Integrating the IQM into a commercial planning system

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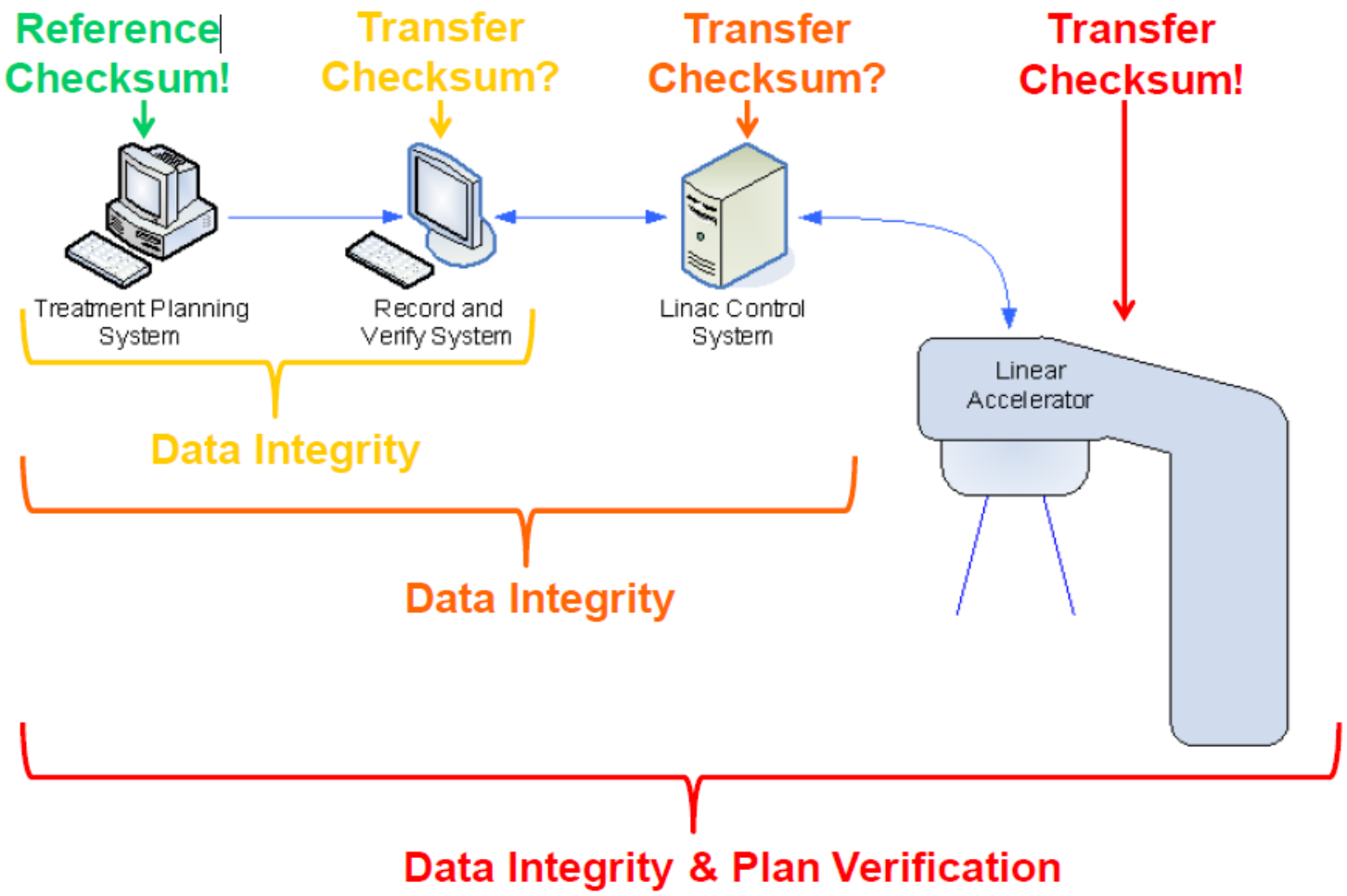
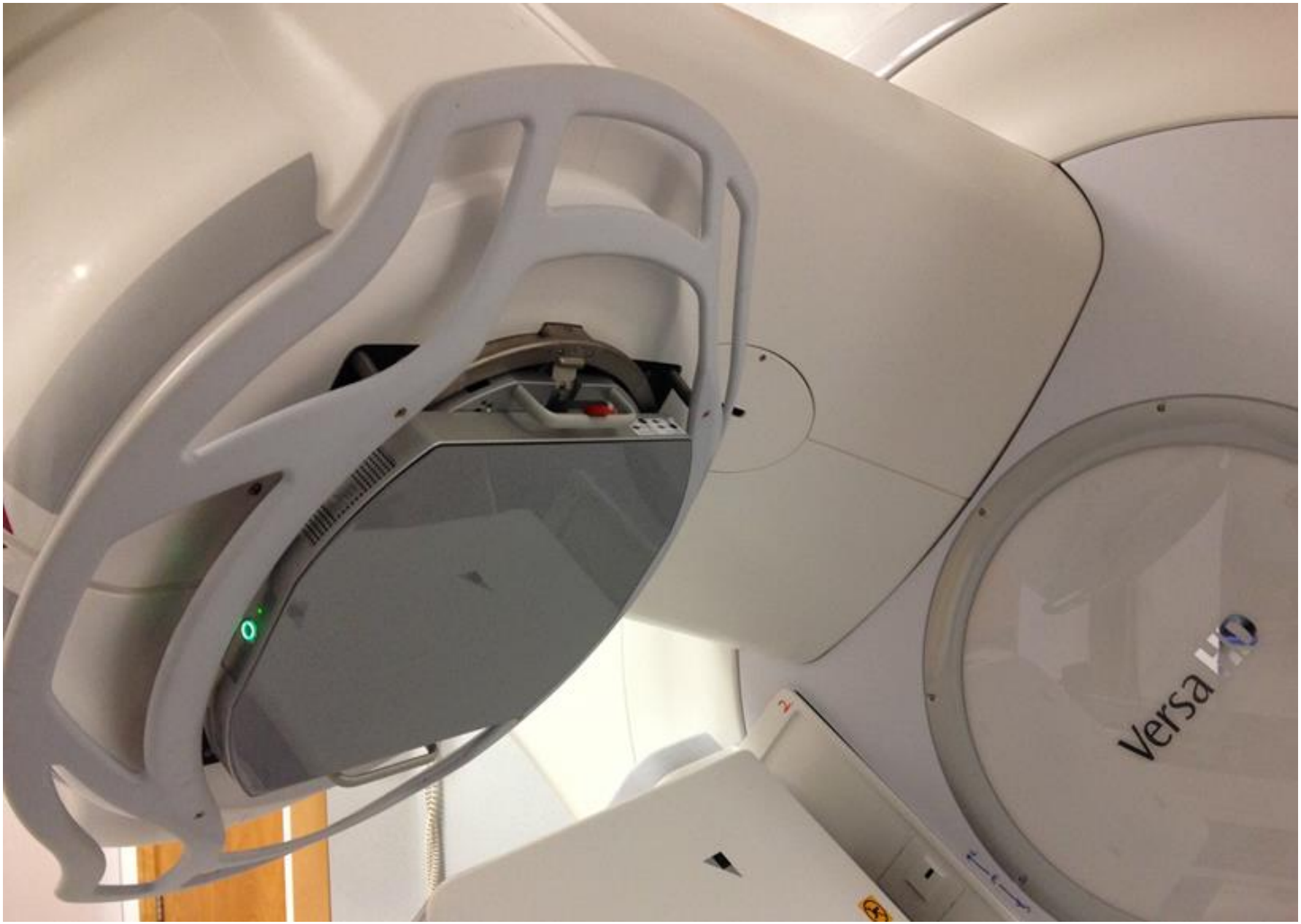
Purpose of IQM

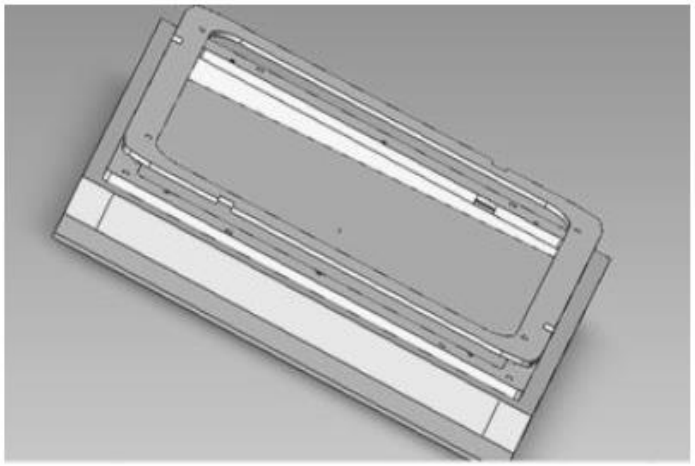


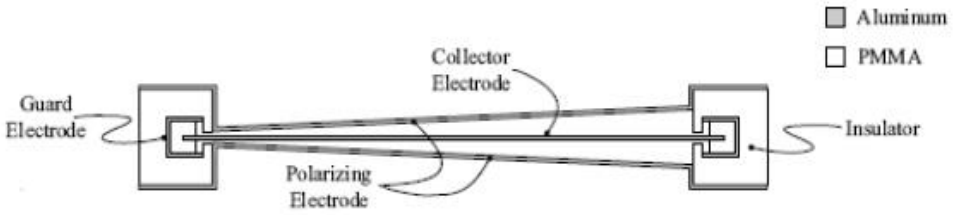

Versa HD

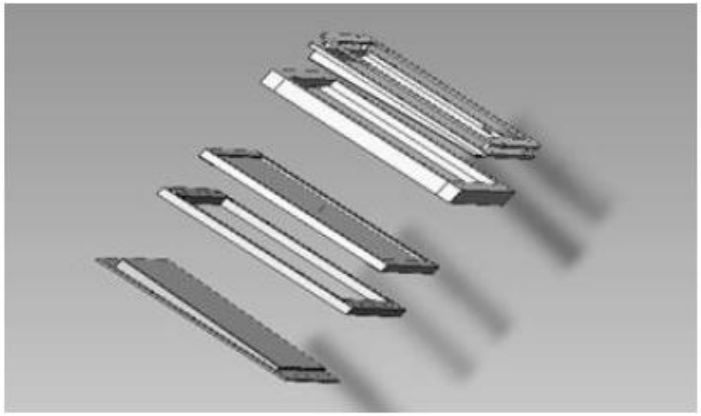
IQM design

Hardware Design (Prototype)

- ✓ Large Area Ion Chamber (550cc)
- ✓ Electrode plates made of 2mm Aluminum
- ✓ Enclosure made of PMMA
- ✓ Sensitive Area: 26cm x 26cm
- ✓ Max. Field Size: 40cm x 40cm
- ✓ Spatial sensitivity: 0.5%/mm





