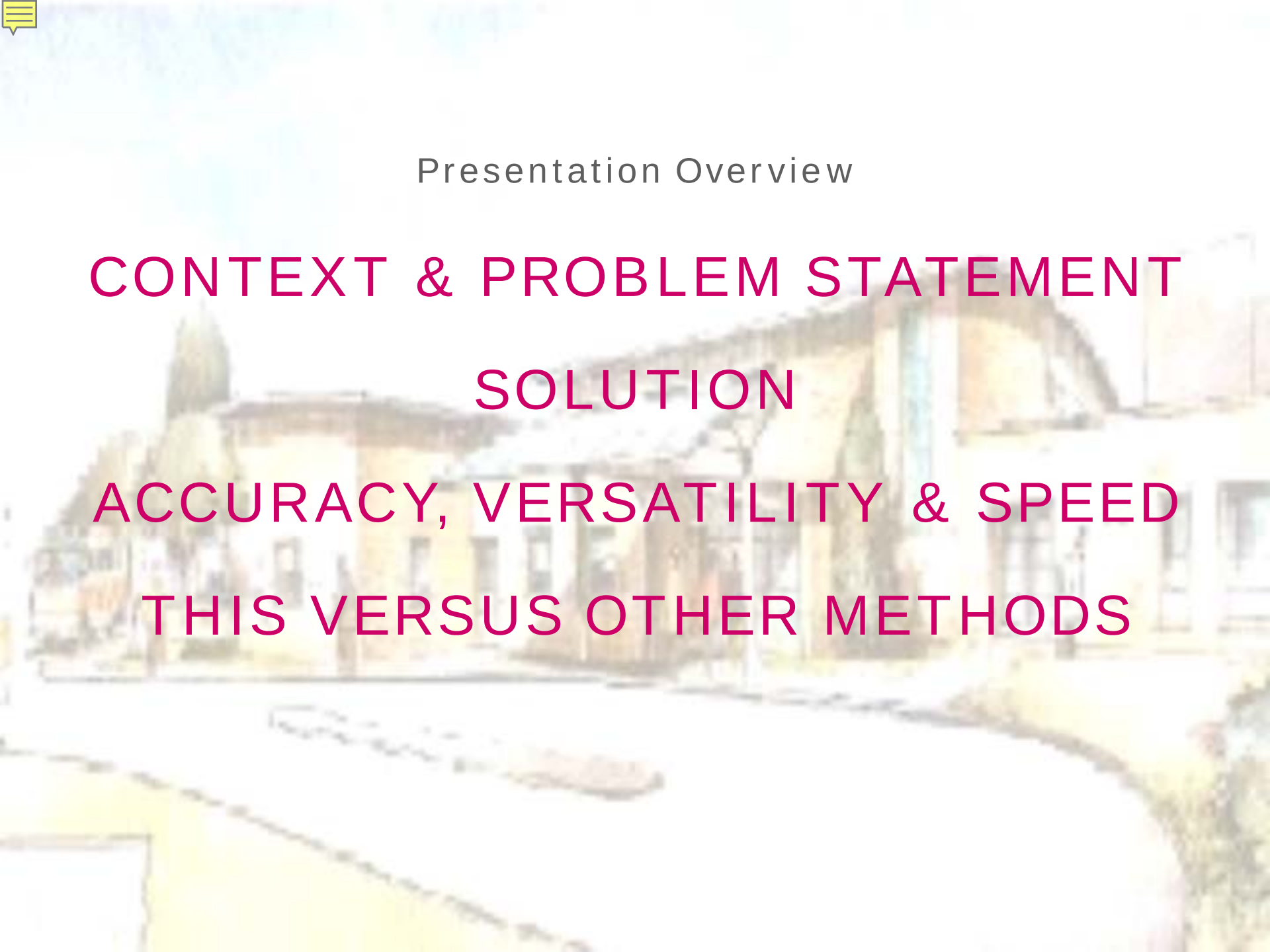
HIGHLIGHTS FROM MY PhD THESIS

MONTE CARLO PORTAL DOSIMETRY

MARY PW CHIN

Velindre Cancer Centre
Canolfan Ganser Felindre



Presentation Overview

CONTEXT & PROBLEM STATEMENT

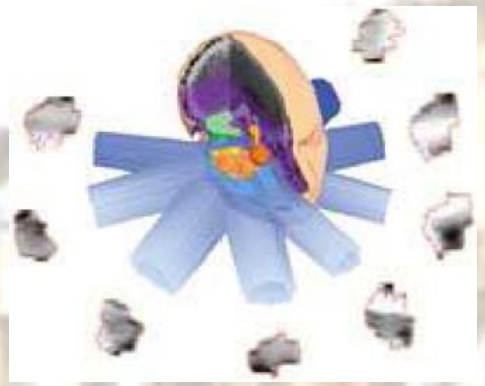
SOLUTION

ACCURACY, VERSATILITY & SPEED

THIS VERSUS OTHER METHODS

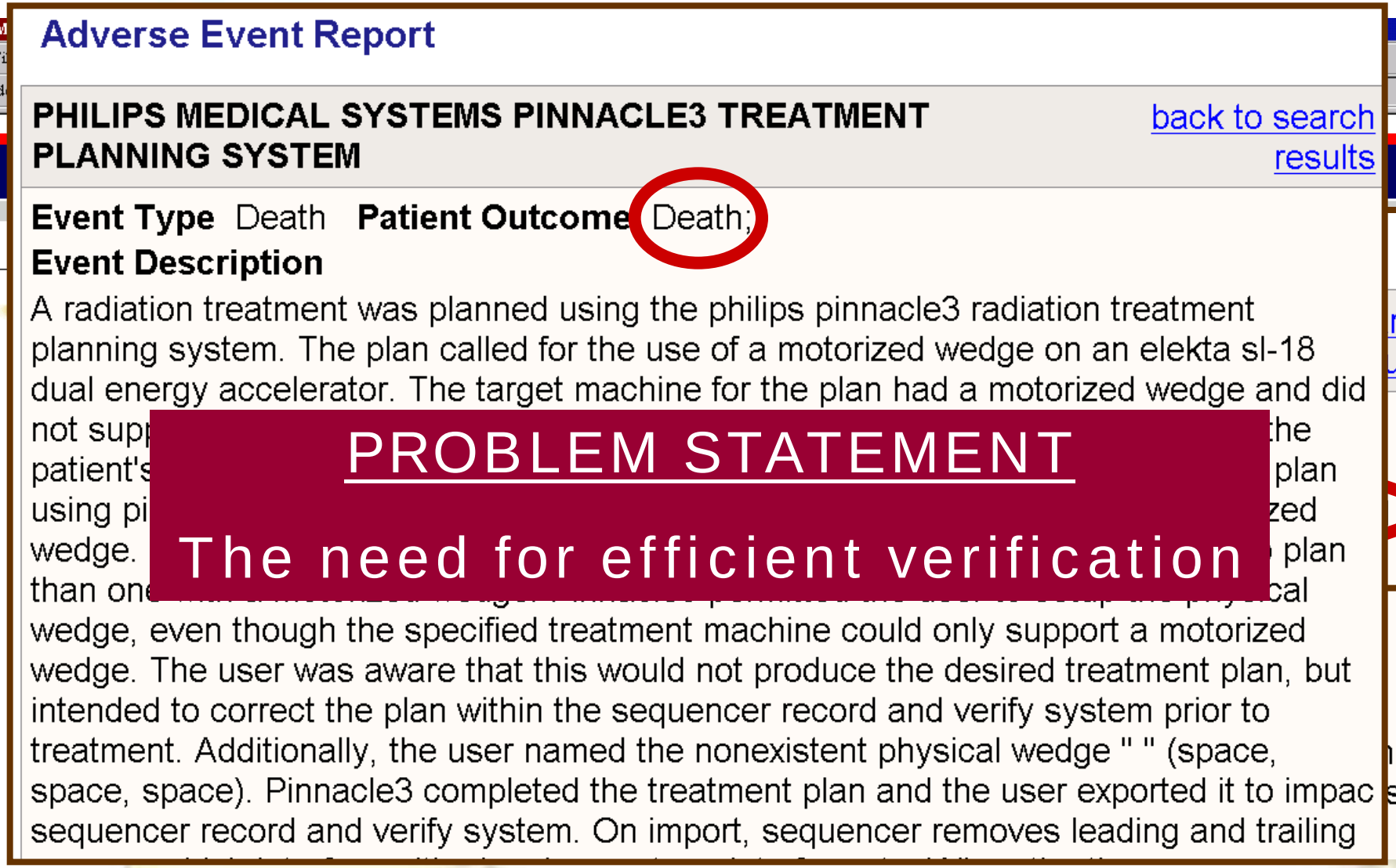
CONTEXT

Increasingly complex radiotherapy modalities



Many things can go wrong

SOME HORROR STORIES



Adverse Event Report

PHILIPS MEDICAL SYSTEMS PINNACLE3 TREATMENT PLANNING SYSTEM

back to search results

Event Type Death **Patient Outcome** Death;

Event Description

A radiation treatment was planned using the philips pinnacle3 radiation treatment planning system. The plan called for the use of a motorized wedge on an elekta sl-18 dual energy accelerator. The target machine for the plan had a motorized wedge and did not supp…he patient's …plan using pi…zed wedge. …plan than one…cal wedge, even though the specified treatment machine could only support a motorized wedge. The user was aware that this would not produce the desired treatment plan, but intended to correct the plan within the sequencer record and verify system prior to treatment. Additionally, the user named the nonexistent physical wedge " " (space, space, space). Pinnacle3 completed the treatment plan and the user exported it to impac…s sequencer record and verify system. On import, sequencer removes leading and trailing

