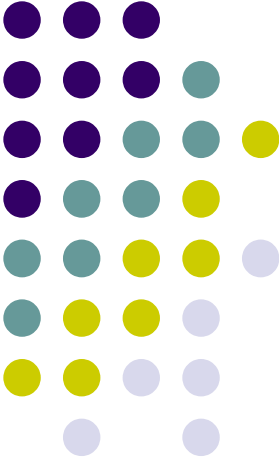


Planificación de IMRT

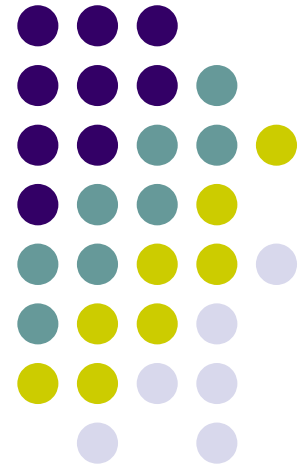
Dr. Eduardo Francisco Larrinaga Cortina

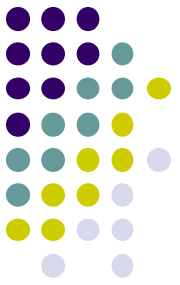


**Créditos;
Dr. Rodolfo Alfonso Laguardia**

**Curso Nacional Introducción IMRT.
HHA Cuba 2008**

**Maestría en Física Médica
Dosimetría Clínica en Radioterapia
Curso 2011-2012**

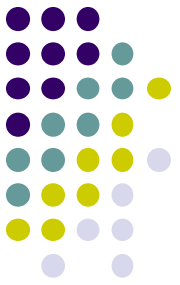




Contenidos

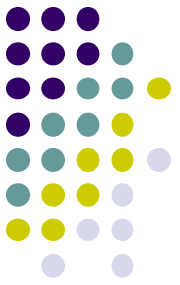
- **Planificación de IMRT**
- **Planificación con optimización directa, Field-in-Field**
- **Planificación con optimización inversa, Múltiples campos estáticos y VMAT**
- **Inteligencia artificial**

Indicaciones más frecuentes de la IMRT



- **Evitar estructuras sensibles**
- **Blancos intracraneales grandes**
- **Lesiones muy irregulares**
- **Re-irradiación**
- **Irradiar blancos múltiples**
- **Escalar dosis**

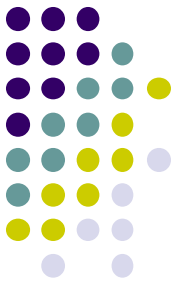
Justificación...



In addition to satisfying at least one of the four selection criteria noted above, the radiation oncologist's decision to employ IMRT requires an informed assessment of benefits and risks including:

- **Determination of patient suitability for IMRT allowing for reproducible treatment delivery.**
- **Adequate definition of the target volumes and organs at risk.**
- **Equipment capability, including ability to account for organ motion when a relevant factor.**
- **Physician and staff training.**
- **Adequate quality assurance procedures.**

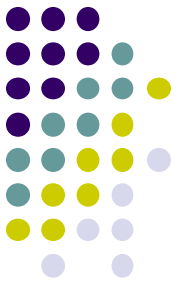
¿Qué diferencia la IMRT de la 3D-CRT?



- **Definición de la prescripción**
- **Optimización**
- **Método de administración**
- **Garantía de Calidad**
- **Administración del tratamiento y verificación**

IAEA TECDOC 1588, 2008. Transition from 2-D Radiotherapy to 3-D Conformal and Intensity Modulated Radiotherapy

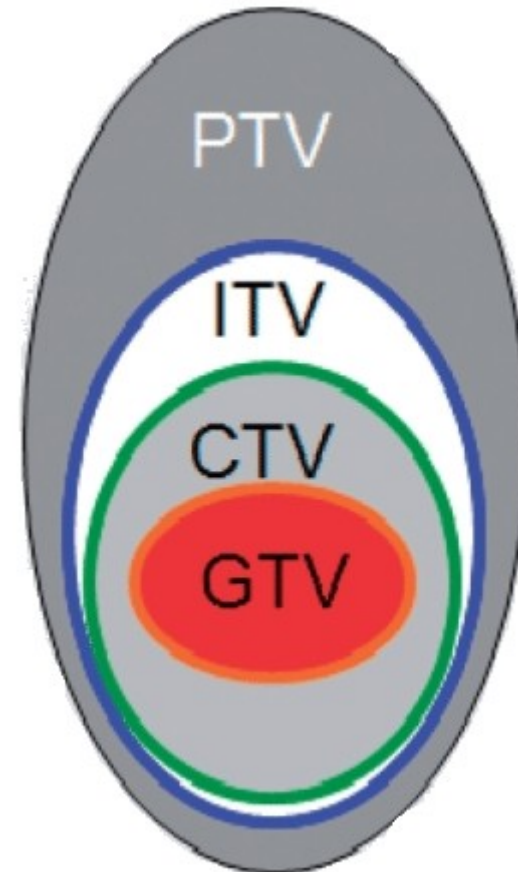
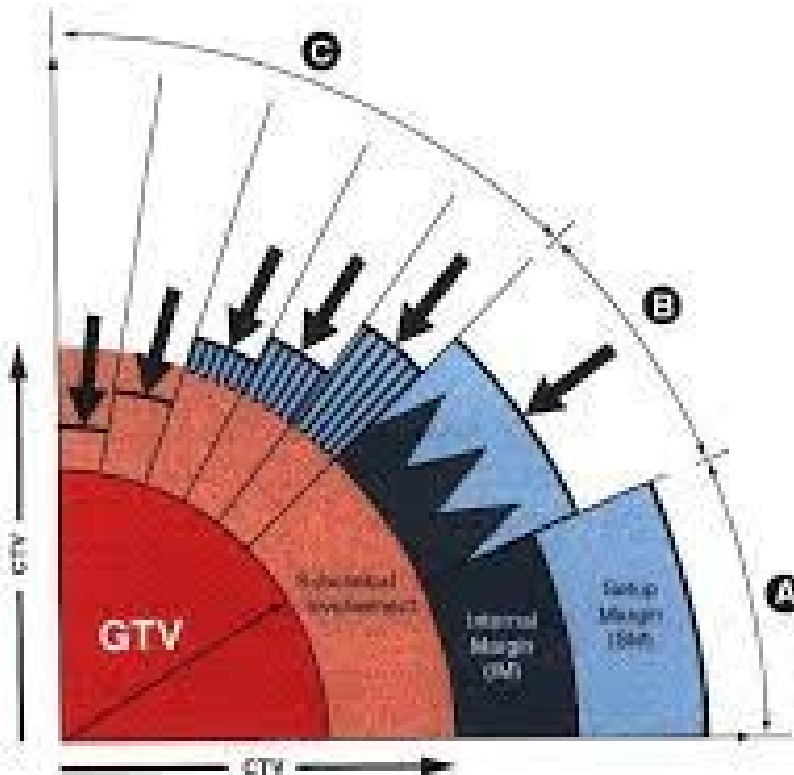
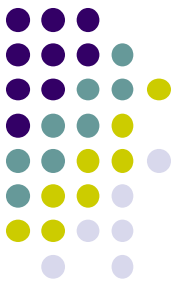
Planificación de IMRT



- **Flujo de Trabajo**
 - 1 Delimitación y márgenes**
 - 2 Colocación de haces, decisión de la configuración de tratamiento**
 - 3 Optimización directa/inversa**
 - 5 Revisión del plan**

Planificación IMRT.

Definición de Volúmenes. ICRU 62

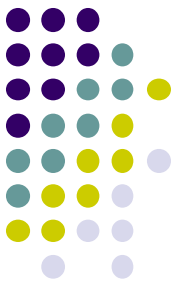


↓ This arrow illustrates the influence of the organs at risk on delineation of the PTV (thick full line).

- Gross Tumor Volume (GTV)
- Subclinical involvement
- Internal Margin (IM)
- Set Up Margin (SM)

Planificación IMRT.

Definición de Volúmenes. ICRU 62



- Identificación del GTV/CTV



Registro CT-PET/SPECT



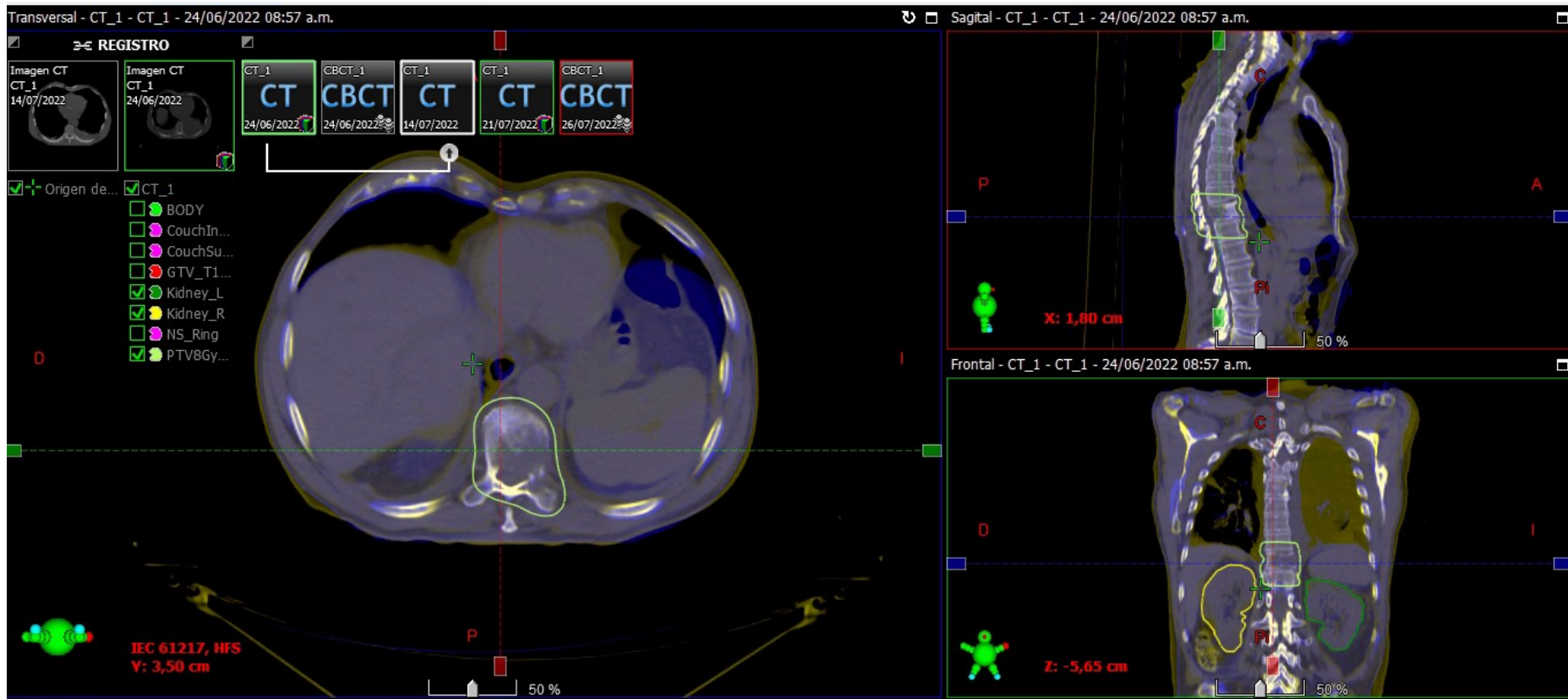
Registro CT-MRI

Planificación IMRT.

Definición de Volúmenes. ICRU 62



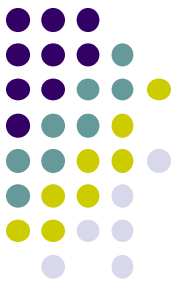
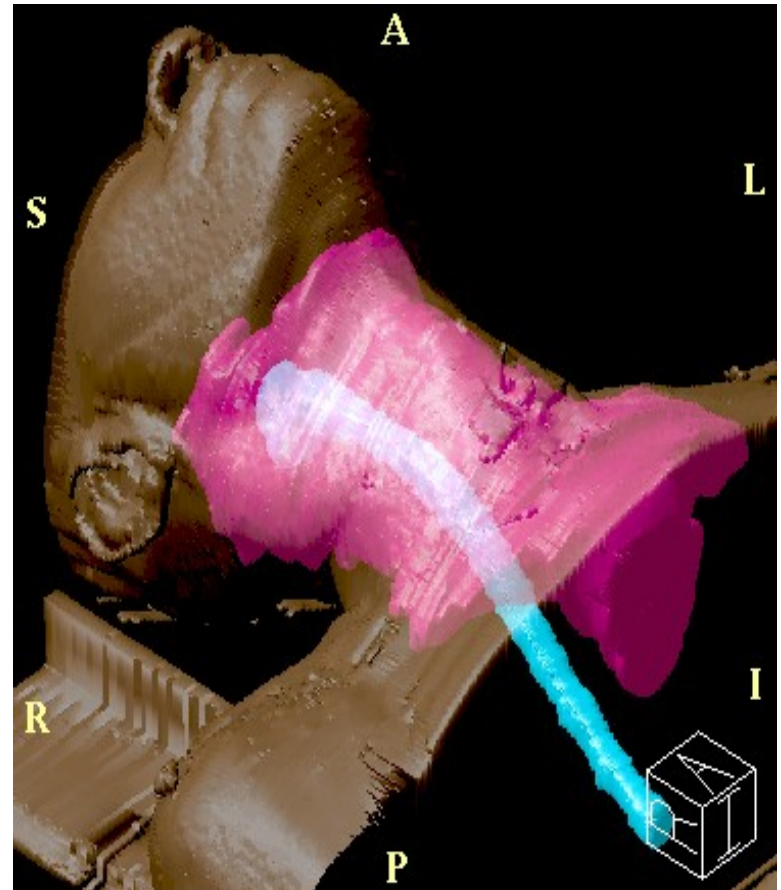
- Identificación del GTV/CTV



Planificación IMRT.

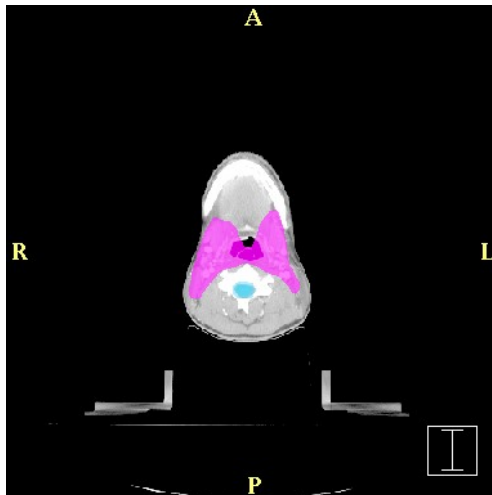
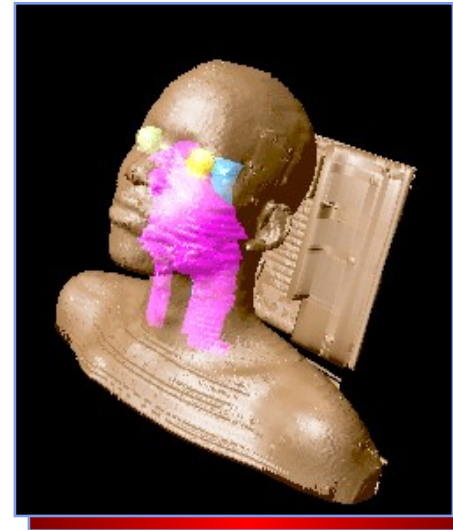
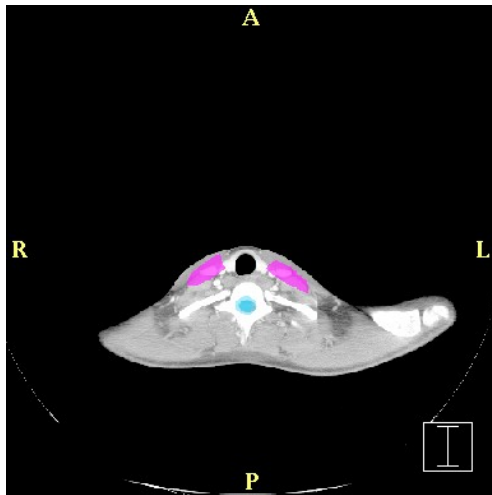
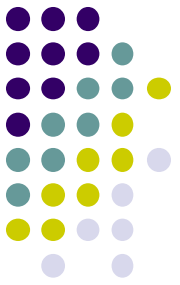
Definición de Volúmenes

- Identificación del GTV / CTV y OARs

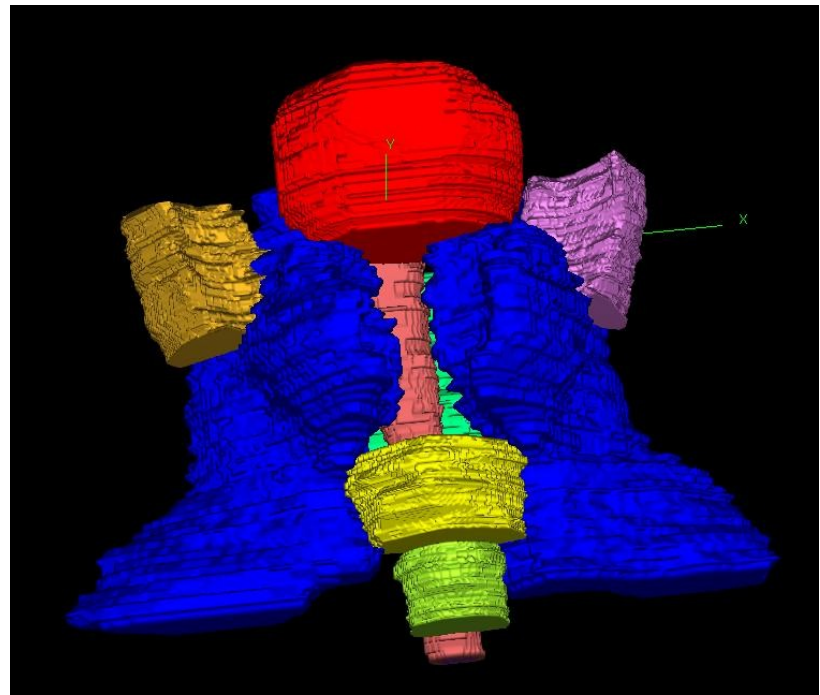
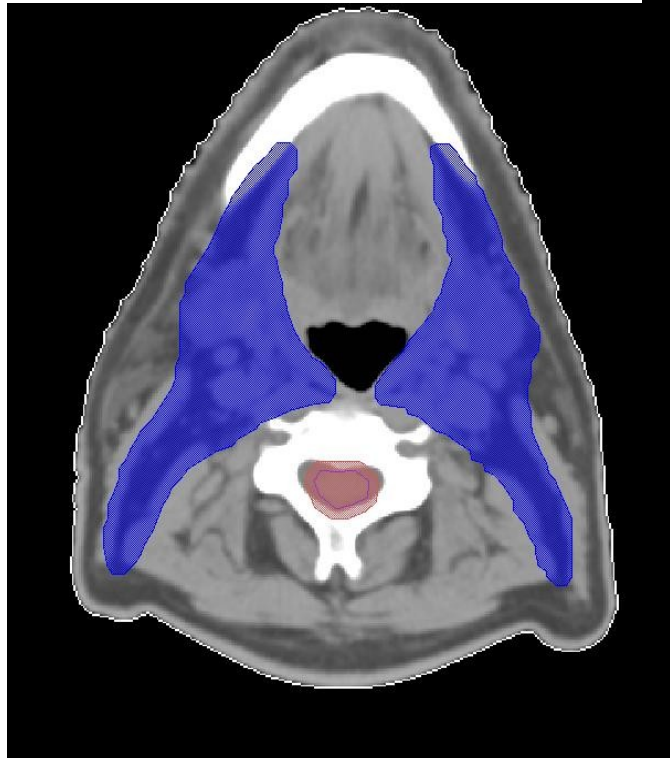
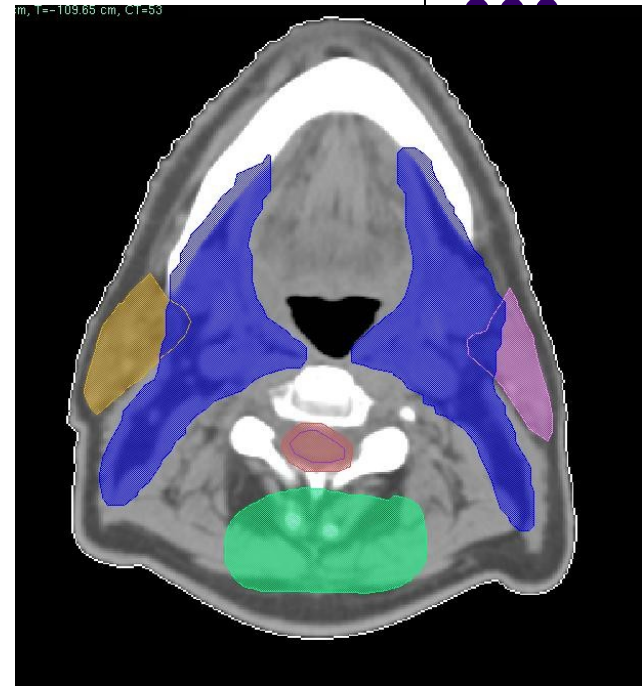
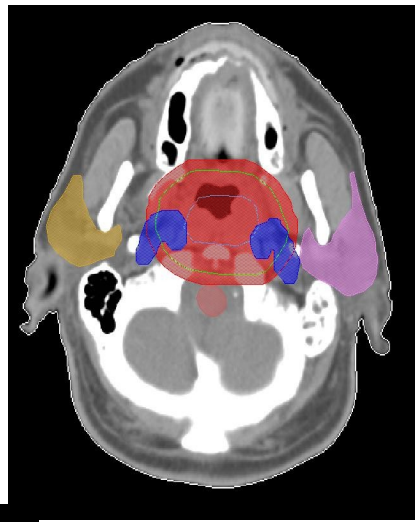
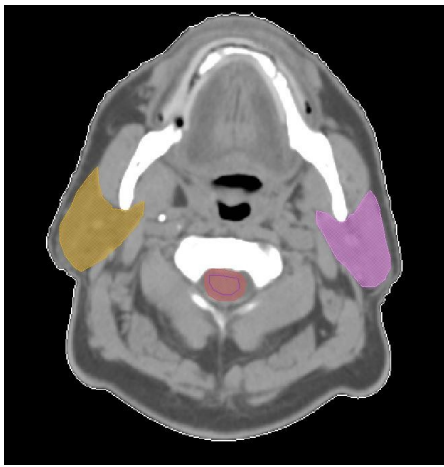


Planificación IMRT.

