Calculation of Skin Dose in Breast Radiotherapy

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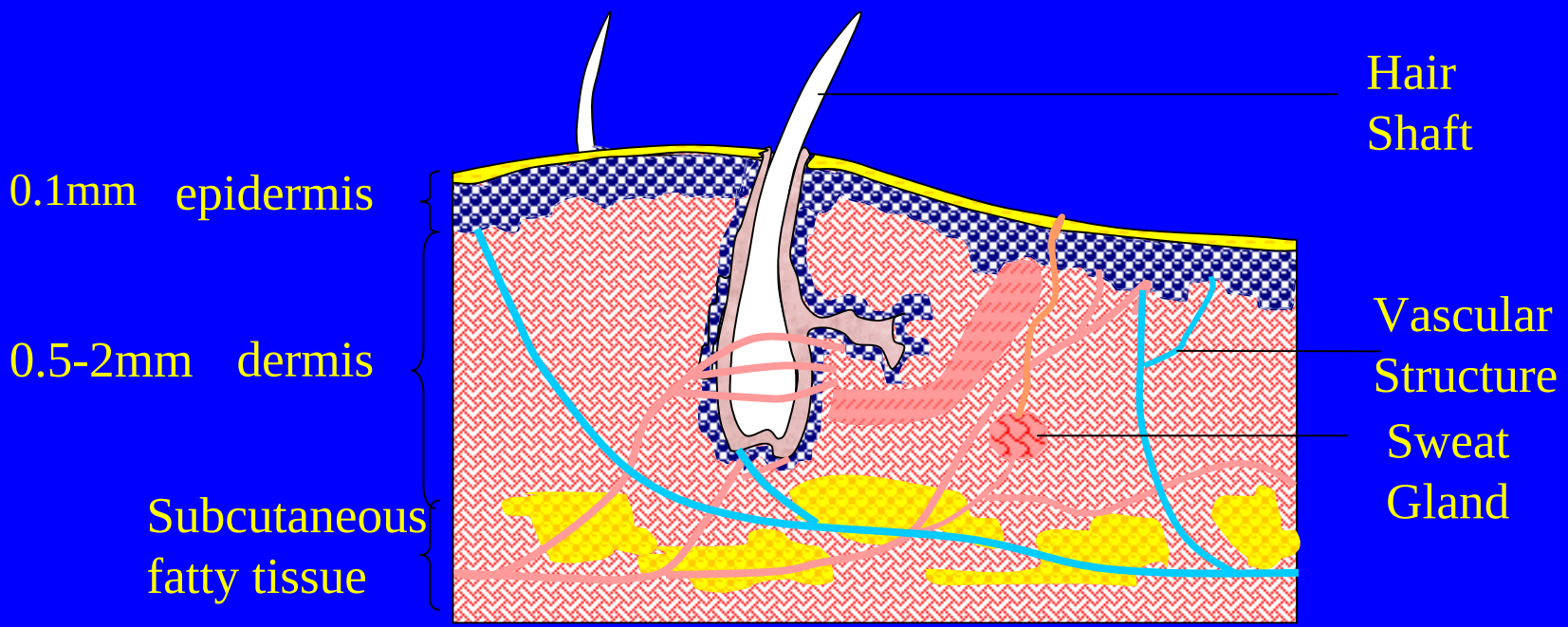
Introduction

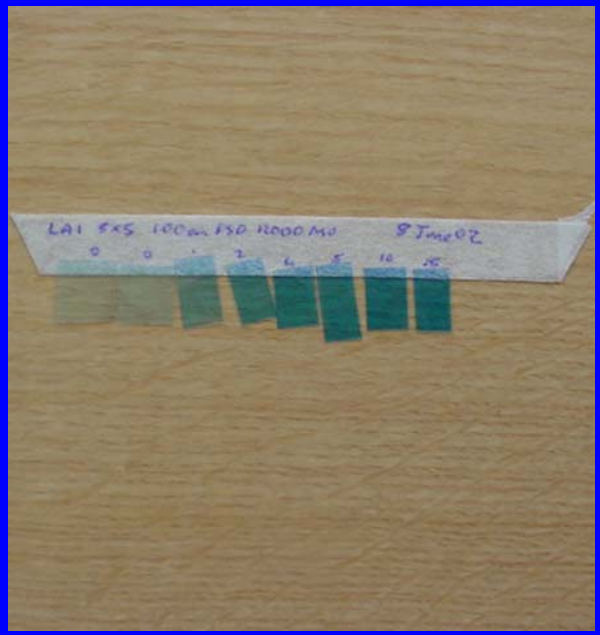
- Side effects of radiotherapy
  - Acute effects
    - Erythema reddening of the skin
    - Moist desquamation
  - Late effects
    - Telangactasia

