Evoluzione ed integrazione tecnologica Tomoterapia e Protonterapia compatta

Lorenzo Scotti – Med. Physicist Product Specialist

TECNOLOGIE AVANZATE

ACCURAY®

Precise, innovative tumor treatments™

Tecnologie Avanzate TA s.r.l.

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iba

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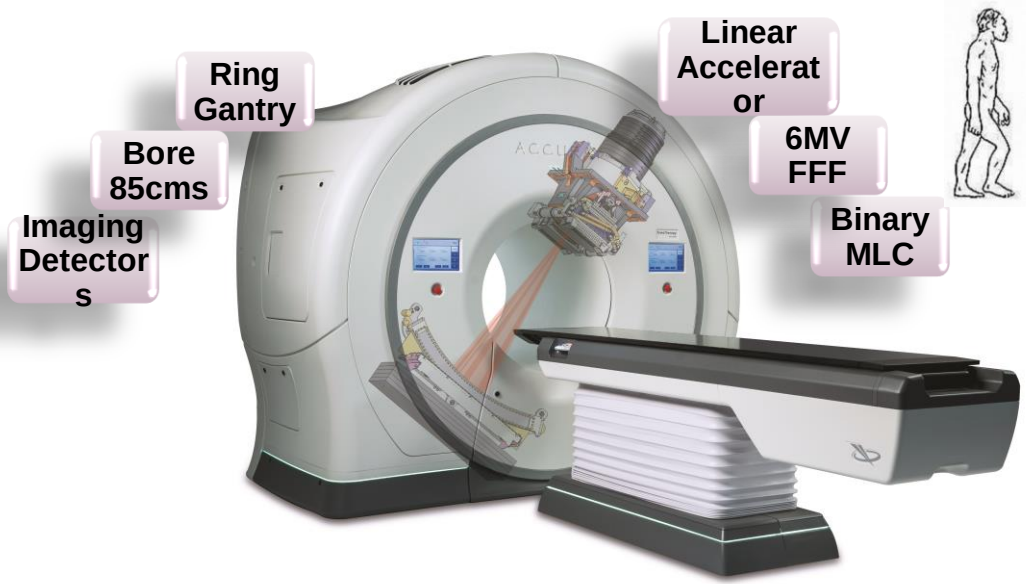
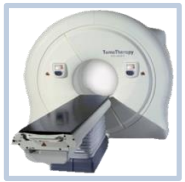
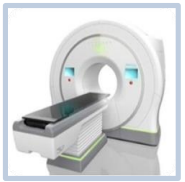
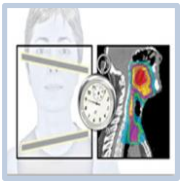
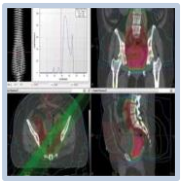
Think big, scale smart

Evoluzione

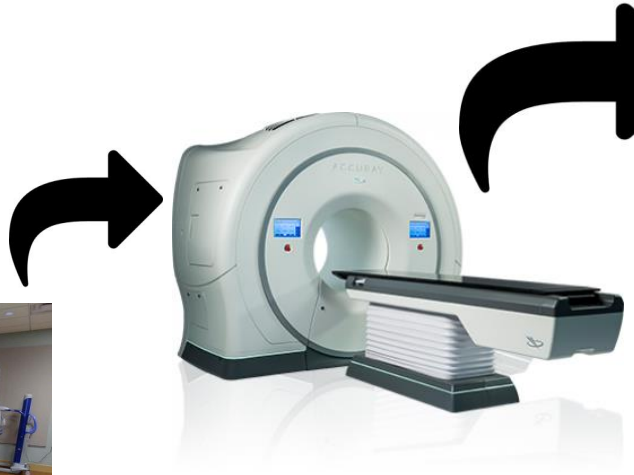


Erogazione elicoidale
MLC binario
TC vera
Rete integrata
TPS e QA integrati

Evoluzione

1993	2004	2010	2012	2014	2015	2016
						
First Paper “A new concept for the delivery of dynamic conformal radiotherapy”	Hi-Art™ First TomoTherapy treatment delivery platform TomoHelical™	TomoDirect™ Fixed angle delivery for indications where les beam angles are needed	TomoTherapy® H™ Series Third generation, configurable TomoTherapy platform	VoLO™ and TomoEDGE™ New GPU based treatment planning optimization system. Asymmetric jaw/opening closing improves dose penumbra inferior/superior to the target volume	Delivery Analysis™ Uses exit fluence data from onboard detectors and powerful visualization tools to verify treatment delivery consistency	TomoTherapy® Radixact™ with iDMS™ and Accuray Precision™ The fourth generation TomoTherapy platform

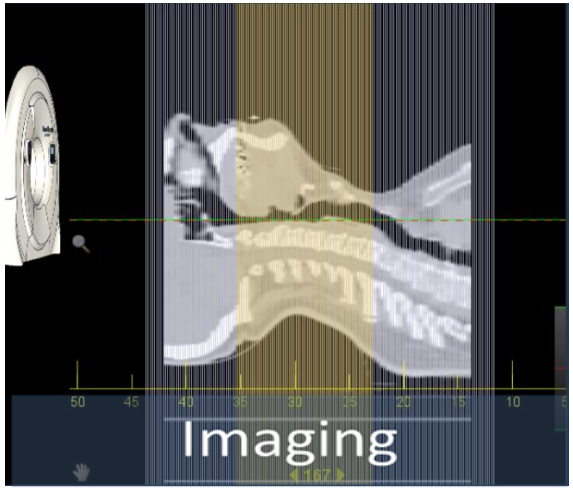
Evoluzione



Descrizione generale

Descrizione generale

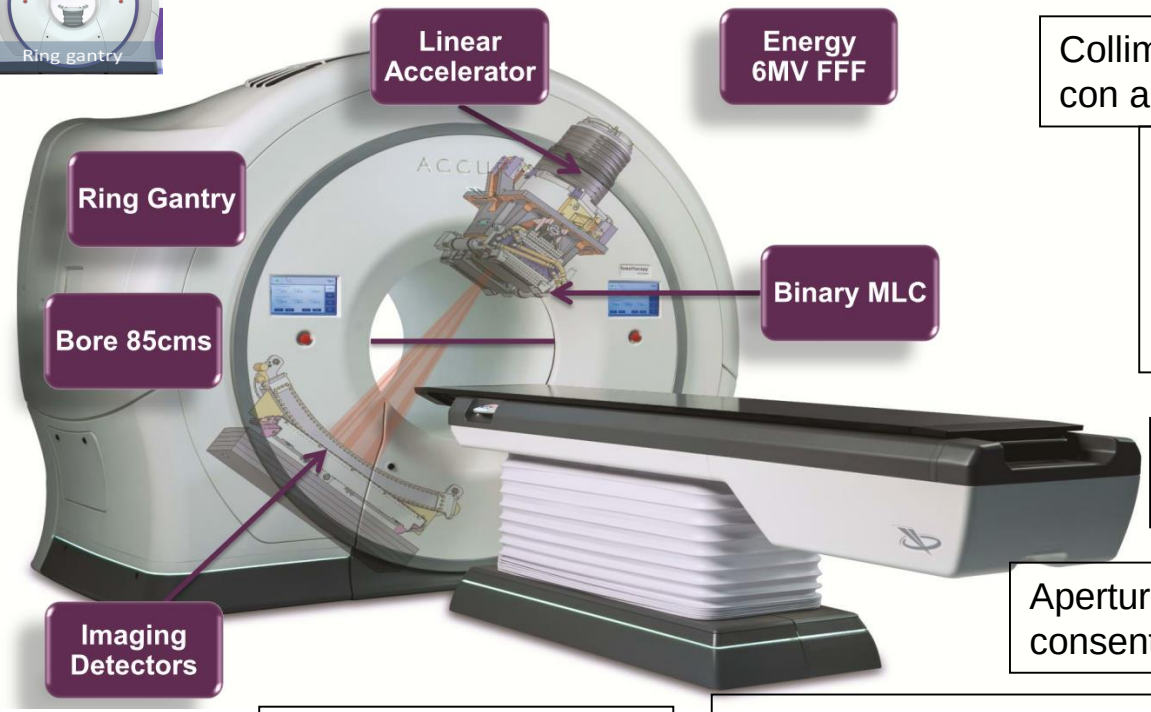
Compatta, parti in movimento interne



Integratato:
Acquisizione immagini
registrazione immagini

TomoEDGE™,
TomoHelical™
TomoDirect™

Descrizione generale



Sorgente 6 MV – FFF da 1000 MU/min
Velocità 5RPM

Collimatore (tungsteno): a forma di conchiglia con aperture 0 – 5 cm (1 - 2,5 - 5 cm)

MLC Binario: ad aria compressa costituito da 64 lamelle da 0,625 cm.

Velocità: 200cm/s - FASCI SOTTILI

Campo da 1x0,62 cm^2 a 40x135 cm^2

SAD è 85 cm - permette un dose-rate più elevato

Apertura del gantry di diametro di 85 cm per consentire tutte le posizioni e gli accessori

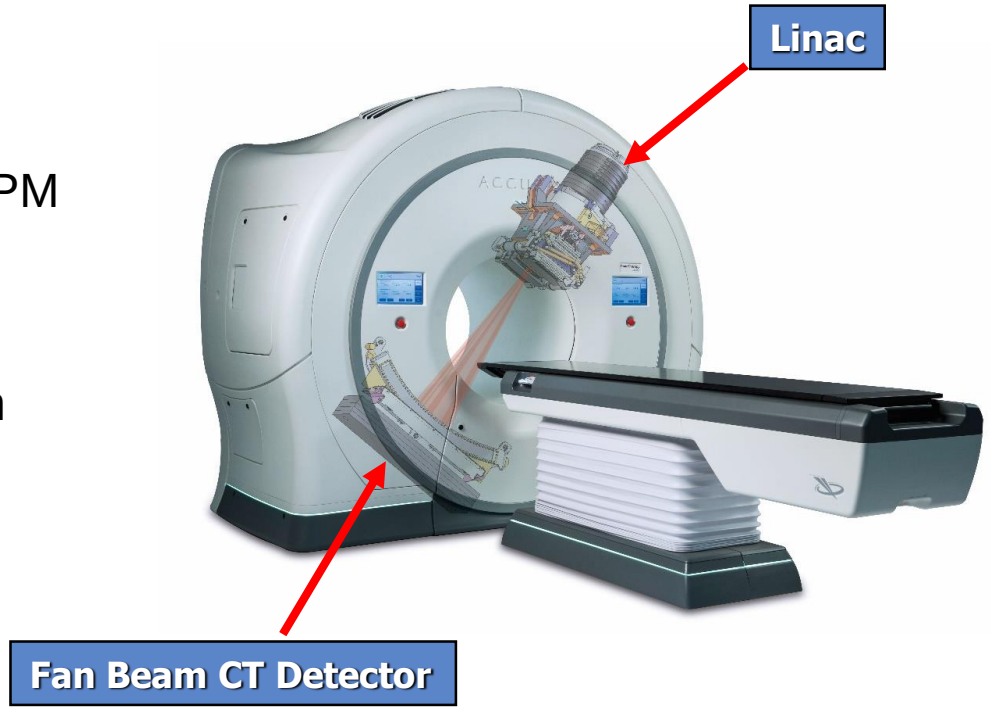
Piombo schermatura

Array di detettori CT: costituito da 764 detettori (xenon) che ruotano in modo contrapposto al fascio – 10 RPM

Descrizione generale

MVCT integrata:

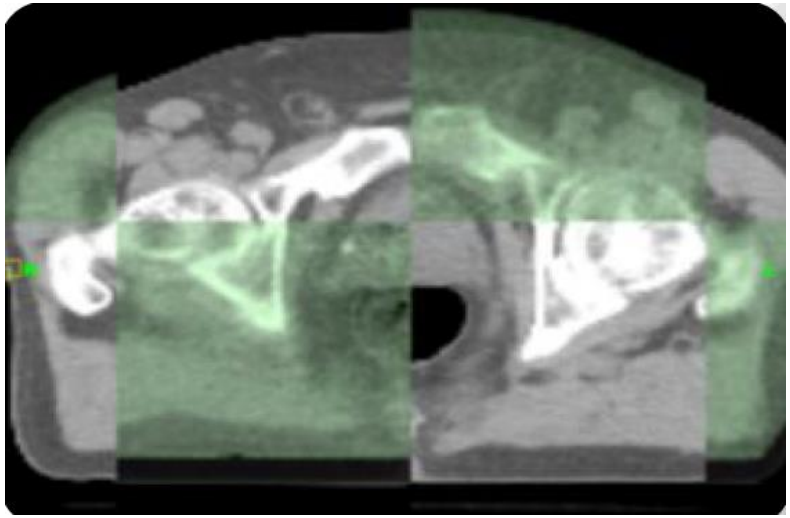
- Fascio da 1 MeV (E_{med})
- Tecnologia slip ring – 10 RPM
- Dosi < 3cGy
- Alta qualità immagini
- Ottime immagini anche con protesi
- 640 detettori allo Xenon allineati alla sorgente



Descrizione generale

MVCT integrata:

- Fascio da 1 MeV (E_{med})
- Tecnologia slip ring – 10 RPM
- Dosi < 3cGy
- Alta qualità immagini
- Ottime immagini anche con protesi
- 640 detettori allo Xenon allineati alla sorgente
- Review off line

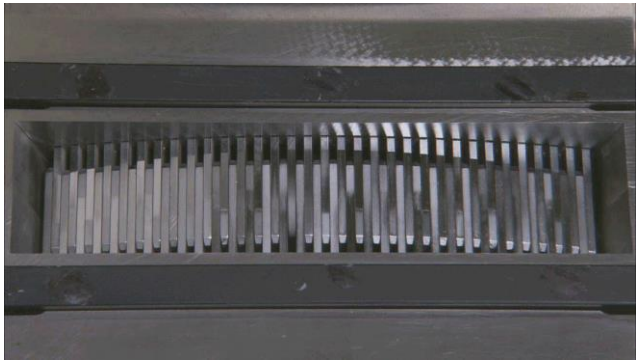


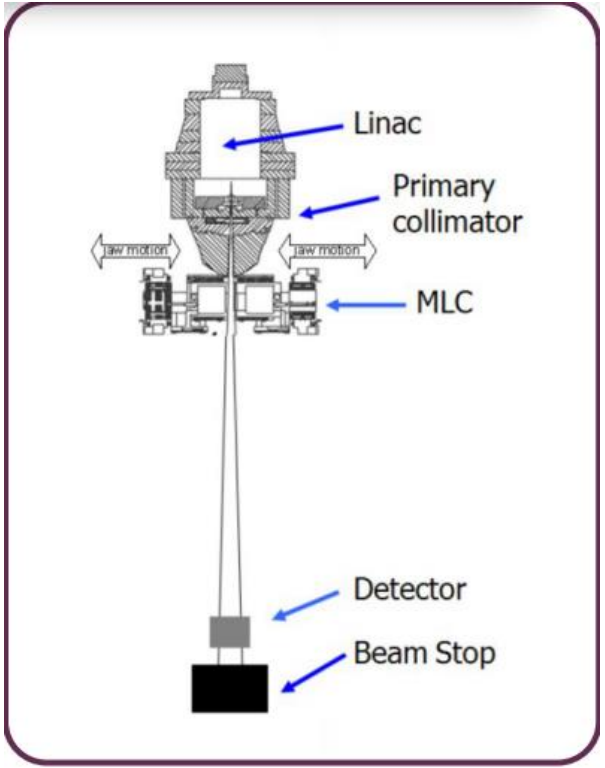
DELIVERY ANALYSIS™

Descrizione generale

MLC binario:

- 64 lamelle da 6,25 mm
- binario
- 200 cm/s
- 12 cm di tungsteno con T&G
- Movimentazione aria compressa





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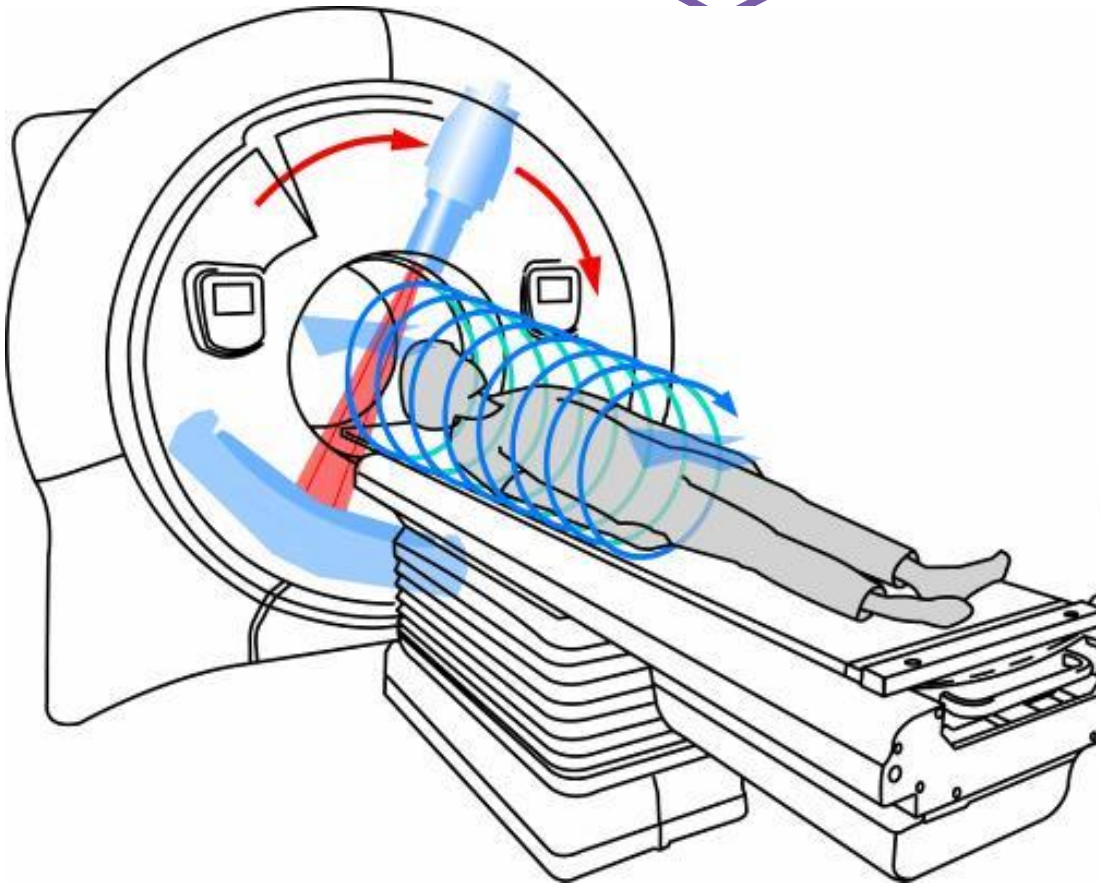
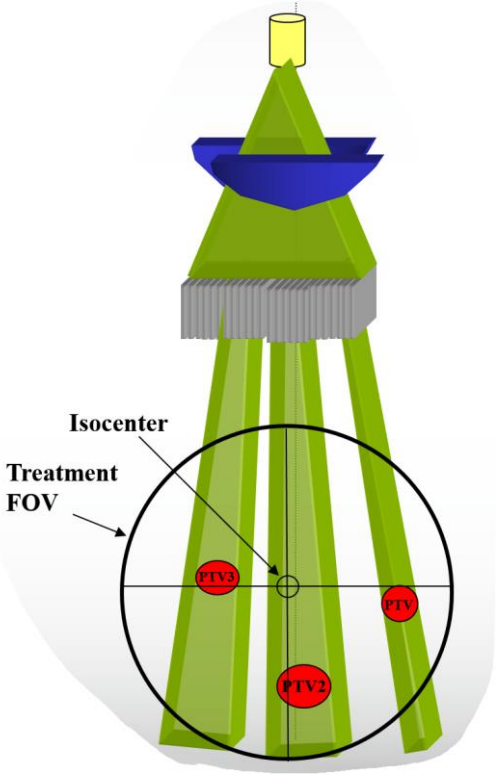
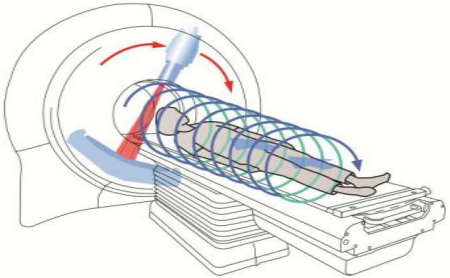
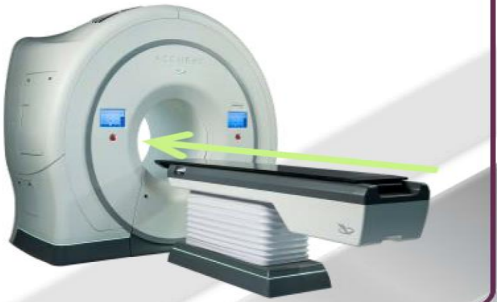




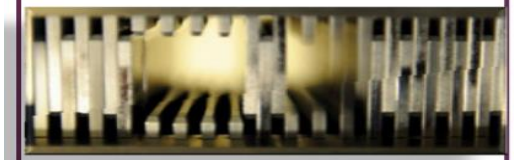
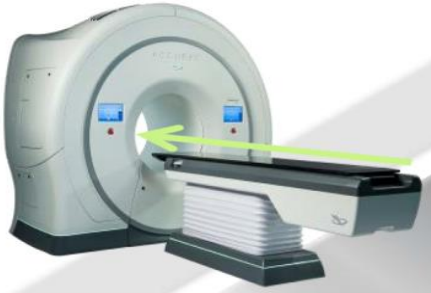
Descrizione generale

Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

Fast binary modulator	Rotating gantry rotation	Continuous couch motion
		
Transit <20 msecs	Thousands of beamlets per 360° rotation	Treatment length ± 135cm with no junctions

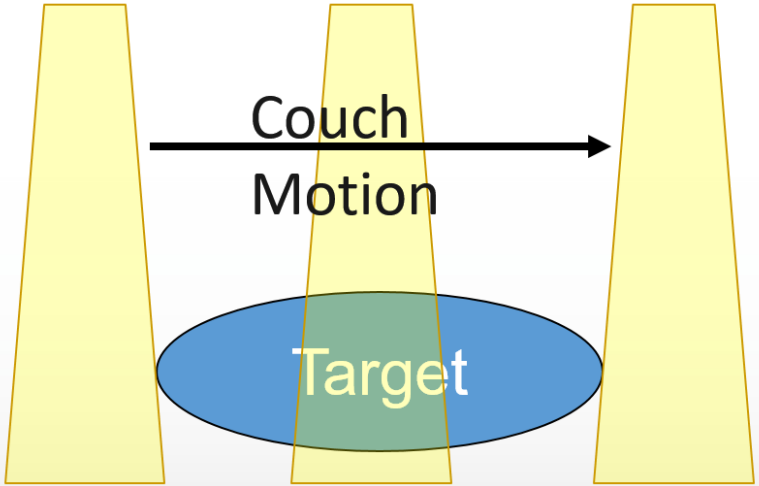
Descrizione generale

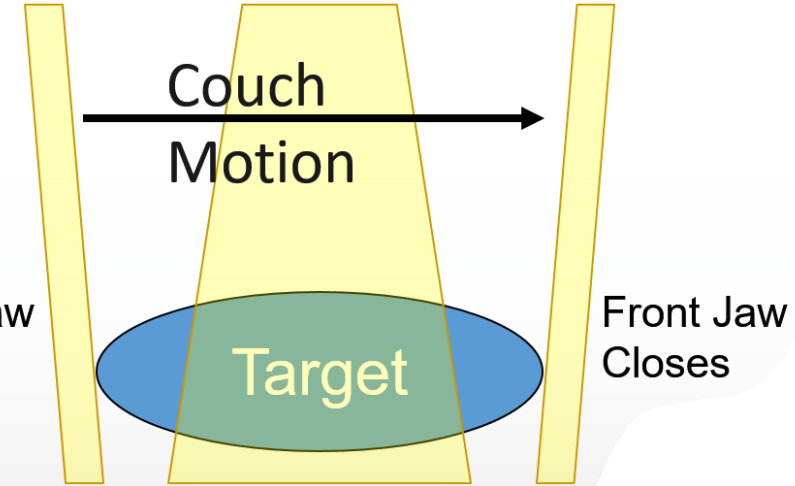
Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