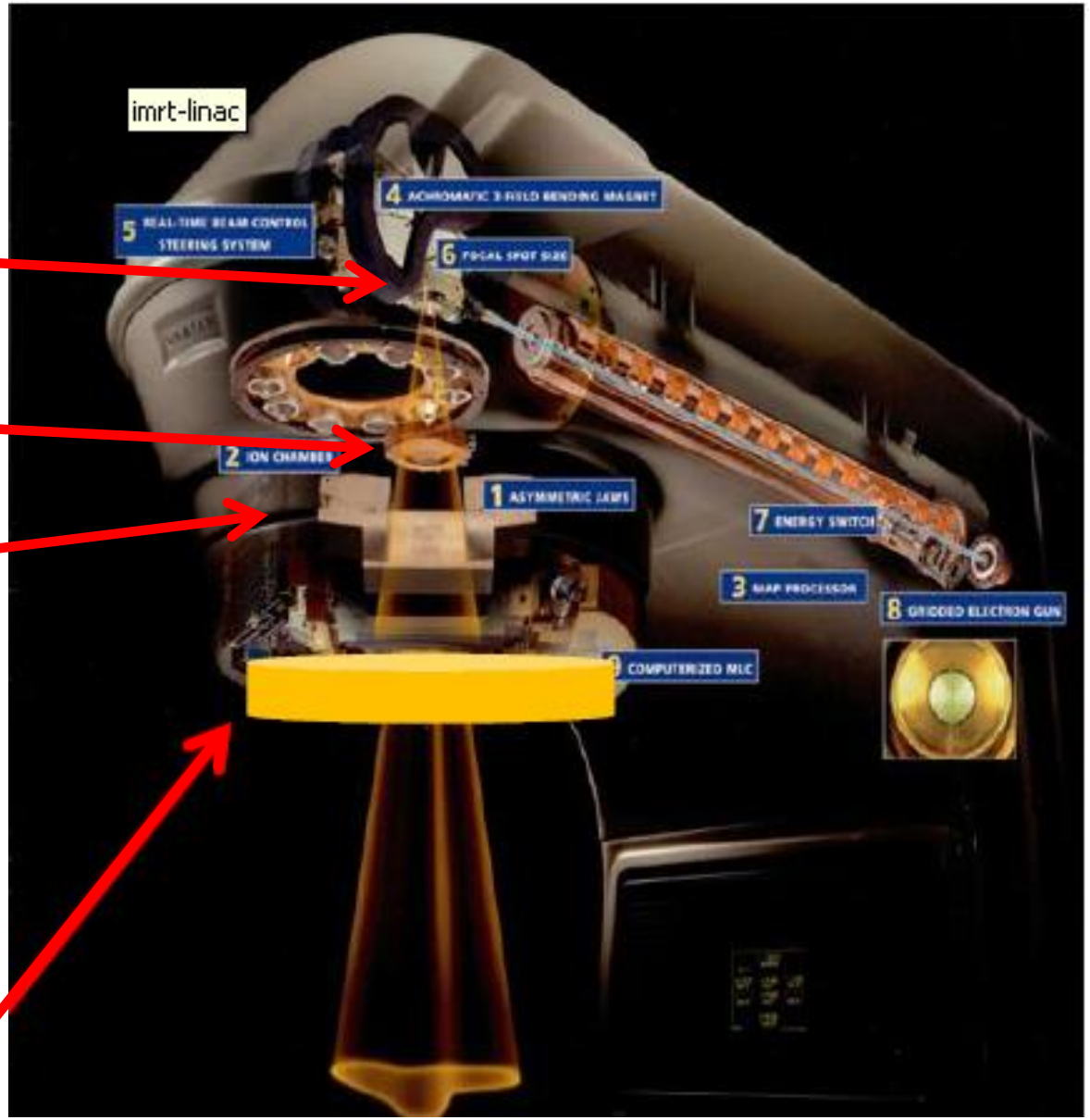


Target

Flattening filter

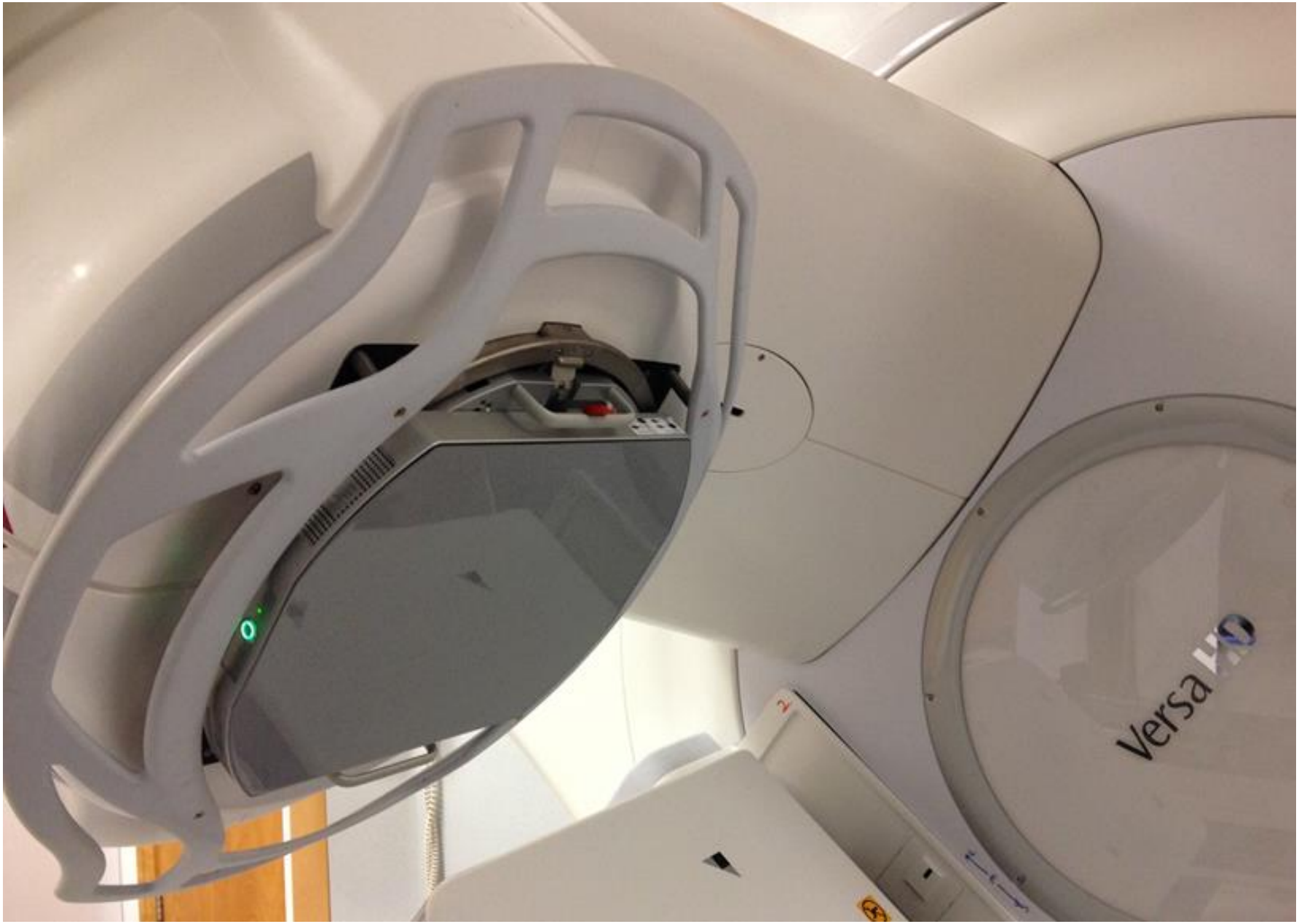
MLC/Jaws

IQM (4.5mm Al)



Integrating the IQM into Pinnacle 9.8

1. Comparison of data measured with & without IQM in plotting tank (6,10 &6FFF)
2. Evaluation of IQM data against clinical models in Pinnacle 9.8
3. Magnitude of adjustments assessed
4. Plans delivered to Delta 4 through IQM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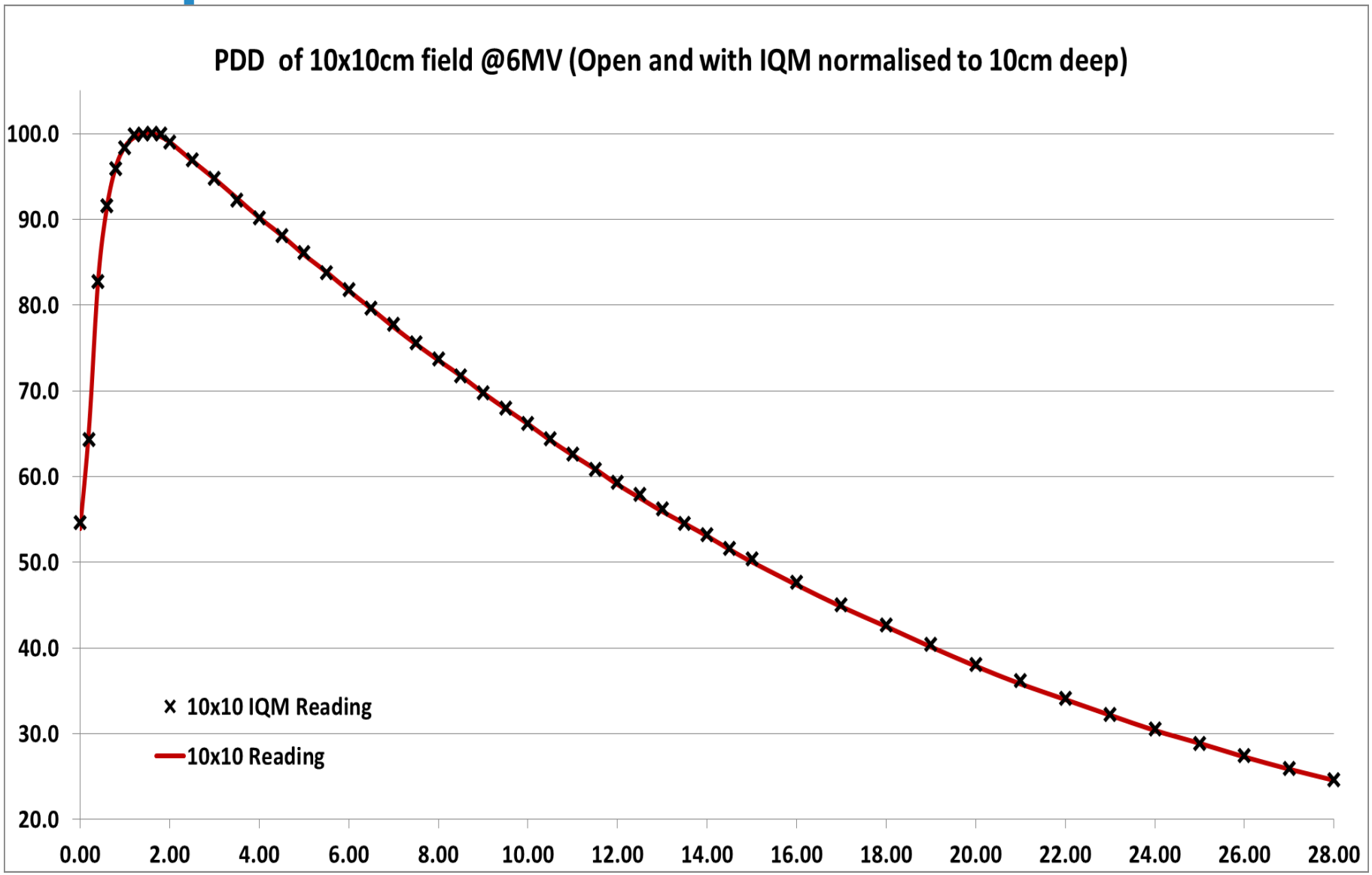
Comparison of radiation beams – 6MV



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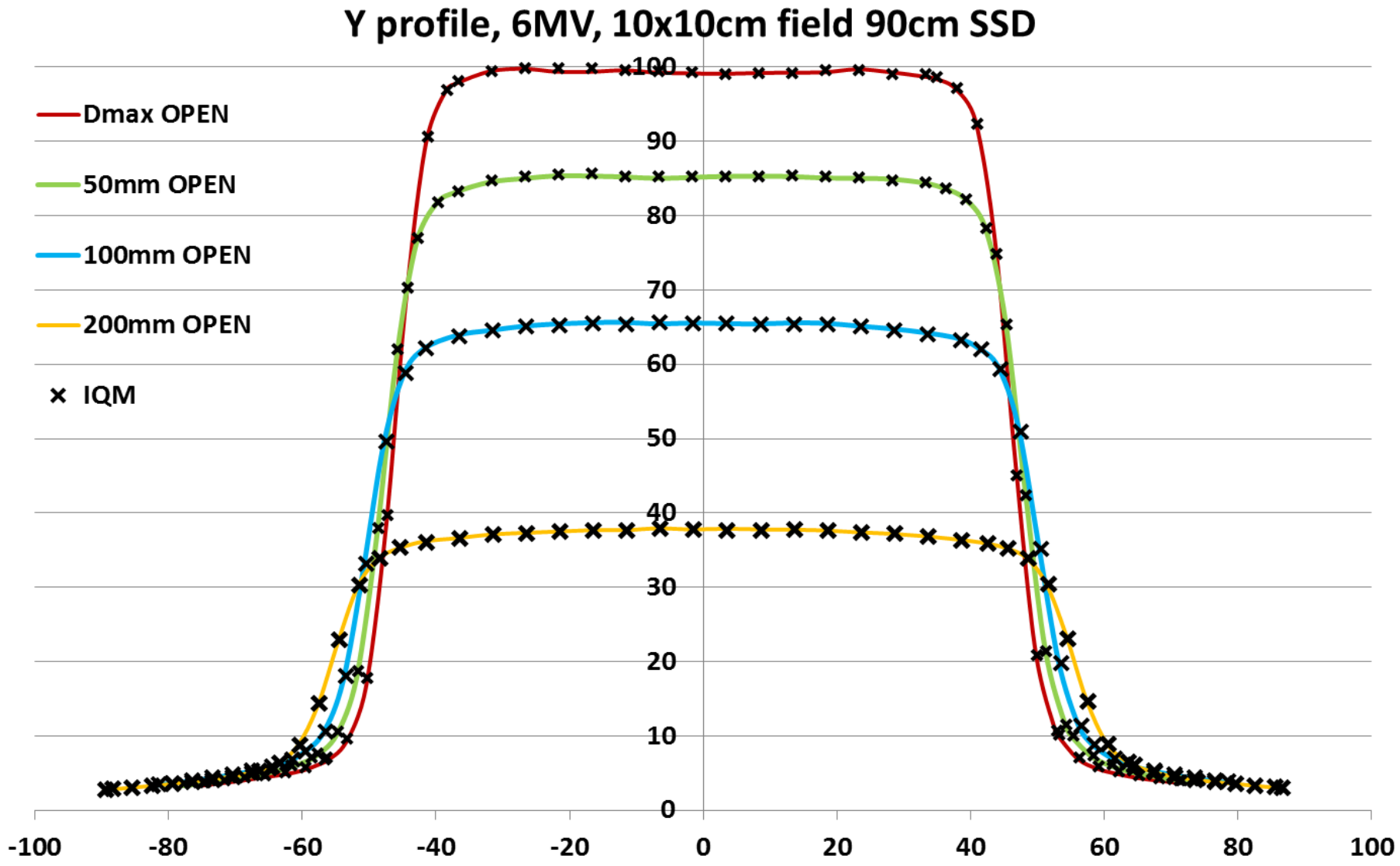
Comparison of radiation beams – 6MV