80-90% of difference between patients due to genetic effects

Human skin

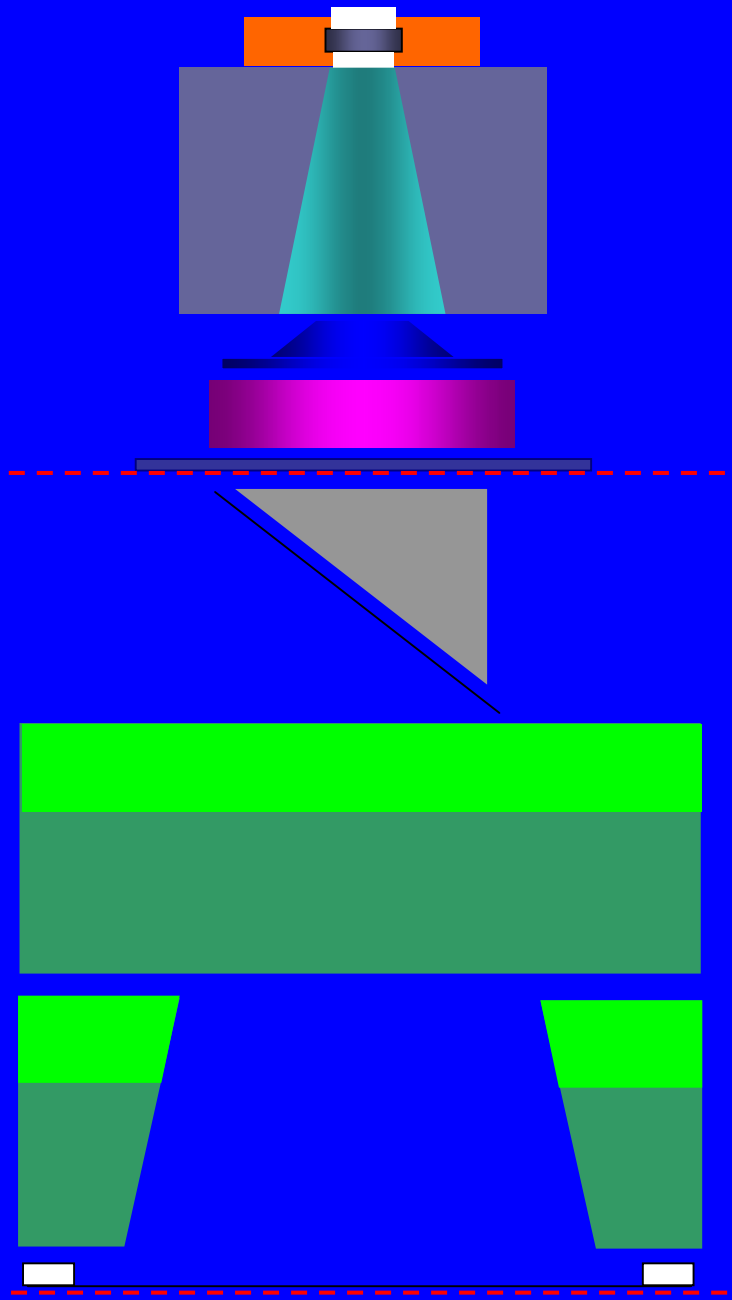

Hair
Shaft
0.1mm epidermis
0.5-2mm dermis
Subcutaneous
fatty tissue
Vascular
Structure
Sweat
Gland

Measurement Method



Monte Carlo method

- 2.5×10^9 electrons incident on target
- 7.5×10^7 particles in phase space 1
- Recycled to give 8×10^7 particles in phase space 2
- Monte Carlo parameters
  - Global ECUT 0.521MeV
  - Global PCUT 0.01MeV
  - No Bremstrahlung splitting,
  - No Russian Roulette,
  - No photon forcing



Target (FLATTENING FILTER)

Primary collimator (PRIMARY COLLIMATOR)

Flattening filter (FLATTTENING FILTER)

Ionisation chamber (CHAMBER)

Backscatter plate (SLABS)

Phase space file 1

Wedge (optional) (JAWS)

Mirror (MIRROR)

Y jaws (JAWS)

X jaws (JAWS)

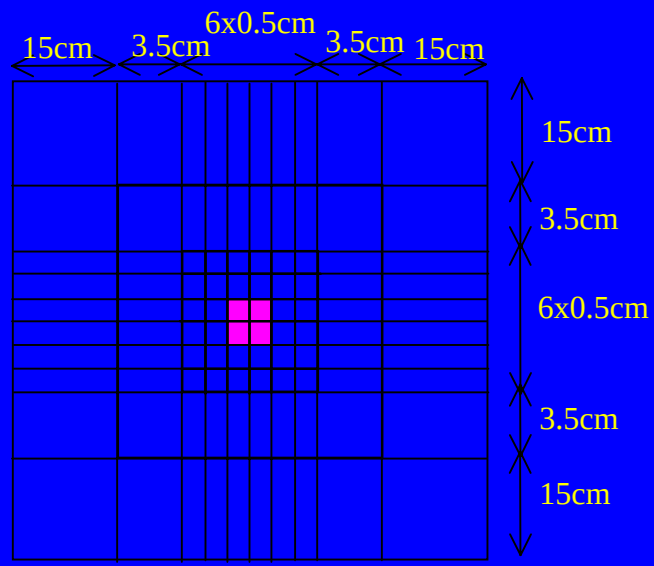
End plate (BLOCK)

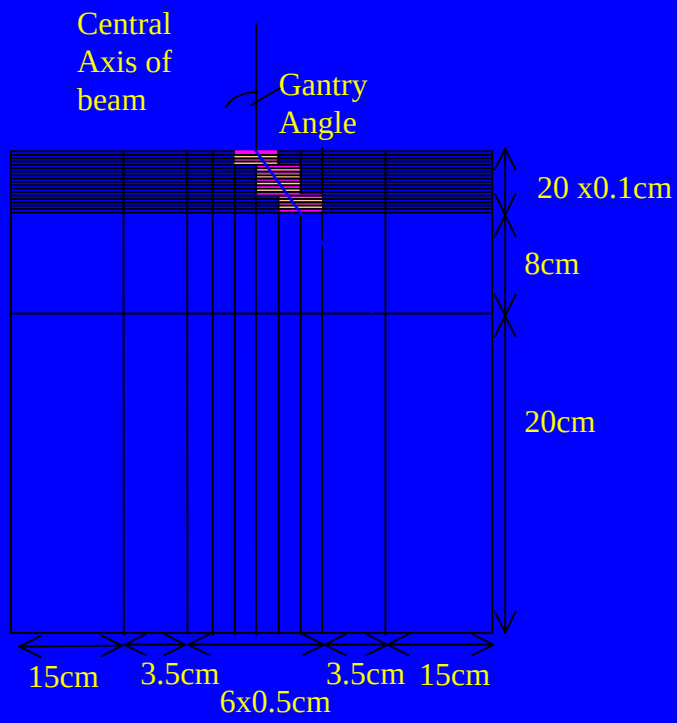
Mylar Screen (SLABS)

