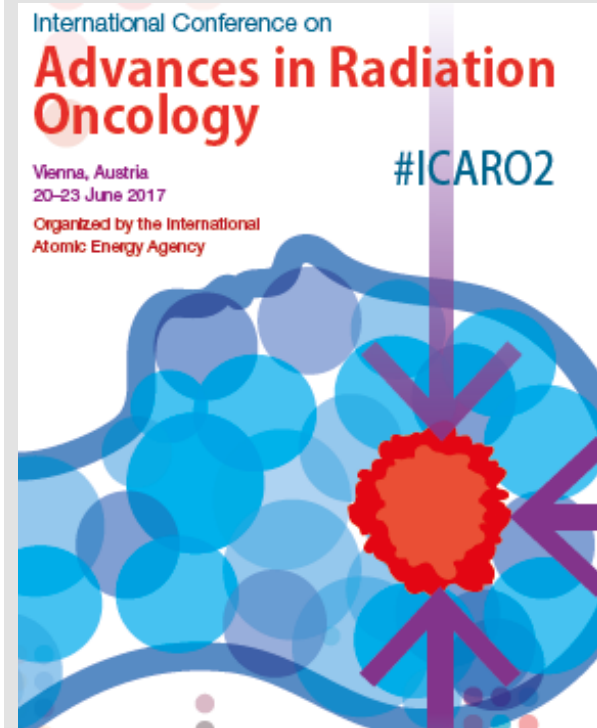


# Application of output correction factors for three small beam radiation detectors: comparison of results for a TrueBeam STx linac



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# Purpose

- To compare and analyze the corrected out factors resulting from three different radiation detectors for small fields of a TrueBeam STx<sup>®</sup> linac

$$\Omega_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}} = \frac{M_{Q_{clin}}^{f_{clin}}}{M_{Q_{msr}}^{f_{msr}}} k_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}}$$

$$\Omega_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}} = \left[ \frac{M_{Q_{clin}}^{f_{clin}}}{M_{Q_{int}}^{f_{int}}} k_{Q_{clin}, Q_{int}}^{f_{clin}, f_{int}} \right]_{det} \left[ \frac{M_{Q_{int}}^{f_{int}}}{M_{Q_{msr}}^{f_{msr}}} k_{Q_{int}, Q_{msr}}^{f_{int}, f_{msr}} \right]_{IC}$$

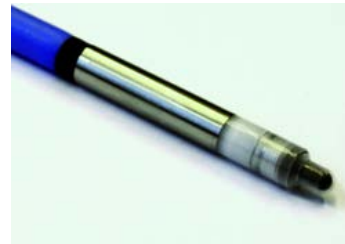
# Materials

- Linear accelerator: TrueBeam STx<sup>®</sup>
- Photon Beam Energy: 6 MV
- Intensity Mode: **6X** (6 MV WFF)
- Medium: Liquid water
- Phatom: MP3-M (PTW-Freiburg, Germany)
- Detector irradiation setup:
  - SSD= 90 cm
  - Depth = 10 cm
- Field sizes defined by the jaw collimators: 0.5, 1.0, 2.0, 3.0, 4.0 y 6.0 cm<sup>2</sup>
- Reference field size used: 10 cm x 10 cm



# Detectors

	PinPoint 3D (PP 3D)	IBA-SFD (SFD)	microDiamond (CVD)
Manufacturer	PTW-Freiburg	IBA-Dosimetry	PTW-Freiburg
Model	PTW-31016	SFD	PTW-60019
Sensitive Material	Air	Silicon	Carbon (synthetic diamond)
Diameter of the sensitive volume	2.9 mm	0.6 mm	2.2 mm
Thickness of the sensitive volume	2.9 mm	60 $\mu\text{m}$	1 $\mu\text{m}$