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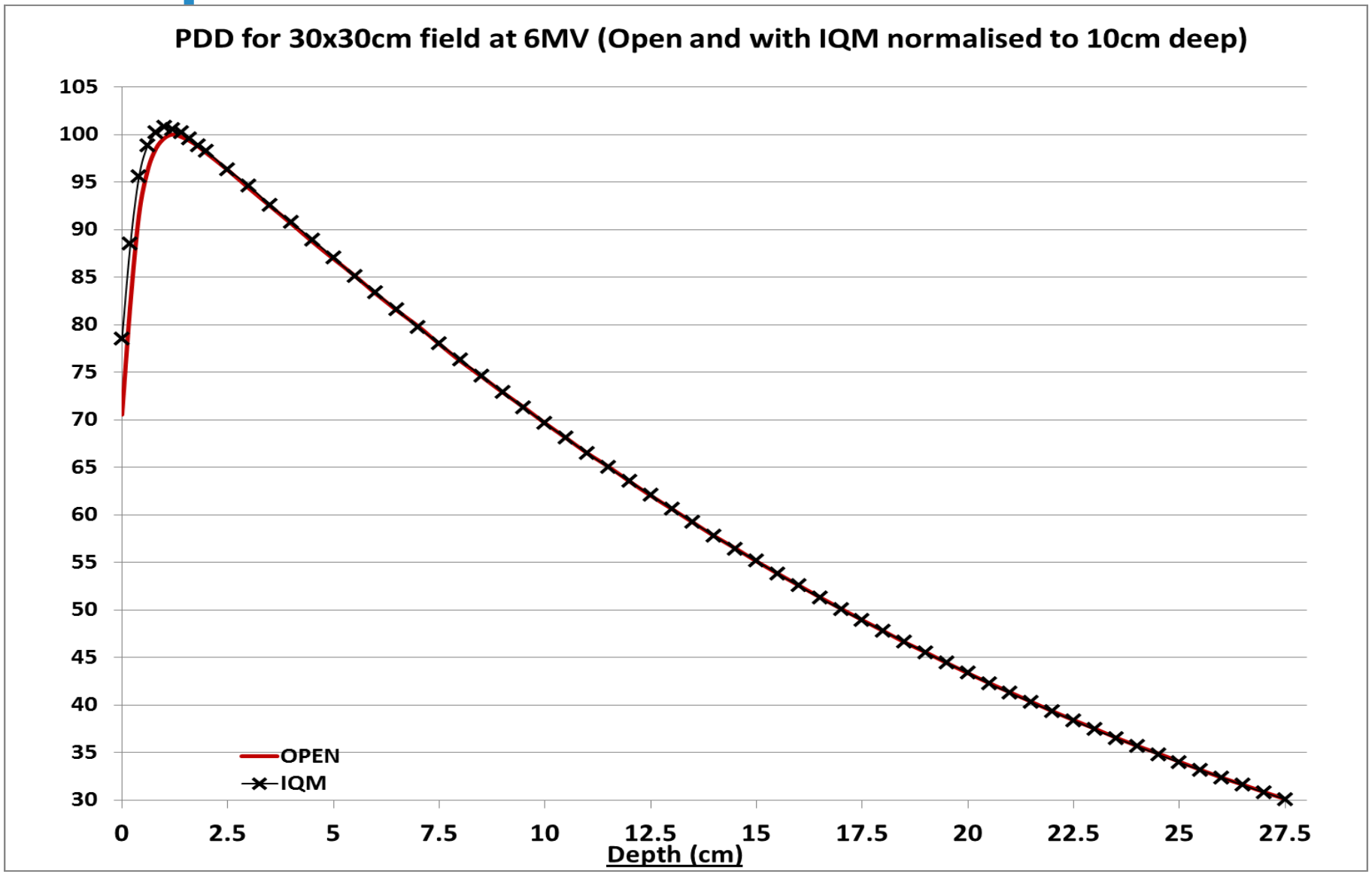

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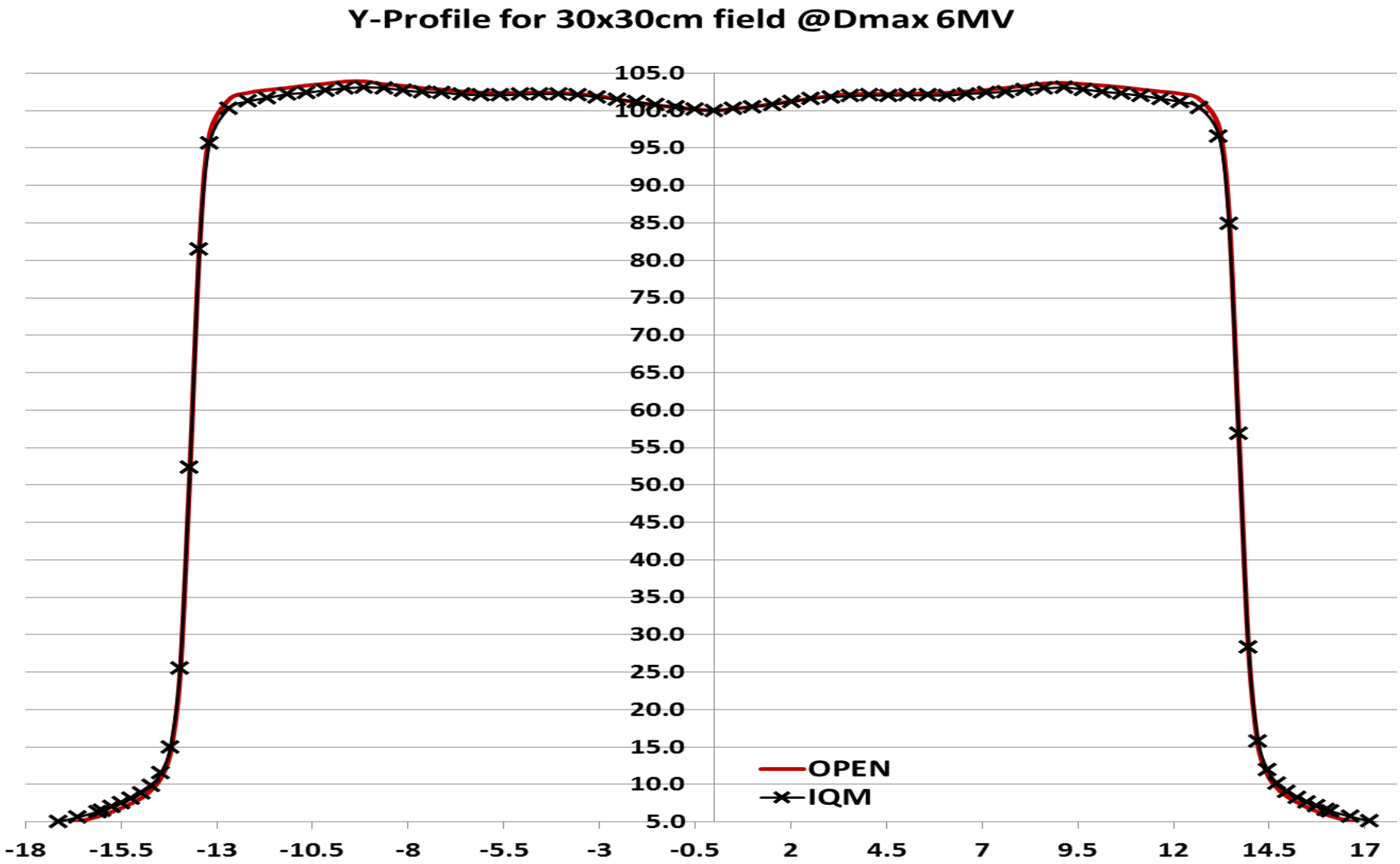

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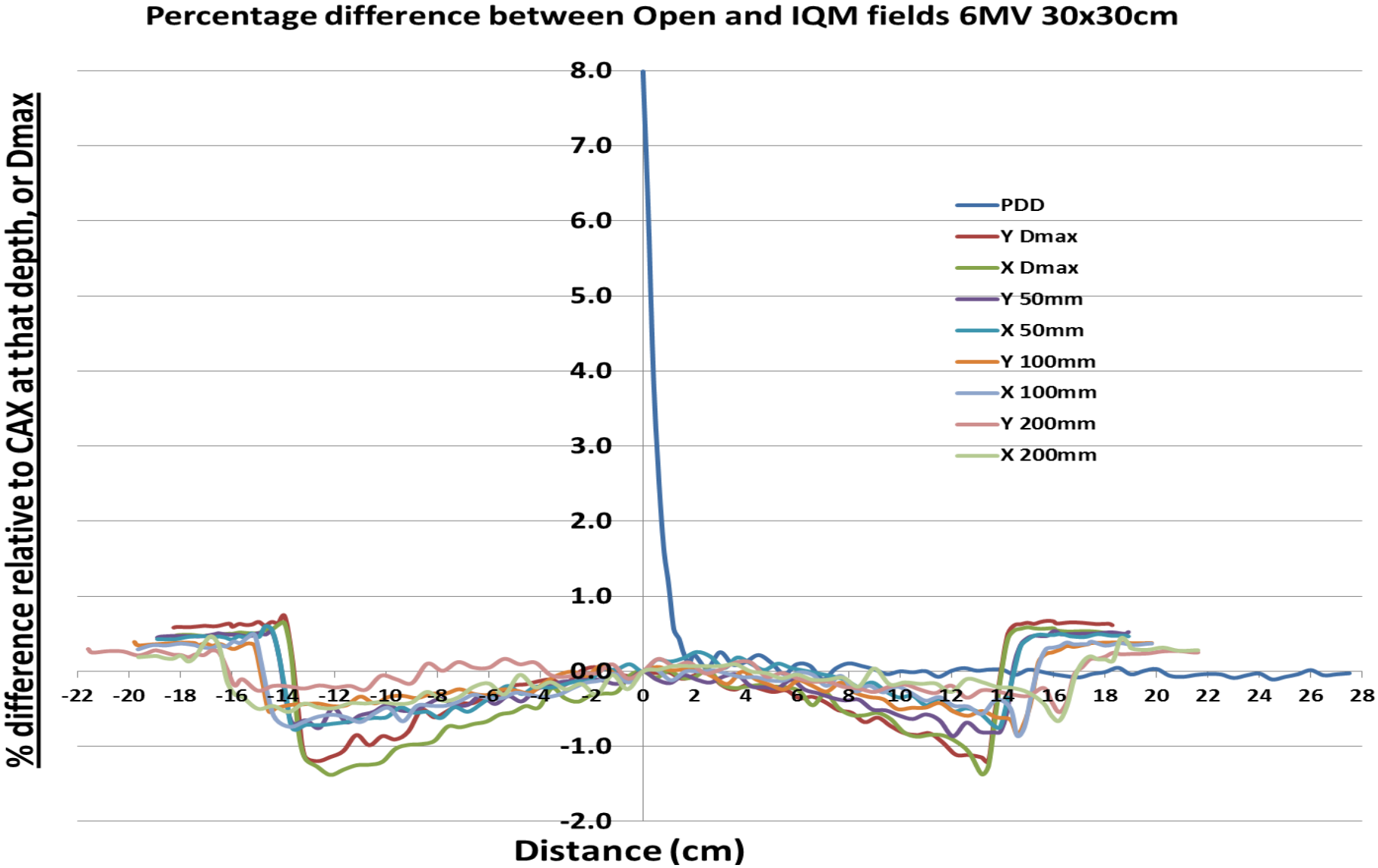
Comparison of radiation beams – 6MV



