2

Digital Imaging and Communications in Medicine (DICOM)

6

Supplement 215

Second Generation Radiotherapy –

8

RT Ion Radiation Objects

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18   **DICOM Standards Committee, Working Group 7, Radiation Therapy**

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22   VERSION: Draft – Revision 01
                                  February 12, 2019

24   Developed pursuant to DICOM Work Item TBD

28

Table of Contents

104   **Table of Figures**

                                    Table of Tables

128

130   **Open Issues and Discussion Points**

#	Item
1	2018-05-22 WG-07 Ion Subgroup: How is presence of Gating is indicated?
2	2018-05-22 WG-07 Ion Subgroup: Do we want to indicate the Device used to obtain the signal steering the gating?
3	
4	

Closed Issues

#	Item

132

134

Foreword

136   This Supplement specifies additional IODs necessary to support the new Second Generation Radiotherapy IODs and operations.

138   ## Scope and Field of Application

Introduction

140   This Supplement introduces RT Radiation IODs and RT Radiation Set IODs. A Radiation Set IOD defines a Radiotherapy Treatment Fraction as a collection of instances of RT Radiation IODs. RT
142   Radiation IODs represent different treatment modalities. This Supplement introduces the representation of the C-Arm techniques.

144   This Supplement is based on the real-world model and specifications defined in Supplement 147. References, definitions etc. not present in this Supplement can be found in Supplement 147.

146   ### General Architectural Principles

- Different types of data are encoded in different IODs. This is in contrast to First Generation
148   objects, where different types of data are encoded in a single IOD, such as RT Plan.

- The new IODs are designed to support all current treatment modalities and be extensible for
150   future modalities and new equipment.

- Compatibility with First-Generation IODs: It will be possible for the content of First Generation
152   IODs to be represented in Second Generation IODs. However, information beyond the content of a First Generation SOP Instance will be needed to create a valid Second Generation SOP
154   Instance.

- IODs specific to use cases: Explicit separate IODs have been developed for specific treatment
156   modalities with the concept of RT Radiation IOD – for example, Tomotherapeutic treatments, C-Arm beams, Robotic beams are modeled separately. This allows more stringent conditions to be
158   applied to the presence or absence of Attributes within those IODs, and thereby increases the potential for interoperability.

160   - Treatment techniques already in use but not yet covered in First Generation (such as robotic therapy and tomotherapy) have been taken into account.

162

164   **Part 2 Addendum**

Add new SOP Classes to PS3.2 Table A.1-2 UID Values:

166

UID Value	UID Name	Category
1.2.840.10008.5.1.4.1.1.481.S215.1	**Ion Modulated Scanning Radiation Storage**	**Transfer**
1.2.840.10008.5.1.4.1.1.481.S215.2	**Ion Scattering Radiation Storage**	**Transfer**
1.2.840.10008.5.1.4.1.1.481.S215.3	**Ion Uniform Scanning Radiation Storage**	**Transfer**
1.2.840.10008.5.1.4.1.1.481.S215.4	**Ion Small Beam Radiation Storage**	**Transfer**

168

Part 3 Addendum

170   **7.14   EXTENSION OF THE DICOM MODEL OF THE REAL-WORLD FOR RADIOTHERAPY SECOND GENERATION INFORMATION OBJECTS**

172   For the purpose of RT Second Generation SOP Classes the DICOM Model of the Real-World is described in this section. This subset of the real-world model covers the requirements for transferring
174   information about planned and performed radiotherapeutic treatments and associated data.

Figure 7.14-1 describes the most important elements involved in the radiotherapy domain in DICOM.

