

---

# GEANT4 MODELING OF VARIAN TRUEBEAM & COMPARISON TO FILM MEASUREMENTS

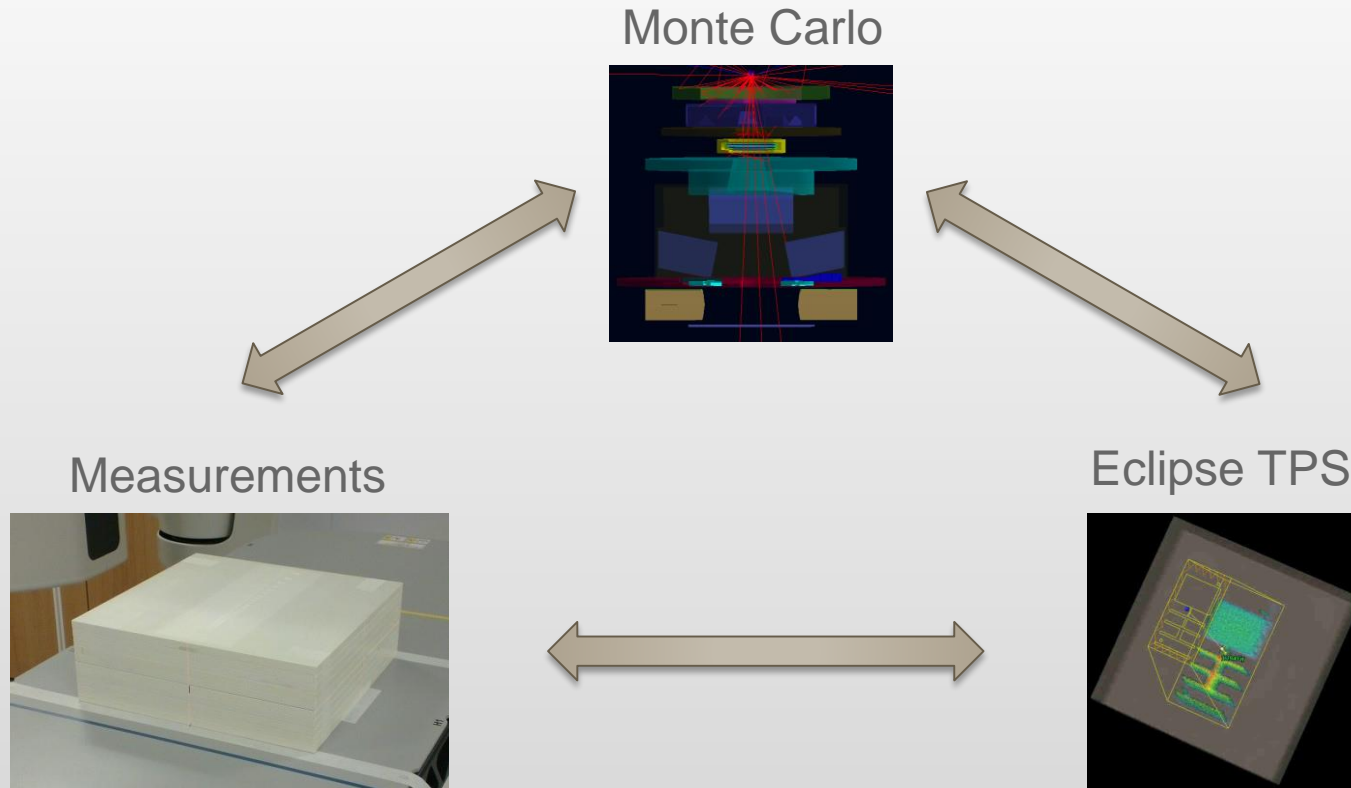
Timo Ikonen<sup>1</sup>, Antti Kulmala<sup>2</sup>, Christopher Boylan<sup>1</sup>, Viljo Petäjä<sup>1</sup>, Daren Sawkey<sup>1</sup>

<sup>1</sup> Varian Medical Systems

<sup>2</sup> Clinical Research Institute HUCH Ltd.

