

OCTAVIUS 4D/1000SRS

**EXPERIENCIA, MEDIDAS Y
RESULTADOS OBTENIDOS EN EL
HOSPITAL DE JEREZ**

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EQUIPAMIENTO

- TrueBeam v2.5
 - Energías X6, X6-FFF y X10
- MLC 120 Millenium
 - 80 láminas interiores de 0,5 cm (anchura total 20 cm)
 - 40 láminas exteriores de 1 cm (anchura total 20 cm)
- Mesa robótica PerfectPitch (6 gdl)
- TPS Pinnacle v9.10
- Red departamental Aria v13.7 “limitada”
- Dosimetría física: PTW (**Octavius4D/1500/1000SRS**, MaxiStarcheck, Quickcheck, *check, BeamScan, cámaras,...)
- CT GE Discovery 550RT

OCTAVIUS 4D PHANTOM

- OCTAVIUS 4D
 - Maniquí cilíndrico de poliestireno
 - Sistema para verificar tratamientos VMAT/SBRT/SRS
 - Configurable según el array de medida



Top Standard: 32 cm diámetro

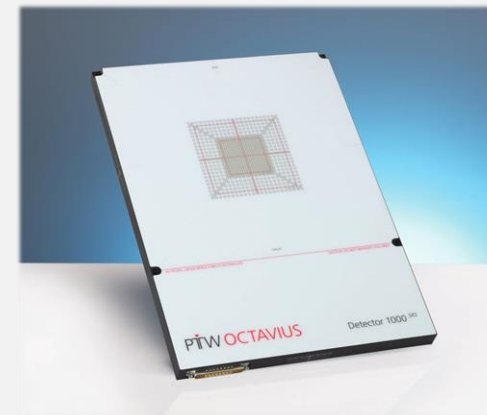
Top SRS: 17 cm diámetro

Top Linac QA: 5 cm espesor

DETECTORES ARRAY

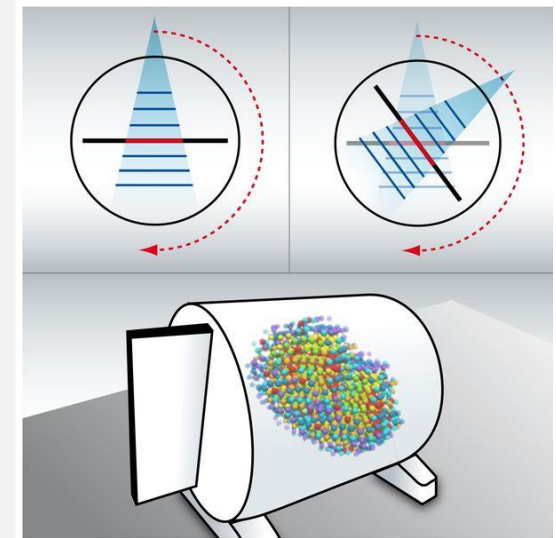
- OCTAVIUS 1500:
 - Array bidimensional de 1405 cámaras de ionización
 - Campo 27 x 27 cm²

- OCTAVIUS 1000 SRS:
 - Array bidimensional de 977 cámaras de ionización de relleno líquido
 - Dimensiones de las cámaras: 0.5 mm x 2.3 mm x 2.3 mm
 - V=0,003 cm³
 - Resolución espacial: 2,5mm
- Área interna de 5x5 cm²
- Área externa de 11x11 cm²



SISTEMA DE MEDIDA

- Medidas en 2D en función del ángulo
 - Inclinómetro inalámbrico acoplado al gantry
- Plano del detector siempre perpendicular a la incidencia del haz
- Cálculo en 3D mediante algoritmo propio basado en los PDD's obtenidos experimentalmente → Independiente del TPS
- Distribución final: Suma de las dosis en 3D



SET UP



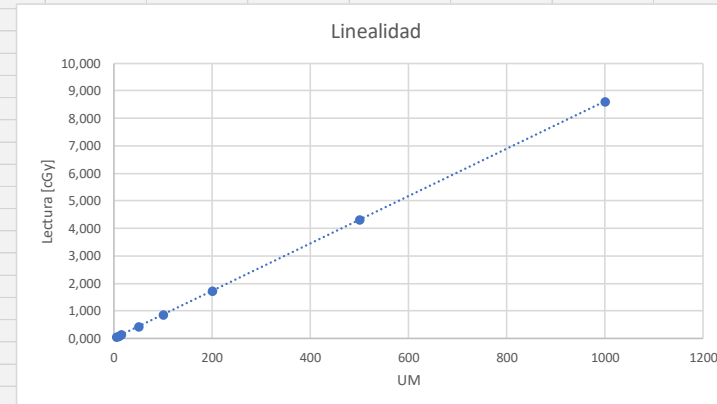
ESTABLECIMIENTO DEL ERI

Linealidad										Pendiente punto a punto	Desv. Pendiente resp.
UM	Lectura	Desviación respecto a linealidad perfecta									
		1 paso	2 pasos	3 pasos	4 pasos	5 pasos	6 pasos	7 pasos			
5	0,043									0,00860	-0,18%
10	0,086	0,00%								0,00860	-0,18%
15	0,129	0,00%	0,00%							0,00860	-0,18%
50	0,430	0,00%	0,00%	0,00%						0,00860	-0,18%
100	0,860	0,00%	0,00%	0,00%	0,00%					0,00862	0,05%
200	1,722	0,12%	0,12%	0,12%	0,12%	0,12%				0,00861	-0,04%
500	4,306	0,02%	0,13%	0,13%	0,13%	0,13%	0,13%			0,00862	0,05%
1000	8,616	0,05%	0,07%	0,19%	0,19%	0,19%	0,19%	0,19%		0,00862	0,00%

0,00861592

Reproducibilidad

UM	Lectura	Diferencia
5	0,043	0,00%
5	0,043	0,00%
5	0,043	0,00%
5	0,043	0,00%
5	0,043	0,00%
50	0,430	0,00%
50	0,430	0,00%
50	0,430	0,00%
50	0,430	0,00%
50	0,430	0,00%
500	4,304	-0,04%
500	4,305	-0,02%
500	4,306	0,00%
500	4,307	0,03%
500	4,307	0,03%



Fuga

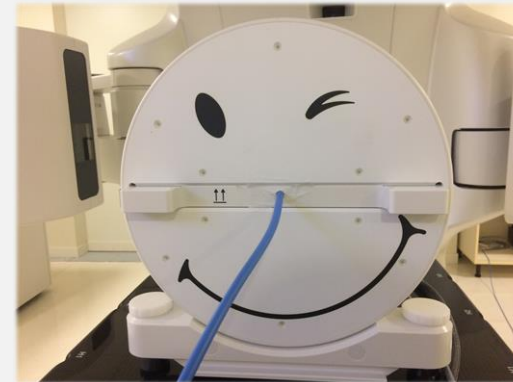
Cámara (-,-): <0.01 cGy/min

Deriva

Cámara (-10,55): <0.1 cGy/min Cámara 593

¿POR DÓNDE EMPEZAR?