Definición de Volúmenes



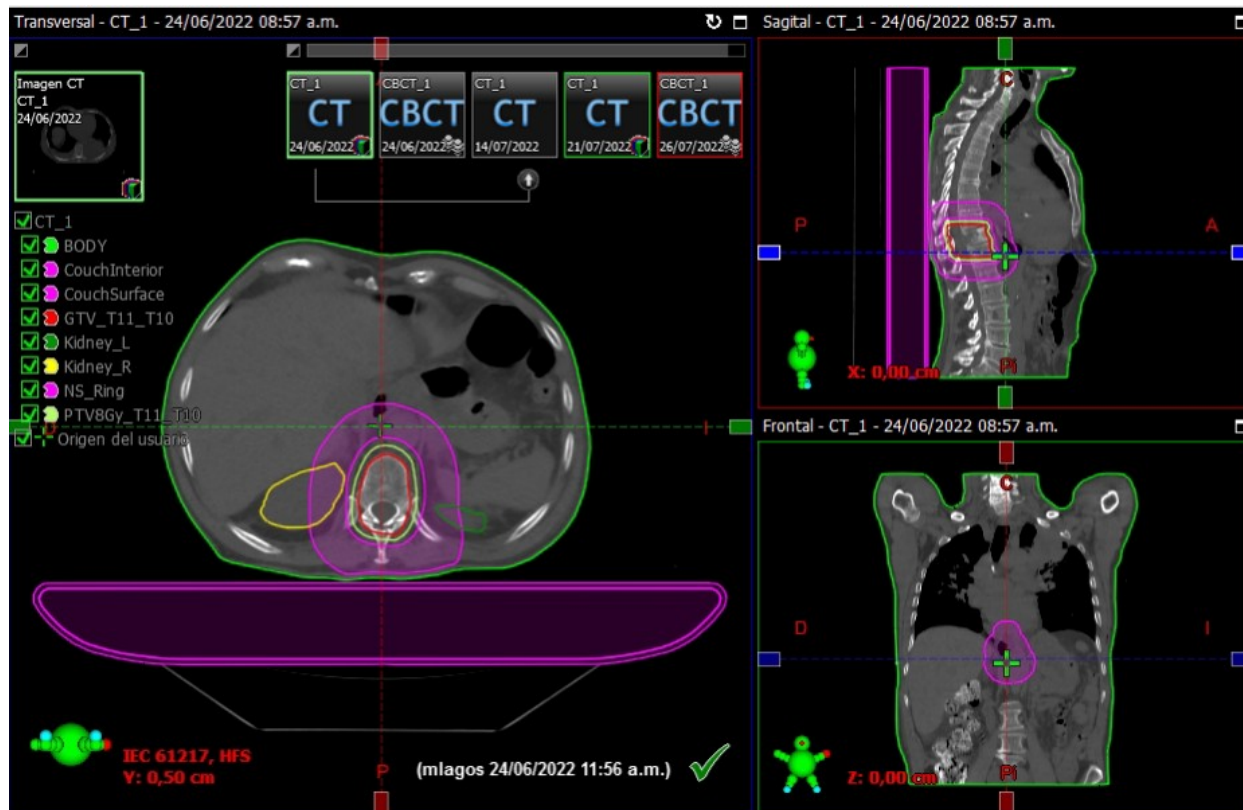
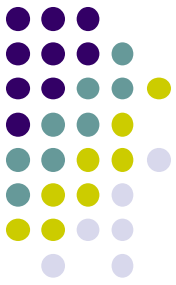
Vista generadas en 3D del GTV/CTV y OARs



Planificación IMRT.

Definición de Volúmenes, estructuras adicionales

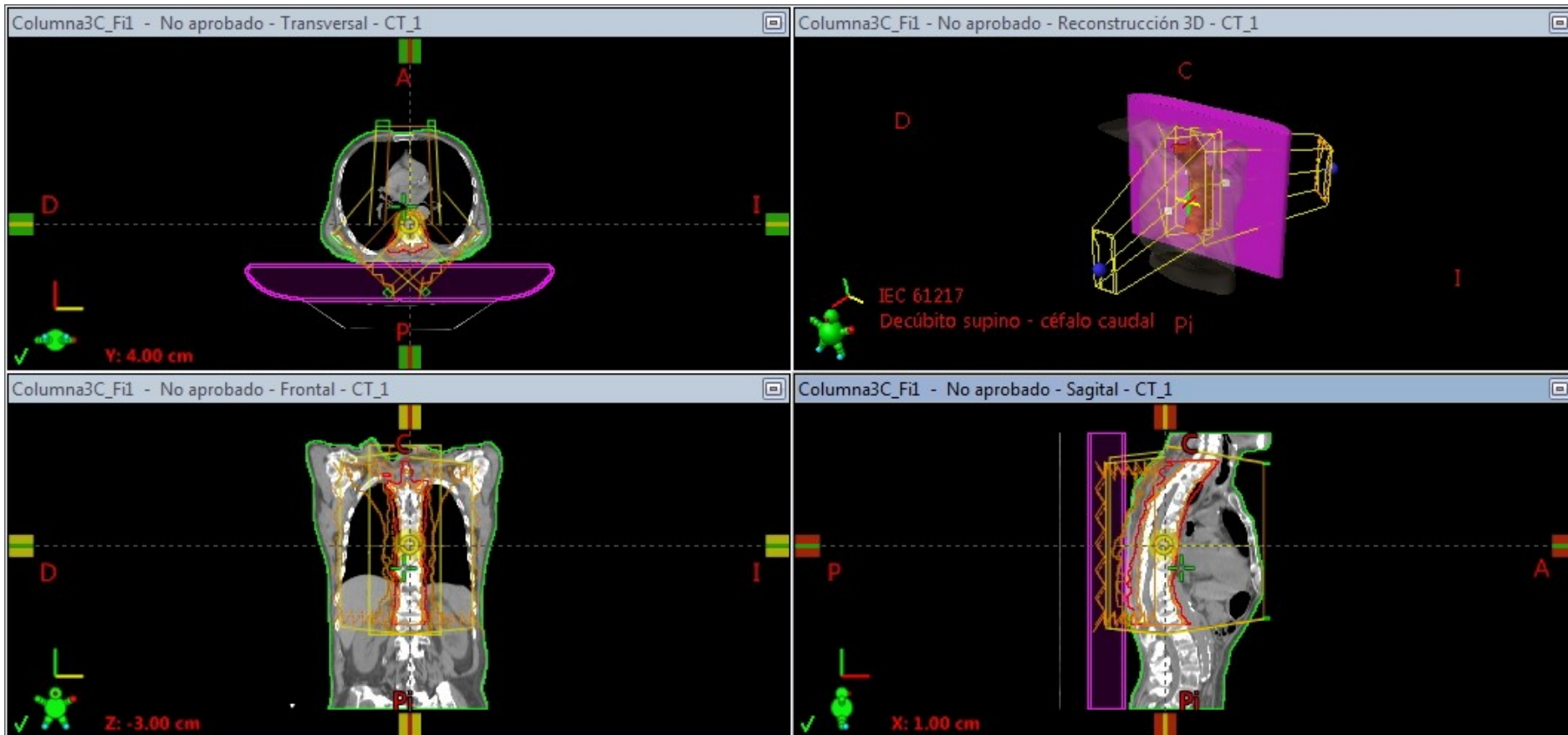
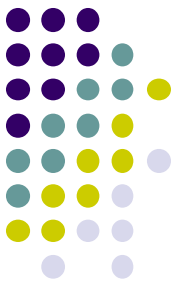
- Estructuras de soporte/camillas
- Compensadores/Bolus
- Estructuras de ayuda a la optimización



Planificación IMRT.

Configuración de tratamiento

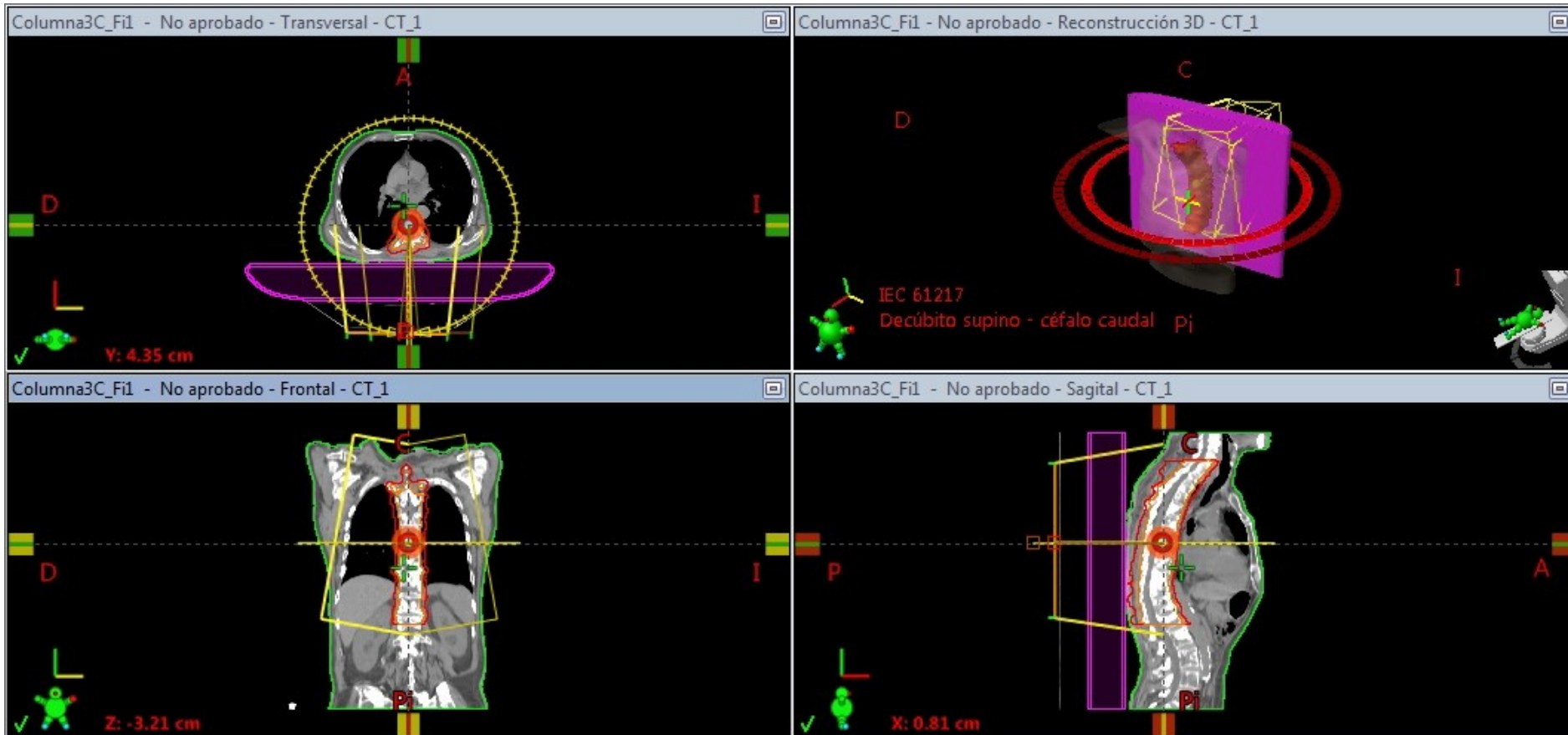
- Administración estática



Planificación IMRT.

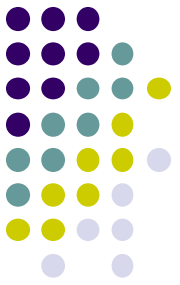
Configuración de tratamiento

- **Administración dinámica**

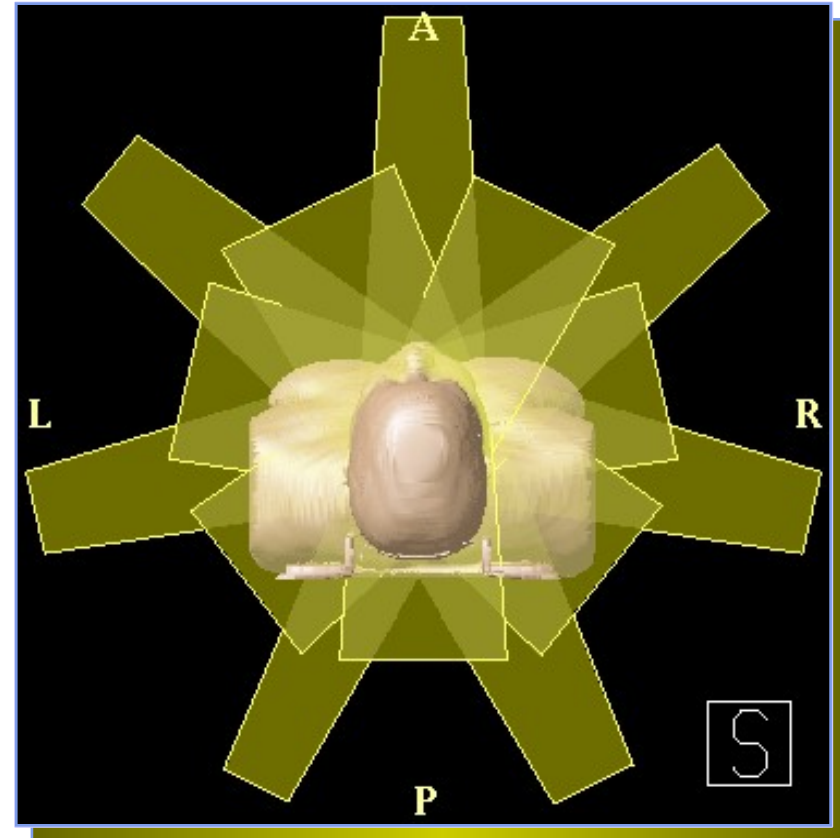


Planificación IMRT.

Configuración de tratamiento. Administración estática

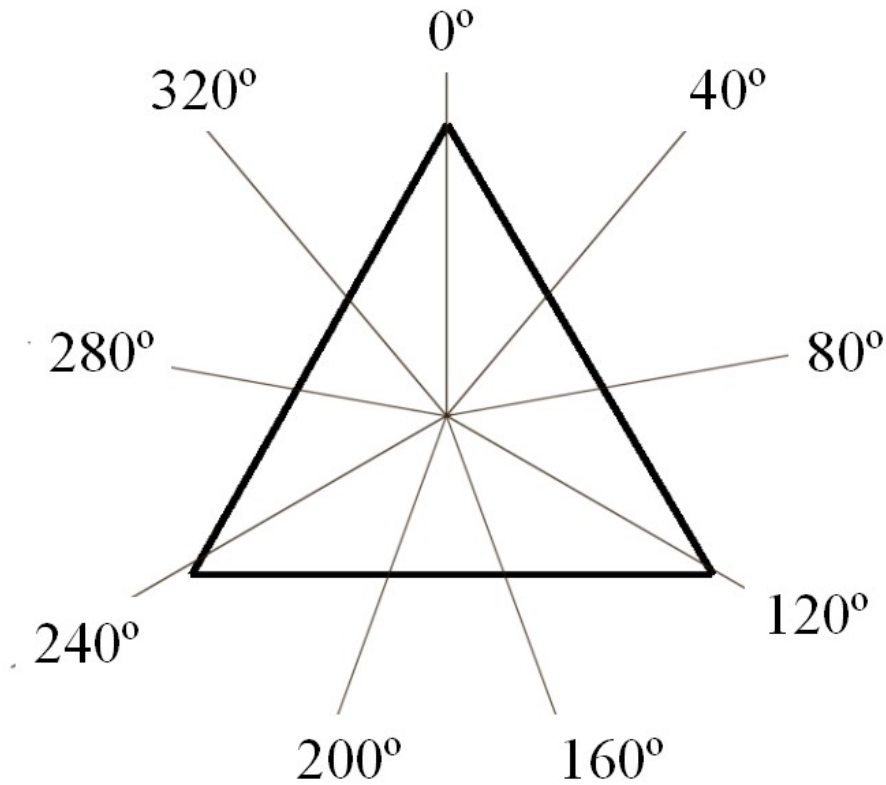
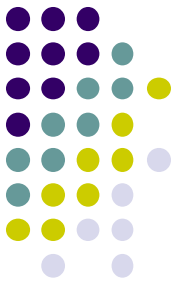


- Se emplean números impares de haces (5, 7 ó 9).
- No se usan haces contrapuestos paralelos



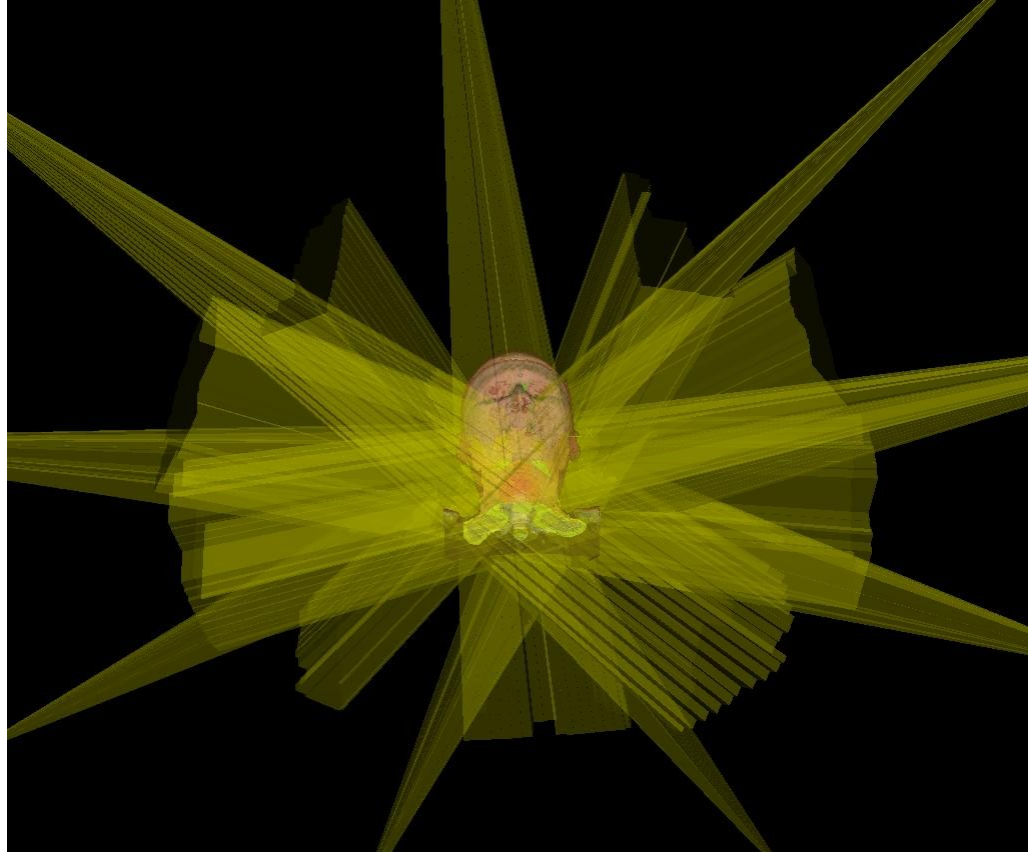
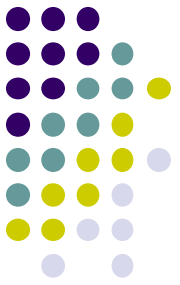
Planificación IMRT.

Configuración de tratamiento. Administración estática



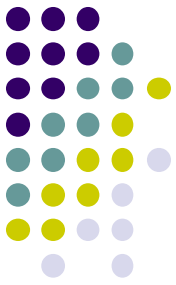
Planificación IMRT.

Configuración de tratamiento. Administración estática

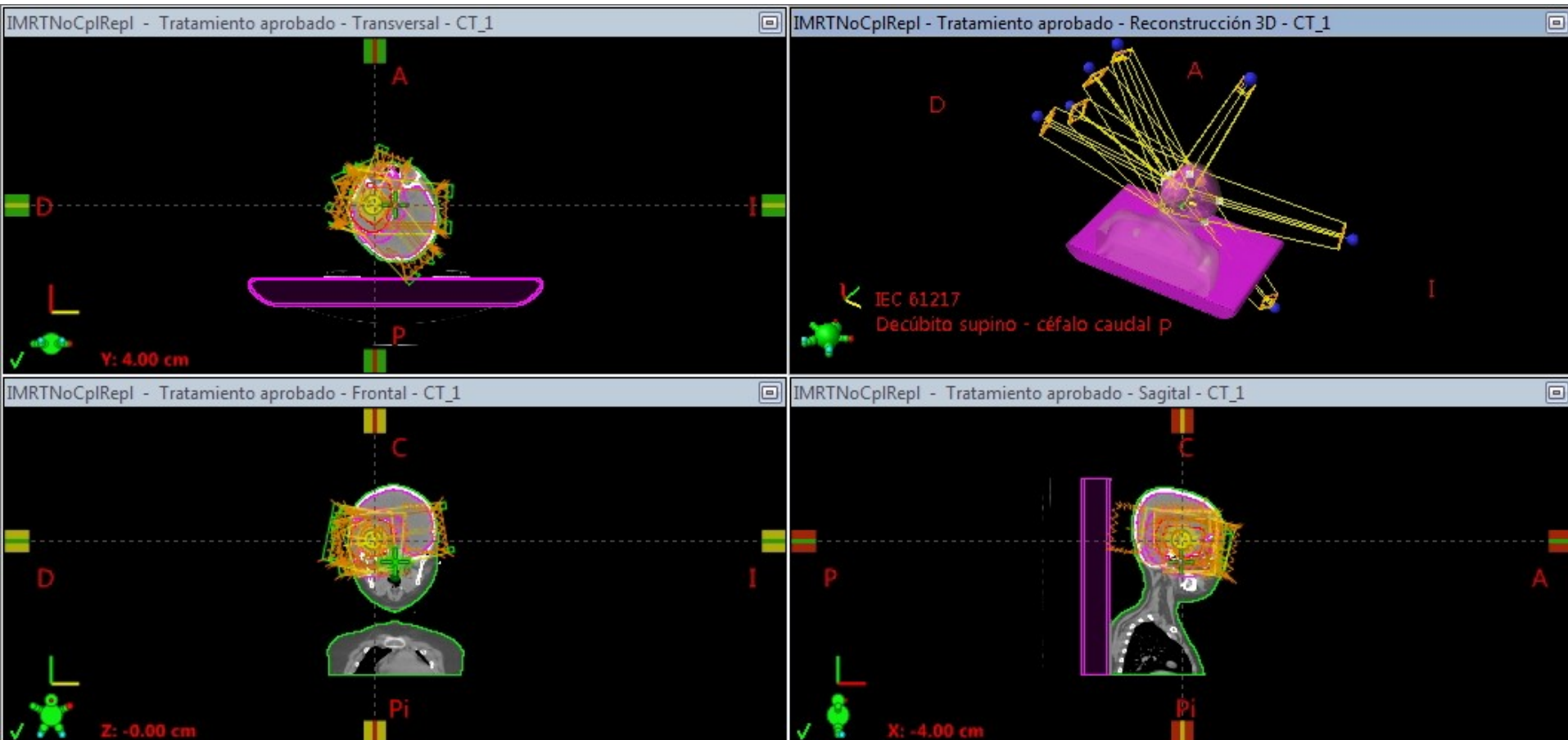


Planificación IMRT.

Configuración de tratamiento. Administración estática



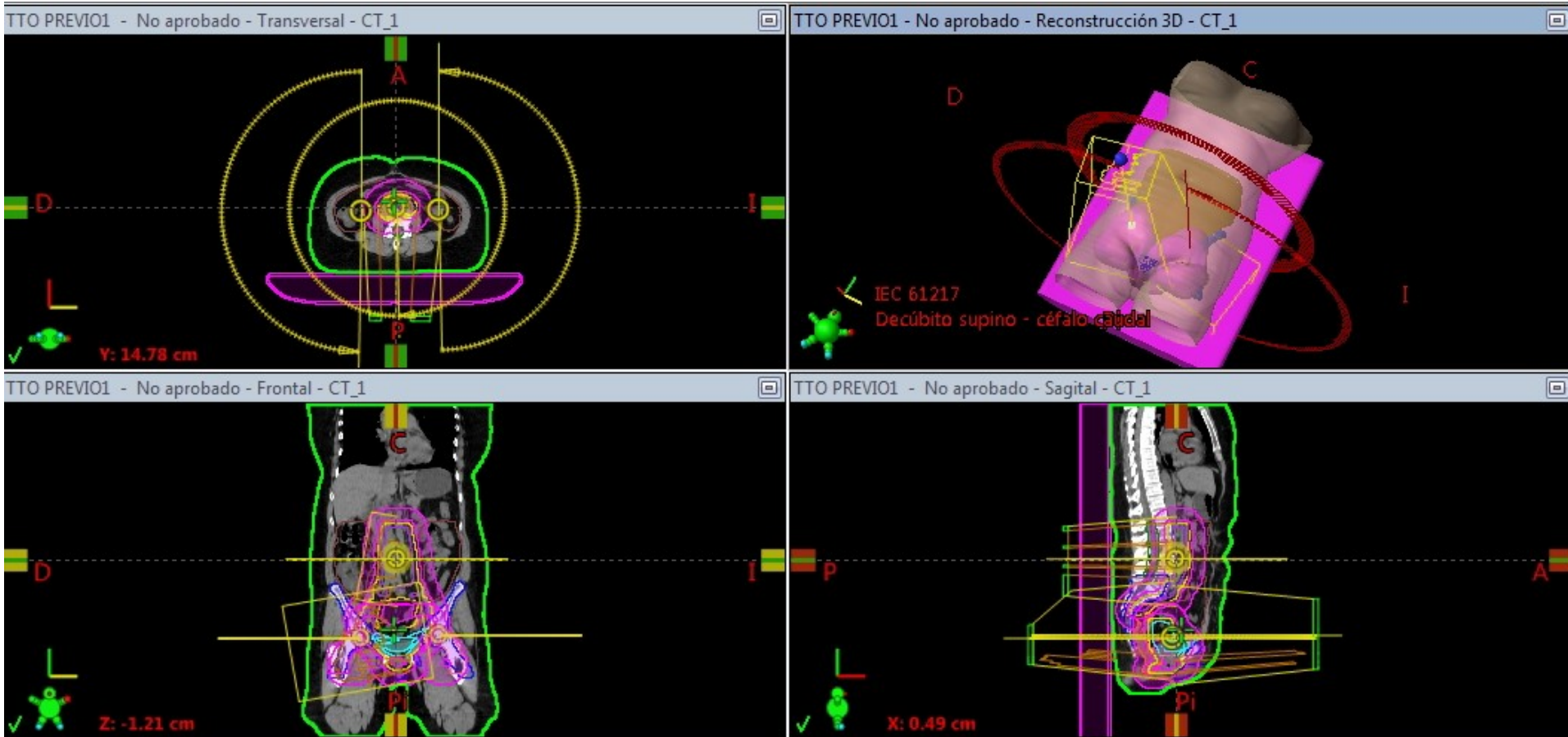
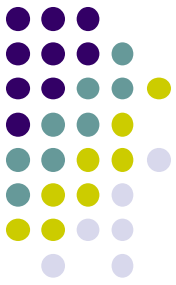
- Campos no coplanares



Planificación IMRT.