176
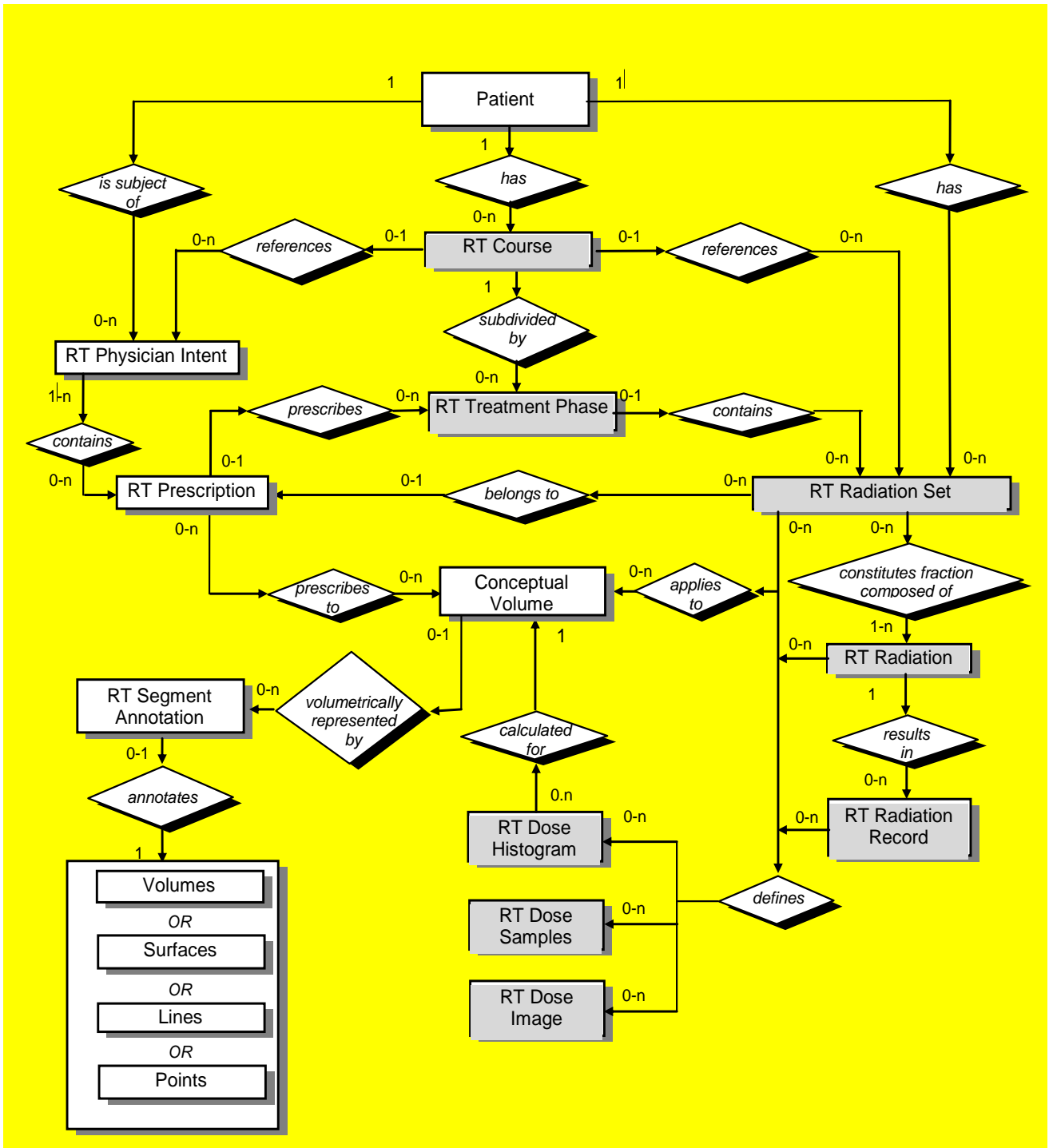
178

Figure 7.14-1 DICOM MODEL OF THE REAL WORLD – RADIOTHERAPY

184

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186 **Add the following columns in PS3.3 Section A.1.4, Table A.1-1 COMPOSITE INFORMATIon OBJECT MODULES OVERVIEW – RADIOTHERAPY**

IODs Modules	Ion Modulated Scanning Radiation	Ion Scattering Radiation	Ion Uniform Scanning Radiation	Ion Small Beam Radiation
Patient	**M**	**M**	**M**	**M**
Clinical Trial Subject	**U**	**U**	**U**	**U**
General Study	**M**	**M**	**M**	**M**
Patient Study	**U**	**U**	**U**	**U**
Clinical Trial Study	**U**	**U**	**U**	**U**
General Series	**M**	**M**	**M**	**M**
Clinical Trial Series	**U**	**U**	**U**	**U**
Enhanced RT Series	**M**	**M**	**M**	**M**
General Equipment	**M**	**M**	**M**	**M**
Enhanced General Equipment	**M**	**M**	**M**	**M**
Frame Of Reference	**M**	**M**	**M**	**M**
General Reference Module	**M**	**M**	**M**	**M**
…				
Radiotherapy Common Instance	**M**	**M**	**M**	**M**
RT Delivery Device Common	**M**	**M**	**M**	**M**
RT Radiation Common	**M**	**M**	**M**	**M**
Ion Modulated Scanning Delivery Device	**M**			
Ion Modulated Scanning Beam Module	**M**			
Ion Scattering Delivery Device Module		**M**		
Ion Scattering Beam Module		**M**		
Ion Uniform Scanning Delivery Device Module			**M**	

IODs Modules	Ion Modulated Scanning Radiation	Ion Scattering Radiation	Ion Uniform Scanning Radiation	Ion Small Beam Radiation
Ion Uniform Scanning Beam Module			**M**	
Ion Small Beam Delivery Device Module				**M**
Ion Small Beam Module				**M**
…				
Common Instance Reference Module	**M**	**M**	**M**	**M**
SOP Common	**M**	**M**	**M**	**M**

188

Add the following to PS3.3 Chapter 10 Miscellaneous Macros:

190

Add the following to PS3.3 Annex A:

---

192 **A.86   RT SECOND GENERATION**

A.86.1   RT Second Generation Objects

194 This section provides a brief description of the IODs of RT Second Generation. Specifically, this description includes:

196 • The Real-World Object which is represented by the IOD

• Information as to the scope of the represented object if appropriate

198 **A.86.1.1   RT Second Generation Common Information**

This section provides a description of the Module structure which is shared by the RT Second
200 Generation IODs.