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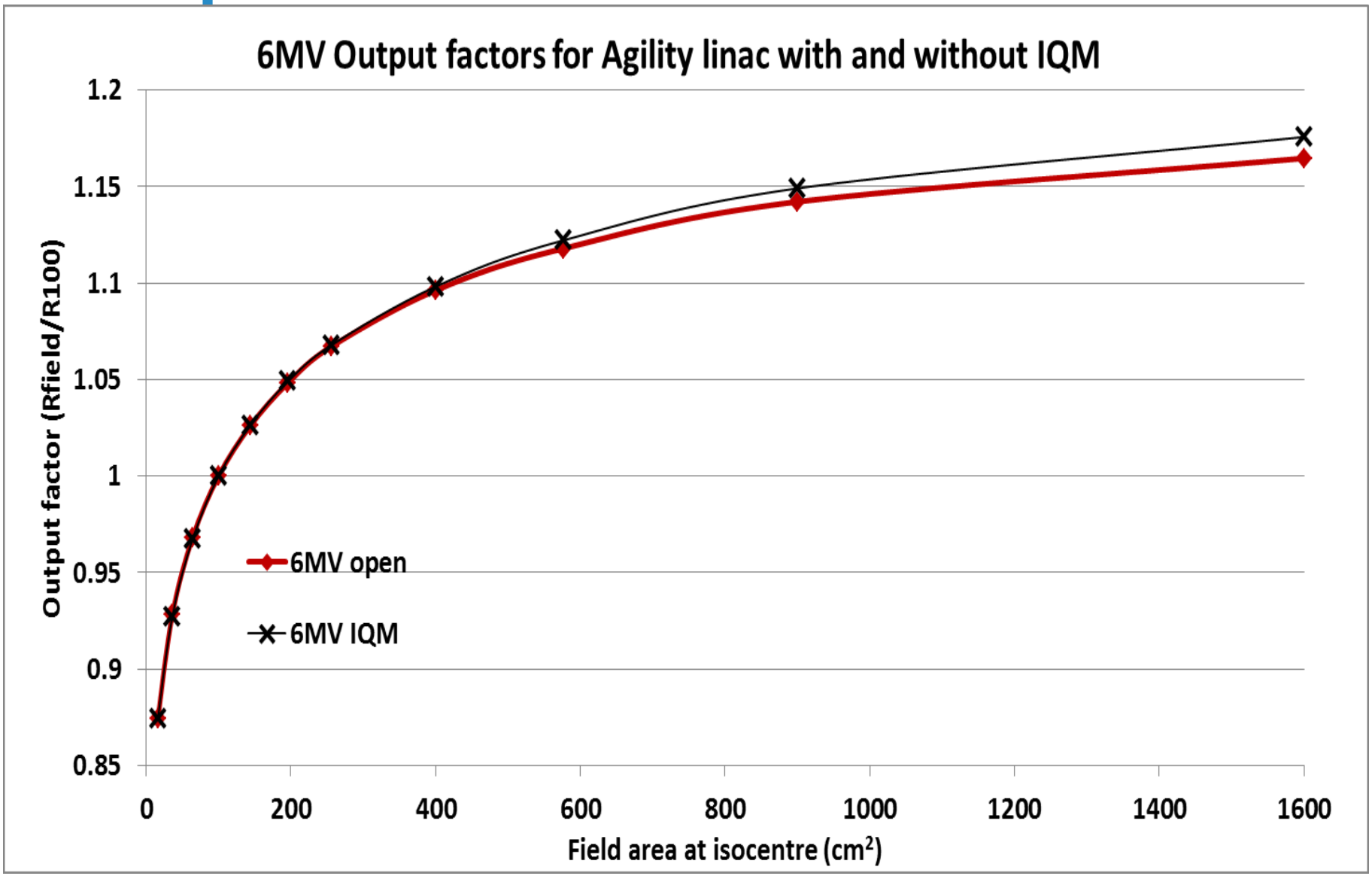
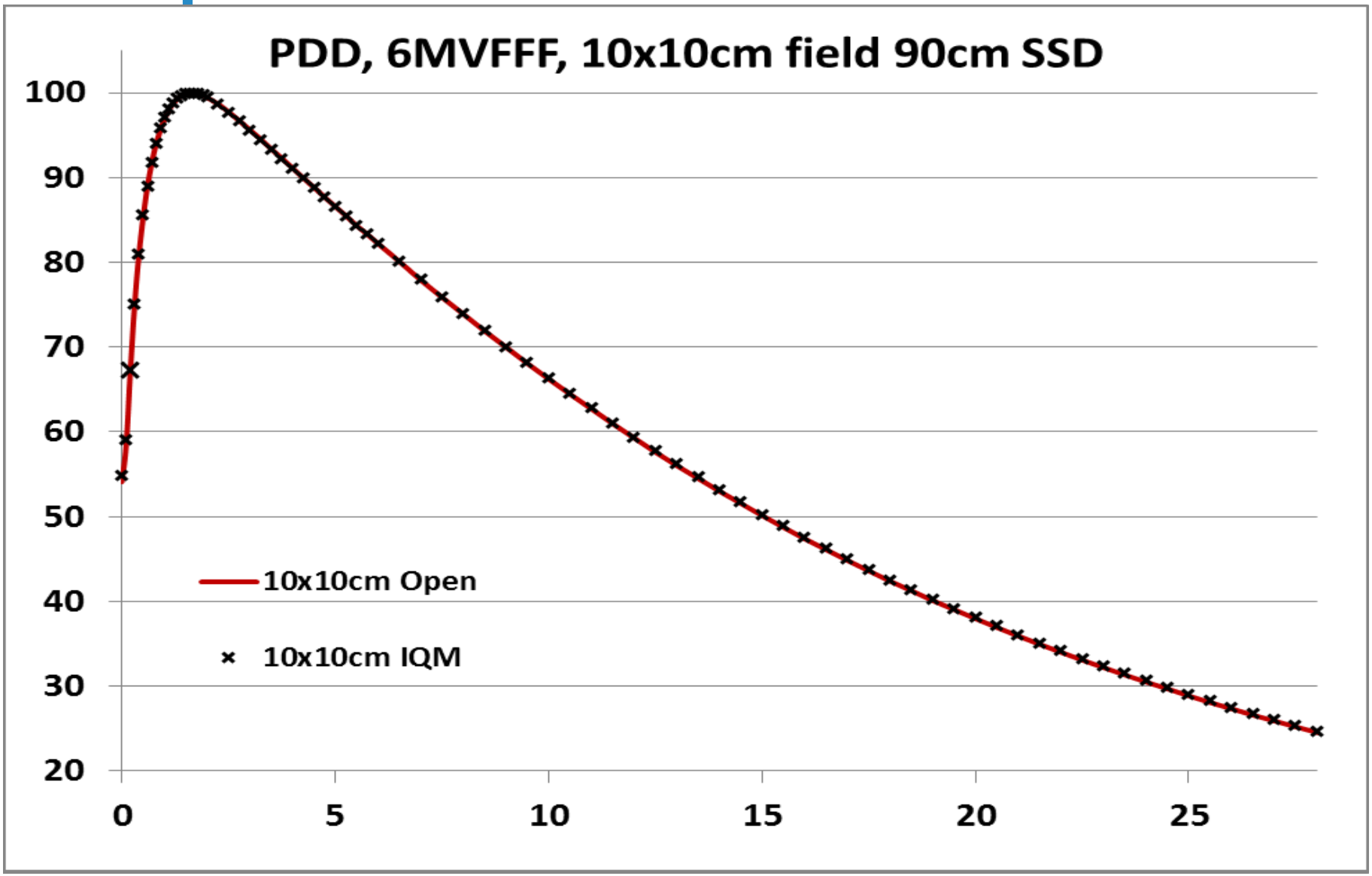
Comparison of radiation beams - 6MV



Comparison of radiation beams – 6FFF



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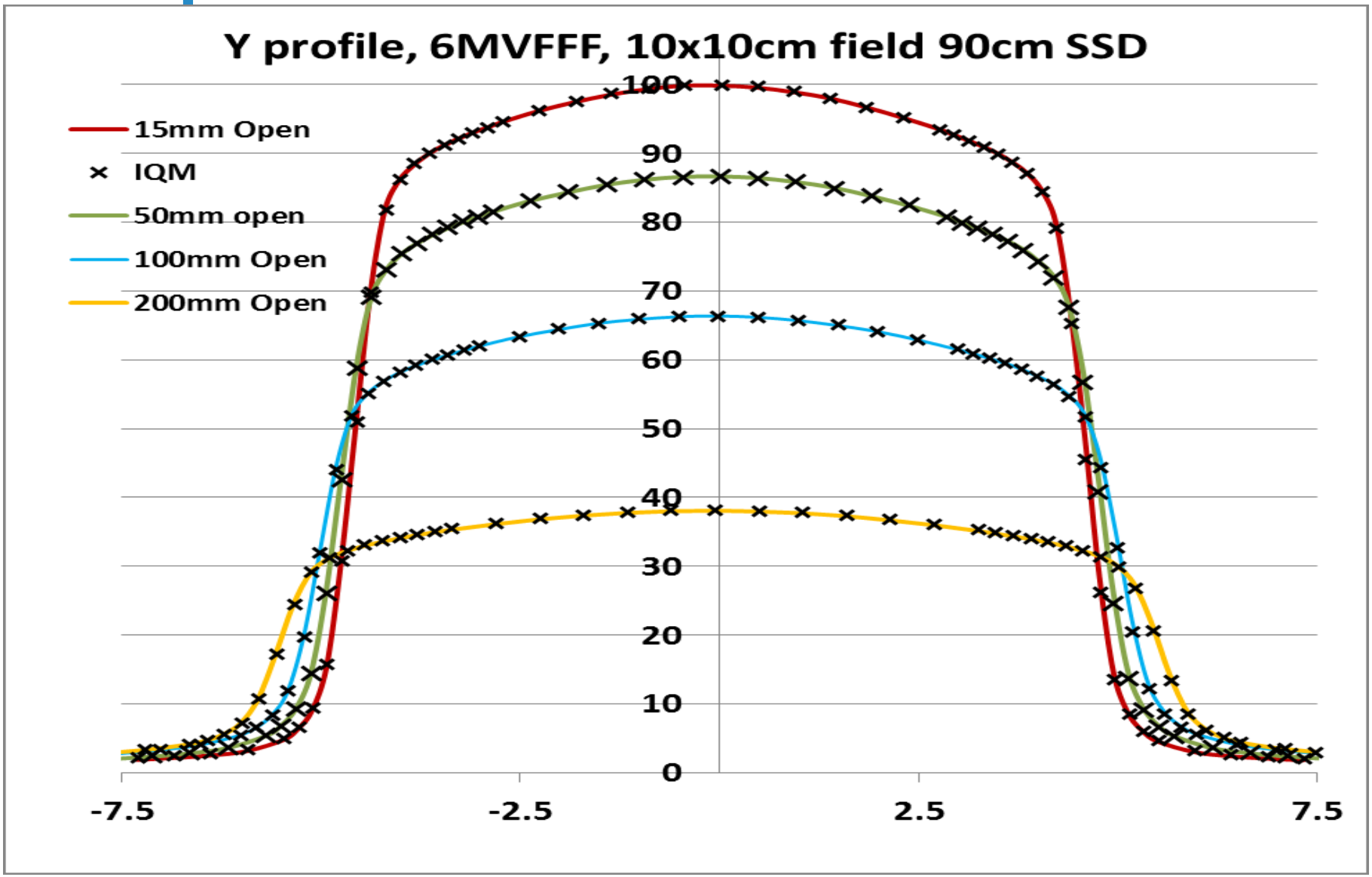

