

RDH-WP11-FRED

A. Schiavi - Sapienza Univ. di Roma

RDH-IRPT meeting - 01/02/**2017**

Dip. SBAI - Sapienza - Roma

CNAO

S. Molinelli

A. Mairani

G. Magro

M. Ciocca



FRED

- **Angelo Schiavi** - Sapienza-Roma / INFN
- Vincenzo Patera - Sapienza-Roma / INFN
- Martina Senzacqua - Post-grad.
- Stefano Pioli - INFN-LNF
- Giuseppe Battistoni - INFN-MI

Milestone per il 2016

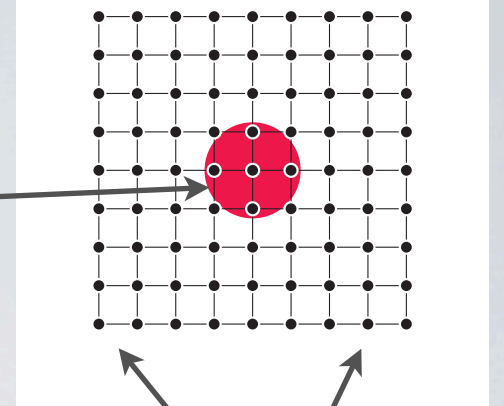
testare e validare su 5 trattamenti a protoni (testa-collo e pelvi) il ricalcolo della dose con Fred e eseguire confronto con TPS-CNAO e full-MC

