Intercomparison study on small field output factor measurements

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Outline

- Why small field dosimetry?
- Detectors suitable for small field dosimetric parameters
- Experimental set-up
- Results and discussion

Why small field dosimetry?

- The term “small field” is a relative term but it is generally accepted to be any field size of 4x4cm2 or smaller
- Small fields are increasingly employed in modern radiotherapy.
  - High doses to small volume
  - Subdivision of larger radiation fields into smaller field segments (IMRT & VMAT)
  - Non-uniform dose distribution (SIB technique)
- Accurate dosimetry becomes more important to ensure the absolute dose

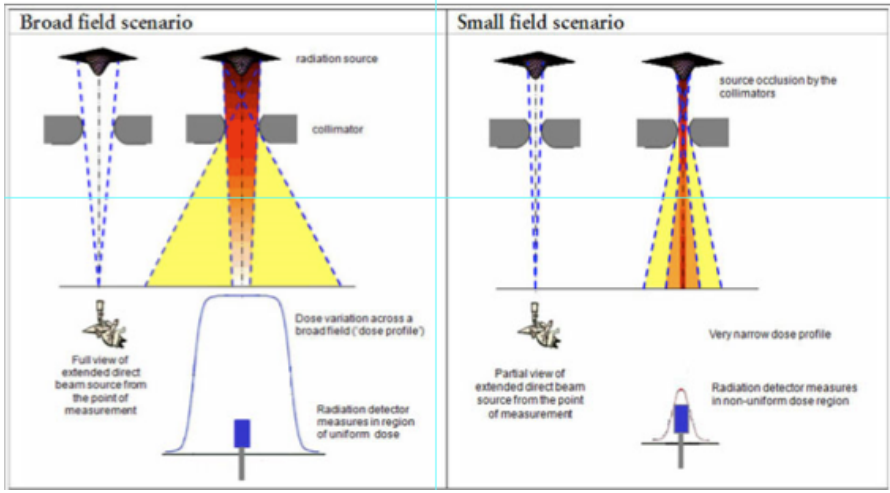
Why small field dosimetry?

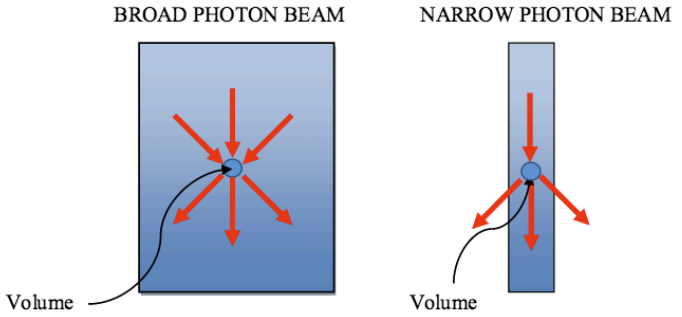
Small field condition are present when:

1. collimating devices block the full view of the direct beam photon source

2. Loss of charge particle equilibrium occurs

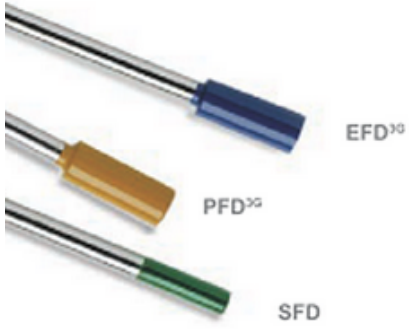
3. Volume averaging causes a reduction in the measured signal produced by detetctors that are large in comparison to the radiation field

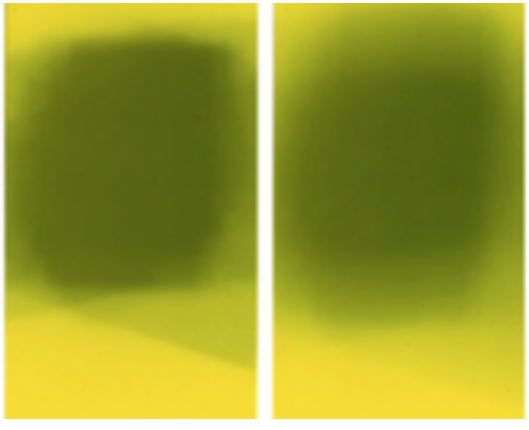




Detectors suitable for small field dosimetric parameters

Requirements: **high spatial resolution**, **response independent** of the **dose rate**, of the **energy**, **fast**, **stable in time**, with a **good linearity, high dynamic range** and **radiation hardness**.





