion Plan Content Storage and Retrieval transactions (Producer and Consumer actors).

For actors supporting the Bolus Beam Modifier, the attributes specified in the table below have these additional requirements if Number of Boli (300A,00ED) is greater than zero.

Attribute	Tag	Beam Modifier	
		Bolus	
		Presence	Specific Rules
> Number of Boli	(300A,00ED)	R+*	Shall be >= 1.
> Referenced Bolus Sequence	(300C,00B0)	R+*	
>> Accessory Code	(300A,00F9)	O+*	Shall be preserved if present.

7.4.4.9.2 Ion Block Beam Modifier Base Content

7.4.4.9.2.1 Referenced Standards

DICOM 2019b Edition PS 3.3

74.4.9.2.2 Required Attributes

One or more Blocks may be optionally included in some of the Treatment Planning - Ion Plan Content Storage and Retrieval transactions (Producer and Consumer actors):

For actors supporting the Block Beam Modifier, the attributes specified in the table below have these additional requirements if Number of Blocks (300A,00F0) is greater than zero.

Attribute	Tag	Beam Modifier	
		Block	
		Presence	Specific Rules
>Number of Blocks	(300A,00F0)	R+*	Shall be >= 1.
>Total Block Tray Water-Equivalent Thickness	(300A,00F3)	O+*	Informational only. Shall not be relied on.

Attribute	Tag	Beam Modifier	
		Block	
		Presence	Specific Rules
>Ion Block Sequence	(300A,03A6)	R+*	
>> Block Tray ID	(300A,00F5)	R+	
>>Accessory Code	(300A,00F9)	RC+*	Required if Number of Block Slab Items (300A,0440) is not present. See notes 1 and 2.
>>Block Type	(300A,00F8)	R+*	Shall be APERTURE
>>Block Number	(300A,00FC)	R+	Shall be >= 1.
>> Material ID	(300A,00E1)	R+	
>> Block Thickness	(300A,0100)	D	
>> Block Number of Points	(300A,0104)	R+*	
>> Block Data	(300A,0106)	R+*	
>>Number of Block Slab Items	(300A,0440)	RC+*	Required if a single physical block has been sliced into multiple slabs. Shall not be present otherwise.
>>Block Slab Sequence	(300A,0441)	-	
>>>Block Slab Number	(300A,0443)	D	
>>>Block Slab Thickness	(300A,0442)	R+	
>>>Accessory Code	(300A,00F9)	R+*	See note 1 and 3.

Note 1: In cases where a single block contains multiple apertures it is necessary to use multiple block items within the Ion Block Sequence (300A,03A6). A common Accessory Code (300A,00F9) shall be used to relate these block items to a single physical block.

Note 2: If block items refer to the same physical block (i.e., multiple apertures within the block), then the Accessory Code (300A,00F9) of the block shall be repeated for each block item describing those apertures.

Note 3: If block items refer to the same physical block (i.e., multiple apertures within the block and manufactured with multiple slabs), the Accessory Code (300A,00F9) for the same physical slab within the Block Slab Sequence (300A,0441) shall be repeated in each block item.

Commented [BR12]: Please check the wording here. This is a workaround to a limitation in DICOM where multiple apertures are not adequately defined. Thus, many vendors describe multiple apertures within a block as separate block items.

7.4.4.9.3 Ion Range Compensator Beam Modifier Base Content

7.4.4.9.3.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.9.3.2 Required Attributes

A single Ion Range Compensator may be optionally included in some of the Treatment Planning - Ion Plan Content Storage and Retrieve transactions (Producer and Consumer actors):

For actors supporting the Ion Range Compensator Beam Modifier, the attributes specified in the table below have these additional requirements: if Number of Compensators (300A,00E0) is equal to one.

Attribute	Tag	Beam Modifier	
		Ion Range Compensator	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	R+*	
> Number of Compensators	(300A,00E0)	R+*	Shall be 1.
> Ion Range Compensator Sequence	(300A,02EA)	R+*	
>> Compensator Number	(300A,00E4)	R+*	Shall be >= 1.
>> Material ID	(300A,00E1)	R+	
>> Compensator ID	(300A,00E5)	R+	
>>Accessory Code	(300A,00F9)	O+*	Shall be preserved if present.
>> Isocenter to Compensator Tray Distance	(300A,02E4)	R+*	
>> Compensator Divergence	(300A,02E0)	R+*	
>> Compensator Mounting Position	(300A,02E1)	R+*	Shall be PATIENT_SIDE or SOURCE_SIDE.

7.4.4.9.4 Variable Aperture MLC Beam Modifier Base Content

This modifier is intended for actors which allow for multiple MLC configurations within a single beam. This includes Step and Shoot techniques, for example where the MLC configuration is different at each energy.

7.4.4.9.4.1 Referenced Standards

DICOM 2019b Edition PS 3.3

7.4.4.9.4.2 Required Attributes

Attribute	Tag	Beam Modifier	
		Variable Aperture MLC	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	R+*	
> Ion Control Point Sequence	(300A,03A8)	R+*	
>>Beam Limiting Device Position Sequence	(300A,011A)	R+*	Shall be consistent with the Beam Limiting Device Sequence (300A,00B6). May change within the Ion Control Point Sequence (300A,03A8).

7.4.4.9.5 Chair Patient Support Type Modifier Base Content

7.4.4.9.5.1 Referenced Standards

DICOM 2019b Edition PS 3.3

See Section C.8.8.25.6.3 Seated Treatments for CHAIR based treatments.

7.4.4.9.5.2 Required Attributes

A CHAIR Patient Support Type may be optionally included the Fixed Beam techniques of Treatment Planning - Ion Plan Content Storage and Retrieve transactions (Producer and Consumer actors):

For actors supporting the Chair Patient Support Type Modifier, the attributes specified in the table below have these additional requirements: if the Patient Support Type (300A,0350) is equal to CHAIR.

Note: See Section 7.4.3.4.5.2 for adding SITTING as a Patient Position (0018,5100).

Attribute	Tag	Patient Support Type Modifier	
		Chair	
		Presence	Specific Rules
Ion Beam Sequence	(300A,03A2)	R+*	
> Patient Support Type	(300A,0350)	R+	Shall be CHAIR.
>Ion Control Point Sequence	(300A,03A8)	R+*	
>>Head Fixation Angle	(300A,0148)	O+	Shall be preserved if present.
>>Chair Head Frame Position	(300A,0151)	O+	Shall be preserved if present.