- “Code of practice: OCTAVIUS 4D, how to start” (Eclipse, Pinnacle...) (PTW)
- Cámara utilizada: Semiflex 3D T3 I02I
 - $V=0,07 \text{ cm}^3$
 - Versátil y estable
 - Útil para todos los tamaños de campo (2x2...26x26)
 - ¿Diodos para campos pequeños?



I. PDD'S

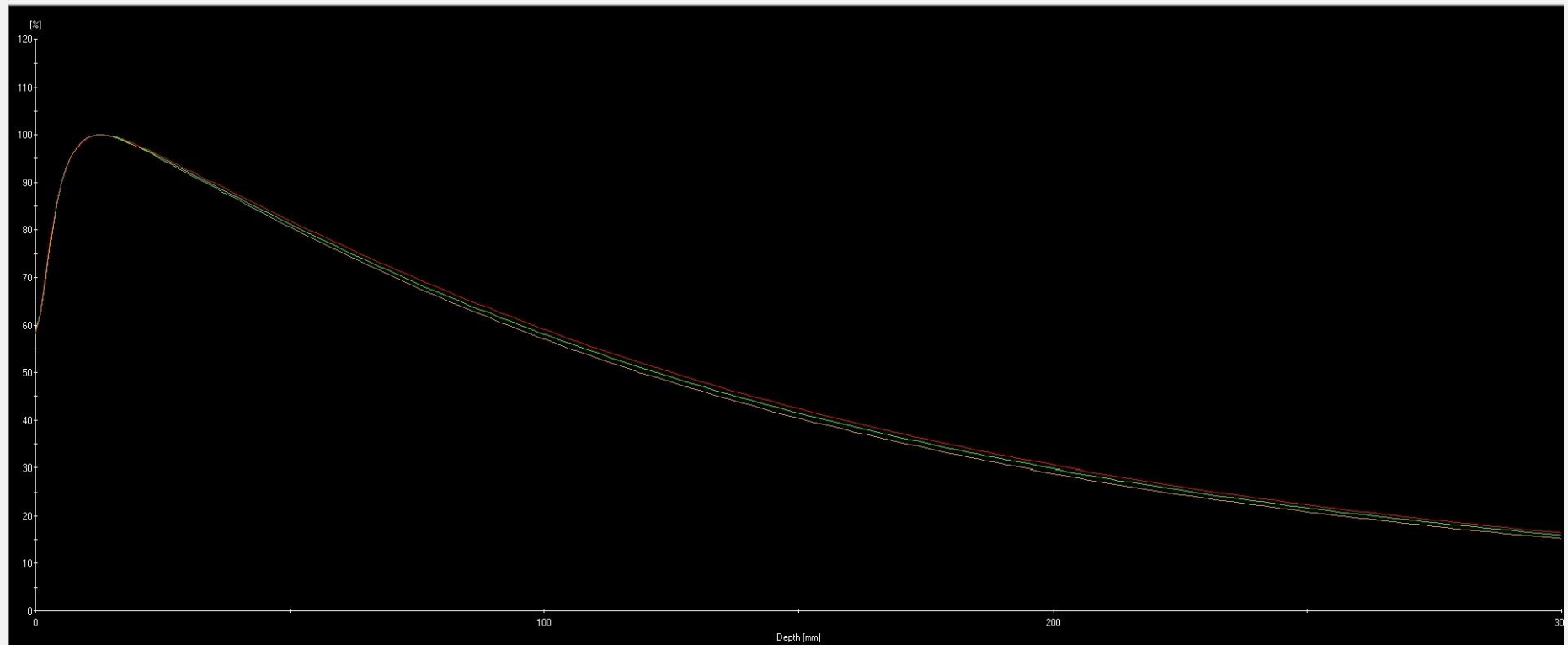
- Tamaños de campos obligatorios:
 - 4x4
 - 10x10
 - 26x26 (Para Octavius I 500)
- Campos adicionales opcionales: 2x2, 3x3, 5x5, 15x15 y 20x20
- Energías X6 y **X6-FFF**
- SSD=;91,5cm! para Octavius I 000SRS (Octavius I 500 SSD=85cm)
- Para el campo 0x0 cm² y para los no medidos, extrapolación mediante Mephysto DataAnalyze y TableGenerator (PTW)

