HITRI plus
Heavy Ion Therapy Research Integration

COSYLAB

Hadron Therapy Control System

Luka Šepetavc & Kristijan Kuhar

With the help of Primož Lavrič & Boštjan Mulej

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About Cosylab

Three areas of Cosylab

- Big Science
- Radiation Therapy
  - **Hadron Therapy Control Systems**
- Medical Devices

300+ people, 9 locations worldwide

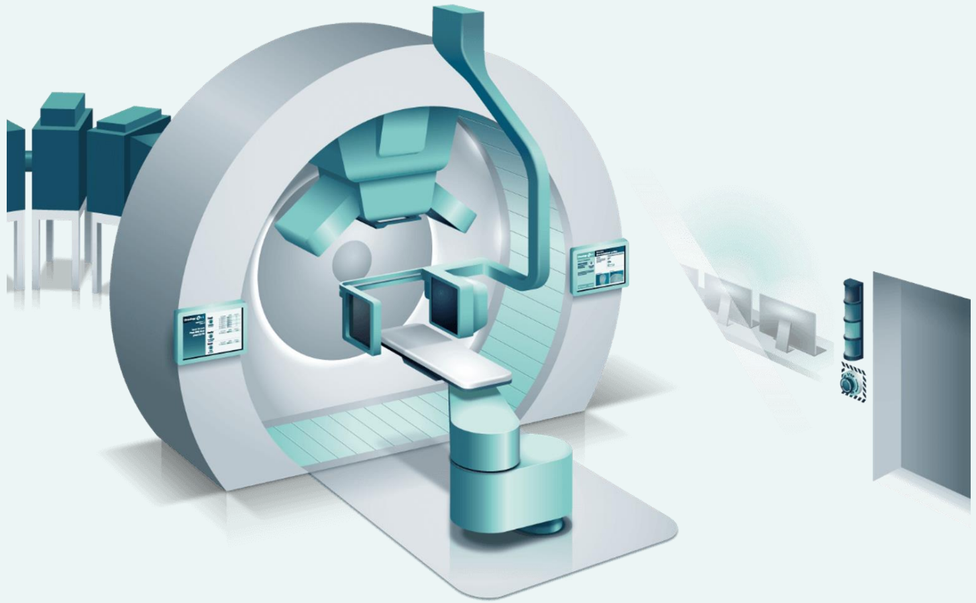
- 200+ highly skilled developers and engineers
- 25+ PhD holders from STEM fields

About us

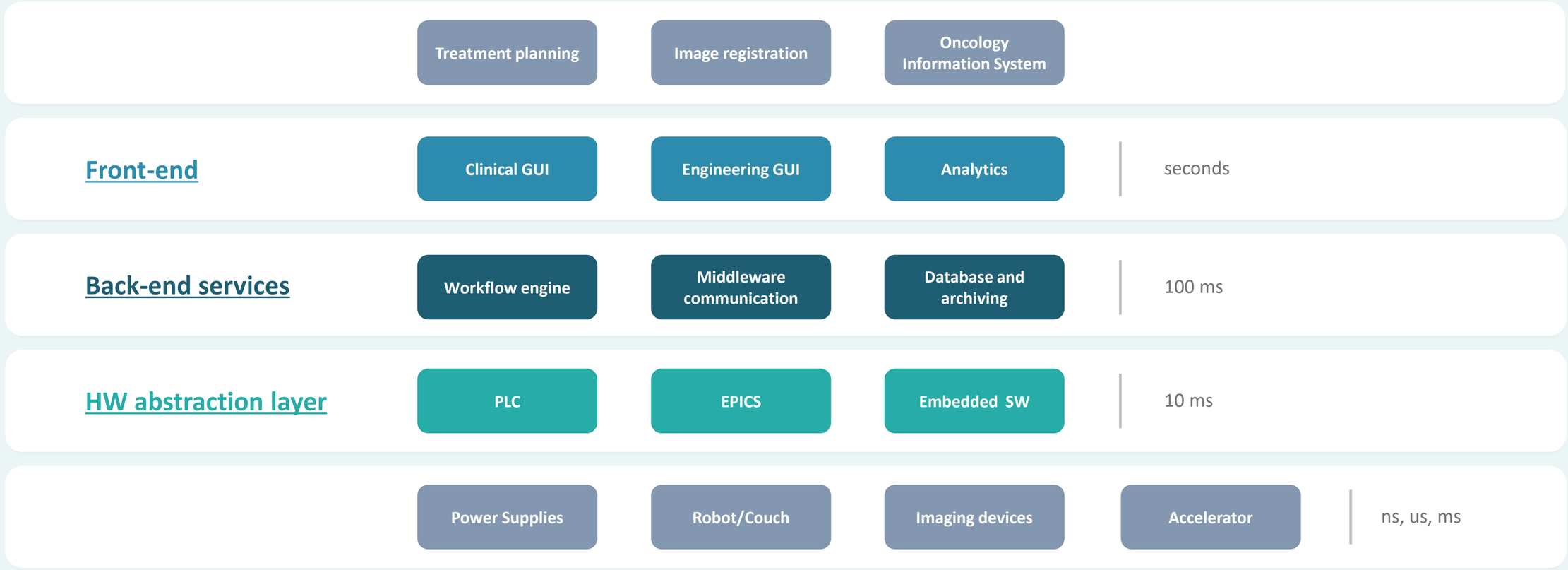
- **Luka Šepetavc,** Senior Systems Engineer & Project Manager
- **Kristijan Kuhar,** Senior Architect & Senior Developer

What is Hadron Therapy, What is a Control System?

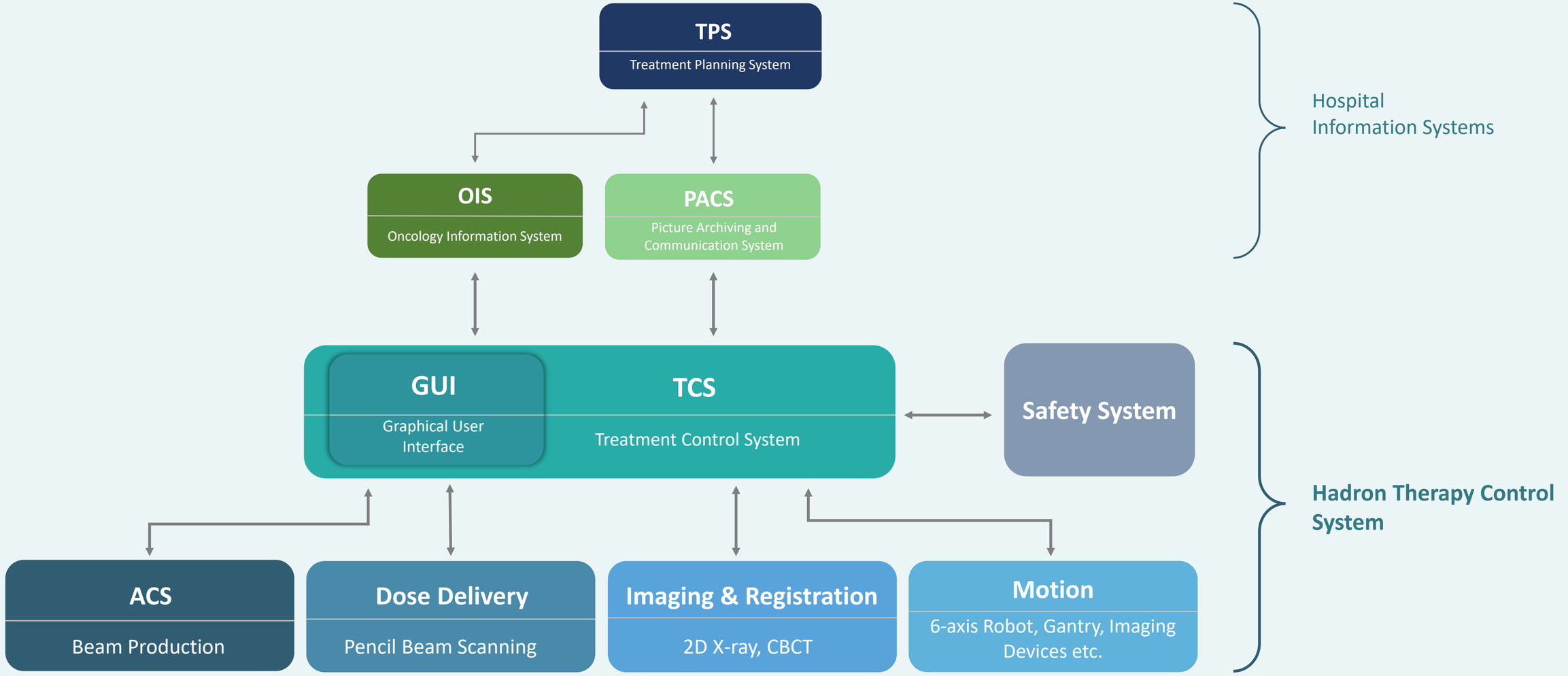
- **Hadron Therapy**
  - Particle therapy: proton, carbon ion
- **Control System**
  - Software which controls devices in a desired way
  - Provides user interface to the operator
- **What is special about Hadron Therapy Control System?**
  - Software must control tens or hundreds of devices
  - Real-time (ns, µs, ms) and non-real-time requirements
  - Optimize on patient throughput
  - Must be safe
- **What about other radiation therapy systems?**
  - RT - electrons and photons
  - BNCT (Boron Neutron Capture Therapy)



