

# RESULTS OF A NATIONAL SMALL FIELD FILM AUDIT

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# Importance of audits

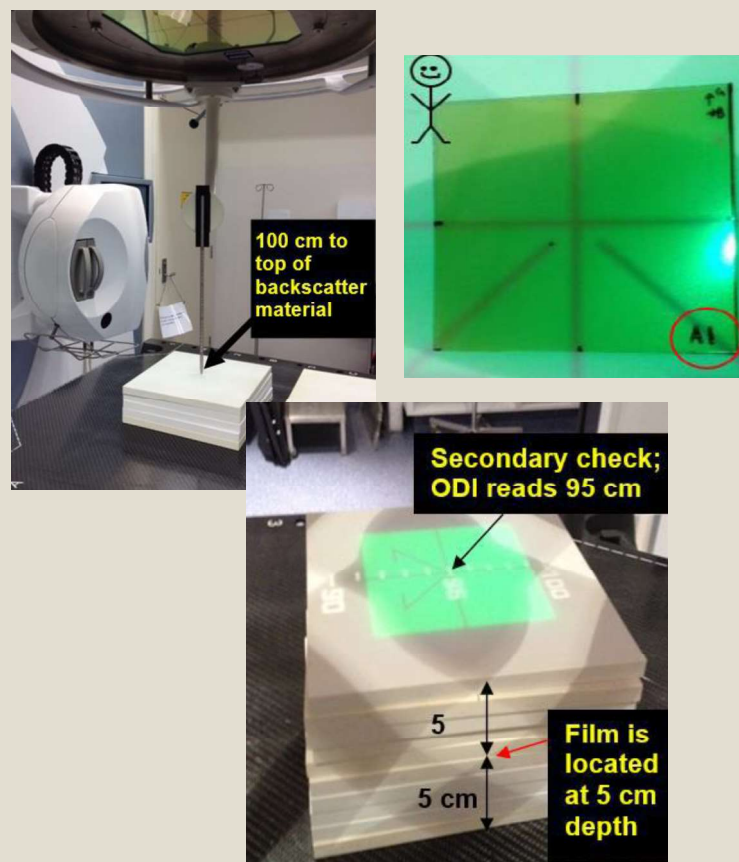
- *“Regular external auditing of delivery accuracy is important for maintaining consistency of practice across different radiotherapy centres and thereby ensuring that reported outcomes are correlated with accurate dose predictions.”*
- Motivations for this study:
  - *To observe variations in small field output factors*
  - *To test for any systematic variation between nominal and delivered field sizes for any given collimator system (for small fields)*
- Why small fields? Small variations in leaf position result in large dose differences

# Systems included

Beam Production	Energy	Collimator	# machines
Elekta	6X	Agility (5 mm leaf width)	6
	6X	Apex (2.5 mm leaf width)	1
	6X FFF	Agility	1
Varian iX Series	6X	M120 (5 mm leaf width)	6
(including Trilogy, Novalis)	6X	HD120 (2.5 mm leaf width)	4
	6X	m3 (3 mm leaf width)	2
	6X-SRS	M120	1
	6X-SRS	HD120	1
	6X-SRS	M3	1
	6X-FFF	HD120	3
Varian TrueBeam	6X	M120	3
	6X	HD120	2
	6X-FFF	M120	3
	6X-FFF	HD120	2