I. PDD'S

Position [mm]	0x0 cm²	1x1 cm²	2x2 cm²	3x3 cm²	4x4 cm²	5x5 cm²	6x6 cm²	7x7 cm²	8x8 cm²	9x9 cm²	10x10 cm²	11x11 cm²	12x12 cm²
0	56.079	57.055	57.94	58.366	58.068	58.886	59.597	60.304	61.012	61.72	62.302	62.834	63.361
1	54.75	56.036	57.231	58.8	61.525	62.37	63.095	63.816	64.538	65.259	65.848	66.383	66.914
2	53.074	52.485	51.791	52.695	58.298	63.295	63.423	70.547	71.172	71.796	72.333	72.836	73.334
3	73.624	73.576	73.406	74.195	77.944	78.56	79.094	79.603	80.123	80.642	81.166	81.451	81.931
4	52.432	52.153	51.738	52.056	54.858	55.274	55.681	56.083	56.484	56.886	57.199	57.476	57.747
5	57.863	57.668	57.320	57.491	59.592	59.326	60.216	60.5	60.783	61.067	61.323	61.566	61.805
6	91.844	91.647	91.3	91.342	93.01	93.169	93.419	93.663	93.906	94.15	94.341	94.51	94.673
7	94.774	94.856	94.363	94.298	95.377	95.543	95.709	95.869	96.028	96.188	96.313	96.423	96.527
8	97.093	96.911	96.569	96.345	97.149	97.276	97.357	97.433	97.508	97.584	97.663	97.732	97.796
9	98.109	98.035	97.8	97.631	98.343	98.453	98.527	98.594	98.662	98.729	98.786	98.838	98.885
10	99.41	99.232	99.012	98.745	99.231	99.267	99.294	99.313	99.333	99.353	99.411	99.465	99.53
11	100	99.957	99.949	99.277	99.775	99.705	99.713	99.714	99.716	99.717	99.756	99.81	99.857
12	99.943	100	99.932	99.707	100	100	99.988	99.969	99.95	99.932	99.947	99.976	100
13	99.836	100	100	99.854	99.994	99.994	100	100	100	100	100	99.994	99.994
14	99.23	99.685	99.977	100	99.918	99.877	99.869	99.854	99.839	99.825	99.818	99.816	99.807
15	99.885	99.917	99.784	99.541	99.722	99.756	99.746	99.731	99.715	99.699	99.677	99.654	99.624
16	99.288	99.576	99.601	99.443	99.471	99.452	99.427	99.396	99.365	99.334	99.329	99.335	99.335
17	99.149	99.191	99.077	98.947	99.025	98.994	99.003	99.006	99.009	99.012	99.008	99.077	98.95
18	98.084	98.428	98.611	98.576	98.56	98.489	98.519	98.544	98.569	98.593	98.62	98.647	98.667
19	97.142	97.67	98.038	98.137	98.088	98.045	98.091	98.131	98.17	98.209	98.206	98.186	98.16
20	96.803	97.205	97.448	97.487	97.57	97.543	97.571	97.593	97.614	97.636	97.668	97.705	97.734
21	96.622	96.845	96.91	96.844	97.052	97.052	97.116	97.173	97.231	97.289	97.321	97.345	97.362
22	94.422	95.311	96.044	96.449	96.492	96.562	96.621	96.674	96.728	96.781	96.818	96.849	96.874
23	94.456	95.054	95.578	95.791	95.915	96.124	96.167	96.204	96.24	96.277	96.314	96.353	96.385
24	93.831	94.534	95.082	95.35	95.405	95.456	95.557	95.653	95.749	95.845	95.902	95.942	95.978
25	92.941	93.754	94.415	94.753	94.769	94.884	94.978	95.066	95.154	95.242	95.334	95.427	95.514
26.5	92.141	92.833	93.373	93.716	94.055	94.171	94.305	94.433	94.562	94.69	94.795	94.794	94.827
29	90.91	91.673	92.286	92.685	93.074	93.239	93.362	93.538	93.684	93.821	93.929	94.007	94.079
29.5	89.56	90.53	91.352	91.884	92.184	92.494	92.654	92.806	92.959	93.112	93.218	93.305	93.386
31	89.577	90.113	90.501	90.77	91.291	91.517	91.686	91.85	92.014	92.178	92.314	92.438	92.556
32.5	87.618	88.602	89.441	90.04	90.487	90.768	90.98	91.185	91.39	91.595	91.73	91.837	91.939
34	86.284	87.268	88.291	89.001	89.502	89.977	90.302	90.421	90.641	90.86	91.015	91.143	91.266
35.5	85.461	86.451	87.301	88.006	88.785	89.132	89.403	89.688	89.933	90.198	90.363	90.486	90.604
37	83.772	85.154	86.398	87.318	87.818	88.269	88.538	88.8	89.064	89.327	89.5	89.637	89.769
38.5	84.158	85.011	85.727	86.322	87.084	87.46	87.765	88.065	88.365	88.665	88.851	88.99	89.124
40	82.765	83.743	84.586	85.279	86.101	86.646	86.963	87.274	87.584	87.895	88.092	88.243	88.389
41.5	81.253	82.497	83.588	84.456	85.288	85.714	86.094	86.449	86.814	87.178	87.399	87.563	87.721
43	79.638	81.183	82.597	83.746	84.541	85.028	85.294	85.754	86.115	86.475	86.7	86.87	87.036
44.5	78.364	80.044	81.596	82.837	83.616	84.208	84.59	84.945	85.312	85.679	85.908	86.083	86.254
46	79.025	80.036	80.917	81.725	82.817	83.407	83.791	84.17	84.549	84.929	85.179	85.377	85.57
47.5	77.64	79	80.232	81.222	81.983	82.567	82.978	83.395	83.791	84.197	84.461	84.668	84.87
49	76.423	77.888	79.229	80.309	81.091	81.724	82.119	82.531	82.962	83.332	83.603	84	84.191
50.5	75.684	76.979	78.15	79.193	80.307	80.963	81.409	81.849	82.289	82.729	83.024	83.26	83.491
52	74.172	75.732	77.29	78.58	79.616	80.2	80.673	81.141	81.609	82.078	82.369	82.589	82.804
53.5	73.079	74.687	76.175	77.493	78.689	79.39	79.888	80.38	80.872	81.365	81.686	81.937	82.183
55	73.382	74.633	75.764	76.807	77.966	78.543	79.071	79.593	80.115	80.637	80.964	81.211	81.452
56.5	71.92	73.391	74.729	75.907	77.059	77.836	78.561	79.291	79.991	80.711	80.919	80.453	80.744
58	70.969	72.521	73.956	75.21	76.329	77.073	77.613	78.148	78.682	79.216	79.564	79.835	80.102
59.5	70.878	72.091	73.187	74.246	75.59	76.301	76.853	77.4	77.947	78.494	78.852	79.132	79.408
61	68.843	70.611	72.265	73.697	74.803	75.52	76.105	76.685	77.266	77.846	78.213	78.495	78.771
62.5	68.289	69.948	71.495	72.849	74.012	74.811	75.403	75.991	76.578	77.165	77.52	77.78	78.035
64	68.289	69.614	70.76	71.87	72.954	74.017	74.688	75.185	75.689	76.195	76.704	77.048	77.343
65	67.289	68.788	70.176	71.452	72.771	73.585	74.172	74.754	75.336	75.918	76.31	76.626	76.936
67	66.237	67.726	69.106	70.395	71.784	72.627	73.234	73.835	74.437	75.038	75.443	75.768	76.088
69	65.104	66.724	68.237	69.604	70.972	71.66	72.281	72.898	73.515	74.131	74.533	74.847	75.156
71	63.796	65.479	67.097	68.546	69.935	70.706	71.335	71.961	72.586	73.211	73.623	73.947	74.267
73	63.239	64.741	66.139	67.465	68.896	69.72	70.372	71.02	71.668	72.316	72.759	73.119	73.474
75	62.628	63.917	65.204	66.441	67.66	68.7	69.386	70.066	70.747	71.429	71.881	72.241	72.597

Generación de un archivo por energía (X6/X6-FFF_PDD_TrueBeamI) en el directorio local:
 C:\Users\Public\Documentos\Verisoft\Data\PDData

Visible	Type	Modality	Energy [MV/MeV]	Field [cm x cm]	Depth [mm]	OffAxis [mm]	Wedge/App.	Groupname	Comment	Accelerator	Block	Gantry [°]	Collimator [°]	Y Offset [mm]	X Offset [mm]	es:Ang [°]	SSD [cm]	Date/Time	Correction
<input checked="" type="checkbox"/>	PDD	Photons	6.0 FFF	5.0 x 5.0	---	0.00	Open		XSFFF - PDD 5x5 - SSD 100 cm	TRUEBEAM1	None	0.0	0.0	0.0	0.0	0.0°	100.0	2017-02-16 11:19	Raw Data
<input checked="" type="checkbox"/>	PDD	Photons	6.0 FFF	5.0 x 5.0	---	0.00	Open		XSFFF - PDD 5x5 - SSD 91.5 cm	TRUEBEAM1	None	0.0	0.0	0.0	0.0	0.0°	91.5	2017-02-27 12:19	Processed
<input checked="" type="checkbox"/>	PDD	Photons	6.0 FFF	5.0 x 5.0	---	0.00	Open		XSFFF - PDD 5x5 - SSD 85 cm	TRUEBEAM1	None	0.0	0.0	0.0	0.0	0.0°	85.0	2017-02-27 12:19	Processed



II. OCTAVIUS4D PHANTOM

The screenshot displays the 'Planning' software interface. The top menu bar includes 'File', 'Options', 'Utilities', and 'View'. A toolbar contains icons for 'Setup', 'Contours', 'Points', 'Beams', 'Dose', 'Eval', 'IMRT', and 'Inv Plan'. The patient information is 'Patient: zzz_Heterogeneidades,,' and the plan is 'Plan: HeterogeneidaRev: R01.P01.D01'. The trial is named 'Trial_1'.