Fast binary modulator	Fixed gantry angles	Continuous couch motion
		
Transit <20 msecs	2 to 12 angles	Treatment length ± 135cm with no junctions

Descrizione generale

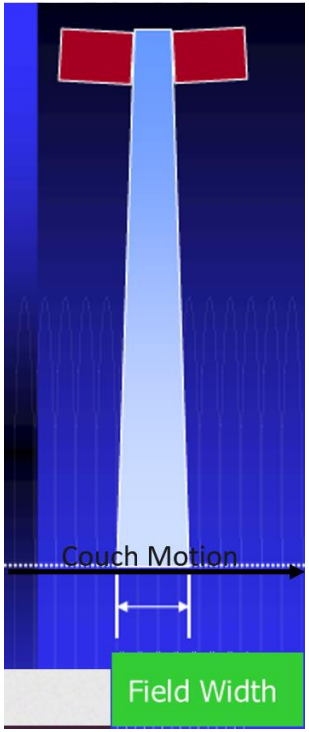
Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

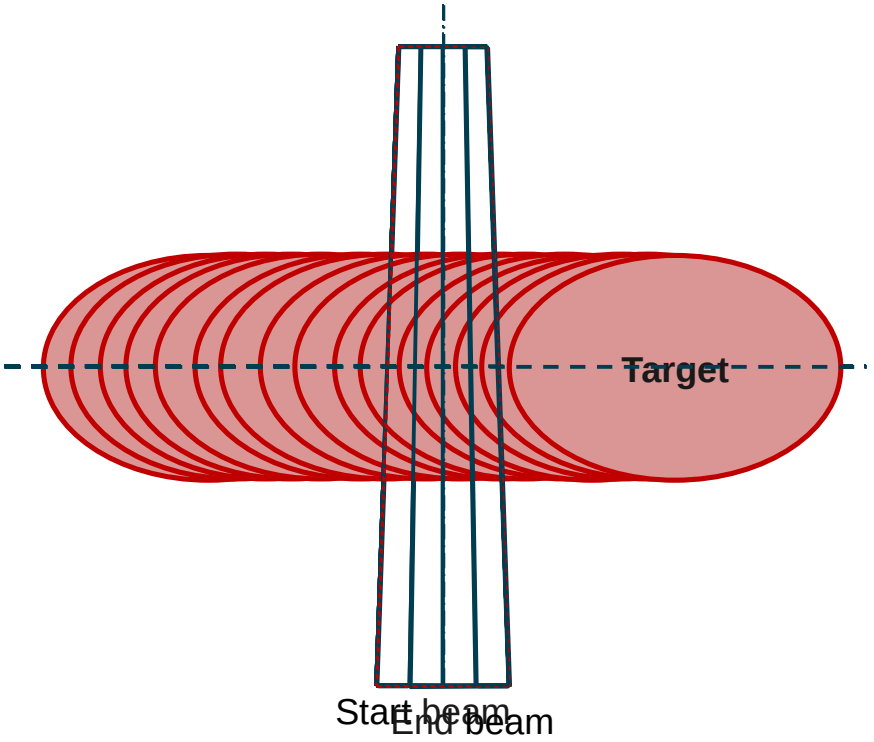




Descrizione generale

Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

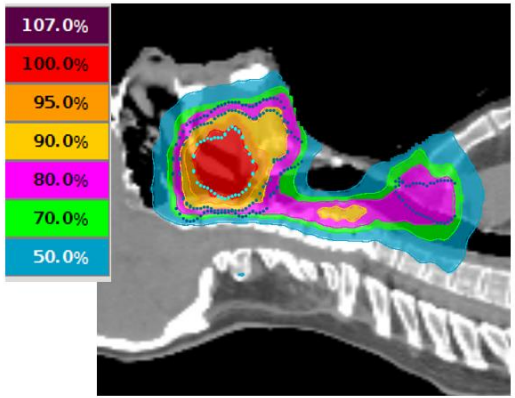




Descrizione generale

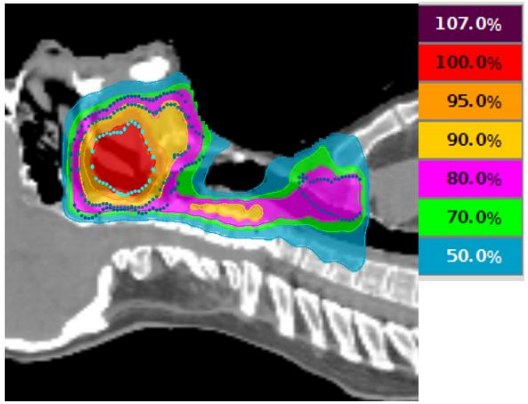
Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

TomoEDGE per Testa-collo



Modalità Fixed Jaw

- Piano con elevata conformalità
- **Tempo di beam on 6.5 minuti**



Modalità Dynamic Jaw

Mantiene la conformabilità

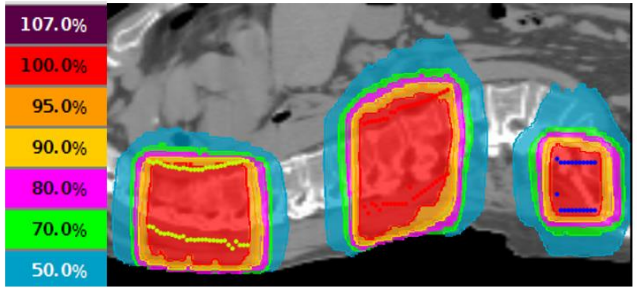
Tempo di beam on 3.7 minuti

•Il tempo di trattamento indicato è approssimato in base a test di Accuray. I tempi possono variare a seconda delle diverse situazioni cliniche.

Descrizione generale

Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

TomoEDGE per Metastasi Multiple

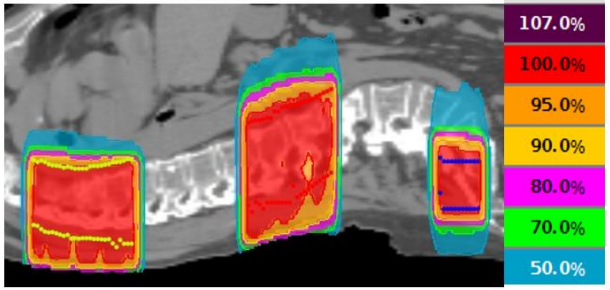


Modalità Fixed Jaw

- Fascio di 5 cm usato per trattamenti veloci

Modalità Dynamic Jaw

- Stesso tempo di trattamento
- I collimatori si aprono e si chiudono per tutti i bersagli



Risultato: Trattamento più veloce e minor tossicità

Descrizione generale

Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

Precision™ + TomoEDGE™ Dynamic Jaws

+ Qualità
Stesso tempo

+ Velocità
Stessa qualità

Descrizione generale

Modalità di erogazione: Tomo Helical; Tomo Direct; TomoEDGE

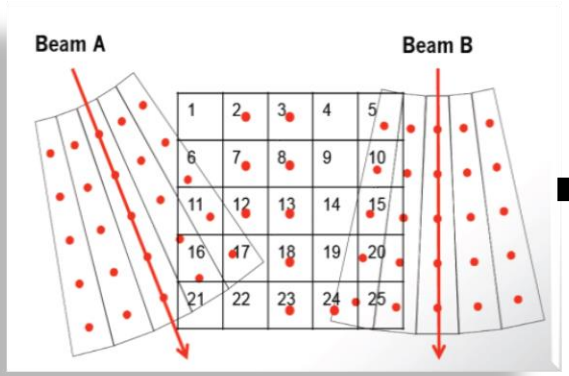
Tomo Helical + Tomo Direct + TomoEDGE

ALL IN ONE
SECOND TO NONE

Descrizione generale

Nuovo TPS – Precision™

- Nuovo SW
- Algoritmo CCCS per ottimizzare le eterogeneità
- Nuovo HW
- Tecnologia GPU



Precision™ : NVBB + GPU= Accuratezza + Velocita’

Descrizione generale

- Calcolo della dose su **più macchine** su un'unica workstation
- **Confronto e somma piani**
- **Strumenti completi di contornamento**
- **AutoSegmentation** ™ (testa e collo, brain e prostata)

- **Remote review** ed approvazione piani
- Personalizzazione della visualizzazione (dosi)
- **Supportate immagini multimodali** con deformazione elastica
- **Forward Planning** 3D CRT
- **PreciseART** ™ – Adaptive Radiation Therapy
- **PreciseRTX** ™ – Ritrattamenti

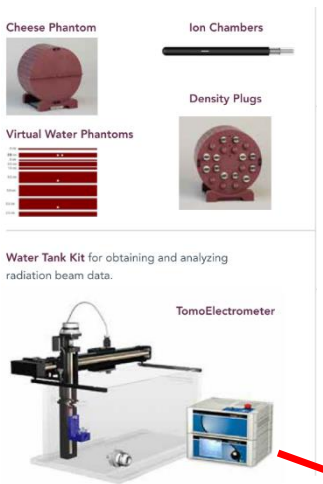
Descrizione generale

Descrizione generale

Rete integrata

Sistema omnicomprensivo:

- Pianificazione
- QA
- Erogazione
- R&V



QA

Console di pianificazione

Gantry

Erogazione dose
Consolle operativa

iDMS

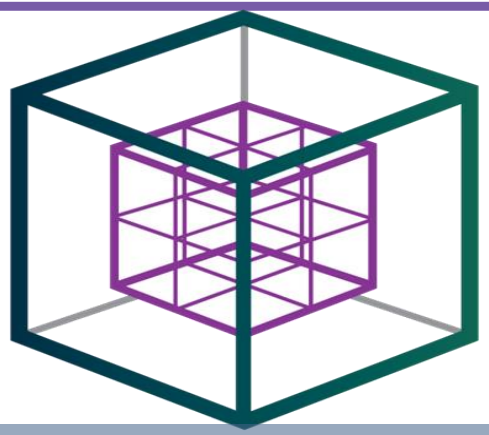
Descrizione generale

Data server

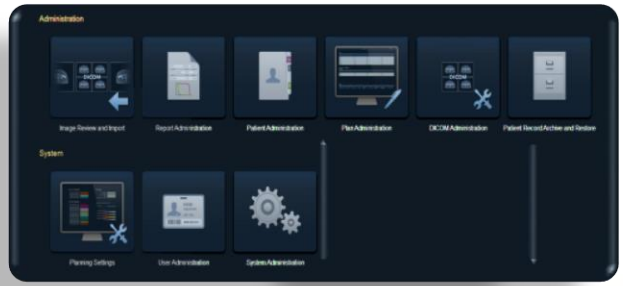
- Connettività tra varie macchine Accuray
- Connettività con macchine terze

Applicazioni disponibili

- Amministrazione utenti
- Image review e import
- Registrazione e archivio pazienti
- Gestione Report
- Gestione Patienti
- Gestione DICOM
- Gestione del Sistema completo
- Gestione Piani
- OIS Connector



iDMS



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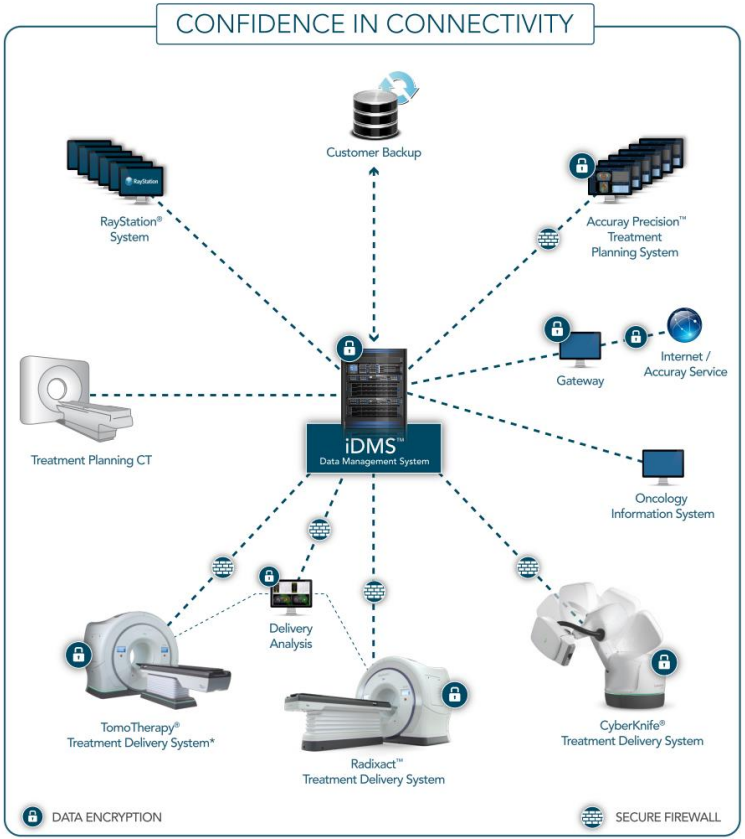

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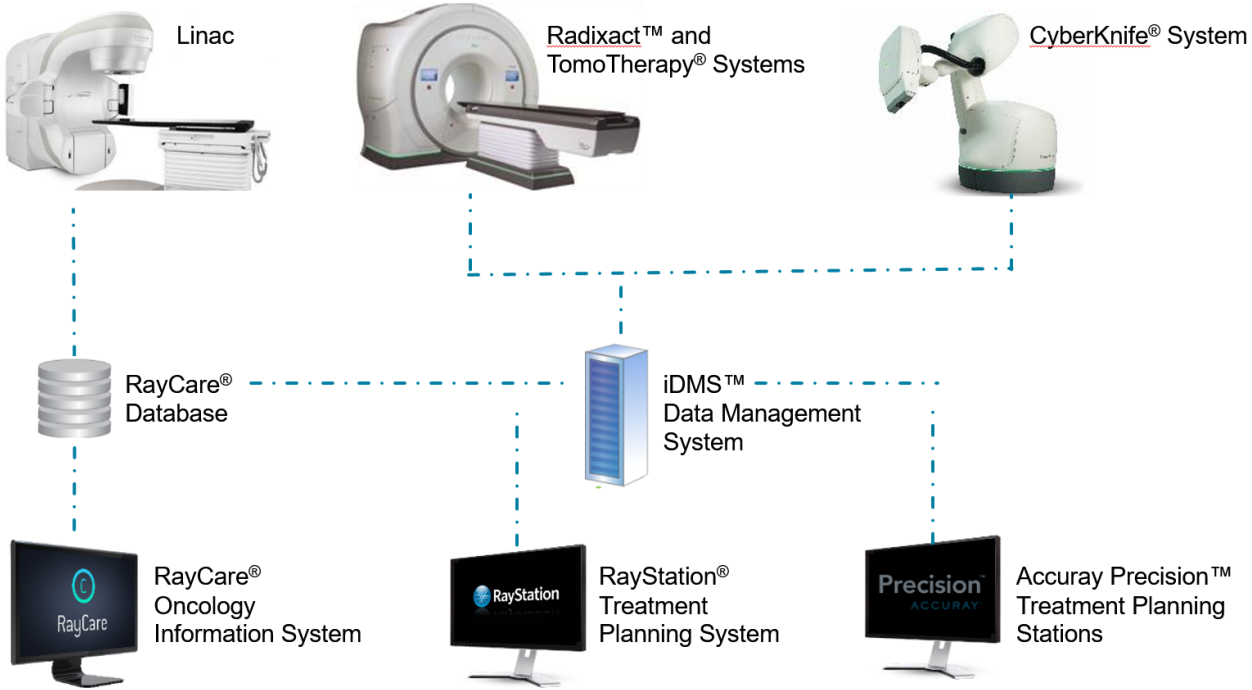


ACCURAY®

RaySearch Laboratories

Descrizione generale

OIS

iDMS™
ACCURAY®

Precision™
ACCURAY®

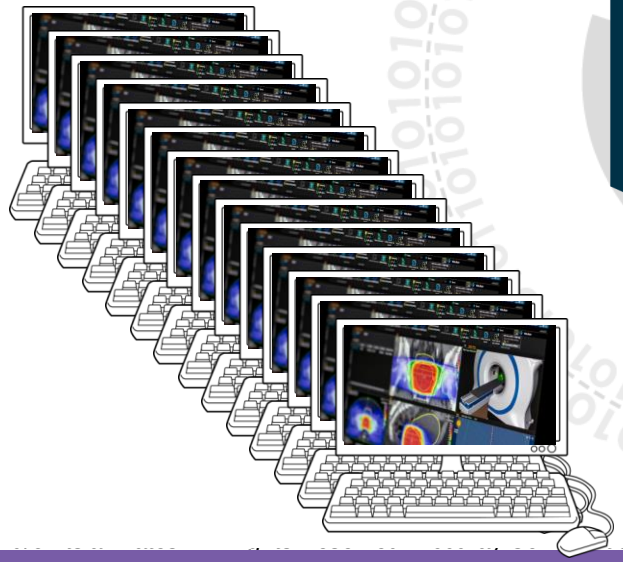
Descrizione generale

OIS

ACCURAY

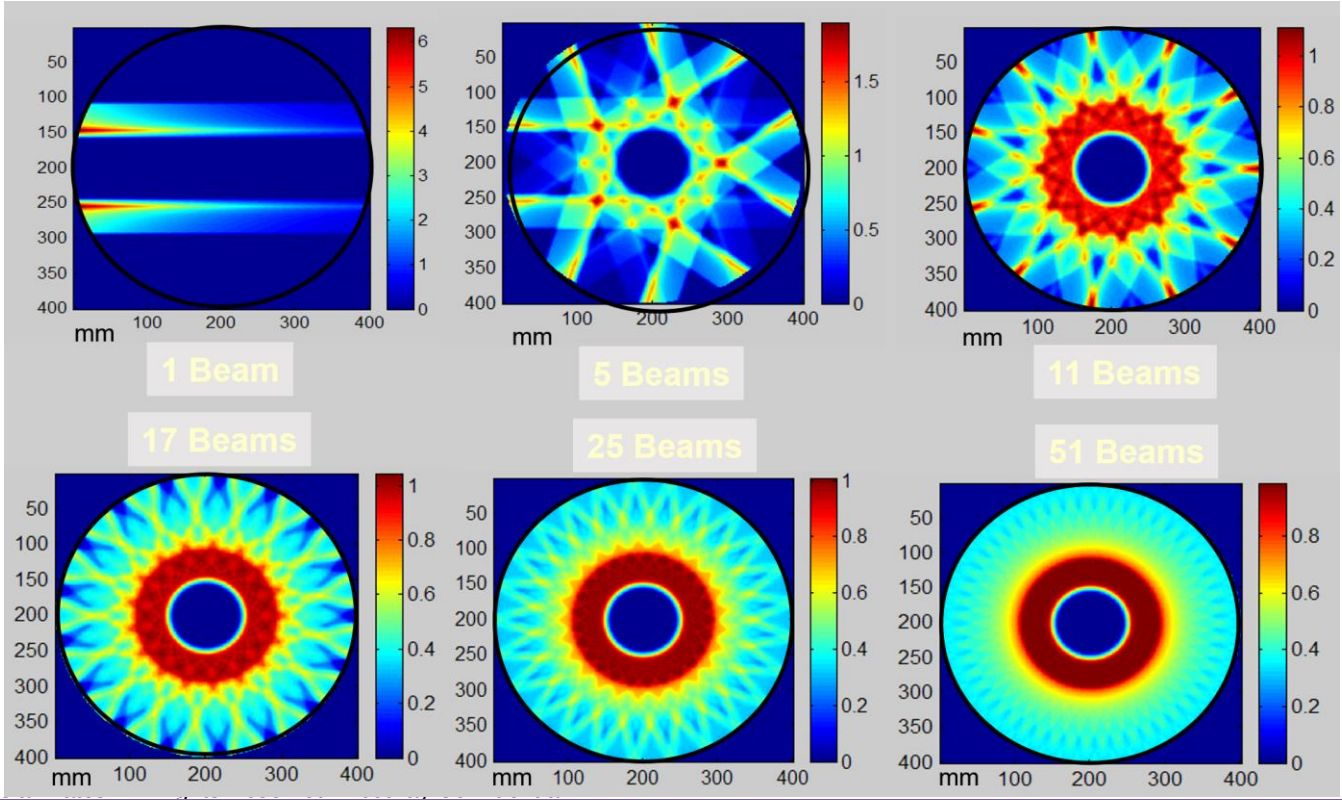
RaySearch Laboratories

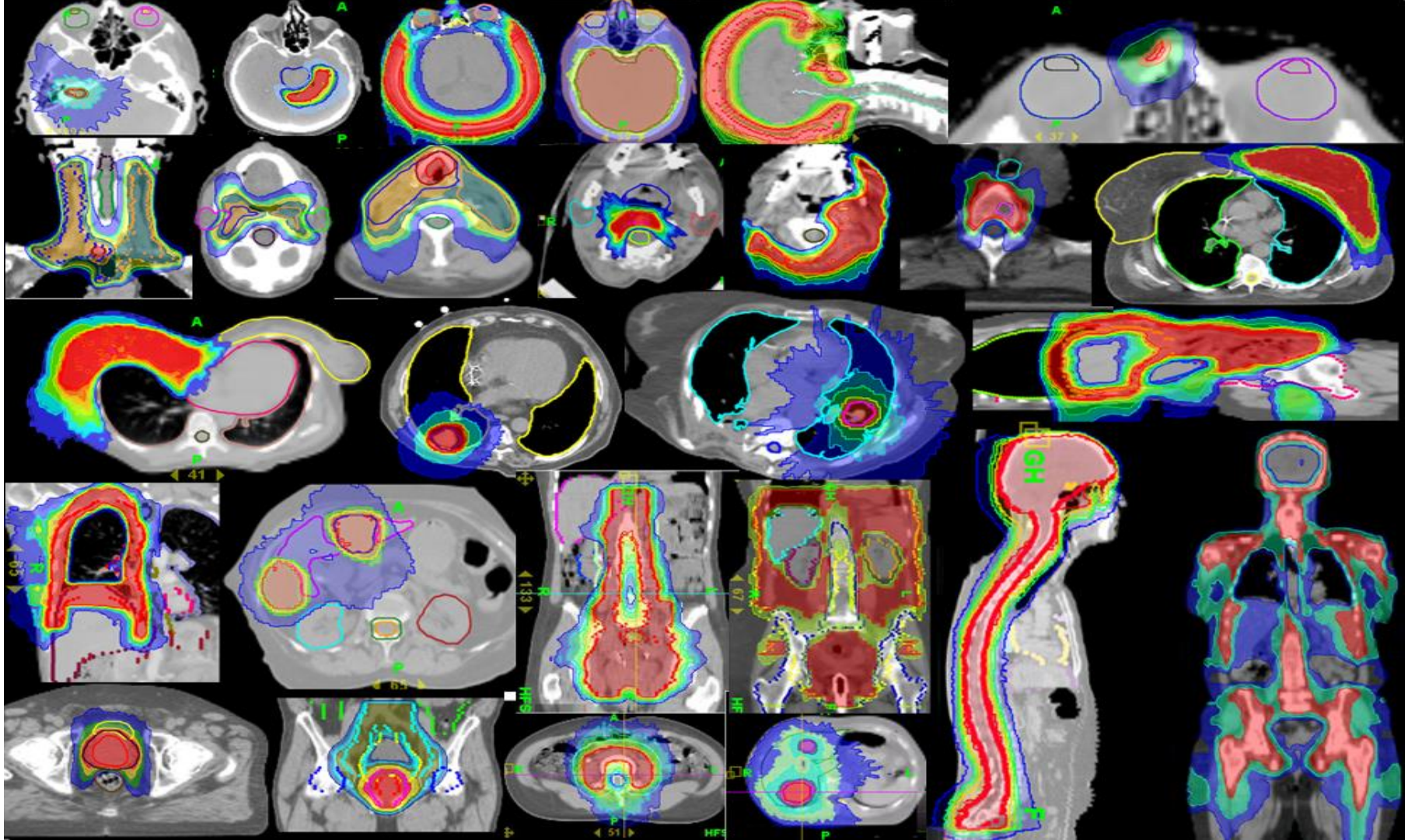
iDMS™ ACCURAY



Vantaggi clinici

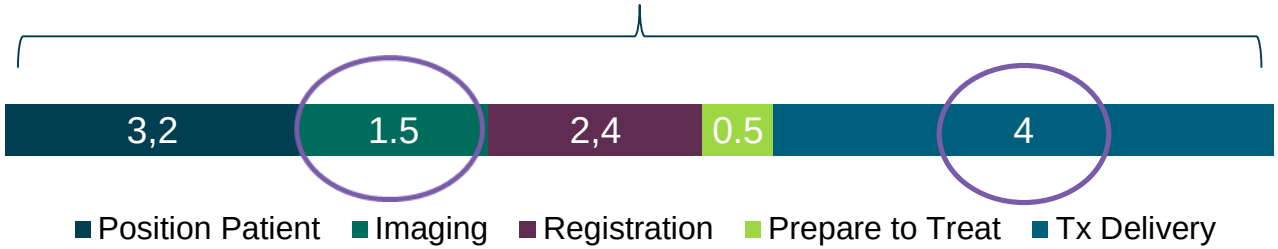
Eccellente omogeneità al target - Minor tossicità: risparmio OAR