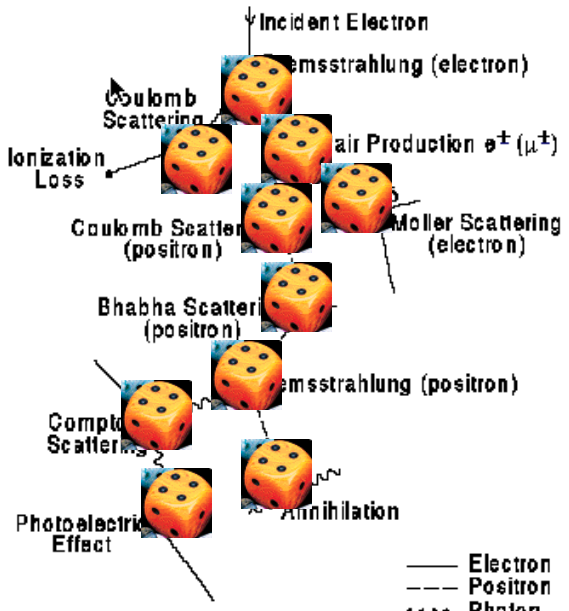
PROBLEM STATEMENT

The need for efficient verification

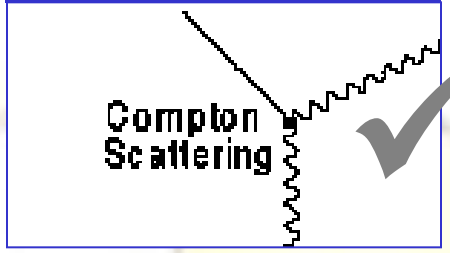
SOLUTION

Monte Carlo Portal Dosimetry

SHOWER OF EVENTS

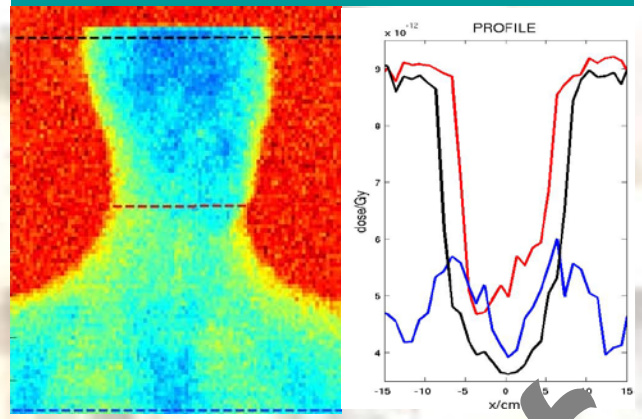


SINGLE EVENT



DETERMINISTIC EQUATIONS

DOSIMETRIC