Phase space file 2

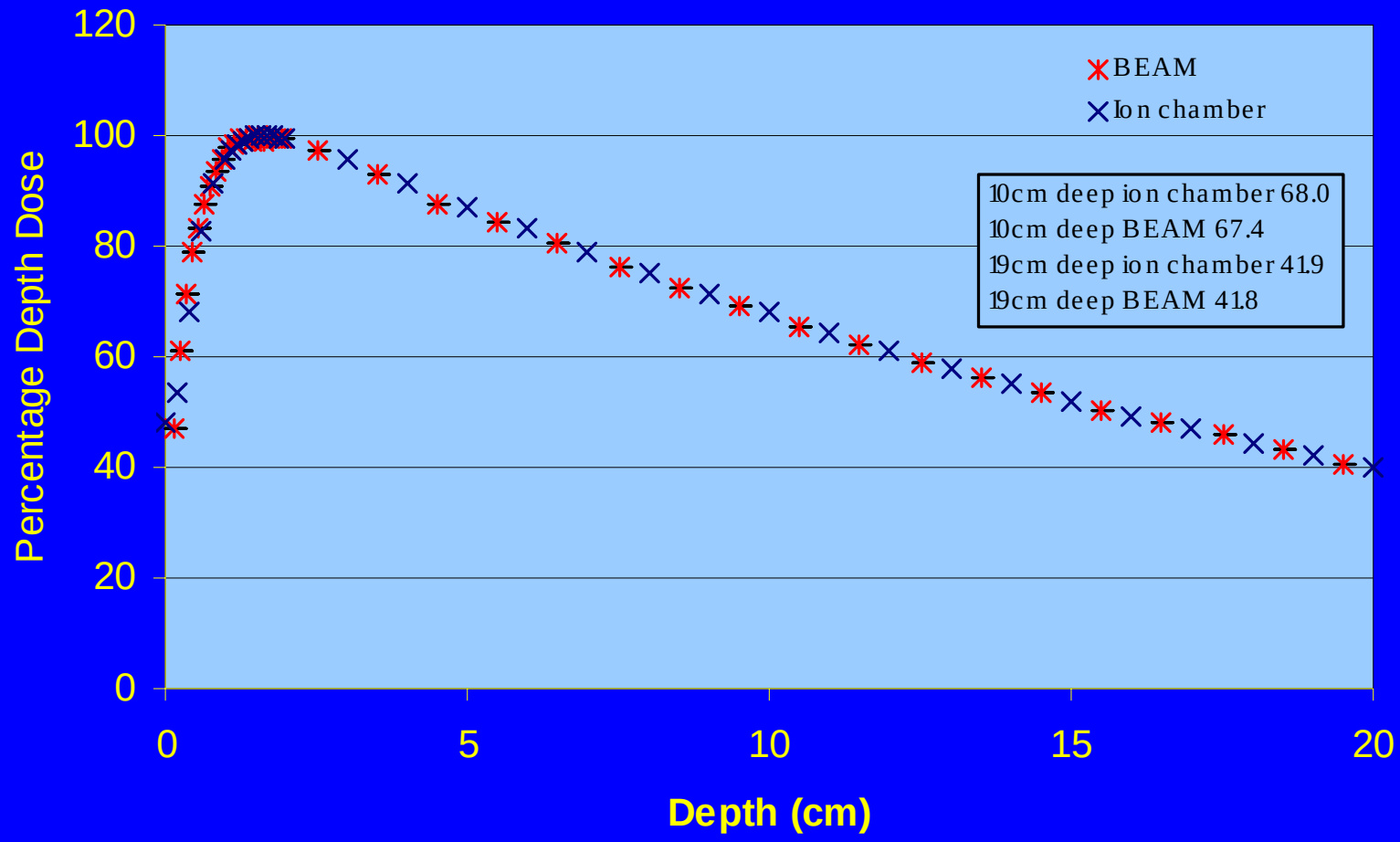
BEAM model

Dosxyz phantom



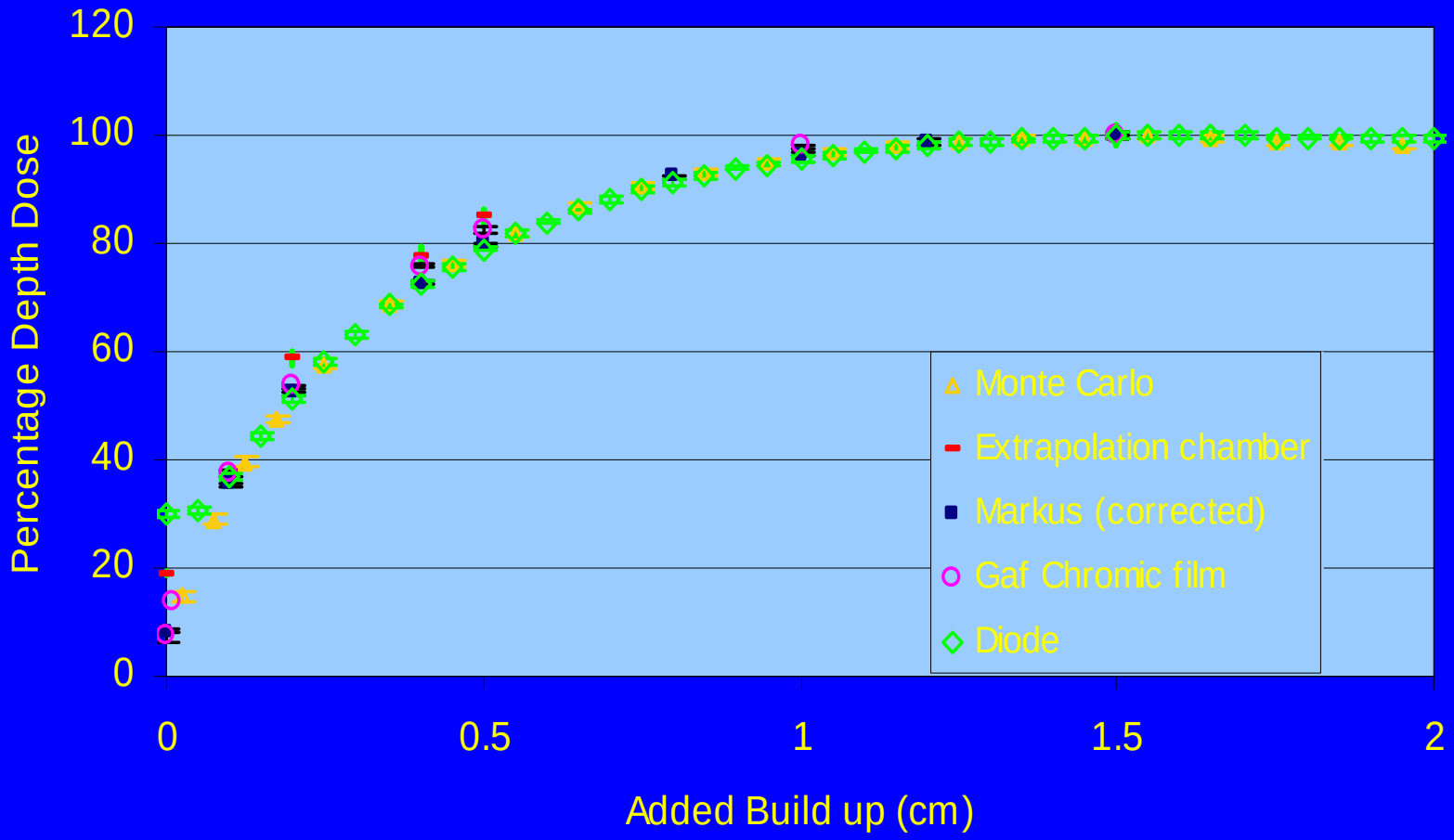


Agreement of Monte Carlo and measured data 10cmx10cm field 6MV



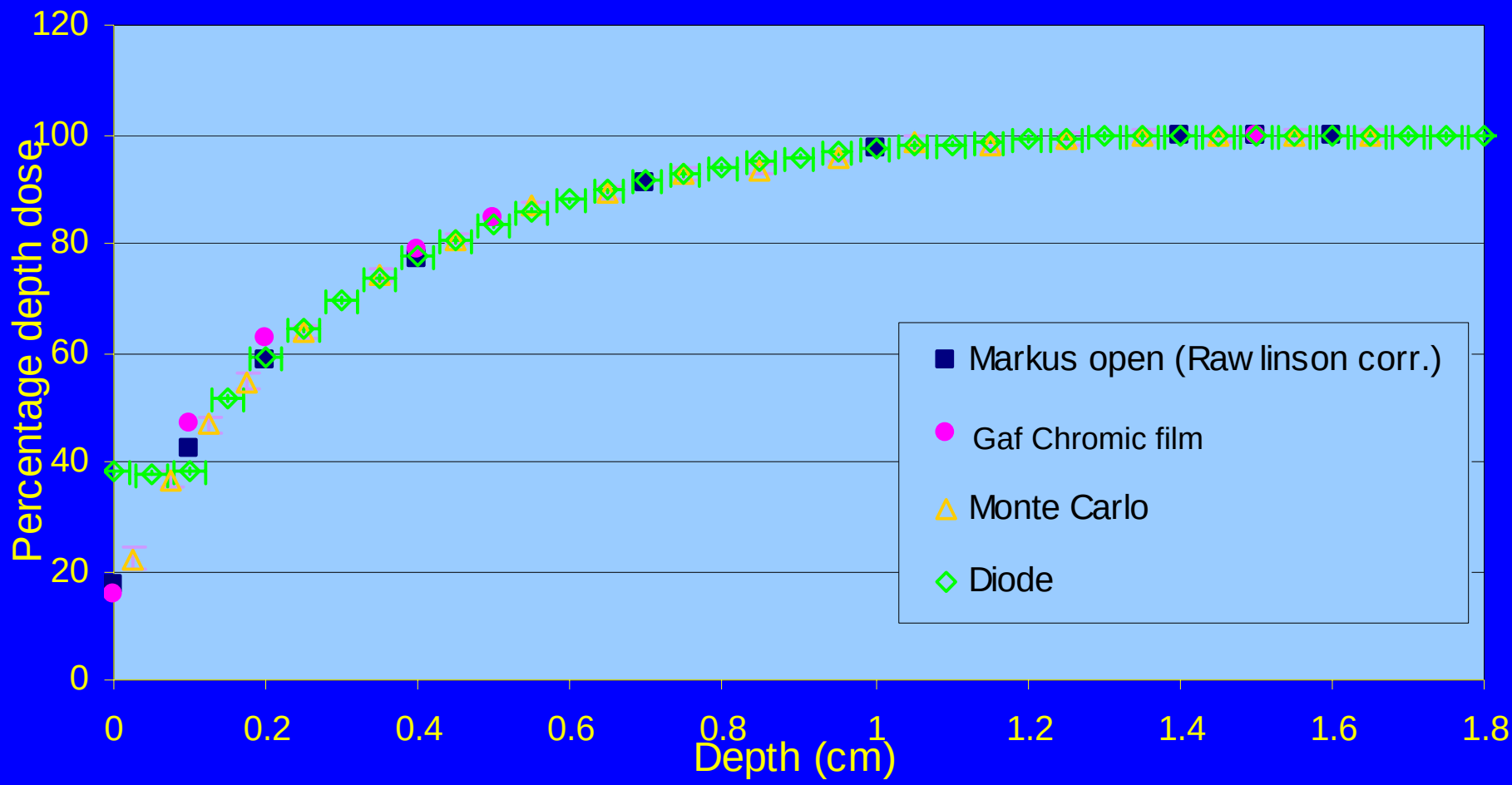