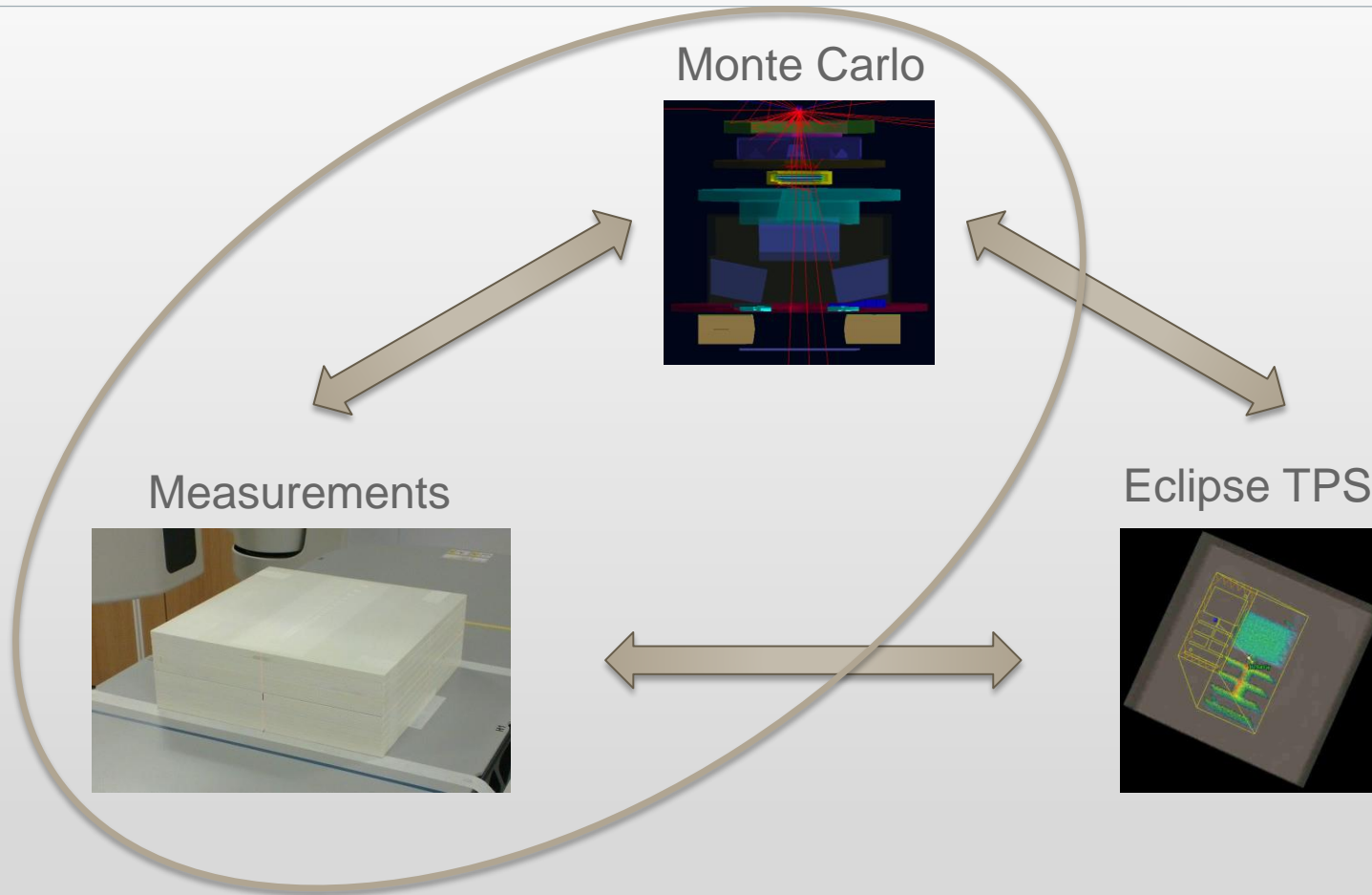
# Motivation: model improvement

---



# Motivation: model improvement

---



# Measurements overview

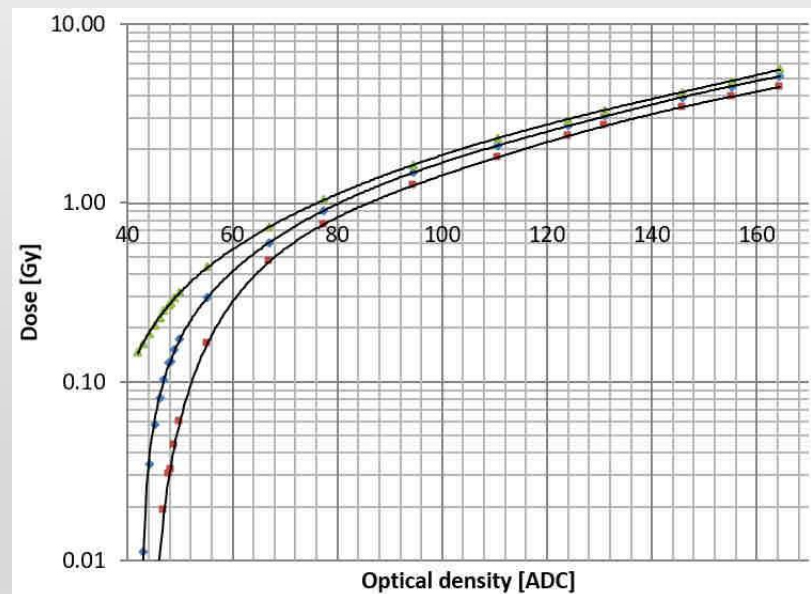


- Measurements with 3 different matched TrueBeam machines at Kotka and Helsinki, Finland