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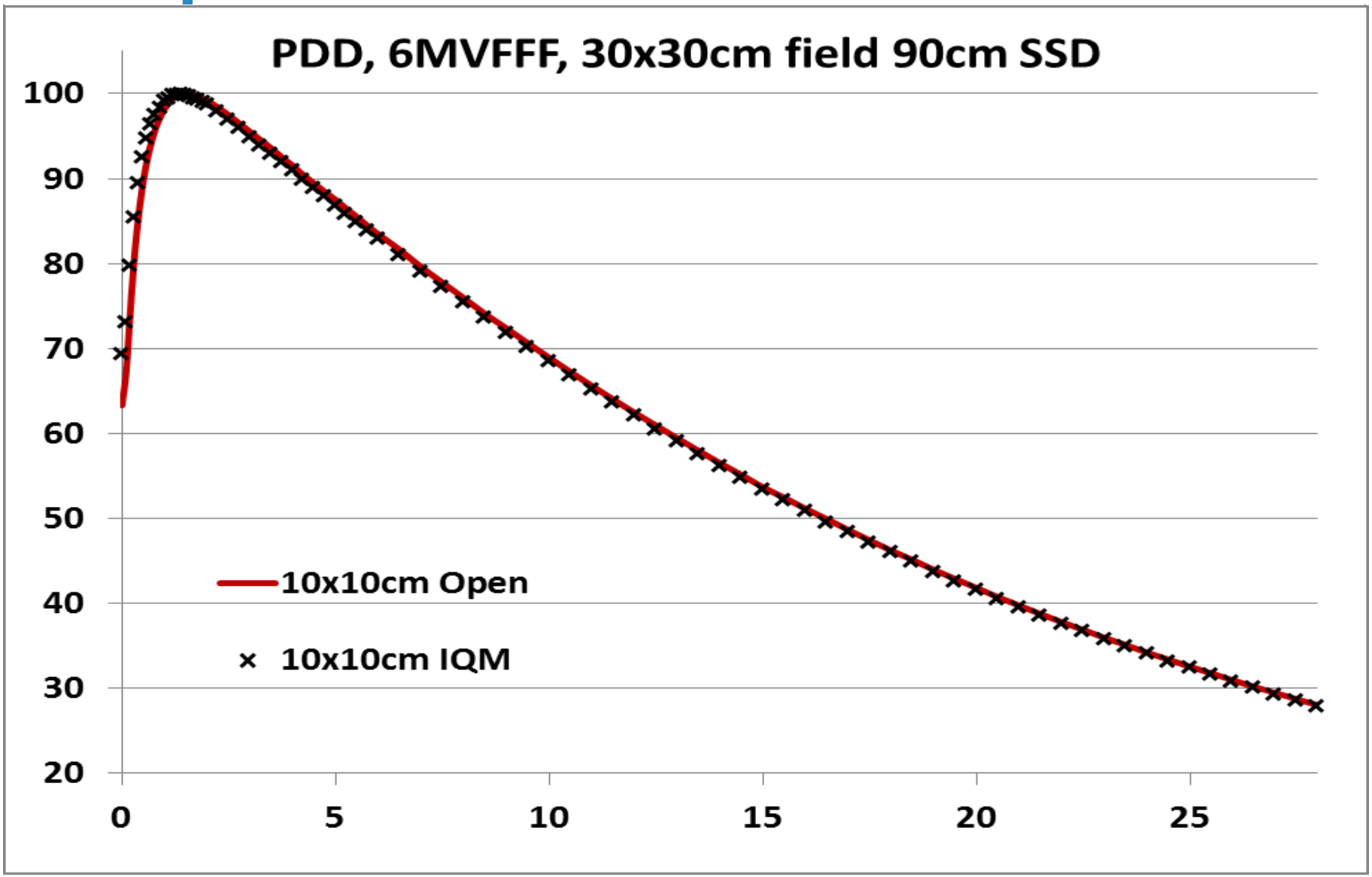
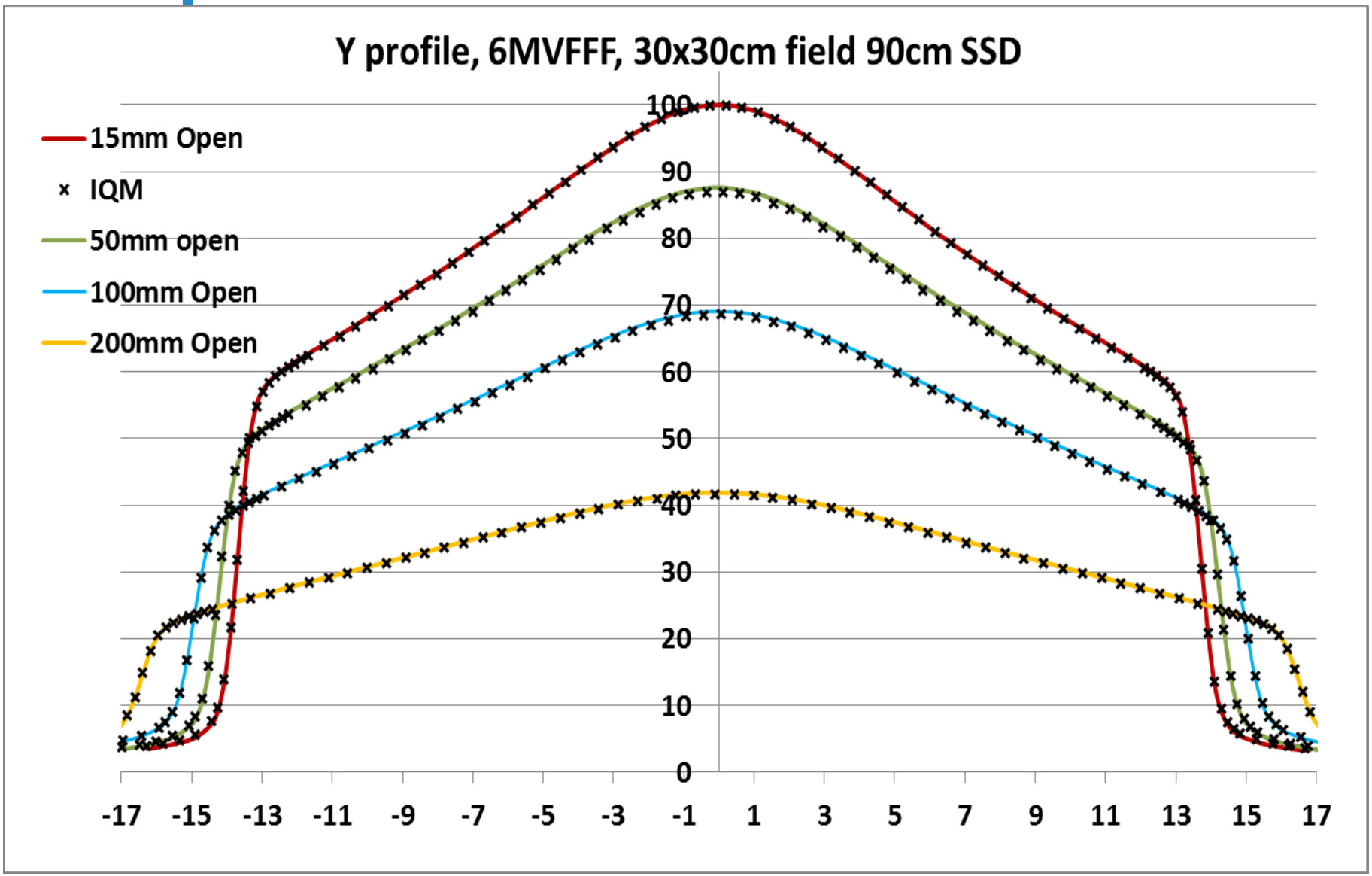
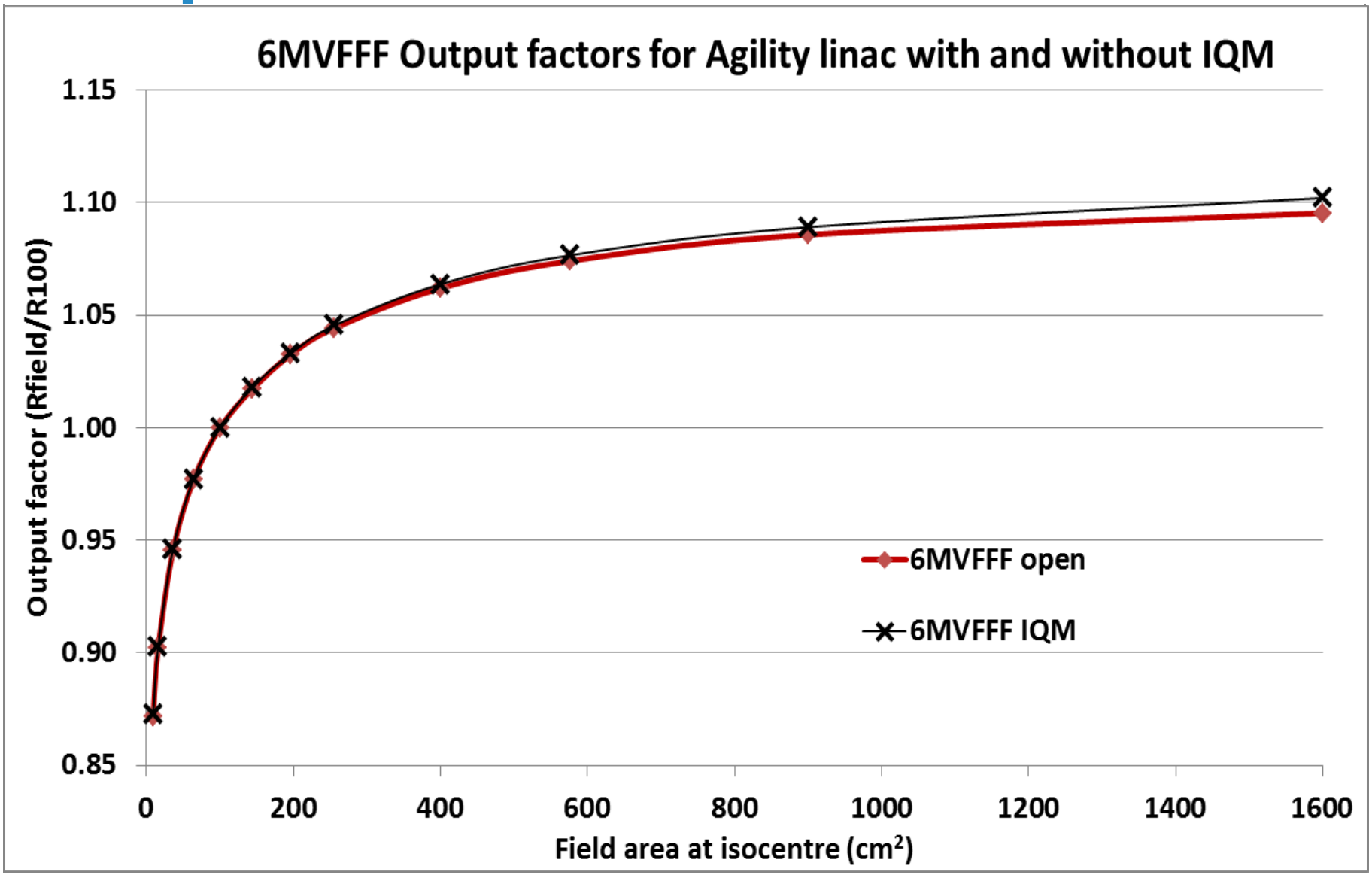


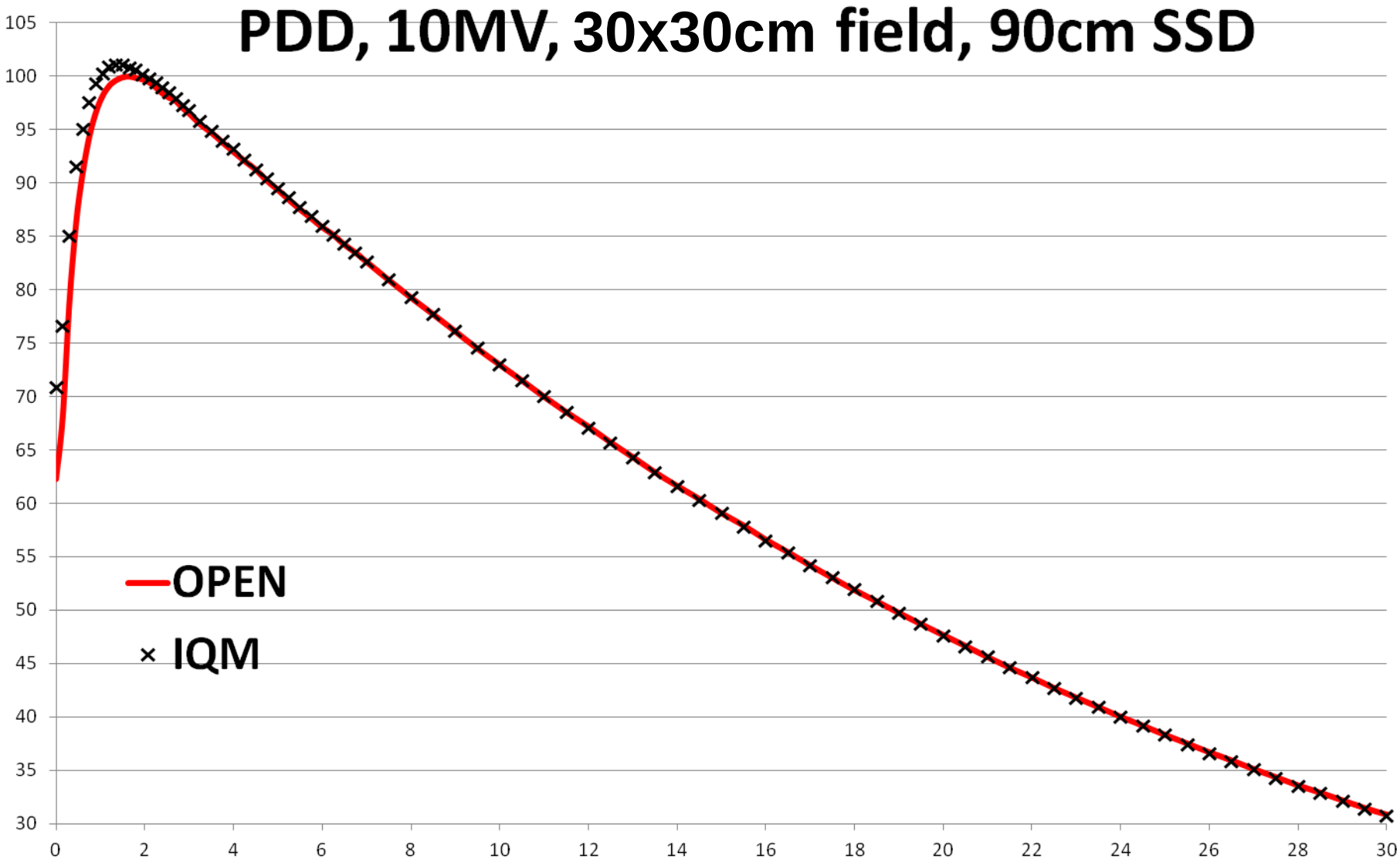
Comparison of radiation beams – 6FFF



Comparison of radiation beams – 6FFF



Comparison of radiation beams 10MV



Attenuation effect of IQM

Energy		Attenuation factor
6MVFFF	($TPR_{20/10}$ = 0.683)	0.946
6MV	($TPR_{20/10}$ = 0.686)	0.946
10MV	($TPR_{20/10}$ = 0.733)	0.959

- Variation of ±0.3% for fields 30x30cm^2 or less.