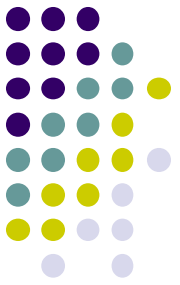
Configuración de tratamiento. Administración dinámica

Uno o más arcos de diferentes amplitudes y centrados en uno o más isocentros dependiendo de la localización/extensión del CTV



Planificación IMRT.

Configuración de tratamiento. Administración dinámica

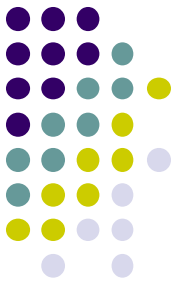


- Arcos no coplanares



Planificación IMRT.

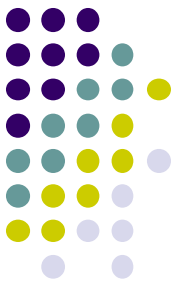
Optimización



- Uno de los pre-requisitos para la aplicación clínica de la IMRT fue el desarrollo de estrategias de PLANIFICACION INVERSA.
- Simplemente porque las estrategias disponibles de planificación directa (“Forward”) no eran factibles de aplicar a la **optimización** del enorme número de parámetros de tratamiento que se presentaron de pronto para lograr una administración eficiente de los campos con IM

Planificación IMRT.

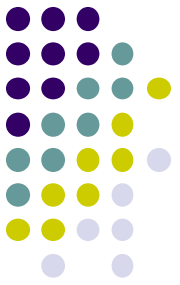
Optimización. Planificación Inversa vs Directa



- **RT Convencional (*Planificación directa*)**
 - El usuario sugiere posible solución
 - El TPS muestra los resultados para implementar el plan
 - Se realiza iteración intuitiva (basada en experticia) hasta lograr un plan aceptable.
- **IMRT (*Planificación inversa*)**
 - El usuario establece objetivos (“*goals*”) deseados en términos de dosis y volúmenes
 - El TPS sugiere una “solución óptima” por iteraciones sucesivas
 - El usuario evalúa el plan sugerido por el TPS y eventualmente restablece los goals hasta que el plan sea satisfactorio

Planificación IMRT.

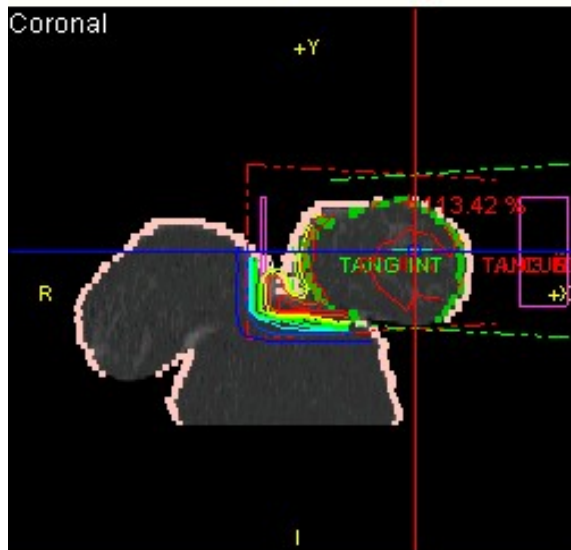
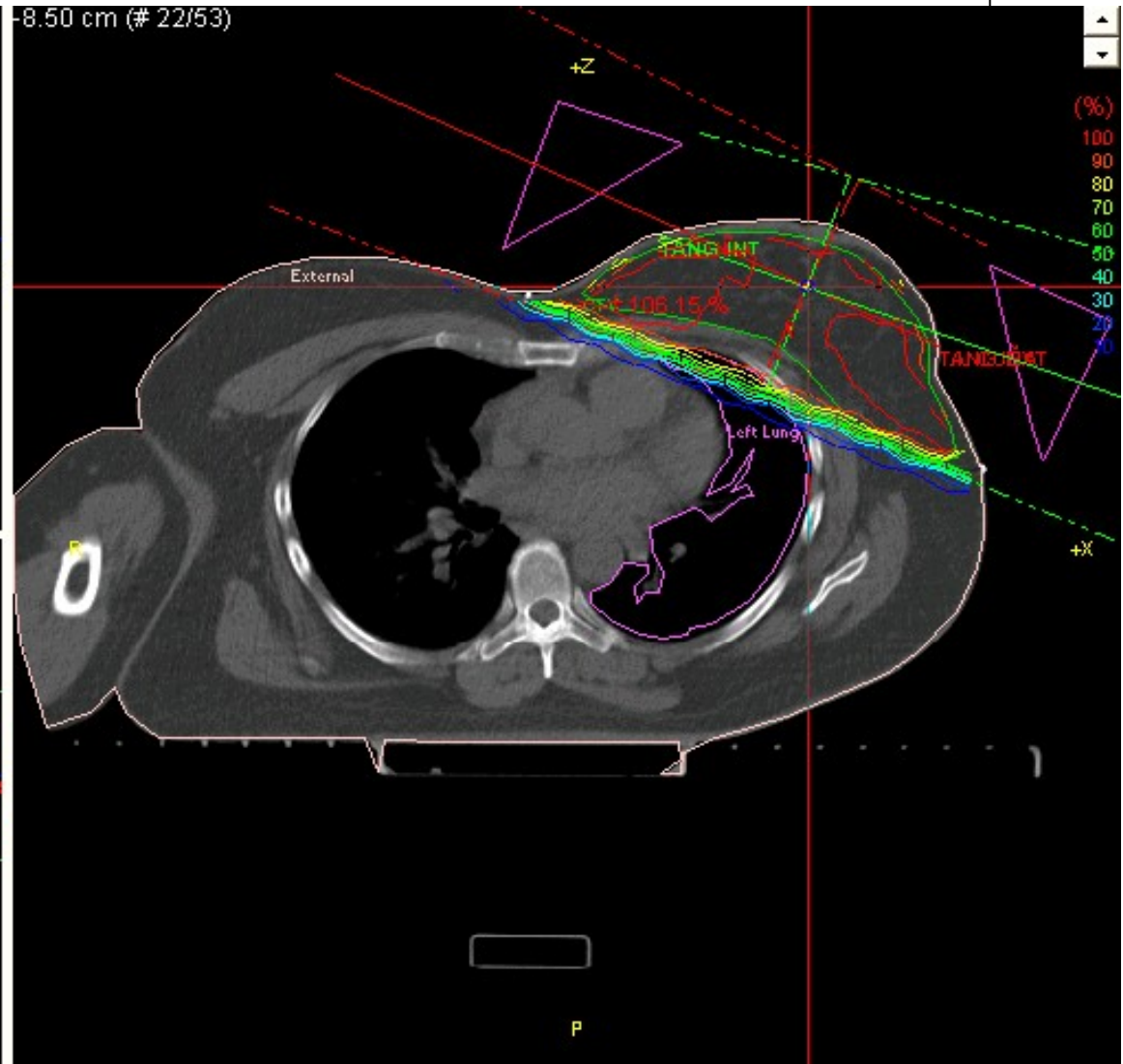
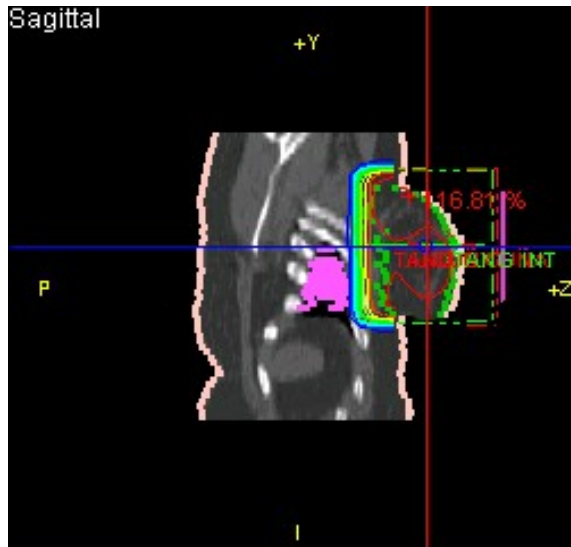
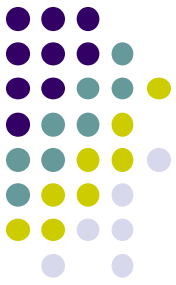
Optimización. Planificación Directa (field-in-field)



- **Utiliza las herramientas de planificación existentes para 3DCRT**
- **Definición de segmentos estáticos de campos superpuestos**
- **pesos intuitivos o asignados mediante optimización asistida**
- **distribuciones de dosis resultantes en el volumen blanco y órganos críticos reajustadas iterativamente (prueba-error)**

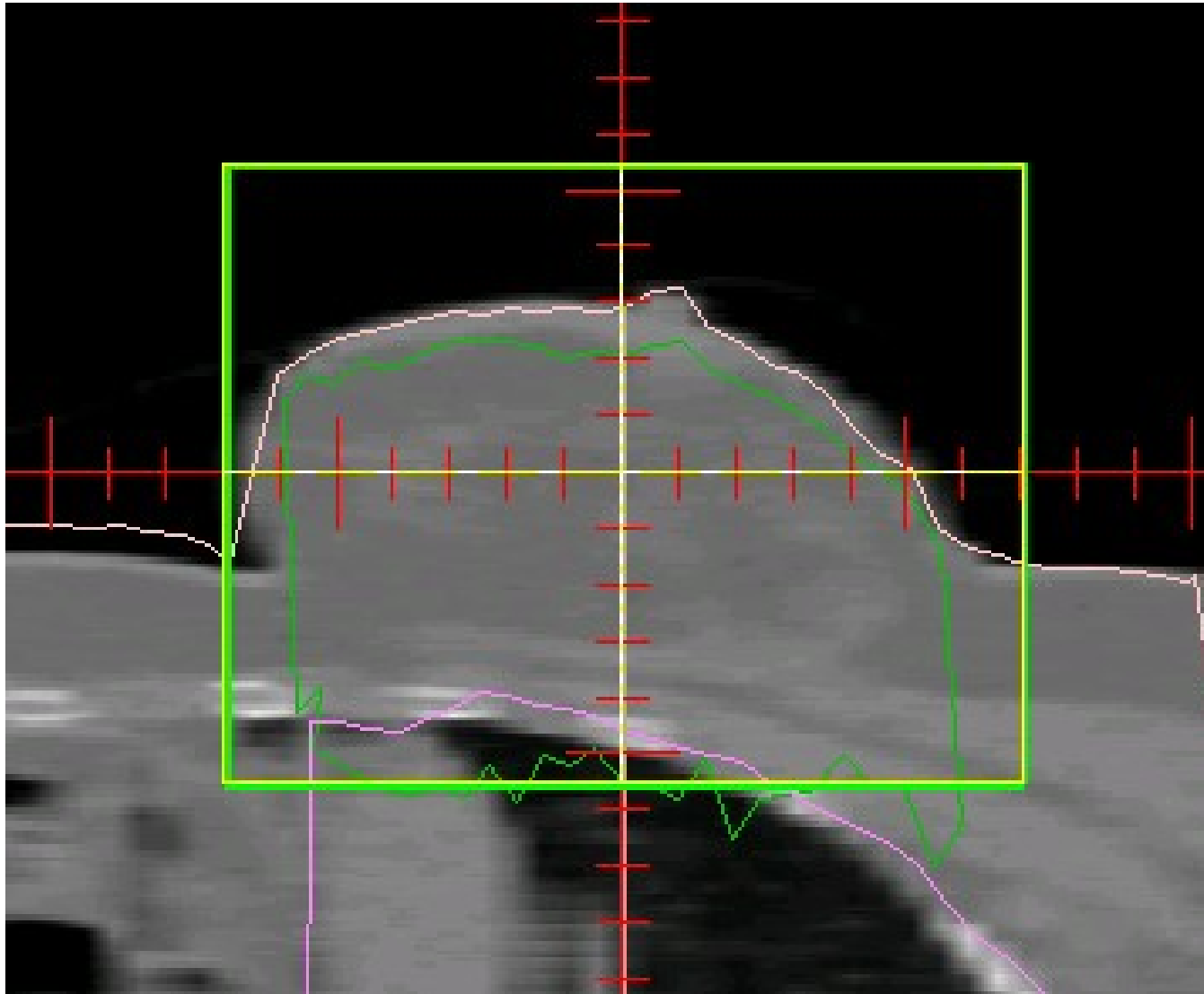
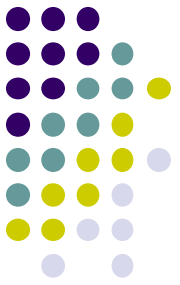
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



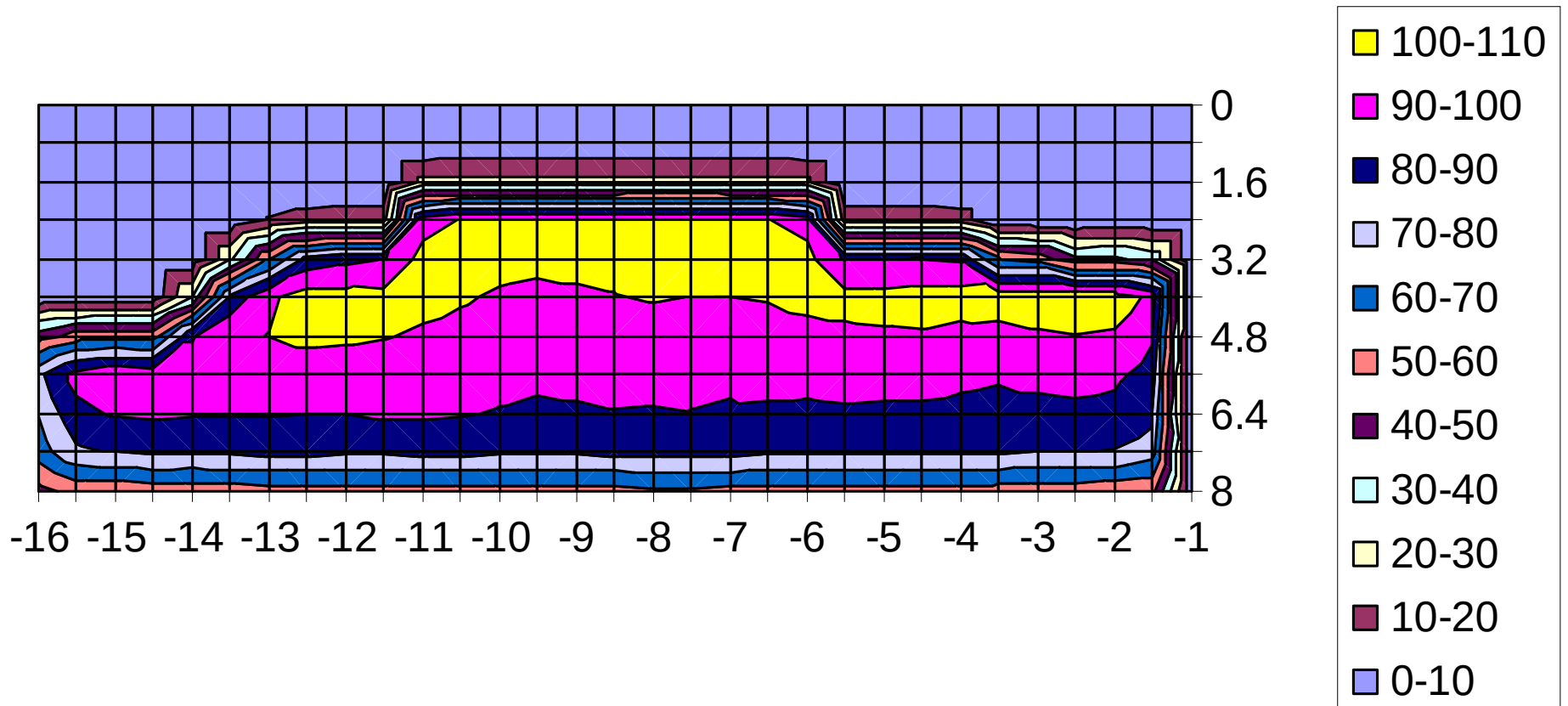
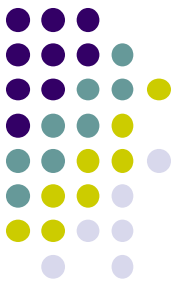
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



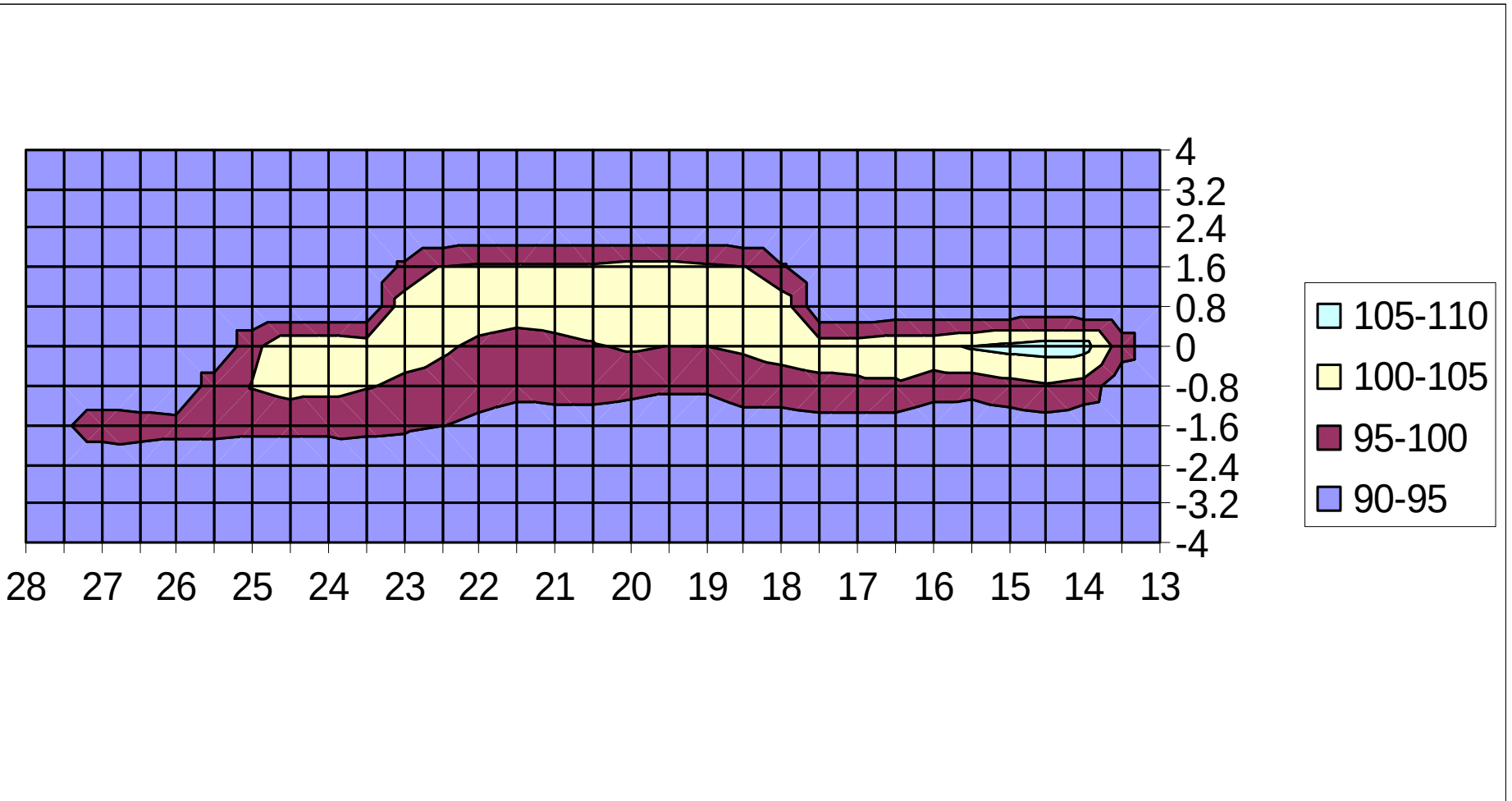
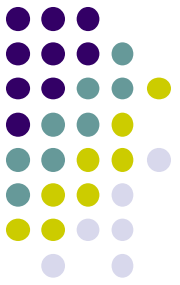
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)

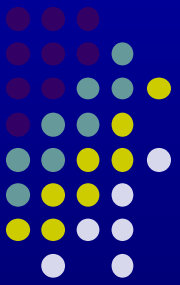


Planificación IMRT.