- Measured on GafChromic EBT2 dosimetry film inside an RW3 plastic water phantom

# Film calibration and response correction

## Film absolute dose calibration

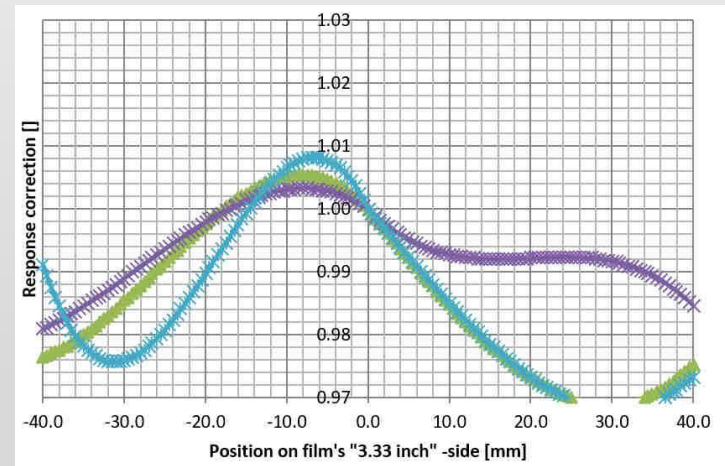
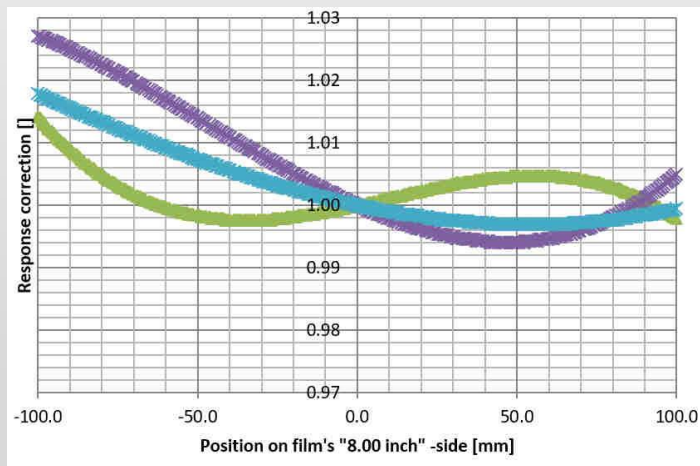
Select middle sheet → Irradiate → Scan → Dose calibration curve of the film stack



