



EBT film Update: Application in Small Fields and Proton Beam

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Small Field Dosimetry

Please attend special session on Thursday TH-A-213-0
TG-155 and IAEA code of practice

Evaluation of the Gafchromic® EBT2 film for the dosimetry of radiosurgical beams

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The results of this work show that the **EBT2** films are not suitable for the measurement of the total scatter factors for radiation field sizes less than 1.0 cm because there are significant differences with the SFD diode due to their potential energy dependence. Further work is required using Monte Carlo simulations to establish the impact of the film's active-layer composition on the dosimetry of small photon beams

EBT-Small Field

Effect of dosimeter type for commissioning small photon beams on calculated dose distribution in stereotactic radiosurgery

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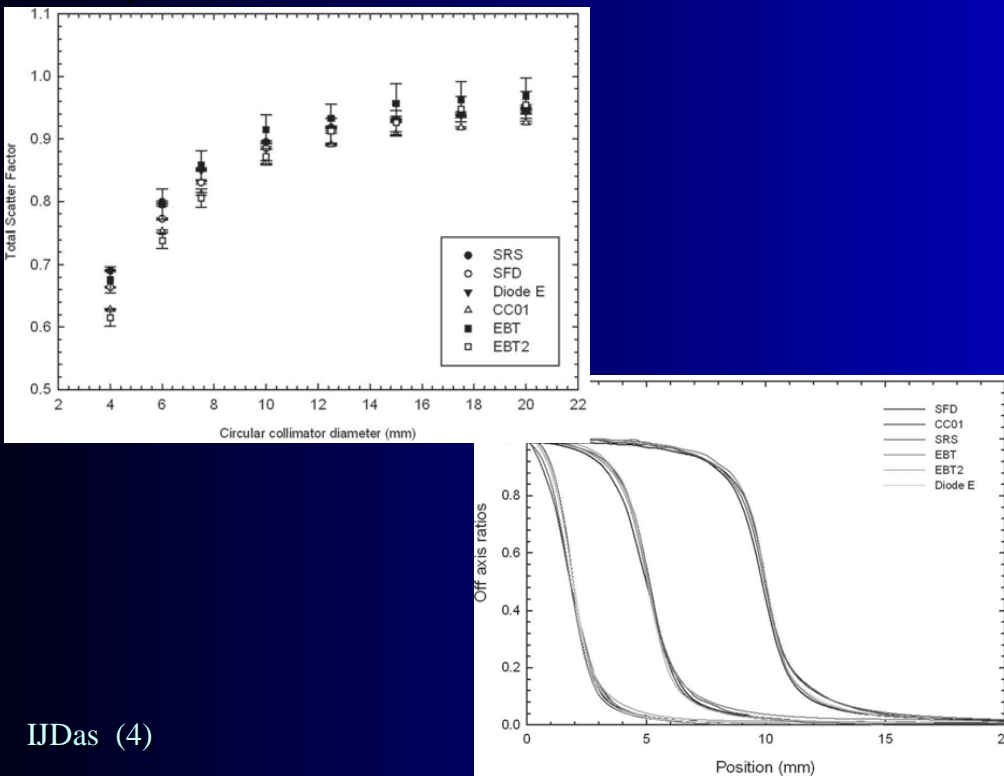
O. O. Galván de la Cruz

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Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada, Unidad Legaria, Instituto Politécnico Nacional, Legaria 694, México City 11500, México

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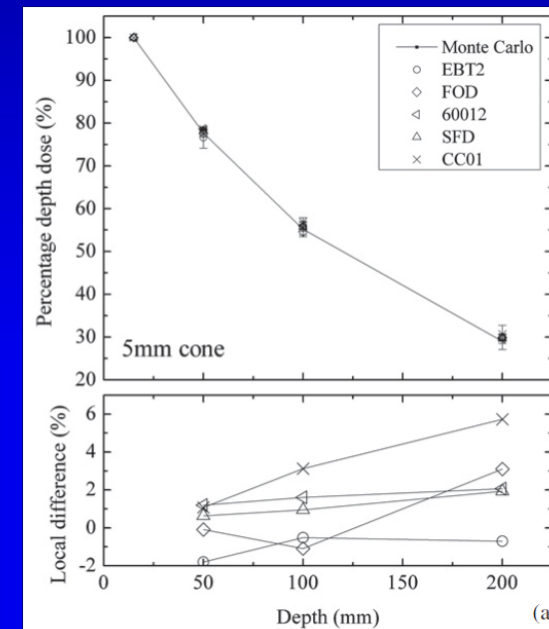
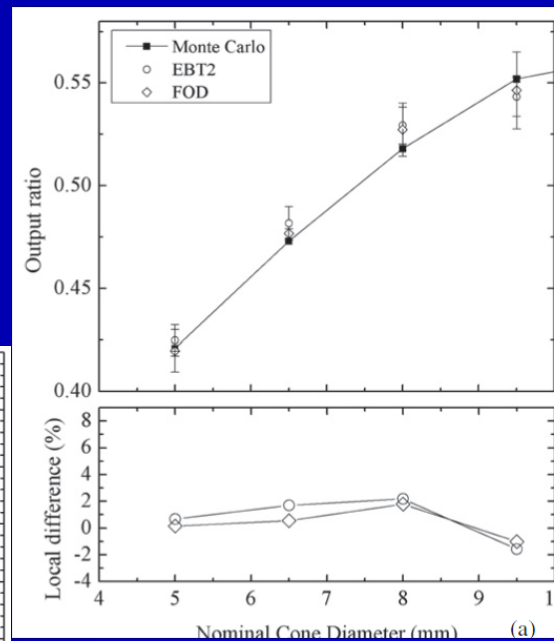
Characterization of small-field stereotactic radiosurgery beams with modern detectors