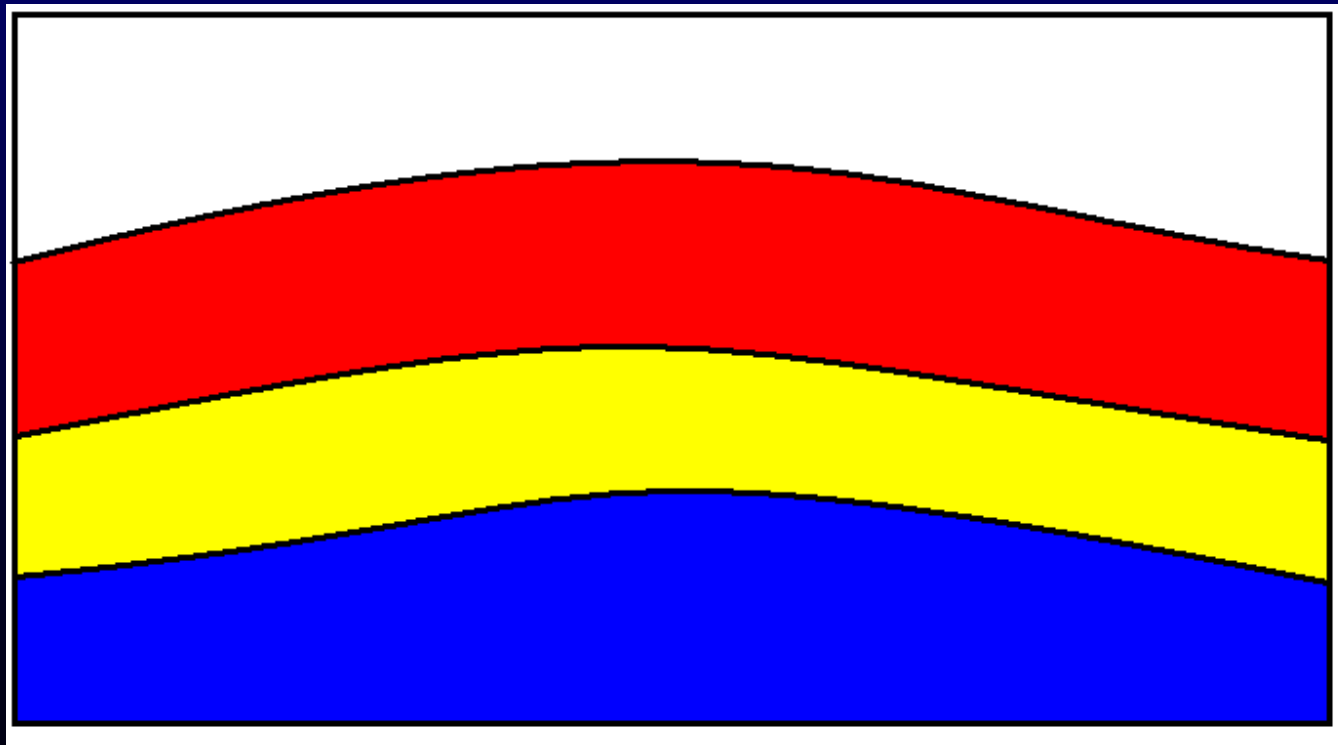
Optimización. Planificación Directa (field-in-field)



Desarrollo de la Solución Tipo. Asignación de pesos



Segmento Tipo A. Peso 100% Condición Inicial

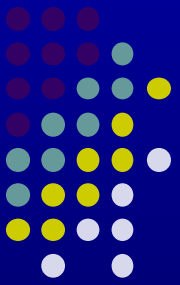


100-105%

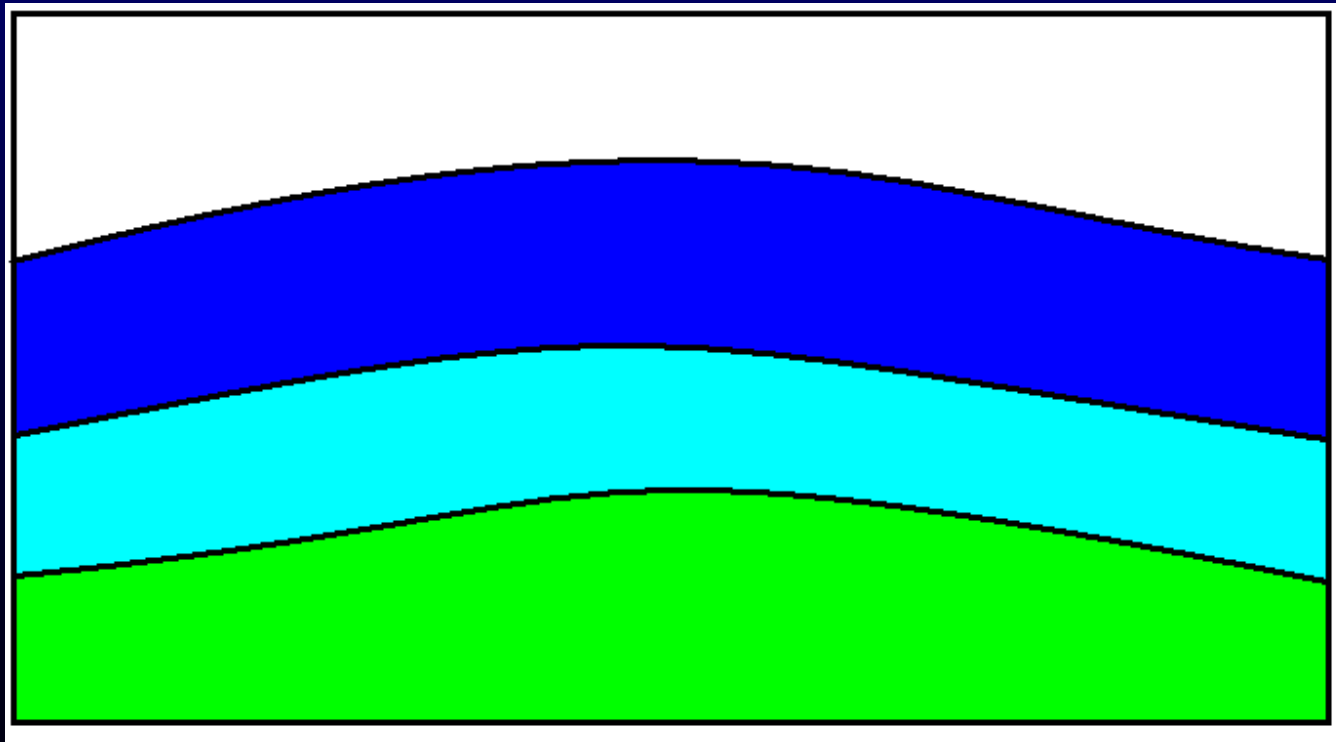
95-100%

90-95%

Desarrollo de la Solución Tipo. Asignación de pesos



Segmento Tipo A. Peso 90%

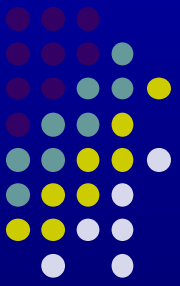


90-95%

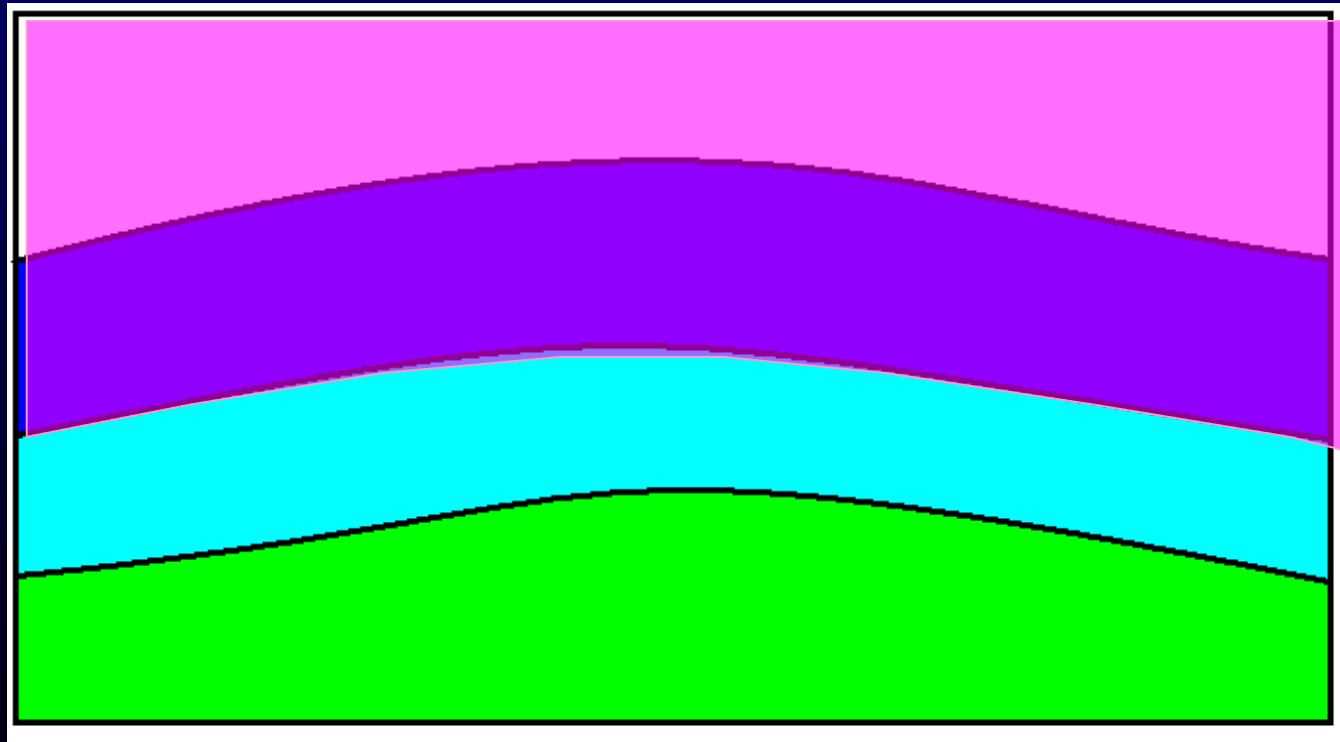
85-90%

80-85%

Desarrollo de la Solución Tipo. Asignación de pesos



Segmento Tipo B. Peso 5%



90-95%

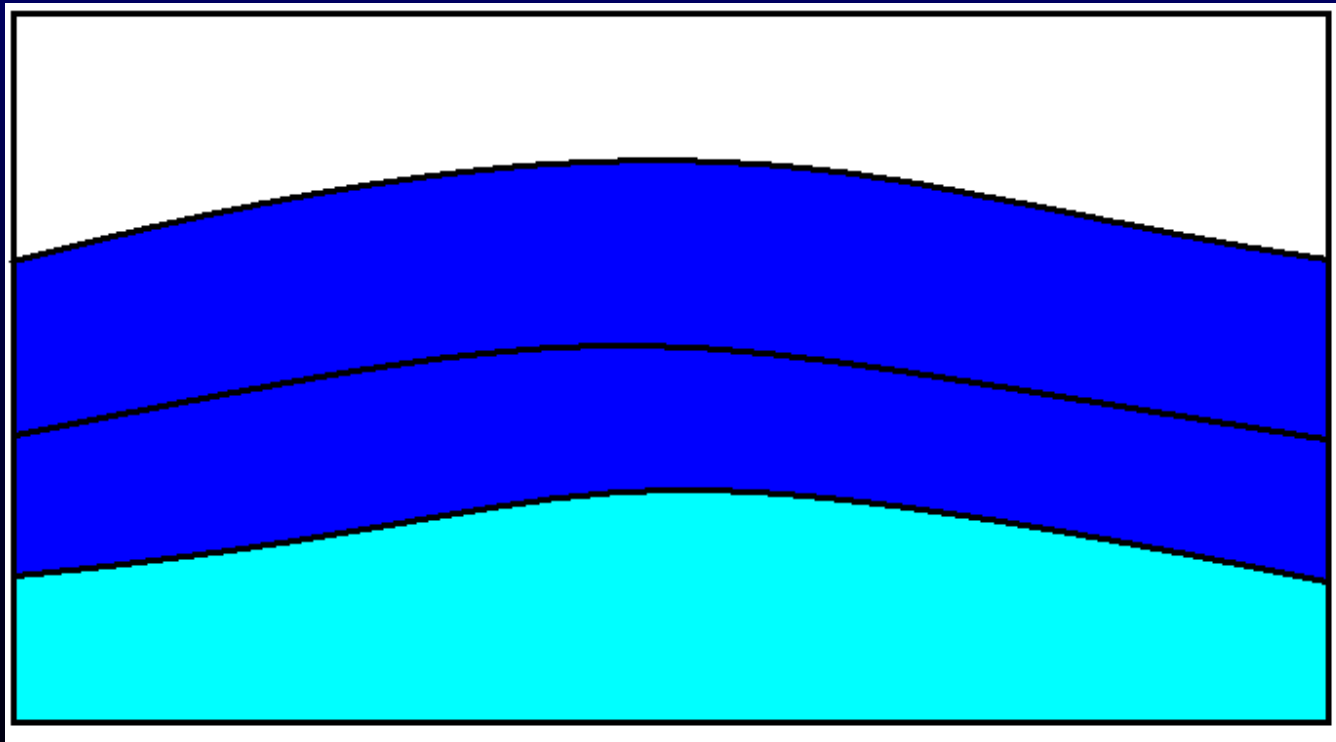
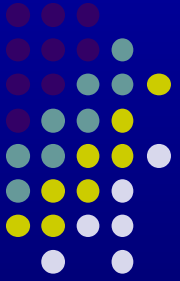
85-90%

80-85%

Desarrollo de la Solución Tipo.

Asignación de pesos

1er Segmento Tipo B. Peso 5%



90-95%

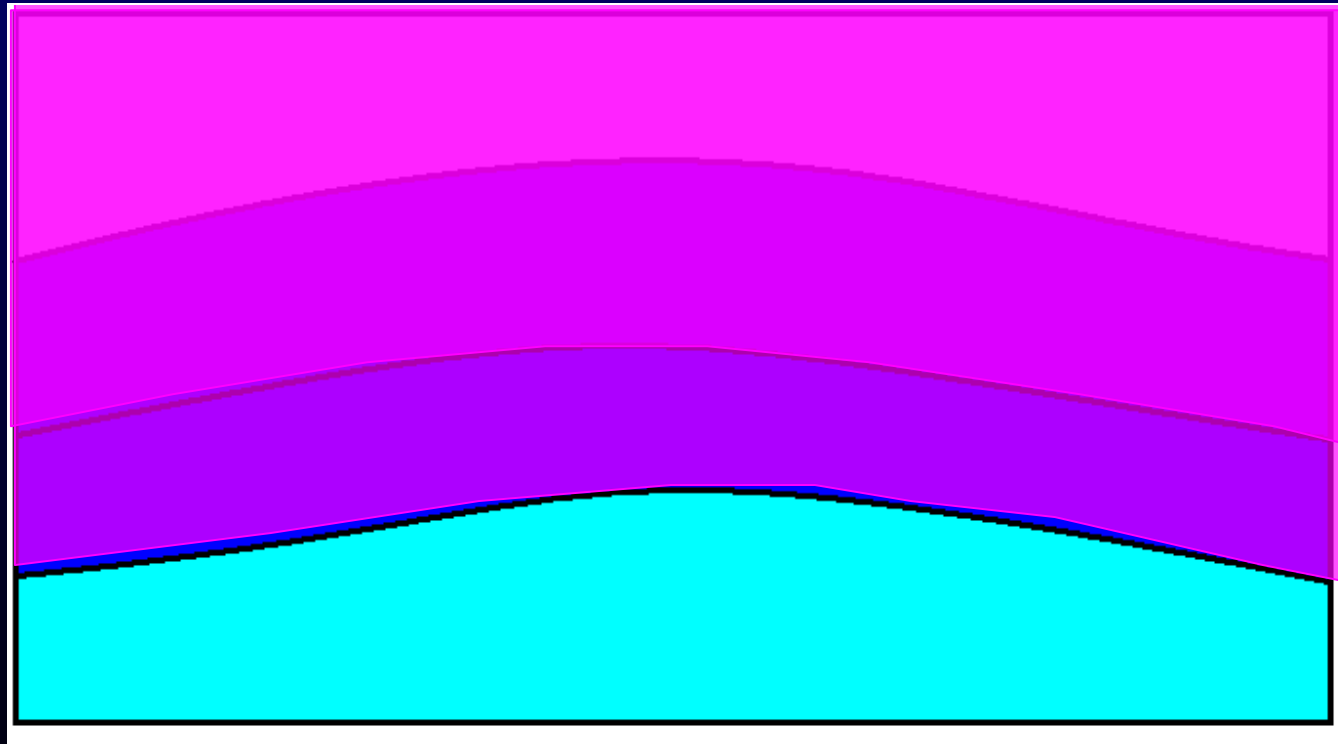
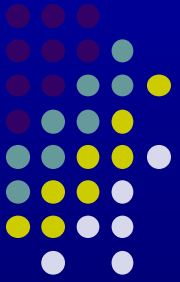
90-95%

85-90%

Desarrollo de la Solución Tipo.

Asignación de pesos

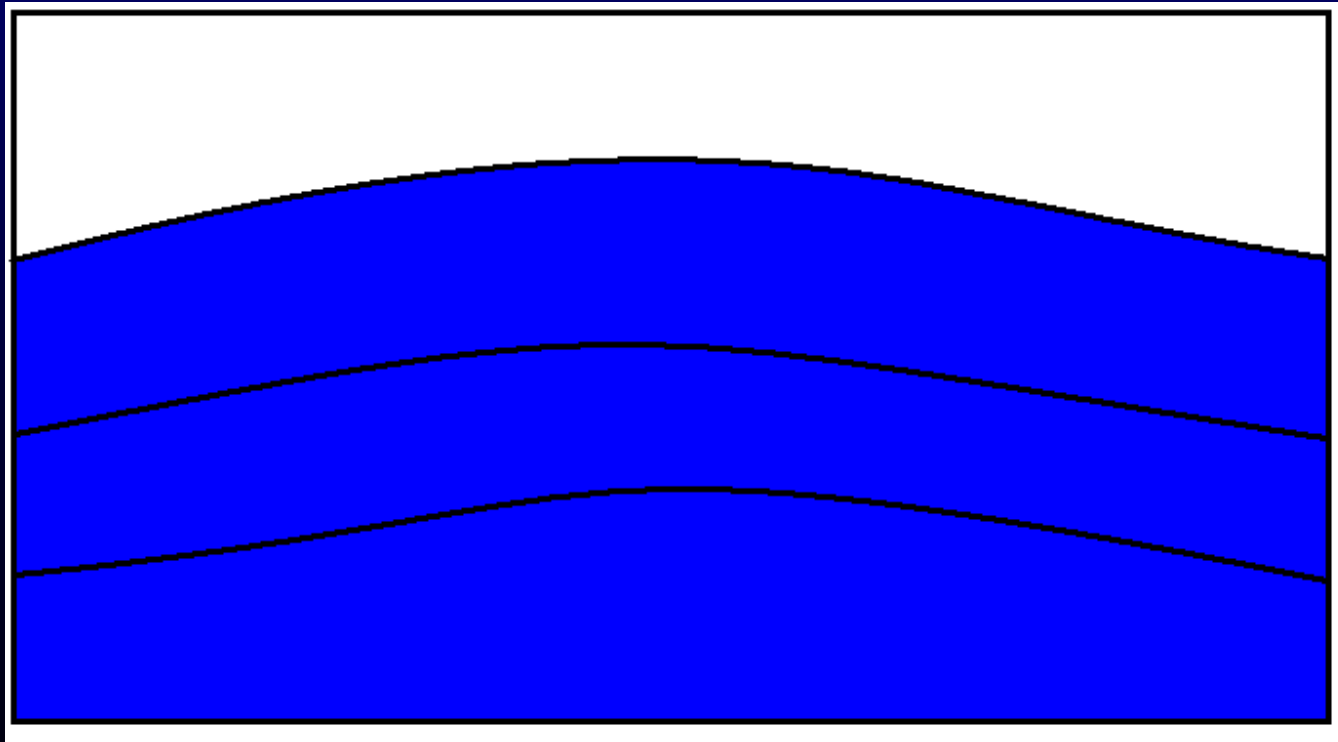
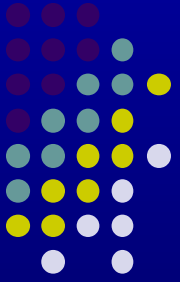
1er Segmento Tipo B. Peso 5%



Desarrollo de la Solución Tipo.

Asignación de pesos

Resultado Final



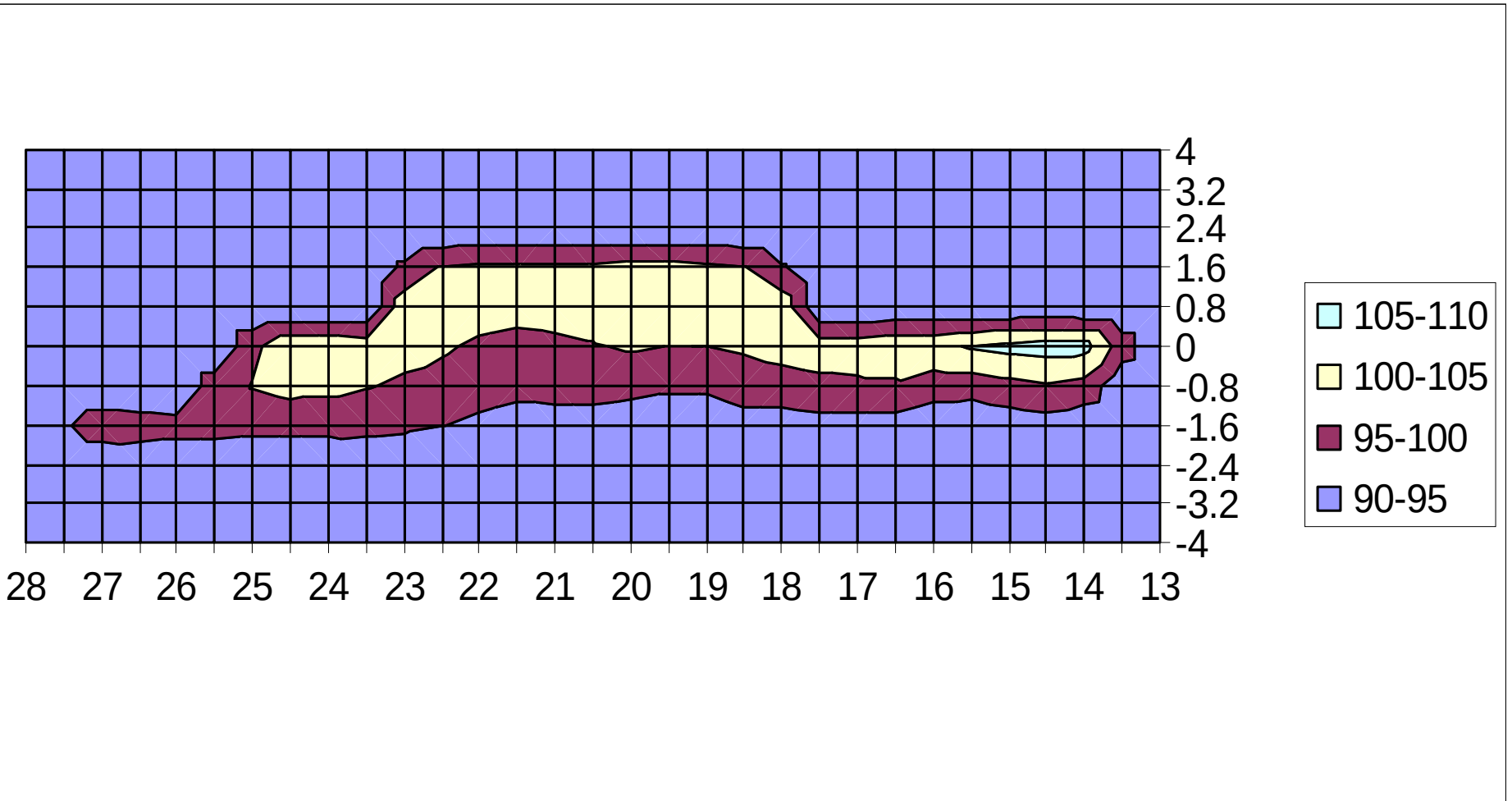
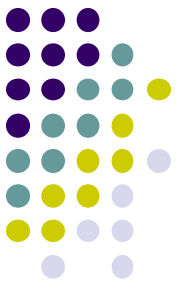
90-95%

90-95%

90-95%

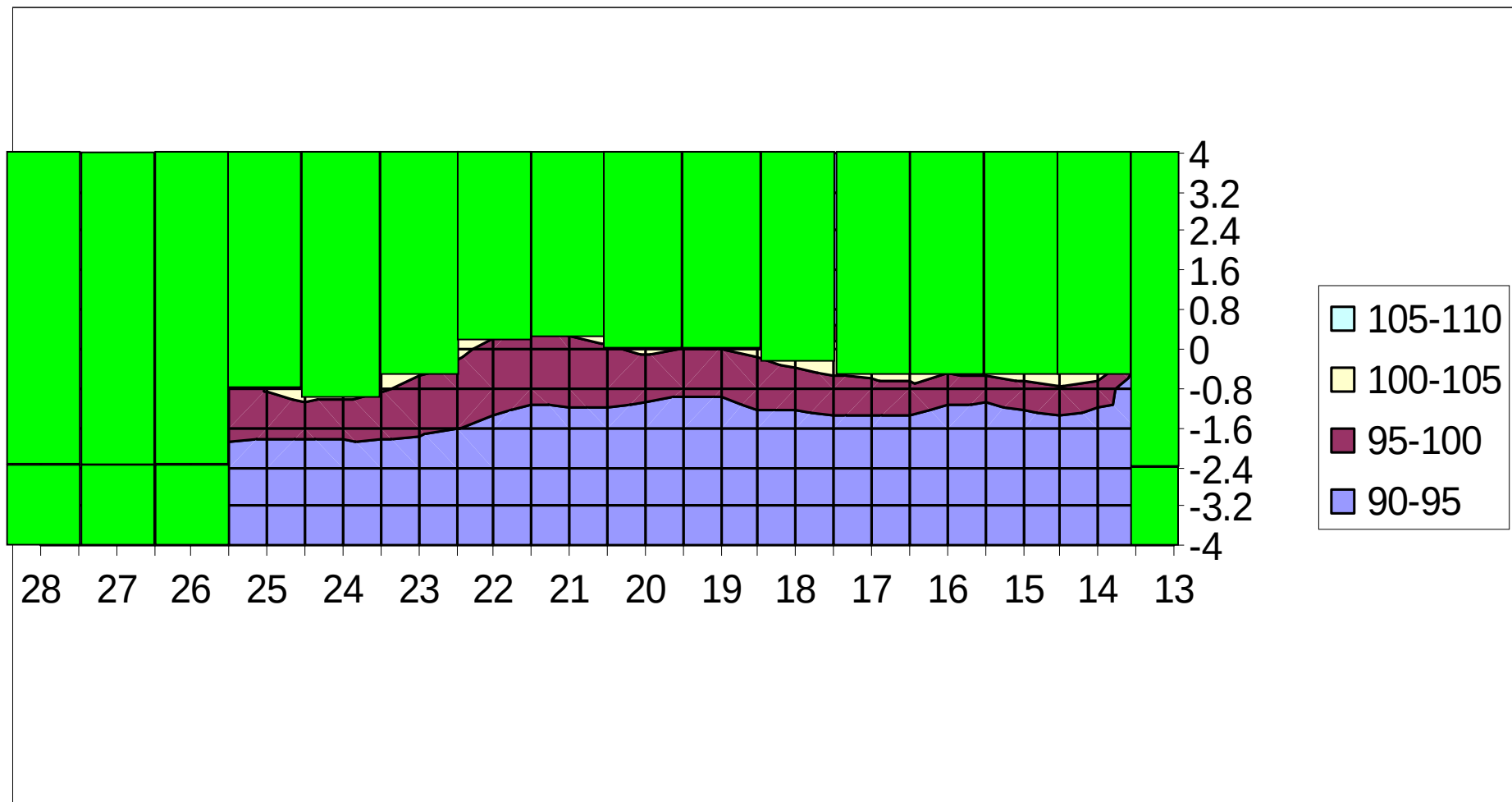
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