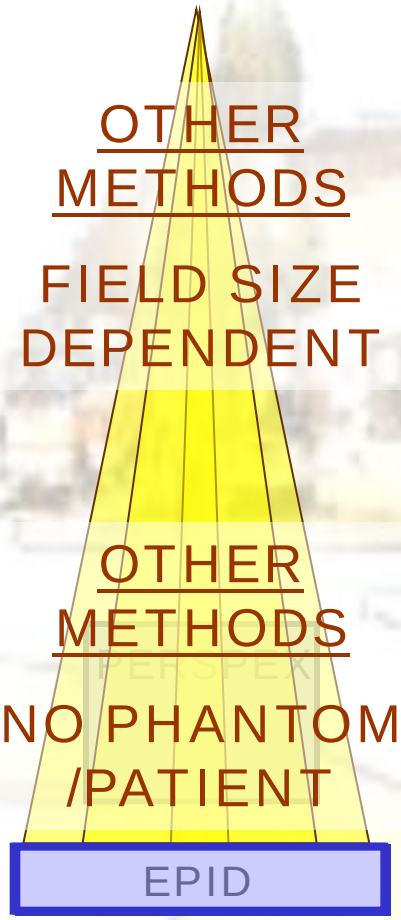


GEOMETRIC

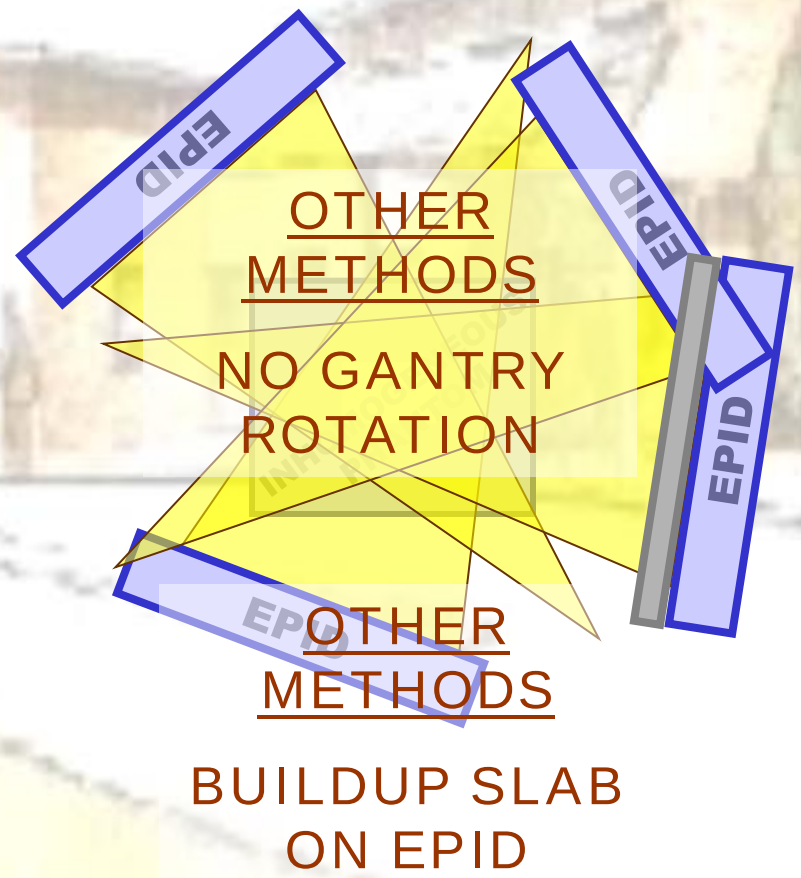
QUALITATIVE ANALYSIS

TESTED
CLINICAL RANGE

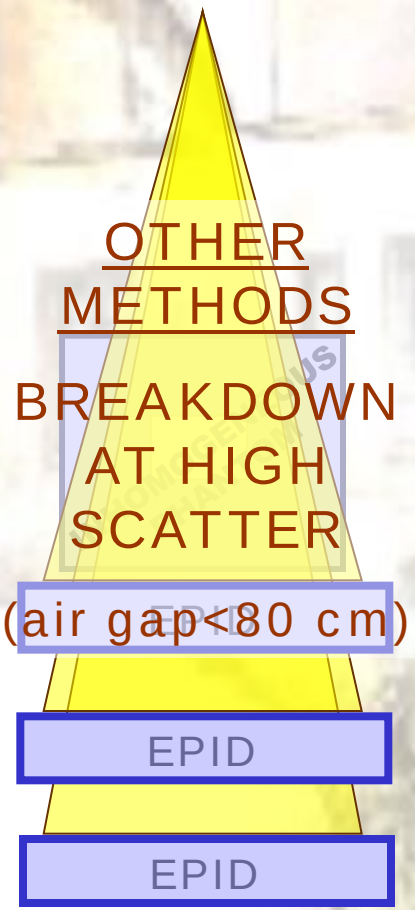
FIELD SIZE



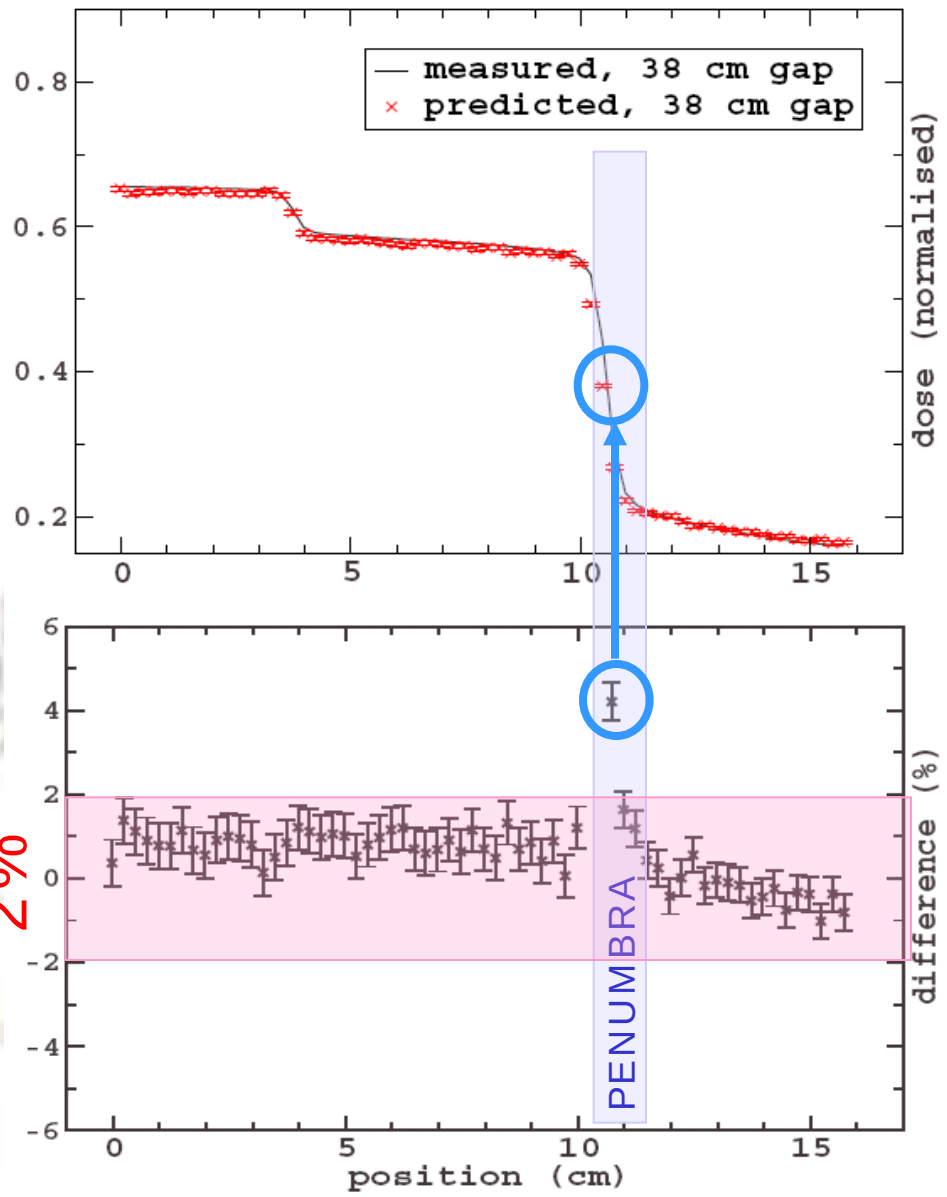
GANTRY ANGLES

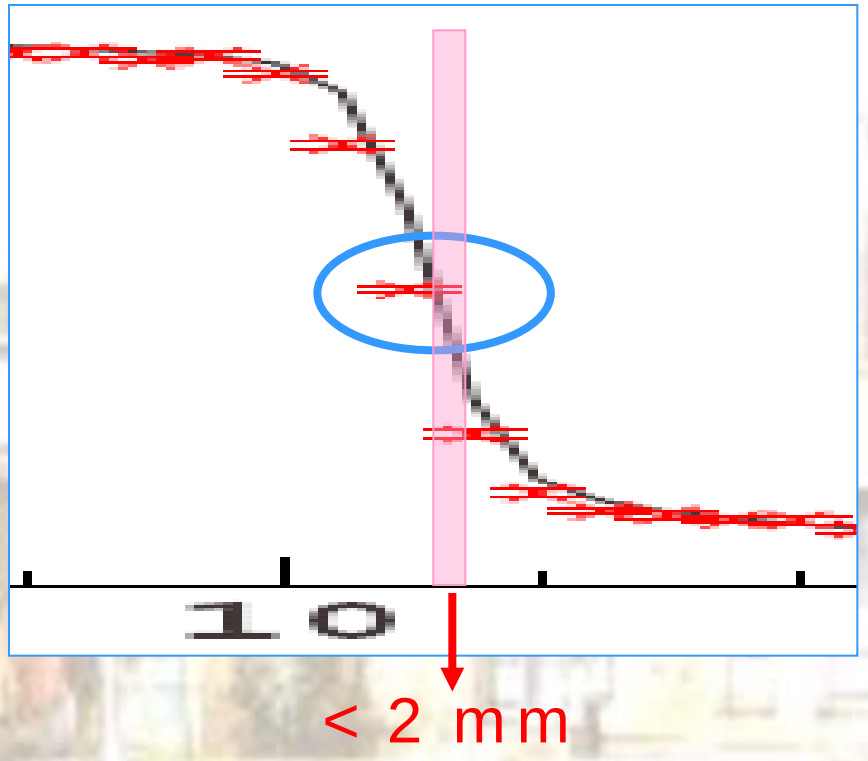


AIR-GAP DISTANCE



AN ACCURATE SOLUTION