- modello nucleare protoni e deutoni
- fine-tuning profili longitudinali in acqua
- fine-tuning profili laterali
- ricalcolo in acqua dei cubi per il QA protocol
- ricalcolo QA verification plan (acqua)
- ricalcolo piano trattamento protoni

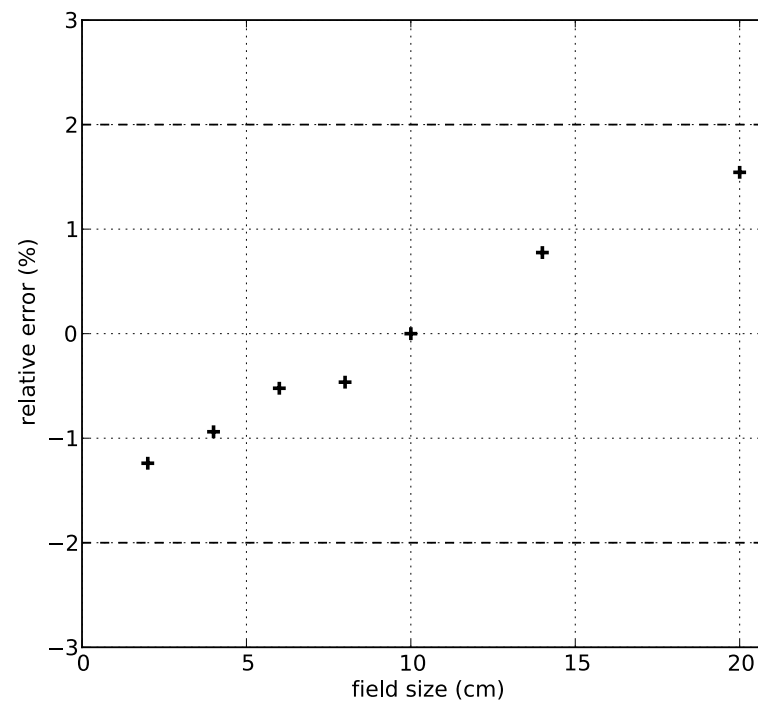
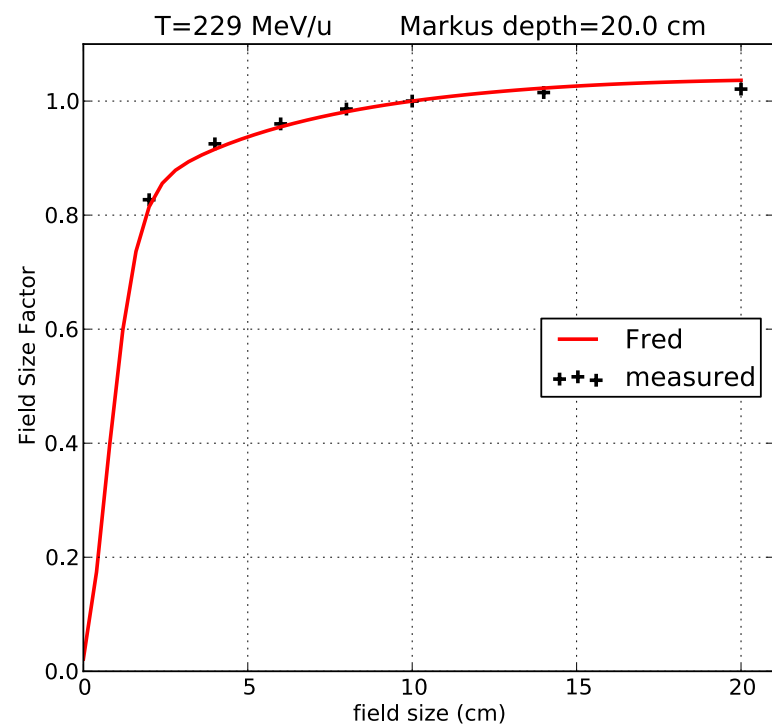
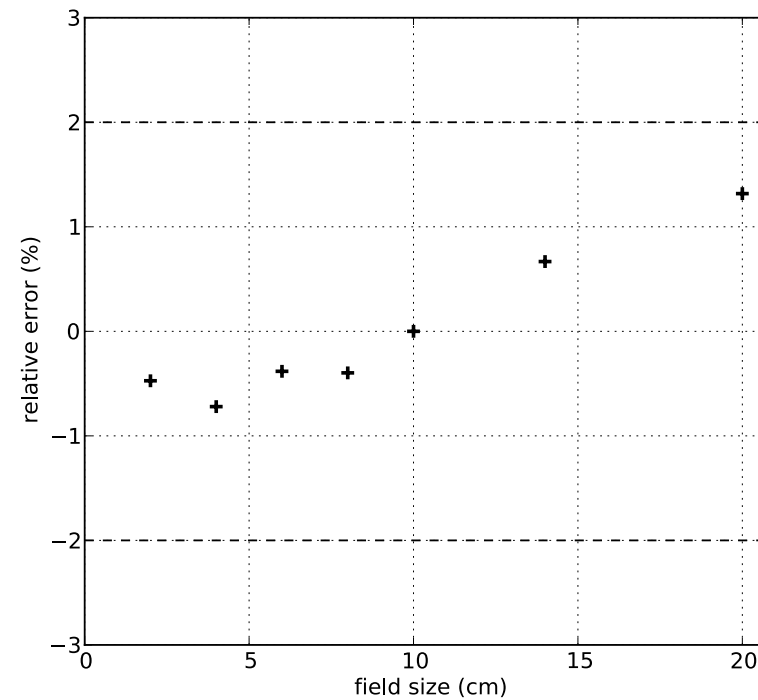
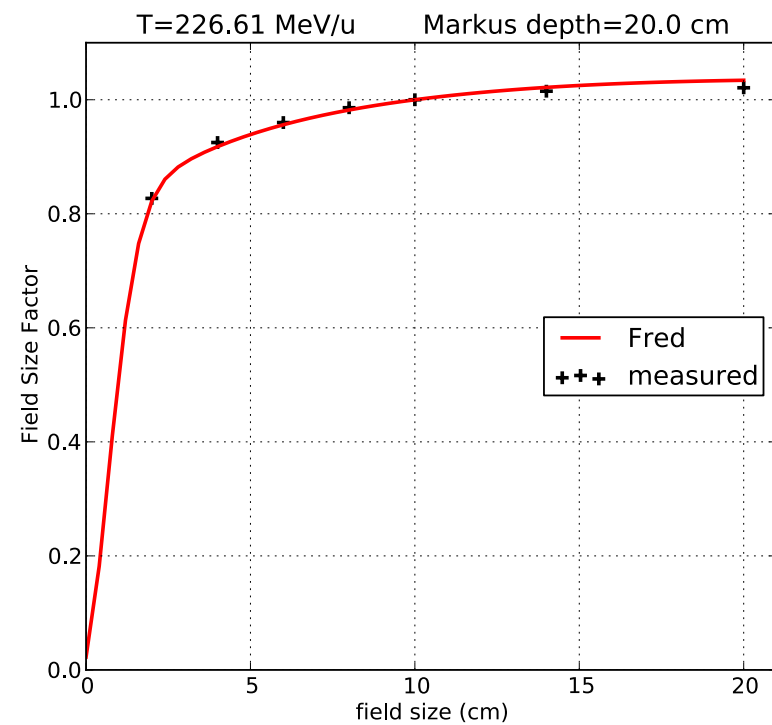
situazione un anno fa