# Film calibration and response correction

## Lateral and longitudinal response correction

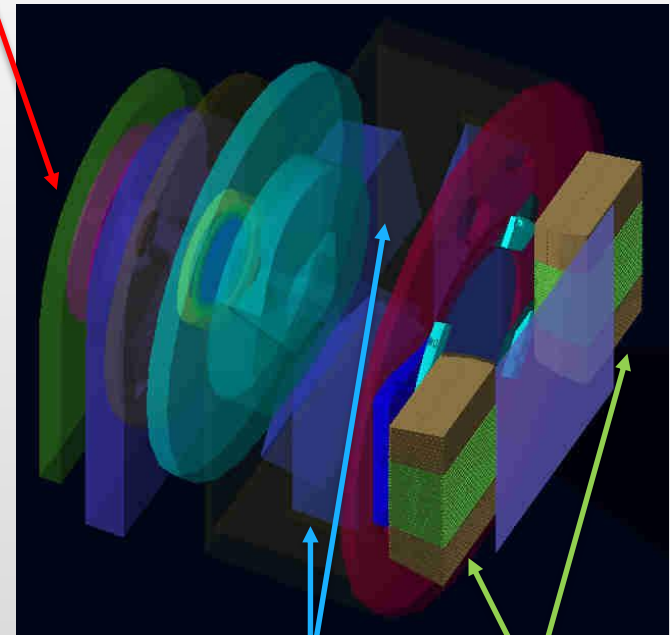
Irradiate with open field → Scan → Compare with known profiles → Get correction curves



# Monte Carlo model

- TrueBeam treatment head geometry implemented in Varian's VirtuaLinac platform
  - Can be run in an Amazon cloud
  - Local implementation at the computer cluster of VMS applied research department
- Physics and MC algorithms by Geant4
  - QGSP\_BIC\_EMZ
- Beam parameters from experiments (e.g. spot size) or fitted to reference data (e.g., electron energy)