Madelaine Tyler¹, Paul Z Y Liu^{2,3}, Kin Wa Chan¹, Anna Ralston³, David R McKenzie², Simon Downes¹ and Natalka Suchowerska^{2,3}

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² School of Physics, University of Sydney, Australia

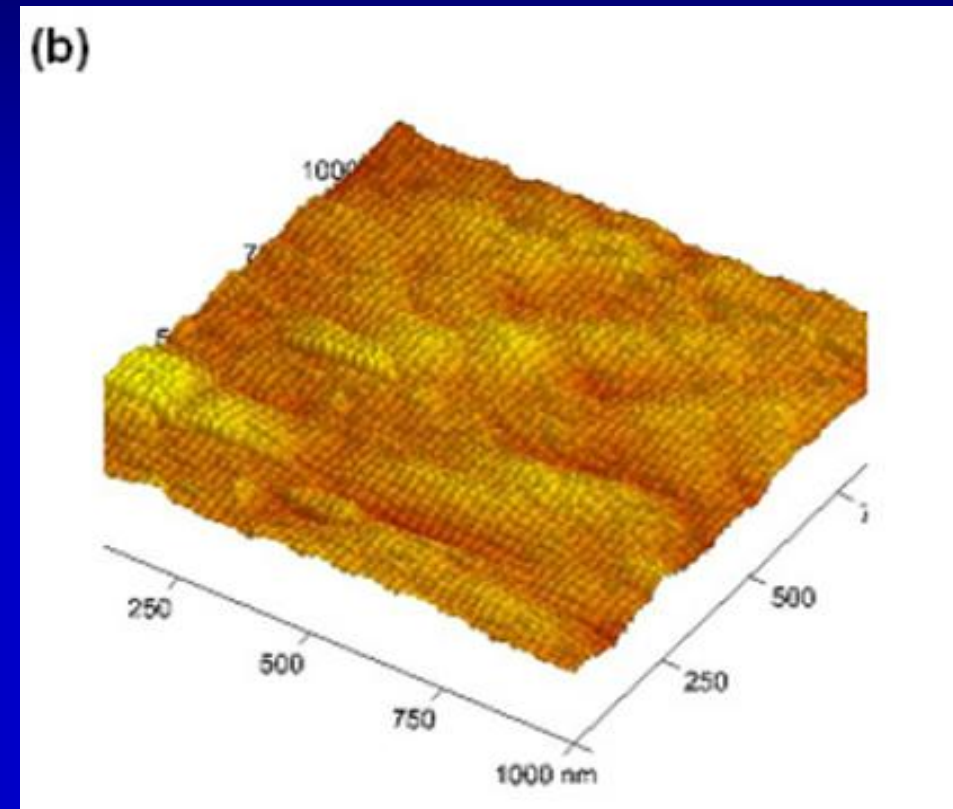
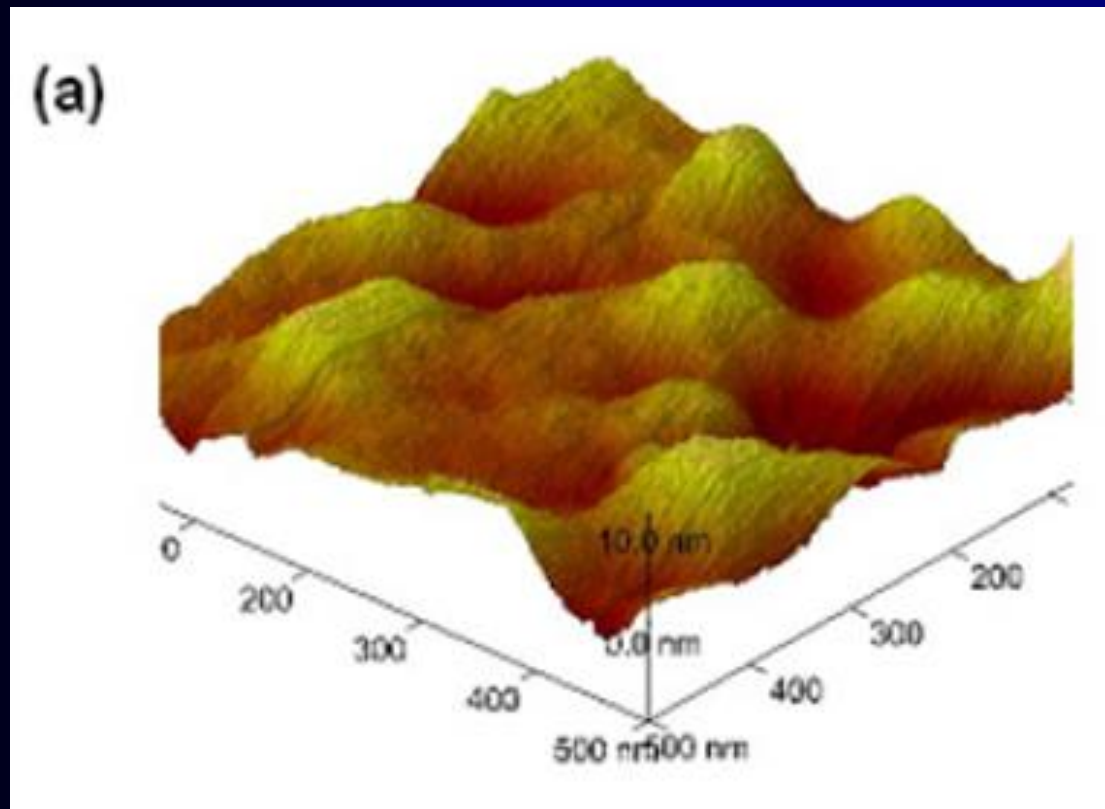
³ Department of Radiation Oncology, Royal Prince Alfred Hospital, Sydney, Australia