Regions Of Interest

Buttons: Add ROI, Delete ROI..., Load Organ..., Auto-Seg...

ROI Name:

Data Set: (3) ZZZ_OCTAVIUS4D

ROI Type:

Contours:

Volume: cm³

ROI Display Options

Color	2D Display	3D Display	Box Size	Line Width
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Display outline in BEV DRR:

Views:

- Top view: Trial: Trial_1, Slice 86: Z = 0,000 (3) ZZZ_OCTAVIUS4D
- Left view: Trial: Trial_1, Slice 296: X = -0,117 (3) ZZZ_OCTAVIUS4D
- Right view: Trial: Trial_1, Slice 296: Y = 0,000 (3) ZZZ_OCTAVIUS4D

Bottom status bar: Primary Secondary Fusion Secondary:

II. OCTAVIUS4D PHANTOM

- 3 OPCIONES:
 - CT *propio* de OCTAVIUS4D
 - Inconveniente: Procesado de imágenes para “rellenar” el hueco de dentro
 - CT de OCTAVIUS4D (facilitado por PTW)
 - CT *artificial* (facilitado por PTW)
 - Ventajas: Contornos de la mesa IGRT Varian incluidos

II. OCTAVIUS4D PHANTOM

The screenshot displays the Octavius4D software interface for planning. The main window shows a cross-sectional view of the Octavius4D phantom with three Regions of Interest (ROIs) outlined: a purple circle (CouchSurf_IGRT), a yellow circle (CouchInt_IGRT), and a green elongated shape (Top_SRS). The interface includes a menu bar (File, Options, Utilities, View), a toolbar, and a status bar. The patient information is zzz_Octavius4D,, Plan: Octavius4D_SRev: R02.P02.D03, Trial_1.

The **Regions Of Interest** panel on the left shows the following settings for the selected ROI (CouchSurf_IGRT):

- ROI Name: CouchSurf_IGRT
- Data Set: Octavius4D Modular
- ROI Type: SUPPORT
- Contours: 282
- Volume: 1819.52 cm³ (Recompute)

The **ROI Display Options** panel shows the following settings:

- Color: purple
- 2D Display:
- 3D Display:
- Box Size:
- Line Width:
- Display outline in BEV DRR: Yes No

The **Edit Options** panel shows the following settings:

- Autocontour thresholds: Lower (800), Upper (4096)
- Raw Values: Lower Upper
- Autocontour Options...:
- Auto-close painted contours: Yes No
- Copy contours from last edited slice to:
- Undo last contouring:
- Interpolate between contours:
- Delete all interpolated contours:
- ROI Expansion/Contraction...:

The **Density Override Display** window shows the density override volume for the selected ROI, with a slice at Z = 0.000.

The **Regions Of Interest** table at the bottom provides a summary of the ROIs:

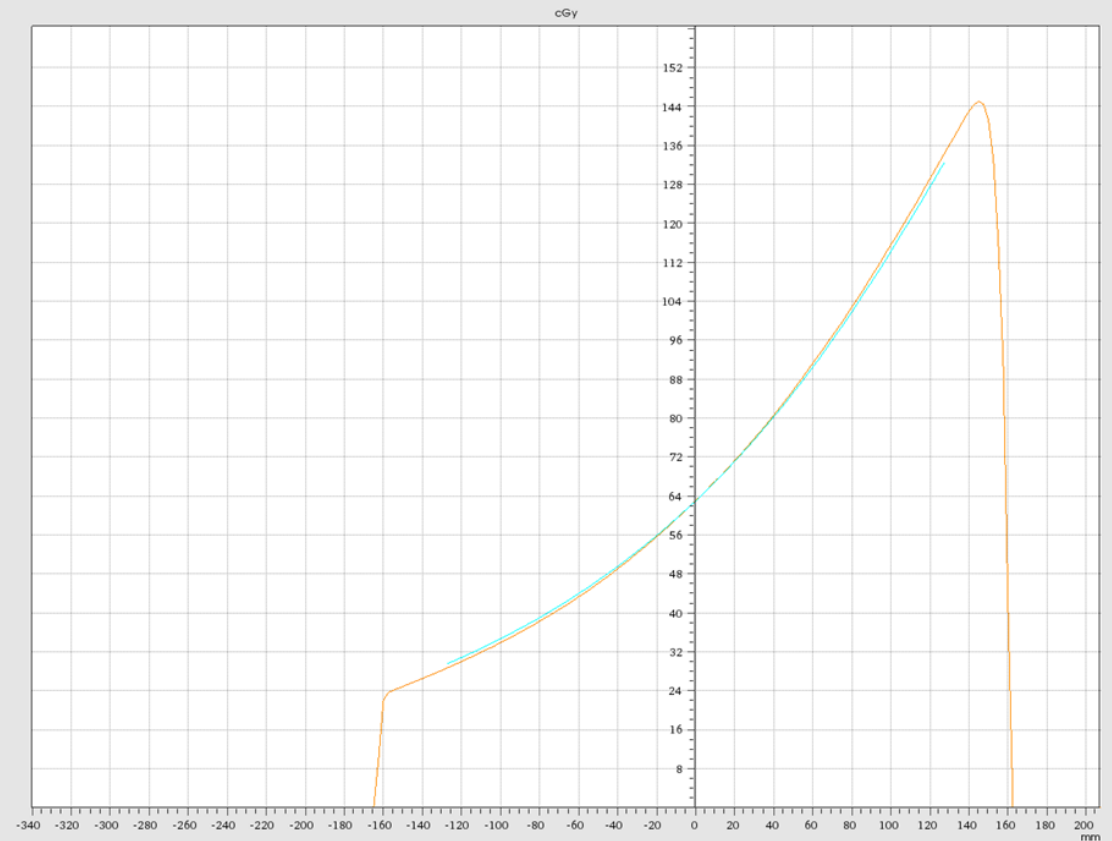
Name	Data Set	2D Mode	3D Mode	Color	Number of Contours	Box Size	Line Width
<input checked="" type="checkbox"/> CouchSurf_IGRT	Octavius4D Module	Contour	Off	purple	282	Medium	Medium
<input checked="" type="checkbox"/> CouchInt_IGRT	Octavius4D Module	Contour	Off	yellow	141	Medium	Medium
<input checked="" type="checkbox"/> Top_SRS	Octavius4D Module	Contour	Off	forest	77	Medium	Medium