Architecture of a Hadron Therapy Control System

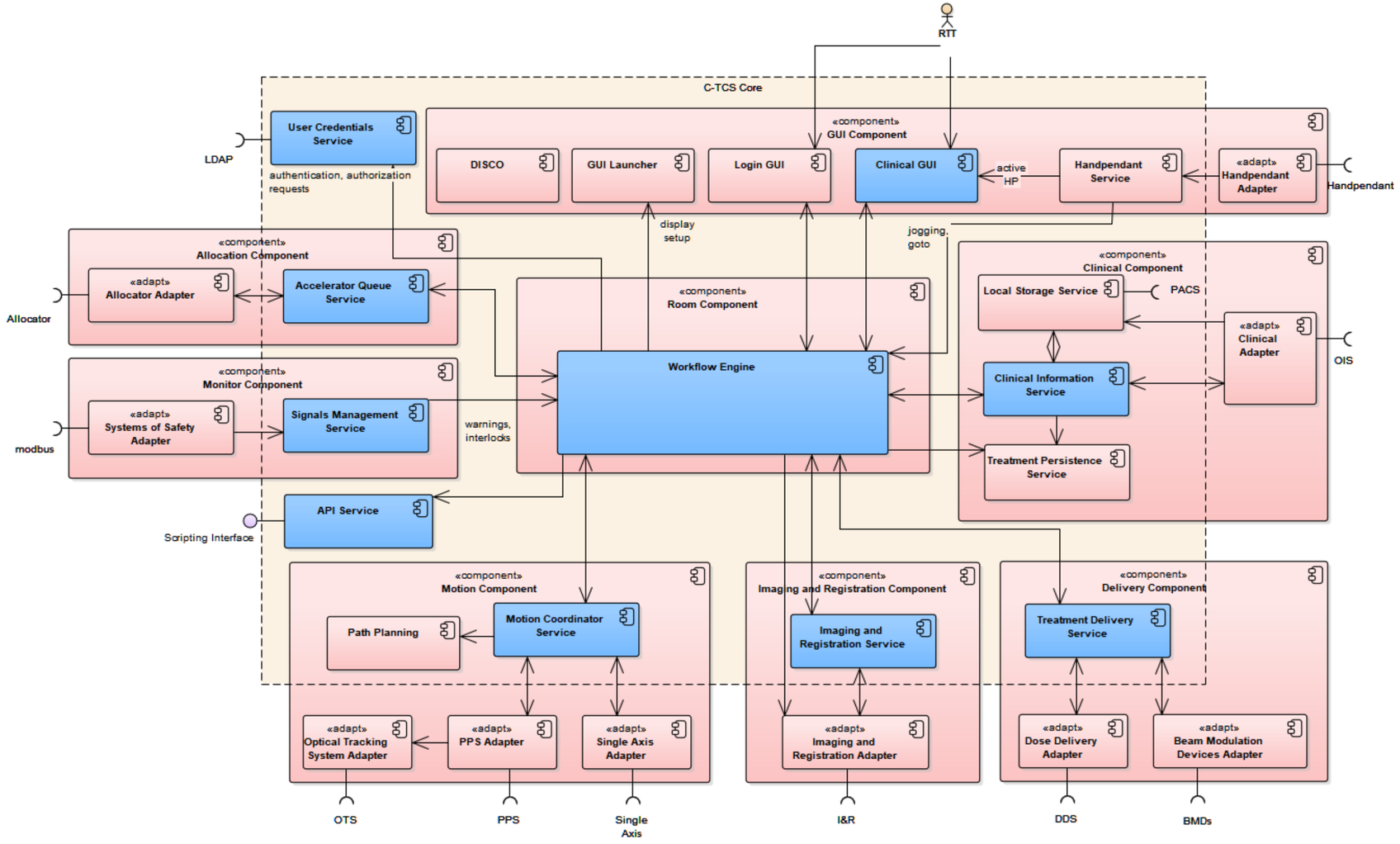


Breakdown of Hadron Therapy Control System



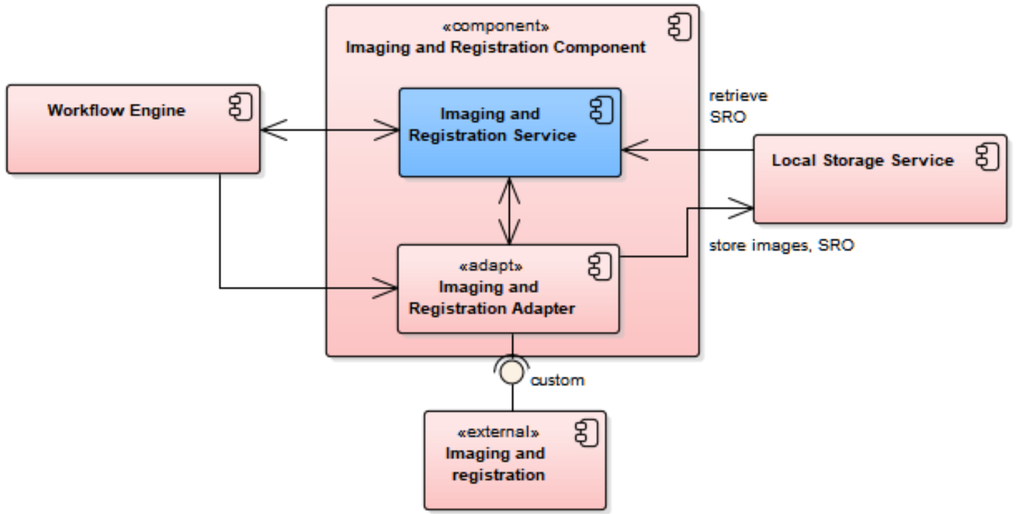
Detailed Architecture 1/4

C-TCS Core

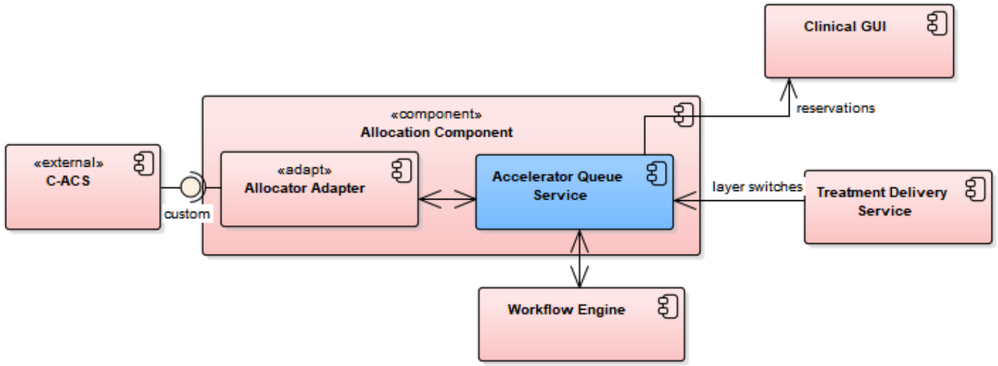


Detailed Architecture 2/4

Imaging and registration Component