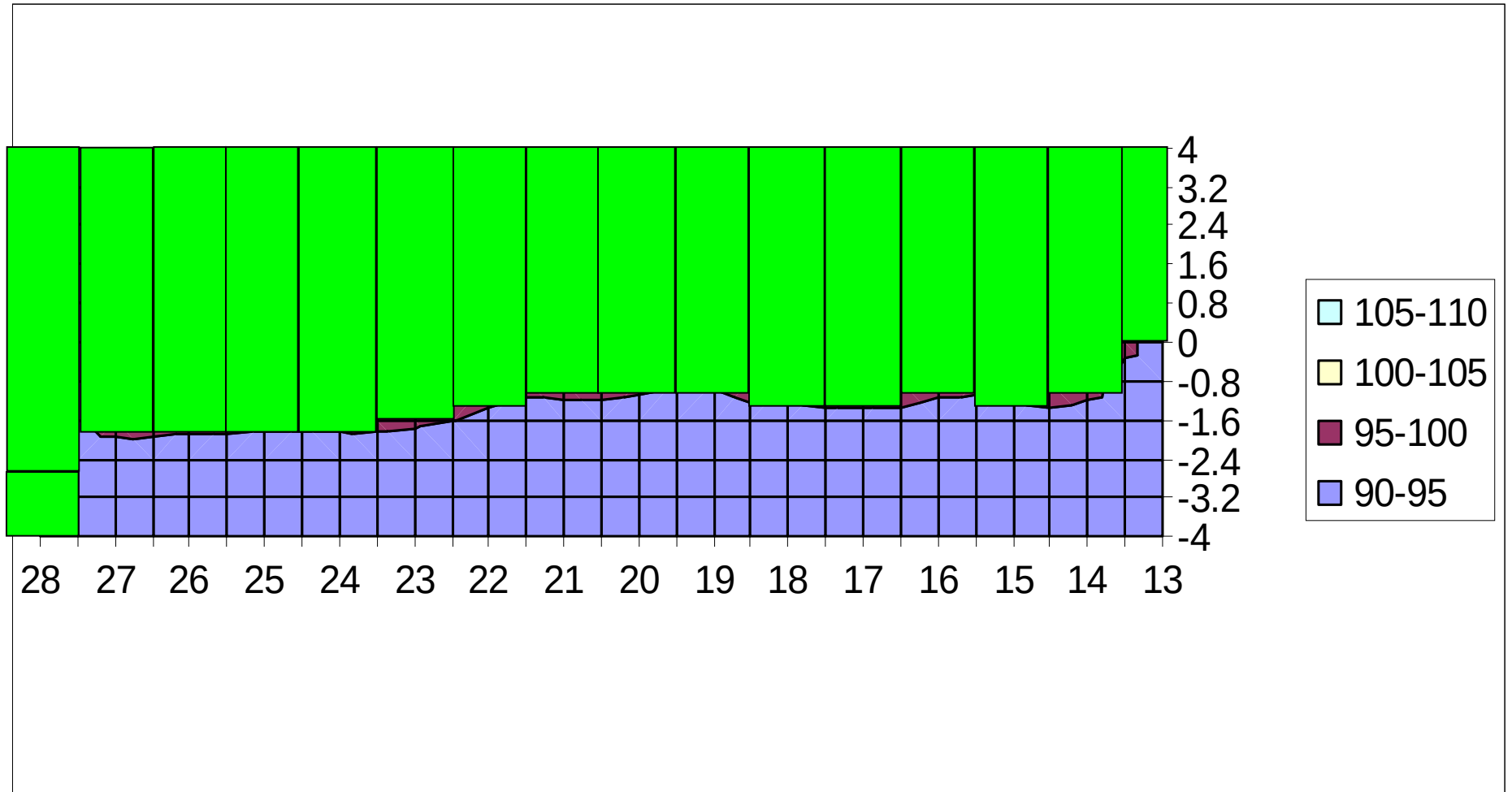
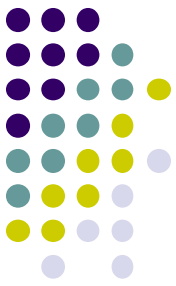
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



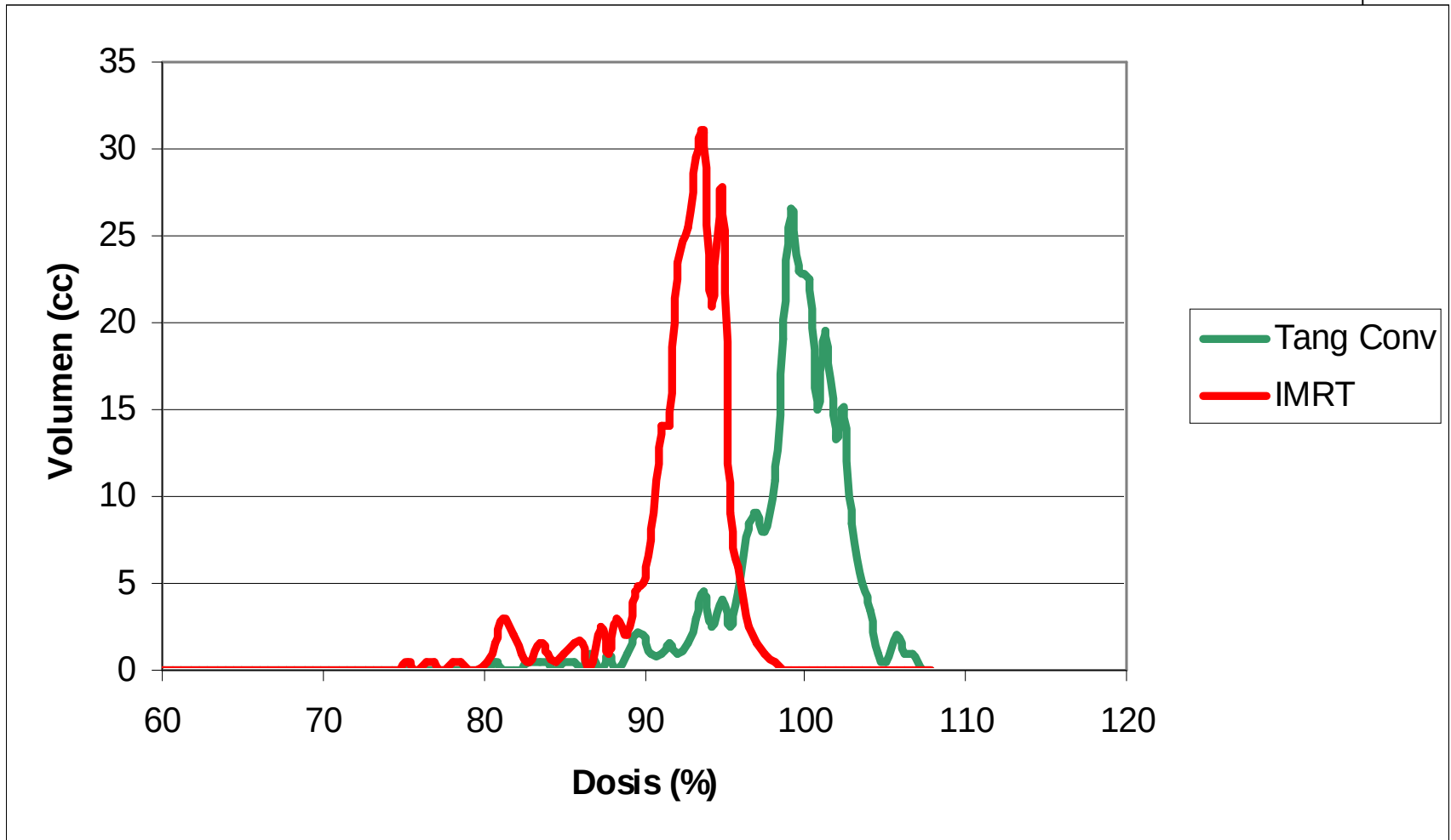
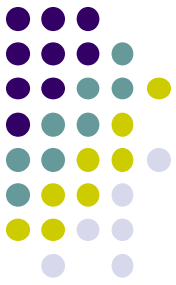
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



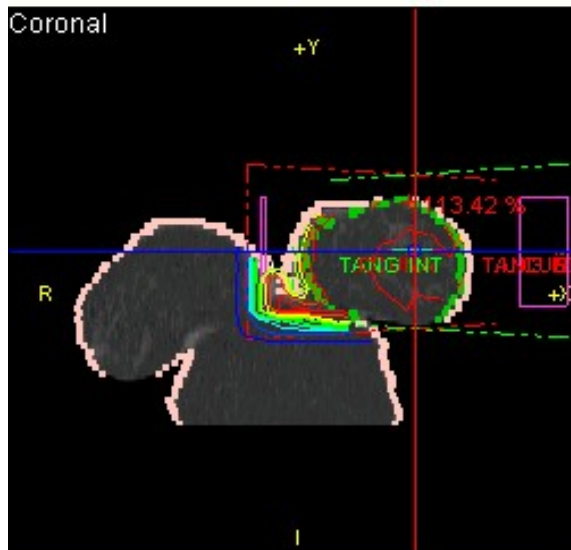
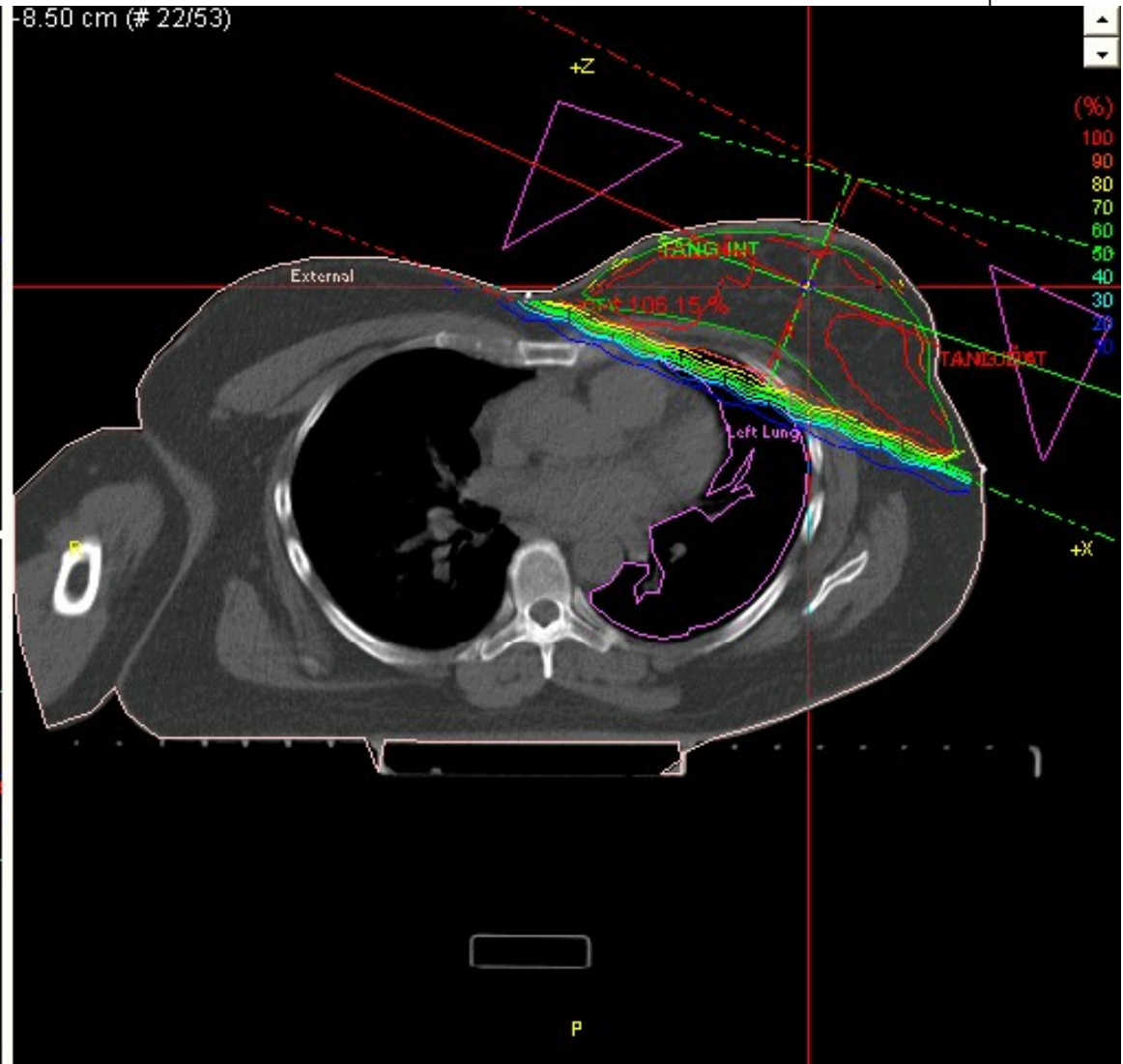
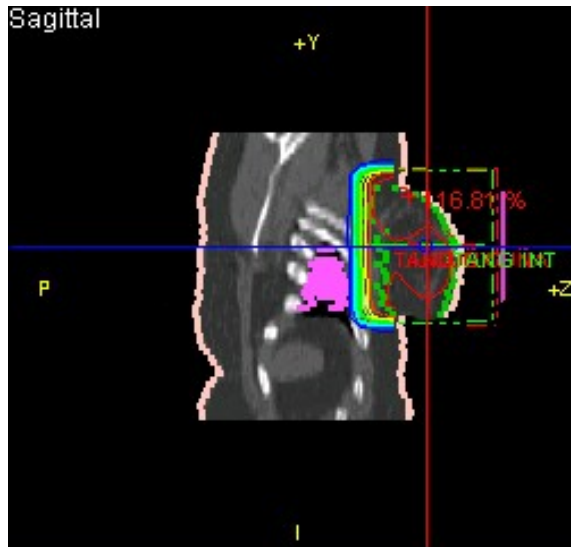
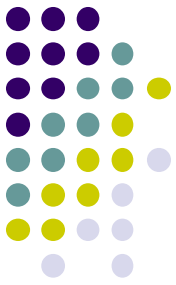
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



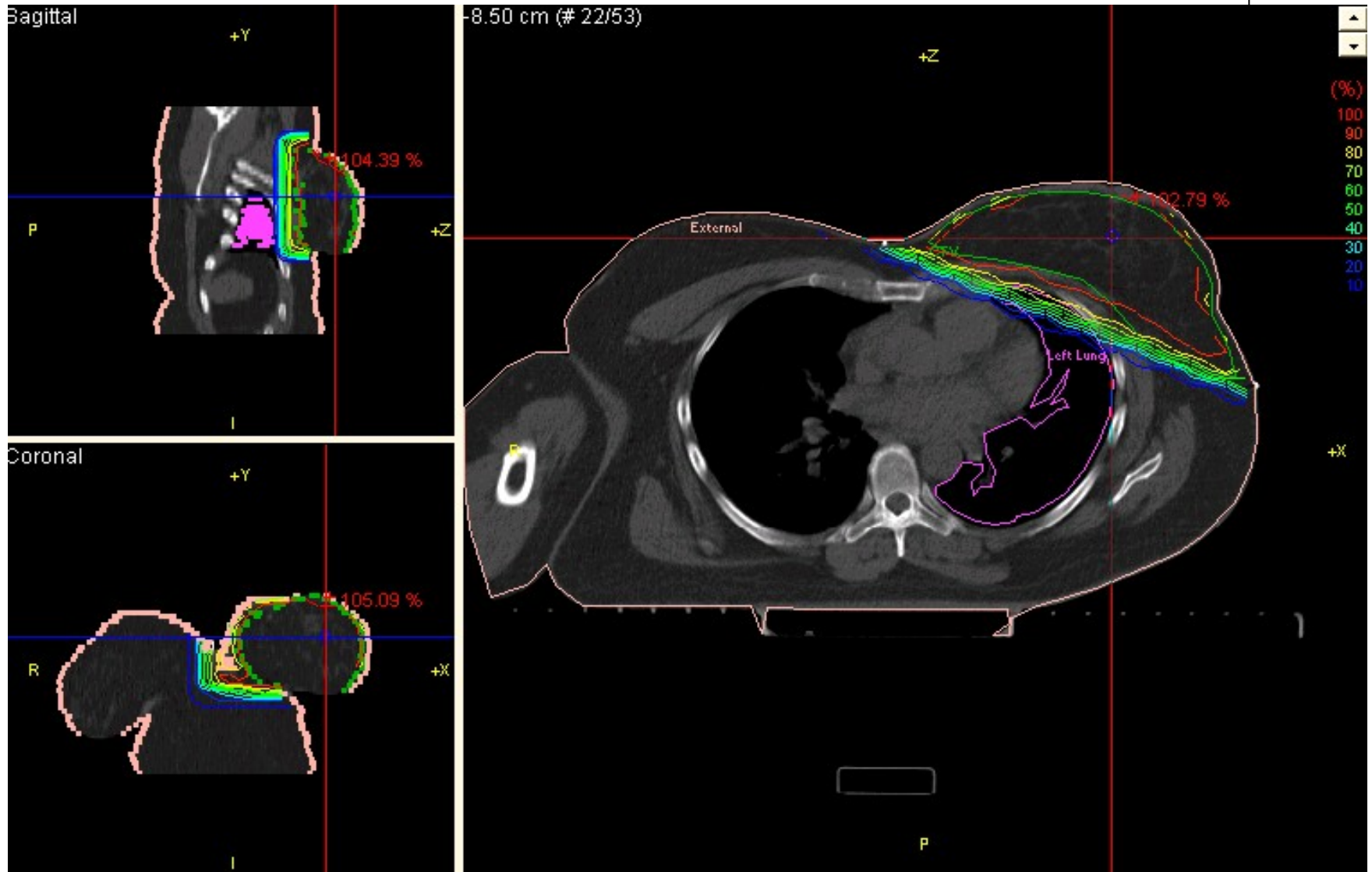
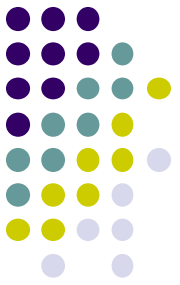
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



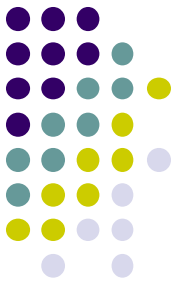
Planificación IMRT.

Optimización. Planificación Directa (field-in-field)



Planificación IMRT.

Optimización Planificación Inversa. Prescripción

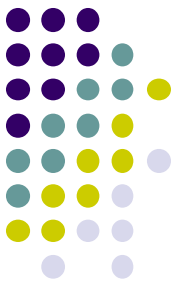


- **Objetivos de dosis (goals)**
- **Restricciones de dosis (constraints)**
- **Restricciones de volumen**
 - Prescripción no en un punto
- **Pérdida de información geométrica**
 - Todas las partes del OAR son iguales
 - Todas las partes del PTV son iguales

Planificación IMRT.

Definición de la Prescripción

- Pre-establecer DVH de PTVs y OARs

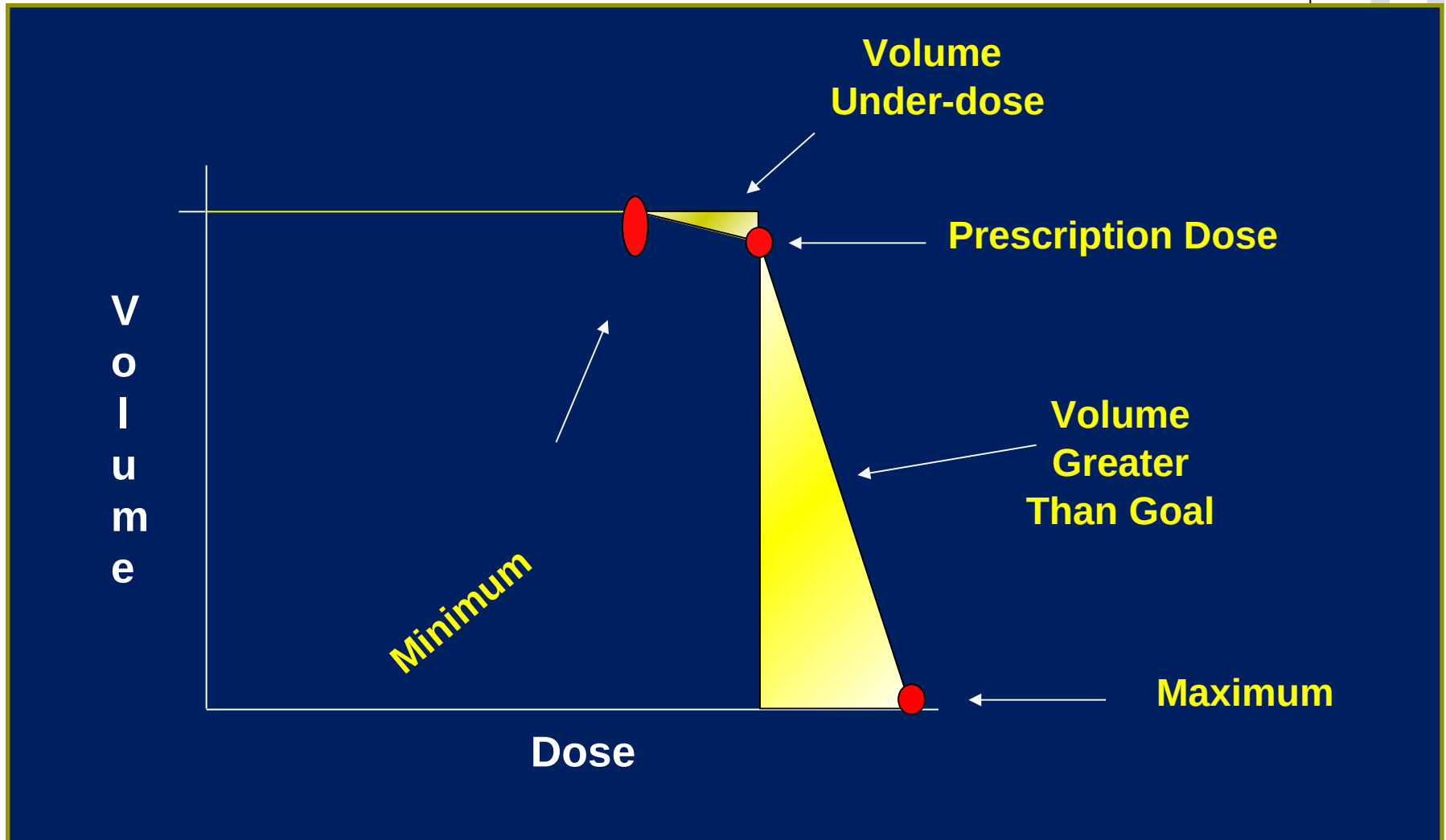
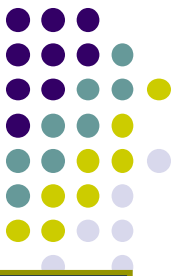


Target Name	Type	Goal (Gy)	Vol Below Goal (%)	Min (Gy)	Max (Gy)
Pros+SemVes_LIJ - target	ICRU 50	25.2	5	24.8	26.2