A.86.1.1.1   RT Second Generation Entity-Relationship Model

202 The E-R Model in Figure A.86.1.1.1-1 depicts those components of the DICOM Information Model that are relevant to second-generation RT IODs.

204
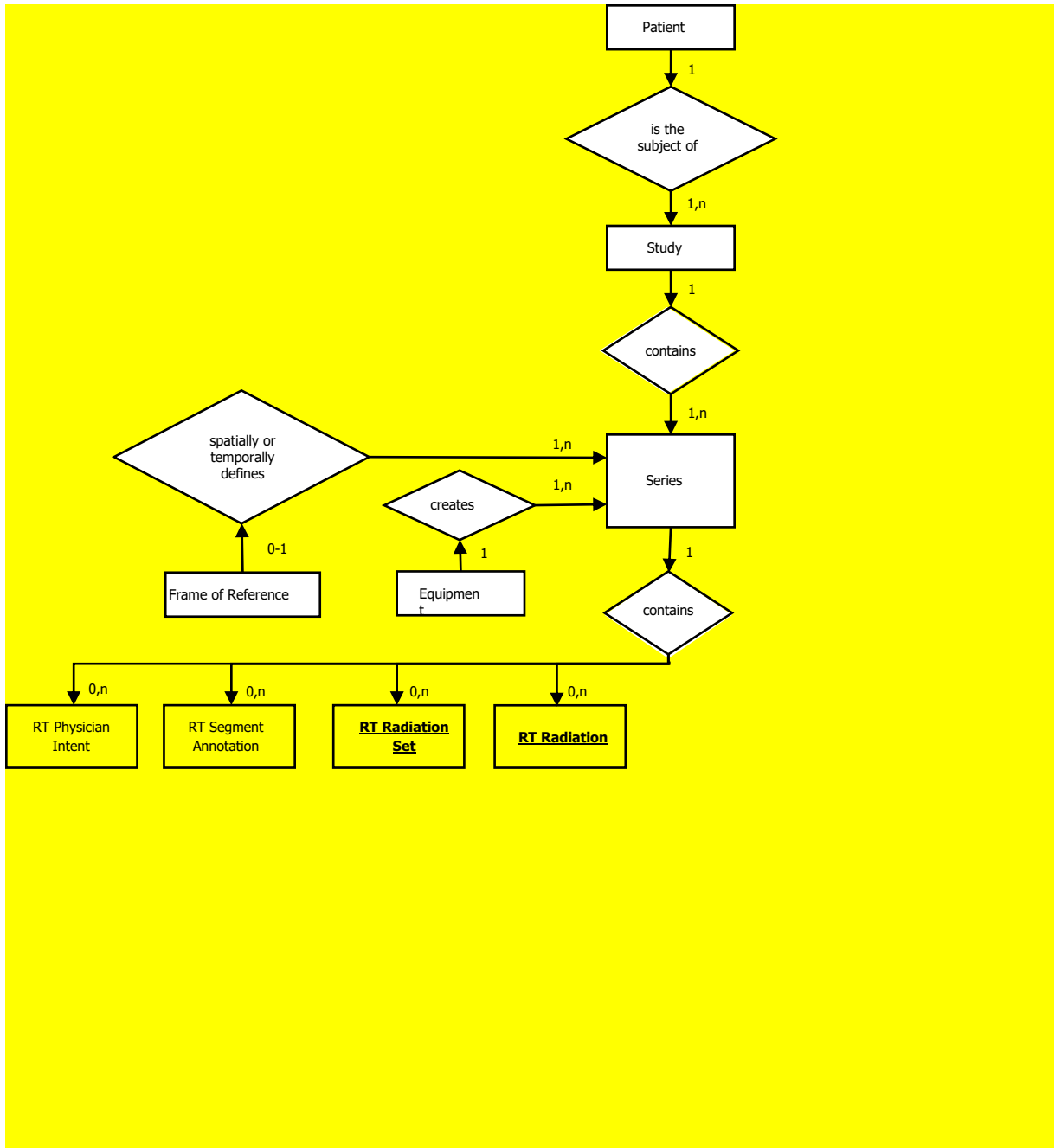
206

Figure A.86.1.1.1-1 — RT Second Generation IOD information model

208   **Add the following Section to Annex A:**

210 **A.86.1.a1   Ion Modulated Scanning Radiation Information Object Definition**

A.86.1.a1.1   Ion Modulated Scanning Radiation IOD Description

212 The Ion Modulated Scanning Radiation IOD describes a radiotherapy treatment on a C-Arm delivery device using ion particles with a modulated scanning technique.

214 **A.86.1.a1.2   Ion Modulated Scanning Radiation IOD Entity-Relationship Model**

See Figure A.86.1.1.1-1.