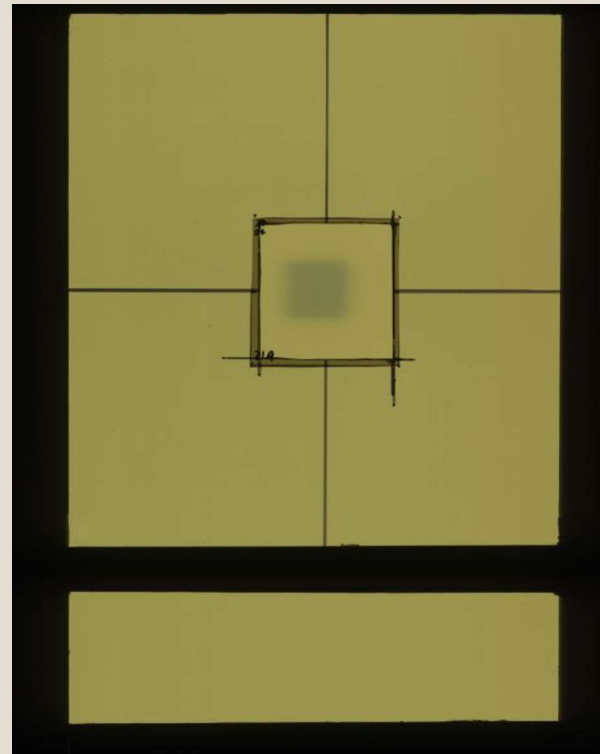
# Audit instructions

- 1 page of instructions and 1 page of photos
- Prescribed setup:
  - 95 cm SSD, 5 cm buildup, backscatter
  - approx. 120 cGy
  - 6 fields: 10×10, 3×3, 1×1 (twice), and 0.5×0.5 (twice) cm<sup>2</sup>
- 1 cm slab of RW3 sent to be placed immediately upstream of the film
- Spare film included, for control and to allow for errors (total of 6 used)



# Scanning the film

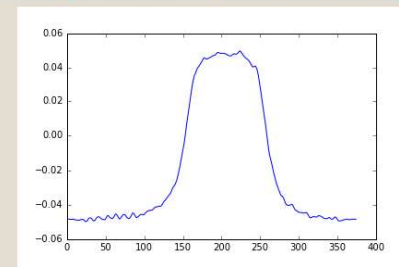
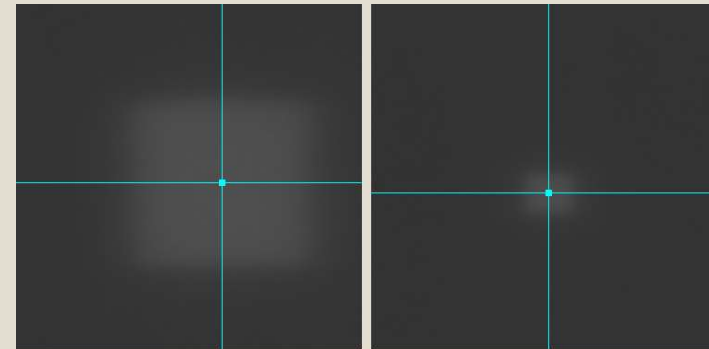
- Scanned on Epson V800
- Film pieces individually scanned in frame
- 420 pieces, with calibration pieces scanned multiple times
- 20 point netOD calibration, for 0-2 Gy
- Corrected for variations in scanner output



# Processing the results

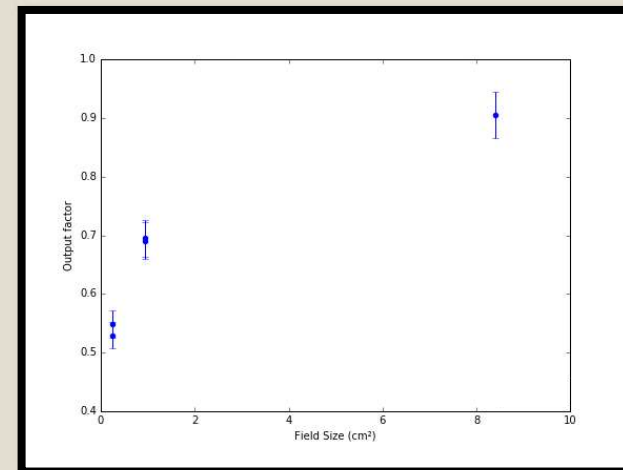
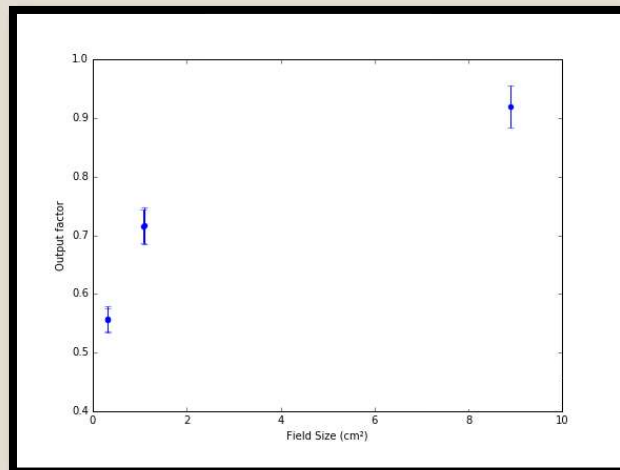
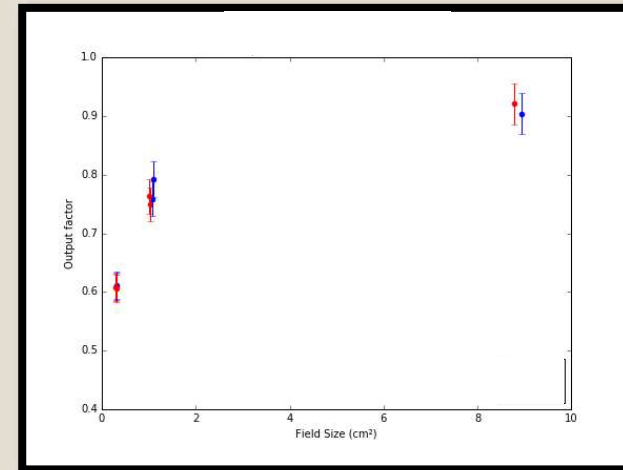
- Python used to automate processing of results
- Centre of field detected using a centre of mass function, FWHM extracted for field size information
- Output factors calculated
- Uncertainty calculated as

