Detector choice for depth dose curves including the build-up region of small MV photon fields

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Motivation:

Traditional choice in build-up region?

Alternative in small fields?
Methods: Depth Dose Curves

- Measured with different detectors at 6 MV
- Ionization chambers with both polarities
- Gafchromic film at several depths
- With and without lead foil
Effective Point Of Measurement (EPOM)

- derived from comparison with reference curve (PPC40 @ 4 cm and 10 cm, PPC05 @ 2 cm)

Reference curve

Detector curve, shift = 0

Shift curve, renormalize

Quantify difference to reference

Obtain best shift: EPOM
Results: EPOM

Small ion chambers require EPOM < 0.5r

<table>
<thead>
<tr>
<th>Detector</th>
<th>z/r</th>
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</thead>
<tbody>
<tr>
<td>FC65</td>
<td>0.49 ± 0.01</td>
</tr>
<tr>
<td>FC23</td>
<td>0.45 ± 0.01</td>
</tr>
<tr>
<td>CC13</td>
<td>0.40 ± 0.01</td>
</tr>
<tr>
<td>CC04</td>
<td>0.36 ± 0.03</td>
</tr>
<tr>
<td>CC01</td>
<td>0.36 ± 0.04</td>
</tr>
<tr>
<td>CC003</td>
<td>0.30 ± 0.04</td>
</tr>
</tbody>
</table>
Results: Volume Averaging Effects

- Due to lateral detector dimensions, neglecting height
- $k_{\text{Vol,lateral}} < 1\%$ for radii $< 3 \text{ mm}$
Results: Polarity effects

- heavily influence the signals of small ion chambers near the surface
Detector Choice 1

- Ion chambers @ larger fields

(m) PPC40

(h) FC23

(i) CC13

- Small ion chambers @ smaller field sizes

(k) CC01

(l) CC003
Detector Choice II

- Diode response depends on type
  - (a) Diode 60012
  - (d) Diode 60008
  - (c) SFD
  - (g) microDiamond 60019

- microDiamond possible choice
Summary

- No perfect detector for build-up region!

- Plane-parallel or cylindrical ion chambers down to 4 cm

- Type-dependent diode response in build-up and at depth

- microDiamond typically requires small corrections

- EPOM < 0.5r for ion chambers depending on type

- Averaging between polarities for small chambers

- Best practice: using several detectors with small corrections
Thank you for your attention!