Field Size Factor @ CNAO

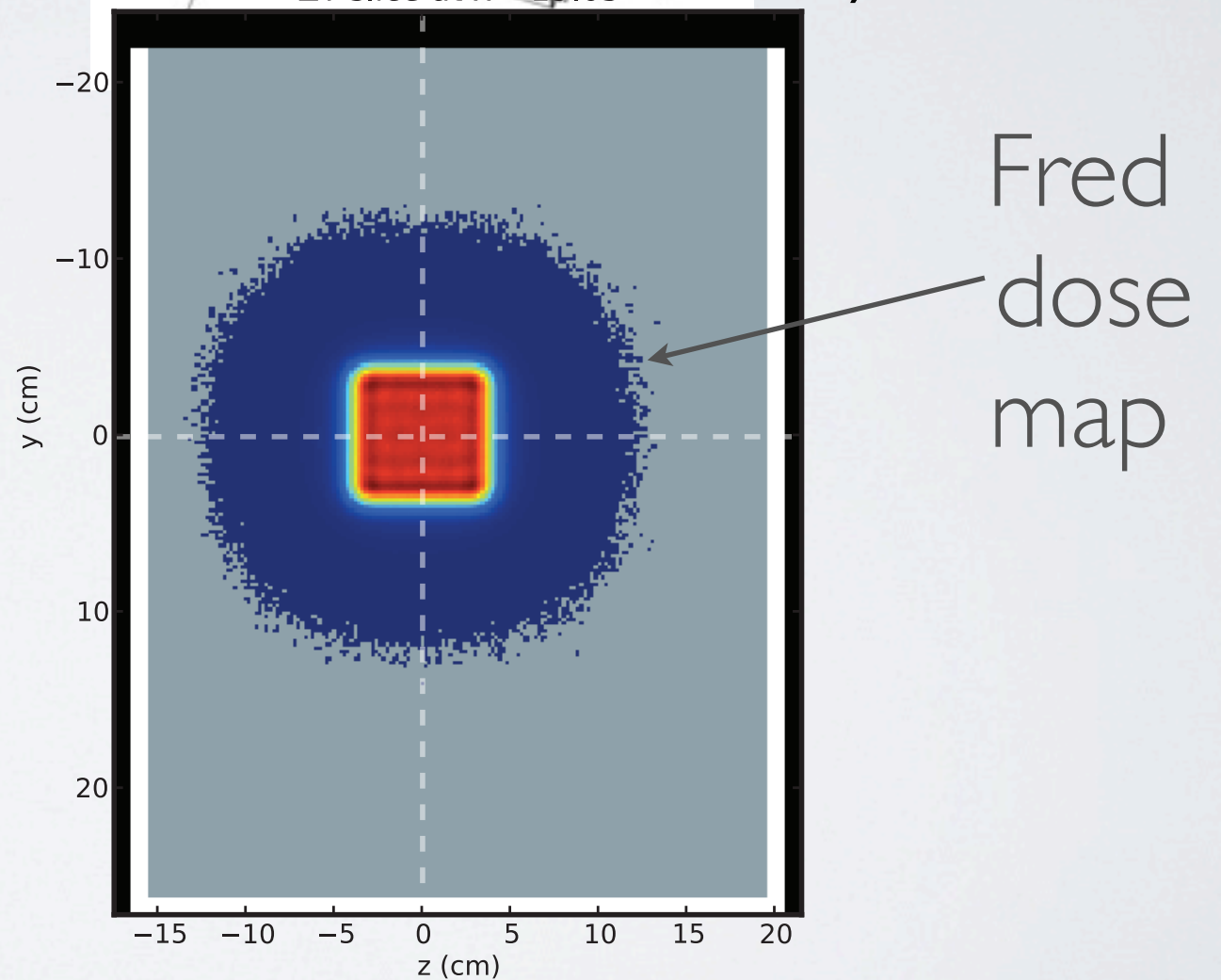
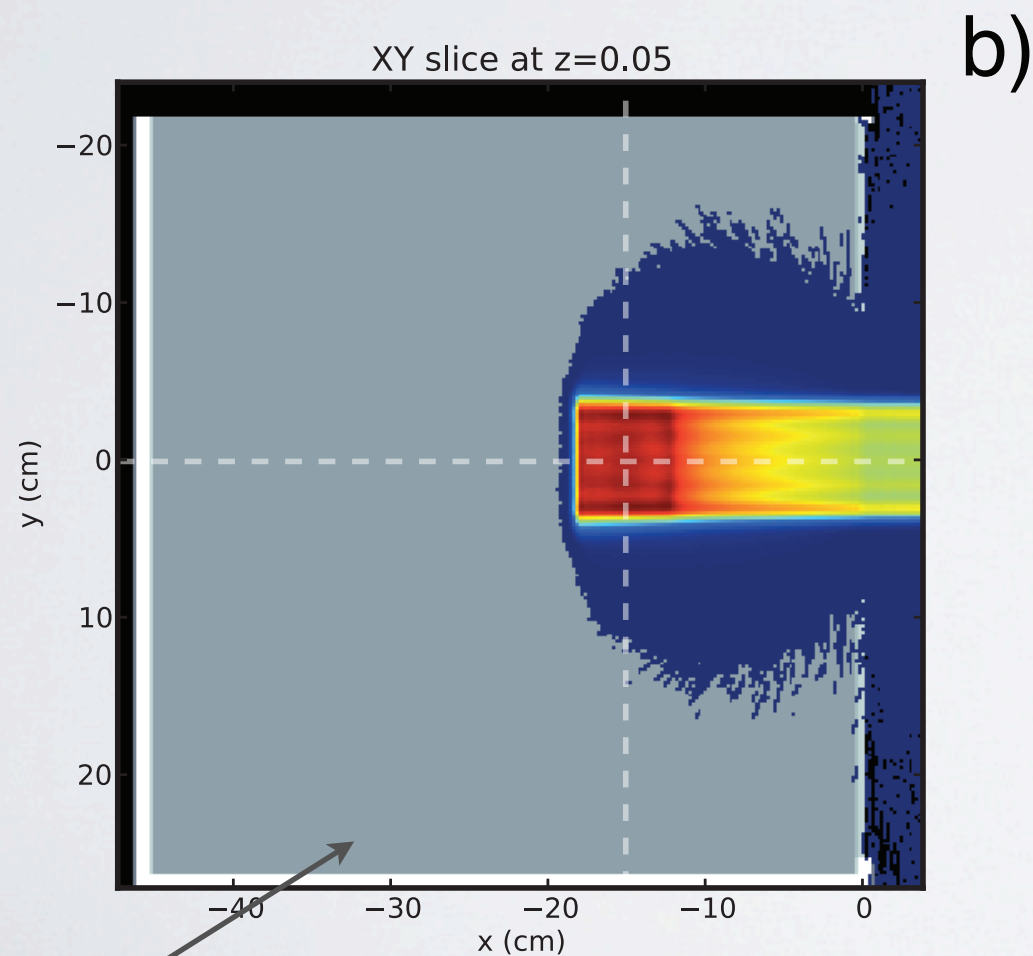