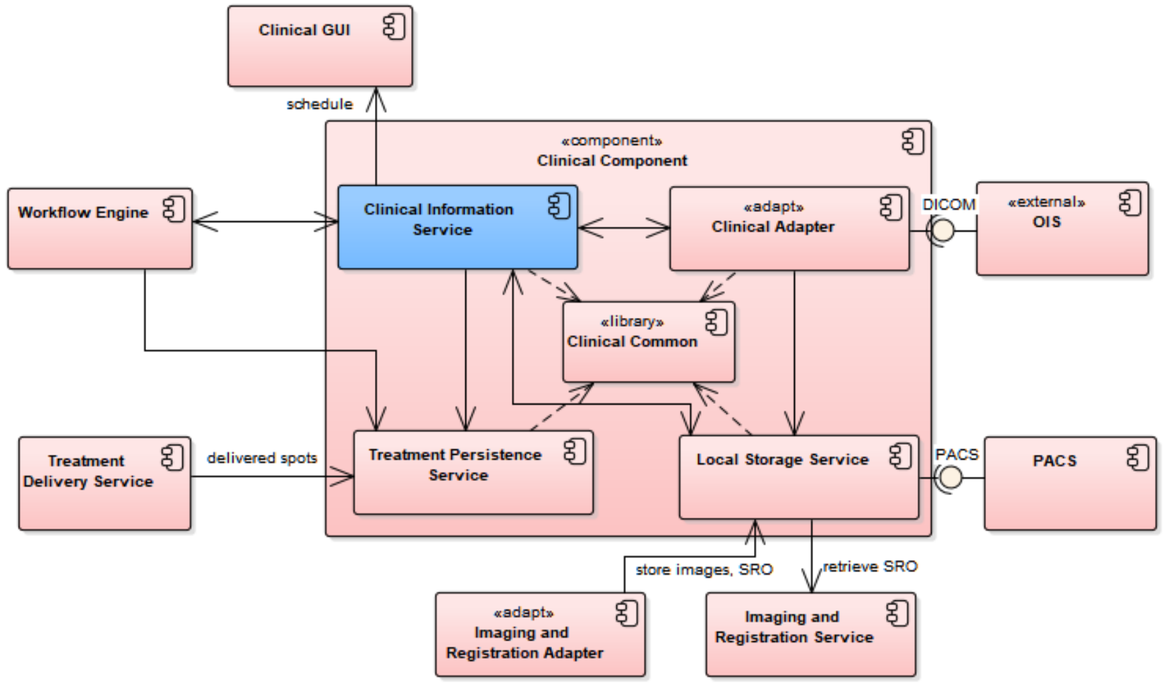


Allocation Component

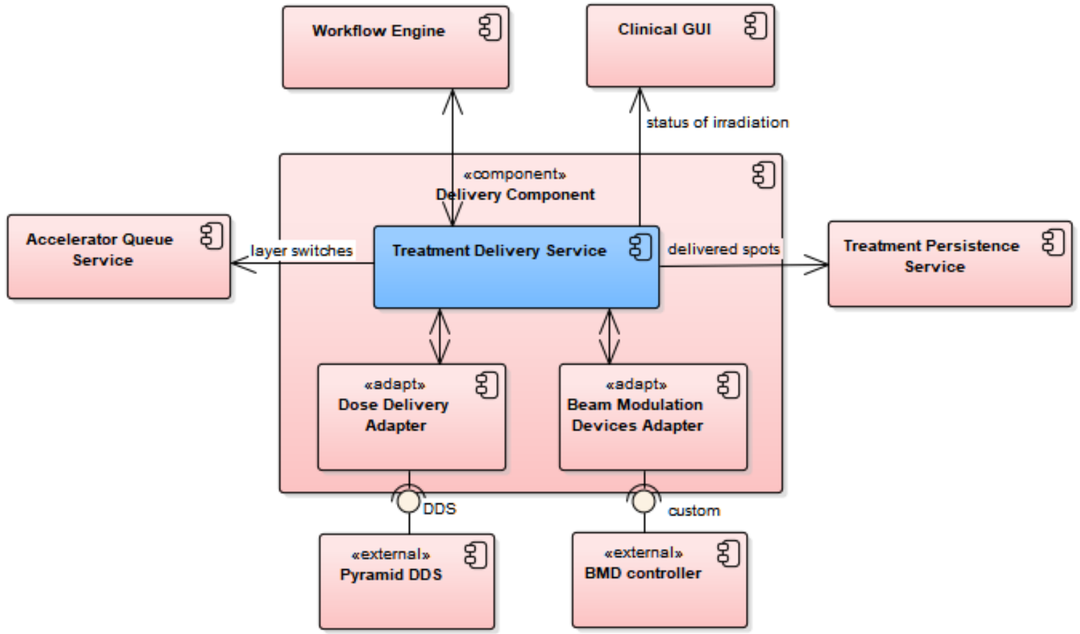


Detailed Architecture 3/4

Clinical Component



Delivery Component



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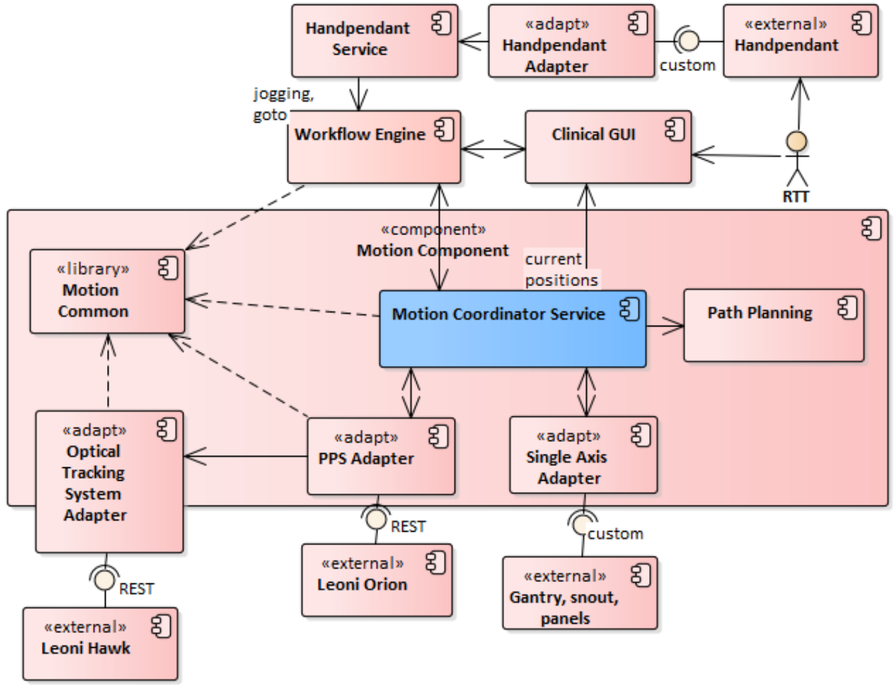
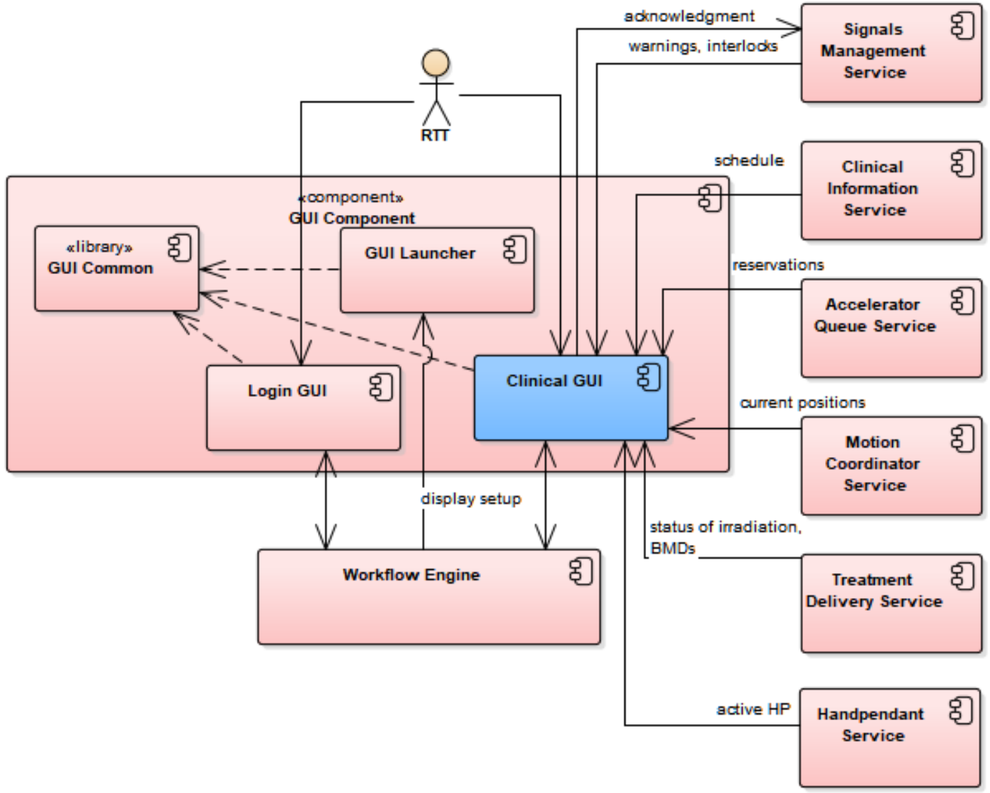
Detailed Architecture 4/4