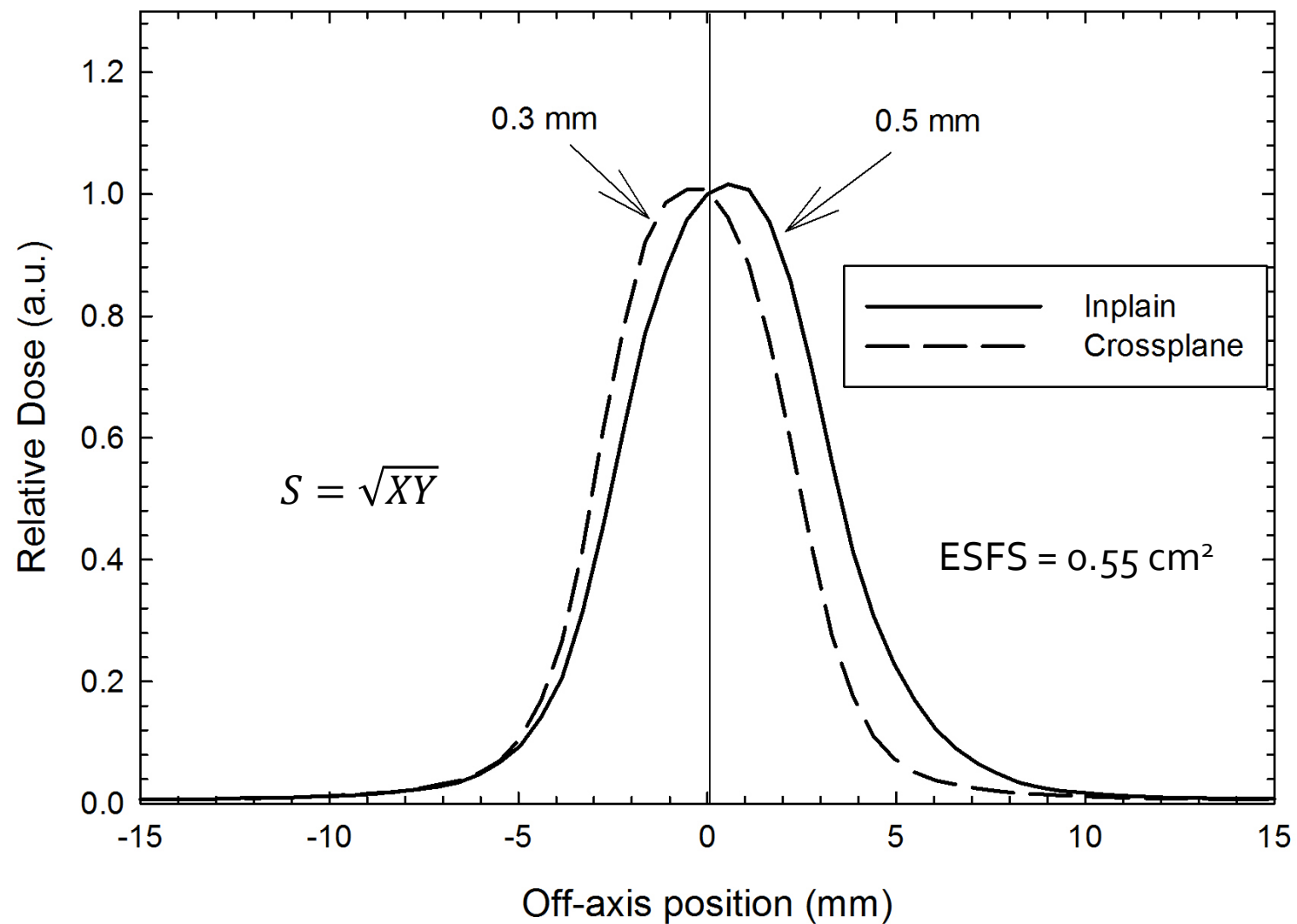
# Methods

- Detector orientation relative to the beam axis:

PinPoint 3D	IBA-SFD	microDiamond
Perpendicular	Parallel	Parallel

- Profile measurements:
  - Detector alignment
  - Field size determination
- Determination of output correction factors from tables from the detector, modality, energy and field size