Preliminary Radixact™ IG-IMRT Workflow Data

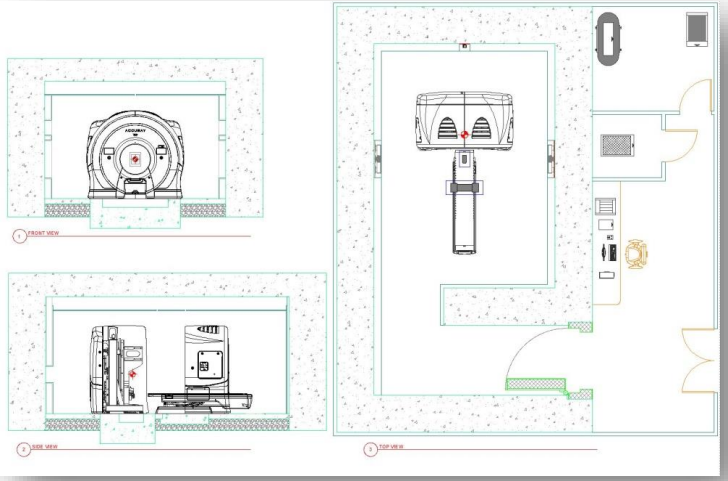
***11.6 Minutes**
Positioning, imaging, registration and treatment



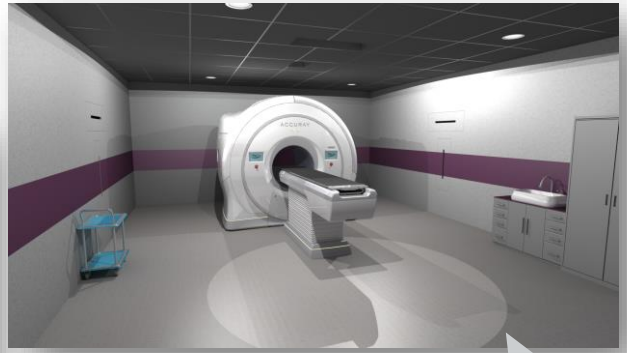
- Imaging time decreased 29% compared to the global average*
- Beam on time decrease 27% compared to global average due to TomoEDGE™ and 1000MU linac
- Indication mix of complex/long treatment fields

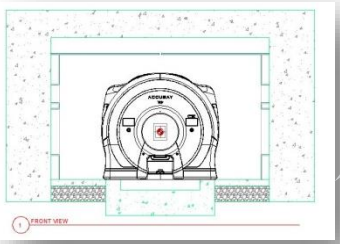
*Data source 2 Radixact Sites in EIMEA 2.1 -2.5.2017
*Data Source: TomoTherapy® system log data; based on all systems with data, 99% of all TomoTherapy systems worldwide, excluding Radixact™

Foot print

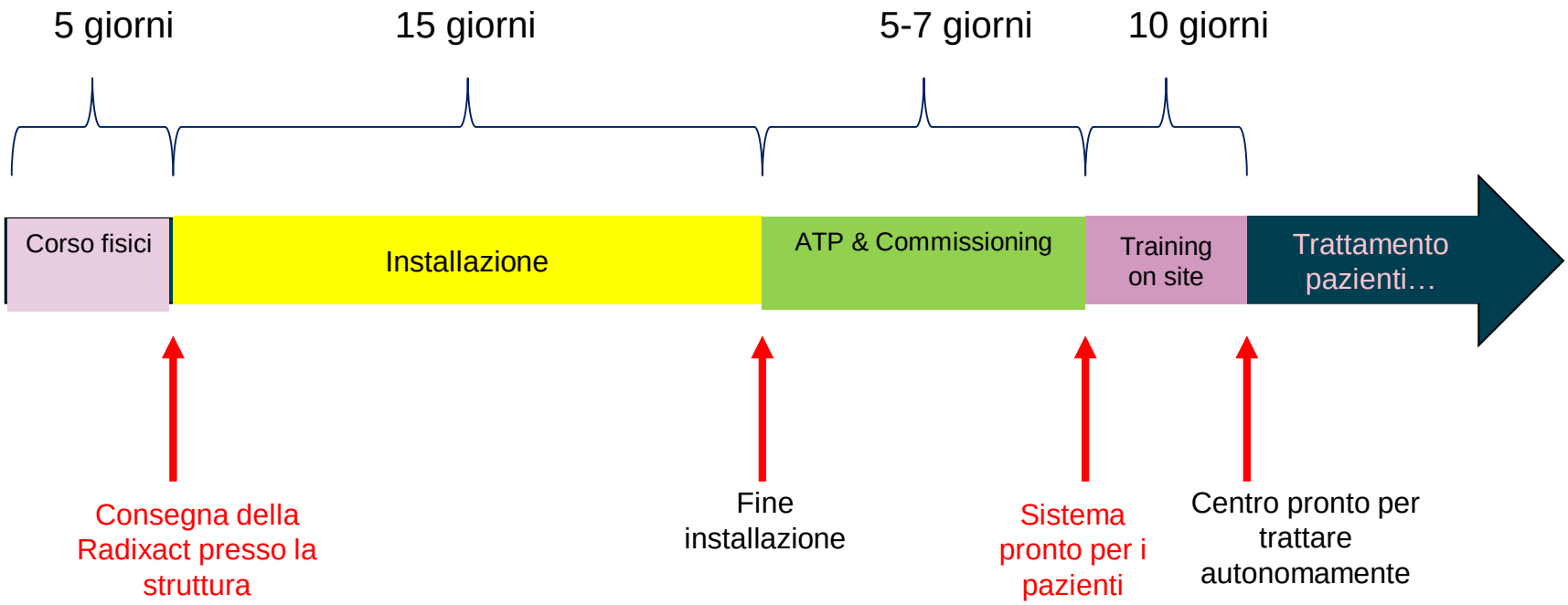


Minime dimensioni: 6,02m x 4,62m





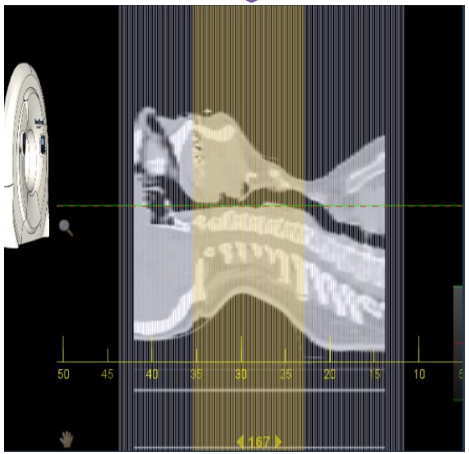
Tipici tempi di installazione e primo paziente



Evoluzione affermata

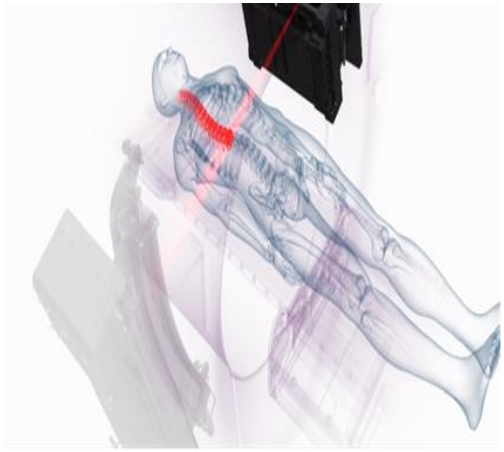
Ring gantry

Nessuna parte in movimento



Imaging

Integrato:
image acquisition
image registration



Treatment delivery

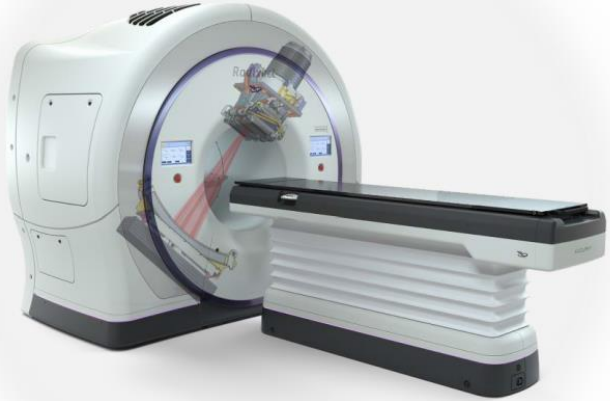
TomoEDGE™,
TomoHelical™
TomoDirect™

Evoluzione affermata

Efficient Treatment
1,000 MU Linac

Highly Reliable
Accelerated Life Tested;
Electronics Shielding

Fast Imaging
10 RPM Image
Acquisition



Dependable Uptime
Remote Diagnostics

Reduced Warm-up
Smart Temperature
Control System

Improved Couch
Integrated Catcher
Design

Quick Installation
RF Chain Pre-calibrated
and Ships Pre-assembled

Refined Beamline
New Sidearm
Magnetron Design

Scalable
1 Database, Multiple
Radixact Systems

ACCURAY®

Radixact at UZB
Affermata, Differente, Migliore

Radixact

Radixact™

L’evoluzione che ci porta:

Qualità

Velocità

Affidabilità

SENZA COMPROMESSI

IBA Proteus

Excellence in Proton Therapy

Why protons ?

Precise dose delivery, fewer side effects

Why protons?

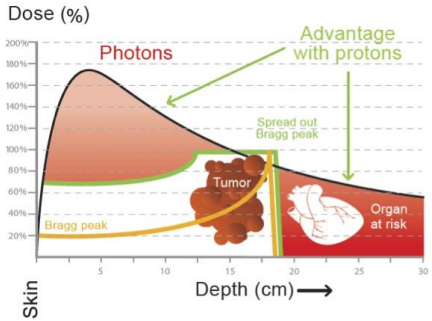
- Deliver maximum energy within a precisely controlled range
- Deposit a high and conformal dose
- Deposit very low entry dose and no exit dose – sparing healthy tissue

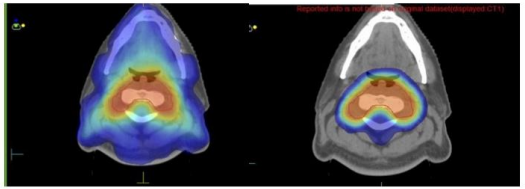
The benefits

- Reduce risk of secondary cancers
- Reduce unnecessary dose to the critical structures like heart while treating a lung cancer reduced by 5X
- Risk of growth abnormality for children: dramatically reduced

Expanding list of key Indications

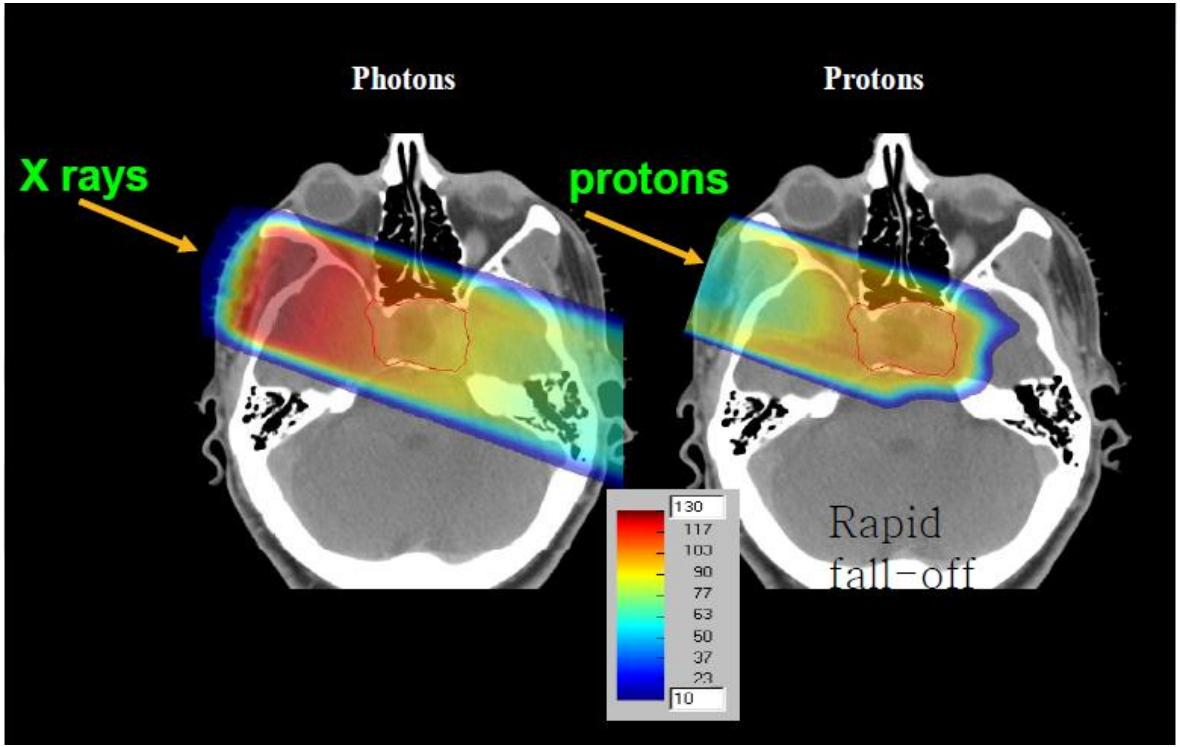
- Head & neck, Spinal cord, Eyes, Orbits, Pelvis, Prostate, **Lung**, Pediatric cancers, **breast**…





Protect, Enhance and Save Lives

Macroscopic advantage for protons



Making a useful beam in a clinical system: specs

Ability to treat most cancer at any depth

Beam range in patient : 0 - 32 cm.

Beam energy range (deep tumors) : 0 - 250 MeV (38 cm. in water)

Beam energy range (eye) : 0 - 70 MeV (3,5 cm. in water)

Range modulation in the patient between 0 – 32 cm.

Continuously adjustable in steps of 0,2 mm. in water for depth less than 5 cm. and in steps of at most 1 mm. for depth larger than 5 cm.

Energy modulation : Continuously adjustable according to range modulation in steps di 0,1 MeV

Making a useful beam in a clinical system: specs

Field Size

Variable from 2 x 2 cm. to 20 x 25 cm.

Steps for adjustement of variable field: 1 mm.

Accuracy of the field : 0,5 mm.

Throw from the source: 3 m.

Field omogeneity, longitudinal : 111%

Field omogeneity, orthogonal: 105%

Field simmetry: 105%

Lateral penumbra (80% - 20%) on entrance in patient body in active delivery systems: < 2 mm.

Making a useful beam in a clinical system: specs

Dose- rate

Maximum dose rate at the target : 2 Gy per litre per minute

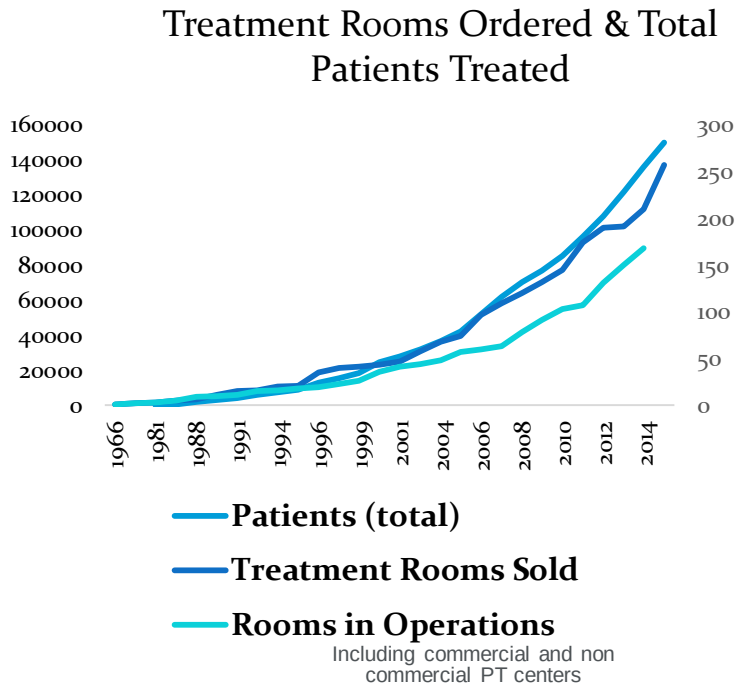
Maximum dose rate to the target for a field 15 x 15 cmq at maximum energy (Head & neck): 10 – 20 Gy/min

Beam current on target: 2 nA for protons ≅ 3,2 x 10^{10} protons/sec

Active Scanning capable: painting 30 layers < 1 min

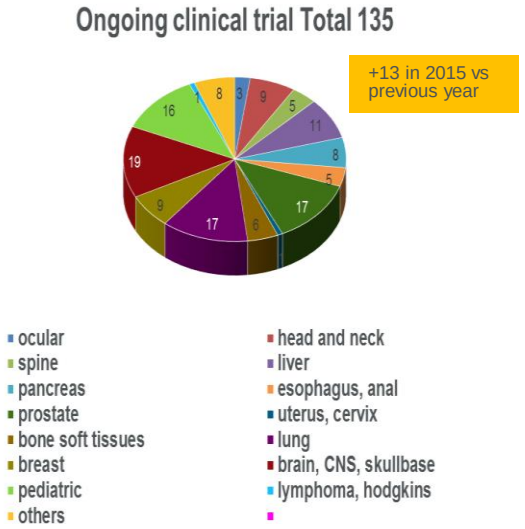
Growth of operational proton therapy rooms

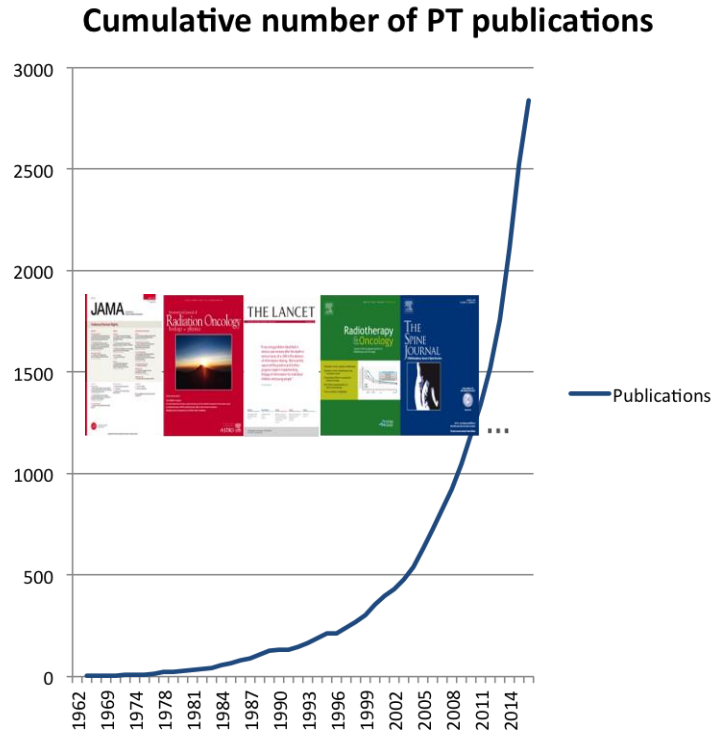
Observed number of PT rooms in operation, patients treated with PT and medical publications



Total number of rooms worldwide, patient evolution index based on number of rooms

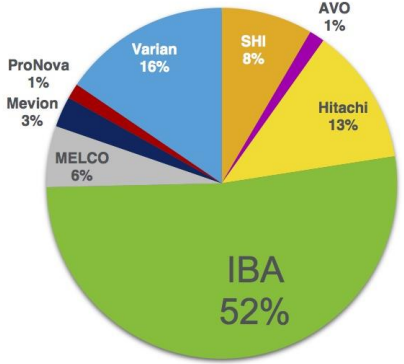
Increasing relevance of proton therapy



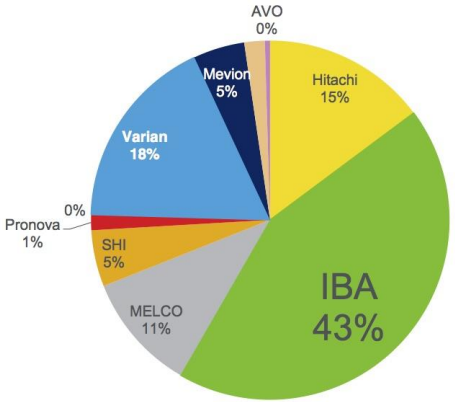


IBA – Leading the Installed Base

Proton Centers Sold Share



Total Room Sold Market Share

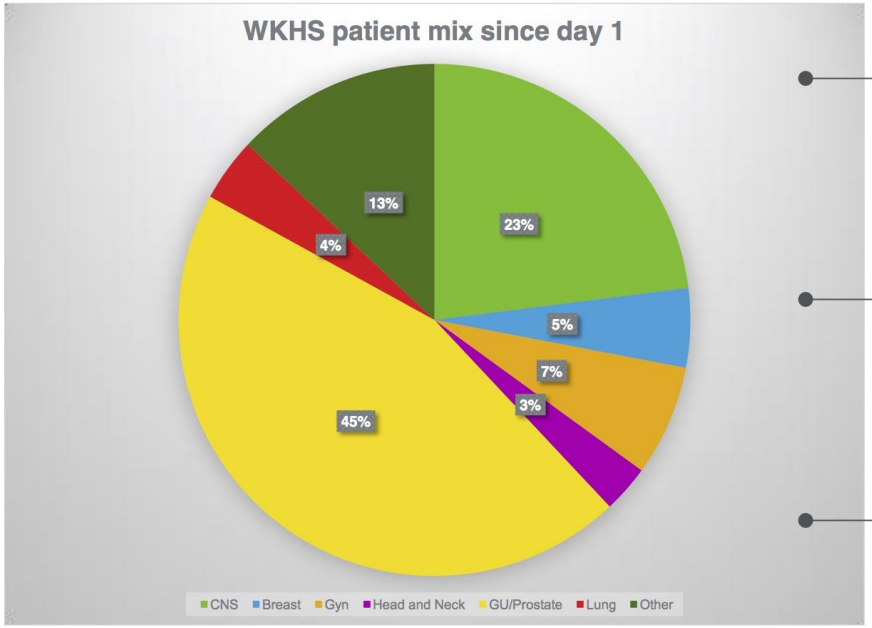


ave Lives

Willis Knighton Medical Center

Shreveport, USA (proteus one)

Throughput : 24 Patients a Day with a Diverse Patient Mix

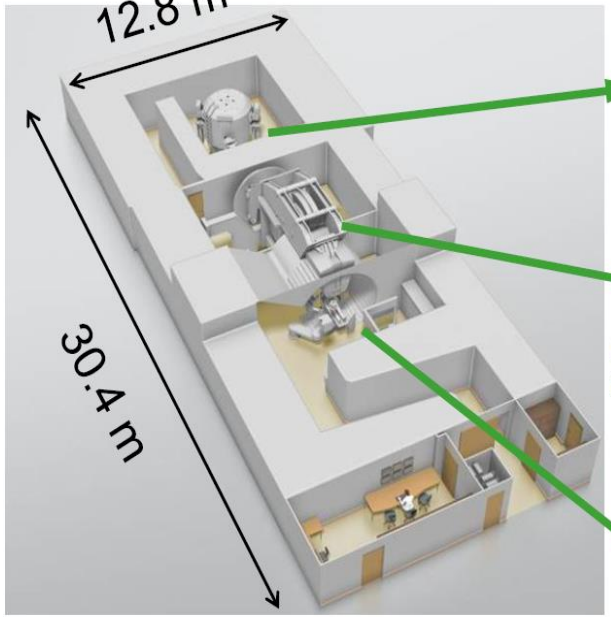


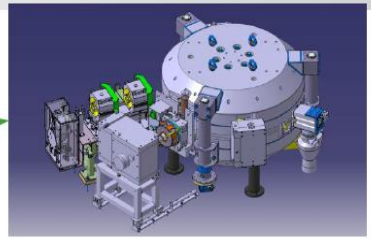
- 2 field pelvis in less than 15 min
- Diverse Patient Mix
- 20 - 24 patients a day in a 10 hour shift

The solution

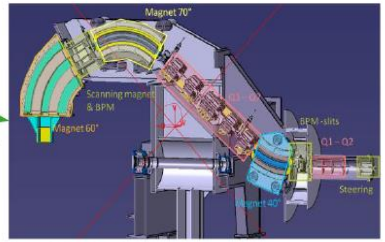
The New IBA Single Room Proton Therapy Solution: ProteusONE®

High quality PBS cancer treatment: compact and affordable





Synchrocyclotron with superconducting coil: S2C2



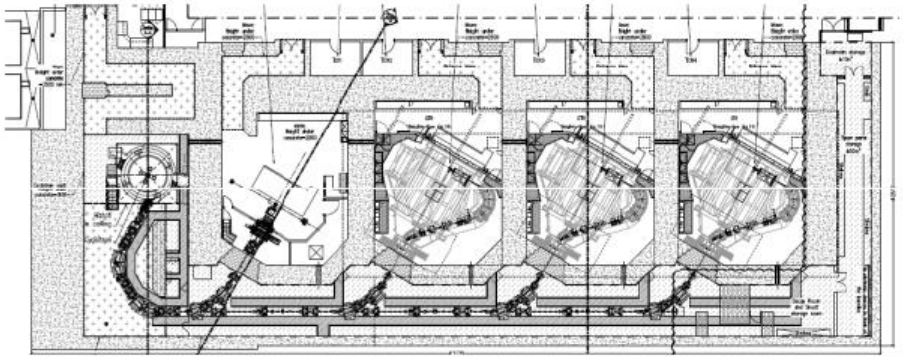
New Compact Gantry for pencil beam scanning