Motion Component

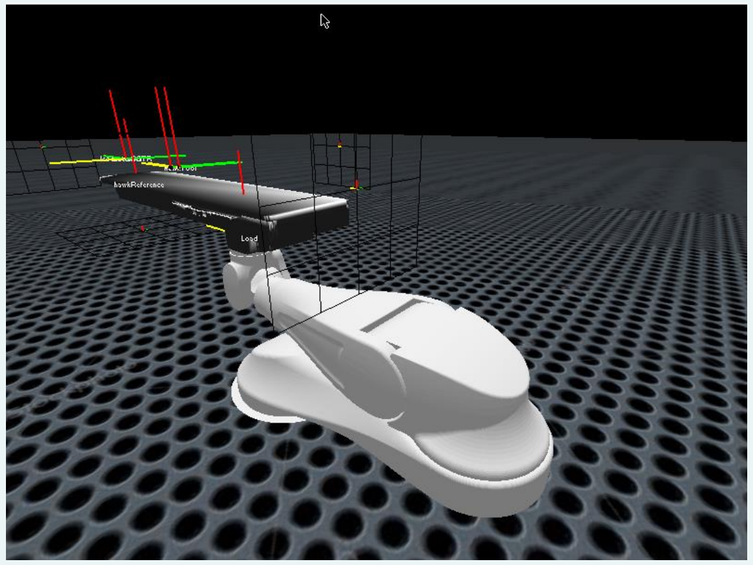


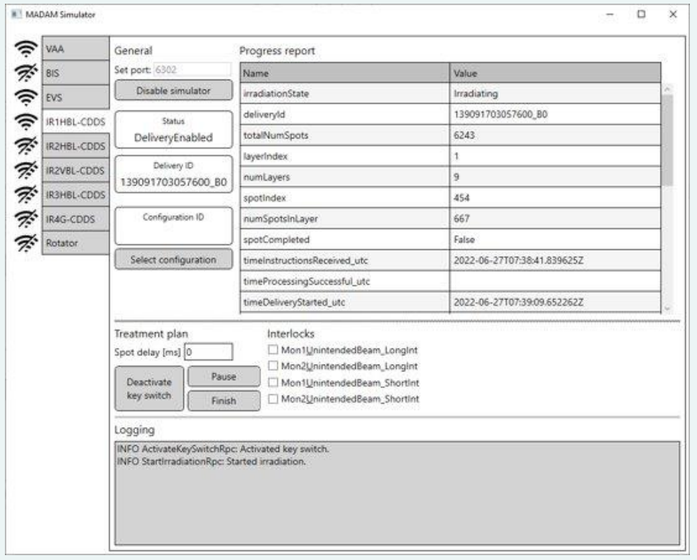
GUI Component

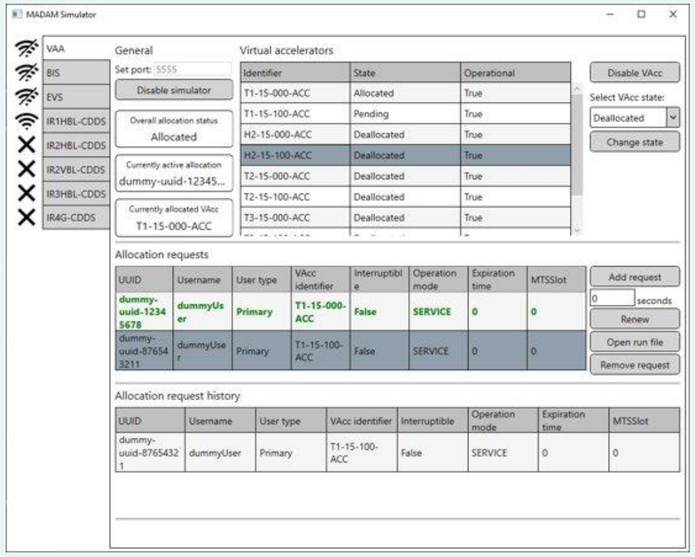


Usage of Simulators

- **Speed up development and testing**
  - Automated testing
  - Test edge cases and issues that occur rarely
  - Replace missing hardware with simulators
  - Save time on the real system
- **Types of simulators**
  - Programmatic
  - With user interface
- **Validation of simulators**
  - Formal testing of medical devices







Clinical Workflow Demonstration

Live demo of the Treatment Control System

Presented by Kristijan Kuhar

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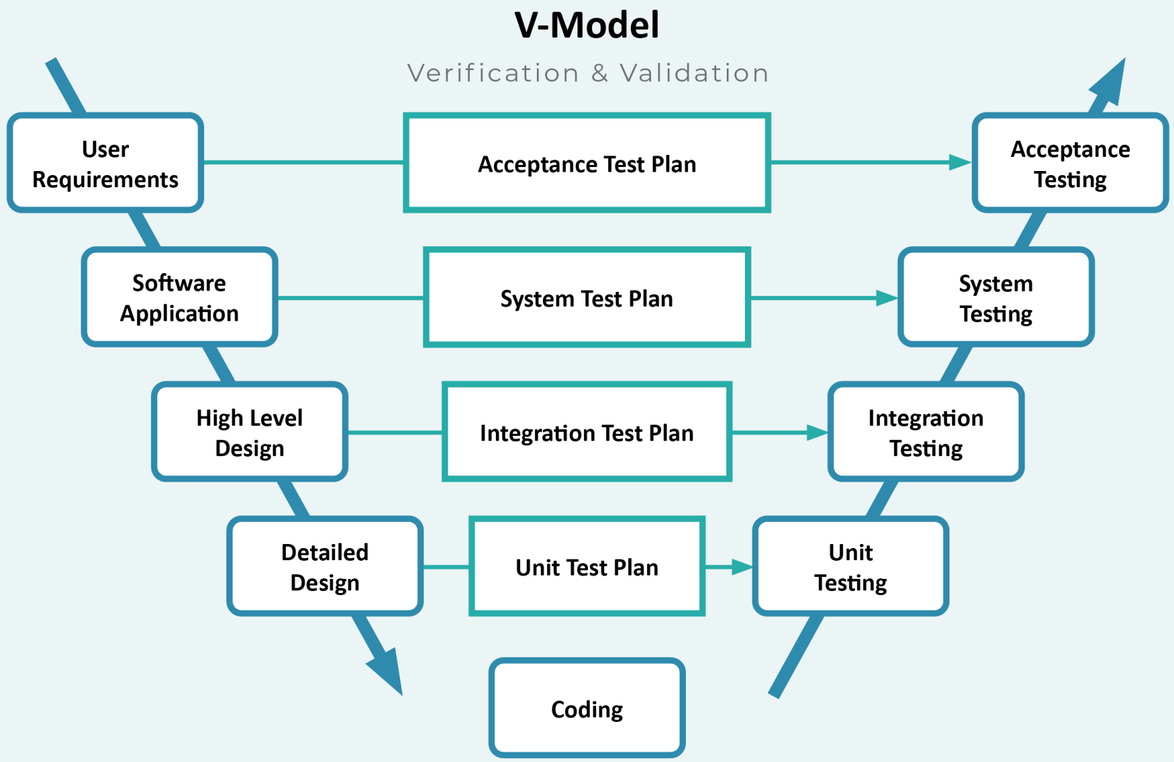
Technologies Used

- **Good object-oriented design is crucial**
  - Readability, testability, scalability and maintainability.
- **Higher level programming languages on higher tiers (C#, Java, Scala)**
  - High performance is not necessary
  - Faster to develop and less bug prone development
- **Lower lever programming languages on lower tiers (C, VHDL)**
  - Real-time control, quick response times
- **Good logging system is very important**
  - Essential during testing
    - Often it is not feasible to block the execution with a debugger
  - Diagnostics when running in production
- **Execution data collection for workflow optimization (future)**

```
// Allow imaging in IMAGING position when imagingReady
when {

  // Imaging ready, imagingAllowed fills getCurrentlyAllowedImagingTypes
  case s @ State(ss: WithBeam, _, None)
    if params.conditions.get(Cond.imagingReady) && ss.plan.planState.getCurrentlyAllowedImagingTypes.isEmpty() =>
      desc
        // Imaging is allowed
        .onCondition(Cond.imagingAllowed, triggerValue = true, () => {
          val planState = ImmutablePlanState.builder().from(ss.plan.planState)
            .currentlyAllowedImagingTypes(
              if (ss.plan.planData.getInitialImagingTypes.isEmpty()) { // ternary if
                params.config.getImagingTypes
              } else {
                ss.plan.planData.getInitialImagingTypes
              }
            ).build
          newSubstate(s, ss.copyBeam(ss.plan.copy(planState = planState), ss.beamState))
      })
}

when {

  // Imaging ready, not imagingAllowed clears getCurrentlyAllowedImagingTypes
  case s @ State(ss: WithBeam, _, None)
    if params.conditions.get(Cond.imagingReady) && !ss.plan.planState.getCurrentlyAllowedImagingTypes.isEmpty() =>
      desc
        // Imaging not allowed
        .onCondition(Cond.imagingAllowed, triggerValue = false, () => {
          val planState = ImmutablePlanState.builder()
            .from(ss.plan.planState)
            .currentlyAllowedImagingTypes(Collections.emptyList())
            .build
          newSubstate(s, ss.copyBeam(ss.plan.copy(planState = planState), ss.beamState))
      })
}
```

Development Lifecycle

- **Software for the most complex medical device in the world**
- **Carefully follow development processes**
  - Requirements
  - Architecture & Design
  - Implementation & Integration
  - Verification & Validation
  - Risk Management
  - Usability
- **Regulatory & standards**
  - EU, USA, China, Japan...



Team & Time to Develop

- **Big Teams**
  - Product development: 10-40 people
  - Integration: 5-10 people
- **Different Roles Involved**
  - Systems Engineer
  - Architect
  - Developer
  - Tester
  - Project Manager
- **Multi-Year Projects**
  - Product development: ~4 years
  - Integration: 1-2 years

Thank you!

Q & A

APPENDIX: Treatment Control System Demonstration

- **Screenshots taken from Cosylab's TreatmentOne Treatment Control System, demonstrating clinical workflow of a proton therapy session.**

COSYLAB

English

no user logged in

TR-1

5 jan, 18:10:31

OFF
PREP
TREAT

Log in

USERNAME

PASSWORD

MODE

Treatment | Simulation | Clinical QA | Machine QA

Log in

Vendor
sample logo

COSYLAB

English

no user logged in

TR-1

5 jan, 18:10:31

OFF
PREP
TREAT

Log in

USERNAME

john.doe

PASSWORD

MODE

Treatment | Simulation | Clinical QA | Machine QA

Validating user

Vendor
sample logo

COSYLAB

English
john.doe

TR-1: Treatment
5 jan, 18:10:31

OFF
PREP
TREAT

Select a session

Vendor
sample logo

SCHEDULED SESSIONS

James Johnson
13 Oct 1976 — male
id: 946502669

Today, 11:30
TREATMENT

Michael Williams
22 Nov 1962 — male
id: 506735284

Today, 11:45
TREATMENT

Charles Miller
3 Jan 1988 — male
id: 305835273

Today, 12:30
TREATMENT

COSYLAB

English
john.doe

TR-1: Treatment

5 jan, 18:10:31

OFF
PREP
TREAT

Verify the patient

Vendor
sample logo

SCHEDULED SESSIONS

James Johnson
13 Oct 1976 — male
id: 946502669

Today, 11:30
TREATMENT

PRESCRIPTION

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi a tellus arcu. Fusce sit amet neque ex. Morbi maximus id erat ac pellentesque. Vestibulum quis mauris ac nisl varius efficitur. Aenean sed turpis in massa sollicitudin molestie. Suspendisse quis mi leo. Suspendisse potenti.