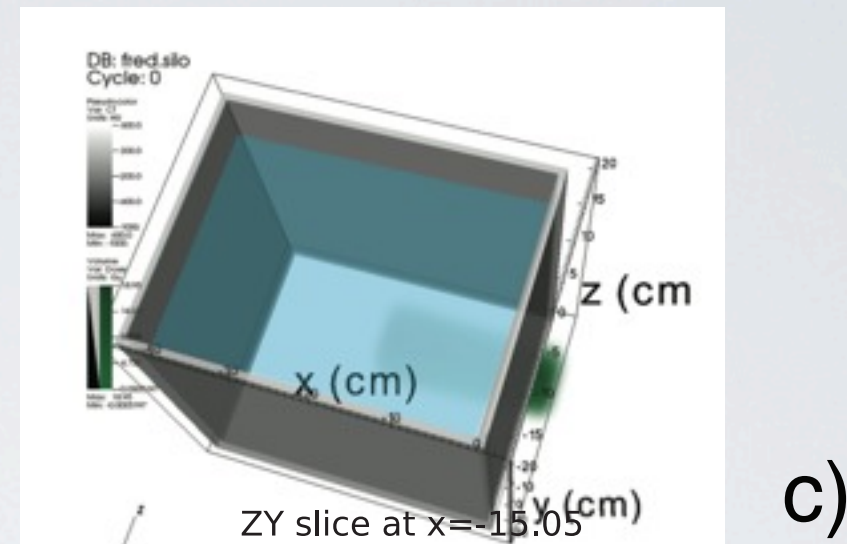
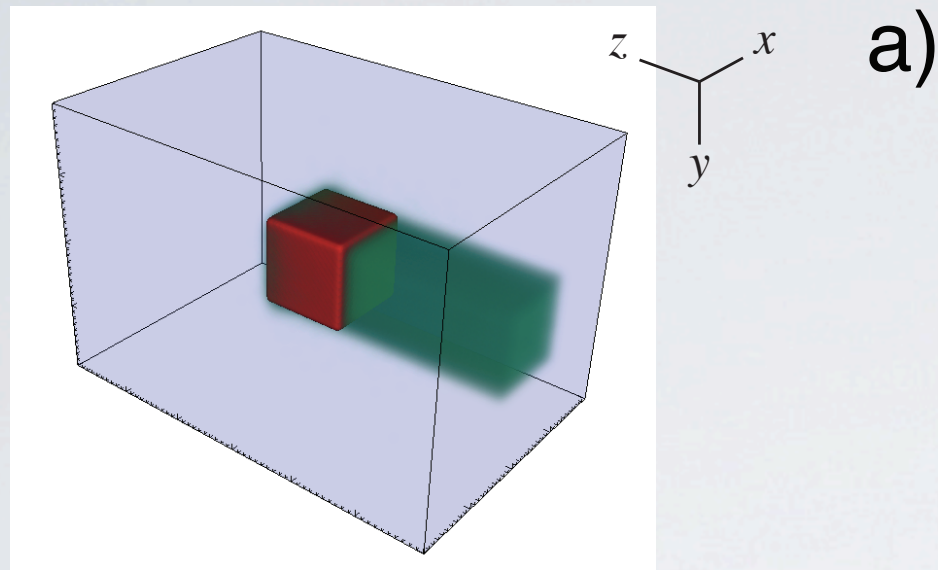
detector