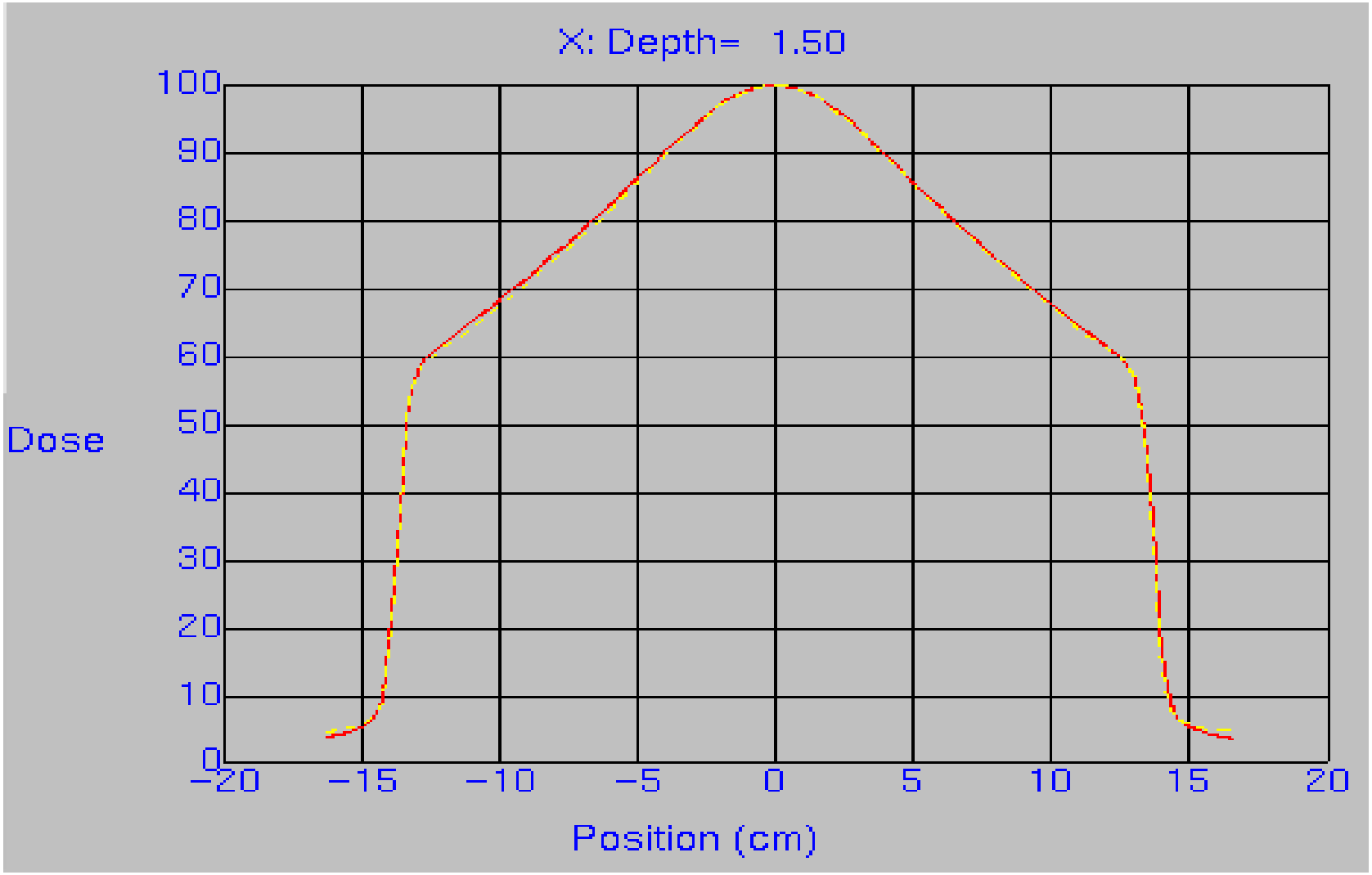
Integrating the IQM in into P^3 (Summary 1)

1. No significant differences in O/P factors
2. Attenuation fixed amount for each energy
3. IQM has little effect on PDD beyond Dmax or on profiles <20x20cm
4. For 6&10MV modelling at larger radial distances needed review

Integrating the IQM into Pinnacle 9.8

Comparison with existing clinical models

Open – Clinical model @6MVFFF



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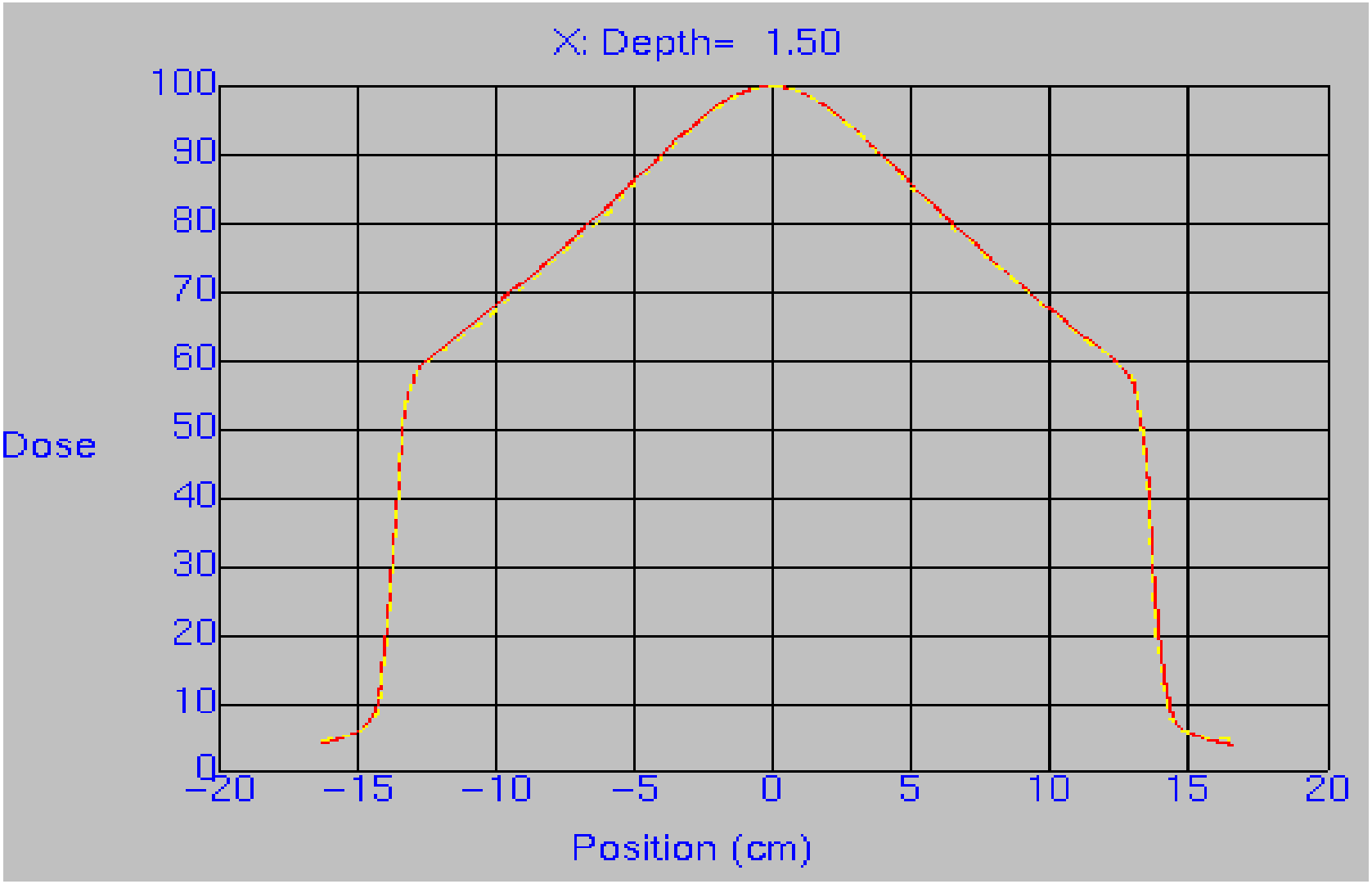
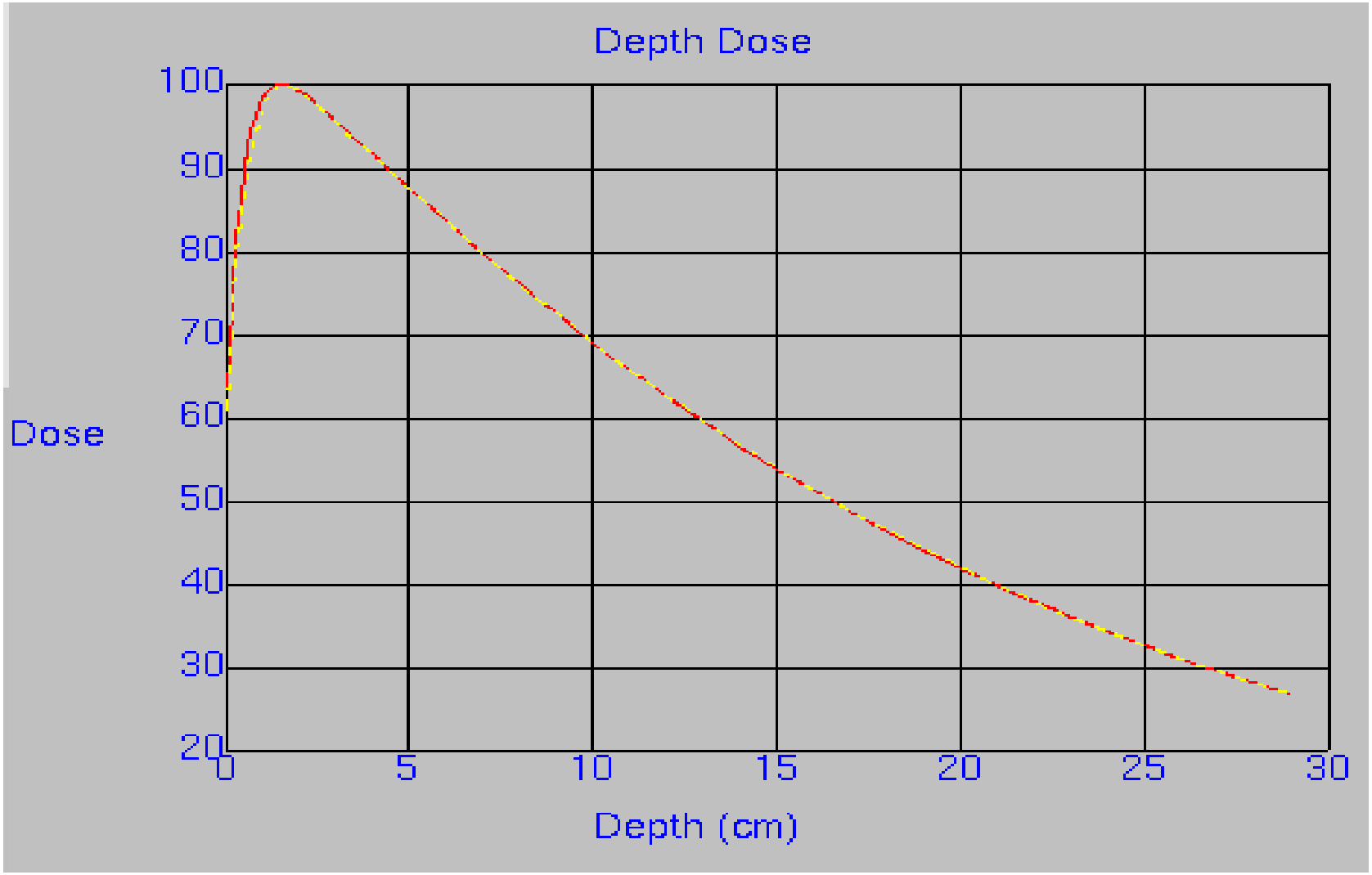
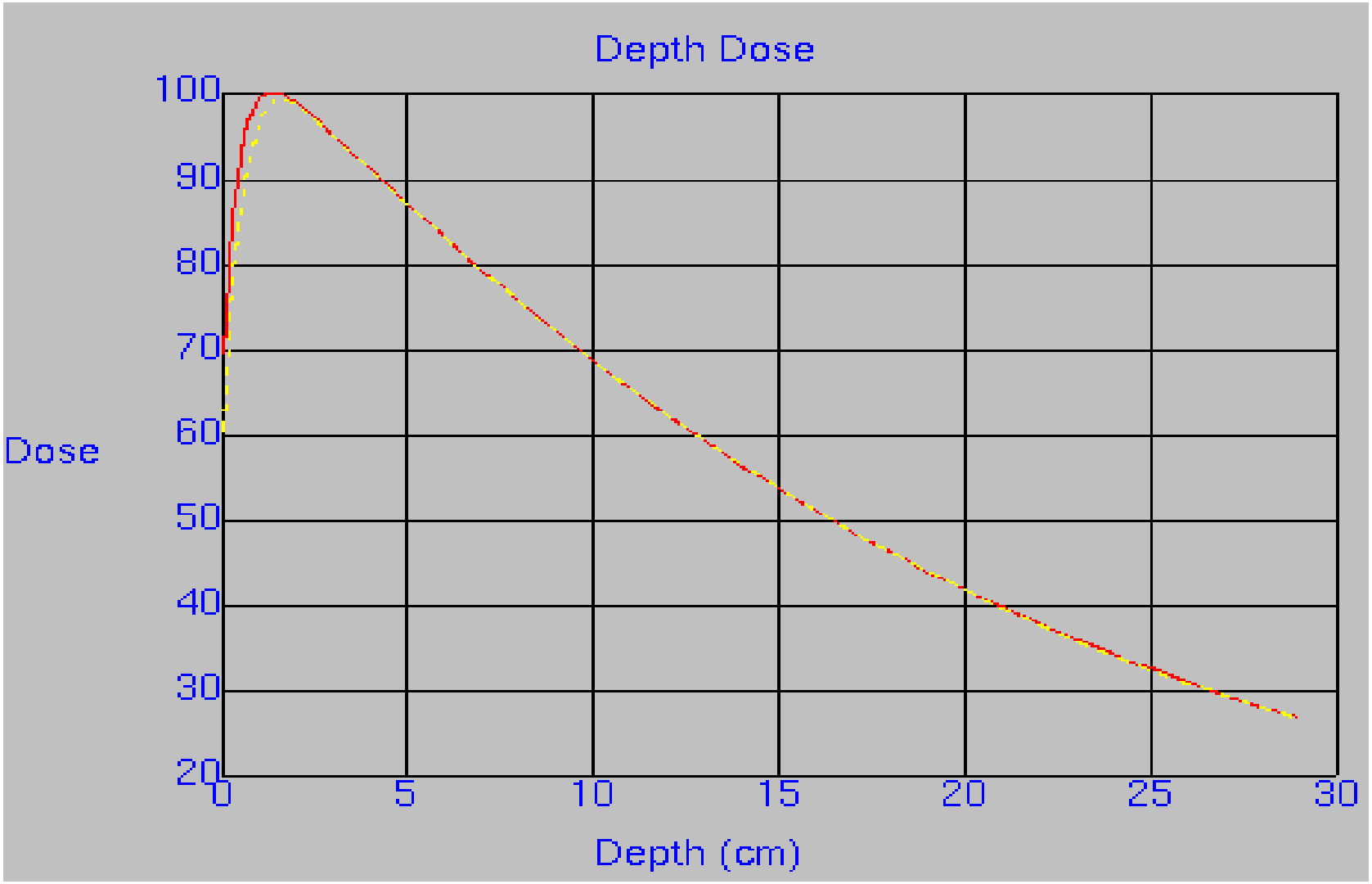
IQM – Clinical model @6MVFFF