Sensitive Structure Name	Type	Limit (Gy)	Vol Above Limit (%)	Min (Gy)	Max (Gy)
Tissue	ICRU 50 Tissue	18.6	20	0.0	26.4
Rectum_l	ICRU Structure	16.0	24	7.6	26.4
Rectal_Wall	ICRU Structure	16.0	24	7.2	26.4
Bladder_l	ICRU Structure	16.0	25	8.1	26.4
Bladder_Wall	ICRU Structure	16.0	24	7.8	26.1
Femur_L	Reference	15.2	16	7.0	19.1
Femur_R	Reference	14.8	16	7.0	19.2

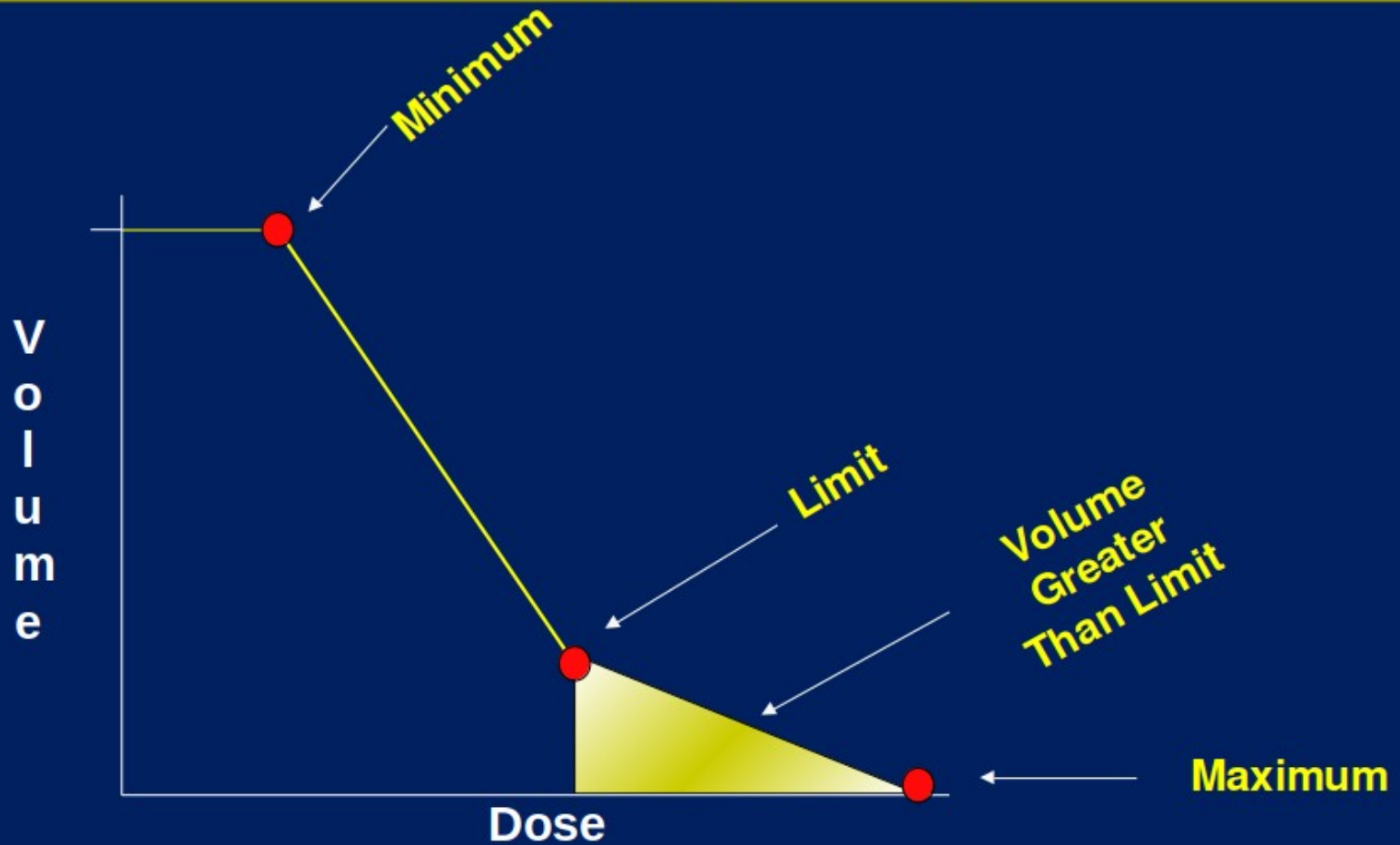
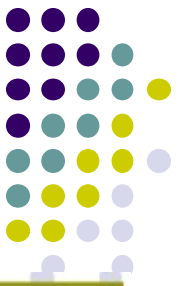
Planificación IMRT.

Definición de la Prescripción (ejemplo de PTV)



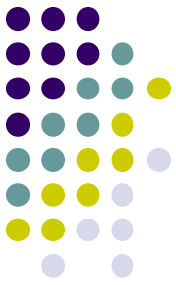
Planificación IMRT.

Definición de la Prescripción (ejemplo de OAR)



Planificación IMRT.

Definición de la Prescripción (Prescripción Corvus)



Issue Heterogeneity Correction during Dose Calculation

Target Name	Type	Goal (Gy)	Vol Below Goal (%)	Min (Gy)	Max (Gy)	I	U
CTV-1 - target	ICRU 50	50.0	5	45.0	60.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Sensitive Structure Name	Type	Limit (Gy)	Vol Above Limit (%)	Min (Gy)	Max (Gy)	I	U
Tissue	ICRU 50 Tissue	20.0	30	0.0	50.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Heart	Critical Structure	40.0	5	30.0	50.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Liver	Critical Structure	35.0	20	30.0	55.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Lung (R)	ICRU Structure	18.0	5	15.0	25.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
OAR-1	Critical Structure	40.0	20	20.0	50.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Spinal cord	Critical Structure	40.0	5	35.0	45.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Prescription Instructions

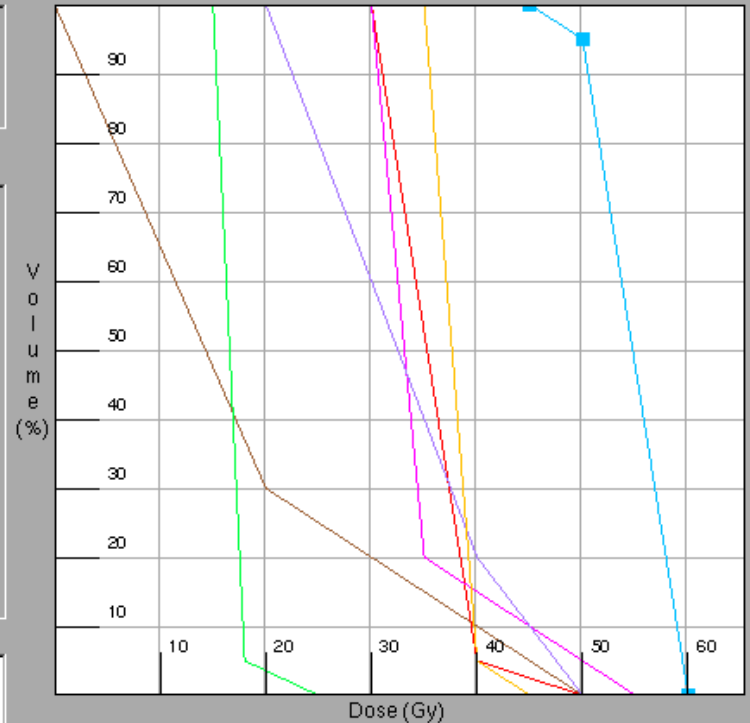
ICRU 50 Target

PURPOSE: Targets where the Maximum dose should not be more than 107% of prescribed dose and where the Minimum should not be less than 95% of prescribed dose.

SETTINGS:

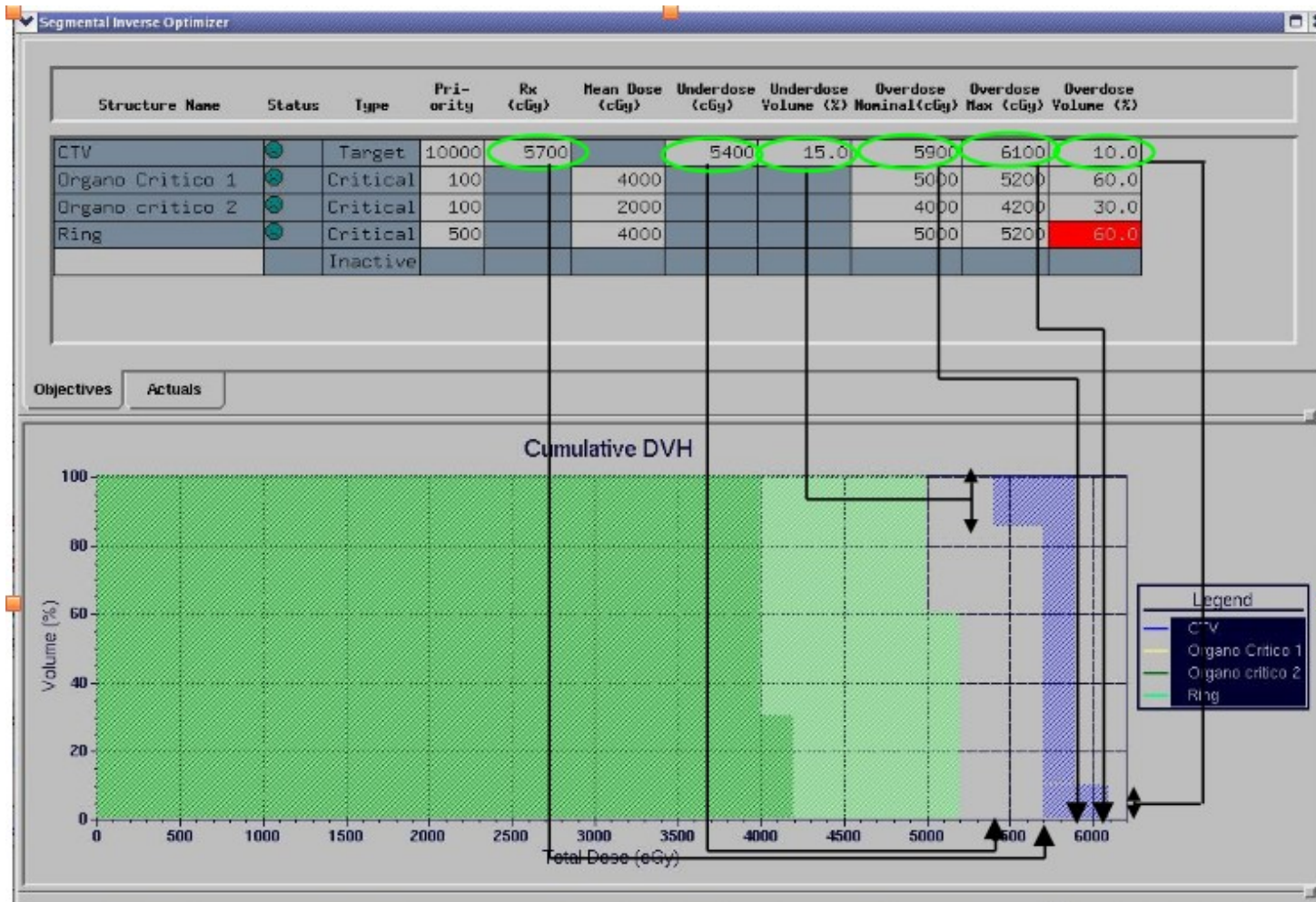
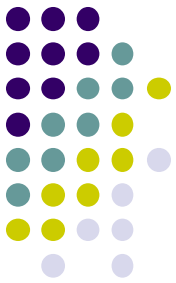
- Goal = Desired dose to 95% of target volume
- Minimum = 95% of Goal
- % under = 3 - 5%
- Maximum = 107% of Goal
- "I" = Improve homogeneity at expense of conformality and coverage

NOTES: Use only ICRU Tissue as Tissue Type



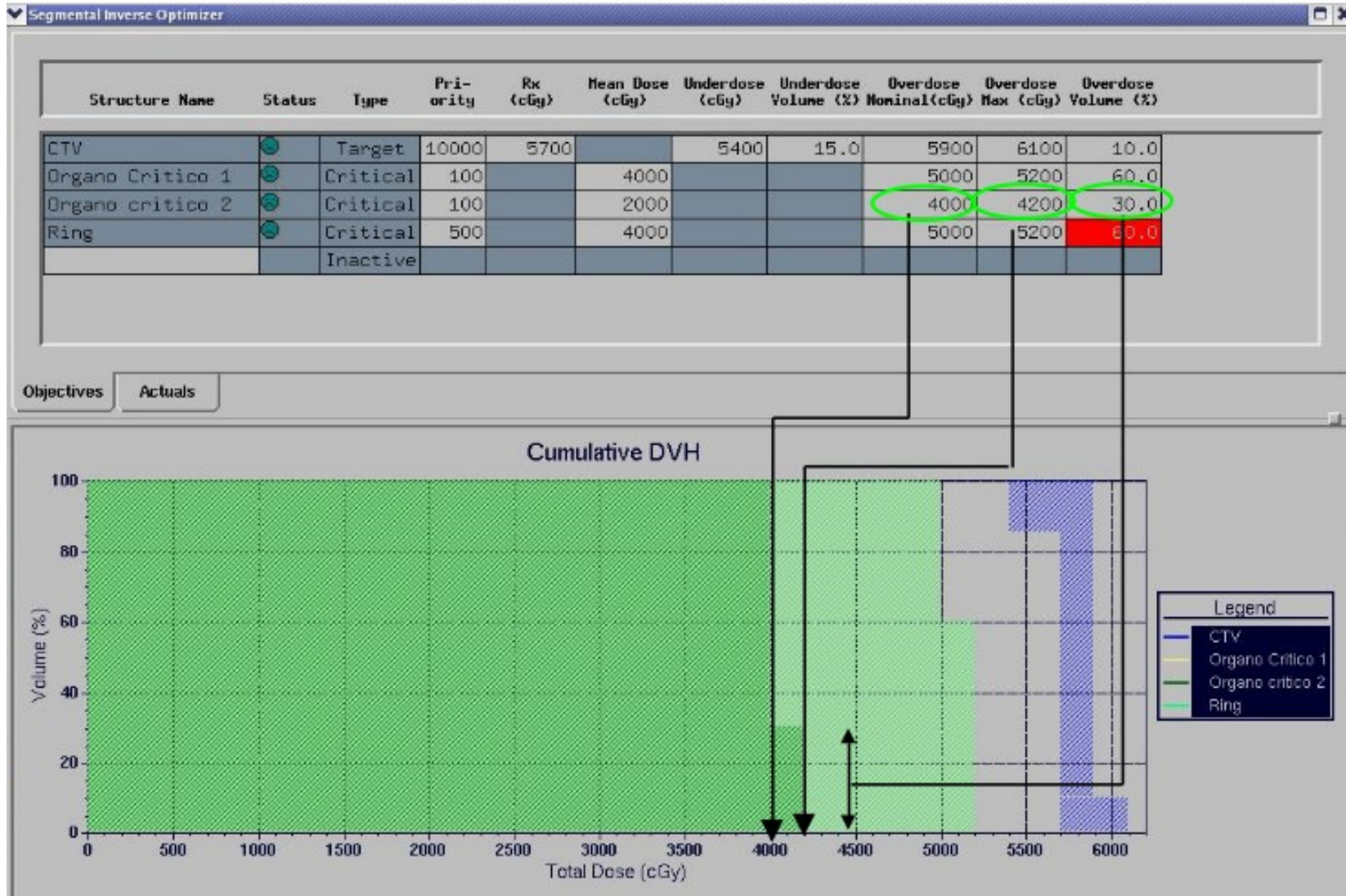
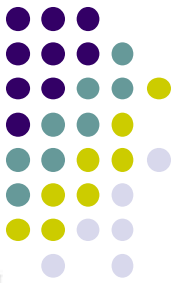
Planificación IMRT.

Definición de la Prescripción (Prescripción PrecisePlan)



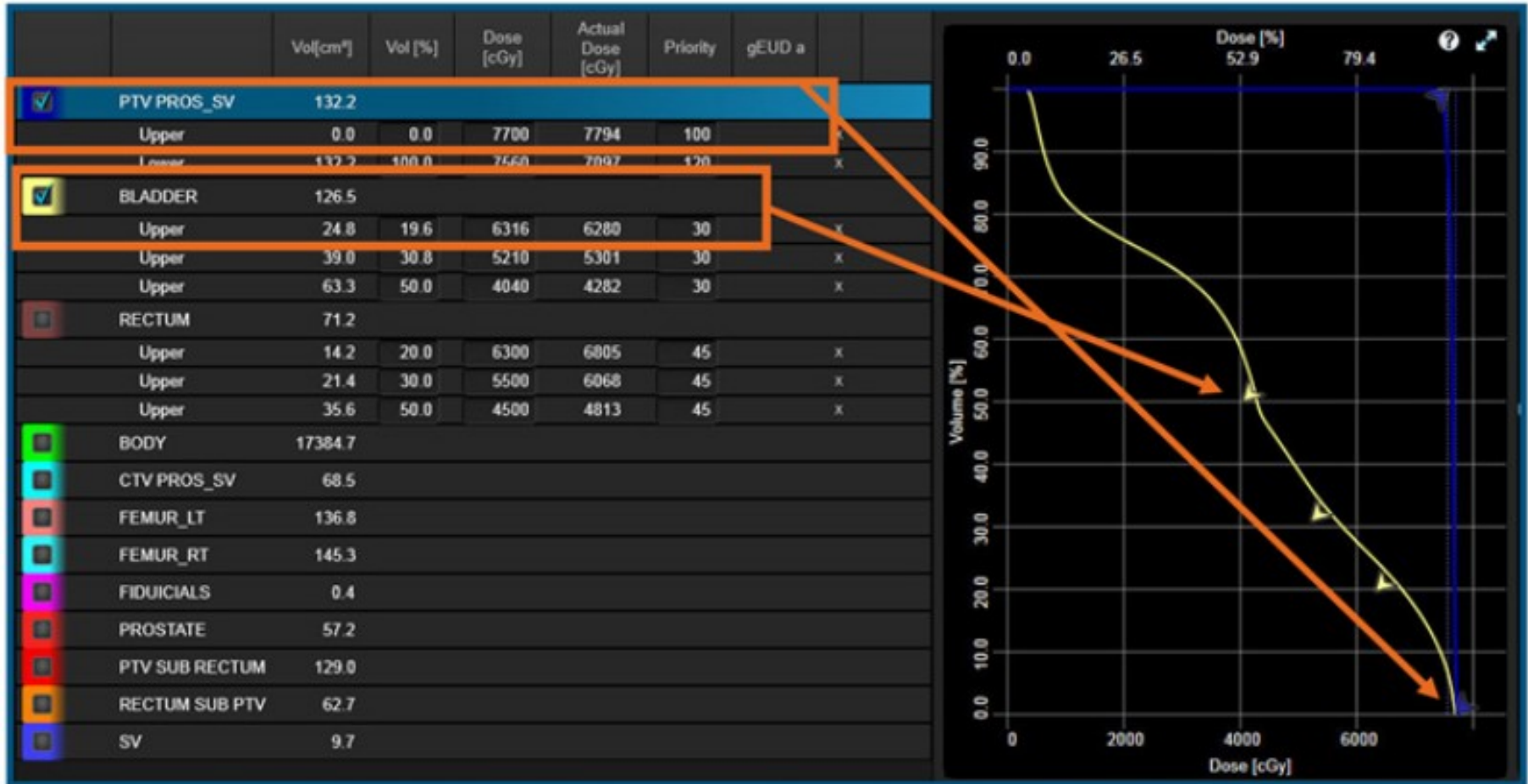
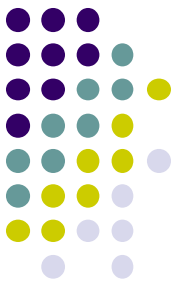
Planificación IMRT.

Definición de la Prescripción (Prescripción PrecisePlan)



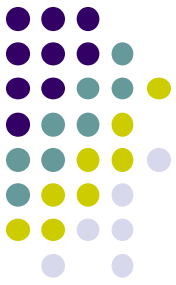
Planificación IMRT.

Definición de la Prescripción (Prescripción Eclipse)



Planificación IMRT.

Definición de la Prescripción (Prescripción Pinnacle)



Redo Spread

Add Objective

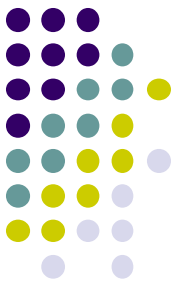
Delete Objective

Sort Objectives

ROI	Type	Constrain	Target cGy	% Volume	% Variation	Weight	Objective Value	a	gEUD
PTV2	Max Dose	<input type="checkbox"/>	7375			100	--		
PTV2	Min Dose	<input type="checkbox"/>	7300			100	--		
PTV2	Uniform Dose	<input type="checkbox"/>	7325			100	--		
RECTUM	Max DVH	<input type="checkbox"/>	7000	10		85	--		
RECTUM	Max DVH	<input type="checkbox"/>	7150	5		85	--		
RECTUM	Max DVH	<input type="checkbox"/>	6500	20		65	--		
RECTUM	Max DVH	<input type="checkbox"/>	6000	30		45	--		
RECTUM	Max Dose	<input type="checkbox"/>	7300			85	--		
RECTUM	Max EUD	<input type="checkbox"/>	3750			25	--	1	--
ptv ring ds	Max Dose	<input type="checkbox"/>	5650			1	--		

Composite objective value: --

Recompute Values



Quantitative Analysis of Normal Tissue Effects in the Clinic (QUANTEC).

Int. J. Radiation Oncology Biol. Phys., Vol. 76, No. 3, Supplement, pp. S1–S2, 2010

Organ-Specific Papers

1. Brain
2. Optic Nerve/Chiasm
3. Brain Stem
4. Spinal Cord
5. Ear
6. Parotid
7. Larynx/Pharynx
8. Lung
9. Heart
10. Esophagus
11. Liver
12. Stomach/Small Bowel
13. Kidney
14. Bladder
15. Rectum
16. Penile Bulb

Vision Papers

True Dose
Imaging
Biomarkers
Data Sharing
Lessons of QUANTEC

Each with 10 sections

1. **Clinical Significance**- Describes the clinical situations where the organ is irradiated, and the incidence/significance of organ injury.
2. **Endpoints**- Describes the different endpoints often considered when assessing injury, the impact of endpoint-selection on the reported injury rates, the challenges/utilities of different endpoints, and the time course of organ injury.
3. **Challenges Defining Volumes**- Describes how the organ is typically defined (or segmented) on treatment planning images. Includes a discussion of uncertainties/challenges in organ definition (e.g. changes in organ volume/shape during therapy), and the associated impact on DVH's and dose/volume/outcome analyses.
4. **Review of Dose/Volume Data**- A comprehensive summary of reported 3D dose/volume data for clinically-relevant outcomes.
5. **Factors Affecting Risk**- Other clinical factors affecting the risk of injury are noted (e.g. age, combined modality therapy, dose fractionation).
6. **Mathematical/Biological Models**- Models that have been used to relate 3D dose/volume data to clinical outcomes are summarized, along with associated model parameters, limitations and uncertainties.
7. **Special Situations**- Most of the data discussed relates to conventional fractionation. This section describes situations where the presented data/models may not apply (e.g. hypo-fractionation).
8. **Recommended Dose/Volume Limits**- The available information is condensed into meaningful dose/volume limits, with associated risk rates, to apply clinically.
9. **Future Toxicity Studies**- Describes areas in need of future study.
10. **Toxicity Scoring**- Recommendations on how to score organ injury.



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A Story of Hypofractionation and the Table on the Wall

Robert Timmerman, MD

Department of Radiation Oncology, University of Texas Southwestern Medical Center, Dallas, Texas

Received Jul 29, 2021; Revised Sep 7, 2021; Accepted for publication Sep 14, 2021

I was recently informed that I won a contest that I did not actually enter. A Twitter poll was organized through @Radiation Nation inspired by Sue Yom, the new editor of the journal, asking, “What do people consider the gold standard for treatment planning for hypofractionated RT?” Response options were “HyTEC; AAPM TG-101; Timmerman Sheet; and NRG/RTOG protocols.” With just over 100 total votes in 24 hours, “Timmerman Sheet,” which at University of Texas Southwestern we call our “constraint tables,” won with 37.5% of votes. Not to rub it in, but 2 of the other options, “AAPM TG-101” and most “NRG/RTOG protocols,” were taken directly from older versions of our tables.

of their conception and evolution has been part of the overall story of SABR and the postmodern use of hypofractionation. For this editorial, I would like to tell my version of the 2, interwoven stories.