☐ I have verified the patient

Open session | Back to selection

Michael Williams
22 Nov 1962 — male
id: 506735284

Today, 11:45
TREATMENT

Charles Miller

Today, 12:30

COSYLAB

English
john.doe

TR-1: Treatment

5 jan, 18:10:31

OFF
PREP
TREAT

Verify the patient

Vendor
sample logo

SCHEDULED SESSIONS

James Johnson
13 Oct 1976 — male
id: 946502669

Today, 11:30
TREATMENT

PRESCRIPTION

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi a tellus arcu. Fusce sit amet neque ex. Morbi maximus id erat ac pellentesque. Vestibulum quis mauris ac nisl varius efficitur. Aenean sed turpis in massa sollicitudin molestie. Suspendisse quis mi leo. Suspendisse potenti.

☑ I have verified the patient

Open session | Back to selection

Michael Williams
22 Nov 1962 — male
id: 506735284

Today, 11:45
TREATMENT

Charles Miller

Today, 12:30

COSYLAB

English
john.doe

Beam opened
Load patient specific device

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam
Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam
Cancel request

wait time: **5 min 31 s**

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF PREP TREAT

PRESCRIPTION
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi a tellus arcu. Fusce sit amet neque ex. Morbi maximus id erat ac pellentesque. Vestibulum quis mauris ac nisl varius efficitur. Aenean sed turpis in massa sollicitudin molestie. Suspendisse quis mi leo. Suspendisse potenti.

PARTICIPATING PERSONNEL
Janez Novak × Anton Hribar × + Add

SESSION NOTES
In hac habitasse platea dictumst. Aliquam erat volutpat. Morbi nec gravida enim. Praesent dictum eleifend magna, vel rutrum mi fringilla et. Cras cursus fringilla facilisis. Nullam eget felis enim. Vestibulum eu consectetur est.
Mauris egestas nibh eros, vitae fringilla enim condimentum eu. Curabitur vehicula ultricies mauris, et consequat nisl rhoncus mattis. Sed lobortis eleifend diam eu ornare. Nam et turpis a dolor aliquam gravida tempor id ipsum. Phasellus posuere, leo sit amet porttitor porttitor, nisi velit suscipit ligula, id laoreet arcu nibh ac arcu. Ut vestibulum mattis ante non mattis. Aliquam laoreet arcu quis quam condimentum commodo. Integer varius sem ac

PATIENT SPECIFIC DEVICES
Beam A1

Prescribed: **ZX32986** (Device name)

Installed: None

SETUP NOTES
Suspendisse pellentesque metus non mi dignissim, a gravida lectus commodo. In tempor venenatis purus. Suspendisse auctor dolor vitae enim pretium, in porttitor dolor ultrices. Pellentesque pellentesque, mauris eu imperdiet ultrices, metus libero dapibus enim, ut laoreet est urna id erat. Aliquam ut convallis ex. Phasellus varius, turpis eu finibus hendrerit, velit diam lacinia lectus, vel sagittis sem nibh at risus. Morbi nec quam augue. Pellentesque quam nulla, porta at porttitor sit amet, facilisis et orci.
Suspendisse eros lectus, ultricies at mi vel, semper ornare magna. Sed laoreet diam sem, id volutpat est semper eget. Nunc maximus leo vel elit aliquet mattis vestibulum nec lacus. Donec ut metus in est tincidunt molestie eu et enim. Maecenas eu lectus ac est tristique vehicula. Vivamus a tincidunt purus. Proin eget facilisis augue, et porta metus. Duis at suscipit risus, elementum pre-

setup photo placeholder | setup photo placeholder | setup photo placeholder

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Not installed**	**Not secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Patient specific devices installed
Go to POSITIONING tab

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam
Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam
Cancel request

wait time: **5 min 31 s**

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF PREP TREAT

PRESCRIPTION

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi a tellus arcu. Fusce sit amet neque ex. Morbi maximus id erat ac pellentesque. Vestibulum quis mauris ac nisl varius efficitur. Aenean sed turpis in massa sollicitudin molestie. Suspendisse quis mi leo. Suspendisse potenti.

PARTICIPATING PERSONNEL

Janez Novak × Anton Hribar × + Add

SESSION NOTES

In hac habitasse platea dictumst. Aliquam erat volutpat. Morbi nec gravida enim. Praesent dictum eleifend magna, vel rutrum mi fringilla et. Cras cursus fringilla facilisis. Nullam eget felis enim. Vestibulum eu consectetur est.
Mauris egestas nibh eros, vitae fringilla enim condimentum eu. Curabitur vehicula ultricies mauris, et consequat nisl rhoncus mattis. Sed lobortis eleifend diam eu ornare. Nam et turpis a dolor aliquam gravida tempor id ipsum. Phasellus posuere, leo sit amet porttitor porttitor, nisi velit suscipit ligula, id laoreet arcu nibh ac arcu. Ut vestibulum mattis ante non mattis. Aliquam laoreet arcu quis quam condimentum commodo. Integer varius sem ac

PATIENT SPECIFIC DEVICES

Beam A1

Prescribed: **ZX32986** (Device name)

Installed: ZX32986 CORRECT

SETUP NOTES

Suspendisse pellentesque metus non mi dignissim, a gravida lectus commodo. In tempor venenatis purus. Suspendisse auctor dolor vitae enim pretium, in porttitor dolor ultrices. Pellentesque pellentesque, mauris eu imperdiet ultrices, metus libero dapibus enim, ut laoreet est urna id erat. Aliquam ut convallis ex. Phasellus varius, turpis eu finibus hendrerit, velit diam lacinia lectus, vel sagittis sem nibh at risus. Morbi nec quam augue. Pellentesque quam nulla, porta at porttitor sit amet, facilisis et orci.
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setup photo placeholder

setup photo placeholder

setup photo placeholder

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Not secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Table is in park position
Move table to imaging position

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result not available

› SLOW » FAST

Patient position

movement ENABLED

Capture alignment
Override position

PCS

	ACTUAL	DELTA	DESTINATION
x	+0.2 cm		+0.2 cm
y	-100.0 cm		-100.0 cm
z	+90.5 cm		+90.5 cm
θ	0.0 °		0.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Park — *In position*

Gantry

movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	90.0 °	- 2°	88.0 °

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: Park — *Out of position*

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Not secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Imaging position is armed
Use hand pendant to start motion

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result not available

› SLOW » FAST

Instrument | Position | State

Patient position

movement ENABLED

Capture alignment

Override position

PCS

	ACTUAL	DELTA	DESTINATION
x	+0.2 cm	+ 5.5 cm	+5.7 cm
y	-100.0 cm	+ 6.8 cm	-93.2 cm
z	+90.5 cm	+ 35.3 cm	+125.8 cm
θ	0.0 °	+ 5.0 °	5.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °

Gantry

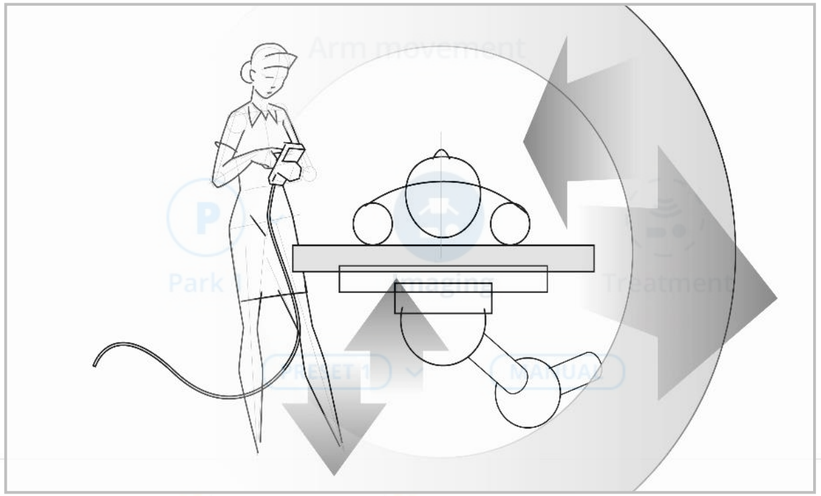
movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	90.0 °	- 2°	88.0 °

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	



Park | Treatment | PRESET 1 | MANUAL

movement available via external system only

Park — *In position*

Park — *Out of position*

Left Retracted

Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Not secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Table is in imaging position
Secure the room

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result not available

› SLOW » FAST

Patient position
movement ENABLED

Capture alignment
Override position

PCS

Instrument	ACTUAL	DELTA	DESTINATION
x	+5.7 cm		+5.7 cm
y	-93.2 cm		-93.2 cm
z	+125.8 cm		+125.8 cm
θ	5.0 °		5.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Imaging — *In position*

Gantry
movement ENABLED

Instrument	ACTUAL	DELTA	DESTINATION
y	90.0 °	- 2°	88.0 °

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: Park — *Out of position*

Panels
movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Not secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Table is in imaging position
Start imaging