Surface Dose

gantry 0, 6MV, 5x5, open fields



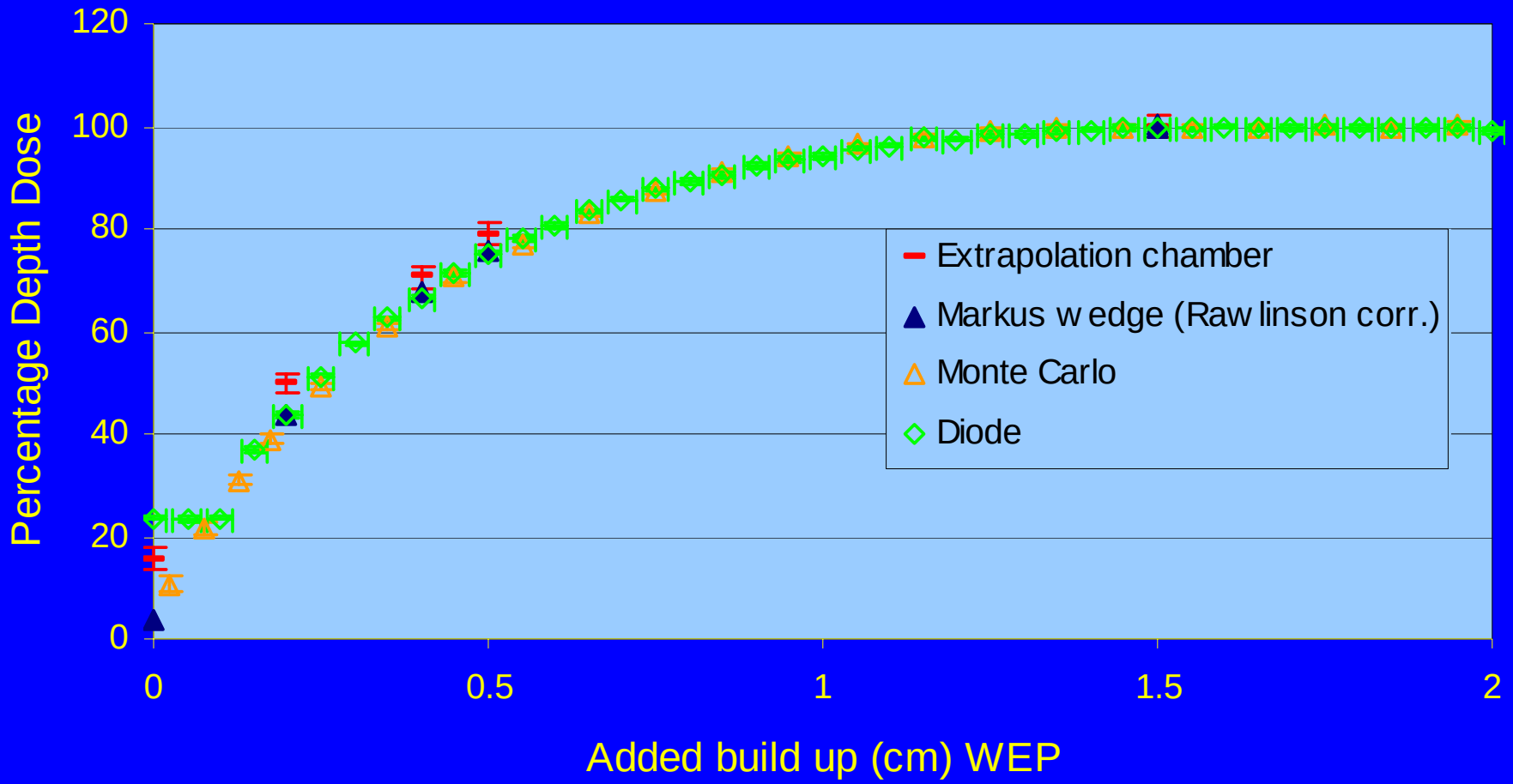
Surface Dose

gantry 0, 6MV, 9x20, open fields



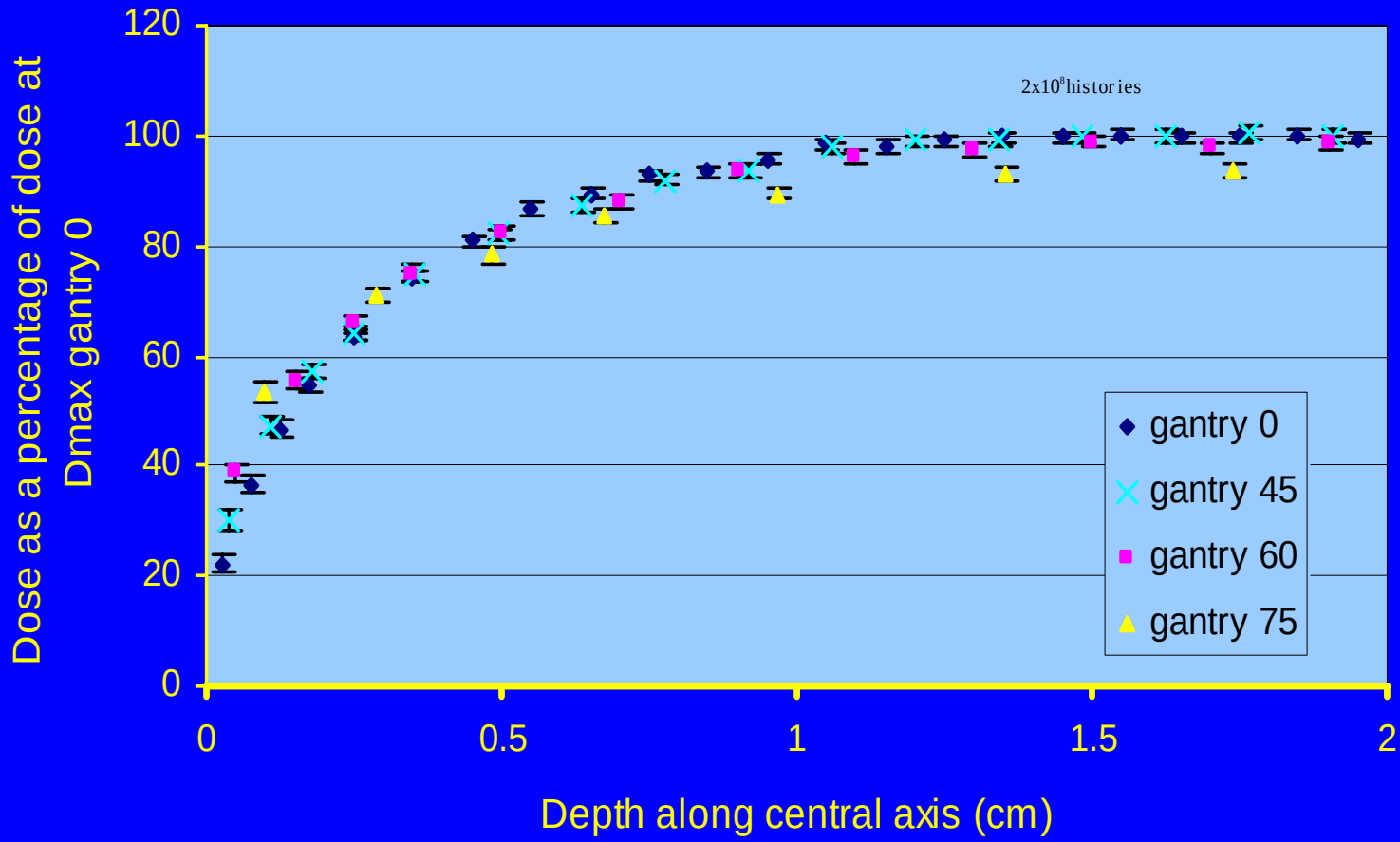
Surface Dose

gantry 0, 6MV, 5x5, wedge fields