216 **A.86.1.a1.3   Ion Modulated Scanning Radiation IOD Module Table**

Table A.86.1.a1-1
218 **Ion Modulated Scanning Radiation IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Frame of Reference	Frame of Reference	C.7.4.1	M
RT Radiation	General Reference	C.12.4	M
	RT Delivery Device Common	C.36.E1	M
	RT Radiation Common	C.36.E2	M
	Ion Modulated Scanning Delivery Device	C.36.m1	M
	Ion Modulated Scanning Beam	C.36.m2	M
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
	Radiotherapy Common Instance	C.36.4	M

220 Note: The Frame of Reference identifies the Patient Coordinate System used to define the geometric setup of the radiation beam with respect to the patient. The relationship of the patient-based coordinates to the Equipment Frame of Reference is specified by a transformation (see 10.A10).

222

A.86.1.a1.4   Ion Modulated Scanning Radiation IOD Constraints

224 **A.86.1.a1.4.1   Modality Attribute**

The value of Modality (0008,0060) shall be RTRAD.

226 **A.86.1.a1.4.2   RT Delivery Device Common Module**

The Equipment Frame of Reference UID (gggg,51A0) shall be 1.2.840.10008.1.4.RRR.1.

Code Sequence	CID
Treatment Machine Special Mode Sequence (gggg,9C97)	Defined CID SUP175003 "Radiotherapy Treatment Machine Modes"
Radiation Dosimeter Unit Sequence (gggg,5113)	Defined CID SUP175012 "C-Arm Photon-Electron Dosimeter Unit"

228

A.86.1.a1.4.3   RT Radiation Common Module

230   The value of RT Record Flag (gggg,5014) shall be NO.

Code Sequence	CID
RT Treatment Technique Code Sequence (3010,0080)	Defined CID SUP215011 "Ion Modulated Scanning Procedure Techniques"

232   ### A.86.1.a1.4.4   Radiotherapy Common Instance Module

Code Sequence	CID
Author Identification Sequence (3010,0019)	Defined CID for Organizational Role is CID SUP175015 "Radiotherapy Treatment Planning Person Roles"

234   **A.86.1.a2   Ion Scattering Radiation Information Object Definition**

A.86.1.a2.1   Ion Scattering Radiation IOD Description

236   **A.86.1.a2.2   Ion Scattering Radiation IOD Entity-Relationship Model**

See Figure A.86.1.1.1-1.

238   **A.86.1.a2.3   Ion Scattering Radiation IOD Module Table**

Table A.86.1.a2-1
240   **Ion Scattering Radiation IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Frame of Reference	Frame of Reference	C.7.4.1	M
RT Radiation	General Reference	C.12.4	M
	RT Delivery Device Common	C.36.E1	M

RT Radiation Common	C.36.E2	M
Ion Scattering Delivery Device	C.36.m3	M
Ion Scattering Beam	C.36.m4	M
SOP Common	C.12.1	M
Common Instance Reference	C.12.2	M
Radiotherapy Common Instance	C.36.4	M

242   Note: The Frame of Reference identifies the Patient Coordinate System used to define the geometric setup of the radiation beam with respect to the patient. The relationship of the patient-based coordinates to the Equipment Frame of Reference is specified by a transformation (see 10.A10).

244

A.86.1.a2.4   Ion Scattering Radiation IOD Constraints

246 **A.86.1.a2.4.1   Modality Attribute**

The value of Modality (0008,0060) shall be RTRAD.

248 **A.86.1.a2.4.2   RT Delivery Device Common Module**

The Equipment Frame of Reference UID (gggg,51A0) shall be 1.2.840.10008.1.4.RRR.1.

Code Sequence	CID
Treatment Machine Special Mode Sequence (gggg,9C97)	Defined CID SUP175003 "Radiotherapy Treatment Machine Modes"
Radiation Dosimeter Unit Sequence (gggg,5113)	Defined CID SUP175012 "C-Arm Photon-Electron Dosimeter Unit"

250

A.86.1.a2.4.3   RT Radiation Common Module

252 The value of RT Record Flag (gggg,5014) shall be NO.

Code Sequence	CID
RT Treatment Technique Code Sequence (3010,0080)	Defined CID SUP215012 "Ion Scattering Procedure Techniques"

254 **A.86.1.a2.4.4   Radiotherapy Common Instance Module**

Code Sequence	CID
Author Identification Sequence (3010,0019)	Defined CID for Organizational Role is CID SUP175015 "Radiotherapy Treatment Planning Person Roles"

256

A.86.1.a3   Ion Uniform Scanning Radiation Information Object Definition

258 **A.86.1.a3.1   Ion Uniform Scanning Radiation IOD Description**

A.86.1.a3.2   Ion Uniform Scanning Radiation IOD Entity-Relationship Model

260 See Figure A.86.1.1.1-1.

A.86.1.a3.3   Ion Uniform Scanning Radiation IOD Module Table

262   **Table A.86.1.a3-1**
                                  Ion Uniform Scanning Radiation IOD Modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Frame of Reference	Frame of Reference	C.7.4.1	M
RT Radiation	General Reference	C.12.4	M
	RT Delivery Device Common	C.36.E1	M
	RT Radiation Common	C.36.E2	M
	Ion Scattering Beam	C.36.m5	M
	Ion Uniform Scanning Delivery Device	C.36.m6	M
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
	Radiotherapy Common Instance	C.36.4	M

264   Note: The Frame of Reference identifies the Patient Coordinate System used to define the geometric
                  setup of the radiation beam with respect to the patient. The relationship of the patient-based
266   coordinates to the Equipment Frame of Reference is specified by a transformation (see 10.A10).