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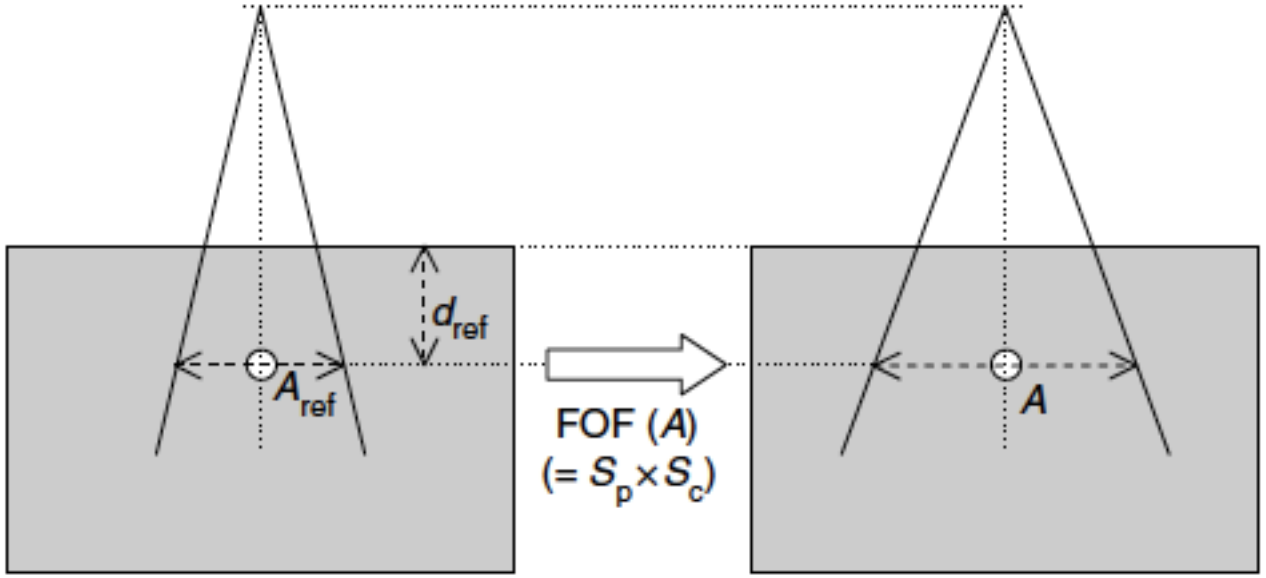

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- The output factor of a radiation field is defined as the ratio of the absorbed dose in water at a point located at the isocentre for the given field, relative to that at the same point in the reference field. I
- In small fields, the measurement of the output factor is subject to large uncertainties

Detectors

- Diamond detector PTW (active volume 0,004mm$^{3)}$
- Silicon diode IBA (active volume 0,28mm^3)
- Plastic scintillator w1
- A1SL Ionization chamber (active volume 57 mm^3)
- A26 Ionization chamber (active volume 7 mm^3)
- Gafchromic film EBT3

Output Factor set-up

- Synergy BM 6MV
- SSD=90 cm; depth in water phantom= 10 cm
- field sizes (cm): 0.8×0.8 , to, 10.4x10.4
- field size check by inplane and crossplane profiles
  (maximum deviation within 1mm/2% for fields> 3cmx3cm and 0.5mm for fields ≤3cmx3cm)