2 % / 2 mm accuracy





< 2 mm

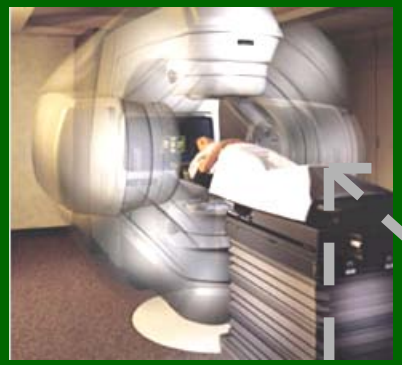
High gradient region
Uncertainty due to collimators & detectors positioning during measurement.

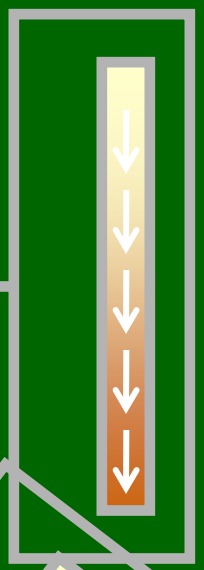
HANDLING OBLIQUE BEAMS

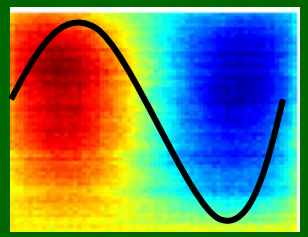
How is that possible?