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session

Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result not available

› SLOW » FAST

Instrument | Position | State

Patient position

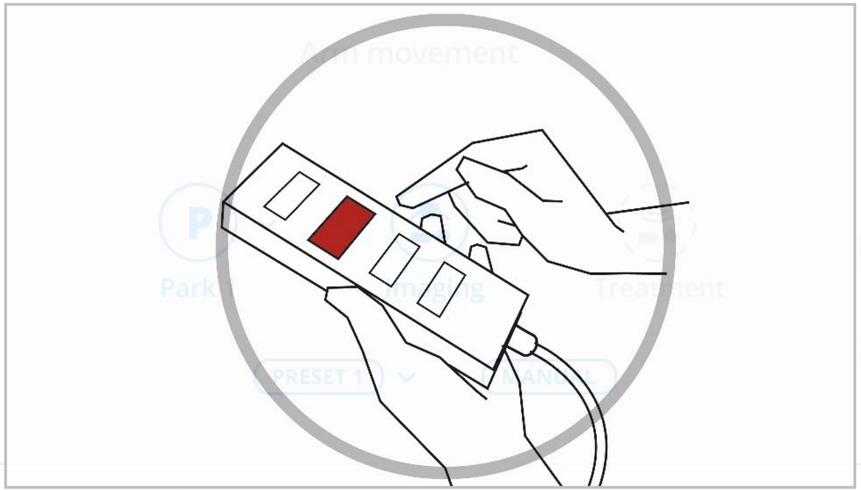
movement ENABLED

Capture alignment

Override position

PCS

	ACTUAL	DELTA	DESTINATION
x	+5.7 cm		+5.7 cm
y	-93.2 cm		-93.2 cm
z	+125.8 cm		+125.8 cm
θ	5.0 °		5.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °



Imaging
In position

Gantry

movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	90.0 °	- 2°	88.0 °

Park | Treatment | PRESET 1 | MANUAL

Park
Out of position

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted

Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Table is in imaging position
Imaging in progress

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT
Go to pressed

OFF
PREP
TREAT

Registration result not available

› SLOW » FAST

Patient position

movement ENABLED

Capture alignment
Override position

PCS

	ACTUAL	DELTA	DESTINATION
x	+5.7 cm		+5.7 cm
y	-93.2 cm		-93.2 cm
z	+125.8 cm		+125.8 cm
θ	5.0 °		5.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 MANUAL

State: **Imaging** *In position*

Gantry

movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	86.0 °	- 6°	80.0 °

Arm movement: Park | Treatment
PRESET 1
MANUAL

State: **External** *In movement*

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	full fan	
Left source	extended	
Right panel	full fan	
Right source	extended	

movement available via external system only

Left **In position**

Right **In position**

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Imaging completed
Registration in progress

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result not available

› SLOW » FAST

Patient position
movement ENABLED

Capture alignment
Override position

PCS

	ACTUAL	DELTA	DESTINATION
x	+5.7 cm		+5.7 cm
y	-93.2 cm		-93.2 cm
z	+125.8 cm		+125.8 cm
θ	5.0 °		5.0 °
ψ	0.0 °		0.0 °
ω	0.0 °		0.0 °

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Imaging — *In position*

Gantry
movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	80.0 °		80.0 °

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: External — *In position*

Panels
movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Imaging completed
Registration in progress

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam
Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam
Cancel request

wait time: **5 min 31 s**

ELIVERY | NOTIFICATIONS

HAND PENDANT
Docked

OFF
PREP
TREAT

› SLOW » FAST

Registration result

Registration has finished.

x	+0.2 cm
y	-1.0 cm
z	+0.5 cm
θ	0.2 °
ψ	0.0 °
ω	0.5 °

Accept
Discard

	ACTUAL	DELTA	DESTINATION
			+5.7 cm
			-93.2 cm
			+125.8 cm
			5.0 °
			0.0 °
ω	0.0 °		0.0 °

position

Position | Arm movement | State

Park 1 | Imaging | Treatment

PRESET 1 | MANUAL

Imaging
In position

Gantry

movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	80.0 °		80.0 °

Park | Treatment

PRESET 1
MANUAL

External
In position

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted

Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Not applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Registration completed
Move table to treatment position

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result accepted

› SLOW » FAST

Patient position

movement ENABLED

Capture alignment
Override position

Instrument	Position	ACTUAL	DELTA	DESTINATION
	PCS			
	x	+5.7 cm		+5.7 cm
	y	-93.2 cm		-93.2 cm
	z	+125.8 cm		+125.8 cm
	θ	5.0 °		5.0 °
	ψ	0.0 °		0.0 °
	ω	0.0 °		0.0 °

Gantry

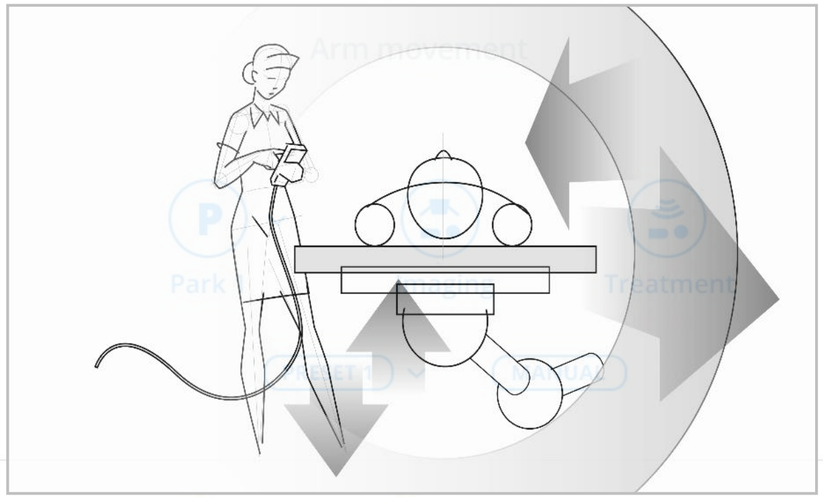
movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	80.0 °		80.0 °

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	



P Park | Treatment | PRESET 1 | MANUAL

movement available via external system only

State

Imaging
In position

E External
In position

Left Retracted

Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	**Not reached**	**No interlocks**	**Not in queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Treatment position is armed
Use hand pendant to start motion

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result accepted

› SLOW » FAST

Patient position
movement ENABLED

Capture alignment
Override position

Instrument	PCS	ACTUAL	REFERENCE	IN TOLERANCE
x		+5.7 cm	+2.2 cm	- 3.5 cm
y		-93.2 cm	-95.2 cm	- 2.0 cm
z		+125.8 cm	+121.5 cm	- 4.3 cm
θ		5.0 °	4.2 °	- 0.8 °
ψ		0.0 °	0.7 °	+ 0.7 °
ω		0.0 °	0.5 °	+ 0.5 °

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Imaging — *In position*

Gantry
movement ENABLED

	ACTUAL	DELTA	DESTINATION
y	80.0 °		80.0 °

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: External — *In position*

Panels
movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	Not reached	**No interlocks**	Not in queue	Not available	Not started

COSYLAB

English
john.doe

Table and gantry are in treatment position
Override position

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result accepted

› SLOW » FAST

Patient position

movement ENABLED

Capture alignment
Override position

PCS

	ACTUAL	REFERENCE	IN TOLERANCE
x	+3.0 cm	+2.2 cm	- 0.8 cm
y	-95.2 cm	-95.2 cm	✓
z	+121.5 cm	+121.5 cm	✓
θ	4.8 °	4.2 °	- 0.6 °
ψ	0.7 °	0.7 °	✓
ω	0.5 °	0.5 °	✓

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Treatment — *In position*

Gantry

movement ENABLED

	ACTUAL	REFERENCE	IN TOLERANCE
y	66.0 °	66.0 °	✓

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: Treatment — *In position*

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	Not reached	**No interlocks**	Not in queue	Not available	Not started

COSYLAB

English
john.doe

Table and gantry are in treatment position
Request beam

Vendor sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	Irradiation in progress
TR-1: Treatment	Session open

Request beam | Cancel request

wait time: **5 min 31 s**

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Docked

OFF / PREP / TREAT

Registration result accepted

› SLOW » FAST

Patient position

movement ENABLED

Capture alignment
Override position

PCS

	ACTUAL	REFERENCE	IN TOLERANCE
x	+3.0 cm	+2.2 cm	✓ - 0.8 cm
y	-95.2 cm	-95.2 cm	✓
z	+121.5 cm	+121.5 cm	✓
θ	4.8 °	4.2 °	✓ - 0.6 °
ψ	0.7 °	0.7 °	✓
ω	0.5 °	0.5 °	✓

Arm movement: Park 1 | Imaging | Treatment
PRESET 1 | MANUAL

State: Treatment — *In position*

Gantry

movement ENABLED

	ACTUAL	REFERENCE	IN TOLERANCE
y	66.0 °	66.0 °	✓

Arm movement: Park | Treatment
PRESET 1 | MANUAL

State: Treatment — *In position*

Panels

movement ENABLED

	ACTUAL	DESTINATION
Left panel	retracted	
Left source	retracted	
Right panel	retracted	
Right source	retracted	

movement available via external system only

Left Retracted
Right Retracted

beam **Open**	passive devices **Installed**	room security **Room secured**	registration **Applied**	treatment position **Overridden**	room status **No interlocks**	beam queue **Not in queue**	beam availability **Not available**	irradiation **Not started**