SABR, my preferred name over the duller, less descriptive, stereotactic body radiation therapy (or SBRT), is now a commonplace treatment such that centers not performing it are arguably out of touch by missing essential modern capabilities.¹⁻³ Indeed, with the approach of the dreaded Alternative Payment Model from the Centers for Medicaid and Medicare Services, I think conventionally fractionated radiation therapy will quickly become untenable, spelling doom



Volume 110, Issue 1, p1-256

A Red Journal Special Issue: HyTEC

Edited by Jimm Grimm, Ellen Yorke, Lawrence Marks, Andrew Jackson, Brian Kavanagh, Jinyu Xue

[Current Issue](#)

[Articles in Press](#)

[Archive](#)

The Editor's podcast for this edition
HyTEC Special Issue
[Click here](#)

HyTEC Introduction

[High Dose per Fraction, Hypofractionated Treatment Effects in the Clinic \(HyTEC\): An Overview](#)

Jimm Grimm, Lawrence B. Marks, Andrew Jackson, Brian D. Kavanagh, Jinyu Xue, Ellen Yorke

Published in issue: May 01, 2021

p1-10

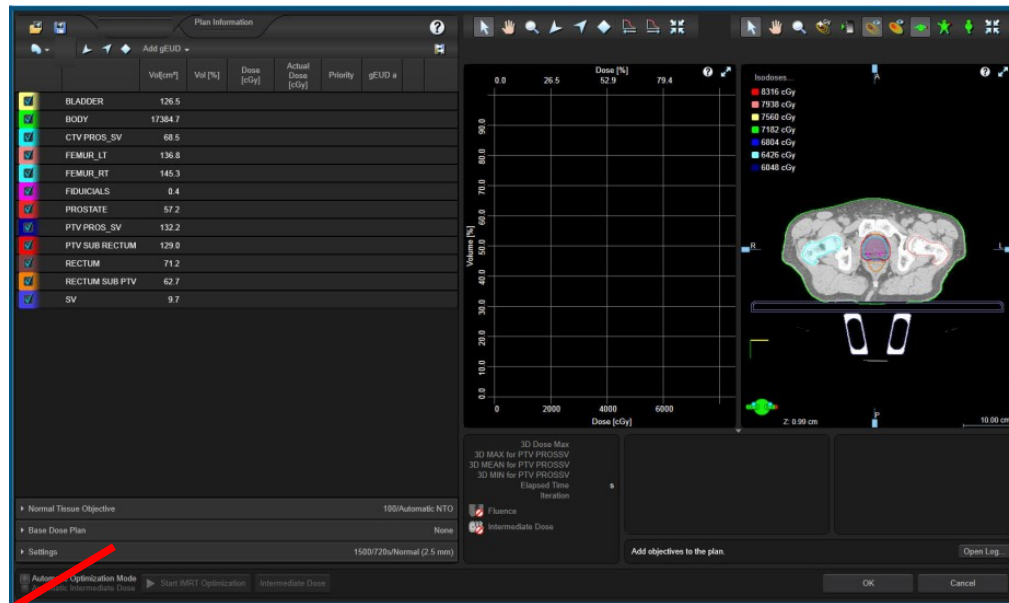
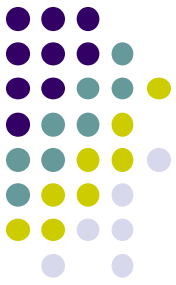
[A Primer on Dose-Response Data Modeling in Radiation Therapy](#)

Vitali Moiseenko, Lawrence B. Marks, Jimm Grimm, ... Niclas Pettersson, Ellen Yorke, Issam El Naqa

Published online: December 23, 2020

Planificación IMRT.

Optimización Planificación Inversa. Herramientas

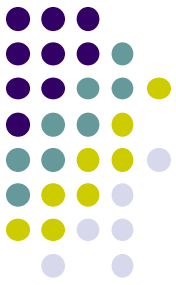


The 'Settings' panel is shown with the following configuration:

- Maximum Iterations: 1500
- Maximum Optimization Time: 720 s
- Resolution: Normal (2.5 mm) (dropdown menu is open, showing options: Normal (2.5 mm), Fine (1.25 mm), Normal (2.5 mm), Low (5.0 mm))
- Automatic Optimization Mode: (checked)
- Automatic Intermediate Dose: (unchecked)
- Intermediate Dose button:

Planificación IMRT.

Optimización Planificación Inversa. Herramientas



▼ Avoidance Sectors

ID	Couch Angle	Collimator Angle	Gantry Rotation	Avoidance Sector 1	Avoidance Sector 2
Field 1	0.0	30.0	181.0CW179.0	260.0	275.0
Field 2	0.0	330.0	179.0CCW181.0	160.0	145.0

Rectum 65.0
RectumSubPTV 62.4

Plan Information

The screenshot shows the main interface of the IMRT planning software. On the left, the 'Plan Information' window is open, displaying a table of target volumes and their respective doses. A red arrow points from the 'Plan Information' label in the top window to this window. The main workspace shows a 3D visualization of the patient's anatomy with various dose levels overlaid. The 'Dose [%]' plot shows a range from 0.0 to 79.4. The 'Volume [%]' plot shows a range from 0.0 to 90.0. The 'Isodases...' legend lists several dose levels: 8316 cGy, 7938 cGy, 7560 cGy, 7182 cGy, 6804 cGy, 6426 cGy, and 6048 cGy. The 3D visualization shows the patient's anatomy with various dose levels overlaid. The 'Z: 0.90 cm' and '10.00 cm' scale are visible. The bottom of the interface shows optimization settings and controls.

Target	Vol[cm ³]	Vol [%]	Dose [cGy]	Actual Dose [cGy]	Priority	gEUD a
BLADDER	126.5					
BODY	17384.7					
CTV_PROS_SV	68.5					
FEMUR_LT	136.8					
FEMUR_RT	145.3					
FIDUCIALS	0.4					
PROSTATE	57.2					
PTV_PROS_SV	132.2					
PTV SUB RECTUM	129.0					
RECTUM	71.2					
RECTUM SUB PTV	62.7					
SV	9.7					

Normal Tissue Objective: 100/Automatic NTO
Base Dose Plan: None
Settings: 1500/720s/Normal (2.5 mm)

Automatic Optimization Mode: Start IMRT Optimization Intermediate Dose

3D Dose Max: 3D MAX for PTV PROSSV
3D MEAN for PTV PROSSV
3D MIN for PTV PROSSV
Elapsed Time: Iteration

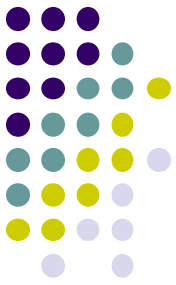
Fluence: Intermediate Dose

Add objectives to the plan. Open Log...

OK Cancel

Planificación IMRT.

Optimización Planificación Inversa. Herramientas



Plan Information

	Vol[cm ³]	Vol [%]	Dose [cGy]	Actual Dose [cGy]	Priority	gEUD a
<input checked="" type="checkbox"/>	BLADDER	126.5				
<input checked="" type="checkbox"/>	BODY	17384.7				
<input checked="" type="checkbox"/>	CTV_PROS_SV	68.5				
<input checked="" type="checkbox"/>	FEMUR_LT	136.8				
<input checked="" type="checkbox"/>	FEMUR_RT	145.3				
<input checked="" type="checkbox"/>	FIDUCIALS	0.4				
<input checked="" type="checkbox"/>	PROSTATE	57.2				
<input checked="" type="checkbox"/>	PTV_PROS_SV	132.2				
<input checked="" type="checkbox"/>	PTV_SUB_RECTUM	129.0				
<input checked="" type="checkbox"/>	RECTUM	71.2				
<input checked="" type="checkbox"/>	RECTUM SUB PTV	62.7				
<input checked="" type="checkbox"/>	SV	9.7				

Normal Tissue Objective 100/Automatic NTO
Base Dose Plan None
Settings 1500/720s/Normal (2.5 mm)

3D Dose Max
3D MAX for PTV PROSSV
3D MEAN for PTV PROSSV
3D MIN for PTV PROSSV
Elapsed Time
Iteration

Fluence
Intermediate Dose

Isodoses...
8316 cGy
7938 cGy
7560 cGy
7182 cGy
6804 cGy
6426 cGy
6048 cGy

Dose [cGy]
0.0 26.5 52.9 79.4

Volume [%]
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0

Dose [cGy]
0 2000 4000 6000

Add objectives to the plan. **Open Log...**

Automatic Optimization Mode
 Automatic Intermediate Dose

Start IMRT Optimization **Intermediate Dose**

OK **Cancel**

▼ MU Objective

In use

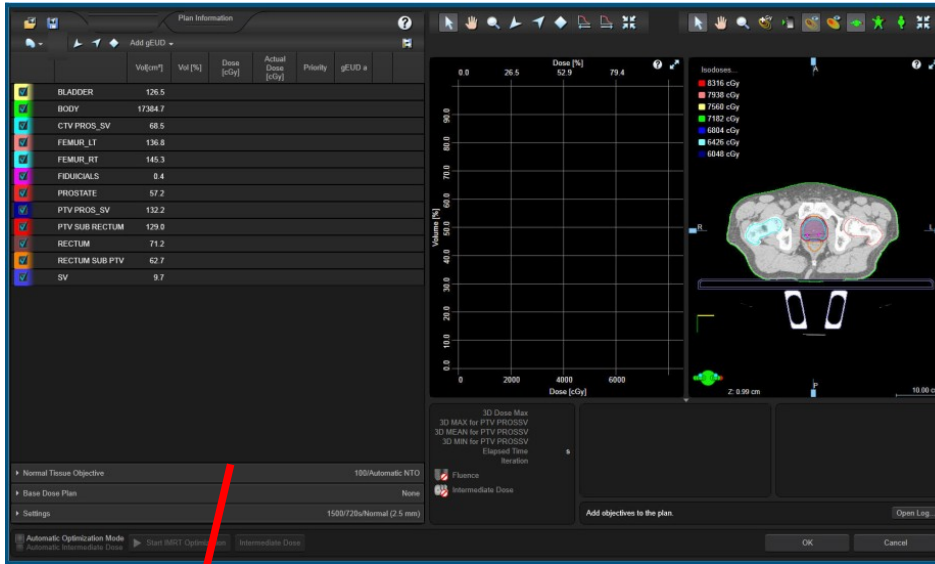
Minimum MU

Maximum MU

Strength

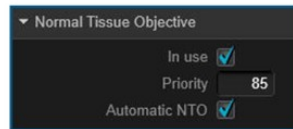
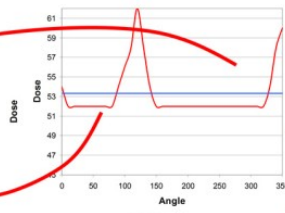
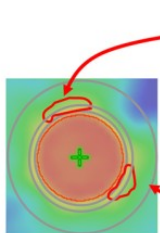
Planificación IMRT.

Optimización Planificación Inversa. Herramientas



Automatic Normal Tissue Objective

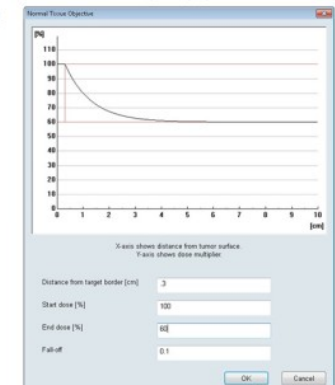
- Automatic - penalty issued for points having higher than mean dose at given distance



- Interactive
 - NTO may be turned on/off during Optimization
- Automatic
 - Penalty issued for points having higher than mean dose at given distance

Manual NTO

- Defines desired dose gradient **outside** the target(s)
 - Minimizes hotspots around the target
- Priority
- Parameters
 - Distance from target border
 - Start and end dose
 - Fall-off



Planificación IMRT.

Optimización Planificación Inversa. Herramientas



Generalized Equivalent Uniform Dose (gEUD)

Skills Circ

- gEUD is the uniform dose distribution that gives the same biological effect (clinical effect) equivalent to that of a given heterogeneous dose distribution

- The concept of equivalent uniform dose (EUD) assumes that any two dose distributions are equivalent if they cause the same radiobiological effect.

- Examples of cord DVHs to one max dose point that result in the same radiobiological effect

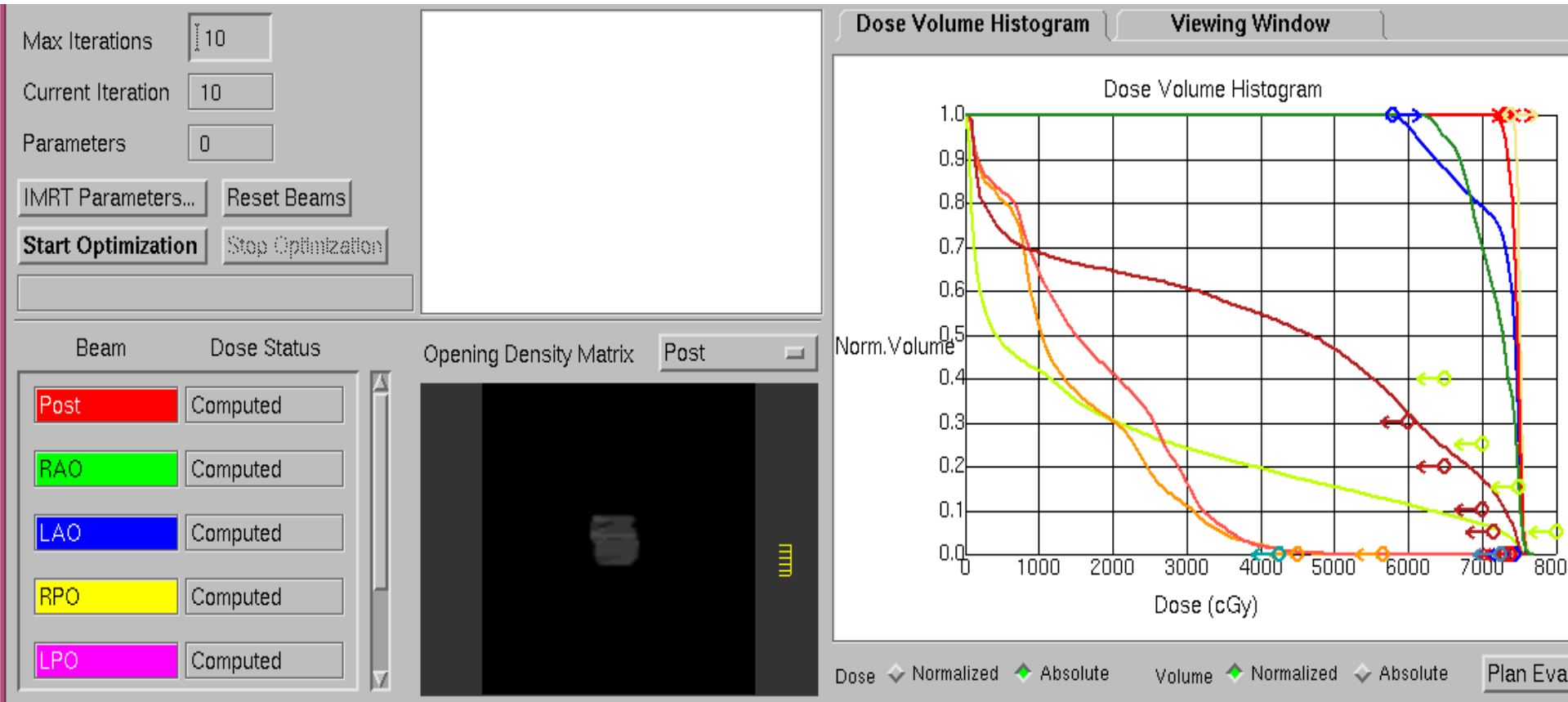
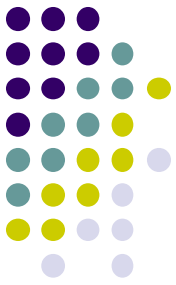


$$gEUD = \left(\sum_i v_i D_i^a \right)^{1/a}$$

- The parameter 'a' is negative for all tumors (targets).
- The parameter 'a' is positive for all normal structures.
- For target structures, 'a=1': acts as a mean dose objective. Cold and hot spots are given equal weight

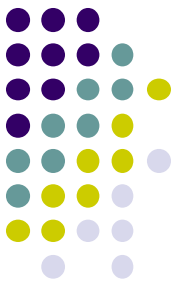
Planificación IMRT.

Evaluación de la optimización (Prescripción Pinnacle)



Planificación IMRT.

Evaluación de la optimización (Prescripción PrecisePlan)

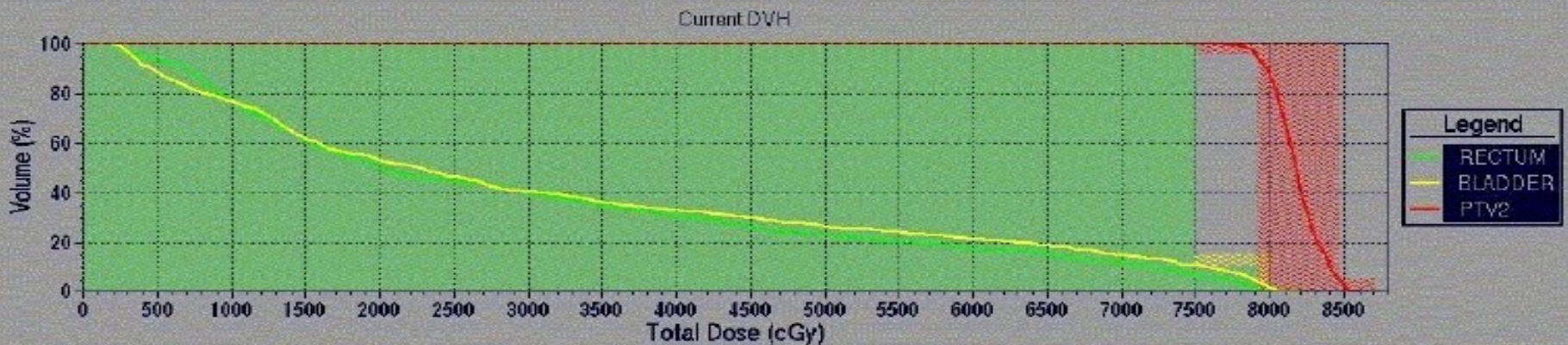


Segmental Inverse Optimizer

Structure Name	Status	Type	Priority	Rx (cGy)	Mean Dose (cGy)	Under Dose (cGy)	Under Dose Volume (%)	Over Dose Nominal (cGy)	Over Dose Max (cGy)	Over Dose Volume (%)
RECTUM	🟢	Critical	10		6000			7500	7920	10.0
BLADDER	🟢	Critical	10		6500			7500	8000	15.0
PTV2	🟡	Target	100	7920		7524	5.0	8474	8712	5.0
		Inactive								

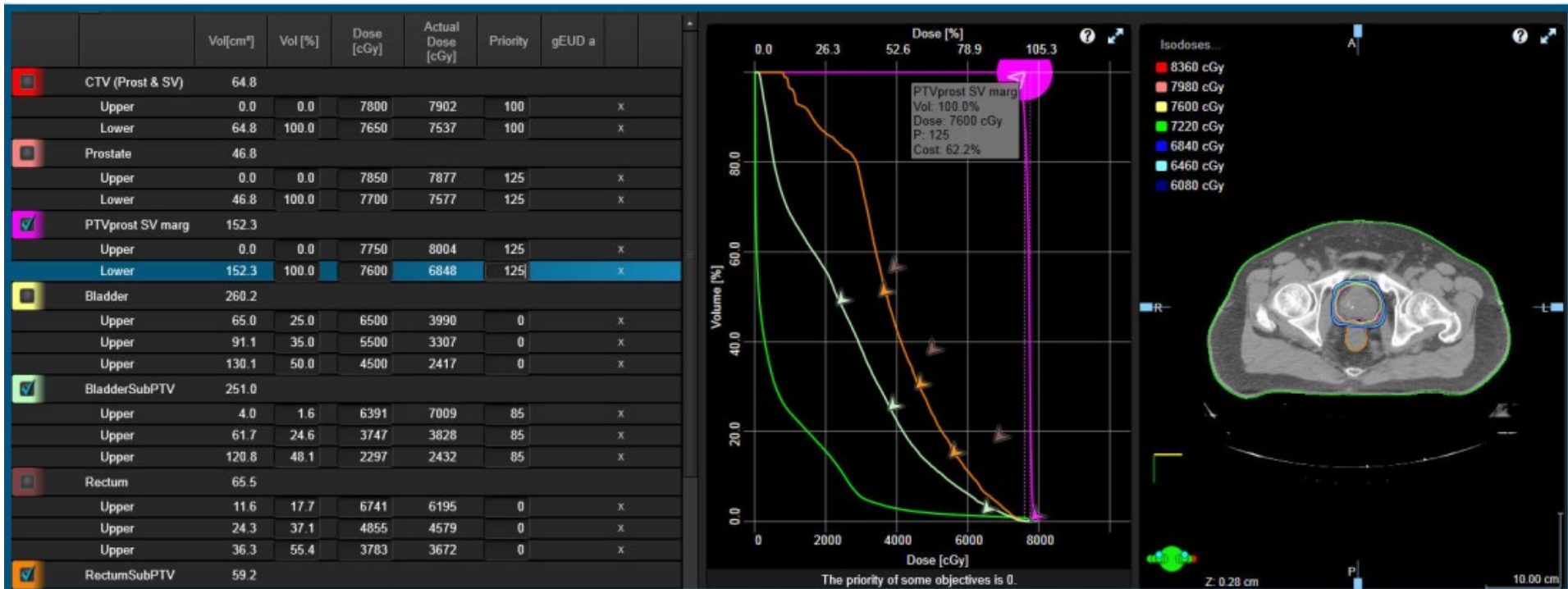
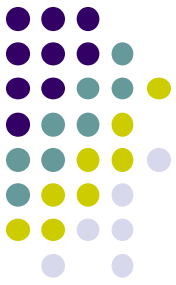
Objectives

Actuals



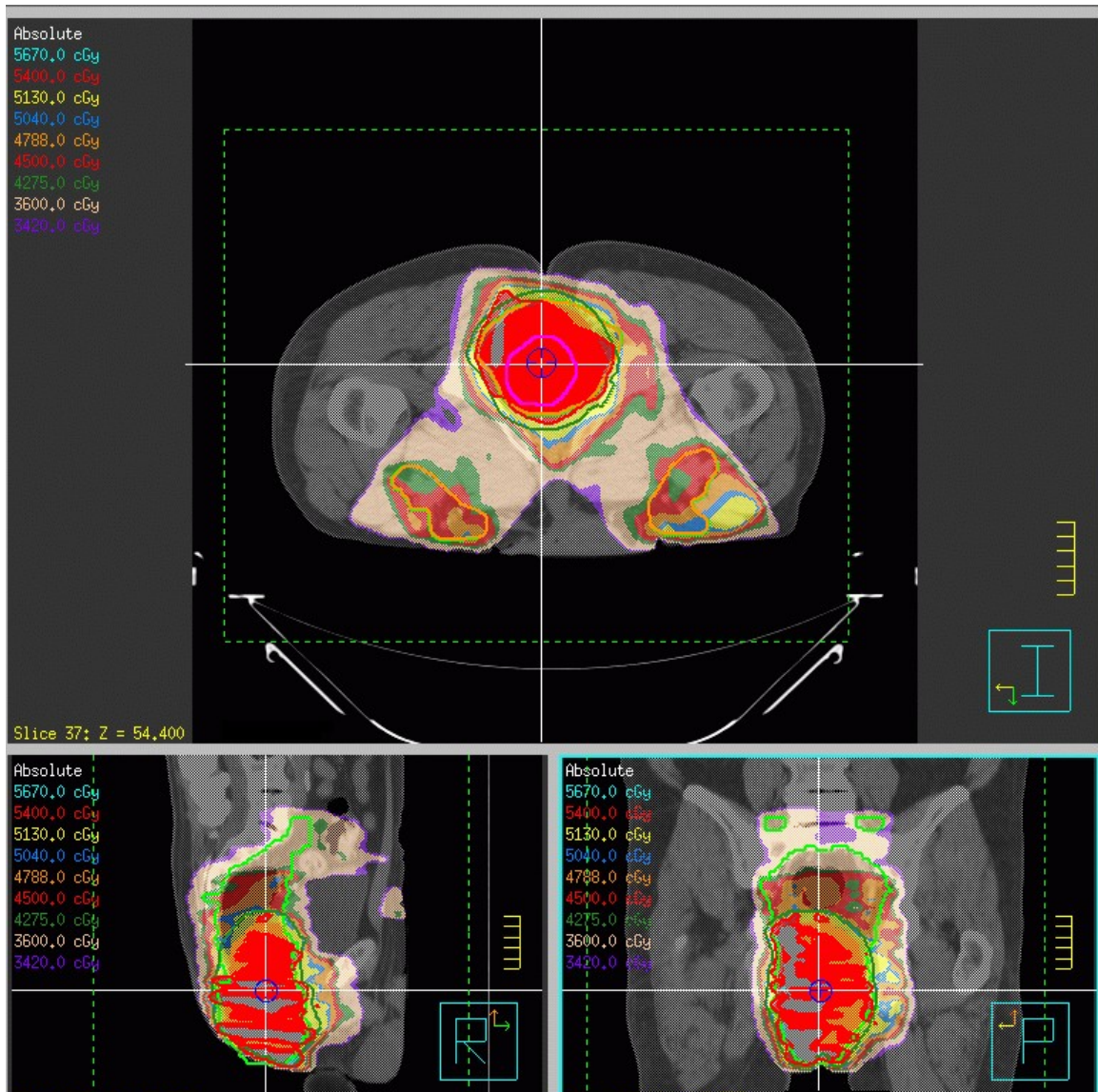
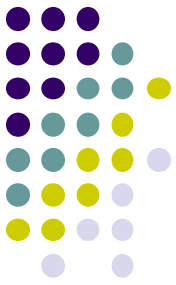
Planificación IMRT.