Patient treatment room

The major advantage: the size

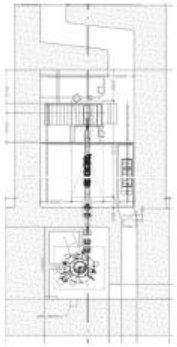
ProteusONE occupies the space of one tennis court
or two traditional linacs

ProteusPLUS



18000 ft² / 1672 m²

ProteusONE

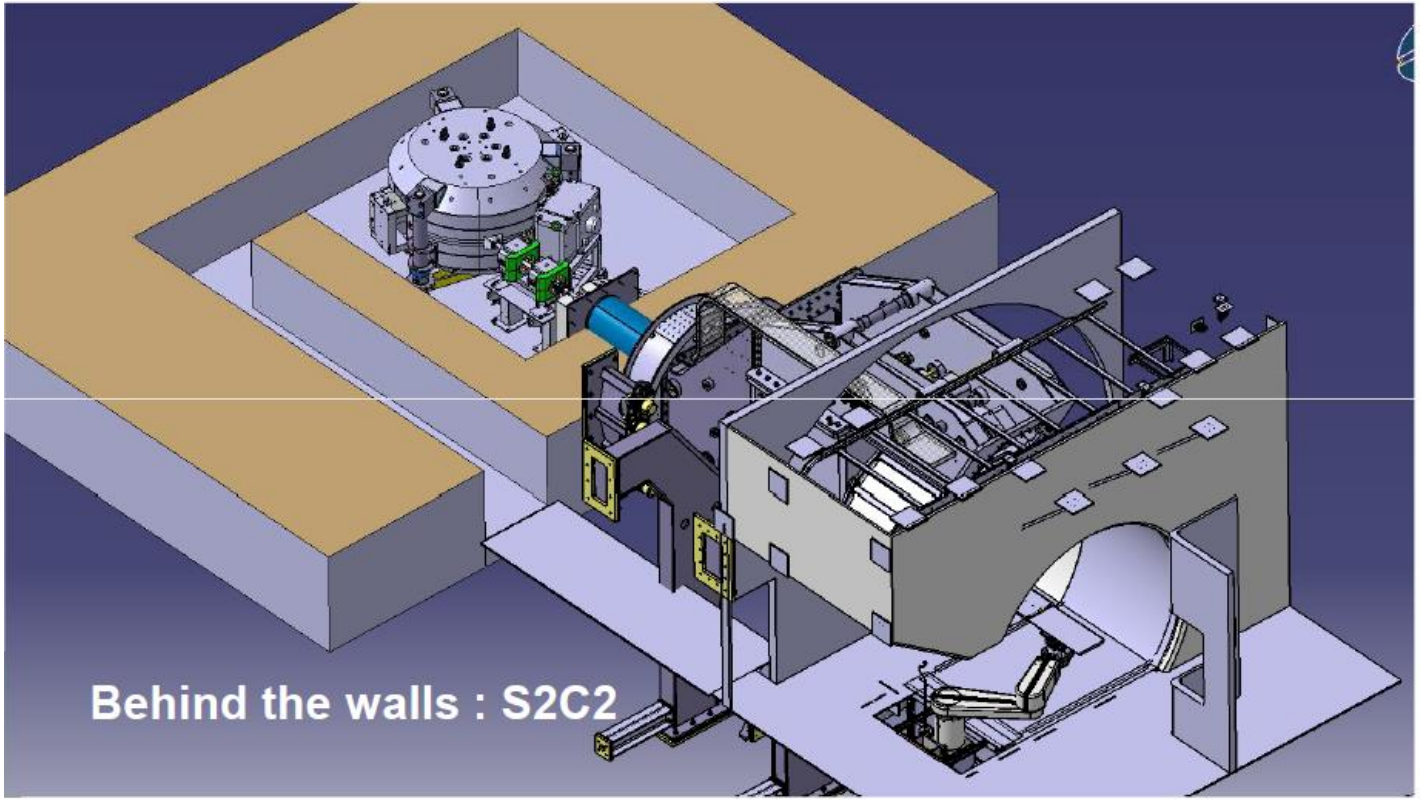


3600 ft² / 334 m²

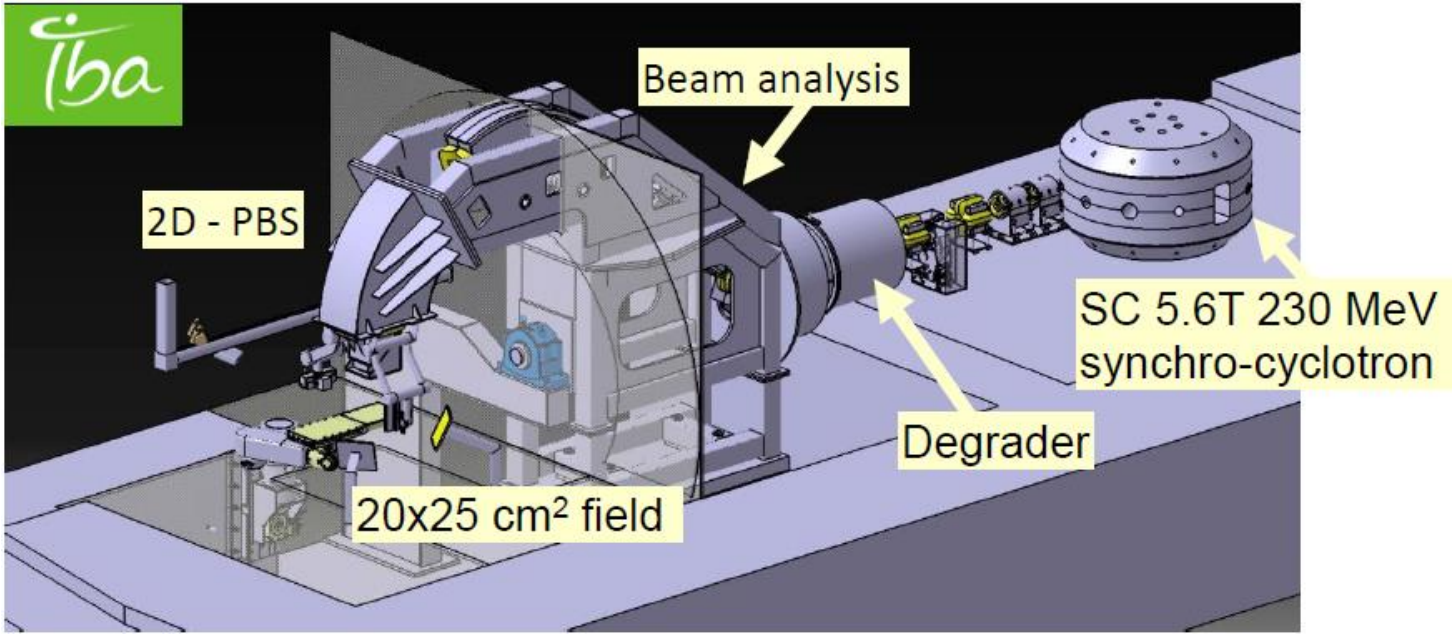
The major advantage: the size

1. Cyclotron reduction
2. Gantry reduction

Cyclotron reduction: A look behind the walls

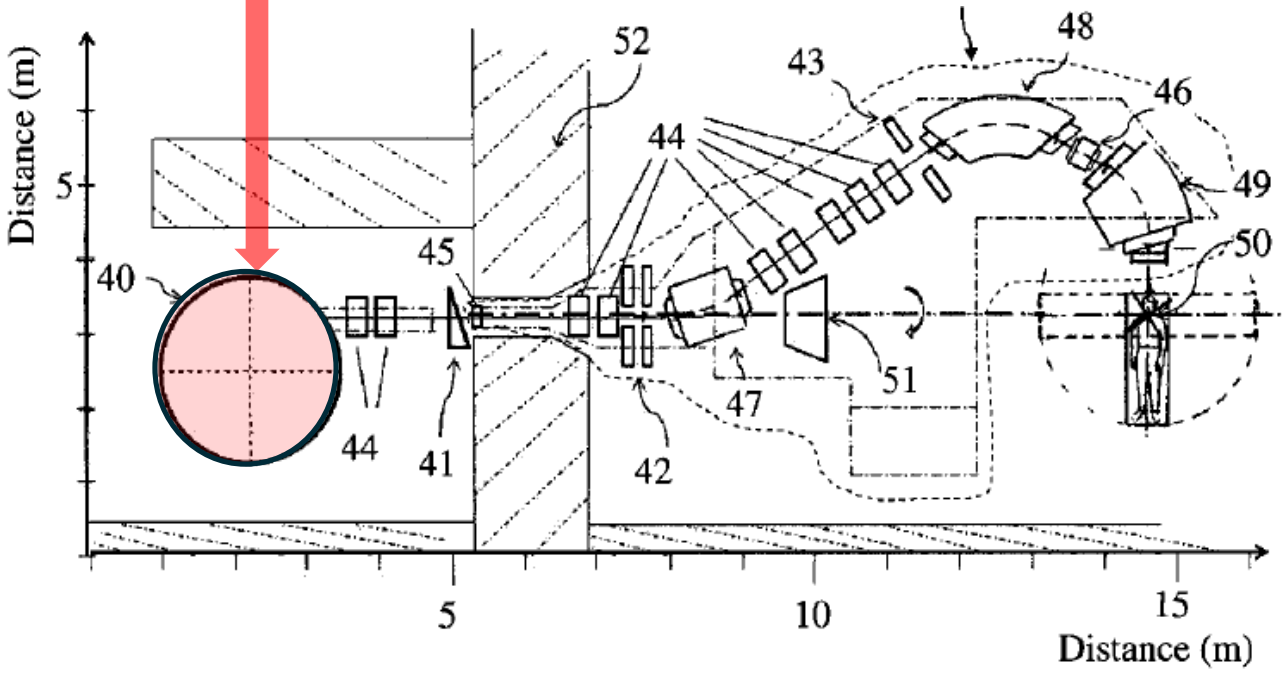


Cyclotron reduction: main components of ProteusONE

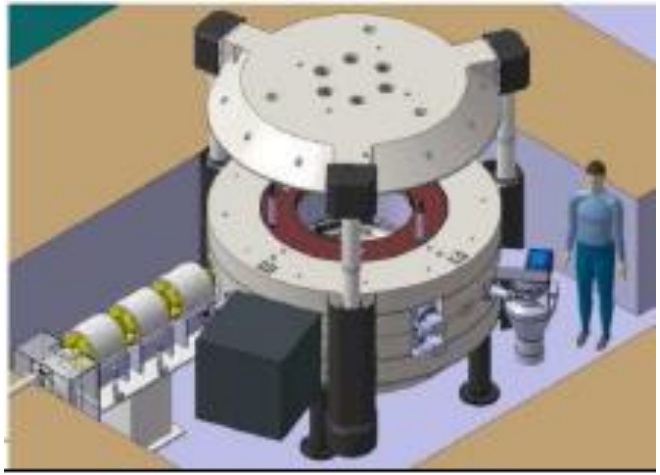


Cyclotron reduction: The path of the proton - accelerator

Accelerator Compact, reliable



Cyclotron reduction:
The SuperConducting SynchroCyclotron (S2C2)



The prototype S2C2 in factory tests

Choice of the type of SuperConducting accelerator

The choice has been oriented toward a Synchro Cyclotron because the average field in an Isochronous Cyclotron is limited to about **2,5 Tesla** due to:

- Iron of the poles is saturated and limit the field gradient between hills/valley
- Flutter quickly becomes too small to provide sufficient focusing and constant orbit frequency.
- Vertical and radial focusing is only possible decreasing B(R)

IBA has given the name of this model of accelerator :

- Synchro Cyclotron
- Super Conducting

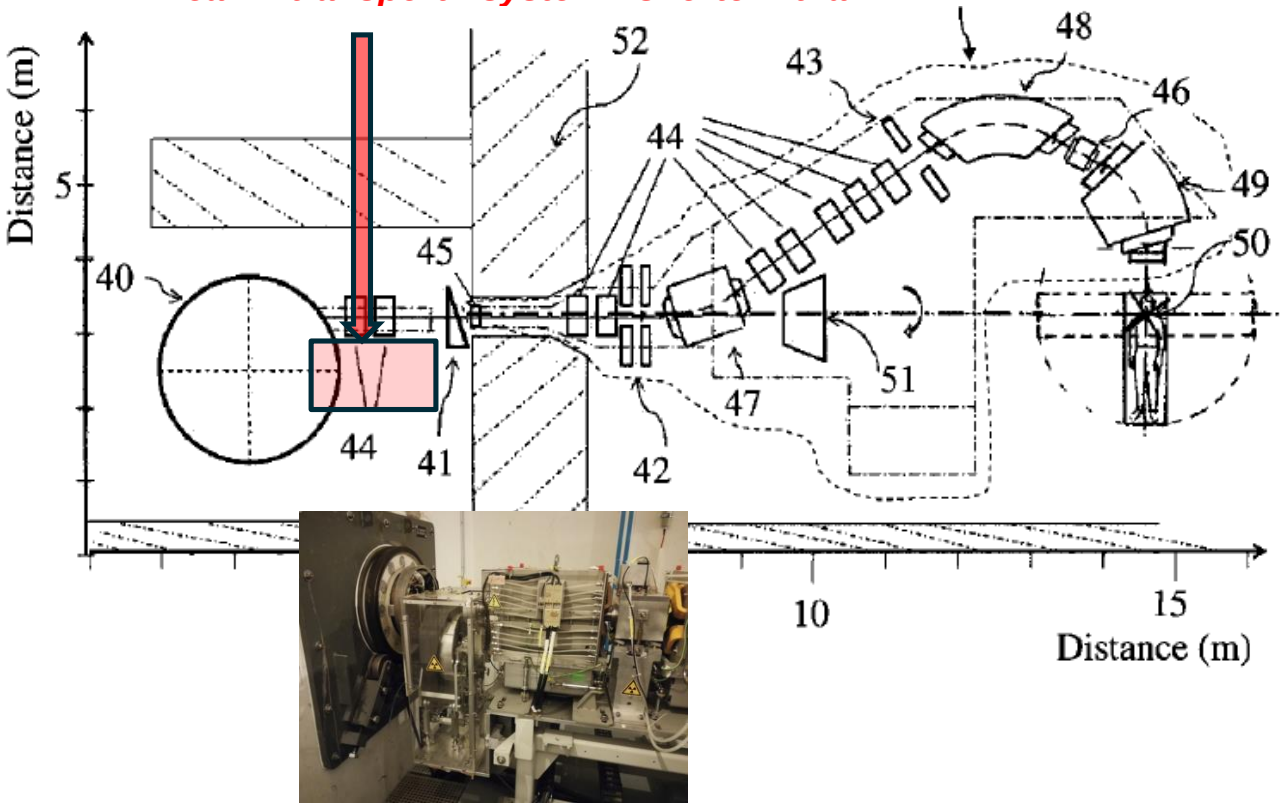
→ **S2C2**

S2C2 -The result of 5 years of work for a new project and experimental tests – technical specs

▪ **Size: diameter= 2,5 m, height= 2 m., weight < 50 t**	➡ ***Compact System***
▪ Magnetic field: central=5,7 T, extraction: 5 T	➡ *High*
▪ 20 nA average beam current at 230 MeV	➡ *Act scan compatible*
▪ 150 nA feasible if required	➡ *Powerful*
▪ 1kHz beam pulse repetition rate	➡ *Act scan compatible*
▪ **Extraction efficiency > 50% at 230 MeV**	➡ ***Powerful***
▪ Still possible to reach 250 MeV	➡ *Powerful*
▪ NbTi cryogen free coil	➡ *Reliable*
▪ Passive magnetostatic extraction	➡ *Reliable*
▪ Standard high quality laminated steel	➡ *Repeatibility*
▪ Low power consumption	➡ *Cost divided by 2*
▪ Operator- free system, remote diagnostic	➡ *Operability*

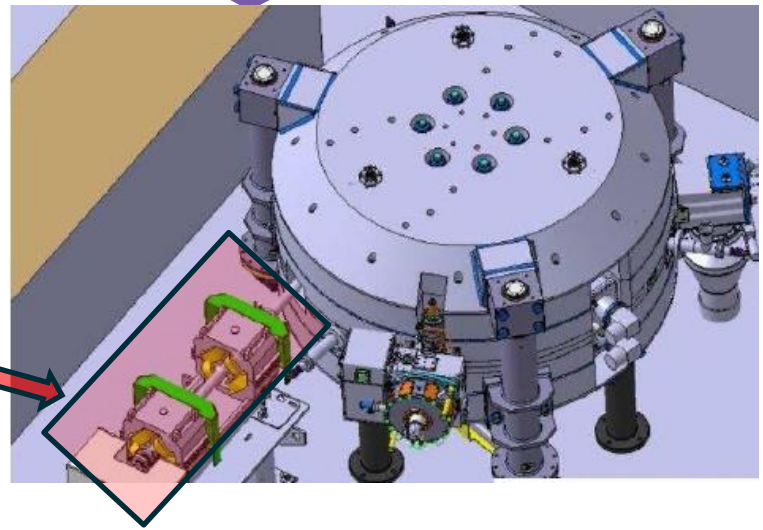
The path of the proton: the first part of the beam transport system

Beam transport system shorter than



The path of proton after the extraction of the accelerator – First part of the beam transport system

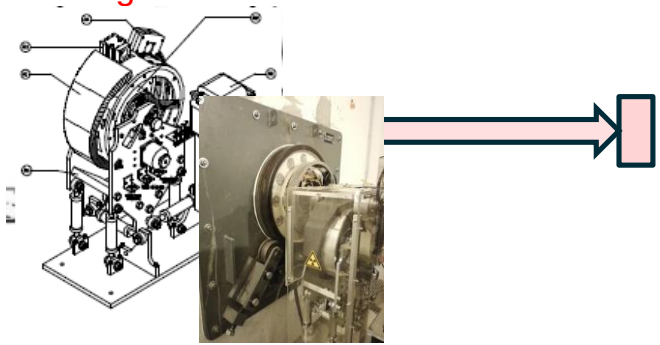
The first part of the beam transport system

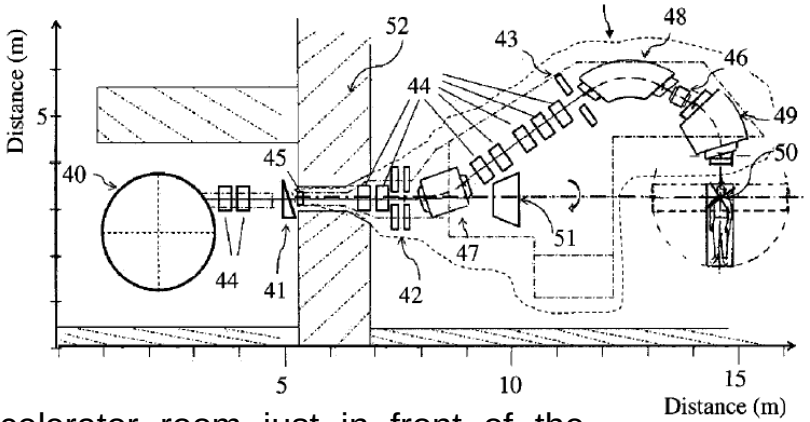


The beam line is constituted by a doublet of permanent magnet quadrupole for transporting and focussing the beam into a small spot (for example between **0,5 mm and 2 mm 1** σ). A variable horizontal collimator between the two quads cuts the horizontal divergence providing constant optics indipendent of gantry angle. The distance between the exit of the accelerator and the degrader is $\cong$ 2 m.

The path of the proton continues – the degrader

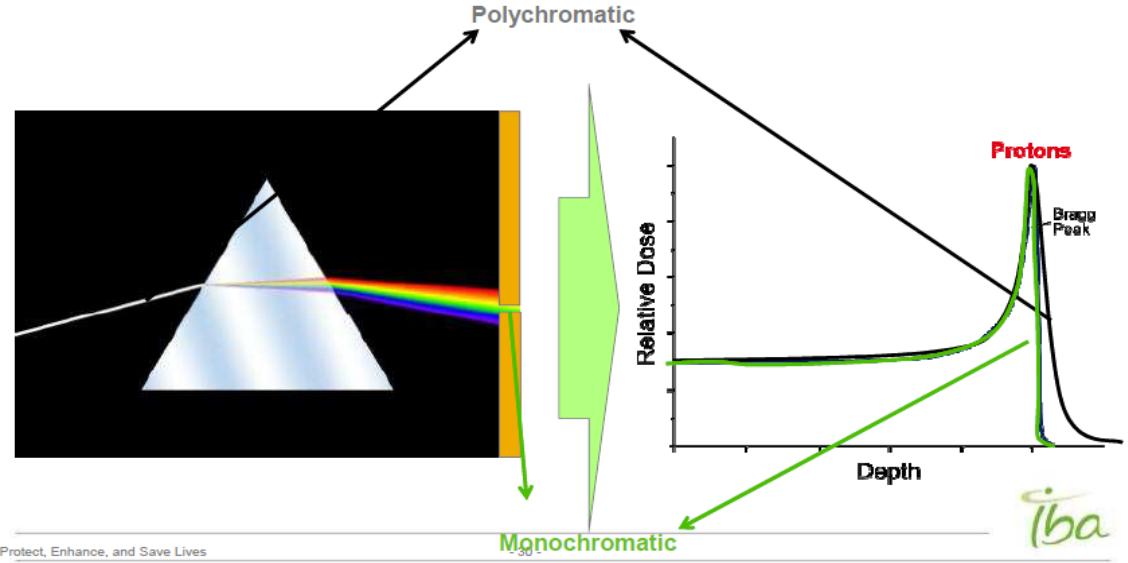
The degrader





- The degrader is positioned within the accelerator room just in front of the shielding wall
- **To reduce the overall size**, there is no energy analyser devices installed between the degrader and the gantry entrance point, devices that requires a relative large area between the stationary accelerator and the rotating gantry
- At the gantry entrance, gives a beam with identical emittance parameter in order to have a gantry beam optics solution that is independent from the gantry rotation angle
- It produces secondary adverse radiation, such as neutrons, scattered protons, gamma radiation , that has to be shielded
- It reduces the intensity of the beam

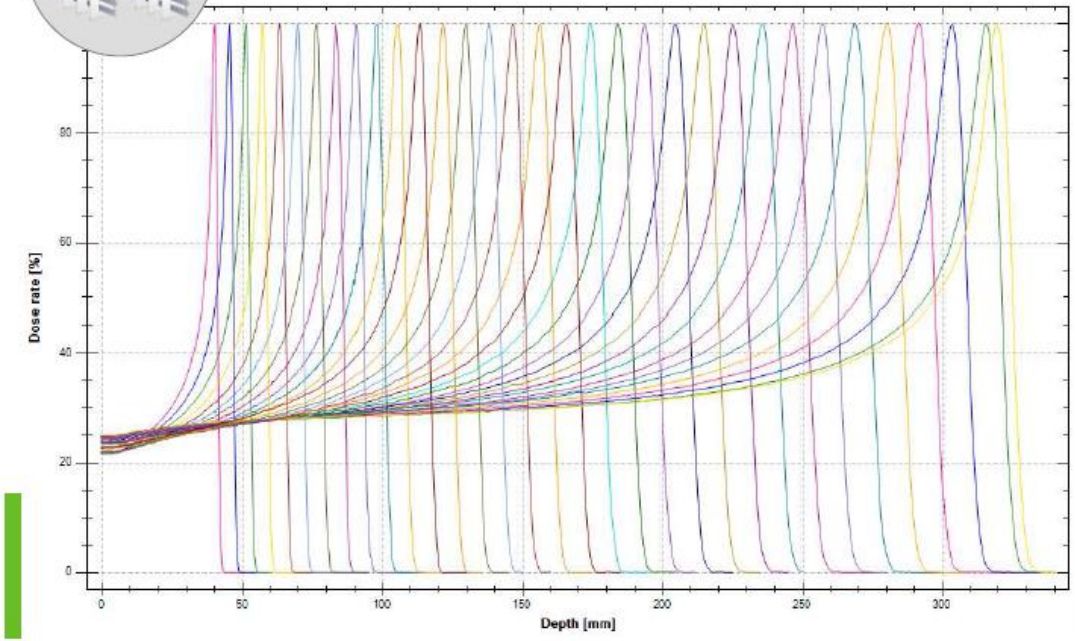
The function of the degrader



- it is constituted by a rapidly, adjustable, servo controlled, rotating, variable thickness, cylinder of degrading material (low atomic number Z as graphite)
- it varies the fixed **energy** of the synchrocyclotron **from 70 to 230 MeV**. The larger the energy reduction introduced by the degrader, the larger will be the transversal emittence in X and Y. Tipically a range step of 5 mm may be achieved in ≅ 100 ms