$$\sigma_{total} = \sqrt{\sigma_{fit}^2 + \sigma_{netOD}^2 + \sigma_{uni}^2 + \sigma_{orient}^2}$$



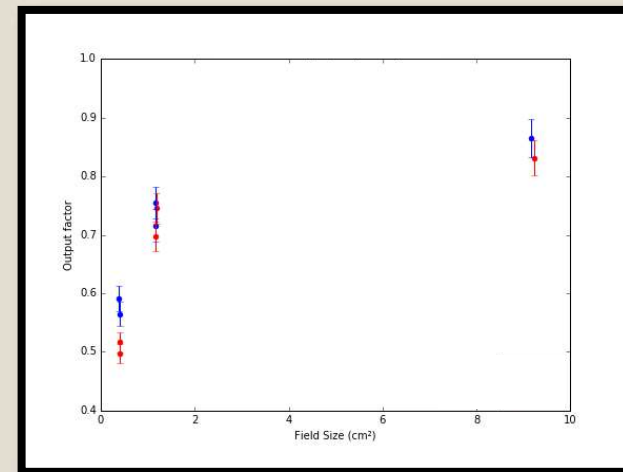
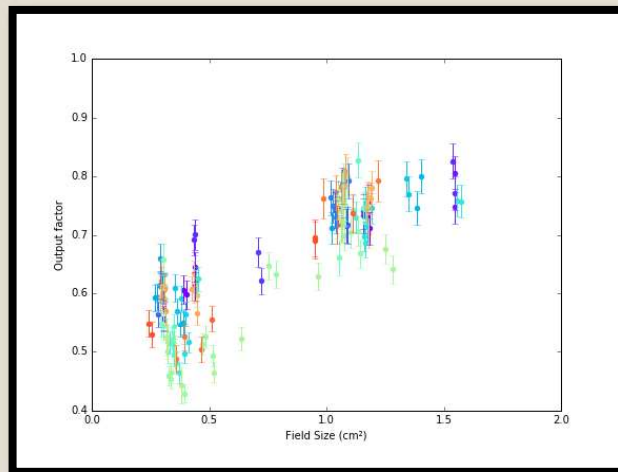
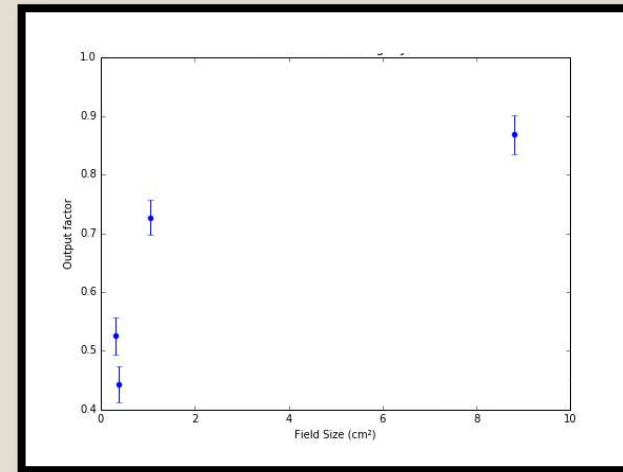
# Output factor determination

- For some centres, the output factor results looked good!
- Possible value for those centres – independent check of existing data