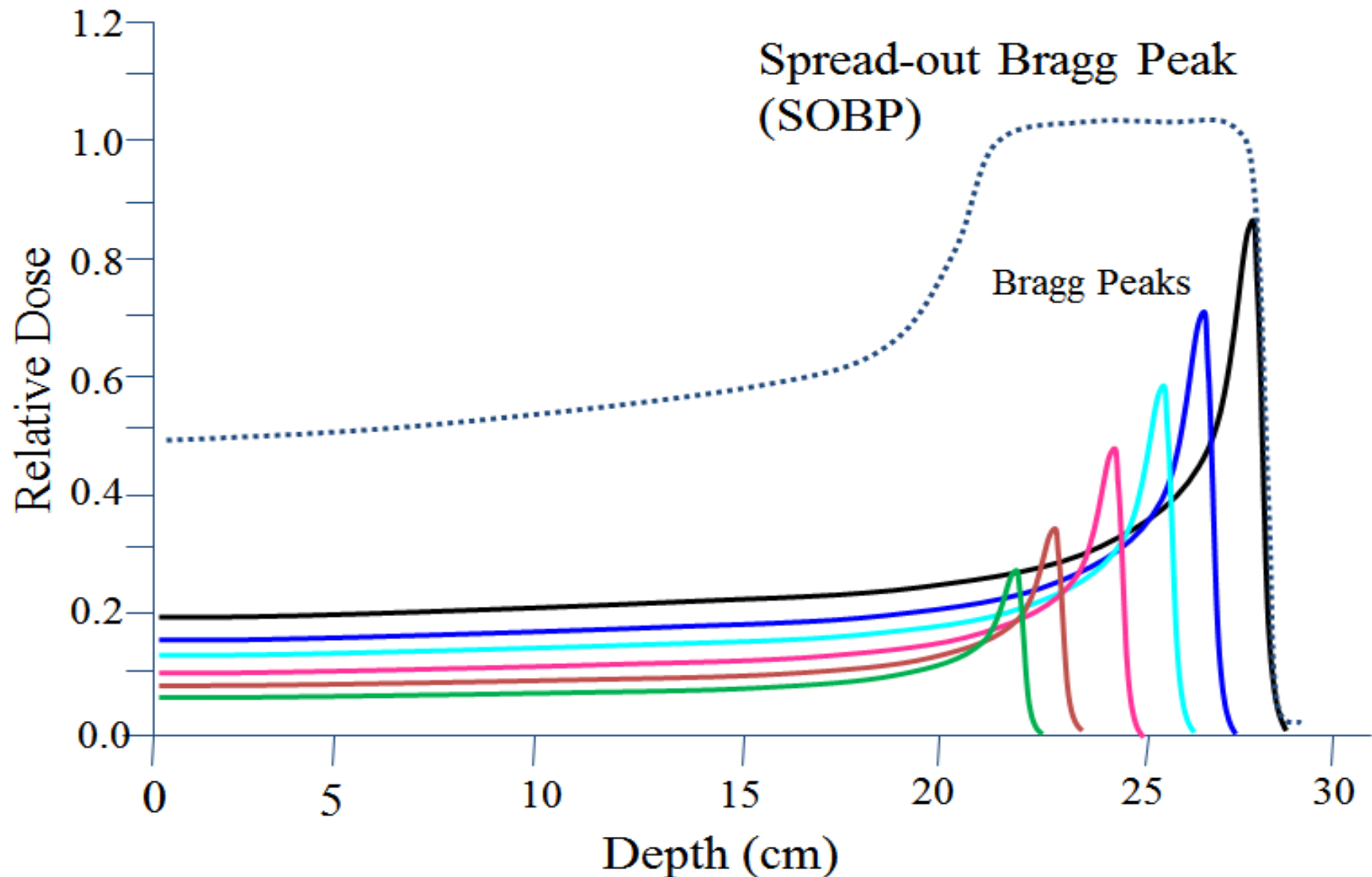
EBT Film-Proton Beam

Color Changes in Radiochromic Film: Polymerization

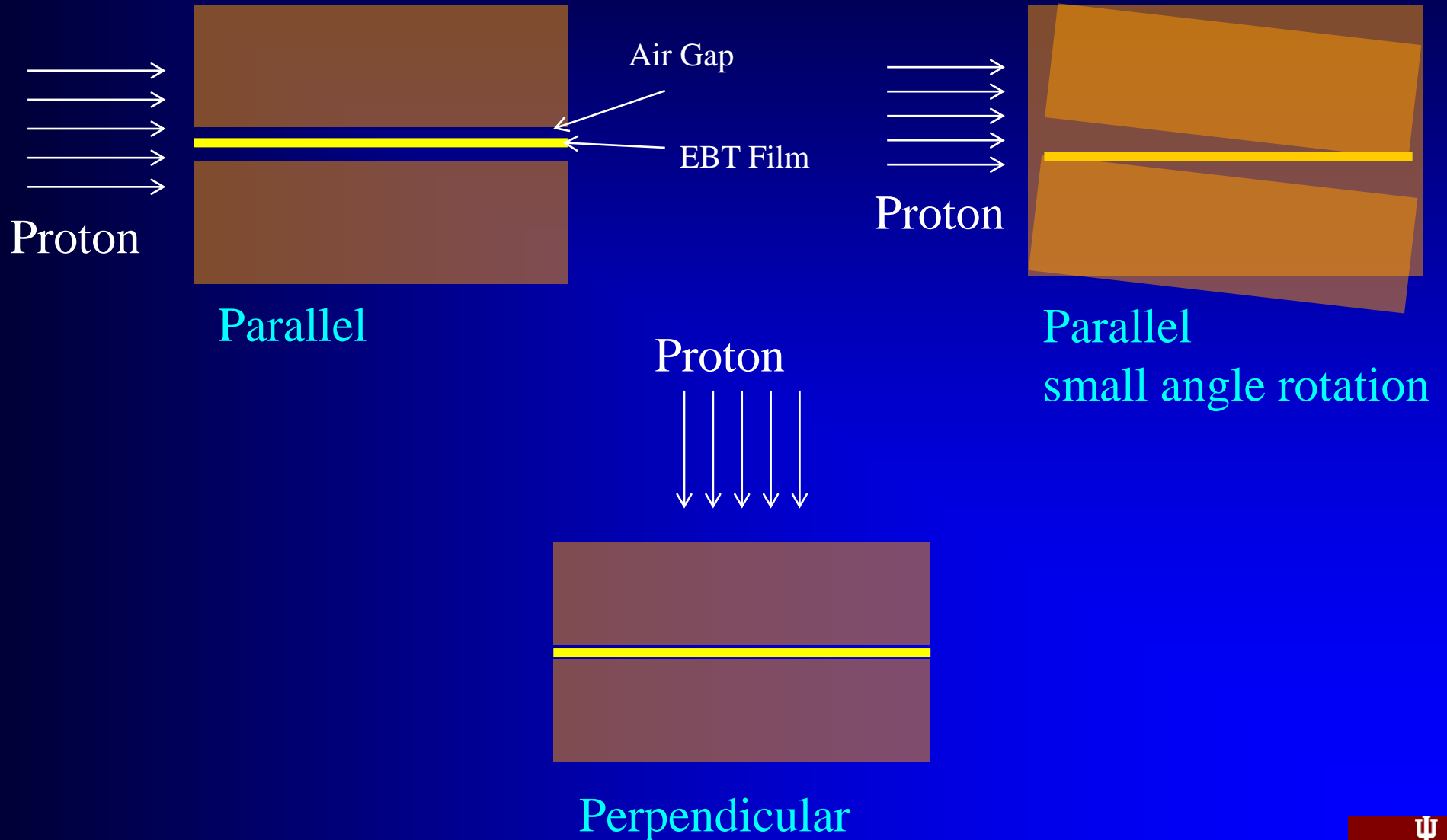


L. Zhao, L. Coutinho, N. Cao, C.W. Cheng, I.J. Das, IFMBE Proceedings **39**, 1164–1167 (2012)

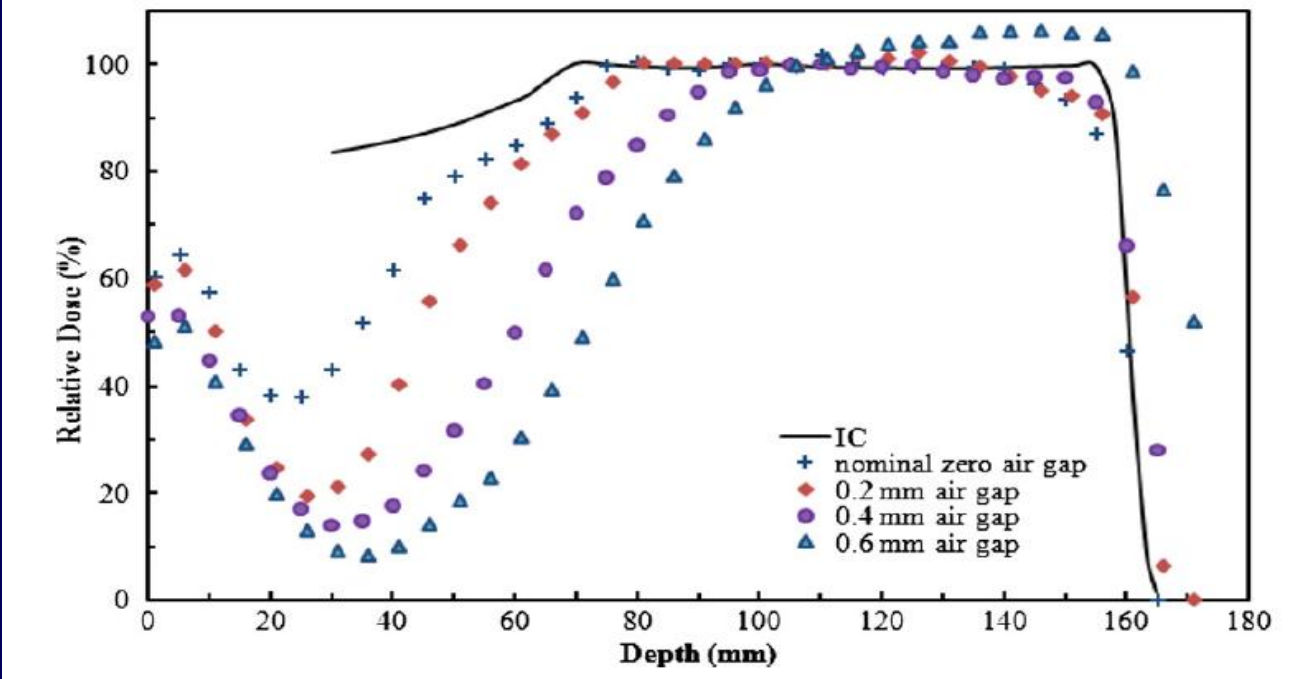
Energy Stacking in SOBP



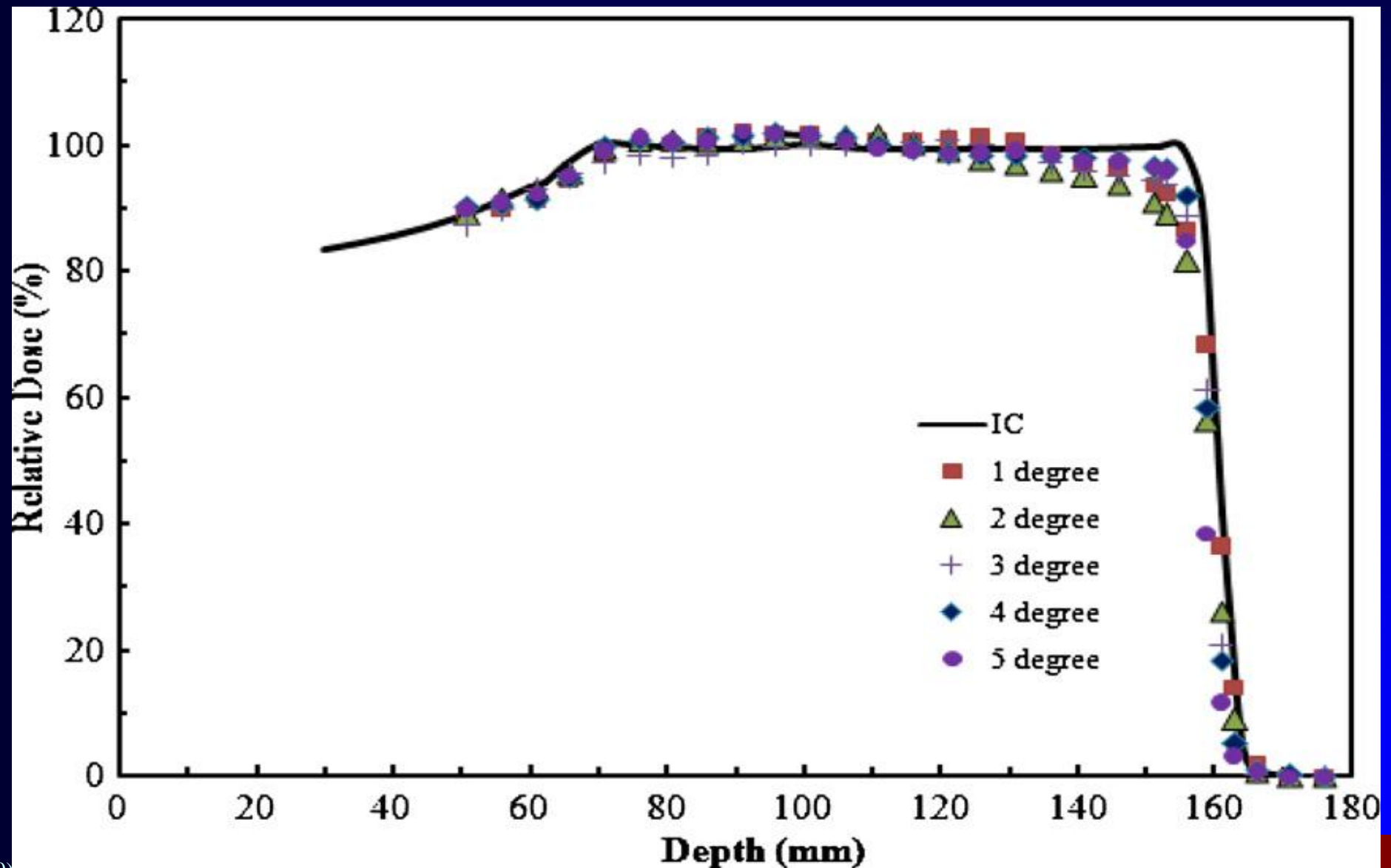
Film Orientations



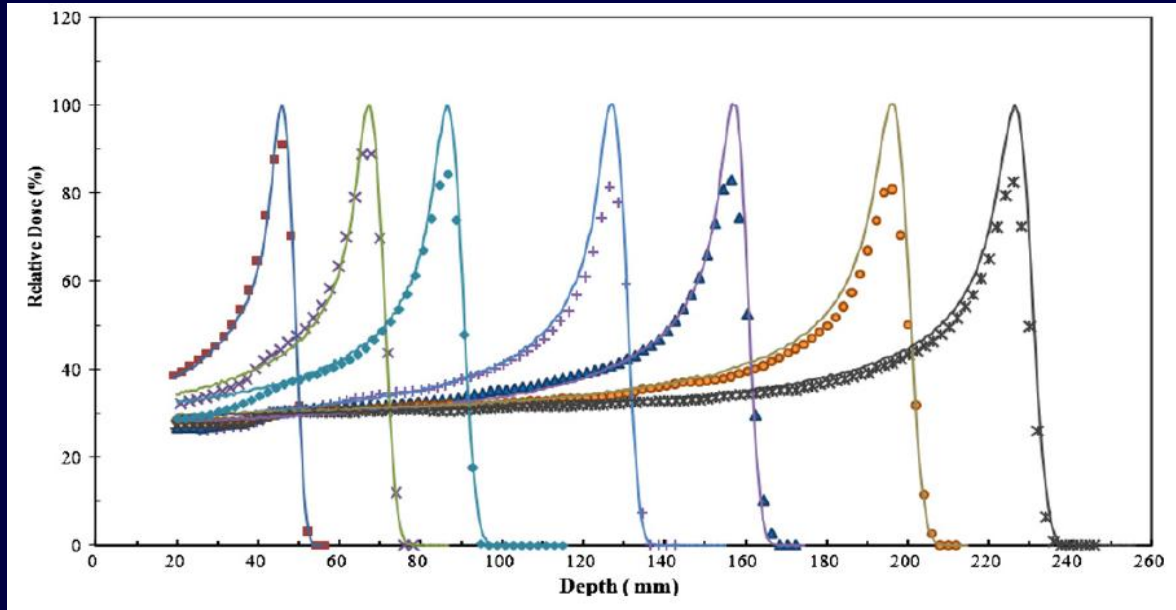
Air Gap: Proton