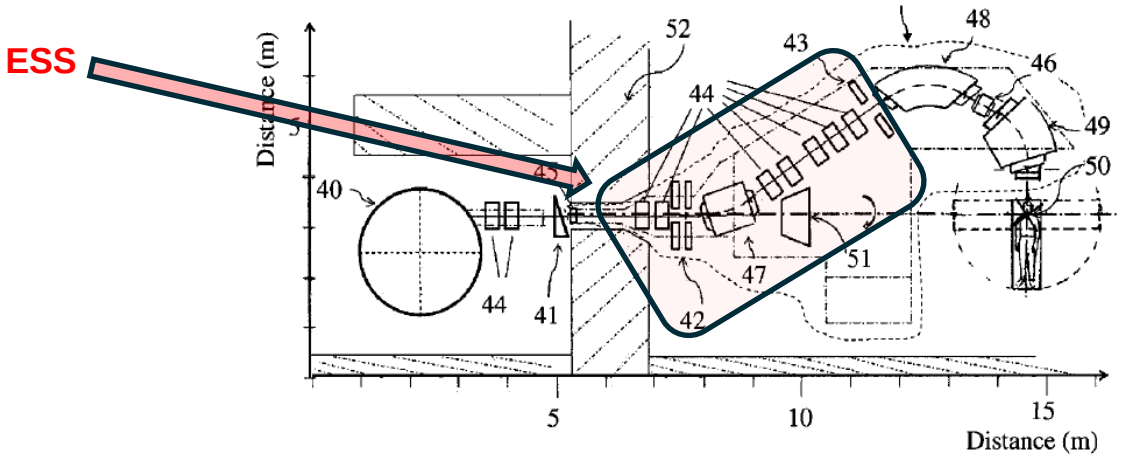
PBS – Range and accuracy

Pencil Beam Scanning : Range accuracy better than 0,1 g/cm²



requested range [g/cm²]	measured range [g/cm²]
4,08	4,07
6,00	6,03
7,70	7,74
10,00	10,03
15,00	14,98
16,01	16,05
20,01	20,01
25,01	25,03
30,01	30,03
30,41	30,44
32,16	32,21

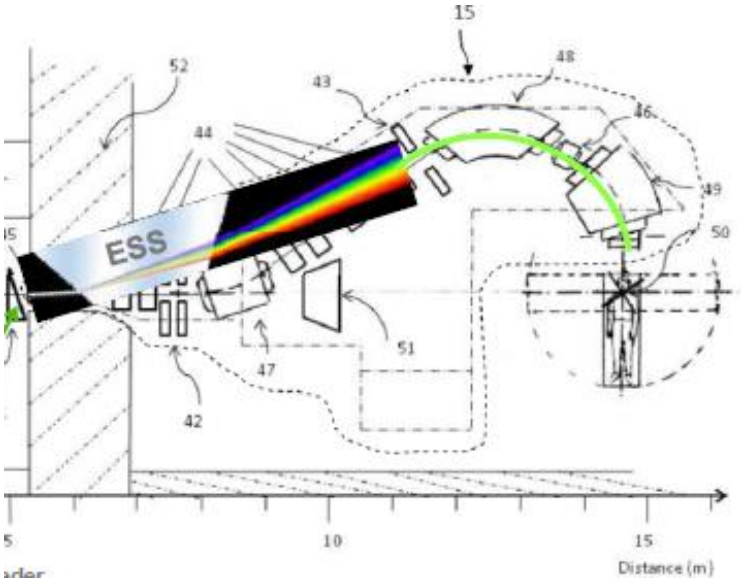
The path of the proton continues: the Energy Selection System (ESS)



The ESS (following the path of the proton) is constituted by:

- n. 2 quadrupoles (44) that serve to focus the divergent beam, originating from the degrader
- n. 2 slits (42) in x and y that limit the beam divergence
- n. 1 dipole achromatic (47) to bend the beam
- n. 5 quadrupole (44) to focus the beam
- n. 1 energy spread limiting slits (43)

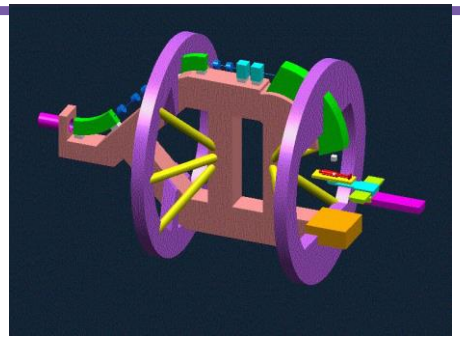
The path of the proton continues – the function of the Energy Selection System (ESS)



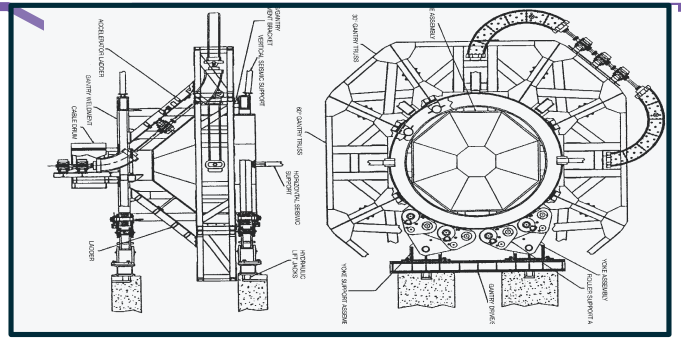
The Beam Analyser part of the ESS, limit the energy spread and emittance of the beam.

The emittance of the final beam can reach 12,5 Pi mm mrad for a beam starting at the degrader with a **small beam spot of 1,25 mm** and a divergence of 6 mrad. With this beam optics a beam size at the treatment isocenter of 3,2 mm (1 σ) is obtained which is an adequate value for performing pencil beam scanning

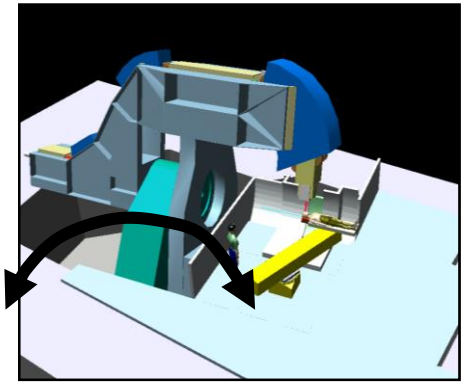
Gantries – huge size and weight



Heidelberg : **15 m diameter**



Loma Linda : **12 m diameter**



PSI gantry 2 : **7 m diameter**

PSI gantry 1: **3,5 m diameter**

The overall size of existing proton gantries, is typically between 3,2 to 5 m in radius, the length is between 9 and 12 m. and the weight between 100 and 200 tons.

Gantry: reduction of the size and weight

The huge size of the gantry is due mainly to the following 3 reasons:

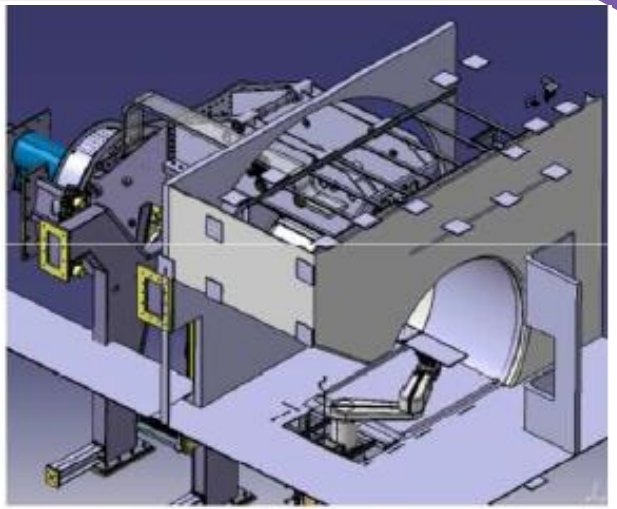
1) The **need to have a rotation of 360°** around the table of the patient with an accuracy of the isocenter of 1 mm.

2) The magnetic rigidity that obliges to have **heavy and big dipoles to assure the bending of the beam** inside the gantry and heavy and big quads for focusing

3) The **position of the scanning system, that needs to have a distance > 3 m** from the isocenter.

NB Consider that the volume of the gantry is ~ L (length) and ~ R^2

1rst issue solution : PT1 220° gantry rotation



If the **gantry rotates 220°** with the patient couch allowed to rotate 360° in the horizontal plane the coverage of the possible directions is 4π and a great part of the volume of the treatment room can be saved. Typical isocentric gantry and table rotation are similar (~ 1 rpm).

It guaranties the same patient clearance as with the 360° gantry and allows the physicians and nurses to have easy access to the patient in treatment position also with non-complanar treatment.

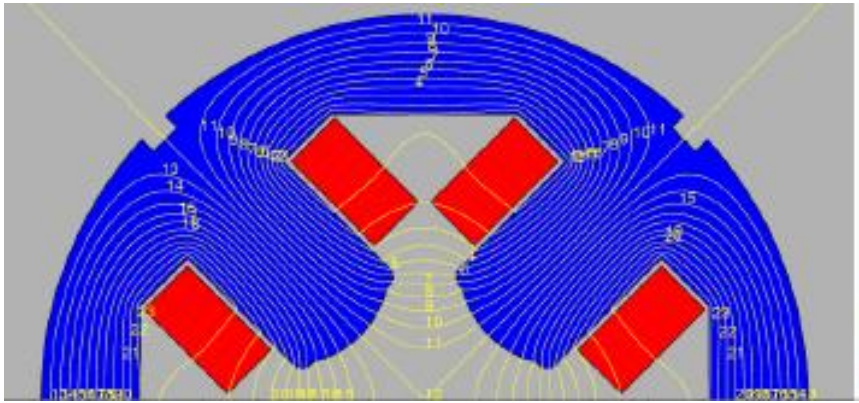
ProteusONE 220 Degree Gantry

ProteusONE : Gantry Rolling Floor (GRF)

Thanks to the highly original design of the GRF, the patient remains very accessible to the medical staff even though the gantry rotates around the isocenter (220°). The GRF ensures staff safety during clinical operation, allowing them to focus on their core tasks and patient wellbeing.

2° issue solution: PT1 new quads

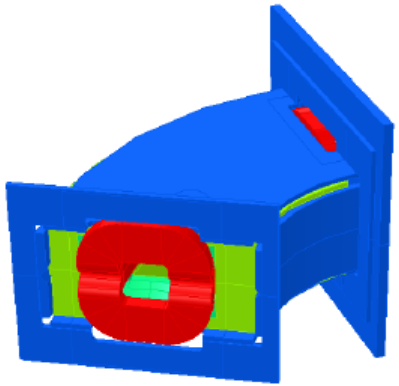
The design and the positioning of the focusing quadrupoles and the bending magnet dipoles is key for the size and the weight of the gantry. The magnetic rigidity requires a large mass of steel. IBA has designed rotating quadrupoles, stronger than standard quads and with small diameter

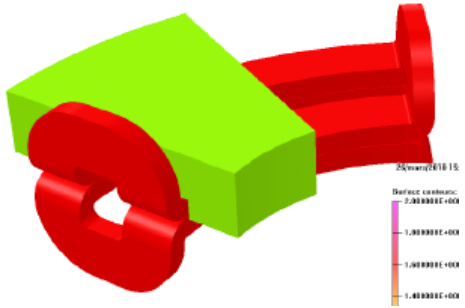


2° issue solution: PT1 new bending dipoles

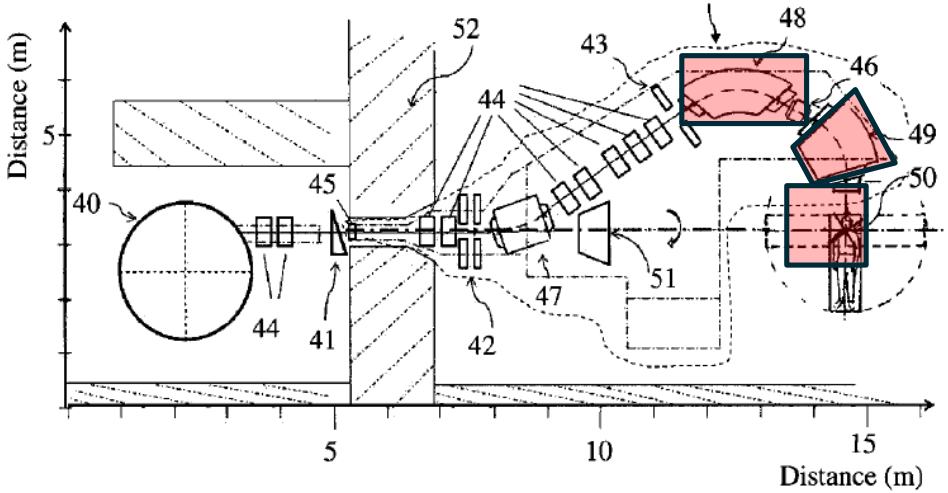
The magnet 40° - 70° : 1,5 m radius, smal gap , 1,53 T

The magnet 60° , : 1,6 m radius, large gap, 1,4 T





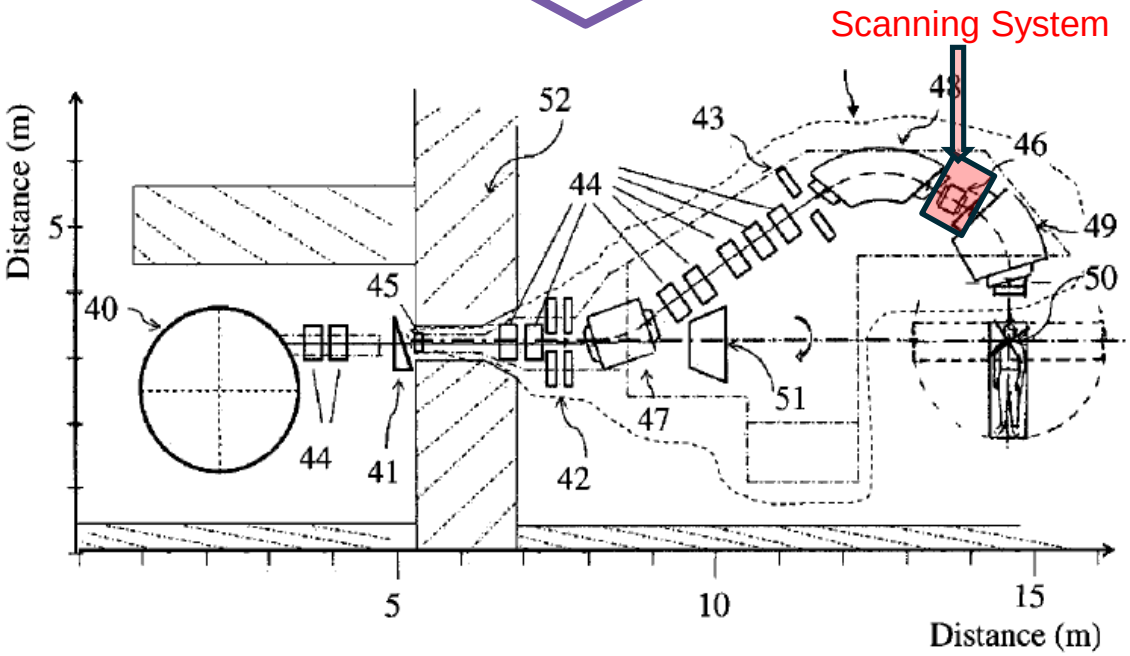
2° issue solution: position of three dipoles



The weight of the dipole (49) is: 9,2 tons and the power consumption: 226 KW

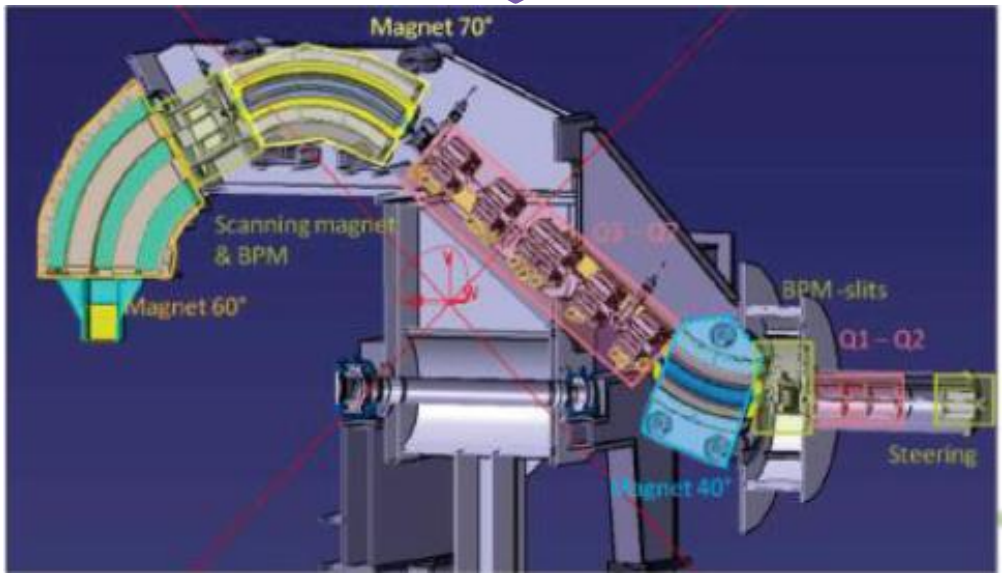
The bending angles and the position of the dipoles have been optimized in order to reduces the emittance of the beam and the size of the gantry.
The position of the bending dipoles is closer to the axis of rotation, which results in less constraints for the mechanical support structure and reduction of size (also for the length of the counter weight).

3° issue solution: position of the scanning system



The scanning system is installed up-stream the last bending dipole allowing a virtual SAD (for the saving of superficial tissue) more than 3 m. and the reduction of the radius of the gantry

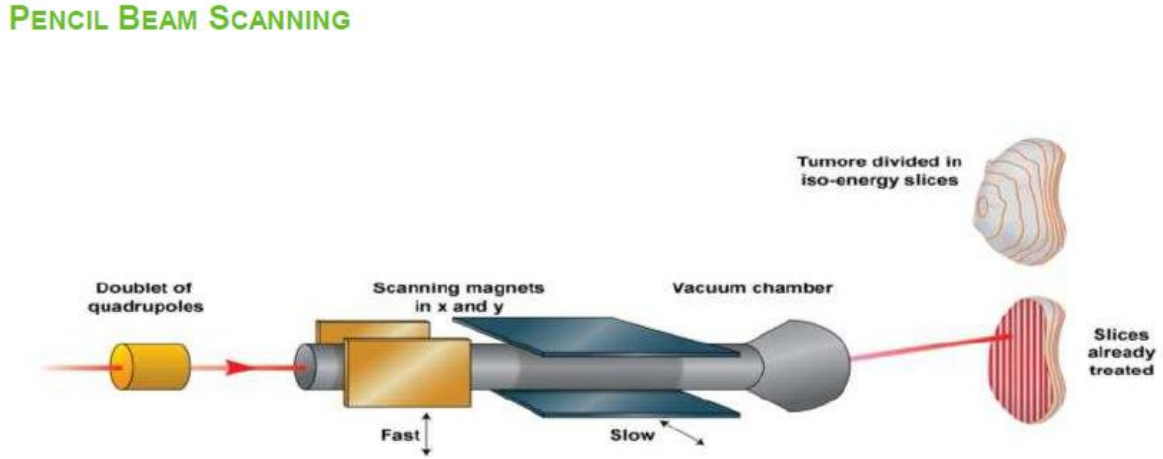
The ProteusONE Gantry: reduction of size and weight

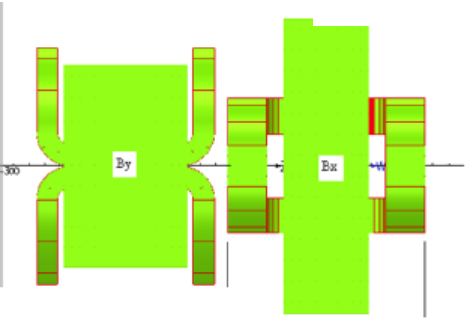


The features of ProteusONE gantry (double cone compact gantry) are:

- radius ≅ 2,7 m with a clearance of isocenter of 1 m from the snout
- length ≅ 7 m
- total weight ≅ 65 tons

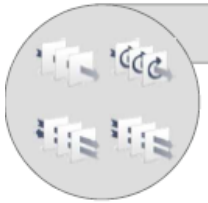
ProteusONE - Scanning active method



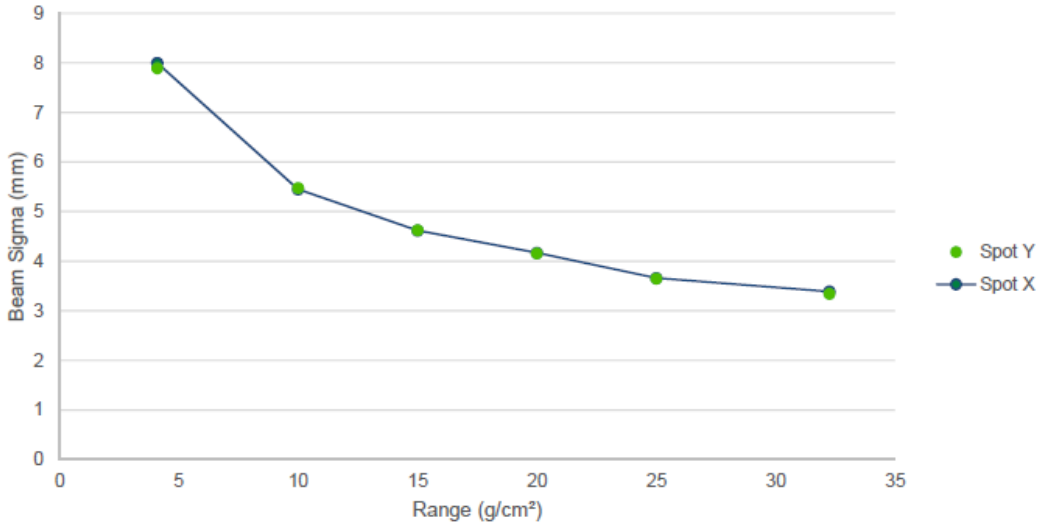


The two scanning magnet selected are compact with high quality field and low power consumption

PBS – SPOT SIZE



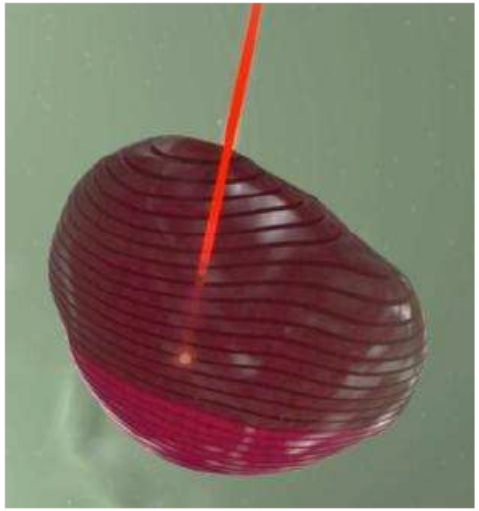
Pencil Beam Scanning : spot size in air → avg in X & Y: 3,2 mm at 32 g/cm²



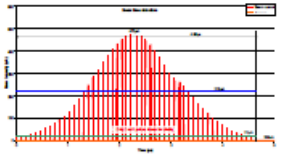
No difference between C230 and S2C2 in spot sizes

PBS - Timing

BEAM DELIVERY - FAST PBS



- Irradiation time 2 Gy in 10X10X10CM³
  - ≤ 60 sec. design target
- Macro pulse length 5 to 7 micro second

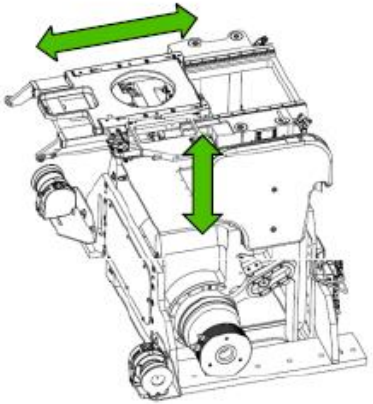


- PBS beam divided in layers
  - Delivery from Distal to Proximal layers
  - Spot by minimum two pulses (repainting 90%/10%) in 2 millisecond
  - Move to next spot ≤1 millisecond