Evaluación de la optimización (Prescripción Eclipse)



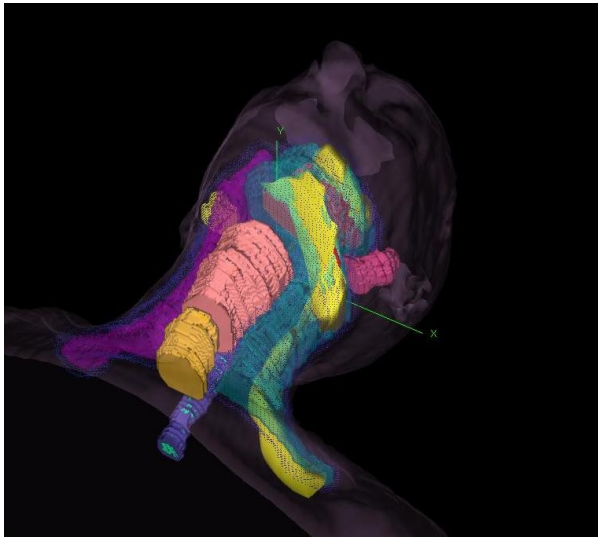
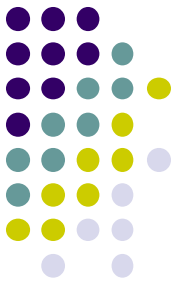
Planificación IMRT.

Evaluación de la optimización (Isodosis Pinnacle)

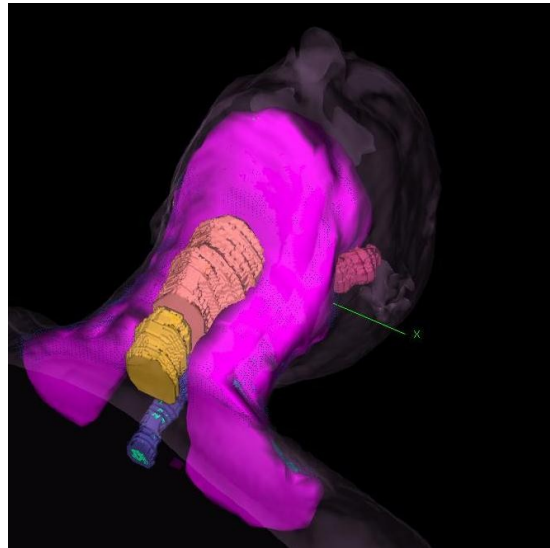


Planificación IMRT.

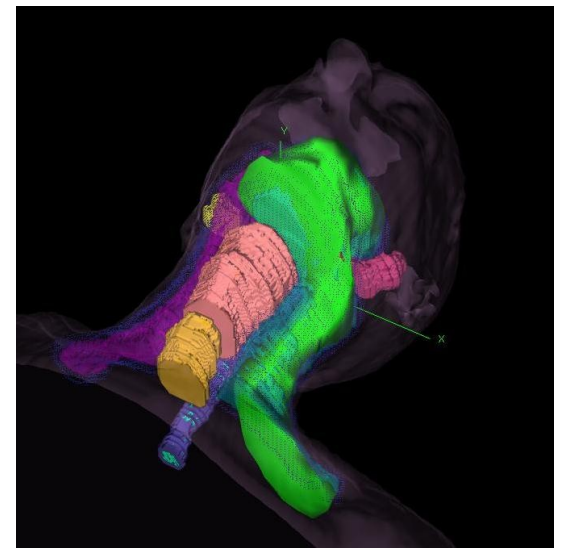
Evaluación de la optimización (Isodosis PrecisePlan)



72 Gy (GTV72)



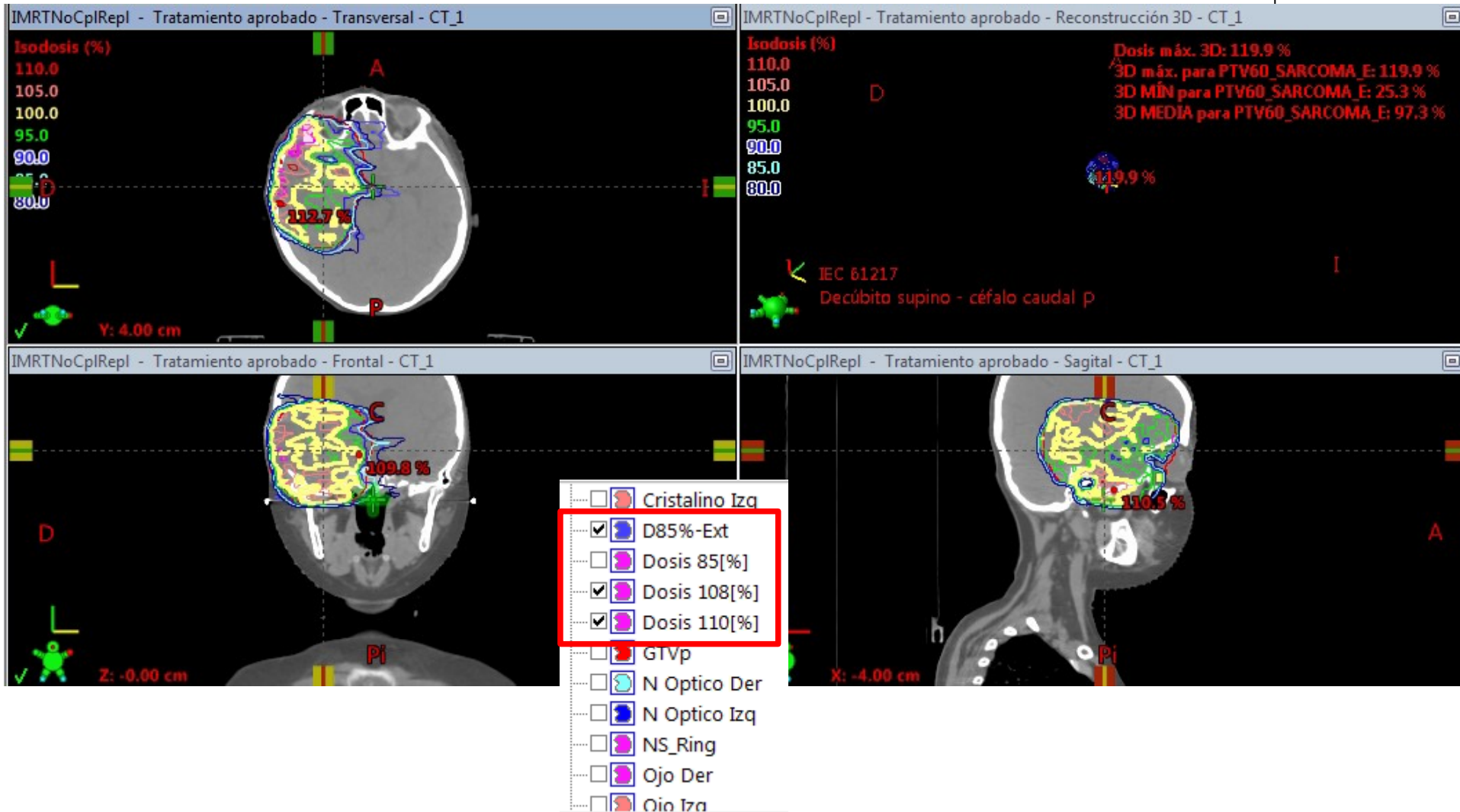
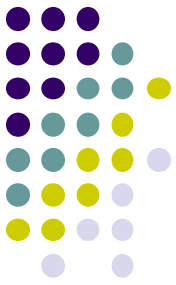
50 Gy (PTV50)



66 Gy (CTV66)

Planificación IMRT.

Evaluación de la optimización (Isodosis Eclipse)



Planificación IMRT.

Nueva optimización (Eclipse)



Información del plan

Agregar gEUD

ID/Tipo	Vol[cm ²]	Vol [%]	Dosis[cGy]	Dosis real [cGy]	Prioridad	gEUD
<input type="checkbox"/> Cristalino Der	0.1					
Superior		0.0	108	409	200	
<input type="checkbox"/> Cristalino Izq	0.1					
Superior		0.0	108	115	180	
<input checked="" type="checkbox"/> D85%-Ext	20.0					
Superior		0.0	1745	2377	200	
<input checked="" type="checkbox"/> Dosis 108[%]	11.2					
Superior		0.0	2291	2511	150	
<input checked="" type="checkbox"/> Dosis 110[%]	2.5					
Superior		0.0	2291	2570	200	
<input type="checkbox"/> N Optico Der	0.3					

Objetivo de tejido normal: 130/Manual

Plan base de dosis: Ninguno

Valores: 1000/720s/Normal (2,5 mm)

Modo de optimización automática **Iniciar optimización IMRT** Dosis intermedia

Dosis intermedia automática

Dosis [%]

Volumen [%]

Dosis [cGy]

Isodosis...

- 2400 cGy
- 2291 cGy
- 2182 cGy
- 2073 cGy
- 1964 cGy
- 1855 cGy
- 1745 cGy

Dosis máx. 3D: 2617 cGy

MÁX 3D para PTV60SARCOMA_E

MEDIA 3D para PTV60SARCOMA_E

MIN 3D para PTV60SARCOMA_E

Tiempo transcurrido: 0 s

Iteración

Fluencia

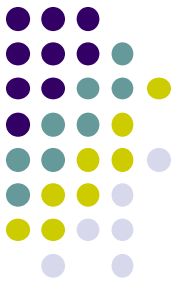
Dosis intermedia

Abrir registro...

OK Cancelar

Planificación IMRT.

Evaluación del plan (Eclipse)



R, sarcoma cerebral : R0

- Arcos
- IMRT-NoCpl
- Verificacion
- TTO PREVIO
- IMRTNoCplRepl

Arcos

- CT_1
- Imágenes registradas
- CT_1
- Origen del usuario
- Puntos de referencia
- 6PTV60_SARCOMA_E
- Dosis
- Campos**
- Campo 1
- MLC
- Campo 2
- MLC

Arcos - Rechazado - Transversal - CT_1

Isodosis (%)

- 110.0
- 105.0
- 100.0
- 95.0
- 90.0
- 85.0
- 80.0

Y: 4.00 cm

Arcos - Rechazado - Histograma dosis-volumen

Proporcion de volumen de estructura

Dosis [cGy]

Dosis relativa [%]

Arcos - Rechazado - Frontal - CT_1

Z: 1.00 cm

Arcos - Rechazado - Sagital - CT_1

X: -4.00 cm

Planificación IMRT.

Evaluación del plan (Eclipse)



IMRTNoCplRepl - Tratamiento aprobado - Transversal - CT_1

IMRTNoCplRepl - Tratamiento aprobado - Histograma dosis-volumen

IMRTNoCplRepl - Tratamiento aprobado - Frontal - CT_1

IMRTNoCplRepl - Tratamiento aprobado - Sagital - CT_1

Varian Leaf Motion Calculator (LMCV) Delivery Options

Delivery Type

Select delivery type and options for each field:

All Fields	Delivery Method	Segments	Fixed Jaws
Field 1	Sliding Window	<input type="checkbox"/>	<input type="checkbox"/>
Field 2	Sliding Window	<input type="checkbox"/>	<input type="checkbox"/>
Field 3	Sliding Window	<input type="checkbox"/>	<input type="checkbox"/>
Field 4	Sliding Window	<input type="checkbox"/>	<input type="checkbox"/>
Field 5	Multiple Static Segments	<input type="checkbox"/>	<input type="checkbox"/>
	None	<input type="checkbox"/>	<input type="checkbox"/>

Select delivery type for all fields:

Isodosis (%)

110.0
105.0
100.0
95.0
90.0
85.0
80.0

Dosis [cGy]

0 436.36 872.72 1309.0 1745.4 2181.8

Dosis relativa [%]

0 25 50 75 100

Y: 4.00 cm

Z: -0.00 cm

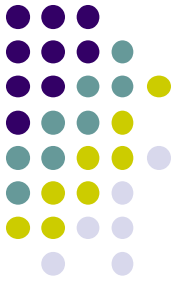
X: -4.00 cm

112.7%

110.5%

Planificación IMRT.

Consejos



Actividades Navegador web Chromium 30 de sep 9:48 AM es 100 %

Programas de formación | Rayos Contra Cancer - Chromium

Programas de formación x +

rayoscontracancer.org/training-programs



[Acerca de](#) [Programas](#) [Involucrarse](#) [Aprende más](#)

Programas de entrenamiento

Cada programa de capacitación de RCC se centra en una técnica de tratamiento de oncología radioterápica única. Haga clic a continuación para ver más información sobre algunos de nuestros programas anteriores:

[Radioterapia de haz externo 2D a 3D](#)

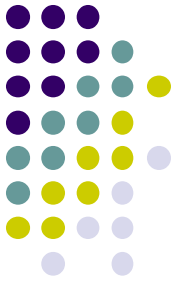
[De 2D a 3D a IMRT para radioterapeutas](#)

[IMRT para físicos médicos y oncólogos radioterapeutas](#)

[IMRT avanzada para radioterapeutas en América Latina](#)

Planificación IMRT.

Consejos



Actividades | Navegador web Chromium | 30 de sep 9:52 AM | ProKnow | Plan Studies - Chromium

Programas de formación | ProKnow | Plan Studies

proknowsystems.com/quality/planning

Support Center | Help | About

Elekta ProKnow® | ProKnow | Quality Systems | Continual Improvement | How ProKnow Helps | News | Sign In | Sign Up

PS Plan Studies
CA Contouring Accuracy

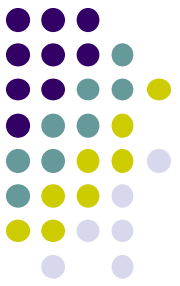
PS

Measure quality, study variation, and share best practices with a global community.

ProKnow® Plan Studies

Planificación IMRT.

Consejos

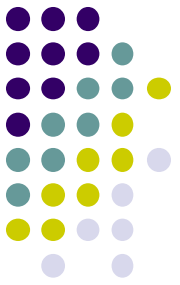


2016 AAMD / RSS PLAN STUDY SBRT PROSTATE

Ben Nelms, Ph.D.
&
Keitt Mobile, M.S., C.M.D.

Planificación IMRT.

Consejos

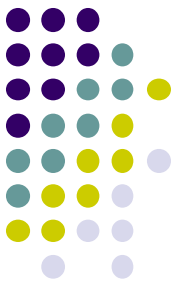


MONACO

- Try to get you best results you can on the first stage
 - Only little tweaks on second stage
- Set calculation grid to 2mm
- Understand how the cost functions work
- Use Quadratic Overdose in Body to create rings

Planificación IMRT.

Consejos

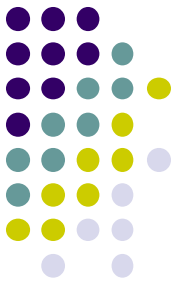


MONACO

- Make sure your constraints are set in the correct order
- Consider manually weighting your Target
- Watch your Iso-constraints and Relative Impacts
 - Compare
 - Will you really gain by your adjustment

Planificación IMRT.

Consejos

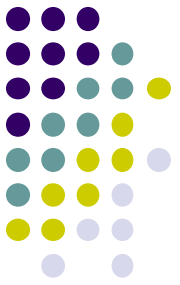


ECLIPSE

- Need to understand how to use the NTO (Normal Tissue Optimizer) properly
- Otherwise need to utilize rings
- About 50% seem to use both rings and NTO
 - .1 to .5cm around PTV
 - 1 to 1.5cm around PTV
 - .1 to .3cm around urethra and NVB

Planificación IMRT.

Consejos



ECLIPSE

- Pay attention to priorities
- Pause the optimizer often
 - Make tweaks if needed
 - Especially in level one and two
- Collimator angles 10-90 degrees use

Planificación IMRT.

Consejos



Actividades Navegador web Chromium

30 de sep 9:55 AM

es 100%

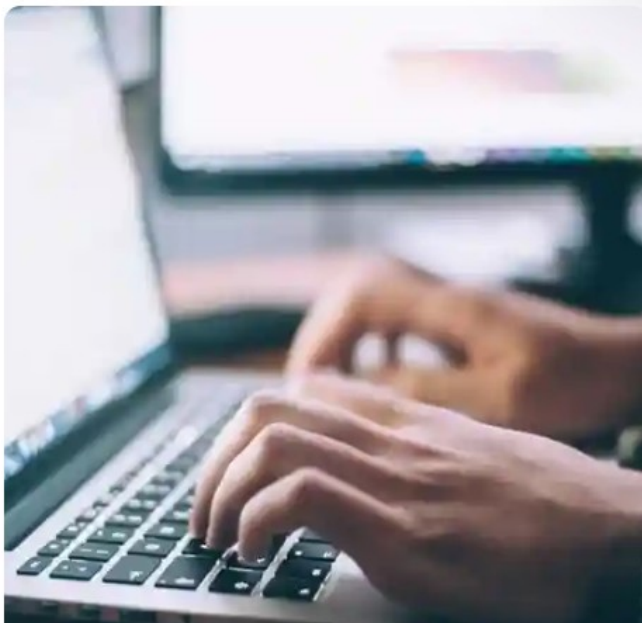
Seminarios web | Varian - Chromium

Programas de formación x ProKnow | Plan Studies x V Seminarios web | Varian x +

varian.com/es/resources-support/education-training/webinars

Google, Back, Star, Shield, Print, Search, Home, Full Screen, Profile

Seminarios web



Seminarios web de MyVarian

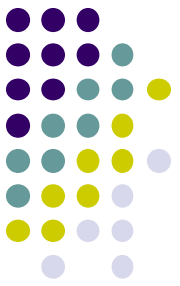
Descubra cómo puede utilizar la tecnología de Varian para prestar una gran calidad asistencial a los pacientes. Regístrese para asistir al próximo seminario web o reproducir una grabación de la biblioteca de seminarios web.

Nota: No necesita cuenta de MyVarian para asistir o ver estos seminarios web.

Más información

Inteligencia Artificial en Radioterapia

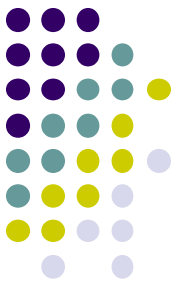
planeación de tratamientos automatizada



- **Implementación de reglas automatizadas y razonamiento (ARIR)**
 - **Varian ESAPI, (Eclipse scripting application programming interface)**
 - **Pinnacle AutoPlanning**
 - **RaySearch Laboratories, RayStation AutoPlanning**

Inteligencia Artificial en Radioterapia

planeación de tratamientos automatizada

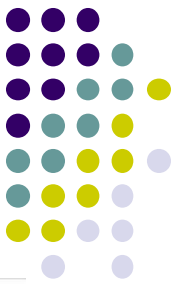


- **Modelación de conocimiento previo en la práctica clínica (KB)**
 - **Varian RapidPlan VMAT**

Quantitative analysis of the factors which affect the interpatient organ-at-risk dose sparing variation in IMRT plans. Yuan L, MP 2012.

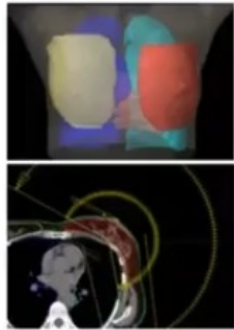
Artificial Intelligence in Radiotherapy Treatment Planning: Present and Future. Wang C, 2019

Inteligencia Artificial en Radioterapia



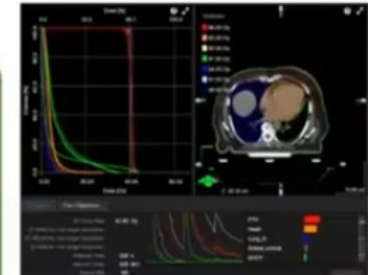
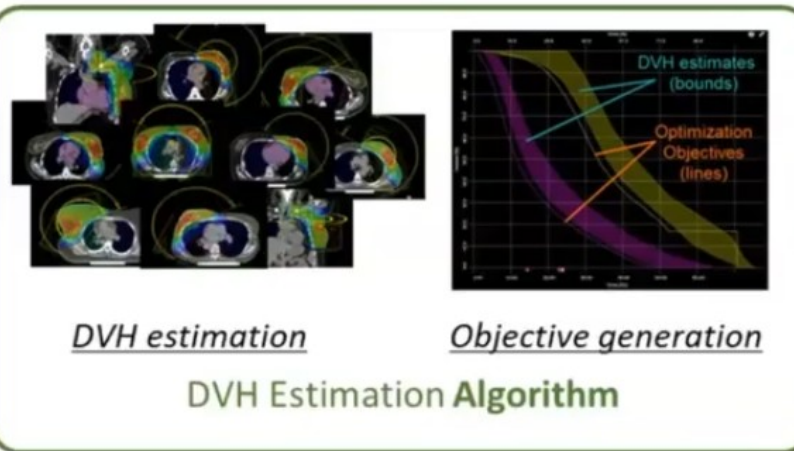
- Varian RapidPlan VMAT

RapidPlan: the flow



New patient info:

- Structures
- Prescription
- Beam geometry



Plan optimization:

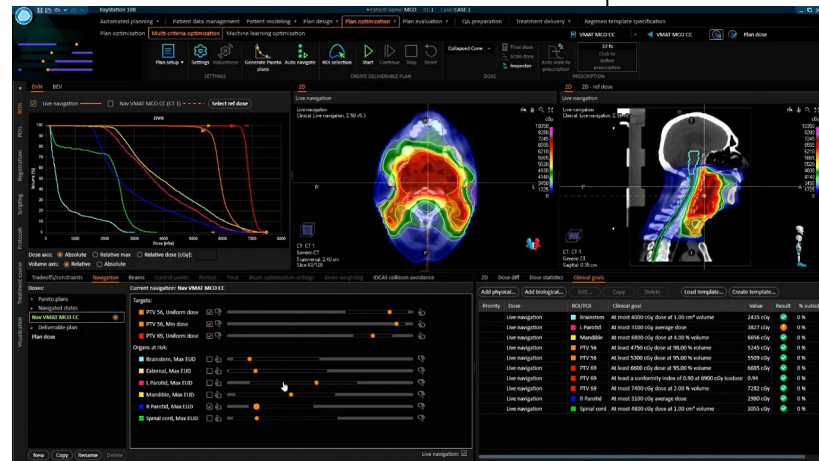
- PO optimization using the objectives generated from estimation

Inteligencia Artificial en Radioterapia planeación de tratamientos automatizada



- **Optimización multicriterio (MCO)**

- RaySearch Laboratories, RayStation



- Varian Eclipse