Target / photon source



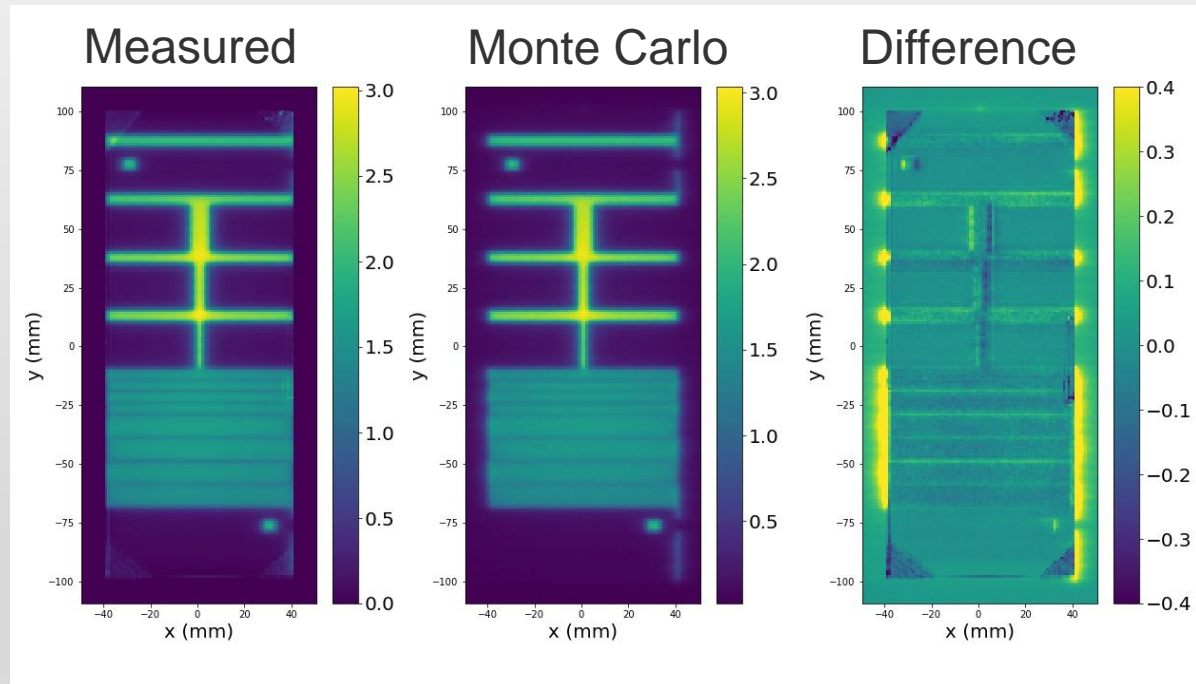
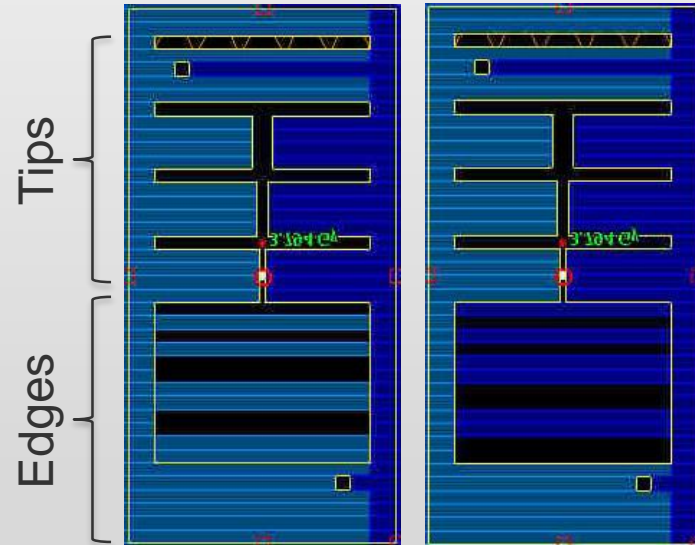
Jaws