II. OCTAVIUS4D PHANTOM -DENSIDAD

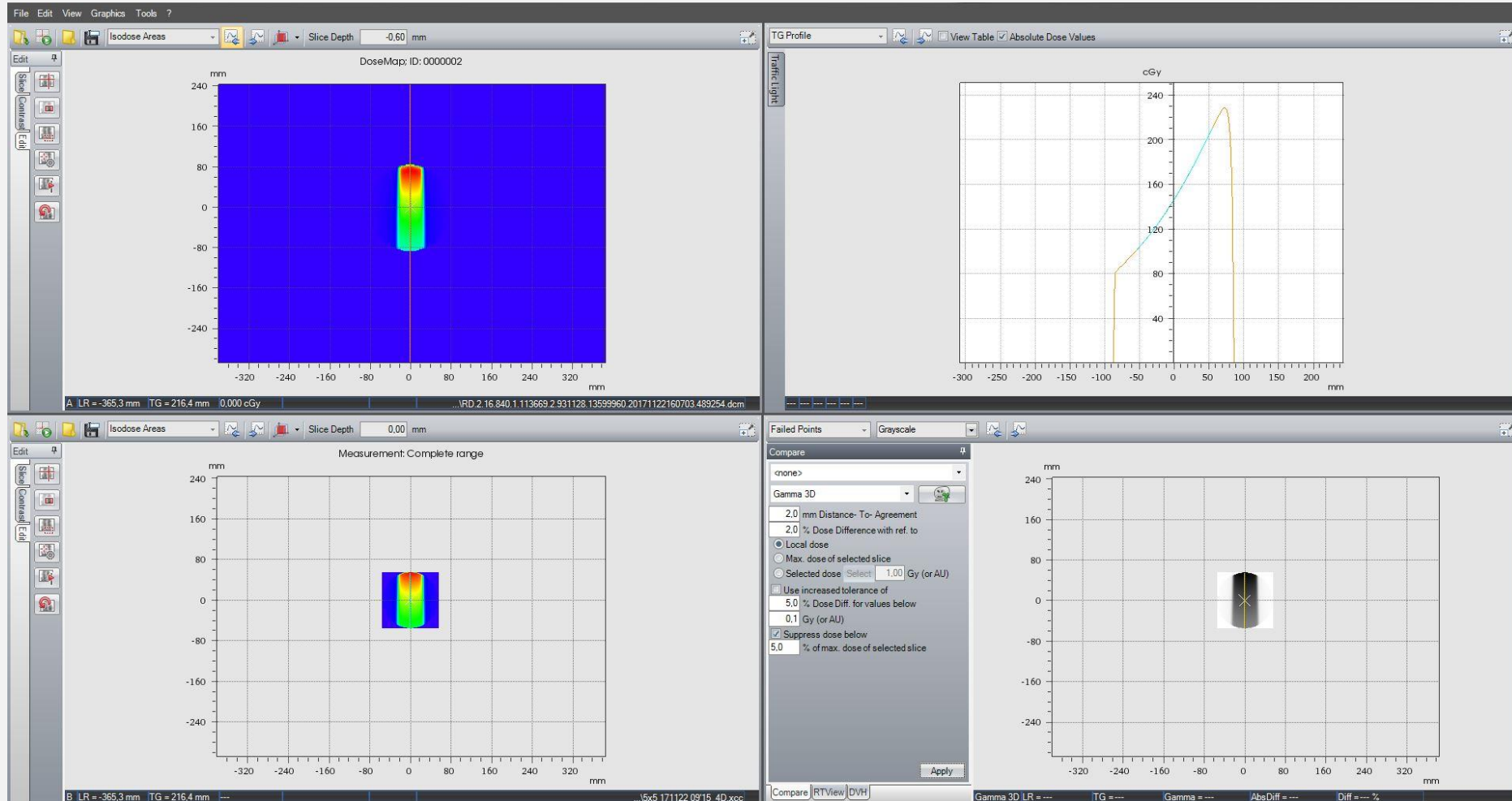
- Pinnacle = Densidad física
- Punto de partida: $\rho = 1,05 \text{ g/cm}^3$ (para top Standard!)
- Necesarias pequeñas correcciones (D913.200.03 “How to adjust the Relative Electron Density of OCTAVIUS 4D to match the TPS value”)

II. OCTAVIUS4D PHANTOM - DENSIDAD

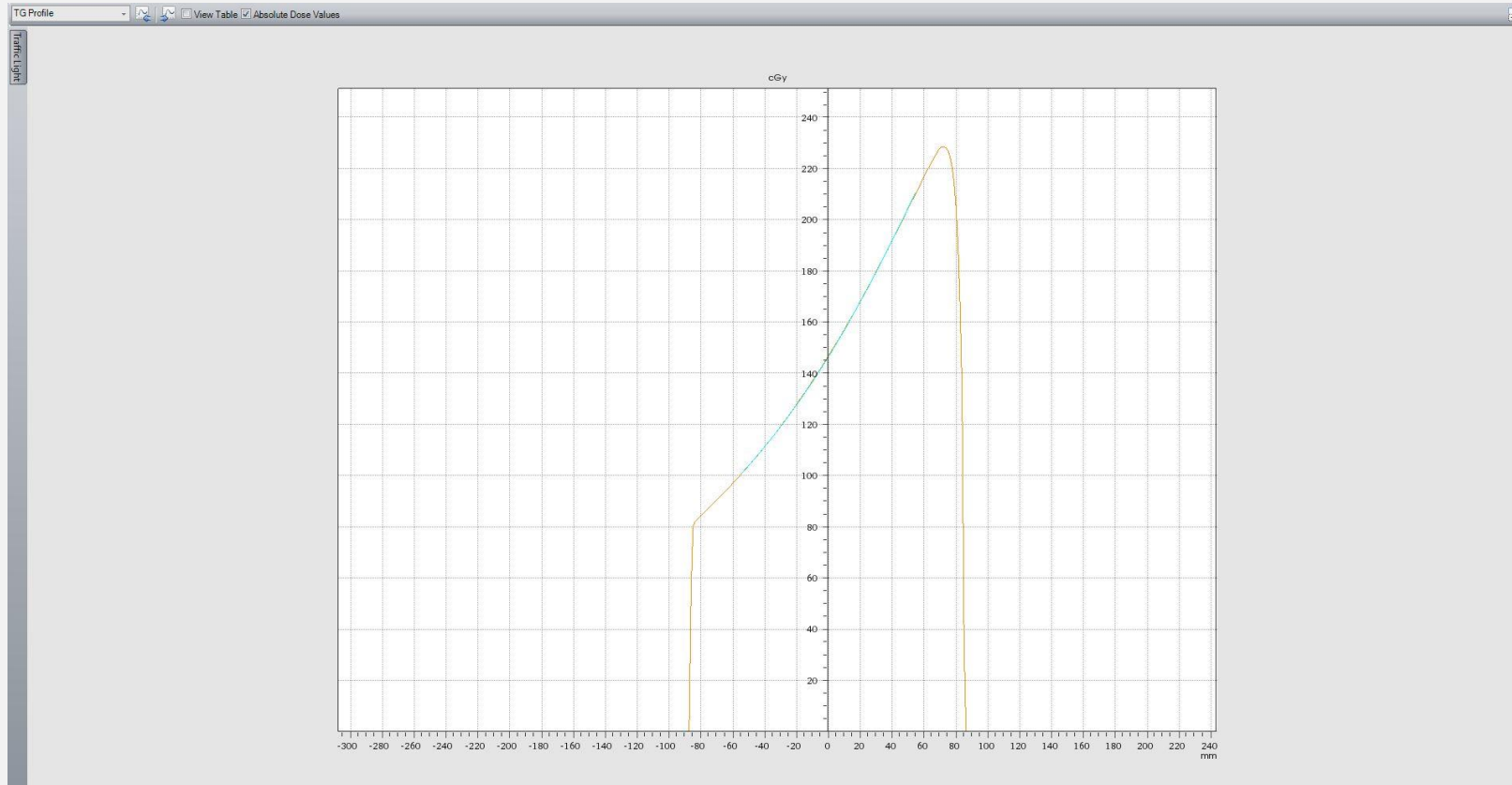
- Campo G000:
 - Gantry = 0°
 - SSD = 91.5 cm
 - Campo= 10x10 cm²
 - 200 MU
- Comparación PDD's
 - Calculado Octavius vs Pinnacle
 - Perfil TG en corte transversal