# Detector Alignment & Field Size

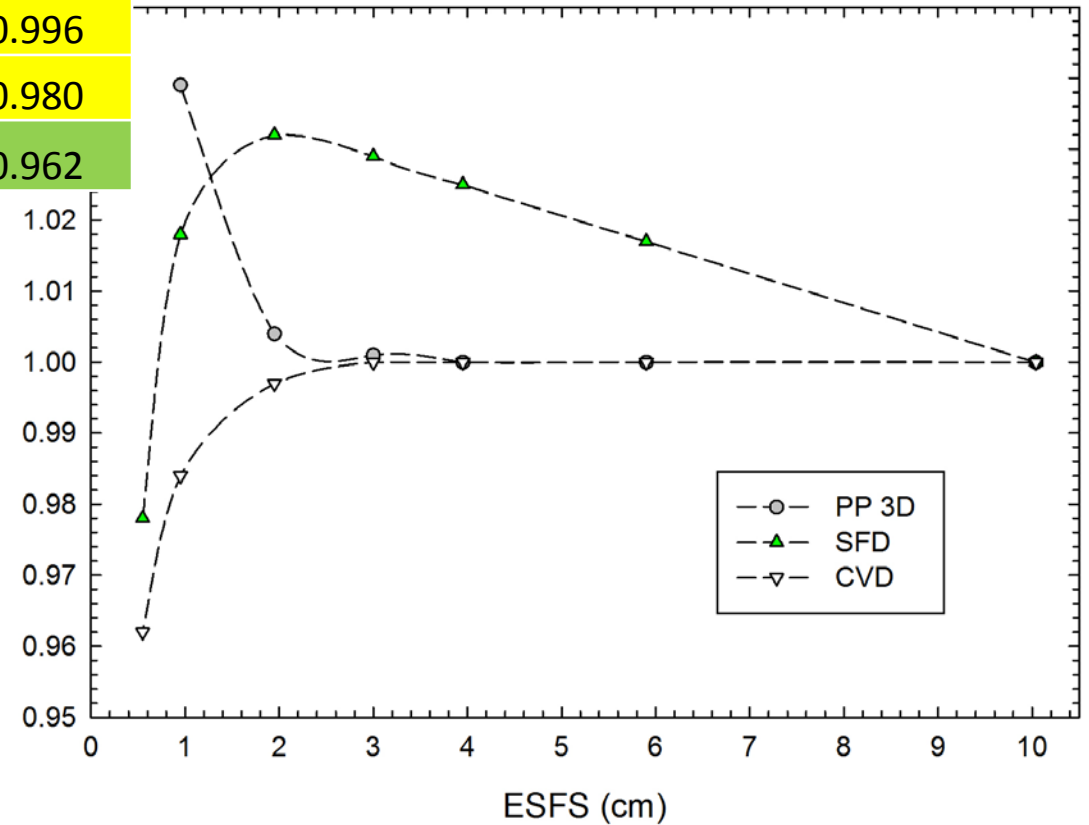


# Output correction factors

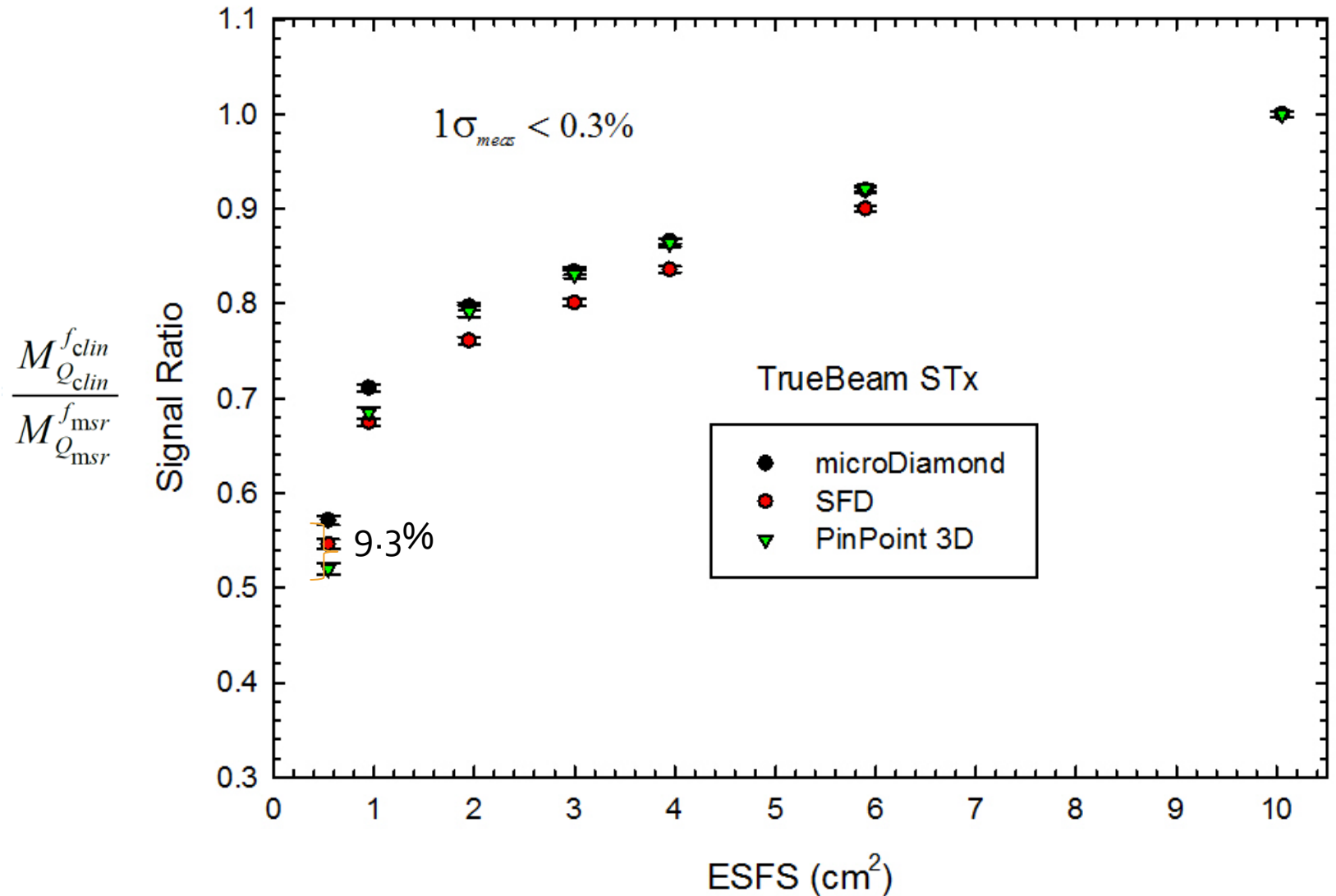
ESFS	PP 3D	SFD	CVD
5.90	1.000	1.017	1.000
3.95	1.000	1.024	1.000
3.00	1.001	1.029	1.000
1.95	1.006	1.032	0.996
0.95	1.051	1.013	0.980
0.55	NA	0.978	0.962