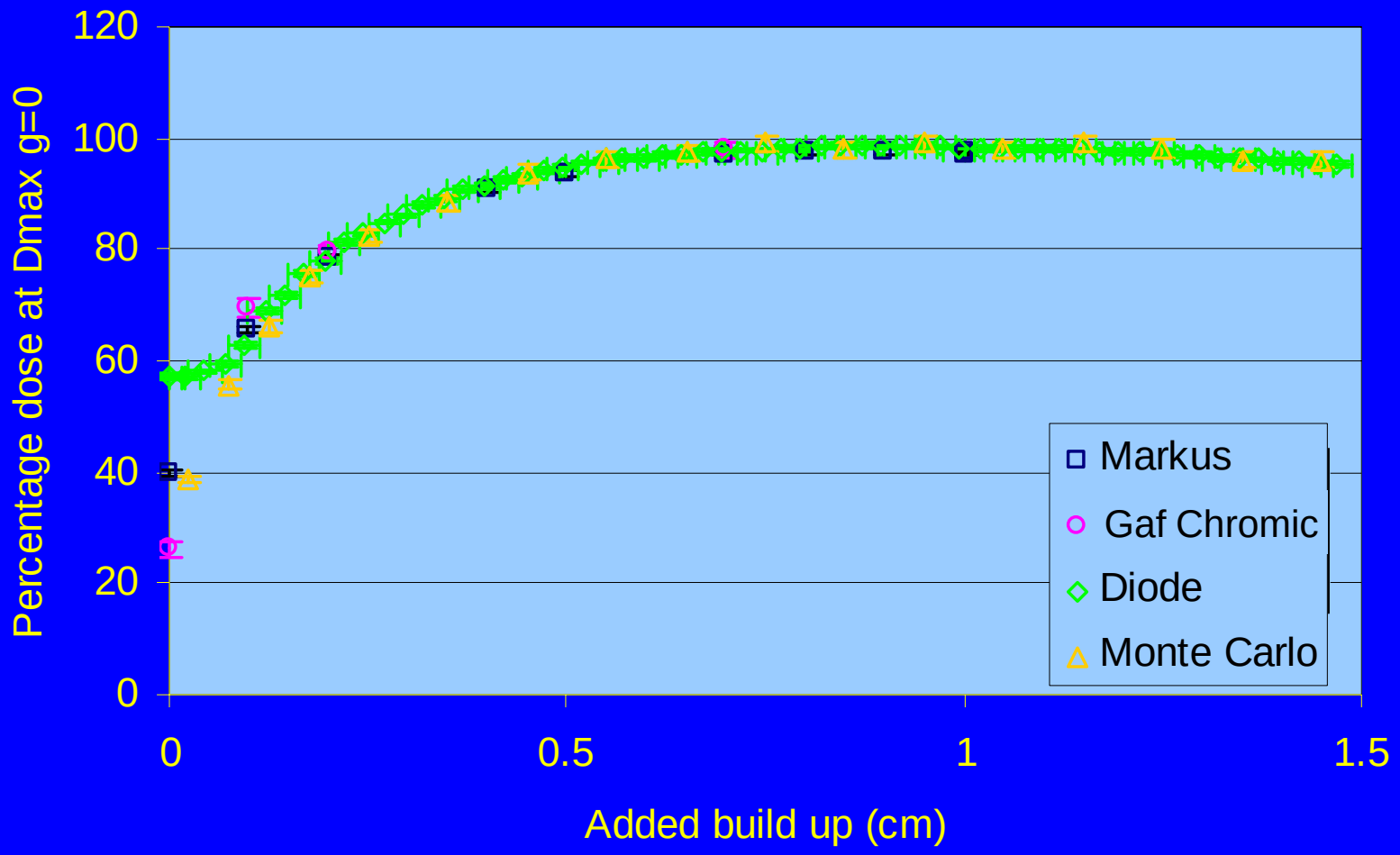
Surface Dose various gantry angles

6MV, 5x5, open fields



Surface Dose

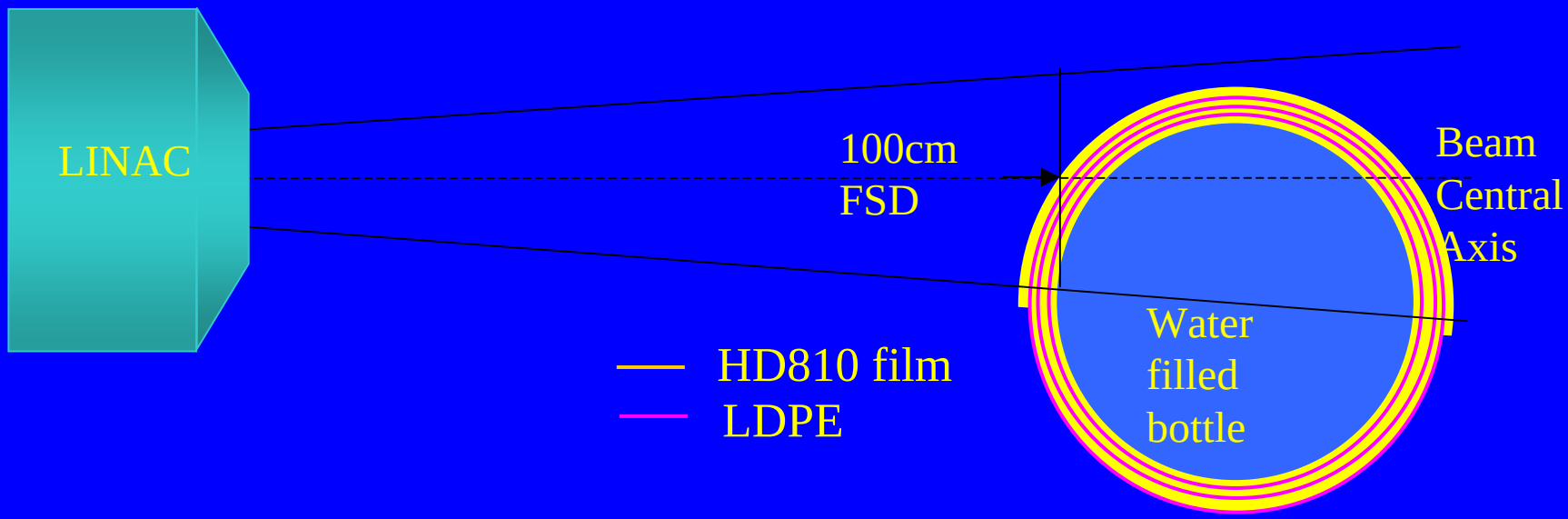
gantry 60, 6MV, 9x20, open fields



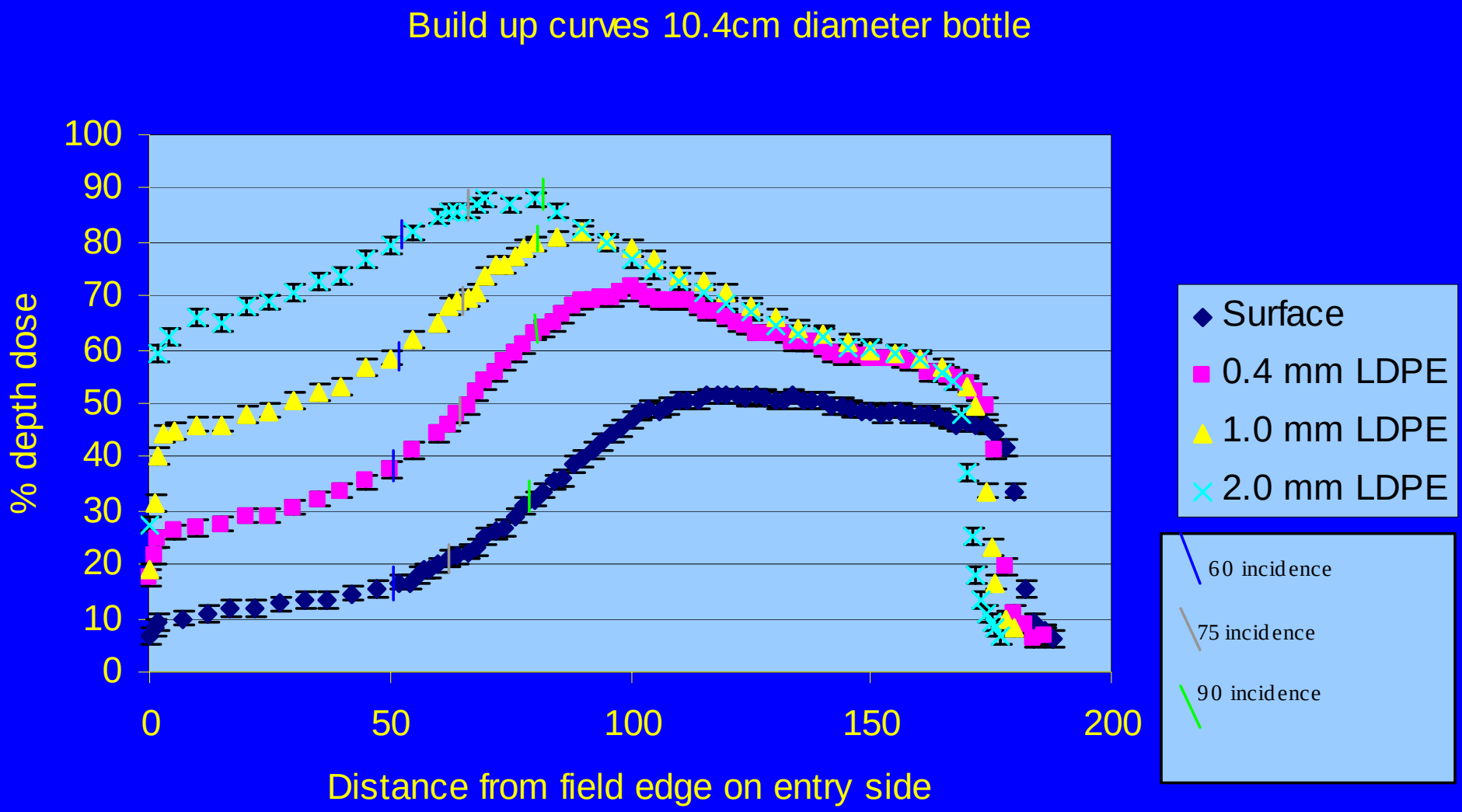
Exit dose calculations

Gantry Angle	Percentage depth dose in last voxel	Percentage depth dose in same voxel under full scatter conditions	Percentage decrease in exit dose due to lack of scatter
0	53.9	60.7	11
60	48.1	61.1	21
75	41.2	62.2	44