COSYLAB

English
john.doe

Table and gantry are in treatment position
Request beam

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session
Hide details

Beams

BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam
Close beam

Room overview

TR-2: Clinical QA	No session open
TR-1: Treatment	**Beam ready**

Auto-rejected in: **27 s**
Reject beam

SETUP | **POSITIONING** | DELIVERY | NOTIFICATIONS

HAND PENDANT Undocked
OFF · PREP · TREAT

Registration result accepted

› SLOW » FAST

Patient position

movement ENABLED

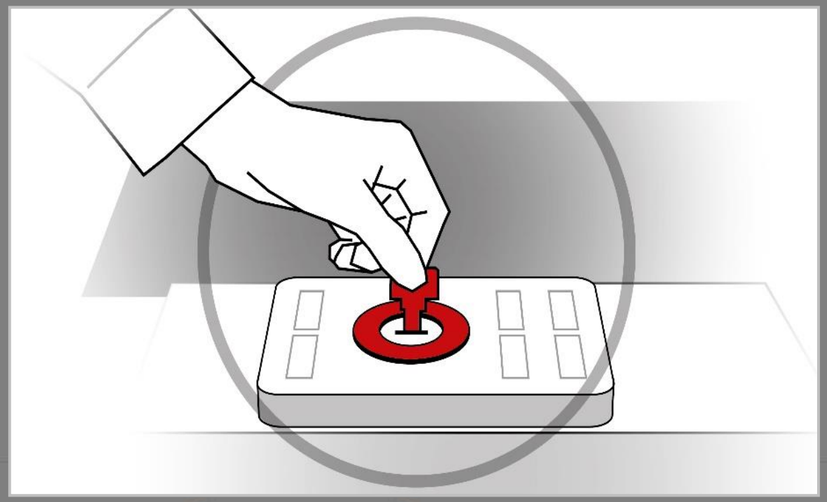
Capture alignment
Override position

Instrument	PCS	ACTUAL	REFERENCE	IN TOLERANCE
x		+3.0 cm	+2.2 cm	✓ - 0.8 cm
y		-95.2 cm	-95.2 cm	✓
z		+121.5 cm	+121.5 cm	✓
θ		4.8 °	4.2 °	✓ - 0.6 °
ψ		0.7 °	0.7 °	✓
ω		0.5 °	0.5 °	✓

Gantry

movement ENABLED

Instrument	ACTUAL	REFERENCE	IN TOLERANCE
y	66.0 °	66.0 °	✓



State

Treatment
In position

P Park
Treatment
PRESET 1
MANUAL

Treatment
In position

	DESTINATION
	ted
	ted
	ted
	ted

movement available via external system only

Left Retracted
Right Retracted

Beam ready

Beam is ready for Room TR-1.

Accept beam by turning switch to **treat**.

Reject beam

Beam auto-rejected in 27 s.

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	**Overridden**	**No interlocks**	**In queue**	**Not available**	**Not started**

COSYLAB

English
john.doe

Beam available
Start irradiation

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

SETUP | POSITIONING | **DELIVERY** | NOTIFICATIONS

HAND PENDANT
Docked

OFF
PREP
TREAT

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session

Hide details

Beams

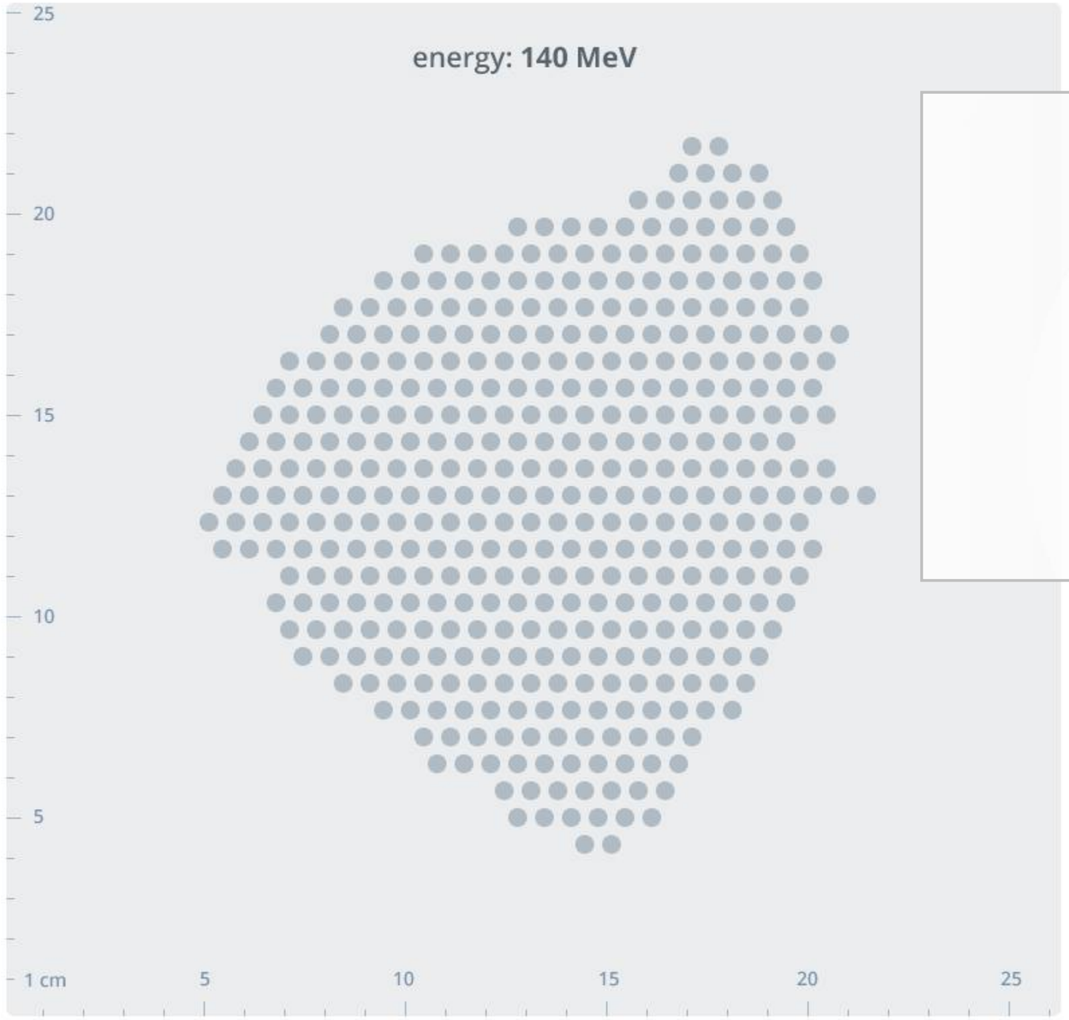
BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		0 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

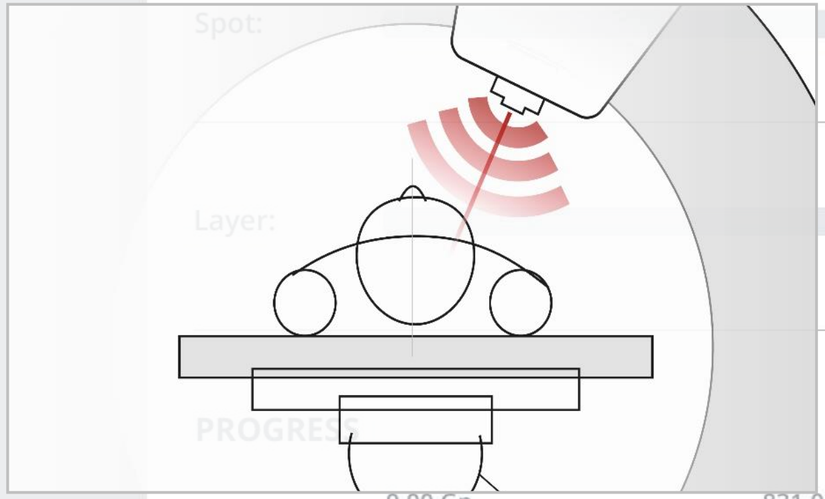
Room overview

TR-2: Clinical QA	No session open
TR-1: Treatment	**Beam accepted**

Request beam | Cancel request



Layer: ‹ 4 5 6 **7** 8 9 10 ›



Spot: 0 / 0

Layer: 0 / 13

PROGRESS

Monitor 1: 0.00 Gp — 831.02 Gp — 0%

Monitor 2: 0.00 Gp — 831.02 Gp — 0%

Time elapsed:

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	**Overridden**	**No interlocks**	**In queue**	**Available**	**Not started**