problem	solution
BULGING EFFECT	SINUSOIDAL CORRECTION FUNCTION
RECTILINEAR VOXELS	INTEGRATED PHANTOM

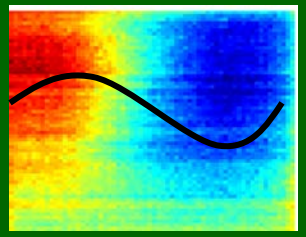
BULGING EFFECT



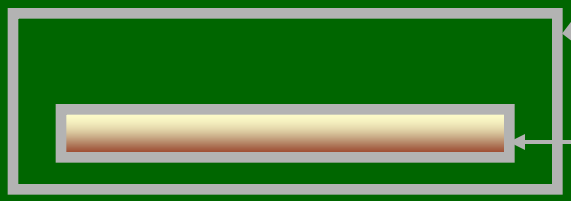




container
bulges

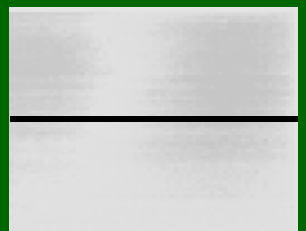


container
bulges



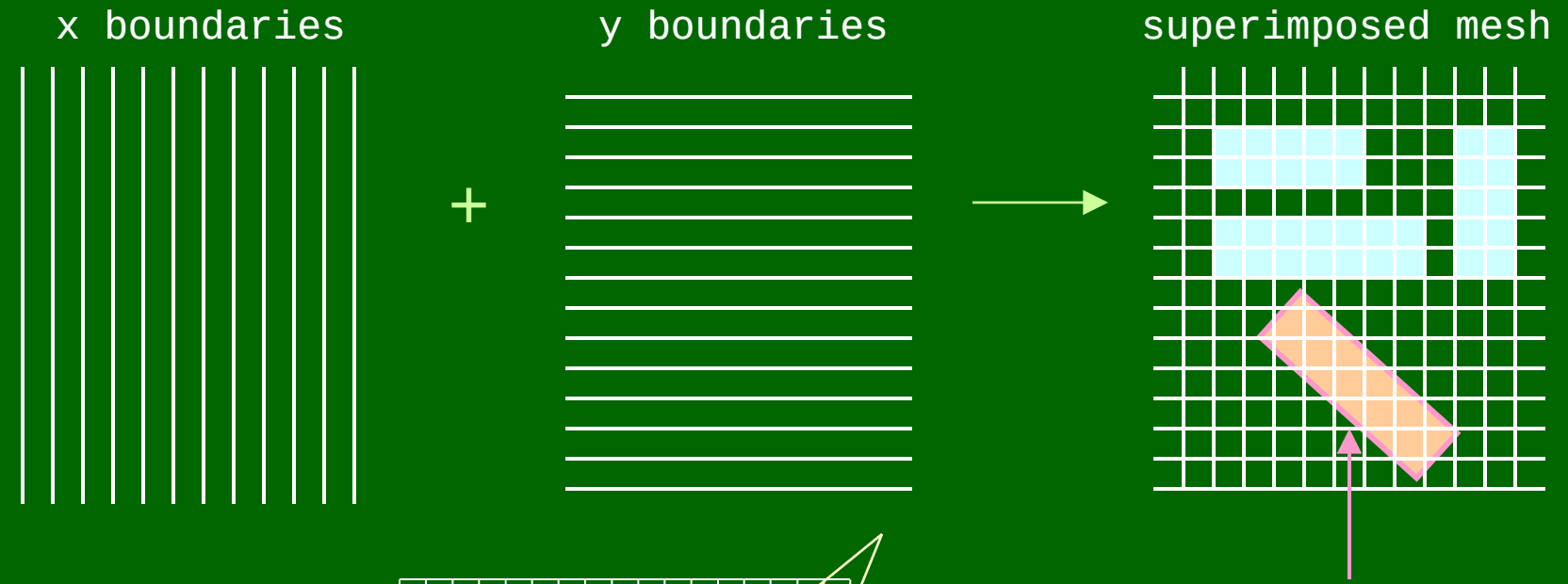
liquid
inside

imager type:
liquid-filled ion chamber



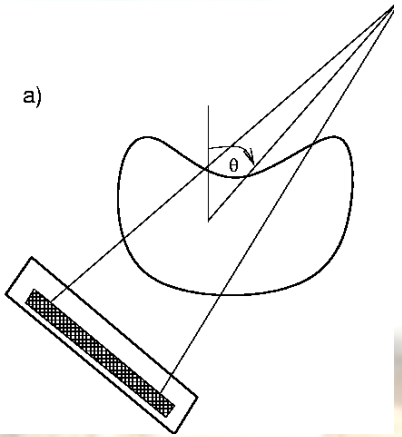
unflatness ~ 5%
if uncorrected,
gives 5% error!

RECTILINEAR VOXELS

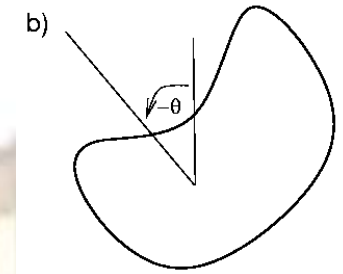


TWIZ&GLU **OVERCOMES THE PROBLEM**

In order to achieve this:

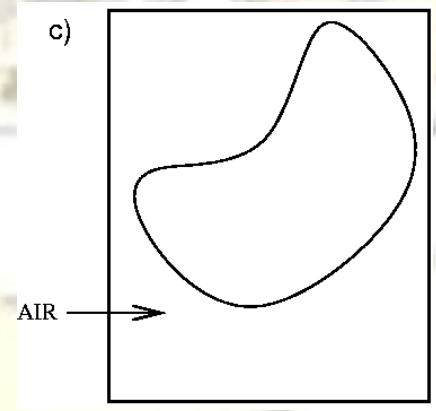


First, rotate phantom in opposite direction



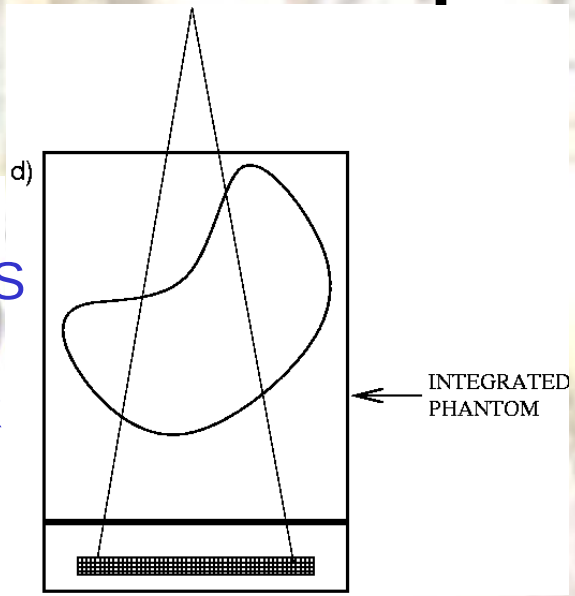
Geometrically equivalent

Then, pad surrounding with air



Finally, attach the EPID

BEAM IS ALWAYS DIRECTED AS IF GANTRY WAS NEVER ROTATED



SPEED

WAYS OF MAKING IT FAST

- VARIANCE REDUCTION
  - *cut corners* during simulation
- DENOISING
  - *smooth* data after simulation
- DISTRIBUTED COMPUTING
  - 
    - CLUSTER ✓
    - DISTRIBUTED ✓
    - GRID ✓