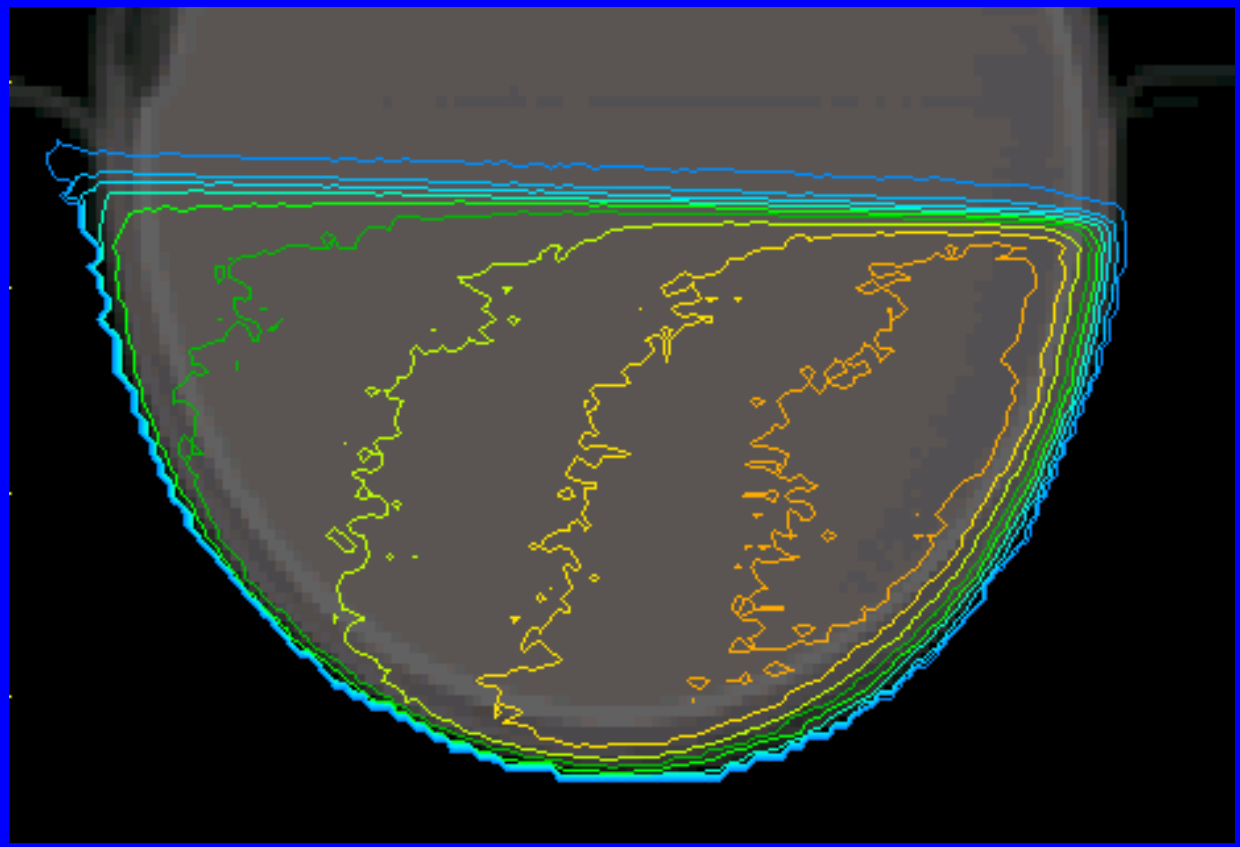
Results bottles measurement

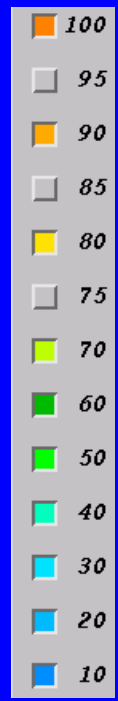


Results bottle measurements

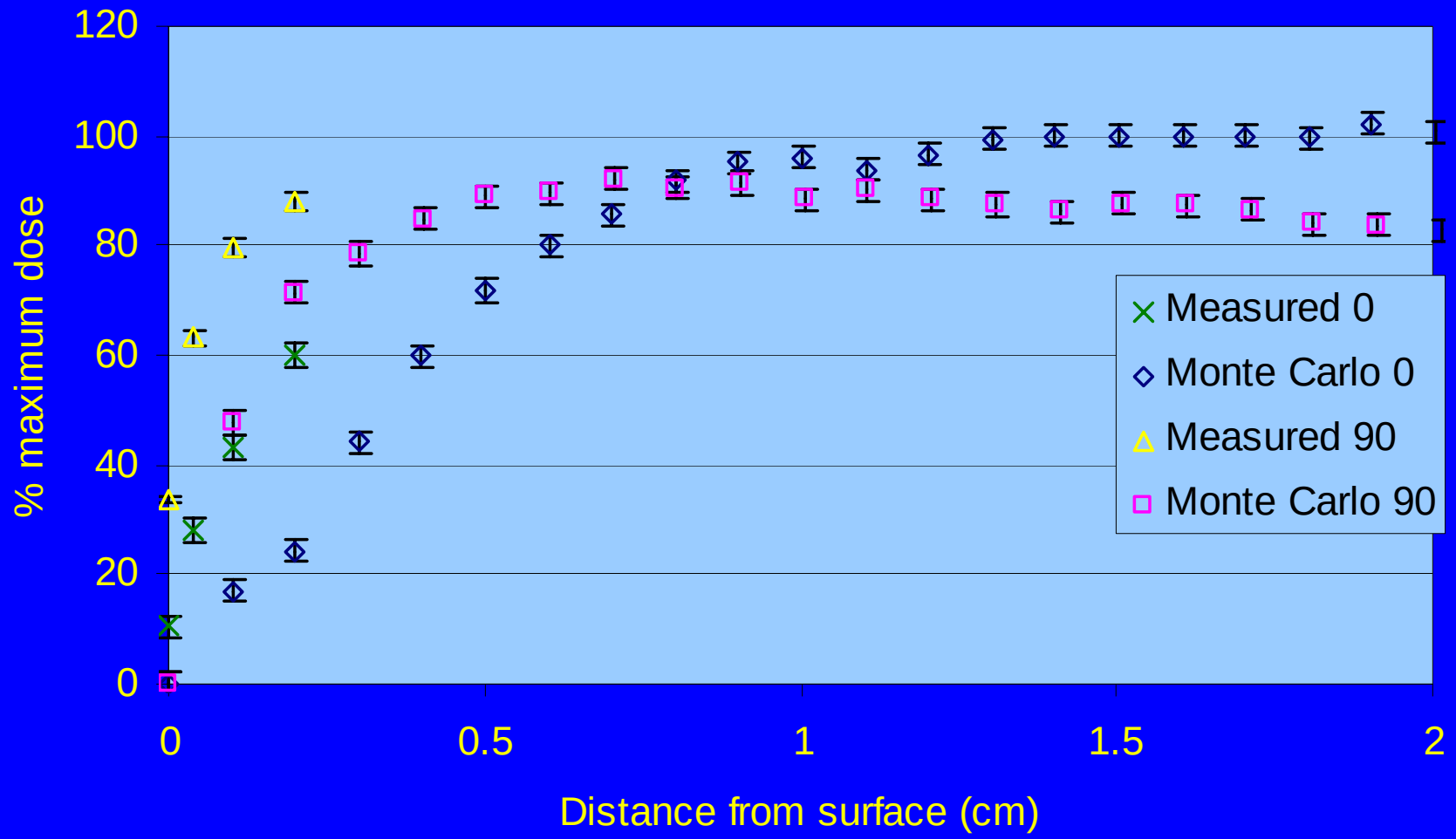


Results bottles Monte Carlo

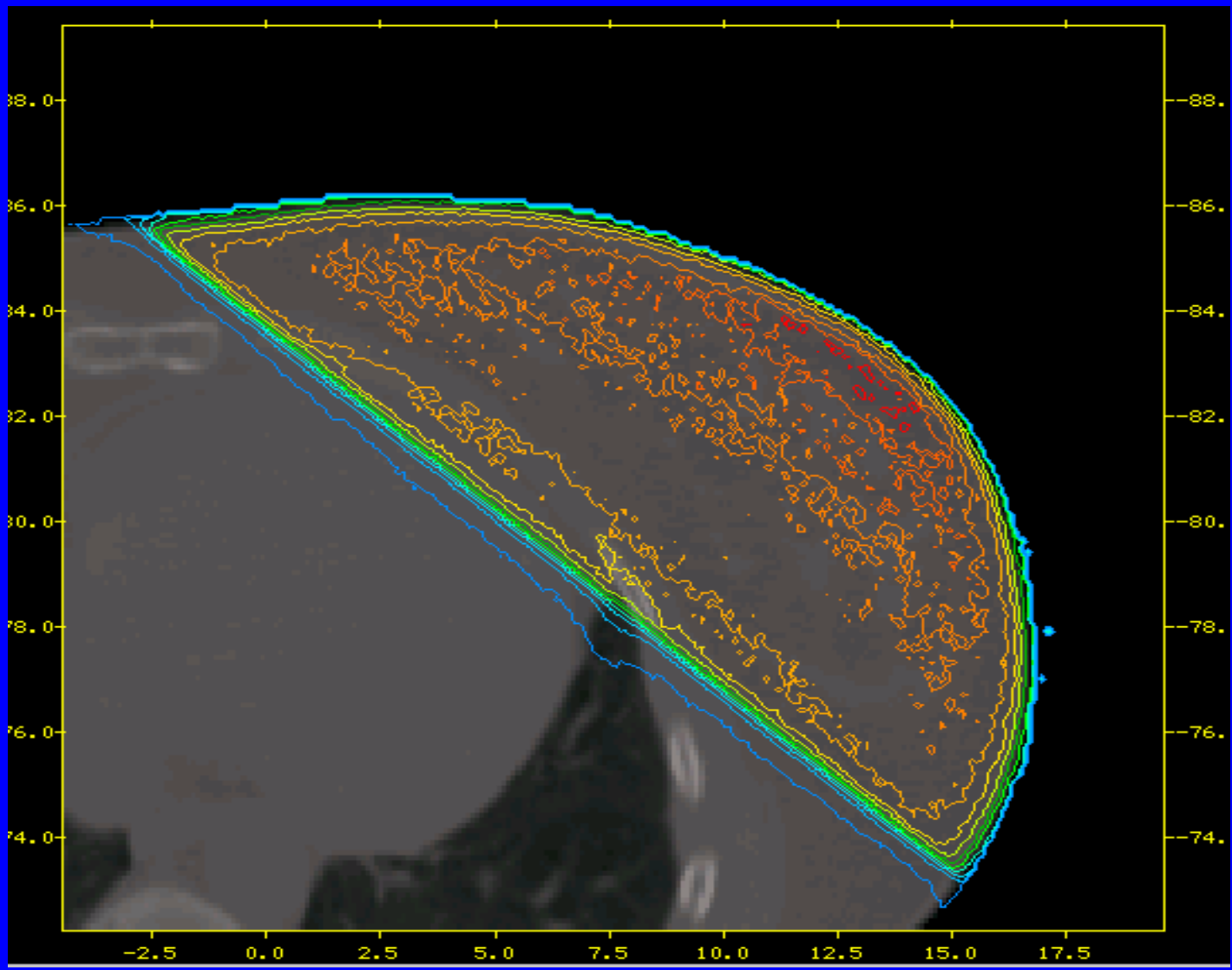




Results Monte Carlo vs gafchromic film



Results patients $1x10^{10}$ histories



Conclusions

- Good agreement has been found between measured and calculated doses for normal incidence
- Depth to maximum dose decreases as the angle of incidence is increased. This effect becomes marked when the angle of incidence is greater than 60°