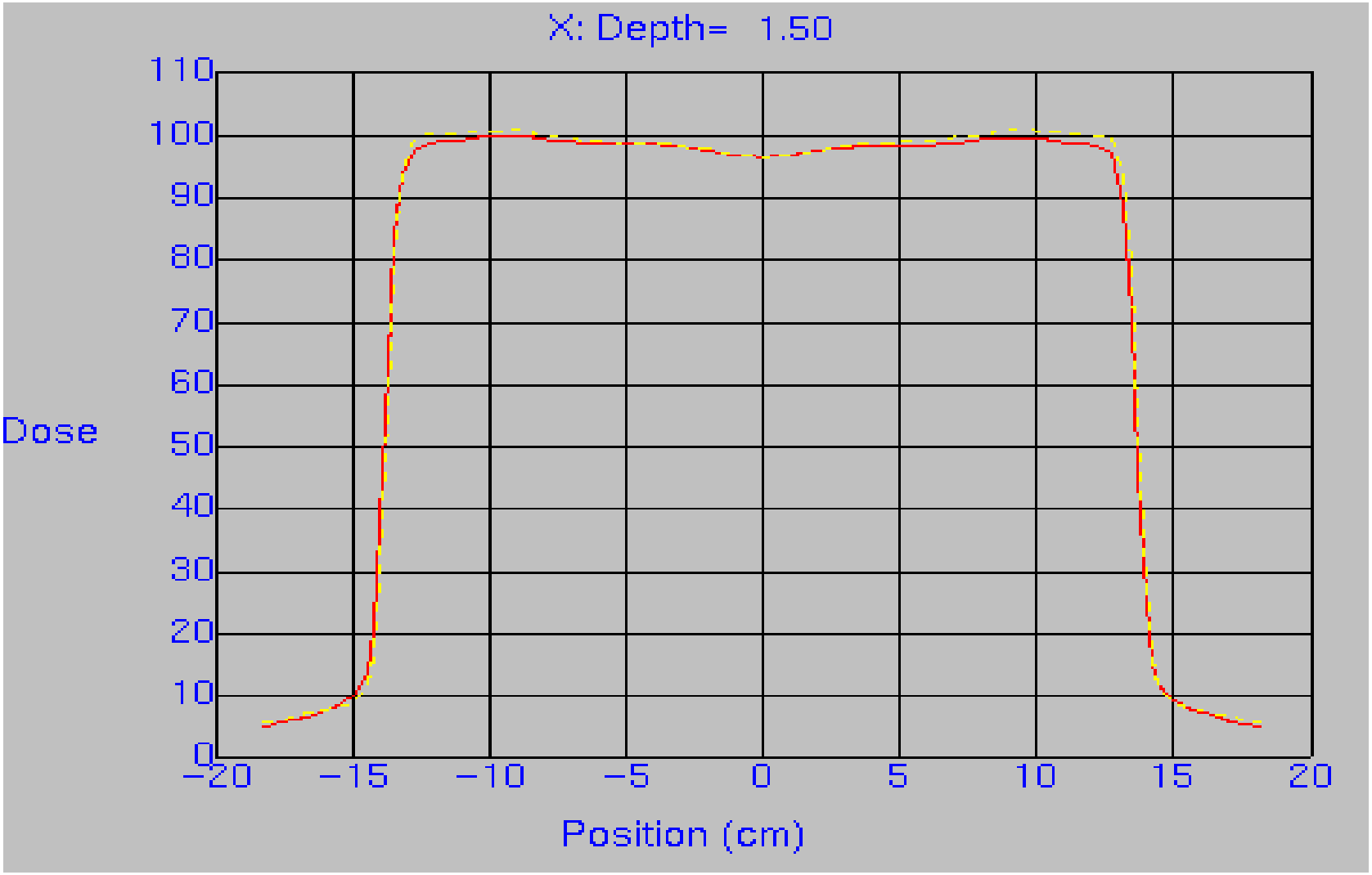
Open – Clinical model @6MVFFF



IQM – Clinical model @6MVFFF



Open – Clinical model @6MV



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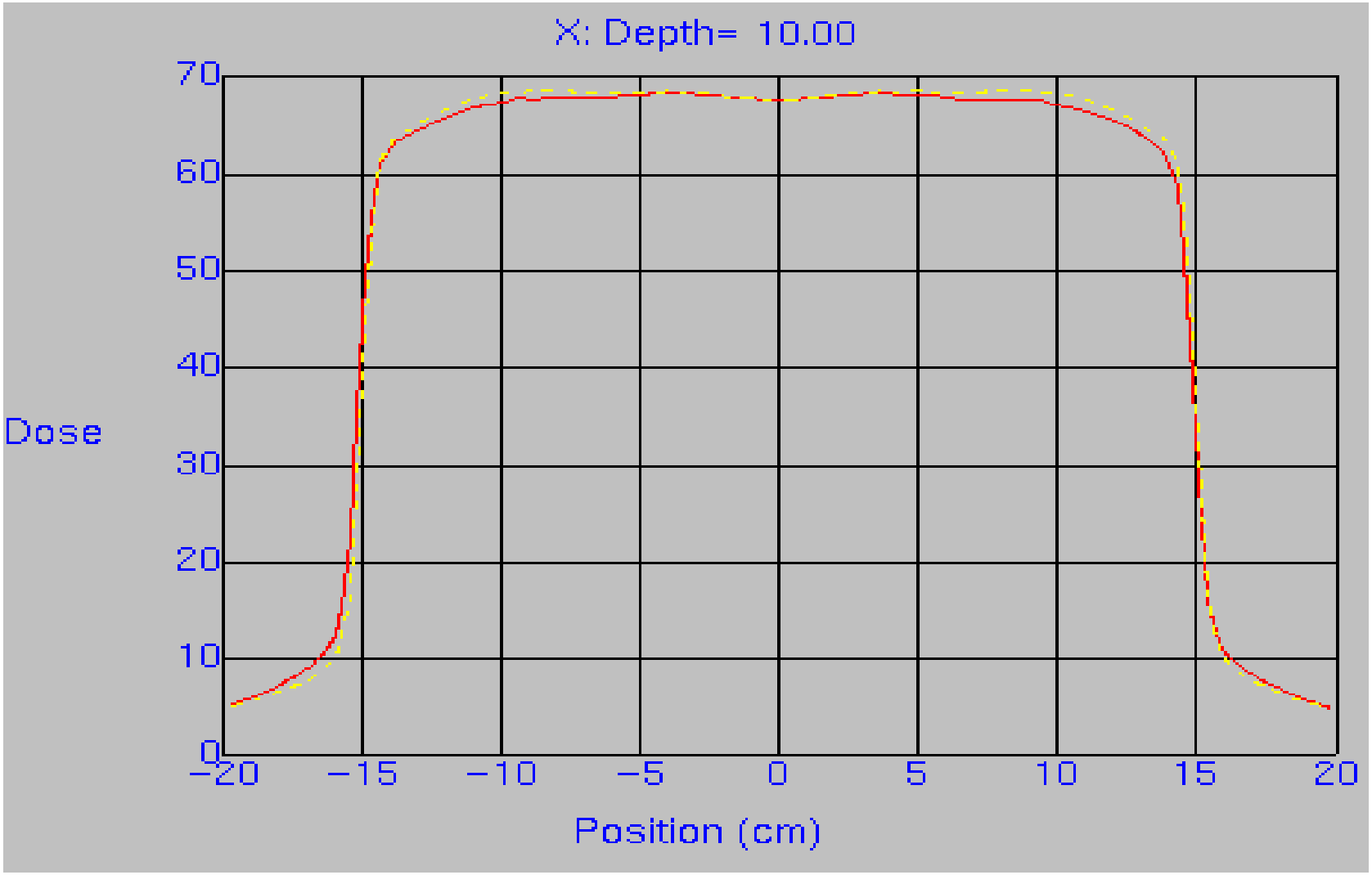
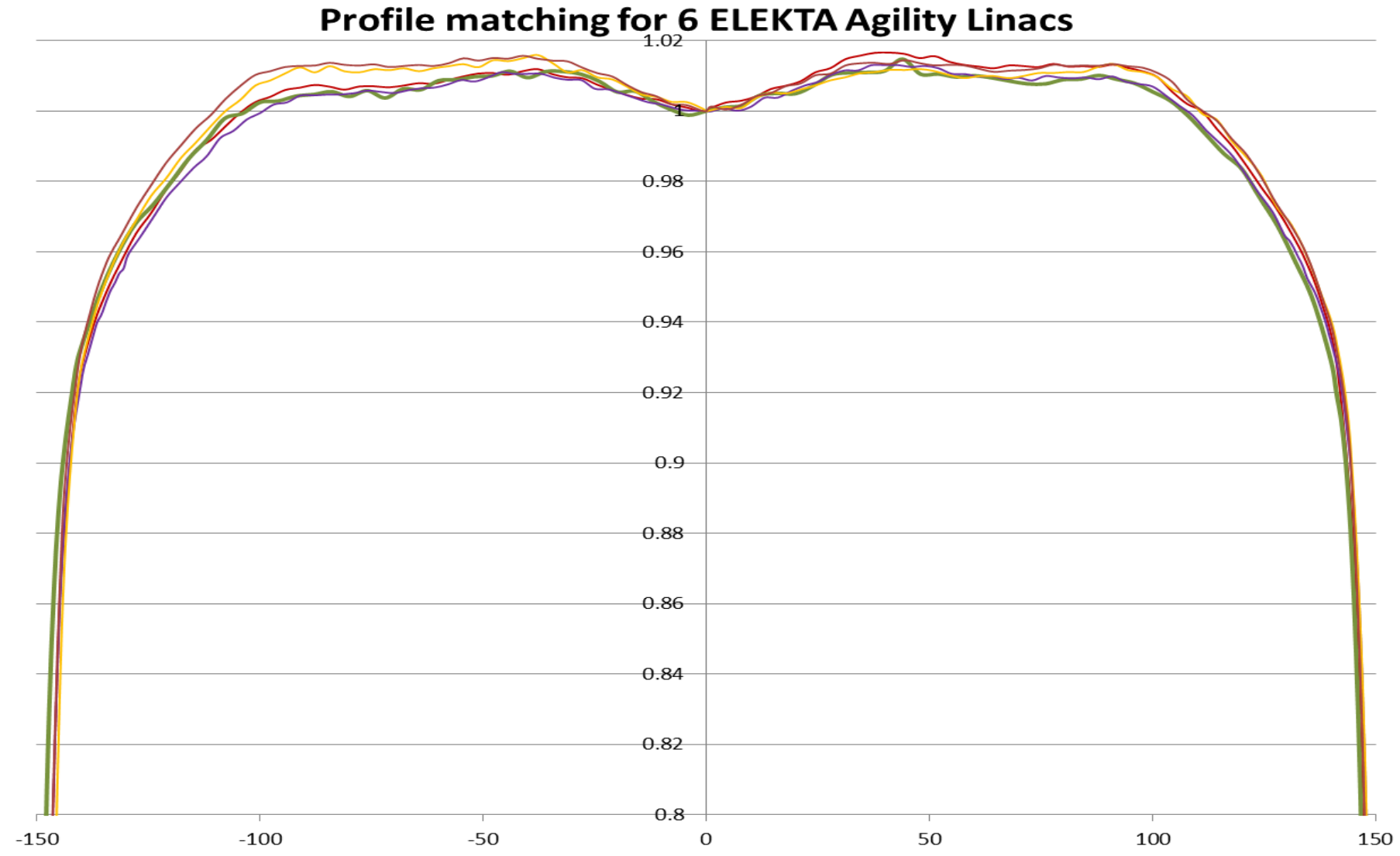
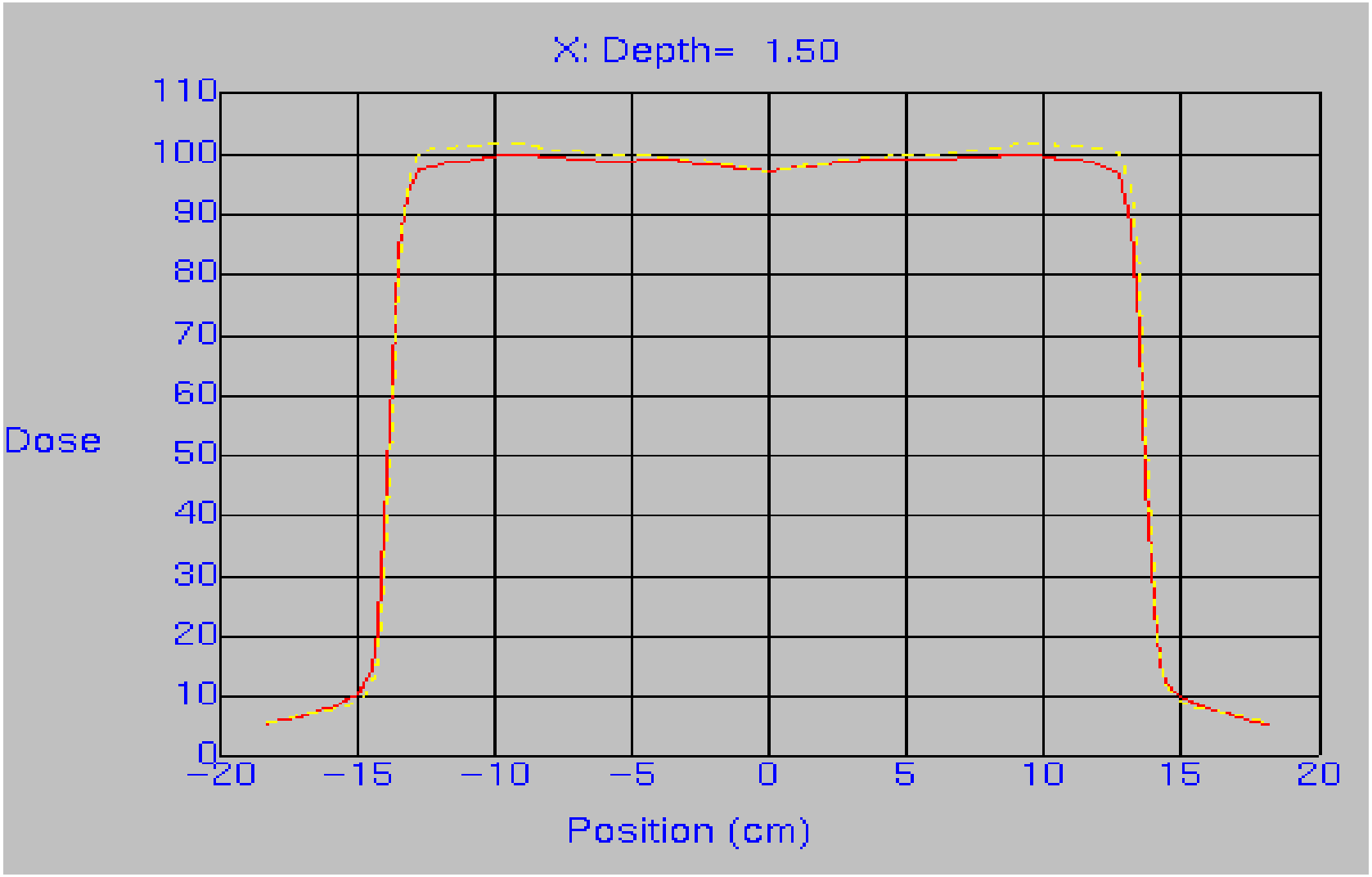