The Nozzle

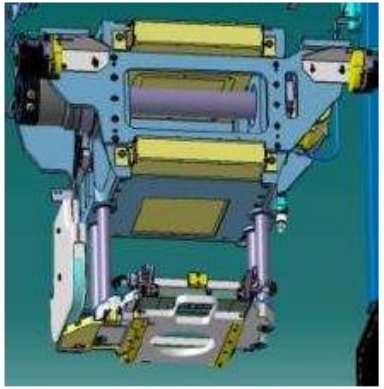
BEAM DELIVERY

NOZZLE READY FOR **REMOTELY CONTROLLED BEAM MODIFIERS**



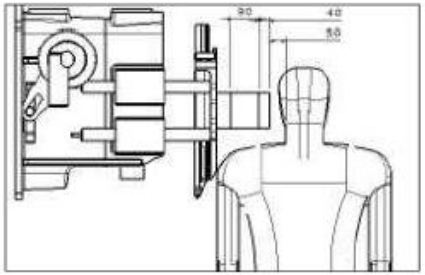
Dual motion

- Towards isocenter
- In & Out beam path



Accessories

- Range Shifter
- Ridge Filter
- Block



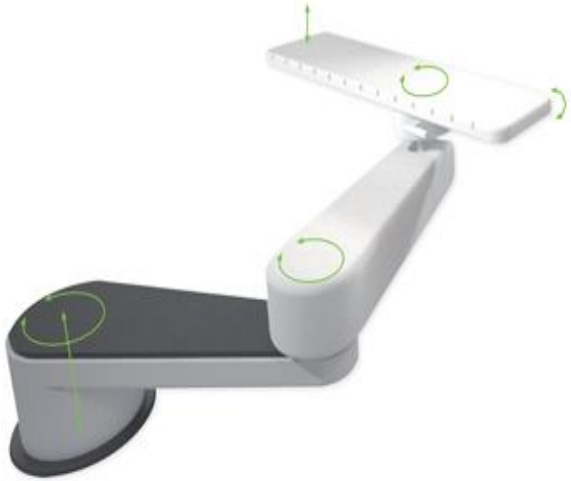
Dedicated snout

(200 mm and 120 mm)

- Support of 2 slots
- Closer to Patient

If the snout is closer to the patient , decrease the pencil beam width and the integral dose (mainly with low penetration depth)

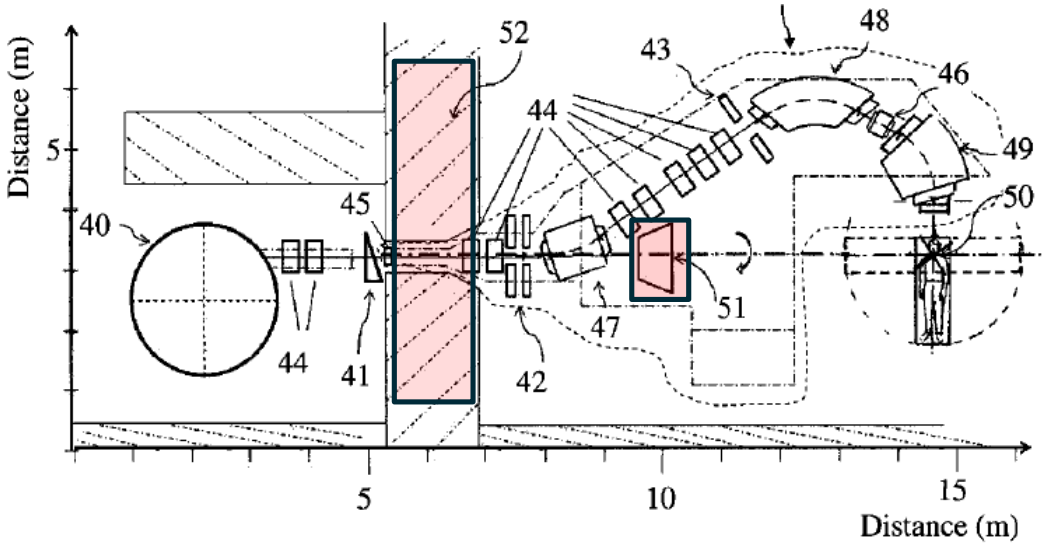
Robotic Patient Positioning System (RPPS)



This RPPS is capable of moving the patient so that the target is placed in the precise position for receiving the treatment beam.

- 6 degrees of freedom (horizontal, lateral, vertical, rotation, pitch and roll movement are possible);
- High positioning accuracy and reproducibility;
- Increased smoothness and reliability.

Shielding against the neutrons



The part highlighted in pink are the shielding against neutron radiation:

- (52) is a concrete wall
- (51) is a neutron shielding across the axis of rotation of the gantry

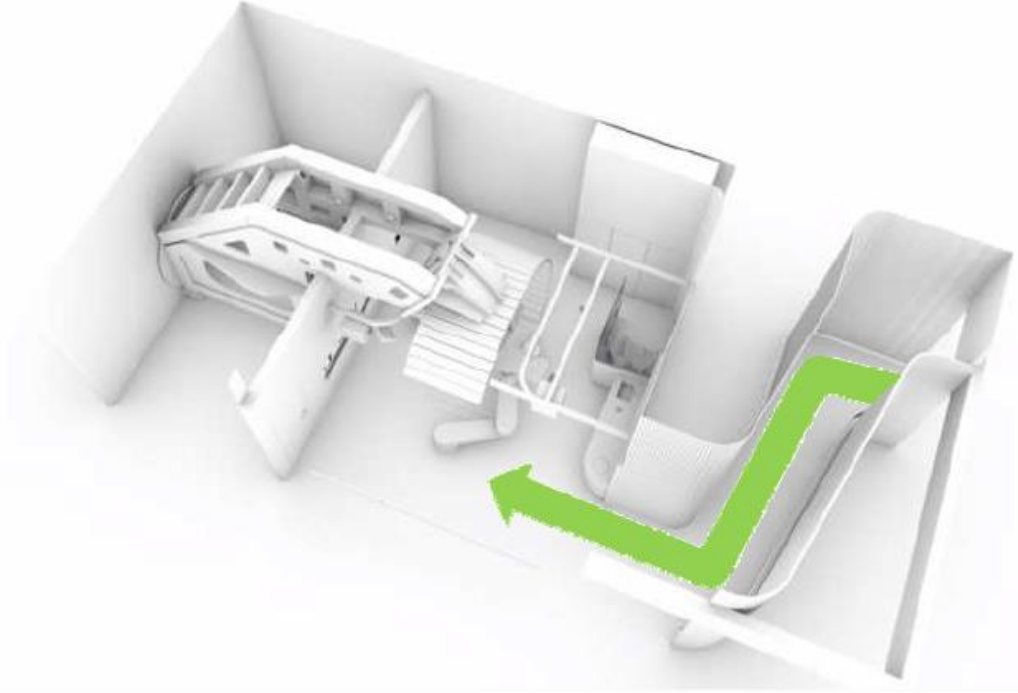
ProteusONE- Safety Interlocks

BEAM DELIVERY - INTERLOCKS

Beam Manager System Beam line check (10Hz)	Scanning Controller (1000Hz)	
	Scanning Generator Control Unit	Redundant Control Unit
Degrader Position	Check prim dose	Check prim dose
	Check Secondary dose	Check Secondary dose
Beam Profilers Measurement Position (#X)	Check SMPS X Voltage Regulation Feed Back	Check SMPS X Voltage Regulation Feed Back
	Check SMPS X Current Regulation Feed Back	Check SMPS X Current Regulation Feed Back
Beam Stops Position (#Y)	Check SMPS Y Voltage Regulation Feed Back	Check SMPS Y Voltage Regulation Feed Back
	Check SMPS Y Current Regulation Feed Back	Check SMPS Y Current Regulation Feed Back
Momentum Slits feed-back	Check exit charge	
	1,000,000 MEASUREMENTS PER SECOND	
Divergence Slits Y feed-back	Check IC2 width	Check IC2 width
	Check IC3 Position	Check IC3 Position
Quadrupoles Power Supply Regulation feed-back (7 Quads)	Check IC3 width	Check IC3 width
	Check IC2 Dose	
Dipoles Power Supply Regulation feed-back (3 Dipoles)		Check IC3 Dose
	Check IC1 Dose	Check IC1 Dose

ProteusONE- the path of the patient

PATIENT ENTERS THE TREATMENT ROOM



Welcome

Set-up

Prepare

Irradiation

iba

ProteusONE- the path of the patient

PATIENT CHOOSES THEME

Welcome

Set-up

Prepare

Irradiation

iba

ProteusONE- the path of the patient

PATIENT CHOOSES THEME

Welcome

Set-up

Prepare

Irradiation

iba

ProteusONE- the path of the patient

PATIENT CHOOSES THEME

Welcome

Set-up

Prepare

Irradiation

iba

ProteusONE- the path of the patient

POSITION PATIENT ON THE COUCH

Welcome

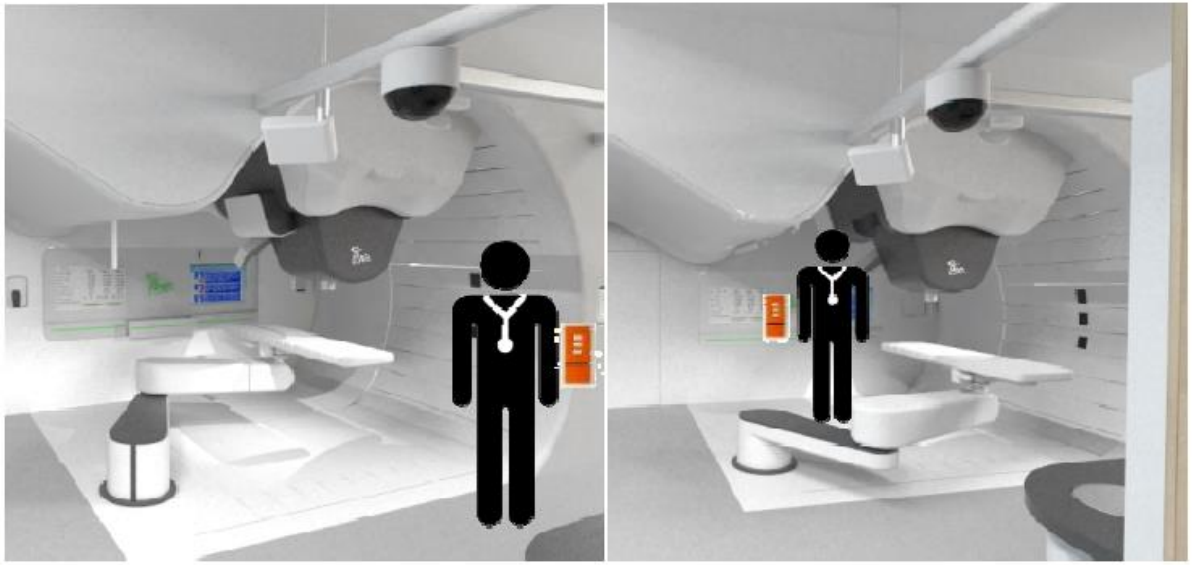
Set-up

Prepare

Irradiation

ProteusONE- the path of the patient

MOVE THE PATIENT



Welcome

Set-up

Prepare

Irradiation

ProteusONE- the path of the patient

MOVE THE PATIENT

Welcome

Set-up

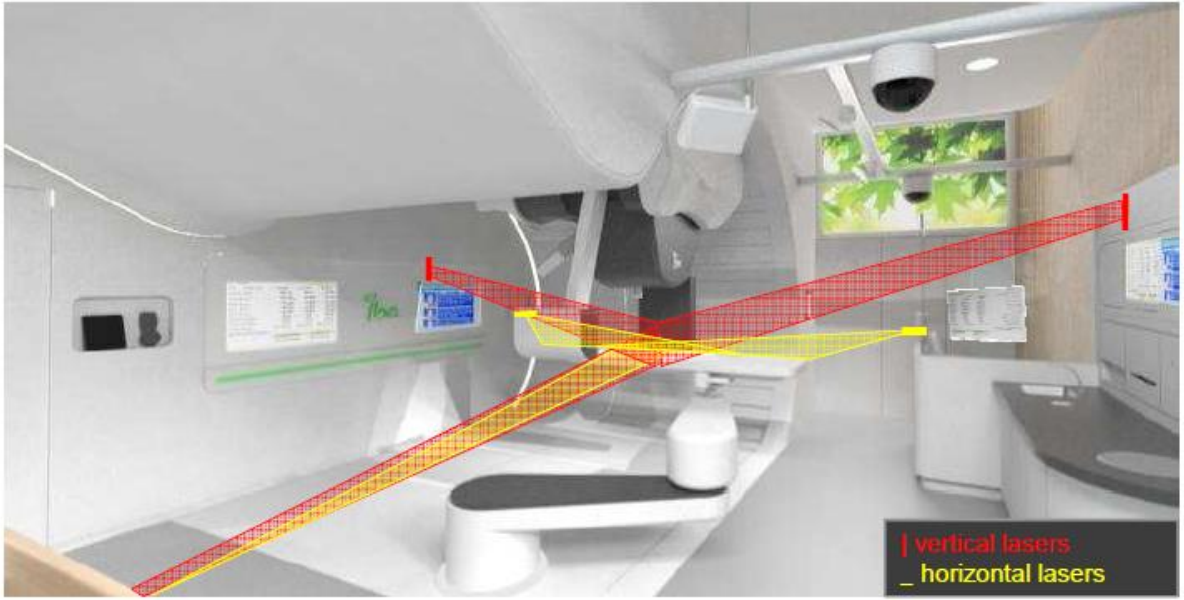
Prepare

Irradiation

iba

ProteusONE- the path of the patient

ALIGN ON LASERS



Welcome

Set-up

Prepare

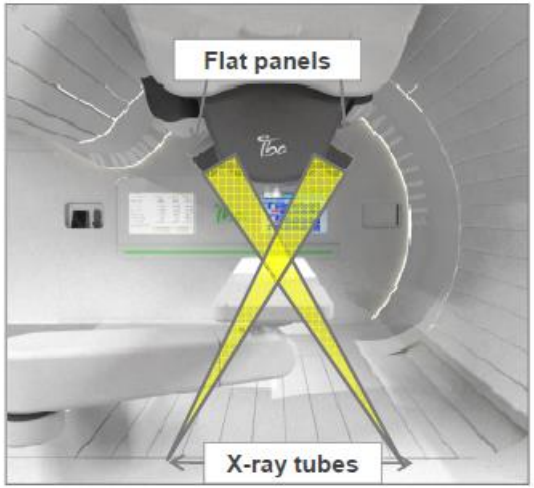
Irradiation

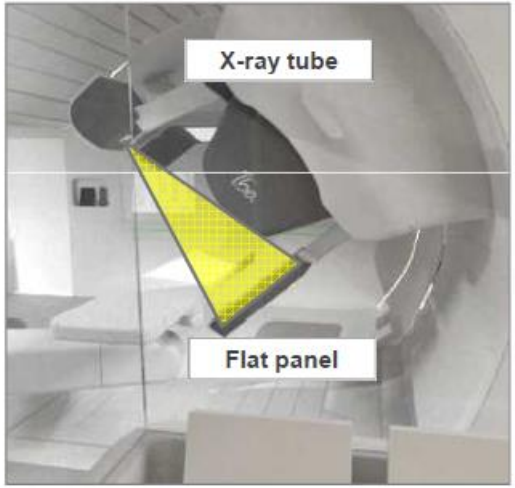
ProteusONE- the path of the patient

SELECT IMAGING MODALITY

2 OPTIONS

Stereoscopic X-ray	CBCT





- Welcome
- Set-up
- Prepare
- Irradiation

iba

ProteusONE- the path of the patient

VERIFY AND CORRECT PATIENT POSITION

Welcome

Set-up

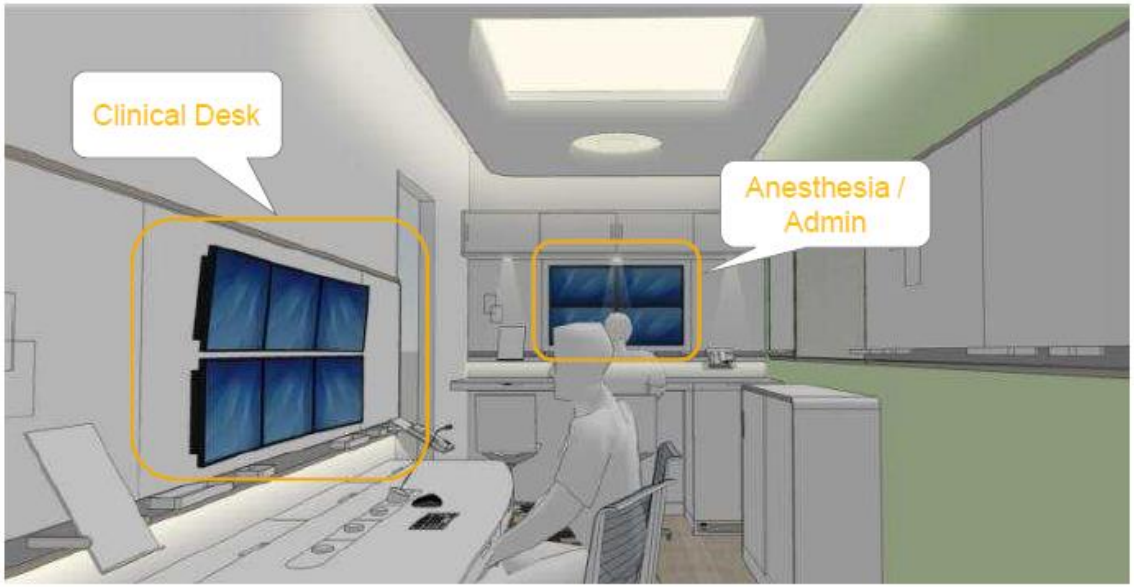
Prepare

Irradiation

iba

ProteusONE- the path of the patient

IRRADIATE PATIENT



Welcome

Set-up

Prepare

Irradiation

ProteusONE- the path of the patient

IRRADIATE PATIENT

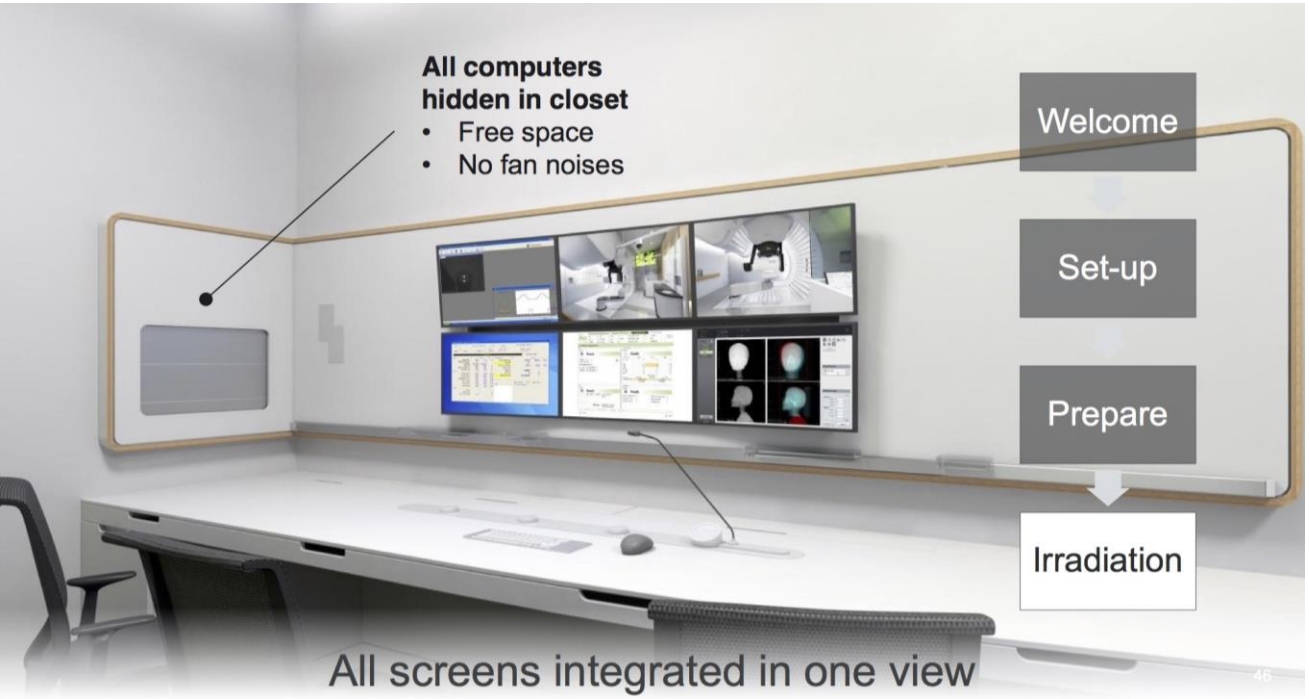
Welcome

Set-up

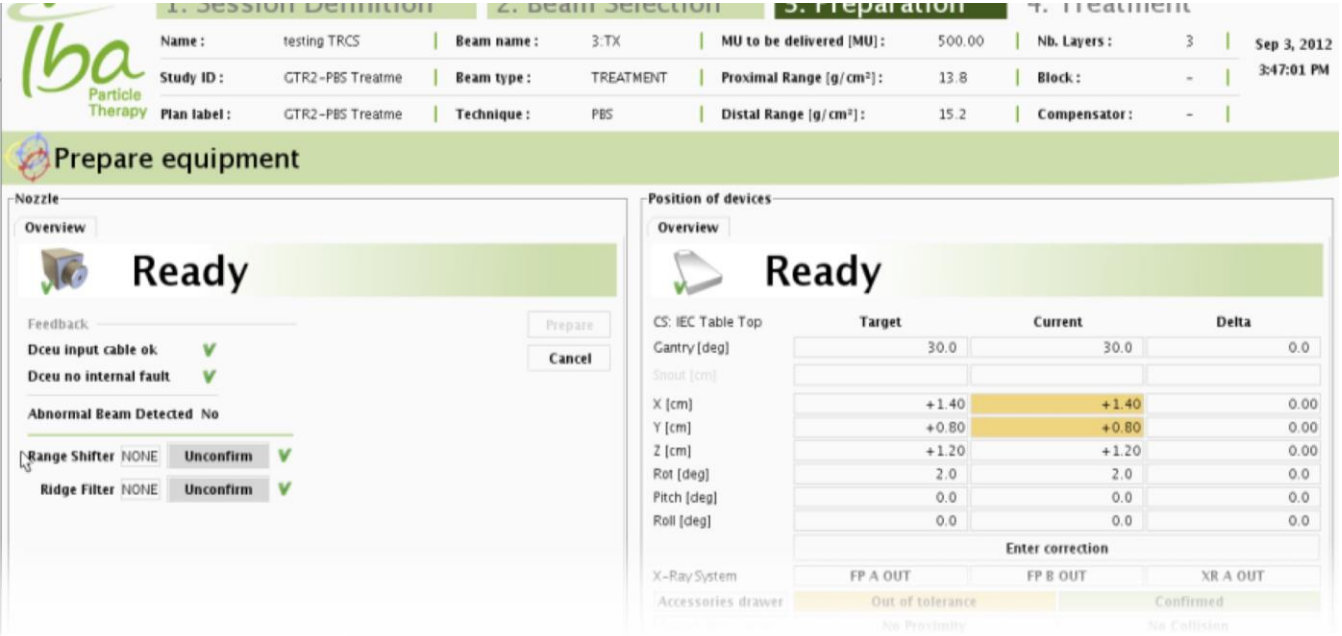
Prepare

Irradiation

Control room



Delivery “ linac mode “

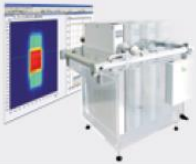


adapt Treatment Suite

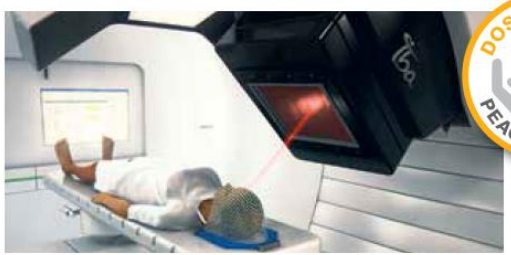
A Platform for Adaptive Treatment

adapt deliver

Dosimetry – all included

QA Workflow	Dedicated PBS Dosimetry Solutions
Commissioning	**Bragg Peaks** • StingRay • Blue Phantom² **Bragg Peaks** • Giraffe **Spot Characteristics** • Lynx
Machine QA	**Spot Characteristics** • Lynx **Bragg Peaks** • Giraffe **Spread Out Bragg Peaks** • Zebra
Patient QA	 **Patient Plan Verification** • DigiPhant PT – Water Phantom system with motorized MatriXX PT detector