268

A.86.1.a3.4   Ion Uniform Scanning Radiation IOD Constraints

270   **A.86.1.a3.4.1   Modality Attribute**

The value of Modality (0008,0060) shall be RTRAD.

272   **A.86.1.a3.4.2   RT Delivery Device Common Module**

The Equipment Frame of Reference UID (gggg,51A0) shall be 1.2.840.10008.1.4.RRR.1.

Code Sequence	CID
Treatment Machine Special Mode Sequence (gggg,9C97)	Defined CID SUP175003 "Radiotherapy Treatment Machine Modes"
Radiation Dosimeter Unit Sequence (gggg,5113)	Defined CID SUP175012 "C-Arm Photon-Electron Dosimeter Unit"

274

A.86.1.a3.4.3 RT Radiation Common Module

276   The value of RT Record Flag (gggg,5014) shall be NO.

Code Sequence	CID
RT Treatment Technique Code Sequence (3010,0080)	Defined CID SUP215013 "Ion Uniform Scanning Procedure Techniques"

278   **A.86.1.a3.4.4   Radiotherapy Common Instance Module**

Code Sequence	CID
Author Identification Sequence (3010,0019)	Defined CID for Organizational Role is CID SUP175015 "Radiotherapy Treatment Planning Person Roles"

280   **A.86.1.a4   Ion Small Beam Radiation Information Object Definition**

A.86.1.a4.1   Ion Small Beam Radiation IOD Description

282   ((Fixed Beam?))

A.86.1.a4.2   Ion Small Beam Radiation IOD Entity-Relationship Model

284   See Figure A.86.1.1.1-1.

A.86.1.a4.3   Ion Small Beam Radiation IOD Module Table

286   **Table A.86.1.a4-1**
                              Ion Small Beam Radiation IOD Modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Frame of Reference	Frame of Reference	C.7.4.1	M
RT Radiation	General Reference	C.12.4	M
	RT Delivery Device Common	C.36.E1	M
	RT Radiation Common	C.36.E2	M
	Ion Small Beam Delivery Device	C.36.m7	M
	Ion Small Beam	C.36.m8	M
	SOP Common	C.12.1	M

Common Instance Reference	C.12.2	M
Radiotherapy Common Instance	C.36.4	M

288   Note: The Frame of Reference identifies the Patient Coordinate System used to define the geometric
setup of the radiation beam with respect to the patient. The relationship of the patient-based
290   coordinates to the Equipment Frame of Reference is specified by a transformation (see 10.A10).

292

A.86.1.a4.4   Ion Small Beam Radiation IOD Constraints

294   **A.86.1.a4.4.1   Modality Attribute**

The value of Modality (0008,0060) shall be RTRAD.

296   **A.86.1.a4.4.2   RT Delivery Device Common Module**

The Equipment Frame of Reference UID (gggg,51A0) shall be 1.2.840.10008.1.4.RRR.1.

Code Sequence	CID
Treatment Machine Special Mode Sequence (gggg,9C97)	Defined CID SUP175003 "Radiotherapy Treatment Machine Modes"
Radiation Dosimeter Unit Sequence (gggg,5113)	Defined CID SUP175012 "C-Arm Photon-Electron Dosimeter Unit"

298

A.86.1.a4.4.3   RT Radiation Common Module

300 The value of RT Record Flag (gggg,5014) shall be NO.

Code Sequence	CID
RT Treatment Technique Code Sequence (3010,0080)	Defined CID SUP215014 "Ion Small Beam Procedure Techniques"

302   **A.86.1.a4.4.4   Radiotherapy Common Instance Module**

Code Sequence	CID
Author Identification Sequence (3010,0019)	Defined CID for Organizational Role is CID SUP175015 "Radiotherapy Treatment Planning Person Roles"

304

306

<div style="border:1px solid">

Add the following to PS3.3 Annex C:

</div>

C.36   RT SECOND GENERATION MODULES

310   The following macros and modules are used by the RT Second Generation radiotherapy IODs.

C.36.1   RT Second Generation Concepts

312   The following terms are used in Radiotherapy Modules and Macros.

…

C.36.2   RT Second Generation Macros

C.36.2.1   RT Second Generation General Purpose Macros

316   *EDITORIAL: Placeholder only. Currently not used by this supplement.*

C.36.2.m   RT Second Generation Radiation Macros

318   **C.36.2.m.x1   RT Ion Range Shifter Device Macro**

320

Table C.36.2.m.x1-1
RT Ion Range Shifter Device Macro Attributes

Attribute Name	Tag	Type	Description
Number of Range Shifters	(300A,0312)	1	Number of Range Shifters in the Range Shifter Sequence (300A,0314).
Range Shifter Sequence	(300A,0314)	1C	RT Ion Range Shifters. The number of Items included in this Sequence shall equal the value of Number of Range Shifters (300A,0312). Required if the Number of Range Shifters (300A,0312) has a non-zero value.
>Include Table C.36.2.m.3-1 "RT Accessory Device Identification Macro Attributes"			*Defined CID SUP215002 "RT Ion Range Shifter Types".*
>Range Shifter Mounting Type	(gggg,TODO)	1	Mounting type. Defined Terms: FIXED = The range shifter is mounted on the gantry or other parts of the beam steering devices. MOVEABLE = The range shifter is mounted on a movable snout.