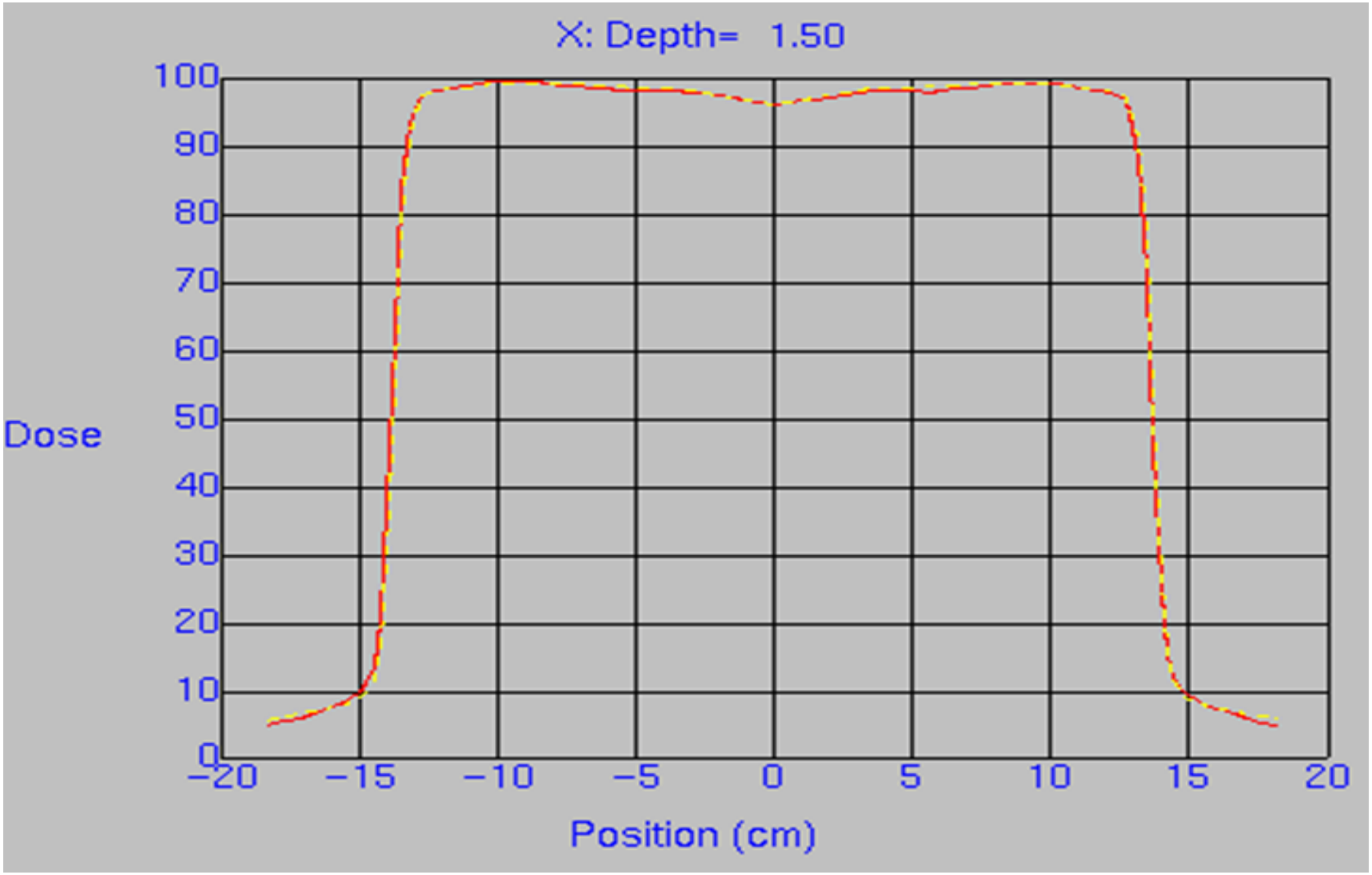
Comparison of radiation beams 6MV



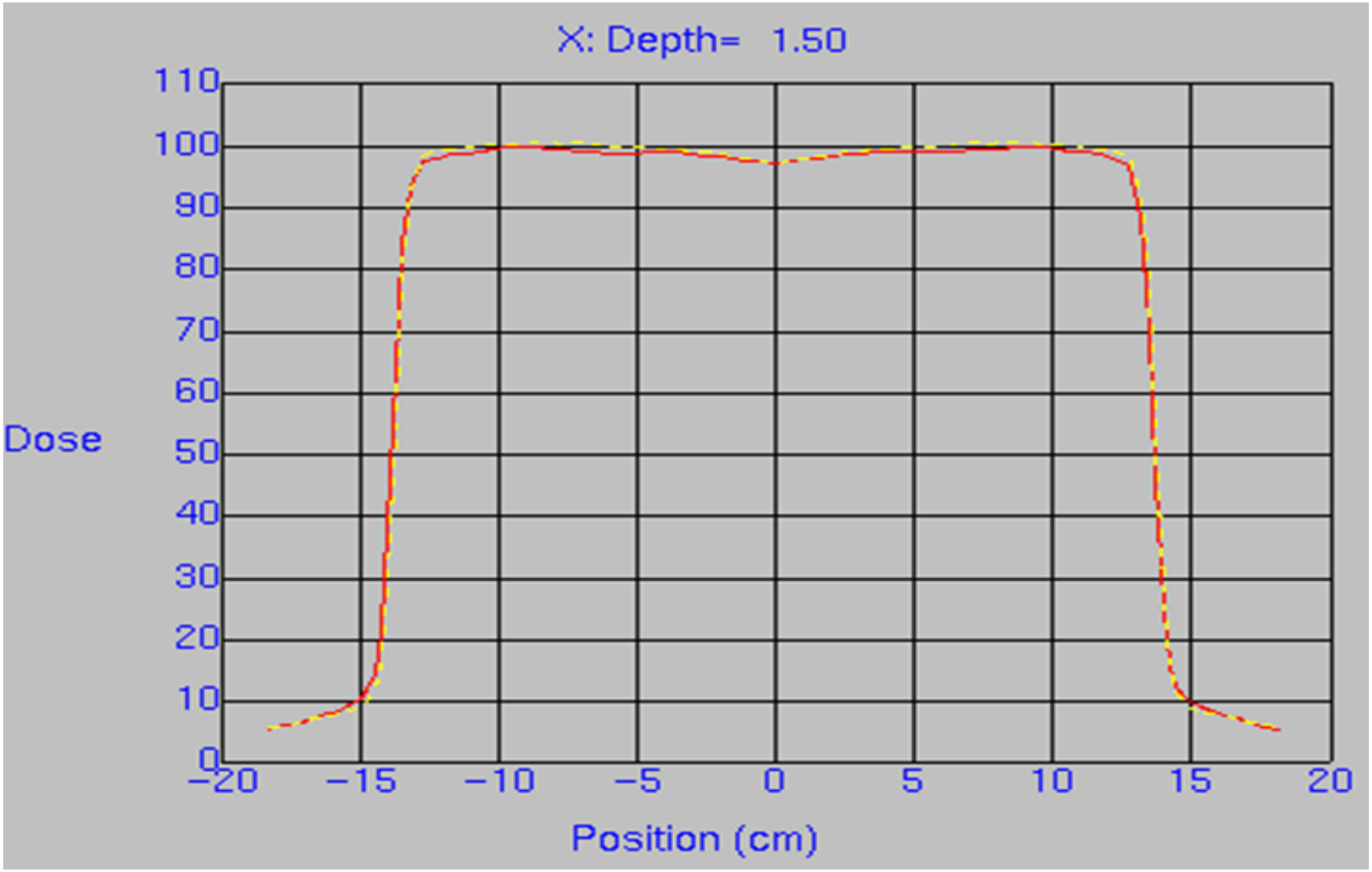
IQM – Clinical model @6MV



Open - modified Arbitrary profile



IQM - modified Arbitrary profile



Integrating the IQM into Pinnacle 9.8

Closing the loop- Initial validation

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Delta4 Comparison with & Without IQM

10MV prostate VMAT

	Patient Name	Median dose diff	Global gamma	Local gamma
			% passing 3%/3mm	% passing 3%/3mm
OPEN Field	1	-0.9	100	100
	3	-0.8	100	99.6
IQM Field	1	-1.5	100	99.3
	3	-1.3	100	98.7
Difference (IQM-Open)	1	-0.6	0	-0.7
	3	-0.5	0	-0.9
	Mean	***-0.55***	***0***	***-0.8***

Delta4 Comparison with & Without IQM

6MV NASOPHARYNX VMAT

	Patient Name	Median dose diff	Global gamma % passing 4%/4mm	Global gamma % passing 3%/3mm	Local gamma % passing 4%/4mm	Local gamma % passing 3%/3mm
OPEN Field	1	-1.8	99.7	96	97.4	89.1
	2	-1	99.7	97.5	98.6	94.1
	3	-3.8	84.9	66.8	69.4	49
	4	-1.5	99.7	96.8	98.6	93.1
	5	-1.2	99.5	97	99	92.5
IQM Field	1	-1.5	99.4	96.2	97.6	91.8
	2	-1.1	99.6	97	97.9	93.4
	3	-3.8	84.3	66.3	68.6	49.6
	4	-1.9	99.7	97.1	98.6	92.6
	5	-1.4	99.2	96.4	98.7	92
Difference (IQM-Open)	1	0.3	-0.3	0.2	0.2	2.7
	2	-0.1	-0.1	-0.5	-0.7	-0.7
	3	0	-0.6	-0.5	-0.8	0.6
	4	-0.4	0	0.3	0	-0.5
	5	-0.2	-0.3	-0.6	-0.3	-0.5
	Mean	***-0.1***	***-0.3***	***-0.2***	***-0.3***	***0.3***

Delta4 Comparison with & Without IQM

SABR 6MVFFF LUNG

	Patient Number	Median dose diff	Global gamma % passing 3%/3mm	Local gamma % passing 3%/3mm
Open field	A	-1.4	100	100
	B	-1.5	100	100
	C	-1.7	99.3	99.3
IQM field	A	-1.8	100	100
	B	-2.1	97.2	96.2
	C	-2	97.8	96.4
Difference (IQM-Open)	A	-0.4	0	0
	B	-0.6	-2.8	-3.8
	C	-0.3	-1.5	-2.9
	Mean	***-0.45***	***-2.15***	***-3.35***

Integrating the IQM in into P^3 Conclusions: 1

1. The build up region is modified by the presence of the IQM, reducing ‘skin sparing’
2. Smaller field PDD’s & Profiles are not affected by IQM
3. Larger fields have shoulders drop, more notably at shallower depths

Integrating the IQM in into P^3 Conclusions: 2

4. **Adjustment of arbitrary fluence profile improved agreement – but not observable clinical benefit.**
5. **Clinical models acceptable at 6MV & 10MV**
6. **Simple correction factor to change MU's was all that was required in Pinnacle 9.8**

Integrating the IQM in into P^3 Conclusions: 3

7. **Validation of your clinical models necessary when integrating the IQM into your planning system, but modifications are likely to be small.**

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