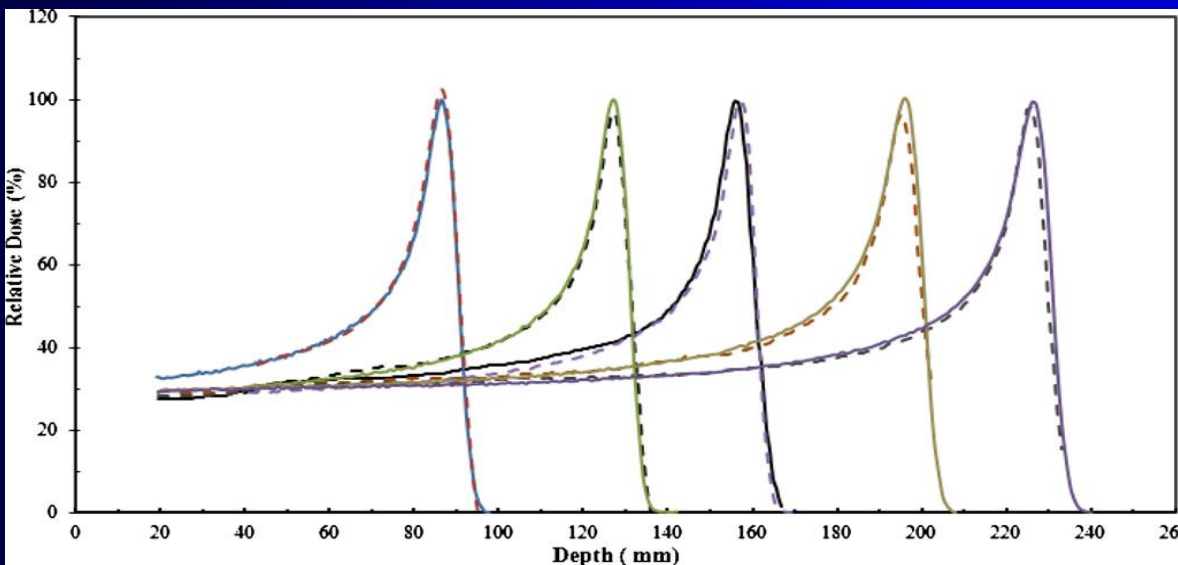
Angle: Proton



Proton Depth Dose

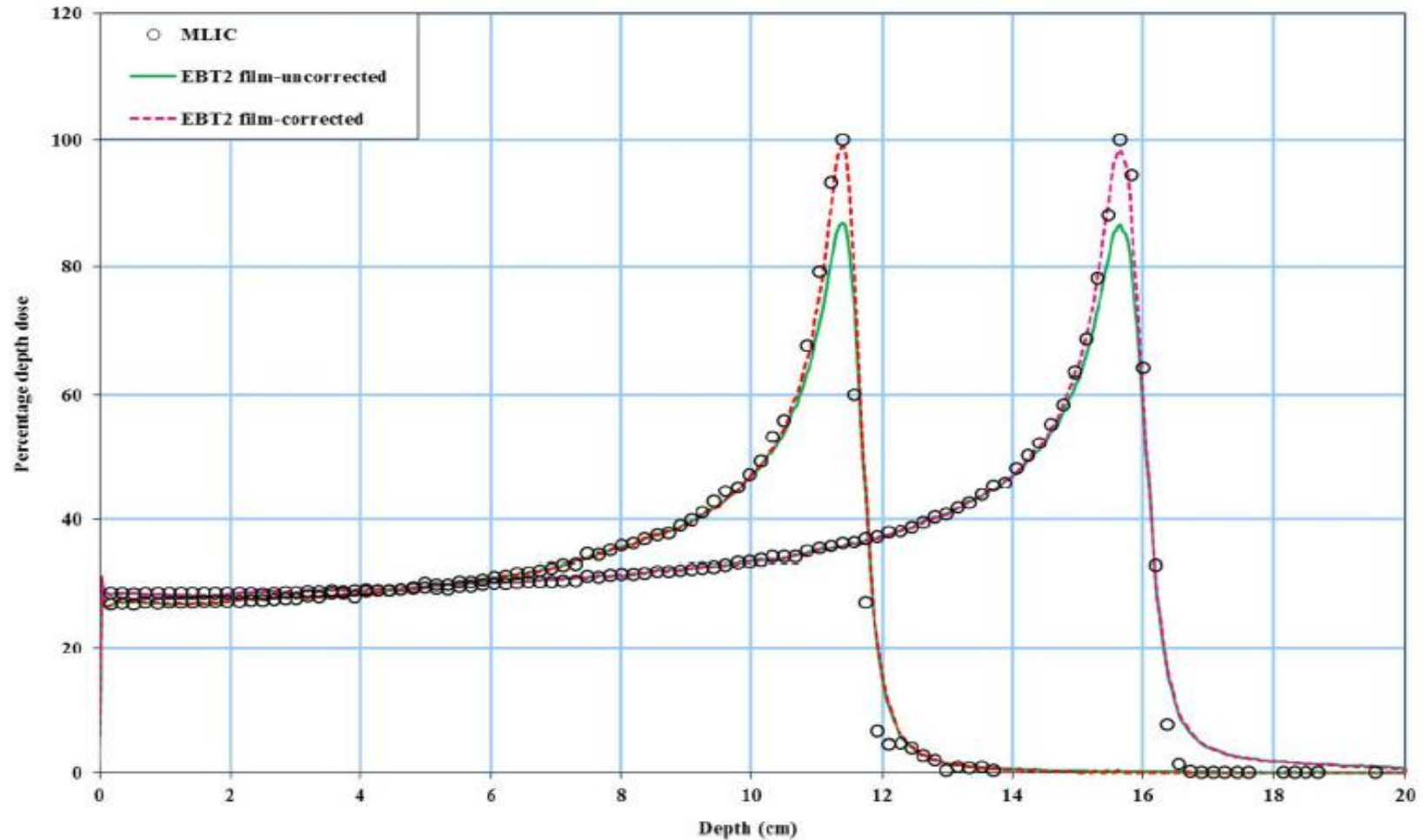


Uncorrected PDD,
Solid line ion chamber
Data Points - EBT



Corrected PDD,
Solid line ion chamber
Data Points - EBT

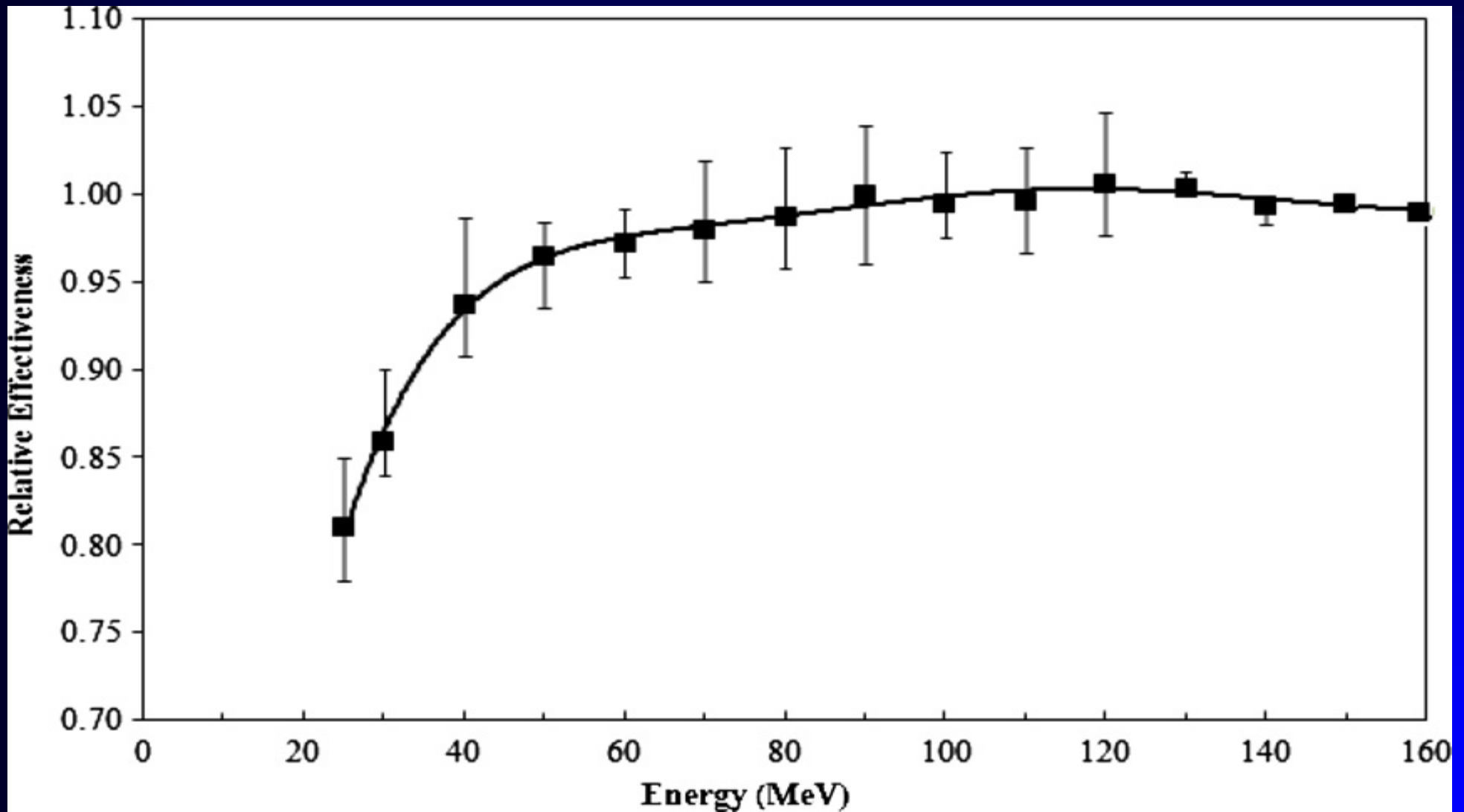
Proton Depth Dose



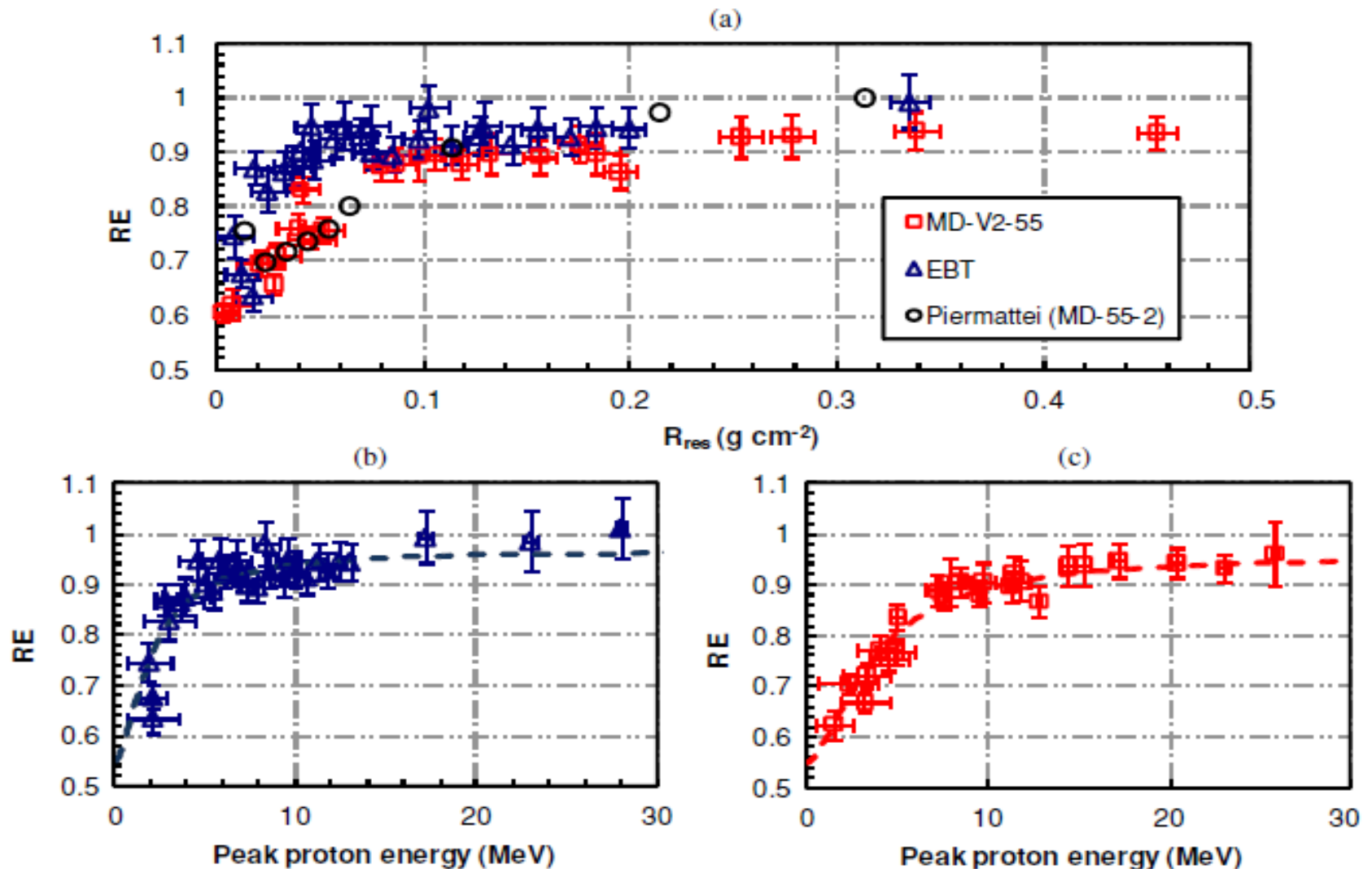
$$PDD' = PDD (K_0 + k_1 d + k_2 d^2 + k_3 d^3)$$

Arjomandy et al, Med Phys 39(2), 912-921, 2012