MLC

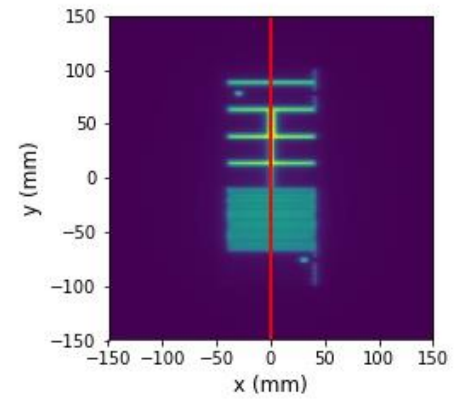
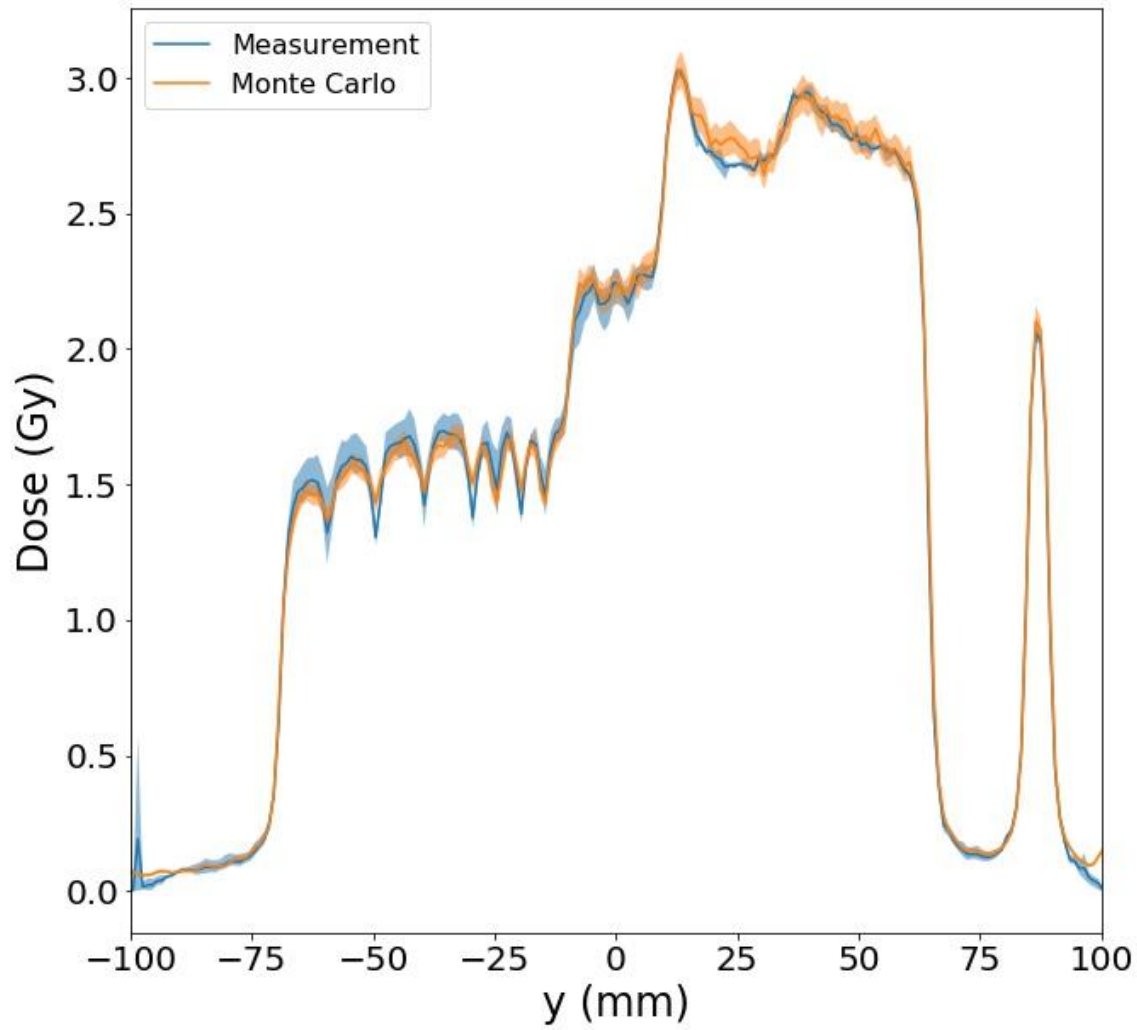
# Comparison of MC and measurements