scan spots

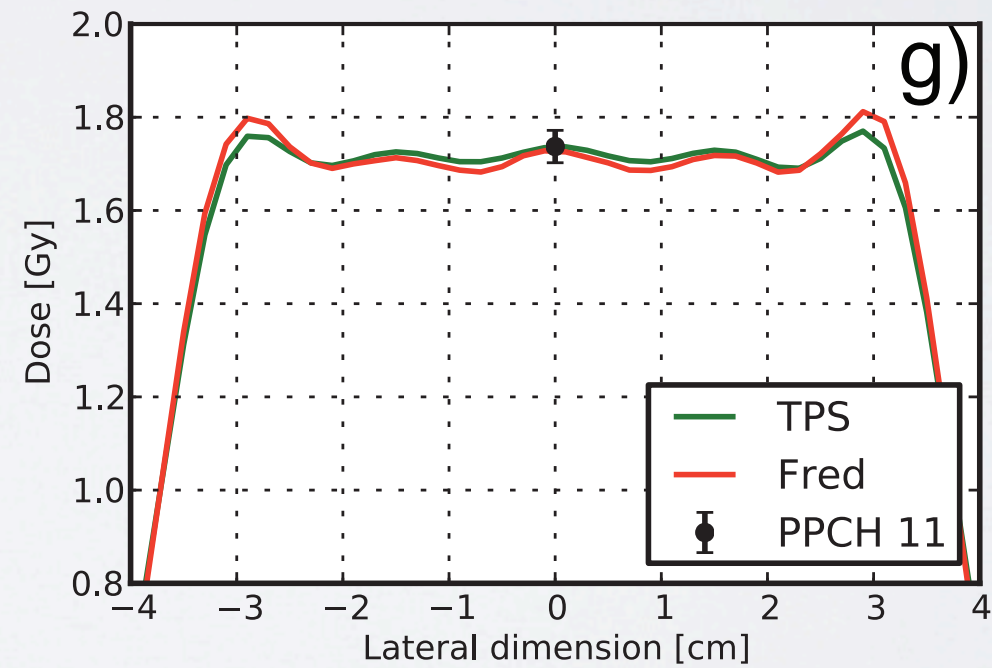
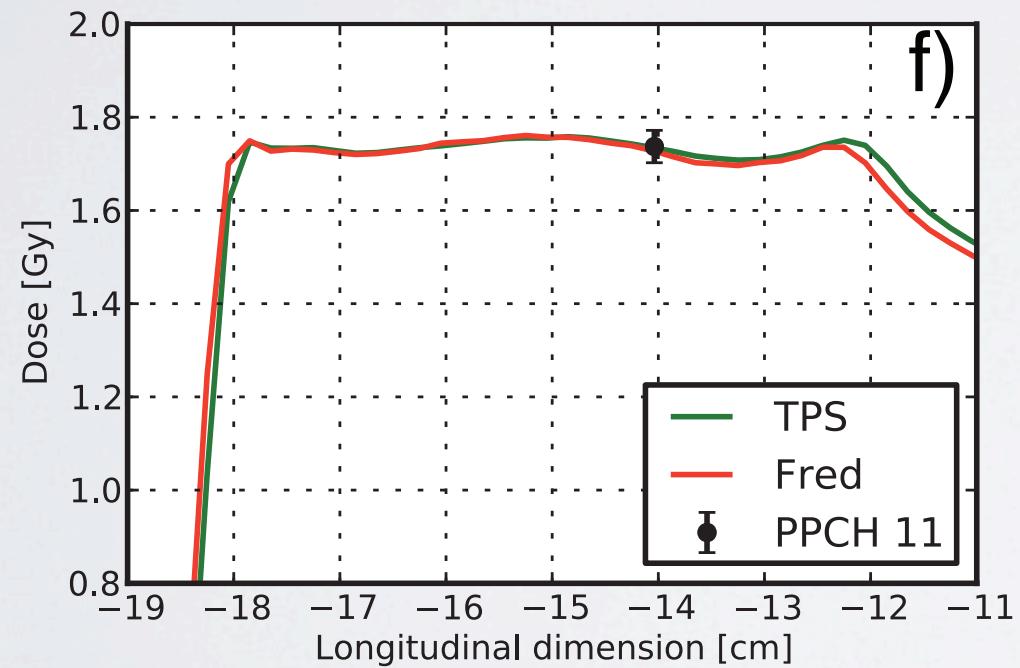
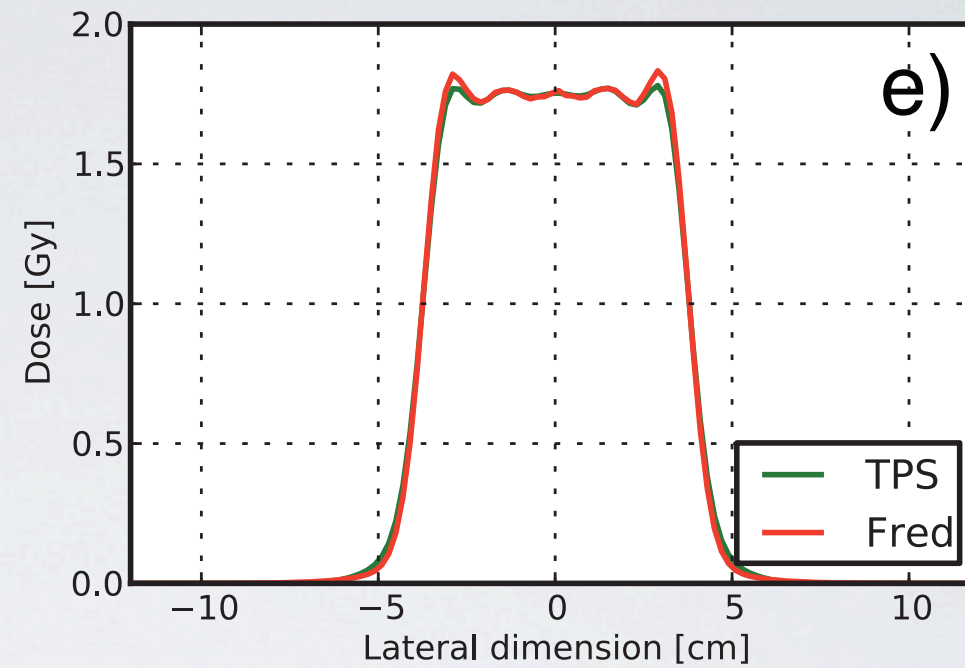
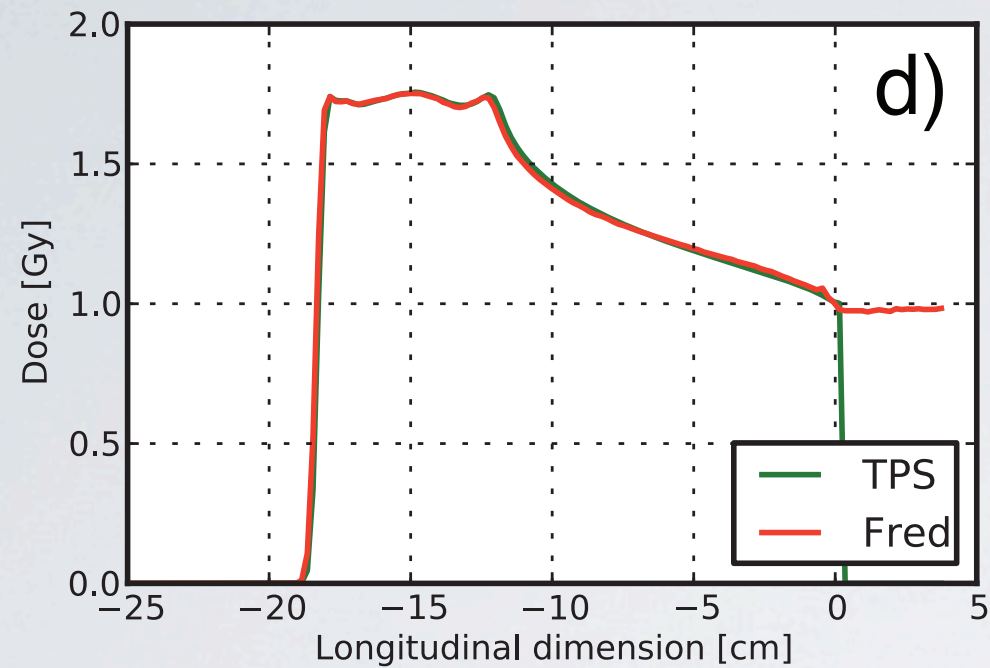