they worry about the computers

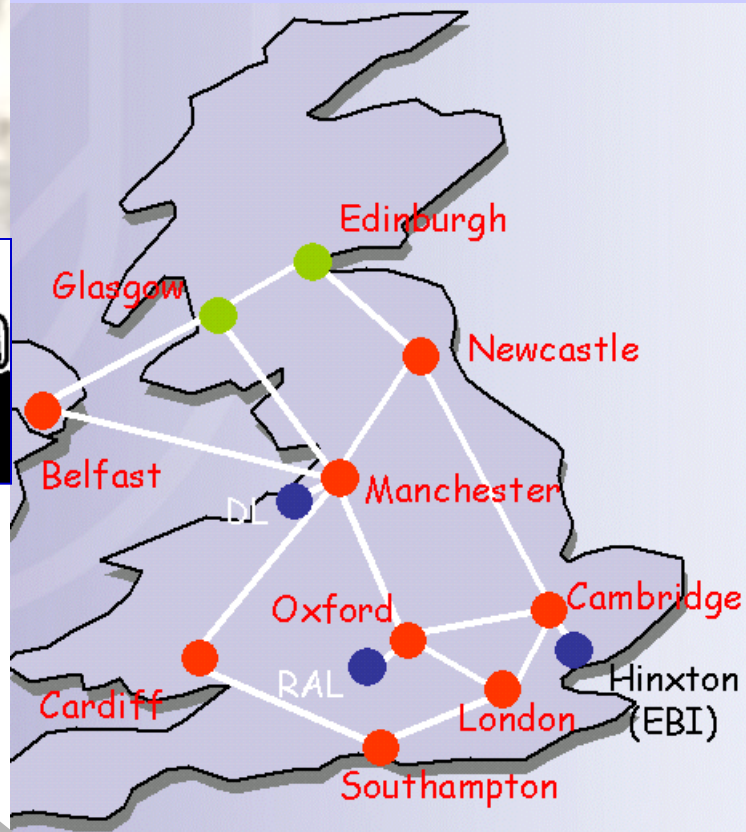
we take care of the science

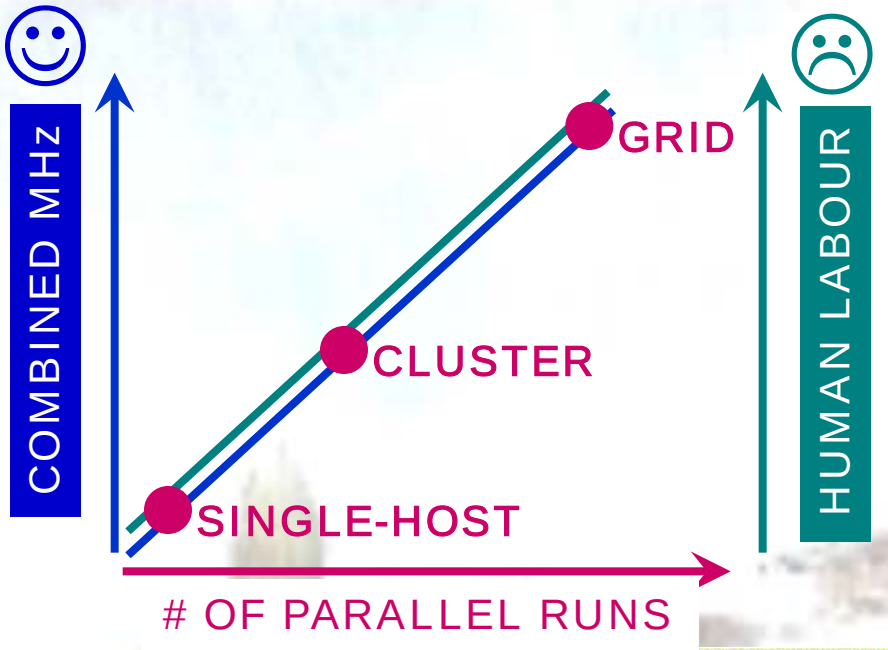
e-Science

THE GRID IDEA

LIKE POWER GRIDs, GENERATION & SUPPLY SHOULD BE HIDDEN FROM THE USER

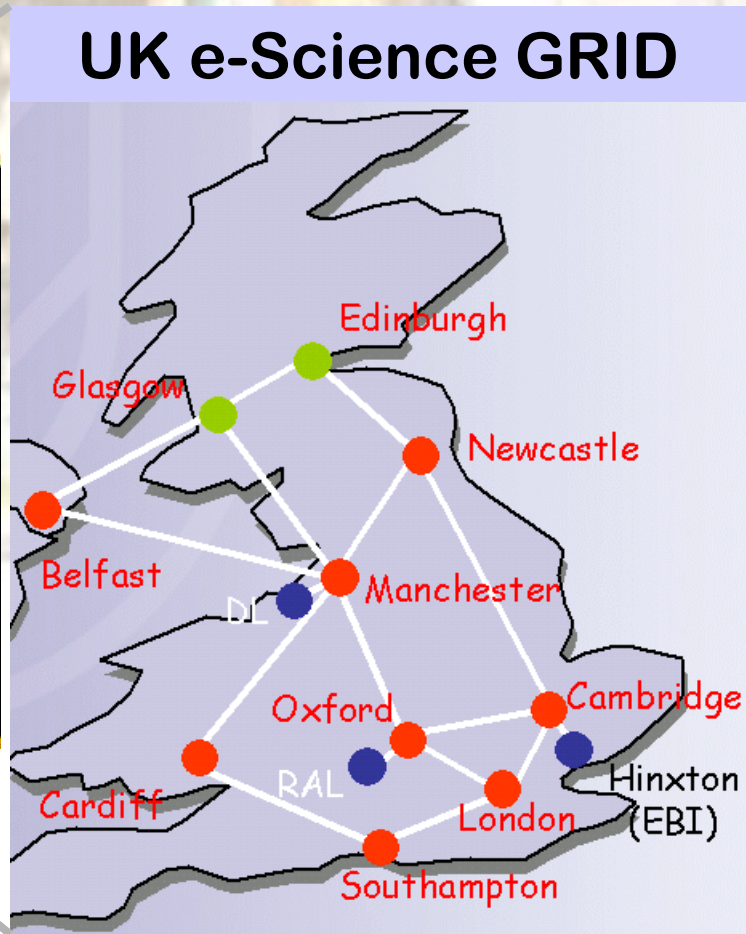
UK e-Science GRID





HOWEVER

INTERFACING IS COMPLEX & APPLICATION-DEPENDENT



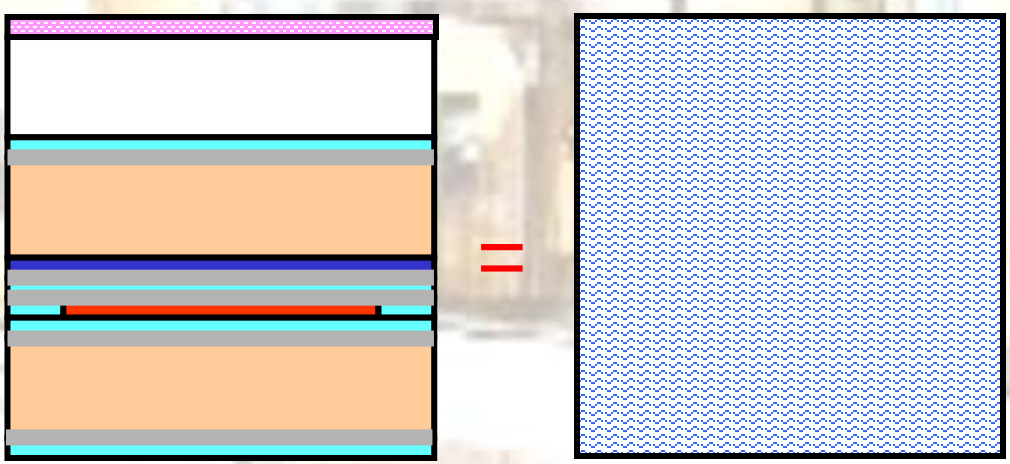
SOLUTION

SINGLE COMMAND-LINE FROM THE USER. NO FURTHER INTERACTION NEEDED.

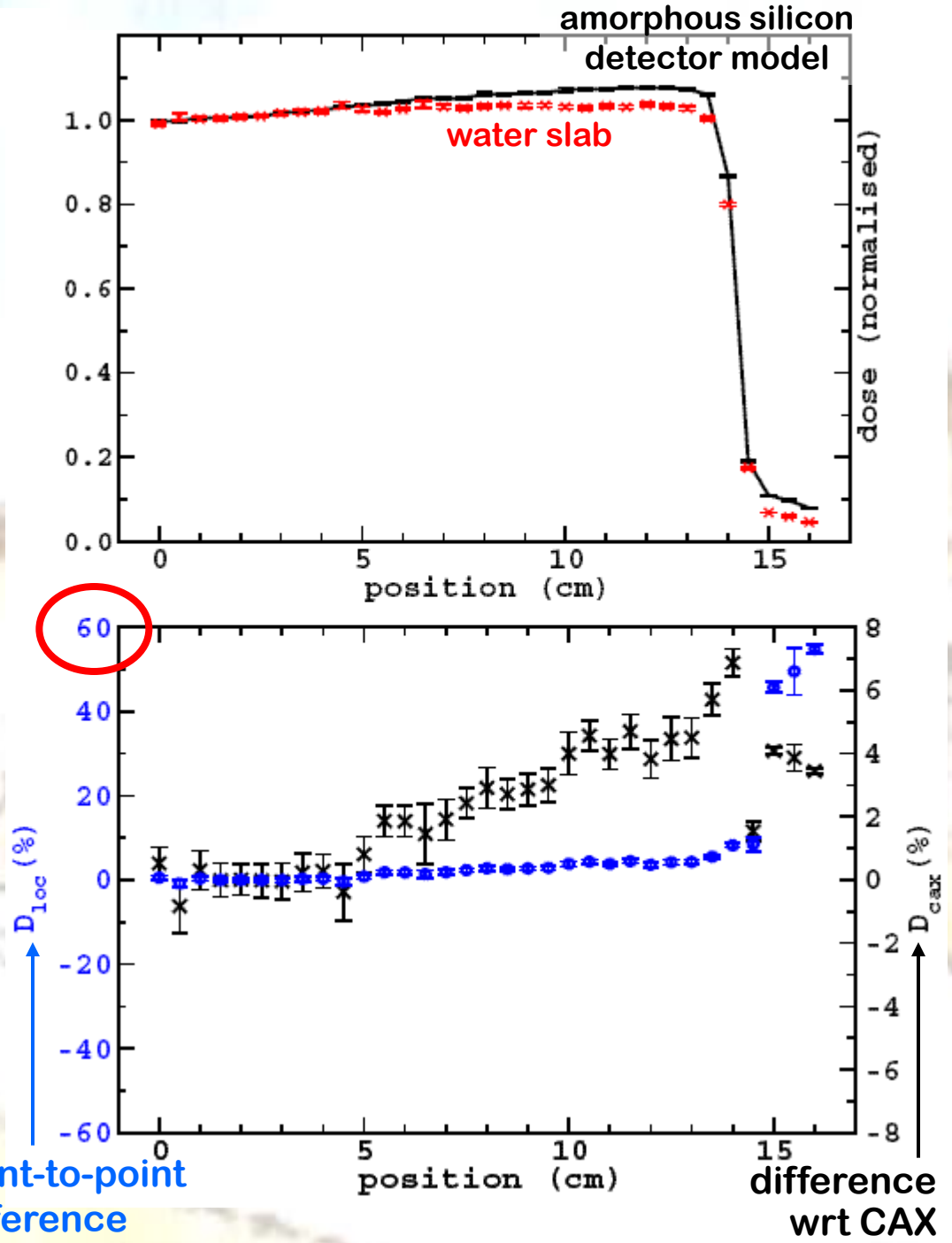
eg. 200 PARALLEL RUNS

THIS VERSUS OTHER METHODS

MOST PORTAL DOSE PREDICTION TECHNIQUES ASSUME



What is the implication?


amorphous silicon
detector model
water slab
dose (normalised)
position (cm)
D_{loc} (%)
D_{cax} (%)
position (cm)
point-to-point
difference
difference
wrt CAX

SUMMARY

A MONTE CARLO SOLUTION
FOR TREATMENT VERIFICATION
COMBINED ACCURACY, VERSATILITY & SPEED
UNREPORTED ELSEWHERE

Acknowledgement

Thanking Cancer Research Wales & Yr Ysgol Uwchradd Tregaron for PhD support.