Attribute Name	Tag	Type	Description
>Range Shifter Distance	(gggg,TODO)	1C	Distance in mm from the reference location as specified by RT Beam Distance Reference Location Code Sequence (gggg,5114) to the distal end of range shifter along the beam axis. Required if the Range Shifter Mounting Type (gggg,TODO) has the value FIXED.

322

C.36.2.m.x2   RT Ion Range Shifter Settings Macro

324

Table C.36.2.m.x2-1
326 **RT Ion Range Shifter Settings Macro Attributes**

Attribute Name	Tag	Type	Description
RT Ion Range Shifters Device Definition Sequence	(gggg,TODO)	1C	RT Ion Range Shifters Settings. The number of Items included in this Sequence shall equal the value of Number of RT Range Shifters (gggg,TODO). Required if the Number of RT Range Shifters (gggg,TODO) has a non-zero value.
>			

328 ### C.36.2.m.x3   RT Ion Range Modulator Device Macro

330 **Table C.36.2.m.x3-1**
RT Ion Range Modulator Device Macro Attributes

Attribute Name	Tag	Type	Description
Number of Range Modulators	(300A,0340)	1	Number of Range Shifters in the Range Modulator Sequence (300A,0342).
Range Modulator Sequence	(300A,0342)	1C	RT Ion Range Shifters. The number of Items included in this Sequence shall equal the value of Number of Range Shifters (300A,0340). Required if the Number of Range Shifters (300A,0340) has a non-zero value.
>*Include Table C.36.2.m.3-1 "RT Accessory Device Identification Macro Attributes"*			*Defined CID Defined CID SUP215003 "TODO".*

Attribute Name	Tag	Type	Description
>			

332

C.36.2.m.x4   RT Ion Range Modulator Settings Macro

334

Table C.36.2.m.x4-1
336   **RT Ion Range Modulator Settings Macro Attributes**

Attribute Name	Tag	Type	Description
RT Ion Range Modulator Device Definition Sequence	(gggg,TODO)	1C	RT Ion Range Shifters. The number of Items included in this Sequence shall equal the value of Number of RT Range Shifters (gggg,TODO). Required if the Number of RT Range Shifters (gggg,TODO) has a non-zero value.
>			

338   ### C.36.m1   Ion Modulated Scanning Delivery Device Module

The Ion Modulated Scanning Device Module defines constant C-Arm-specific parameters pertaining
340 to the physical device used to deliver external ion beams using modulated scanning techniques.

Table C.36.m1-1
342   **Ion Modulated Scanning Delivery Device Module Attributes**

Attribute Name	Tag	Type	Description
Virtual Source-Axis Distances	(300A,030A)	1	Distance (in mm) from virtual source position to gantry rotation axis or nominal isocenter position (fixed beam-lines) of the equipment to be used for beam delivery. Specified by a numeric pair - the VSAD in the IEC Gantry X direction followed by the VSAD in the IEC Gantry Y direction. The VSAD is commonly used for designing apertures in contrast to the effective source-axis-distance (ESAD) that is commonly used with the inverse square law for calculating the dose decrease with distance. See Section C.8.8.25.4.
Scanning Type Code (TODO)			

Attribute Name	Tag	Type	Description
Include Table C.36.2.m.7-1 "Radiation Generation Mode Macro Attributes"			*Defined CID for Radiation Type Code Sequence (gggg,51C4) is CID 9526 "Ion Therapy Particle".*
			Defined CID for Energy Unit Code Sequence (gggg,51C9) is CID SUP215001 "Energy Unit for Particle Therapy".
			No baseline CID defined for Radiation Fluence Modifier Code Sequence (gggg,51C8).
Include Table C.36.2.m.8-1 "RT Beam Limiting Device Definition Macro Attributes"			*Defined CID for included 'RT Accessory Device Identification Macro' is CID SUP175001 "Beam Limiting Device Types".*
Include Table C.36.2.m.12-1 "Compensators Definition Macro Attributes"			
Include Table C.36.2.m.13-1 "Blocks Definition Macro Attributes"			
Include Table C.36.2.m.14-1 "RT Accessory Holders Definition Macro Attributes"			
Include Table C.36.2.m.15-1 "General Accessories Definition Macro Attributes"			
Include Table C.36.2.m.16-1 "Boluses Definition Macro Attributes"			
Include Table C.36.2.m-x1-1 "RT Ion Range Shifter Delivery Device Module Attributes"			
Include Table C.36.2.m.x3-1 "RT Ion Range Modulator Device Module Attributes"			

344 **C.36.m1.1   Ion Modulated Scanning Delivery Device Module Attribute Description**

346 **C.36.m2   Ion Modulated Scanning Beam Module**

The C-Arm Photon-Electron Beam Module specifies how a C-Arm photon or electron treatment beam
348 is to be delivered.