SOBP QA - I



PTW MP3-P water phantom

SOBP QA - 2



dose profiles and measured data point

SOBP QA - 3

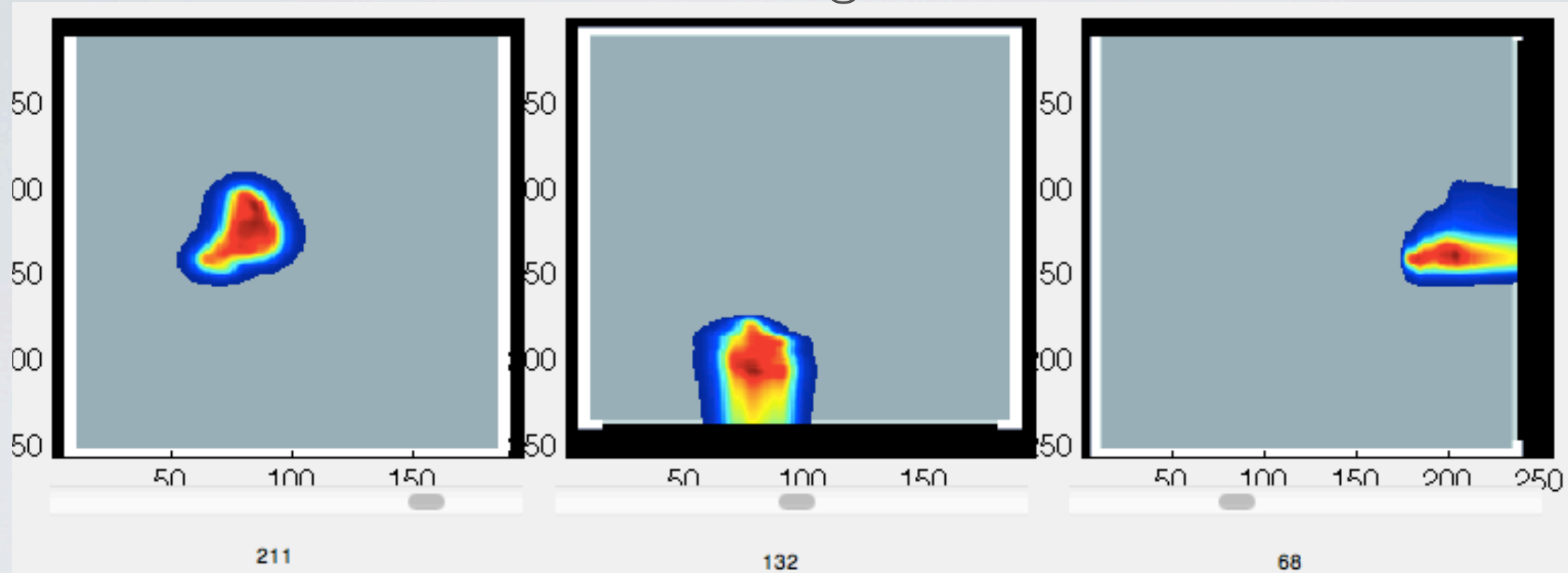
		zero shift				best shift			
		TPS		FRED		TPS		FRED	
cube	N	mean dose diff	stdev	mean dose diff	stdev	mean dose diff	stdev	mean dose diff	stdev
6x6x6 cm ³ 9 cm depth	11	-1.89 %	0.72%	1.27%	0.65%	-1.60%	1.08%	-0.56%	1.32%
6x6x6 cm ³ 15 cm depth	11	-0.44%	0.55%	0.06%	0.57%	0.0%	0.62%	0.0%	0.58%
6x6x6 cm ³ 21 cm depth	11	-0.16%	0.47%	0.41%	0.85%	0.0%	0.38%	0.06%	1.13%
3x3x3 cm ³ 21 cm depth	10	-0.32%	1.78%	0.65%	2.03%	0.0%	1.27%	0.0%	1.48%
6x6x6 cm ³ 27 cm depth	11	-0.29%	0.48%	1.57%	0.60%	-0.15%	0.88%	1.4%	0.8%