II. OCTAVIUS4D PHANTOM – DENSIDAD



II. OCTAVIUS4D PHANTOM – DENSIDAD



Densidad final = 1.01 g/cm³ (?)

II. OCTAVIUS4D PHANTOM –MESA


- Mismo procedimiento que antes, pero con $G=180^\circ$
- Verificación con ARCO completo
- Medida de dosis absoluta

UM:	200		
Campo:	10x10		
Fecha:	24/04/17		
SSD:	91.5 cm		
Array:	OctaviusSRS1000		
P. Medida:	Cámara central		
	X6		
	TPS [cGy]	Medido [cGy]	Diferencia [%]
G000	171,2	171,1	-0,06%
G180	166,1	166,063	-0,02%
ARC	169,6	169,658	0,03%
	<i>Isocentro</i>		
	X6FFF		
	TPS [cGy]	Medido [cGy]	Diferencia [%]
G000	164	164	0,00%
G180	158,4	158,687	0,18%
ARC	162,2	162,05	-0,09%
	<i>Isocentro</i>		

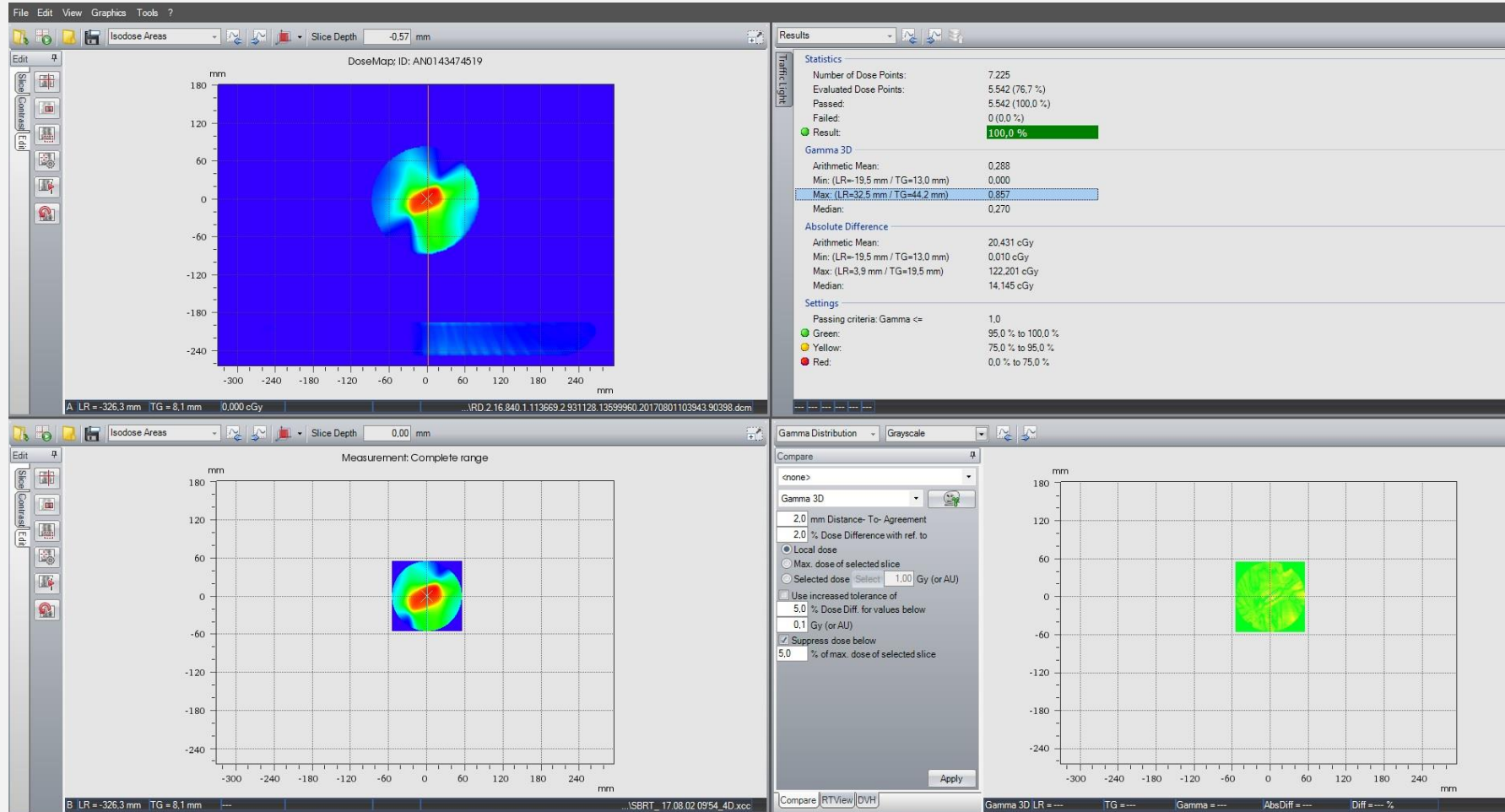
III. MEDIDAS

- Exportación RTDose y RTPlan desde Pinnacle
- Calibración cruzada para corregir por el OF diario
- Medidas de verificación
 - G000, G180 y ARCO
- Medida plan tratamiento
- Cálculo distribución de dosis mediante algoritmo propio basado en los PDD's introducidos
 - Dimensiones de los vóxeles en la reconstrucción de la dosis = Resolución rejilla TPS
 - 1,25 mm para Octavius I000SRS
- Comparación planes aplicando análisis gamma