	1σ
	<0.5%
	<1.0%
	<3.0%

$$k_{fref, Qref}^{fclin, Qclin}$$



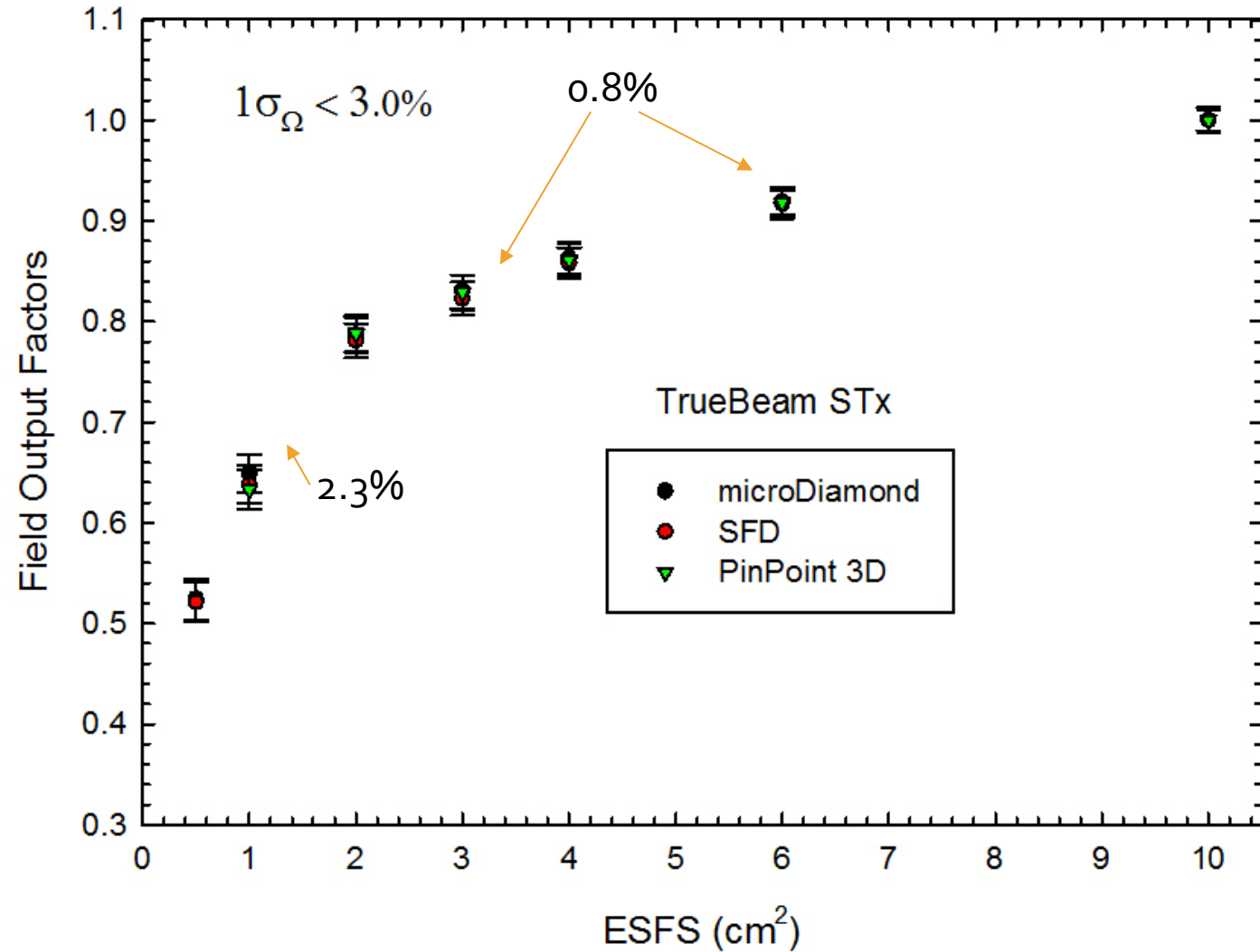
Signal ratio  
(uncorrected  
output factors)





# Corrected output factors

$$\Omega_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}} = \frac{M_{Q_{clin}}^{f_{clin}}}{M_{Q_{msr}}^{f_{msr}}} k_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}}$$



# Comparison of Daysi-Chain results

ESFS (cm <sup>2</sup> )	microDiamond	SFD
	Int = 4 cm	
3.00	0.3%	0.4%
1.95	0.3%	0.3%
0.95	0.1%	0.4%
0.55	0.3%	0.7%

$$\Omega_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}} = \left[ \frac{M_{Q_{clin}}^{f_{clin}}}{M_{Q_{int}}^{f_{int}}} k_{Q_{clin}, Q_{int}}^{f_{clin}, f_{int}} \right]_{det} \left[ \frac{M_{Q_{int}}^{f_{int}}}{M_{Q_{msr}}^{f_{msr}}} k_{Q_{int}, Q_{msr}}^{f_{int}, f_{msr}} \right]_{IC}$$

$$\left[ k_{Q_{clin}, Q_{int}}^{f_{clin}, f_{int}} \right]_{det} = \frac{\left[ k_{Q_{clin}, Q_{msr}}^{f_{clin}, f_{msr}} \right]_{det}}{\left[ k_{Q_{int}, Q_{msr}}^{f_{int}, f_{msr}} \right]_{det}}$$

# Conclusions

- A set of field factors were determined for a TrueBeam STx<sup>®</sup> linear accelerator with a 6 MV photon beam and WFF
- The output correction factors from TRS-483 were used for microDiamond, IBA-SFD and PinPoint 3D detectors
- In overall, the field factors show an excellent agreement better than 0.8%
- The nominal field of 1.0 cm<sup>2</sup> shown the biggest differences up 2.3%. These differences are between the uncertainties of the field factors, but further research is required
- The comparison between direct and daisy-chained output factors are < 0.7%