protocol acceptance threshold = 5 %

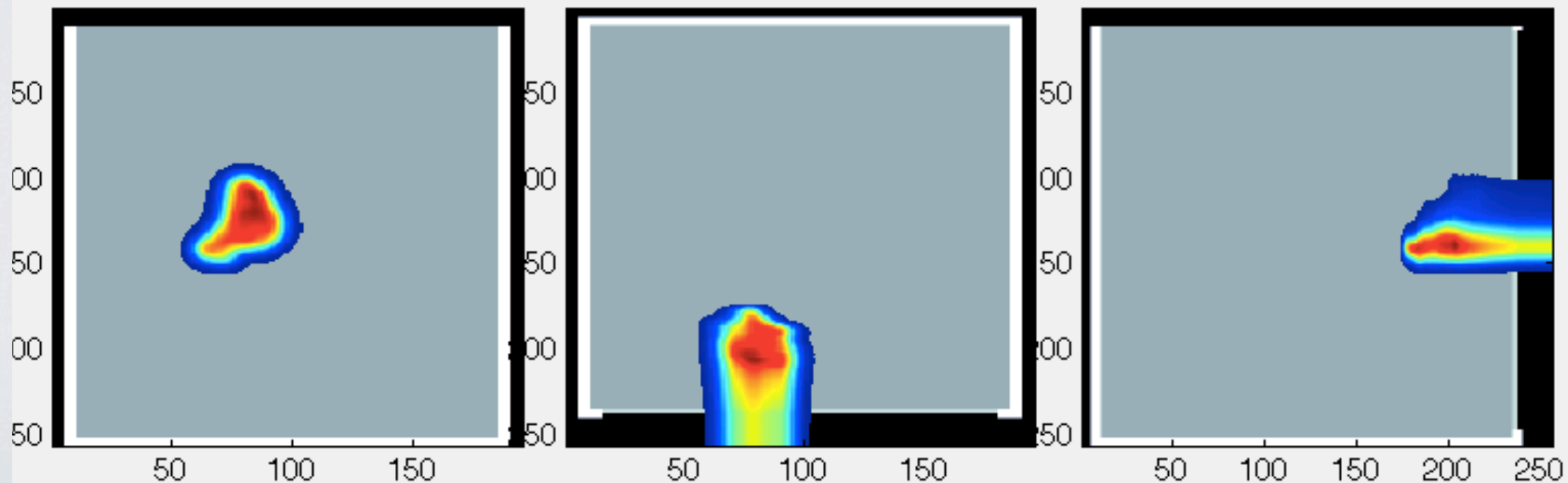
Patient verification plan

gamma-index 99.6% @ 2mm/2%

gamma-index 96.7% @ 1mm/1%



tps



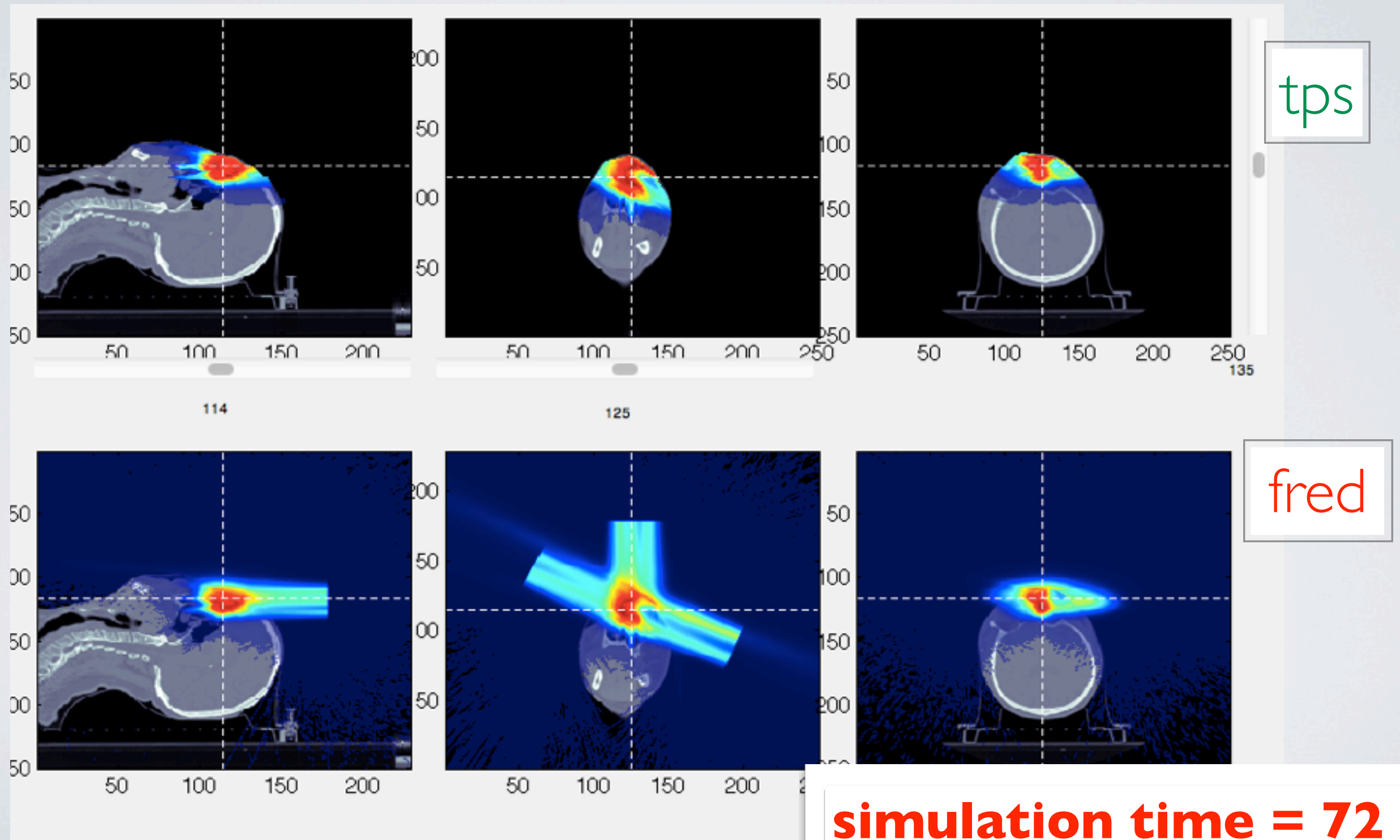
fred

Patient recalculation plan

recalculation at 1% = 700
million primary protons

gamma-index 97% @ 2mm/2%

gamma-index 92% @ 1mm/1%



Hardware and Performance

		Threads	primary/s	$\mu s/primary$
CPU ^a	full-MC *	1	0.75 k	1340
	FRED	1	15 k	68
	FRED	16	50 k	20
	FRED	32	80 k	12.5
GPU	FRED	1 GPU ¹	500 k	2
	FRED	2 GPU ²	2000 k	0.5
	FRED	4 GPU ³	20000 k	0.05

Table A1: Computing times for different hardware architectures.