COSYLAB

English
john.doe

Irradiation in progress
Monitor irradiation progress

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

SETUP | POSITIONING | **DELIVERY** | NOTIFICATIONS

HAND PENDANT
Docked

OFF
PREP
TREAT

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session

Hide details

Beams

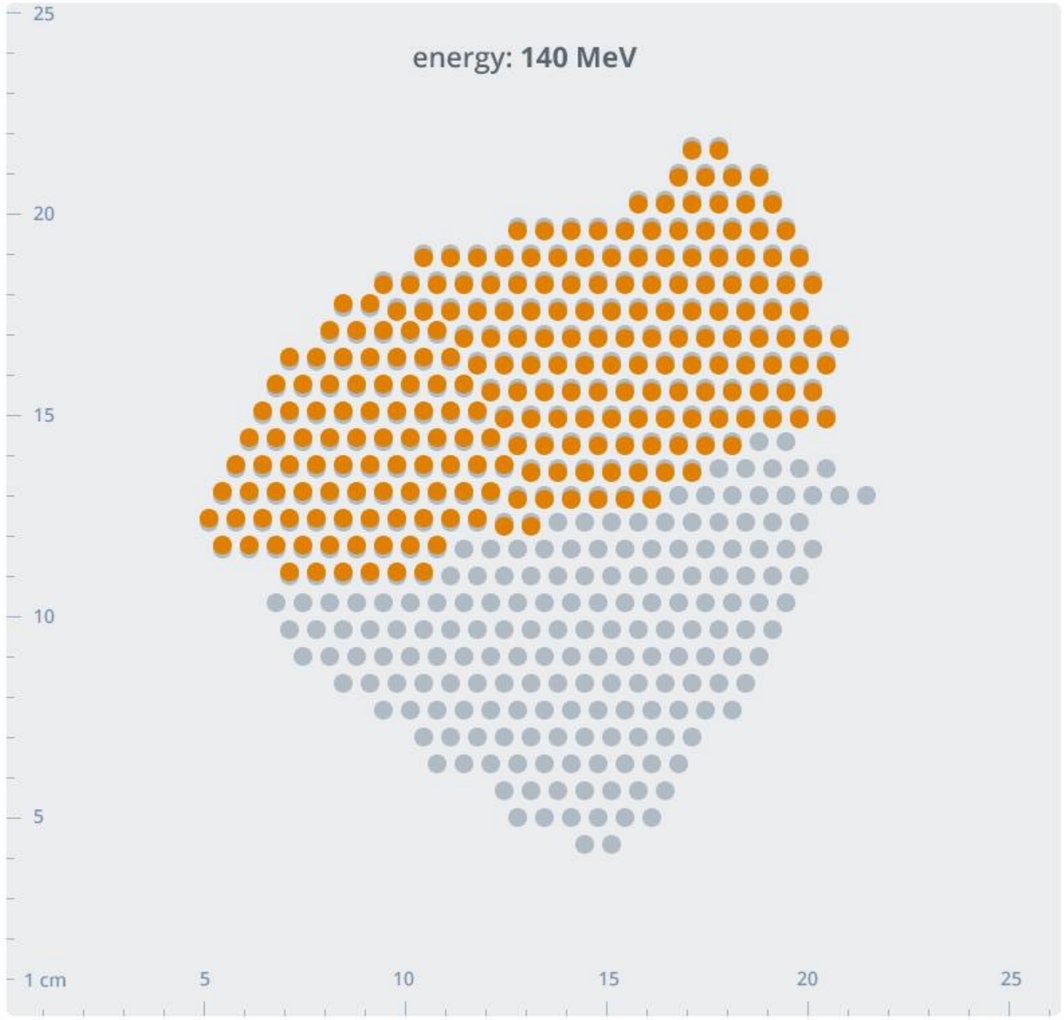
BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		465.40 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	No session open
TR-1: Treatment	**Beam accepted**

Request beam | Cancel request



Layer: ‹ 4 5 6 **7** 8 9 10 ›

Spot: 167 / 389

Layer: 7 / 13
energy: **140 MeV**

PROGRESS

Monitor 1: 465.40 Gp / 831.02 Gp — 56%

Monitor 2: 465.40 Gp / 831.02 Gp — 56%

Time elapsed: 2 min 01 s

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	**Overridden**	**No interlocks**	**In queue**	**Available**	**In progress 56%**

COSYLAB

English
john.doe

Irradiation finished
Close beam

Vendor
sample logo

TR-1: Treatment
5 jan, 18:10:31

SETUP | POSITIONING | DELIVERY | NOTIFICATIONS

HAND PENDANT
Docked

OFF
PREP
TREAT

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session

Hide details

Beams

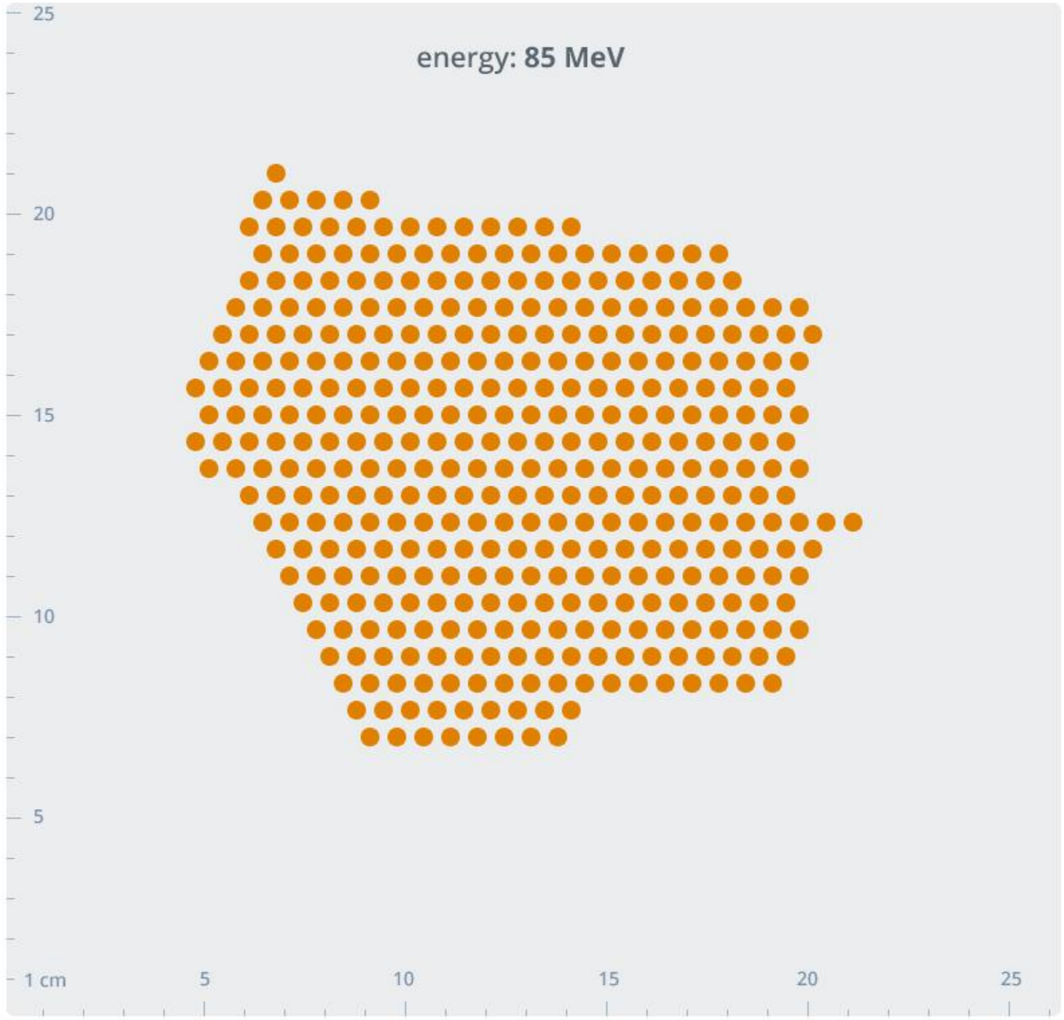
BEAM	GATING	DELIVERED / PRESCRIBED
ISOCENTER A		REGISTRATION ACCEPTED
Beam A1		831.02 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Open beam | Close beam

Room overview

TR-2: Clinical QA	No session open
TR-1: Treatment	**Beam accepted**

Request beam | Cancel request



Layer: ‹ 10 11 12 13

Spot: 268 / 268

Layer: 13 / 13
energy: 85 MeV

PROGRESS

Monitor 1: 831.02 Gp / 831.02 Gp 100%

Monitor 2: 831.02 Gp / 831.02 Gp 100%

Time elapsed: 3 min 27 s

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Open	**Installed**	**Room secured**	**Applied**	**Overridden**	**No interlocks**	**In queue**	**Available**	**Finished**

Session summary

Please verify that all the data is entered correctly.

PARTICIPATING PERSONNEL

Janez Novak × Anton Hribar × + Add

SESSION NOTES

In hac habitasse platea dictumst. Aliquam erat volutpat. Morbi nec gravida enim. Praesent dictum eleifend magna, vel rutrum mi fringilla et. Cras cursus fringilla facilisis. Nullam eget felis enim. Vestibulum eu consectetur est.
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SESSION DURATION

17 min 9 s

BEAMS

BEAM	GATING	DELIVERED
ISOCENTER A		
Beam A1		8.31.02 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Close session | Cancel

TR-1: Treatment
5 jan, 18:10:31

HAND PENDANT
Docked

OFF
PREP
TREAT

Patient
James Johnson
13 Oct 1976 — male
id: 946502669

Close session

Beams
BEAM GATING
ISOCENTER A
Beam A1
Beam A2
ISOCENTER B
Beam B1
Beam B2

Open beam

Room overview
TR-2: Clinical QA
TR-1: Treatment

Request beam

wait time: **5 min 31 s**

Session summary

Please verify that all the data is entered correctly.

PARTICIPATING PERSONNEL

Janez Novak × Anton Hribar ×

SESSION NOTES

In hac habitasse platea dictumst. Aliquam erat volutpat. Morbi nec gravida enim. Praesent dictum eleifend magna, vel rutrum mi fringilla et. Cras cursus fringilla facilisis. Nullam eget felis enim. Vestibulum eu consectetur est.
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SESSION DURATION

17 min 9 s

BEAMS

BEAM	GATING	DELIVERED
ISOCENTER A		
Beam A1		8.31.02 / 831.02 Gp
Beam A2		0 / 749.46 Gp
ISOCENTER B		
Beam B1		0 / 812.22 Gp
Beam B2		0 / 649.79 Gp

Reporting to oncology information system. Please wait.

...ices

...evice name)

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setup photo placeholder

setup photo placeholder

beam	passive devices	room security	registration	treatment position	room status	beam queue	beam availability	irradiation
Not open	Not installed	Not secured	Not applied	Not reached	No interlocks	Not in queue	Not available	Not started