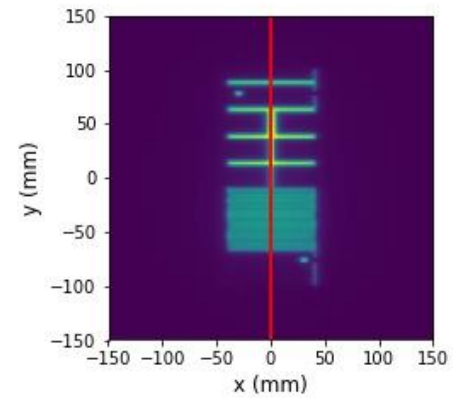
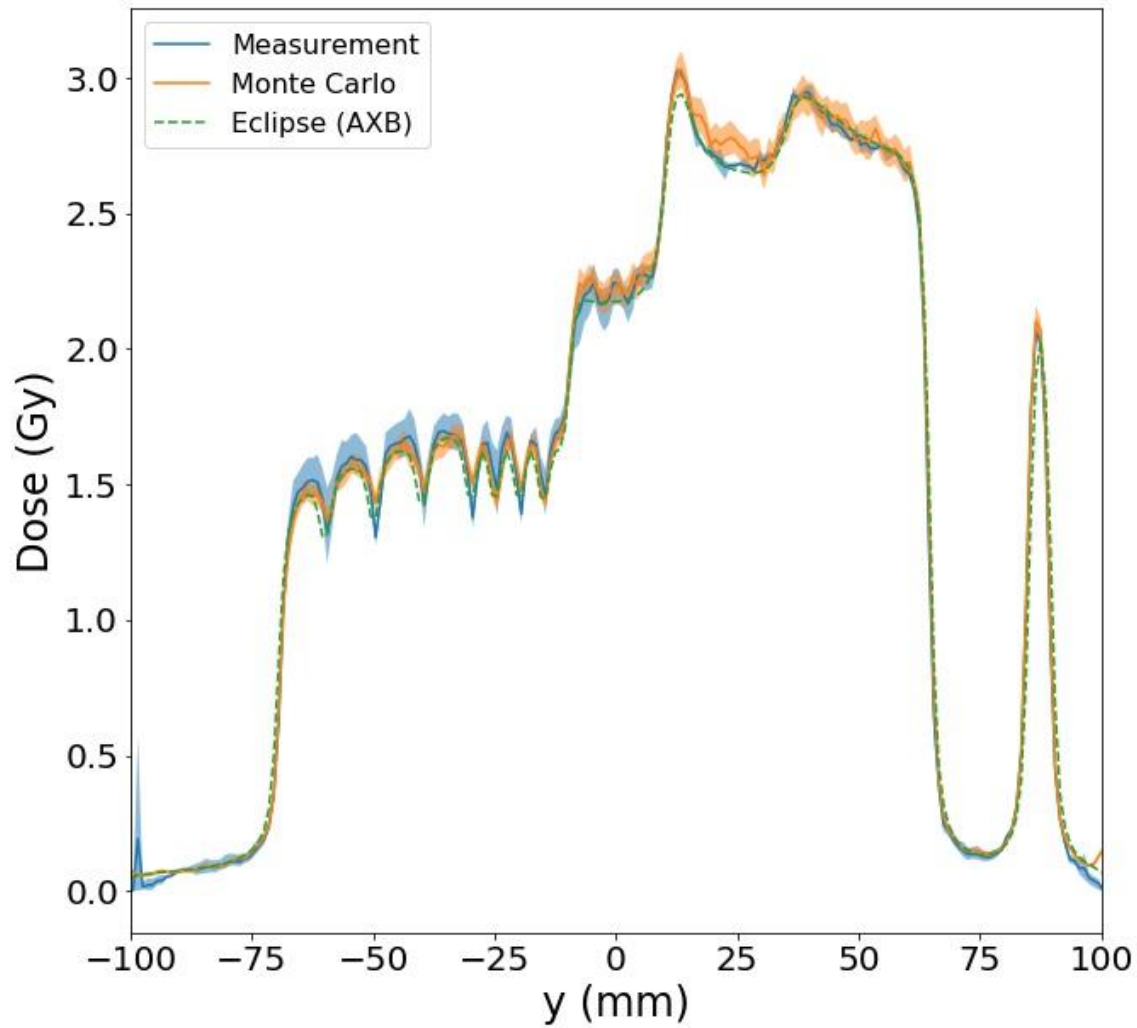
## Irradiation plan