Table C.36.m2-1
350 **Ion Modulated Scanning Beam Module Attributes**

Attribute Name	Tag	Type	Description
C-Arm Photon-Electron Control Point Sequence	(gggg,9C00)	1	Control Points used to model the beam delivery.
			Two or more Items shall be included in this Sequence.
>Include Table C.36.2.m.6-1 "External Beam Control Point General Macro Attributes"			*Defined CID SUP175010 "C-Arm Photon-Electron Delivery Dose Rate Unit"*
>Referenced Radiation Generation Mode Index	(gggg,9124)	1C	Radiation Generation Mode Index (gggg,9113) in the Radiation Generation Mode Sequence (gggg,51C0) in this IOD.
			Required if the conditions in Section C.36.2.m.5.1.1 are satisfied.

Attribute Name	Tag	Type	Description
>*Include Table C.36.2.m.9-1 "RT Beam Limiting Device Opening Macro Attributes"*			
>*Include Table C.36.2.m.x2 "Ion Range Shifter Settings Macro Attributes"*			
>Source Roll Continuous Angle	(gggg,51B5)	1C	Continuous gantry roll angle in degrees of the radiation source at the Control Point with respect to the Equipment Frame of Reference. See C.36.G2.1.1, C.36.1.8 and C.36.E1.1.1. Required if the conditions in Section C.36.2.m.5.1.1 are satisfied.
>RT Beam Limiting Device Continuous Angle	(gggg,51B4)	1C	Angle in degrees of the Beam Modifier Coordinate System about the Z-axis relative to the parent coordinate system. See C.36.1.8 and C.36.G2.1.2. Required if the conditions in Section C.36.2.m.5.1.1 are satisfied.
>Source to Patient Surface Distance	(gggg,9C63)	2C	Source to Patient Surface (skin) distance in mm. Required if the conditions in Section C.36.2.m.5.1.1 are satisfied.
>Source to External Contour Distance	(gggg,9C62)	2C	Source to External Contour distance in mm including devices associated with the patient anatomy model. For dosimetric purposes this value may differ from the Source to Surface Distance (300A,0130). See C.36.C2.1.4. Required if the conditions in Section C.36.2.m.5.1.1 are satisfied.

352 **C.36.m2.1   Ion Modulated Scanning Beam Attribute Description**

C.36.m2.1.1   Source Roll Continuous Angle

354 For an Equipment Frame of Reference UID (gggg,51A0) 1.2.840.10008.1.4.RRR.1 the source roll angle is the rotation of the IEC 61217 GANTRY coordinate system about the Y-axis of the IEC 61217
356 FIXED coordinate system.

C.36.m2.1.2   RT Beam Limiting Device Continuous Angle

358 For an Equipment Frame of Reference UID (gggg,51A0) 1.2.840.10008.1.4.RRR.1 the RT Beam Limiting Device Continuous Angle (gggg,51B4) is the rotation of the IEC 61217 BEAM LIMITING
360 DEVICE system about the Z-axis of the IEC 61217 GANTRY system.

362 **C.36.m3   Ion Scattering Delivery Device Module**

Table C.36.m3-1
364 **Ion Scattering Delivery Device Module Attributes**

Attribute Name	Tag	Type	Description

366 **C.36.m4   Ion Scattering Beam Module**

Table C.36.m4-1
368   **Ion Scattering Beam Module Attributes**

Attribute Name	Tag	Type	Description

370 **C.36.m5   Ion Uniform Scanning Delivery Device Module**

Table C.36.m5-1
372   **Ion Uniform Scanning Delivery Device Module Attributes**

Attribute Name	Tag	Type	Description

374 **C.36.m6   Ion Uniform Scanning Beam Module**

Table C.36.m6-1
376   **Ion Uniform Scanning Beam Module Attributes**

Attribute Name	Tag	Type	Description

378 **C.36.m7   Ion Small Beam Delivery Device Module**

Table C.36.m7-1
380   **Ion Small Beam Delivery Device Module Attributes**

Attribute Name	Tag	Type	Description

382 **C.36.m8   Ion Small Beam Module**

Table C.36.m8-1
384   **Ion Small Beam Beam Module Attributes**

Attribute Name	Tag	Type	Description

386

Part 4 Addendum

388   **Add the following to PS3.4, Appendix B.5, Table B.5-1**

SOP Class Name	SOP Class UID	IOD Spec (defined in PS 3.3)
Ion Modulated Scanning Radiation Storage	**1.2.840.10008.5.1.4.1.1.481.S215.1**	**Ion Modulated Scanning Radiation IOD**
Ion Scattering Radiation Storage	**1.2.840.10008.5.1.4.1.1.481.S215.2**	**Ion Scattering Radiation IOD**
Ion Uniform Scanning Radiation Storage?	**1.2.840.10008.5.1.4.1.1.481.S215.3**	**Ion Uniform Scanning Radiation IOD**
Ion Small Beam Radiation Storage	**1.2.840.10008.5.1.4.1.1.481.S215.4**	**Ion Small Beam Radiation IOD**