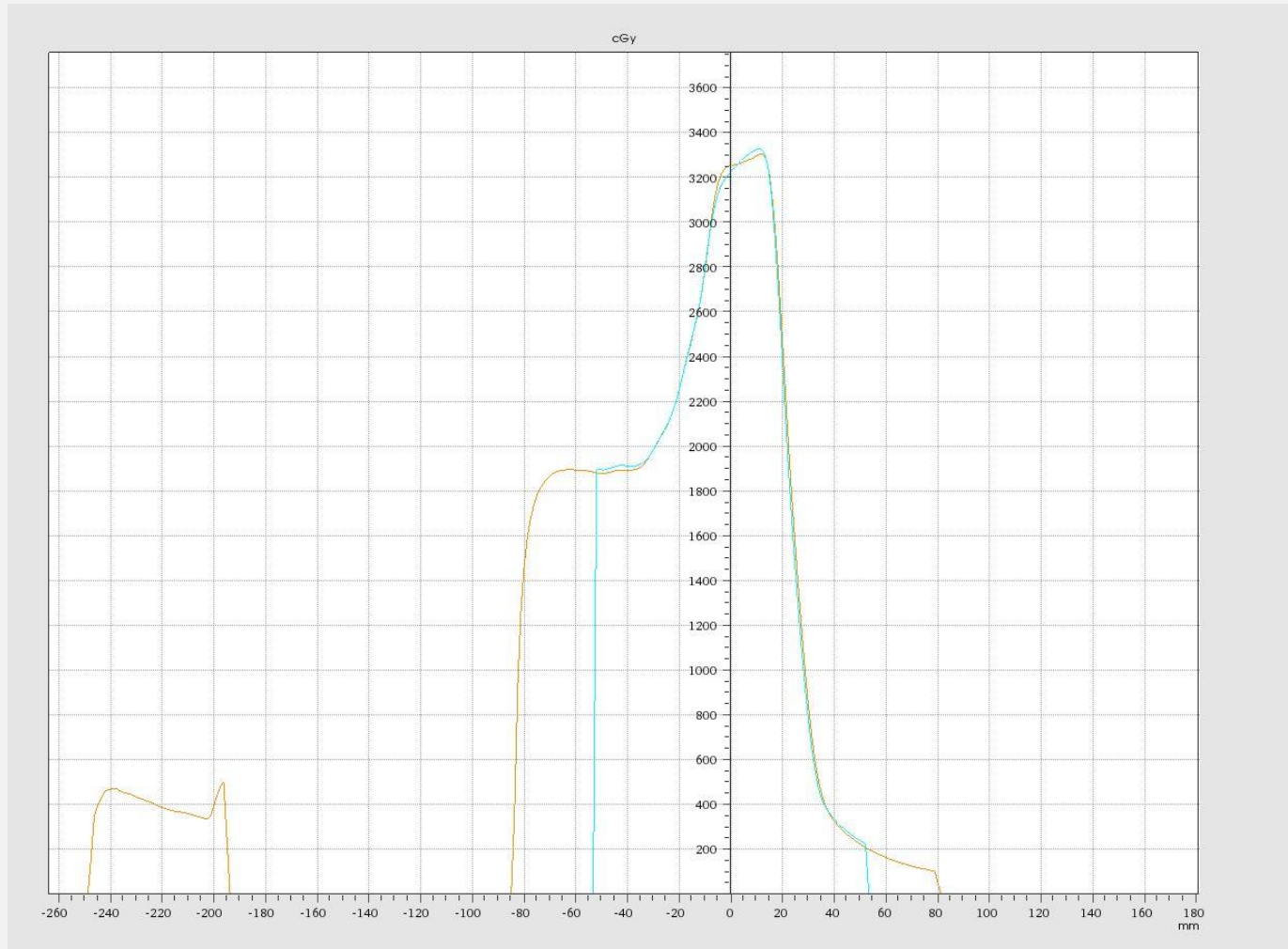
III. MEDIDAS

		Servicio Andaluz de Salud CONSEJERÍA DE SALUD																					
Hoja creada por: Álvaro Seguro																							
Nombre:																							
Apellidos:																							
NUHSA:																							
UM: 200		UM: 200																					
Campo: 5X5		Campo: 5X5																					
Fecha:		Fecha:																					
SSD: 91,5 cm		SSD: 91,5 cm																					
Cámara: Semiflex (1)		Array: Octavius1500																					
DOSIS ABSOLUTA – X6FFF																							
Electrómetro		Unidos-webline																					
Cámara		Semiflex 3D (1)																					
Referencia		TM31021																					
Número de serie		141618																					
Nd,w [Gy/C]		5,800E+08																					
Ksat		1,005																					
Kpol		0,998																					
Kq,q0		0,9957																					
P [hPa]																							
T [°C]																							
Kp,t		#DIV/0!																					
Carga [nC] – L1																							
Carga [nC] – L2																							
Carga [nC] – L3																							
Carga [nC] – Promedio		#DIV/0!																					
Dosis [cGy]		#DIV/0!																					
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TOTAL	0	0,000	#DIV/0!																				