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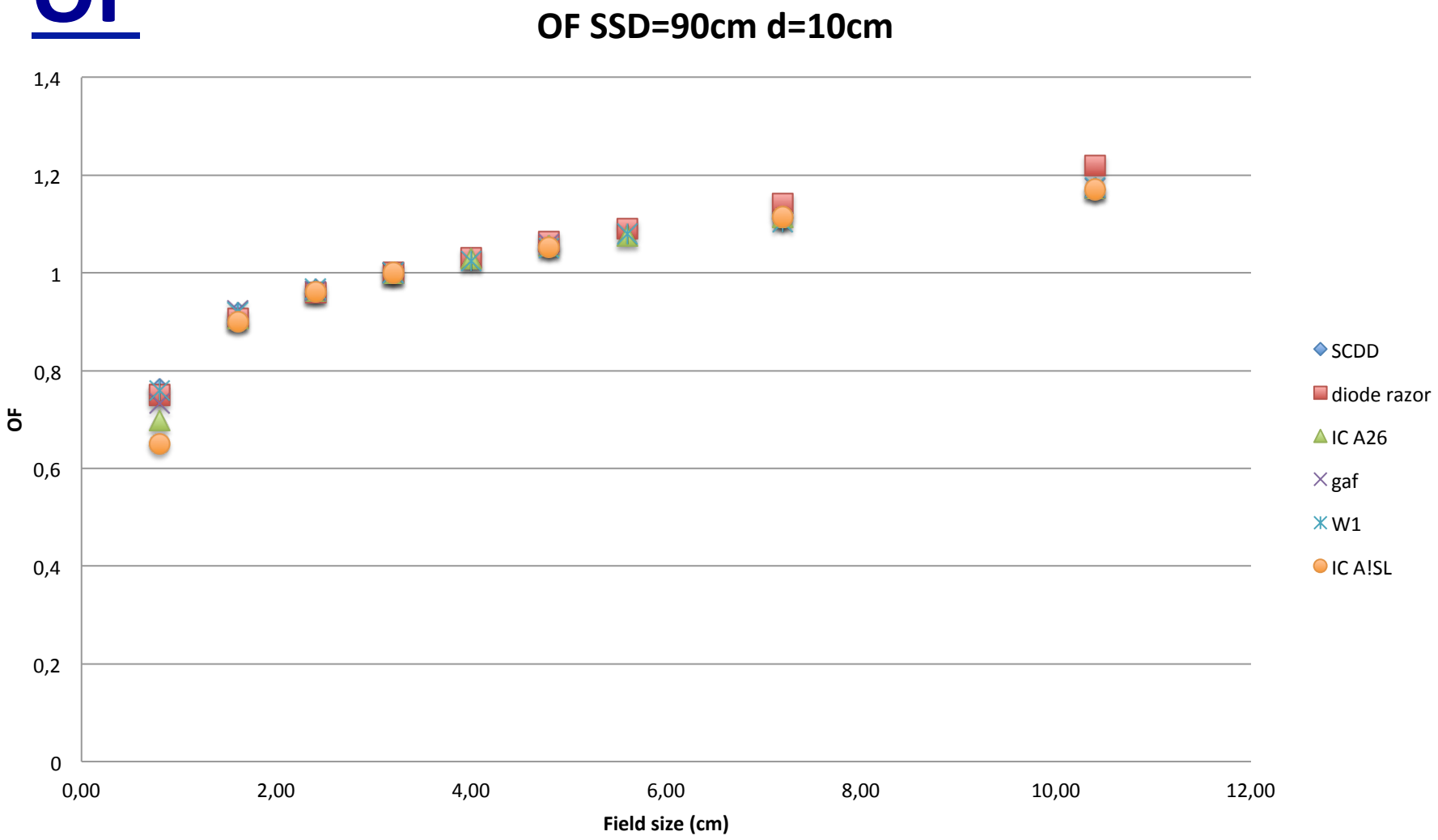
OF SSD=90cm d=10cm
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6,00
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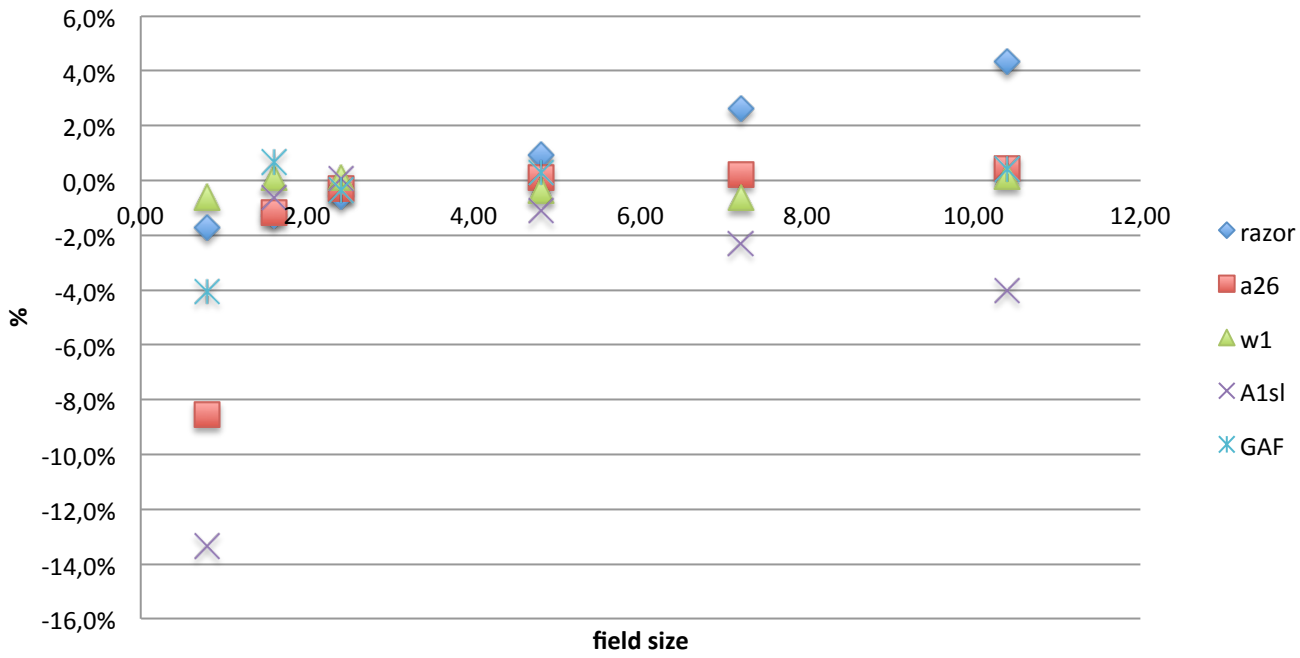
Field size (cm)
SCDD
diode razor
IC A26
gaf
W1
IC A!SL

Relative difference respect to diamond OF



Conclusion

- The measurement of dose with sufficient accuracy for contemporary clinical practice in fields of small size, is challenging.
- OF measurements, performed up to 0.8mm field width, show that diamond, gaf and scintillator dosimeters are good candidaties for this kind of measurements and silicon diode works well from 0.8 to 30mm field size while the smallest IC can be used up to 10mm field size.

THANKS!