390

392   **Part 6 Addendum**

Add the following data elements to PS3.6:

394

Editorial Note:

396   *Use Range (gggg,A000) – (gggg,A7FF).*

398

6   REGISTRY OF DICOM DATA ELEMENTS

(gggg,A000)	
(gggg,A001)	

400

402

Add the following to PS3.6 Annex A:

404

ANNEX A   REGISTRY OF DICOM UNIQUE IDENTIFIERS (UID) (NORMATIVE)

406   **Table A-1 UID Values**

UID Value	UID NAME	UID TYPE	Part
1.2.840.10008.5.1.4.1.1.481.S215.1	**Ion Modulated Scanning Radiation Storage**	**SOP Class**	**PS3.4**
1.2.840.10008.5.1.4.1.1.481.S215.2	**Ion Scattering Radiation Storage**	**SOP Class**	**PS3.4**
1.2.840.10008.5.1.4.1.1.481.S215.3	**Ion Uniform Scanning Radiation Storage**	**SOP Class**	**PS3.4**
1.2.840.10008.5.1.4.1.1.481.S215.4	**Ion Small Beam Radiation Storage**	**SOP Class**	**PS3.4**

408

Table A-3 Context Group UID Values

410

Context UID	Context Identifier	Context Group Name
1.2.840.10008.6.1.S215.001	**SUP215001**	**Energy Unit for Ion Therapy**
1.2.840.10008.6.1.S215.002	**SUP215002**	**RT Ion Range Shifter Types**
1.2.840.10008.6.1.S215.011	**SUP215011**	**Ion Modulated Scanning Procedure Techniques**
1.2.840.10008.6.1.S215.012	**SUP215012**	**Ion Scattering Procedure Techniques**
1.2.840.10008.6.1.S215.013	**SUP215013**	**Ion Uniform Scanning Procedure Techniques**
1.2.840.10008.6.1.S215.014	**SUP215014**	**Ion Small Beam Procedure Techniques**

412

414   **Part 16 Addendum**

Add the following new CIDs to PS3.16, Annex B:

416   **CID SUP215001   ENERGY UNIT FOR ION THERAPY**

Context ID SUP215001
418   **Energy Unit for Ion Therapy**
Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
420   **Type: Extensible**
Version: yyyymmdd
422   **UID: 1.2.840.10008.6.1.S215.001**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
UCUM	MeV	Megaelectronvolt

424   **CID SUP215002   RT ION RANGE SHIFTER TYPES**

Context ID SUP215002
426   **RT Ion Range Shifter Types**
Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
428   **Type: Extensible**
Version: yyyymmdd
430   **UID: 1.2.840.10008.6.1.S215.002**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP215	S215001	Binary RT Ion Range Shifter
99SUP215	S215002	Variable Analog RT Ion Range Shifter
99SUP215	S215003	Fixed Analog RT Ion Range Shifter

432   **CID SUP215011   ION MODULATED SCANNING PROCEDURE TECHNIQUES**

Context ID SUP215011
434   **Ion Modulated Scanning Procedure Techniques**
Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
436   **Type: Extensible**

Version: yyyymmdd

438   **UID: 1.2.840.10008.6.1.S215.011**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)

440   **CID SUP215012   ION SCATTERING PROCEDURE TECHNIQUES**

Context ID SUP215012

442   **Ion Scattering Procedure Techniques**

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

444   **Type: Extensible**

Version: yyyymmdd

446   **UID: 1.2.840.10008.6.1.S215.012**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)

448   **CID SUP215013   ION UNIFORM SCANNING PROCEDURE TECHNIQUES**

Context ID SUP215013

450   **Ion Uniform Scanning Procedure Techniques**

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

452   **Type: Extensible**

Version: yyyymmdd

454   **UID: 1.2.840.10008.6.1.S215.013**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)

456   **CID SUP215014   ION SMALL BEAM PROCEDURE TECHNIQUES**

Context ID SUP215013

458   **Ion Small Beam Procedure Techniques**

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

460   **Type: Extensible**

Version: yyyymmdd

462   **UID: 1.2.840.10008.6.1.S215.014**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)

464

Add the following to the table in PS3.16, Annex D:

466

ANNEX D   DICOM CONTROLLED TERMINOLOGY DEFINITIONS (NORMATIVE)

468

Code Value	Code Meaning	Definition	Notes
S215001	Binary RT Ion Range Shifter	Range Shifter composed of different thickness materials that can be moved in or out of the beam in various stepped combinations.	
S215002	Variable Analog RT Ion Range Shifter	Range Shifter where the thickness can be changed during the beam. It may be composed of opposing sliding wedges, water column or similar mechanism.	
S215003	Fixed Analog RT Ion Range Shifter	Device has been manufactured with a customized thickness, adapted for this beam.	