Treatment Safety & Accuracy



Upgrade

Keeping Our Installed base Up-To-Date

MGH – Gantry rolling floor and covers

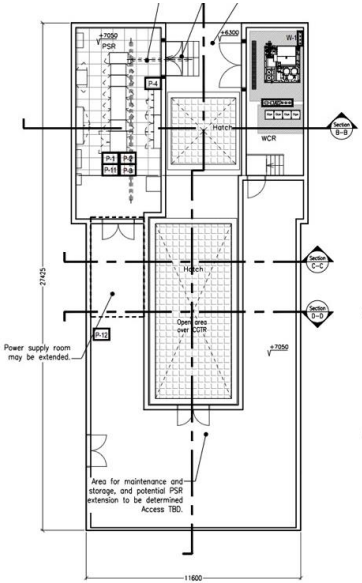
Last 11 Years

Today

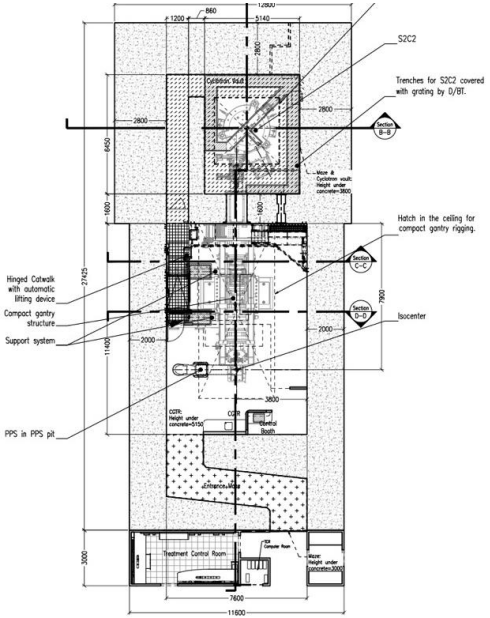
Zero Downtime

Protect, Enhance and Save Lives

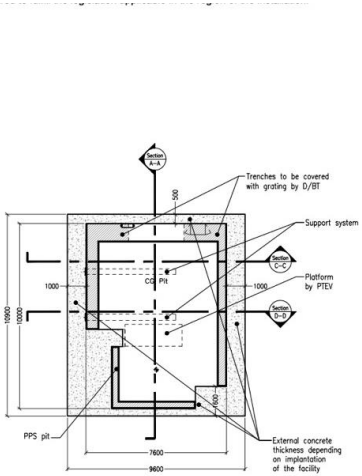
Layout : 360 m²



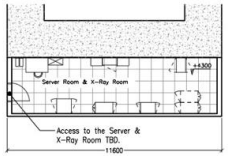
UPPER LEVEL LAYOUT



TREATMENT LEVEL LAYOUT



BASEMENT LAYOUT



REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	24/10/12	Original issue	LCHEN	OBA	PV
B	31/12/15	Layout update	ADUVIVI	OBA	PV
C	30/03/16	Layout update	ADUVIVI	OBA	PV

iba S.A. ION BEAM APPLICAT

MATERIAL: --
SCALE: 1/200
DIMENSIONS: mm
TOLERANCES: --

PROJECT: PROTON THERAPY

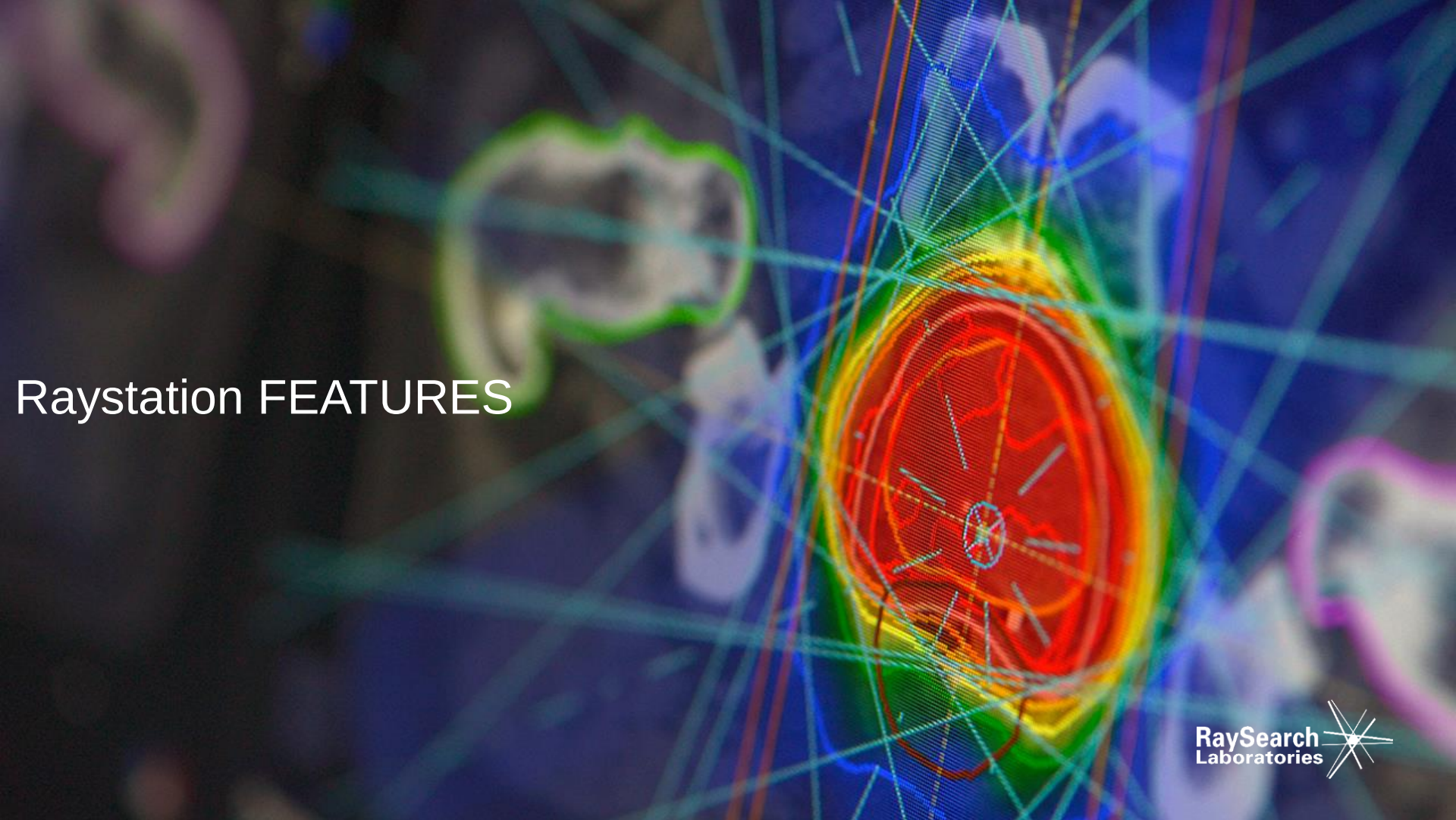
Proteus One S2C2

STANDARD PROPOSAL

TITLE:
Facility General Layout

conclusion

- Compact
- “linac “ concept : procedure and accessory
- Compact SC 2.4 m dia x 2 m h 55T
- Compact gantry 220° 7.4 lunghezzs 2.5 m h 65T
- Save time bulding : 1 year installation time (bunker 2000m3 ready)
- Save time commission 3 -5 months
- Save power supply average 660 MWh
- Save “Space and Neutrons” 12.8m x 30.4m x 10.4 (360 m2)
- Installation base and experience
- Service and maintance 97.5 % platforrm upgrade
- Complete Training class



Raystation FEATURES

RaySearch Laboratories

RaySearch

Dedicated to radiation therapy software

Spin-off from **Karolinska Institutet**, founded in **2000**

Installations at more than **2,500+ centers** in over **65+ countries**

2001

First **IMRT module** released in **2001**

203 employees, **115** in R&D, more than **20%** of all employees holds a PHD

Partners:
Philips, Nucletron, IBA, Varian, Accuray, Brainlab

RayStation

Main focus now is **RayStation** and **RayCare**

RAYSEARCH partner products

Over 2600 installations in more than 65 countries

PHILIPS

BrainLAB

iba

Nucletron

ACCURAY

VARIAN medical systems

RaySearch partner products

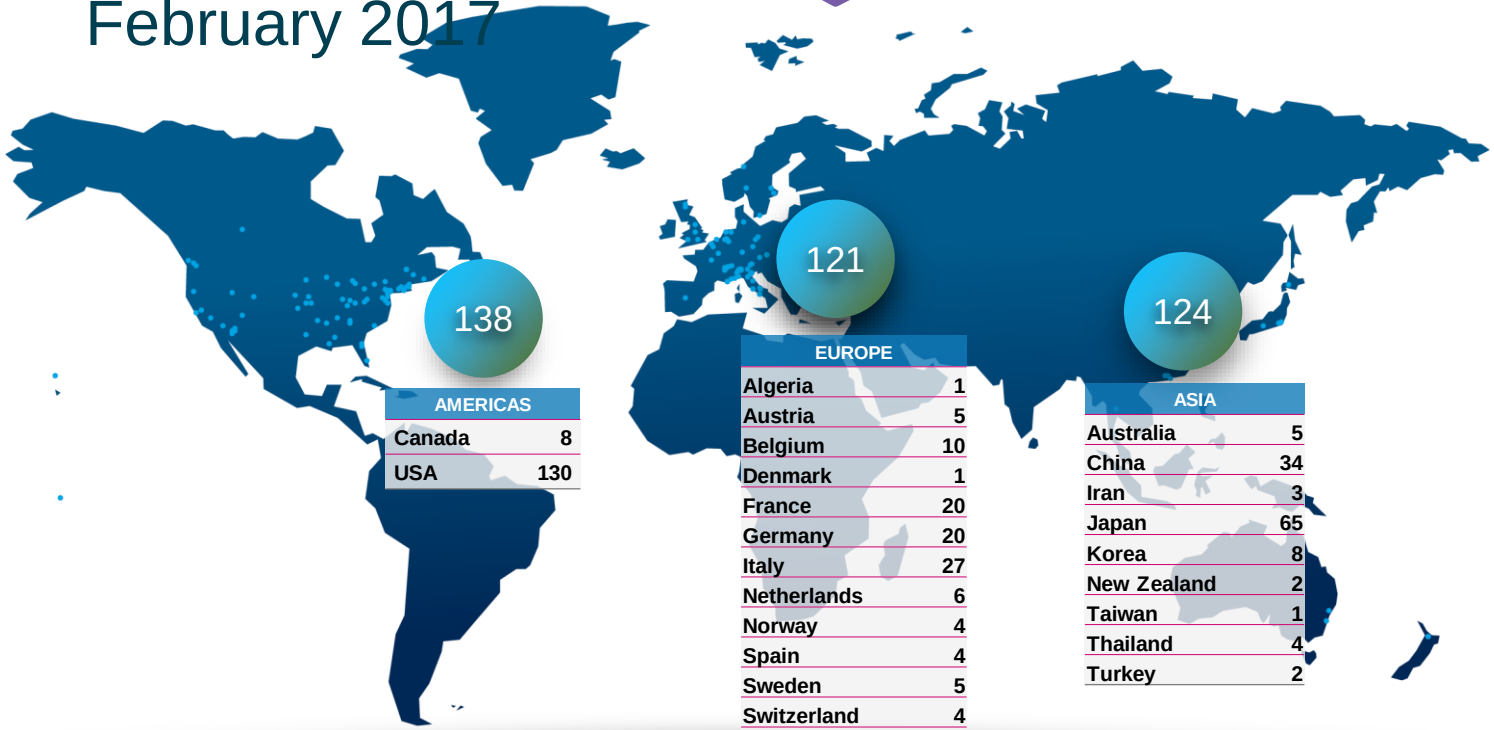
Ongoing relationships, first partner in 2001

Partner product	Philips	Nucletron	IBA Dosimetry	Varian	Accuray*	Brainlab
3D-CRT				■		
IMRT	■	■				
VMAT	■	■				■
Biology	■			■		
Automated Planning					■	
Dose Calculation			■			
Quality Assurance			■			
Model Based Segmentation		■				
Vero						■
InverseArc						■

* RaySearch and Accuray ended the partnership in 2013 and the functionality provided to Accuray customers is now available as an integrated module in RayStation (rayFallback).

383 RayStation centers in 25 countries

February 2017



AMERICAS	
Canada	8
USA	130

EUROPE	
Algeria	1
Austria	5
Belgium	10
Denmark	1
France	20
Germany	20
Italy	27
Netherlands	6
Norway	4
Spain	4
Sweden	5
Switzerland	4
Tunisia	1
UK	13

ASIA	
Australia	5
China	34
Iran	3
Japan	65
Korea	8
New Zealand	2
Taiwan	1
Thailand	4
Turkey	2

292 sites at end of December 2015

Numbers include converted Shareplan sites and Inverse Arc installations – Updated 21.2.2017

RayStation

VIRTUAL SIMULATION
- One-click plan creation with orthogonal beam pair
- Isocenter placement using DRR pair
- Export to patient marking systems

ADVANCED OPTIMIZATION TOOLS
- Multi-criteria optimization
- Co-optimization of multiple beam sets
- Radiobiological optimization and evaluation

PHOTON AND ELECTRON PLANNING
- 3D-CRT
- IMRT
- VMAT
- TomoTherapy
- Electron
- MR-based planning

ADAPTIVE PLANNING
- Deformable registration
- Dose tracking
- Adaptive replanning

AUTOMATED PLANNING
- Plan Explorer
- Fallback planning
- Automatic breast planning
- Scripting

PLAN EVALUATION
- Dose statistics and clinical goal lists
- Plan evaluation tools
- Perturbed dose computation

PROTON PLANNING
- IMPT optimization (PBS)
- Uniform scanning
- Double scattering
- Sumitomo wobbling
- Sumitomo line scanning
- Support for Mitsubishi machines

PATIENT MODELING
- Manual and semi-automatic organ and target delineation tools
- Rigid image registration and fusion tools
- Model-based segmentation
- Atlas-based segmentation

CARBON-ION PLANNING
- Carbon-ion PBS optimization

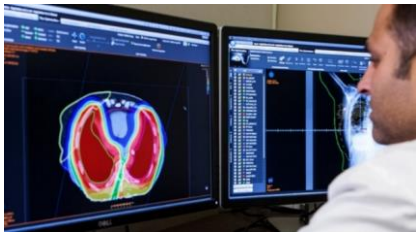
TREATMENT PLANNING THE WAY IT SHOULD BE

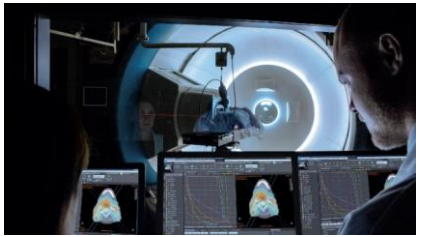
RayStation

Advancing cancer treatment

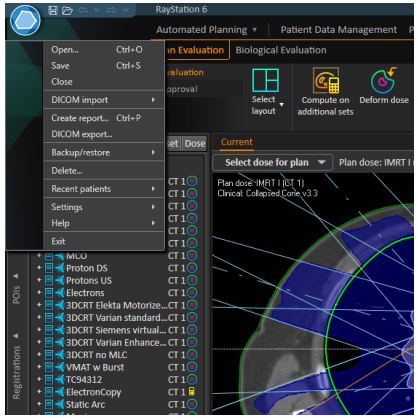
- **Compatibility** with most linacs, OIS and third-party QA solutions
- Automated planning tools with **plan generation protocols, fallback planning** and new **Plan Explorer**
- **Real-time evaluation** of clinical trade-offs with **multi-criteria optimization**
- Comprehensive **Adaptive Radiation Therapy** features and workflow
- **Flexibility** beyond the standard user interface (scripting, protocols…)
- **Workflow-driven design**, user experience is an integral part of our product development
- **Speed**
- **Advanced particle therapy expertise**, RayStation is in use at several proton sites worldwide

RayStation



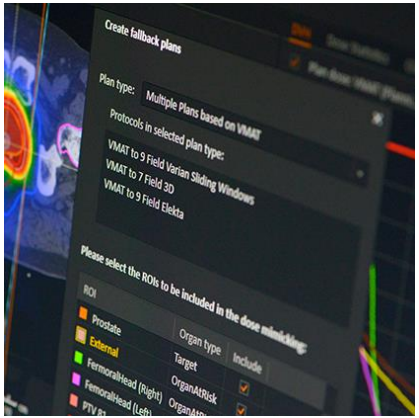


RayStation graphical user interface



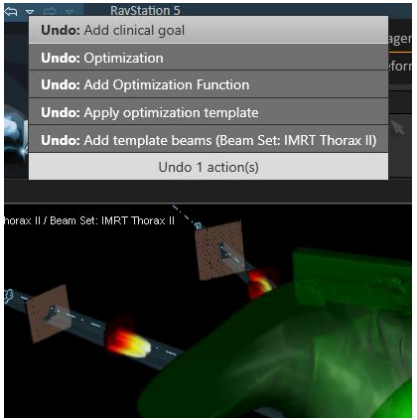
No confusion

RayStation runs on Windows and appears as any other modern application.



Flexible and Efficient

Easy accessible, clinic-tailored protocols and templates help to automate customized workflows.



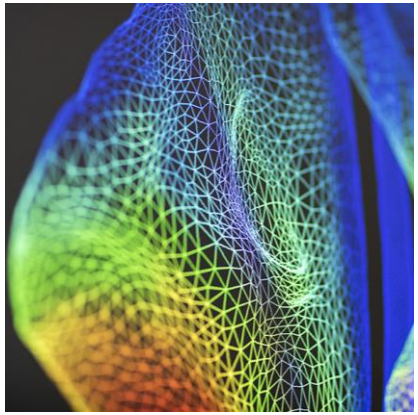
Smart Undo Redo

RayStation supports complete undo and redo. It works on any action and on any number of actions.

Help when needed

The RayStation user manual tells it all. Lots of images and to the point descriptions make it easy to understand all functions and algorithms.

RayStation graphical user interface

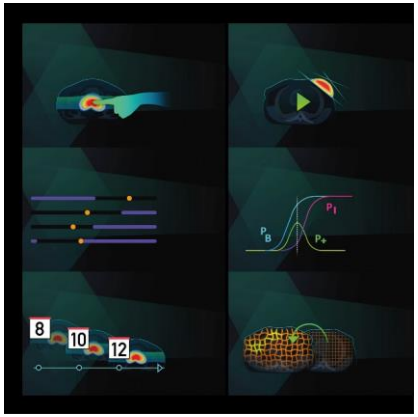


Aestetic and Minimalistic

RayStation’s visual components are carefully designed to ensure a pleasant experience

Easy-to-understand icons

No unnecessary memory load for the user as objects, actions and options are on display as intuitive icons in carefully organized toolbars.

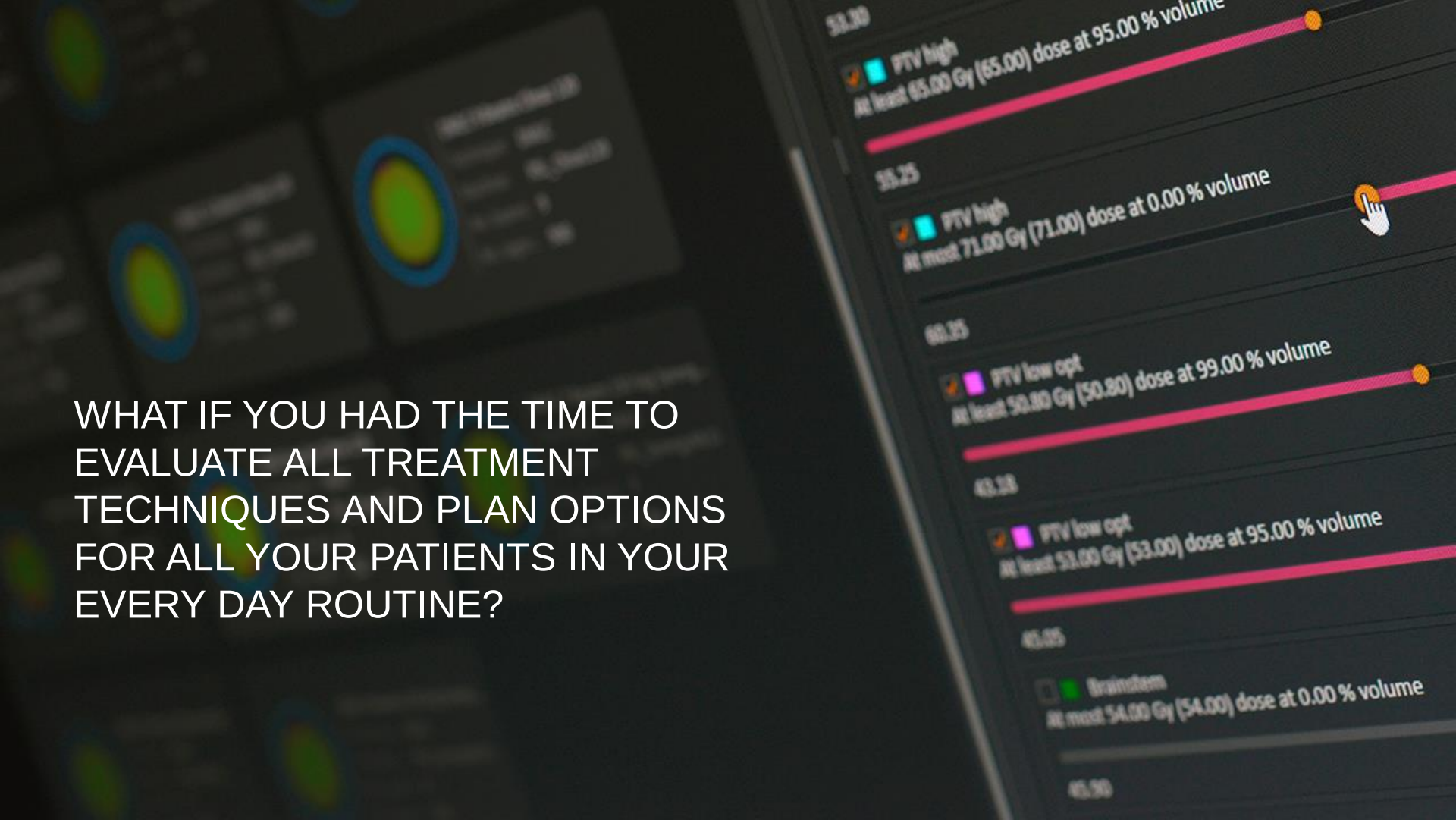


It's all there

RayStation provides easy access between task oriented modules, at all times. This enables flexible workflows, with little risk of getting stuck.

Help when needed

The RayStation user manual tells it all. Lots of images and to the point descriptions make it easy to understand all functions and algorithms.



WHAT IF YOU HAD THE TIME TO EVALUATE ALL TREATMENT TECHNIQUES AND PLAN OPTIONS FOR ALL YOUR PATIENTS IN YOUR EVERY DAY ROUTINE?