# Output factor determination

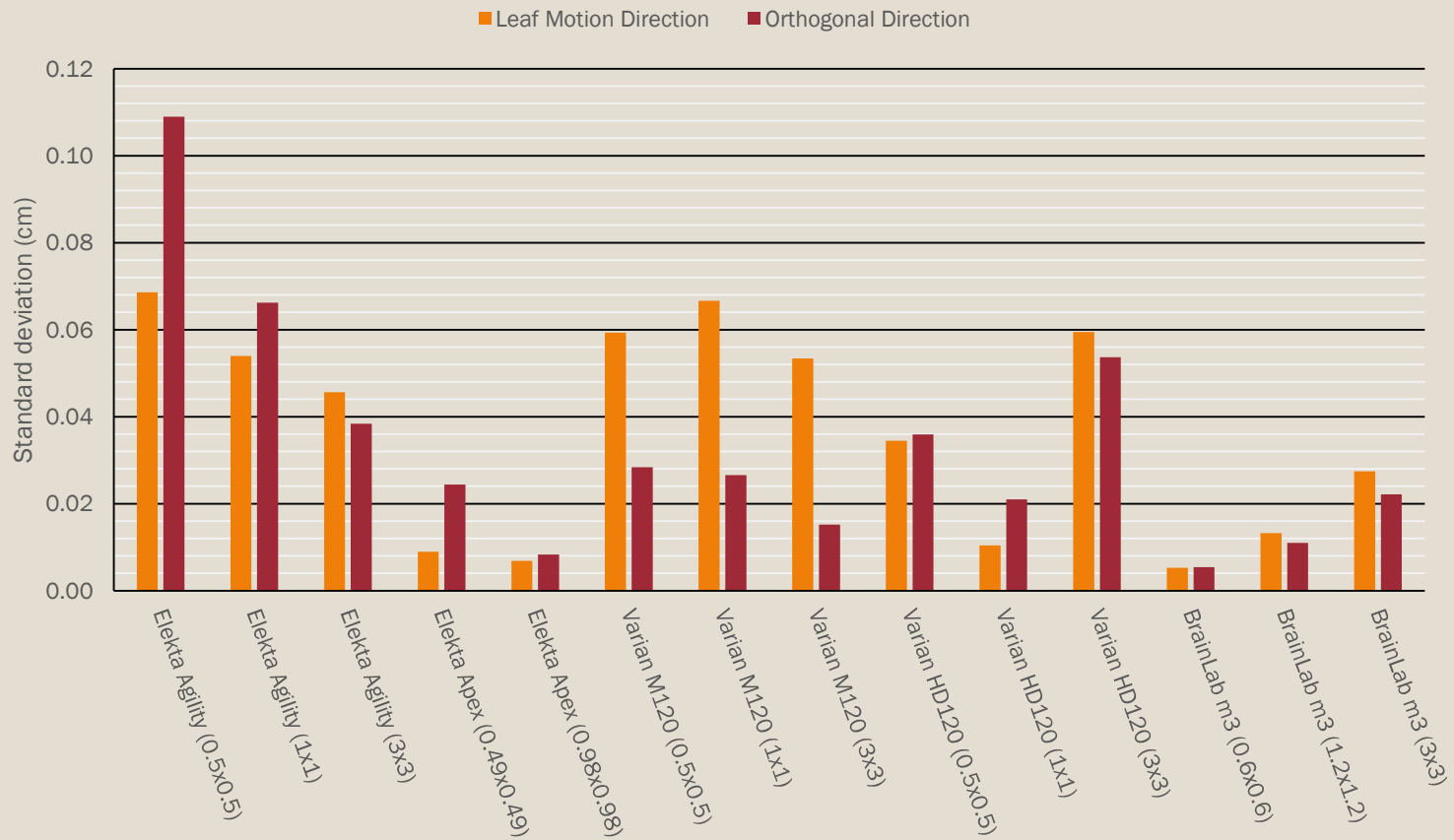
- Not so nice for other centres
- Dataset is probably not particularly useful as a whole – too much variation