LET Dependence



LET Dependence : Low Energy Protons



Comparison of Range and Bragg Peak Dose: Ion-chamber, EBT films

Range (IC; film)	Bragg peak position (IC; film)	Relative effectiveness at the Bragg peak
4.74 cm; 4.71 cm	4.59 cm; 4.50 cm	0.92
6.90 cm; 6.87 cm	6.70 cm; 6.70 cm	0.91
8.87 cm; 8.85 cm	8.66 cm; 8.66 cm	0.85
12.88 cm; 12.91 cm	12.70 cm; 12.70 cm	0.82
15.88 cm; 15.85 cm	15.65 cm; 15.66 cm	0.83
19.80 cm; 19.77 cm	19.60 cm; 19.60 cm	0.81
22.83 cm; 22.78 cm	22.60 cm; 22.60 cm	0.82

Zhao & Das, Phys Med Biol, 55, N291-N301, 2010

Summary

- ❖ EBT response is variable with type, batch, age, lot size, air gap, angle, orientation, scanner readout- frequency, position and orientation
- ❖ Not suited for small field dosimetry except profile
- ❖ Parallel versus perpendicular film orientation provides different response and hence calibration and measurement should be performed in the same orientation
- ❖ Polymerization is time dependent; at least 12 hr post irradiation should be given or mathematical expression be applied for proton beam
- ❖ LET dependence should be properly accounted which is energy dependence

Sam Question # 1

In proton beam, EBT film response is dependent on

3%

A. Air gap

1%

B. Beam angle

2%

C. Range and location

2%

D. Scanner type

91%

E. All of above

Sam- Answer

Answer: E - all of above

Ref: Zhao & Das, Phys Med Biol, 55, N291-N301, 2010

Arjomandy et al, Med Phys 39(2), 912-921, 2012

Sam Question # 2

EBT film response is proton energy dependence due to;

- 23% A. Composition of medium and stopping power
- 3% B. Scattering power
- 66% C. LET
- 2% D. RBE
- 5% E. Multiple scattering

Sam- Answer

Answer: C- LET

Ref: Zhao & Das, Phys Med Biol, 55, N291-N301, 2010

Arjomandy et al, Med Phys 39(2), 912-921, 2012



Thanks