IV. RESULTADOS CASO I



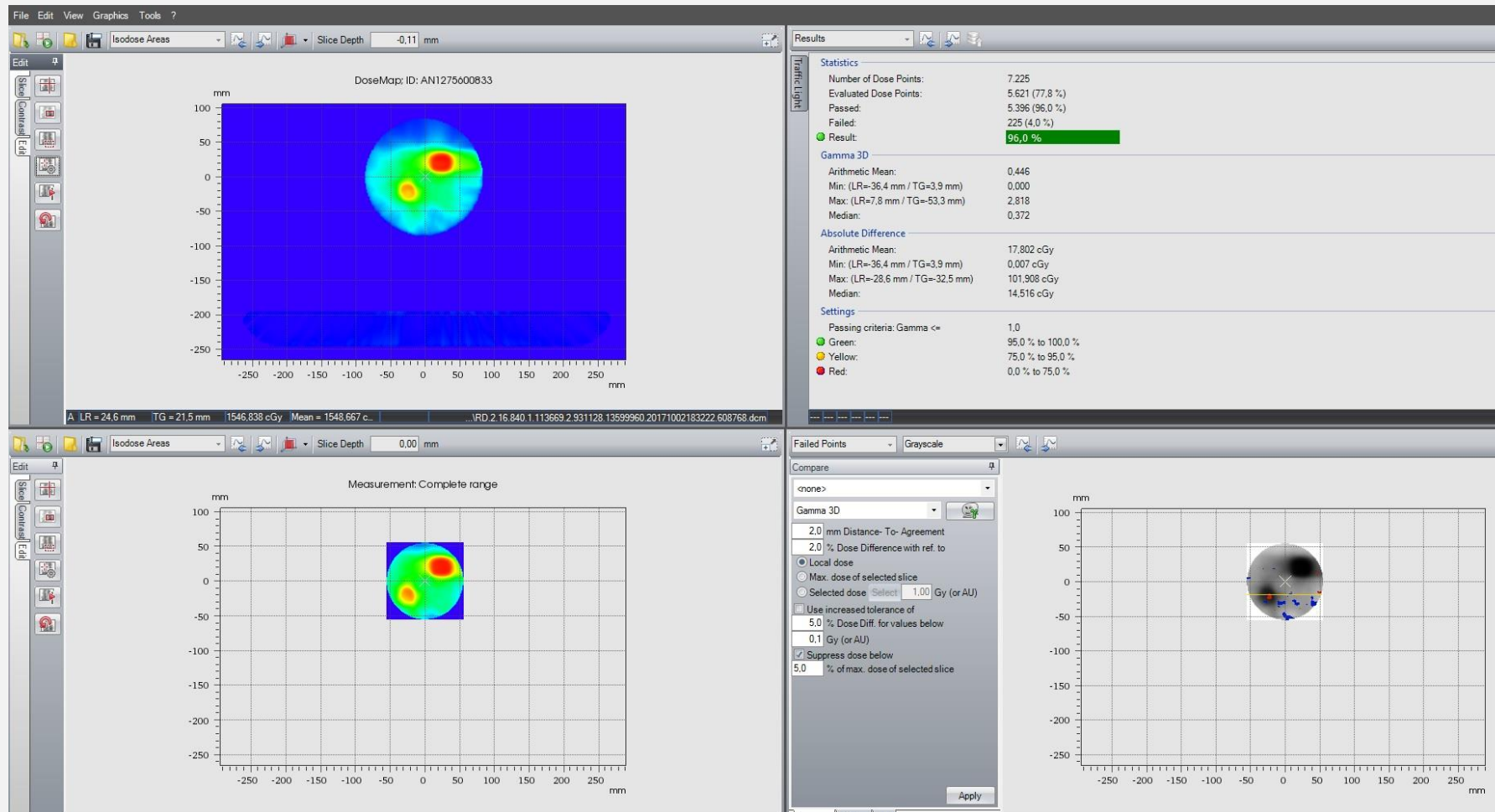
IV. RESULTADOS CASO I



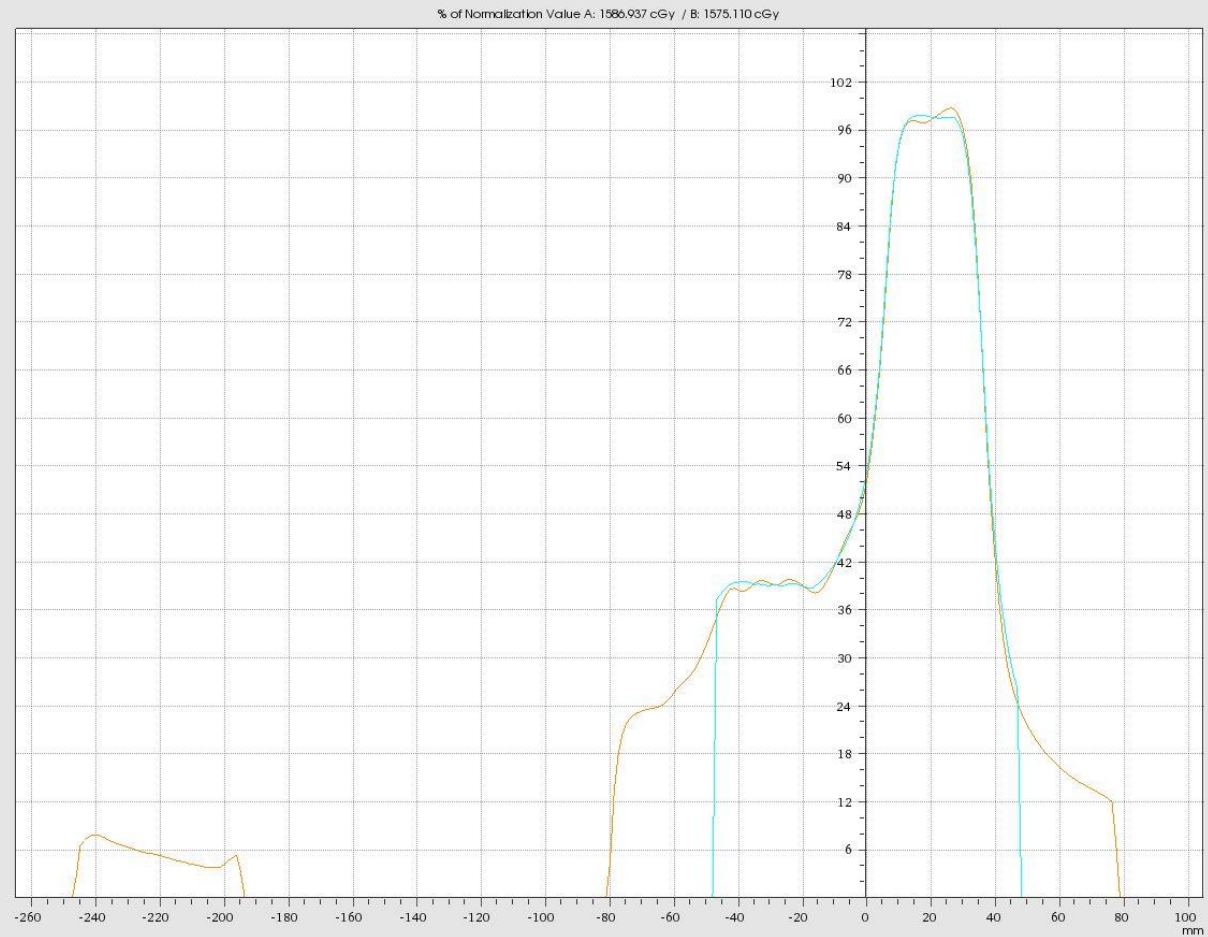
IV. RESULTADOS CASO I

 Servicio Andaluz de Salud CONSEJERÍA DE SALUD																																					
Hoja creada por: Álvaro Seguro																																					
Nombre:	XXXXX																																				
Apellidos:	XXXXX																																				
NUHSA:	XXXXX																																				
UM:	200			UM:	100																																
Campo:	10x10			Campo:	5x5																																
Fecha:	01/08/17			Fecha:	02/08/17																																
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IV. RESULTADOS - CASO 2



IV. RESULTADOS - CASO 2



IV. RESULTADOS - EXPERIENCIA

	Análisis2D							
	Local				Global			
ID	1mm/1%	2mm/2%	3mm/3%	5mm/5%	1mm/1%	2mm/2%	3mm/3%	5mm/5%
1	75,5%	99,9%	100,0%	100,0%	78,2%	100,0%	100,0%	100,0%
2	77,3%	98,8%	100,0%	100,0%	82,2%	98,8%	100,0%	100,0%
3	97,1%	100,0%	100,0%	100,0%	98,6%	100,0%	100,0%	100,0%
4	76,8%	98,6%	99,7%	100,0%	80,8%	99,3%	100,0%	100,0%

	Análisis3D							
	Local				Global			
ID	1mm/1%	2mm/2%	3mm/3%	5mm/5%	1mm/1%	2mm/2%	3mm/3%	5mm/5%
1	78,1%	100,0%	100,0%	100,0%	80,5%	100,0%	100,0%	100,0%
2	77,3%	96,0%	100,0%	100,0%	82,2%	98,8%	100,0%	100,0%
3	97,5%	100,0%	100,0%	100,0%	98,6%	100,0%	100,0%	100,0%
4	80,9%	100,0%	100,0%	100,0%	85,0%	100,0%	100,0%	100,0%



MUCHAS GRACIAS