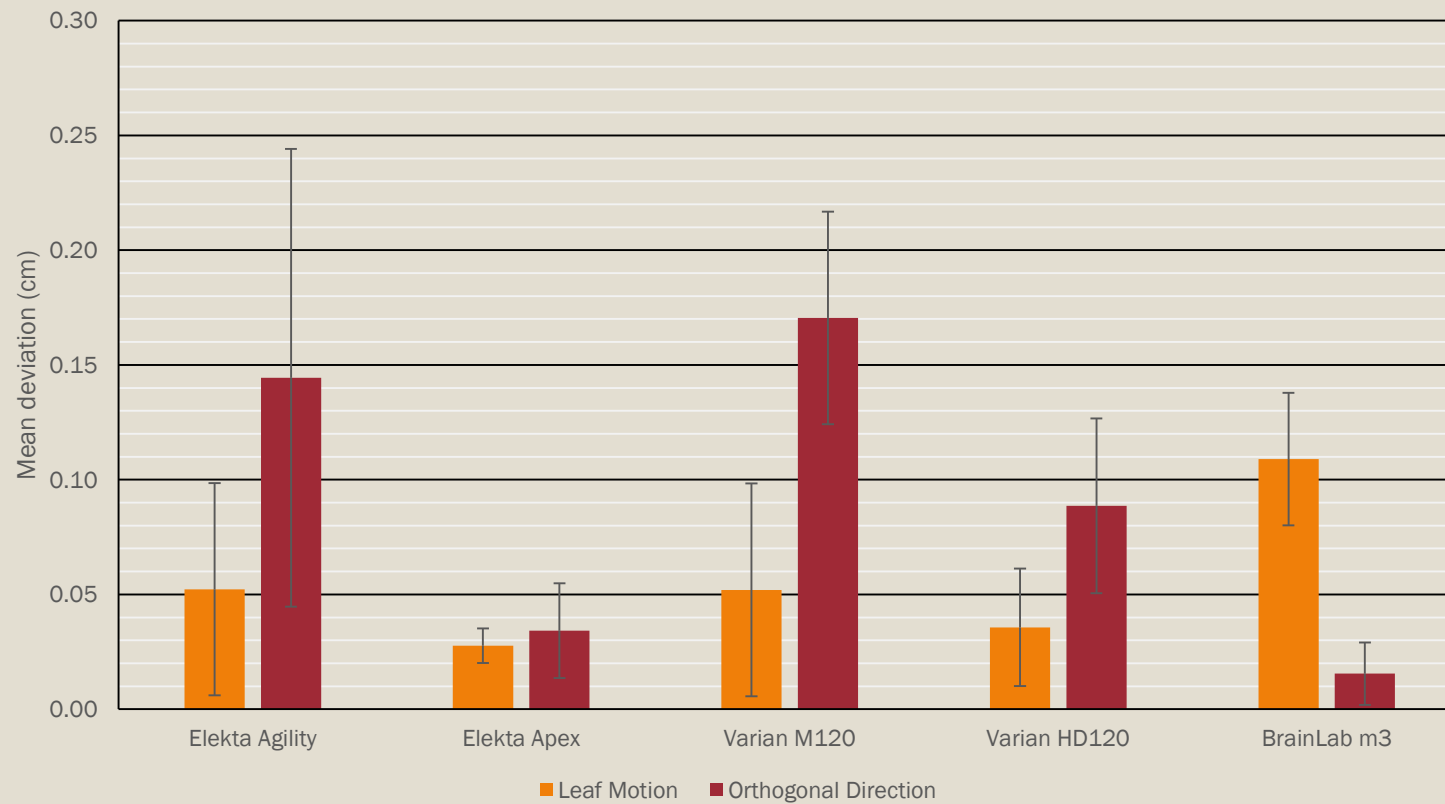
# Field size variation

Standard deviation in measured field edges



# Field size variation

Absolute deviation between nominal and delivered field edge



# Discussion

- What could have been done differently?
  - *Been more prescriptive describing conditions:*
    - We should have only specified the MU instead of asking for ~120 cGy. 1 centre did 120 MU at 10x10 cm<sup>2</sup> and 101 MU at 0.5x0.5 cm<sup>2</sup> (it should have been >200 MU).
    - We should have specified for leaves to be closed off-axis.

# Acknowledgements

Want to acknowledge the following, who offered to participate and/or performed measurements:

*Ben Cooper, Bess Sutherland, John Kenny, Jonathon Lee, Joerg Lehmann, Johnny Morales, Kim Quach, Leon Dunn, Mark West, Michael Douglas, Michael Roche, Nick Hardcastle, Robin Hill, Sam Towns, Simon Downes, Steven Sylvander, Trish Ostwald, Vaughan Moutrie, Zoë Moutrie*