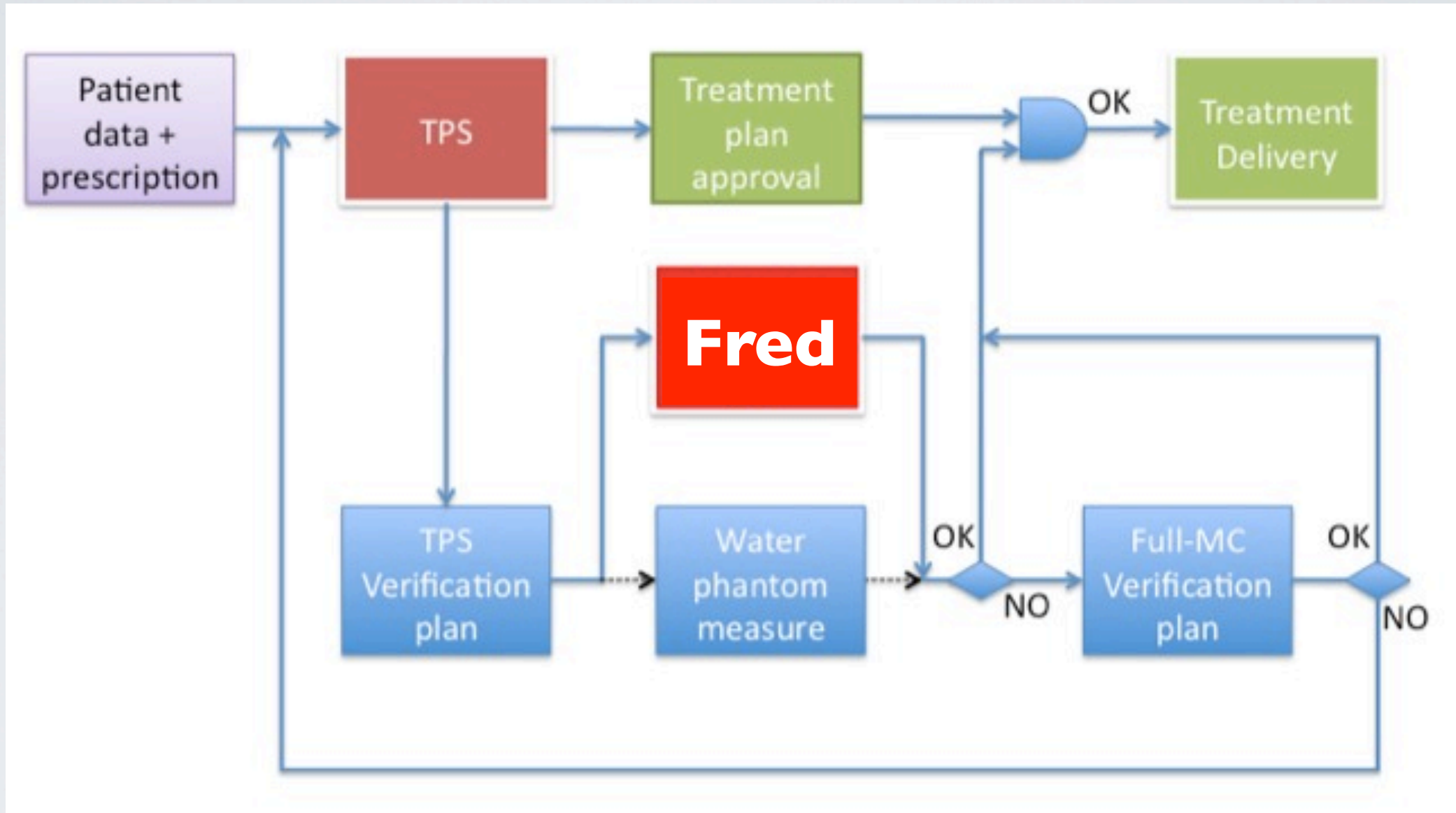
^a motherboard with two Intel[®] Xeon E5-2687 8-Core CPU at 3,1GHz

¹ LAPTOP: Apple[®] MacBook Pro with one AMD[®] Radeon R9 M370X.

² DESKTOP: Apple[®] Mac Pro with two AMD[®] FirePro D300.

³ WORKSTATION: Linux box with four NVIDIA[®] GTX 980.

Proton Patient QA



Consuntivo attività Fred - WP1 I e prospettive

- completato il modello “protoni in acqua”
- fine-tuning e confronto con TPS
- accordo Fred-TPS ampiamente entro le soglie del protocollo QA per i SOBP
- ricalcolo piani di verifica in acqua in meno di 2 min
- ricalcolo fast-MC piano paziente
- commissioning per il proton patient QA
- curve di calibrazione CNAO per paziente
- validazione ricalcolo paziente e dose biologica