PLAN EXPLORER

Treatment planning will never be the same

- **Automatic generation**, based on given clinical objectives, of multiple plans for the different treatment techniques and beam settings available at the clinic.
- Choose plans instead of designing them

PLAN EXPLORER

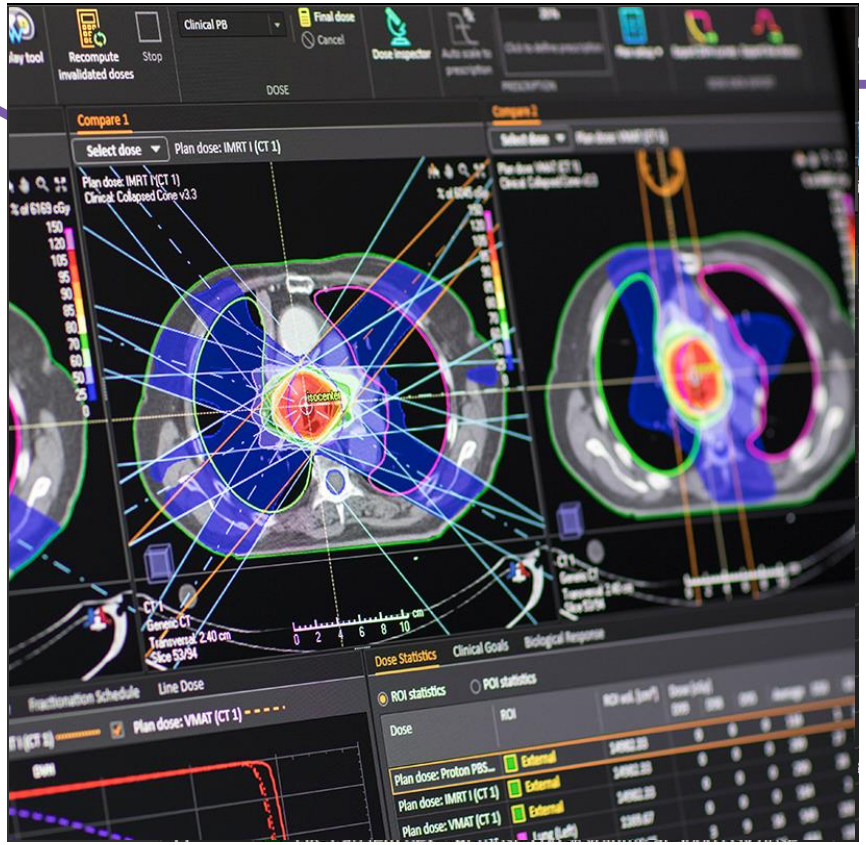
Treatment planning will never be the same

- Explore **different treatment techniques** that would have been too time consuming to consider in the everyday routine
  - **The best treatment setup** (machine, #beams, #segments) is not known beforehand
  - **Same**, or better **plan quality** can be achieved with a different treatment setup (time, MU, #segments)
- **Optimize the use of your current treatment delivery machines**
- Get more time to evaluate the plans

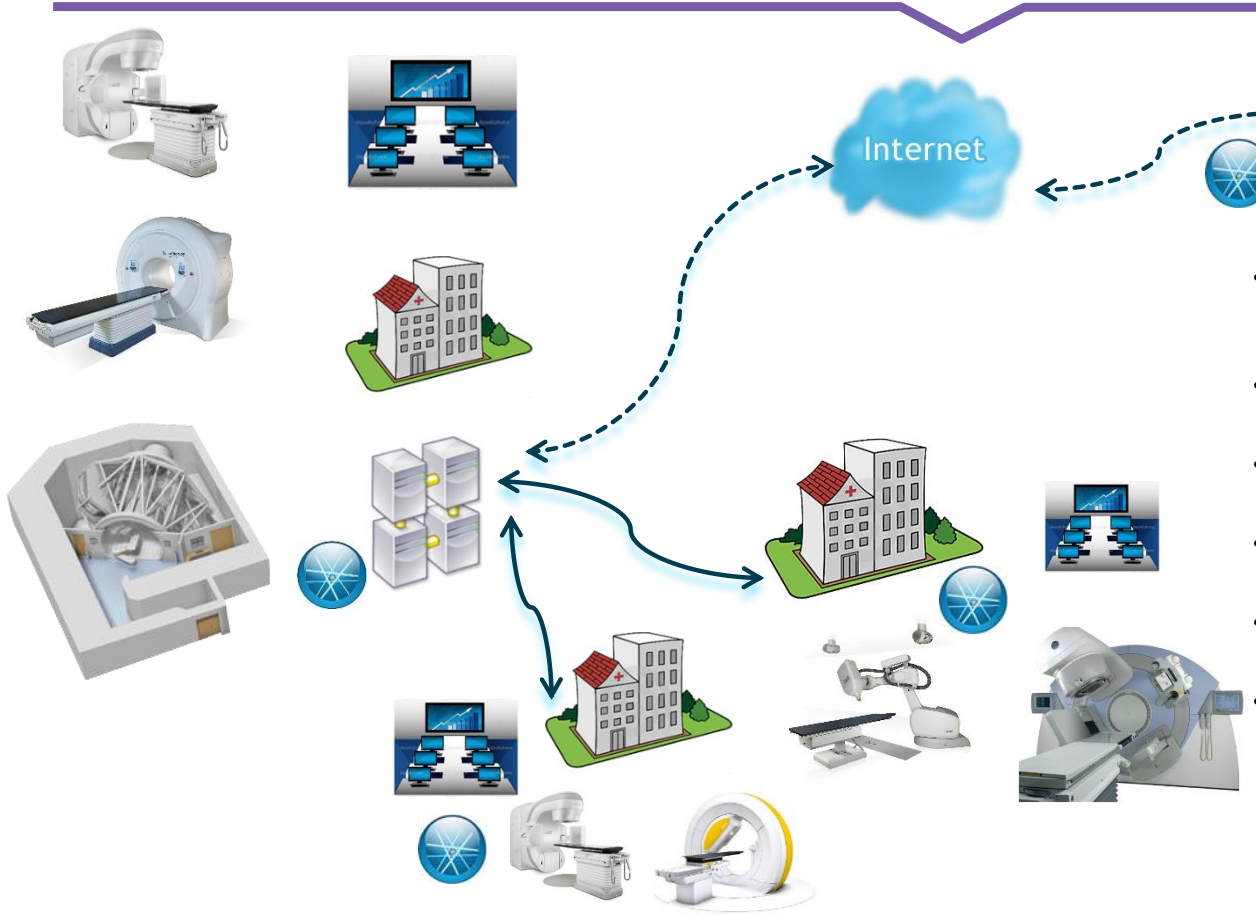
PLAN EXPLORER

Treatment planning will never be the same

1. Start by establishing your **clinical goals** and priorities.
2. Load your **exploration templates with different machine**, beam and segment settings
3. **Click start** and let RayStation do the work
4. **It creates multiple plans** for the templates you have uploaded
5. **Get a rapid overview** of which plans best fulfill your goals with the intuitive “radar chart” visualization
6. Filter plans easily by machine, by number of beams, segments or MU, or for each clinical goal
   - You can for example uncheck machine X and remove all related plans
   - You can adjust dose to a specific organ
7. Once you have selected some plans you want to further work with, you click on compare to evaluate plans side by side
8. You can then choose the plan you find most suitable



Virtualization



- Gestione del Personale
  - Personale condiviso indipendente dalla posizione
- Gestione dei Pazienti
  - Situazione dei pazienti condivisa sul territorio
- Gestione del sistema HW e SW
  - Centralizzazione manutenzione hw e sw
- Gestione applicativo RayStation / RayCare
  - Unica installazione, unico server di licenza
- Gestione delle Macchine per il trattamento
  - Fallback Planning
- Gestione della Logistica
  - I pazienti possono recarsi nel centro più vicino

RISULTATO: OTTIMIZZAZIONE

HARMONIZE YOUR TREATMENT PLANNING

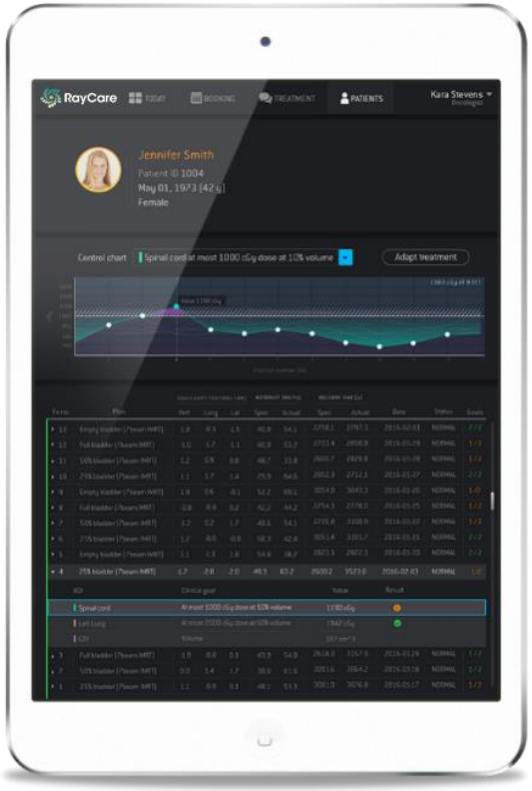
- **Multiple modalities**. **Diverse treatment machines.** Numerous software systems. There's a lot to orchestrate if you want to reach the highs in treatment quality and efficiency.
- **RayStation 6 with TomoTherapy and protons planning brings integrated workflow**. Now you have one control center for all your treatment planning needs – **any equipment composition, any scale.**
- You have the **flexibility to plan in only one system and change treatment technique or modality if needed**. You can choose the best treatment for your patients and even combine treatments.
- **One system to maintain and one system for staff to learn**.

RayCare

ONE ONCOLOGY WORKFLOW

RaySearch Laboratories

Before we get started…



- RayCare is currently under development at RaySearch Laboratories
- RayCare is developed in close collaboration with partner clinics
- First version of RayCare is due for release end of 2017

umcg

UCSF

iridium kankernetwerk
Radiotherapie
Medische Oncologie
Hematologie

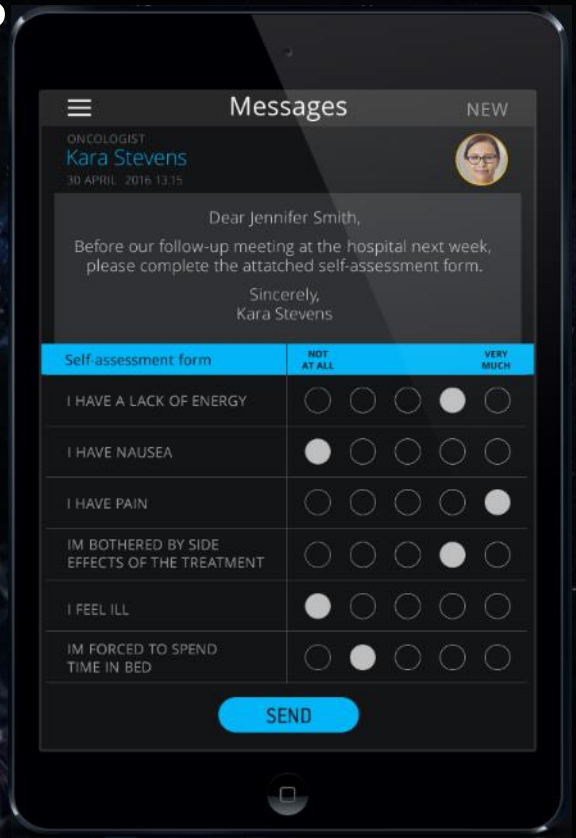
THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

PROVISION HEALTH PARTNERS

RAYCARE – The next generation OIS

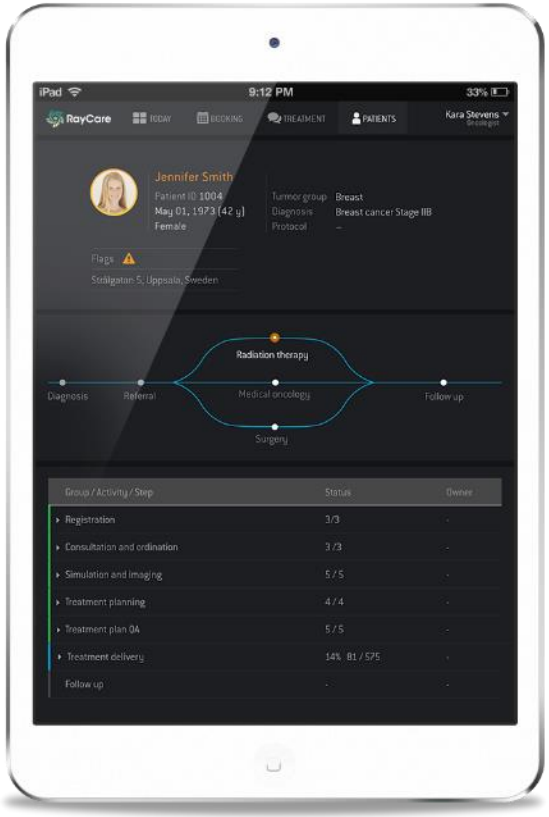
- Platform-independent architecture
- Combined radiation-, chemo-, and surgery workflows
- Efficient adaptive therapy workflow
- Optimization of resource utilization
- Integrated cancer analytics and decision support



RaySearch Laboratories

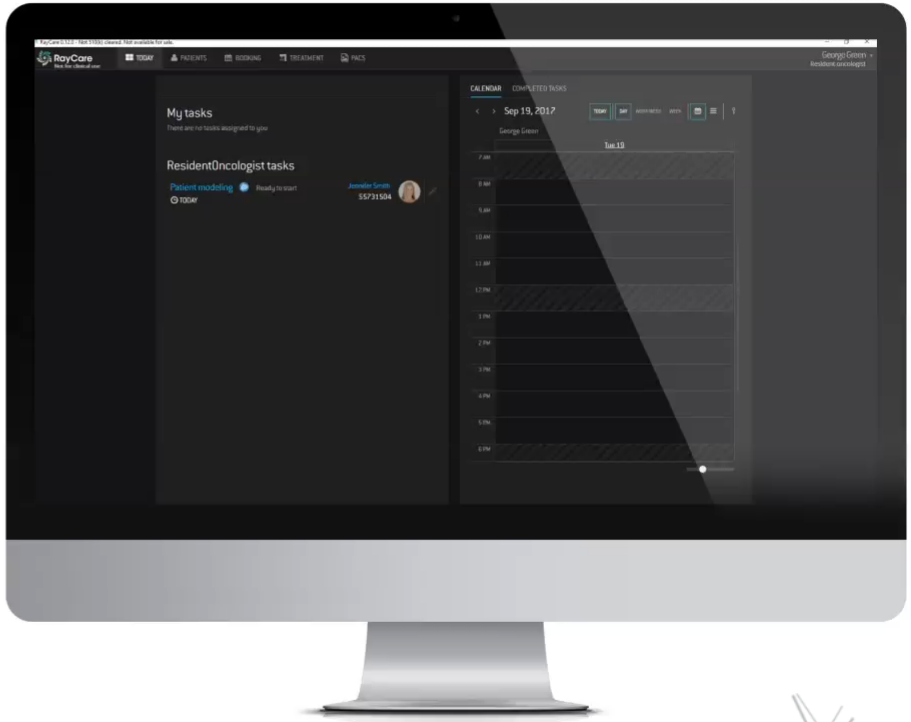
Flexible and user friendly workflow management

- Advanced workflow and task management based on user roles
- Automation of tasks and data processing wherever possible
- Seamlessly integrated with RayStation
- Information presented when and where needed and few clicks to perform tasks
- Supports the continuous evolution of your clinical workflows by user friendly configuration tools



Planning Workflow support for RayStation

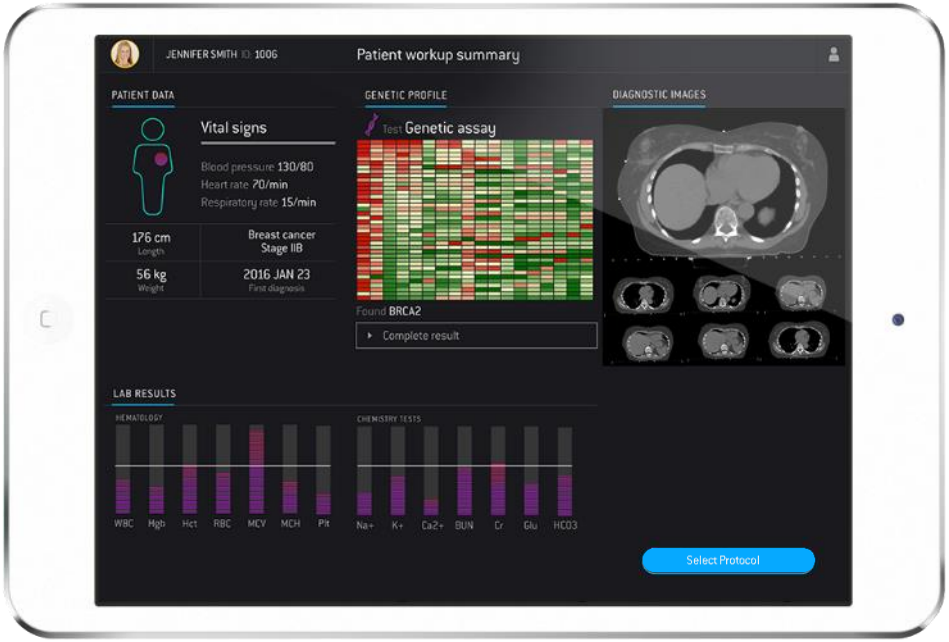
- Workflow, task management and communication support for RayStation planning
- RayStation always opens for the current patient in the right workspace
- Key tasks in RayStation drive the workflow in RayCare
- Overview of all planning activities in a whiteboard view
- Task automation reduces number of manual steps



RaySearch Laboratories

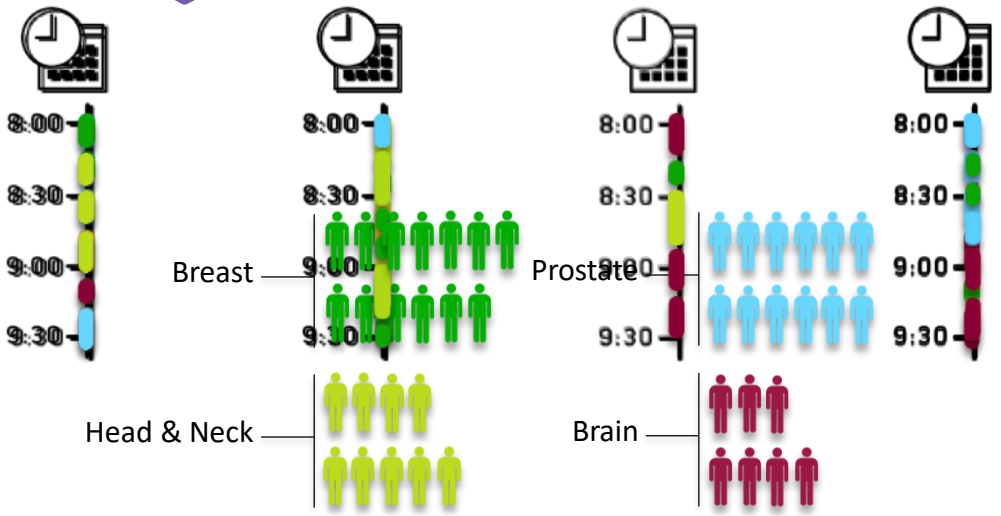
Comprehensive cancer care

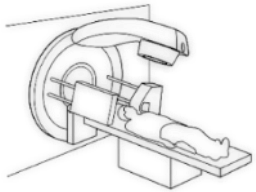
- Supports combined radiation-, chemo-, and surgery workflows
- Schedule all steps of the combined treatment
- Shared information facilitates communication between specialties
- Enables outcome analysis and optimization of the combined treatment strategy

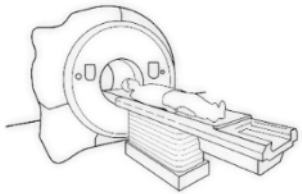


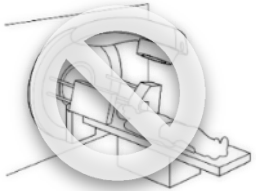
OPTIMIZATION OF RESOURCE UTILIZATION

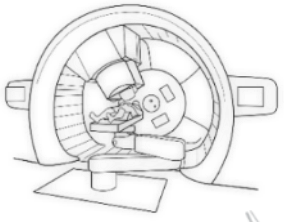
- Advanced rule-based scheduling engine that optimizes the schedule
- Treat more patients with existing resources
- Advanced rescheduling functionality







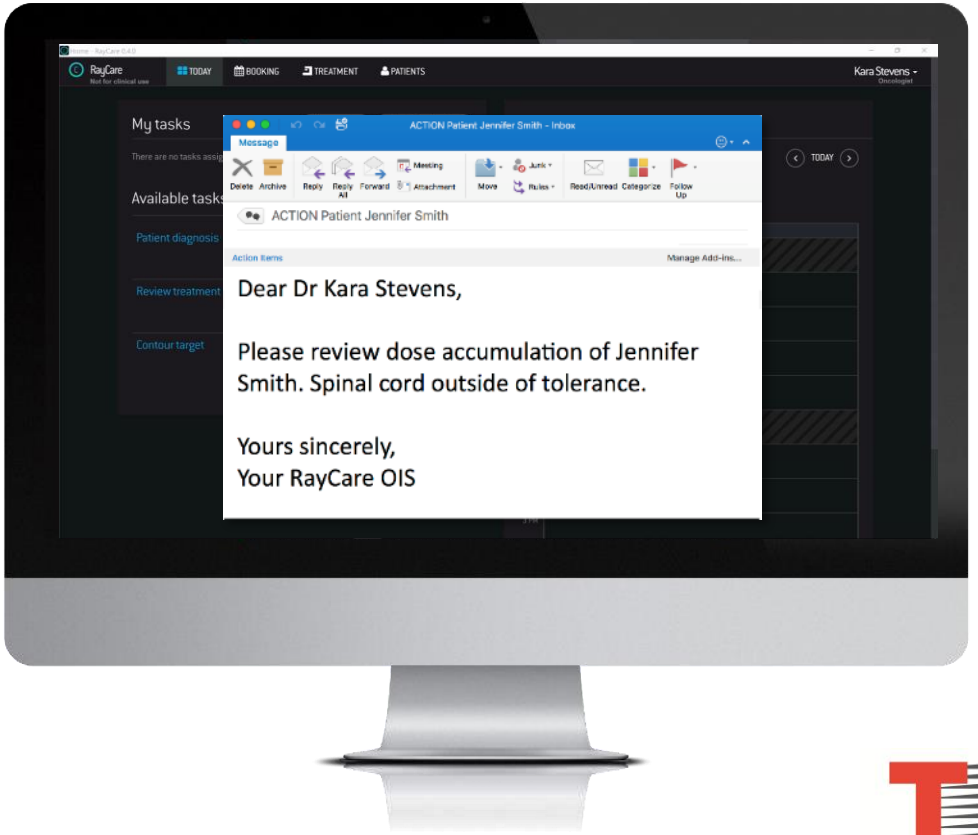




RaySearch Laboratories

Built to support adaptive radiation therapy

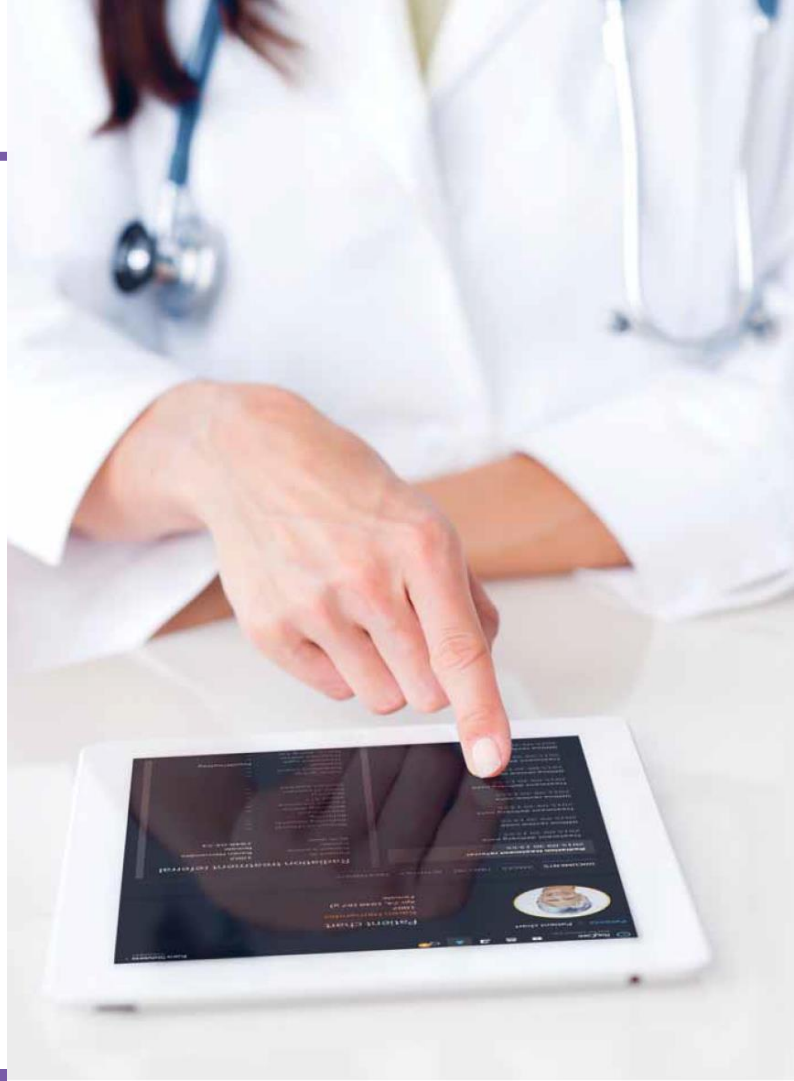
- RayCare is the first OIS designed to safely and efficiently support adaptive workflows
- RayStation already fully supports adaptive radiation therapy, integrating with RayCare will make it even more efficient
- RayCare will drive the complex workflows and automate manual tasks
- RayCare brings support for managing large amounts of image data



Designed for connectivity

- Connectivity through DICOM, HL7 and other protocols
- Integration with TomoTherapy & Protons + any other treatment machine
- Integration with hospital information systems such as EPIC
- RayPacs provides a hub for image management
- Meets demands on security and privacy

HIPAA



Evoluzione ed Integrazione Tecnologica in RT

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