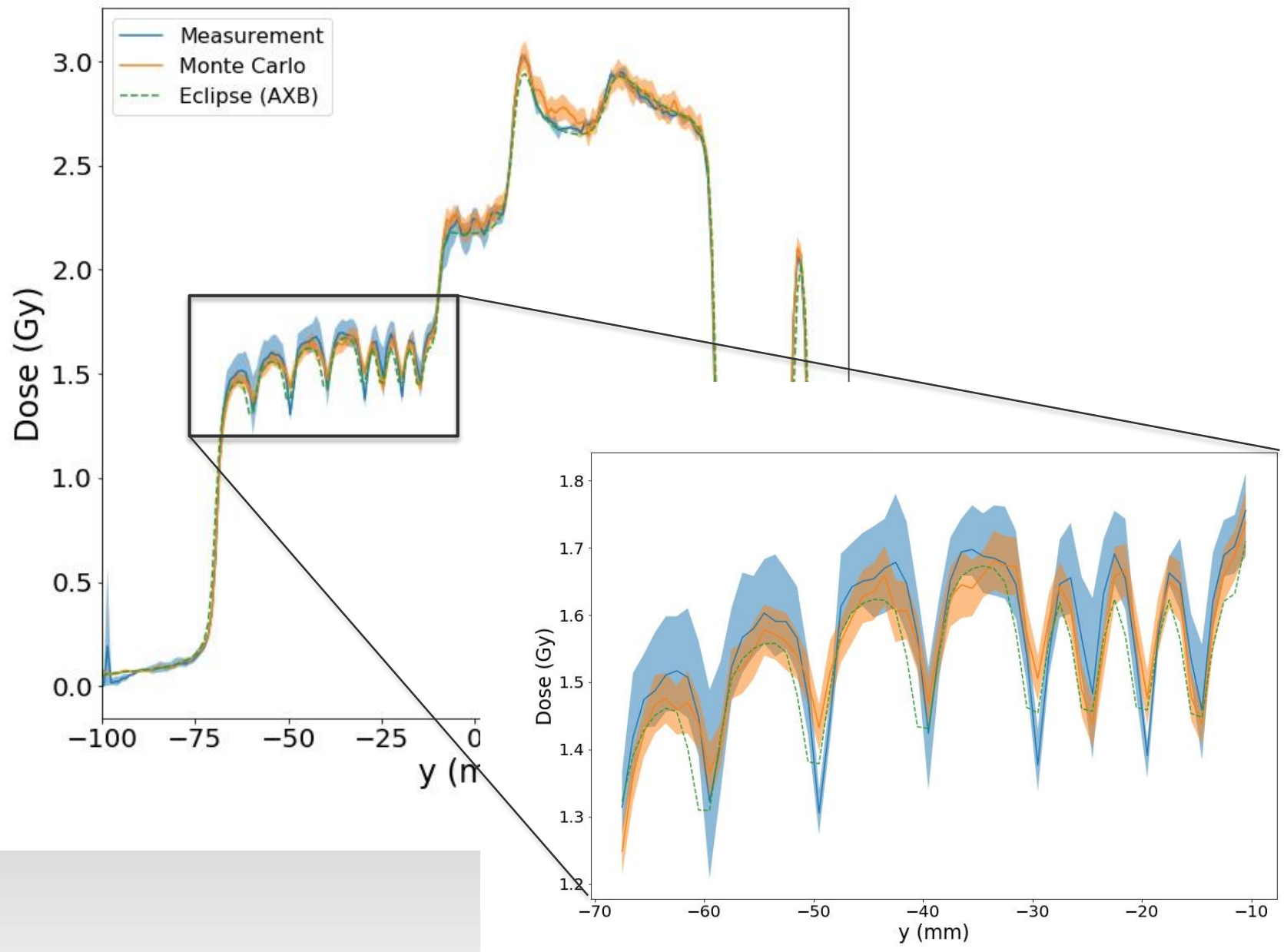
- Step-and-shoot IMRT
- 6FFF field, 2 segments
- Millennium 120 MLC

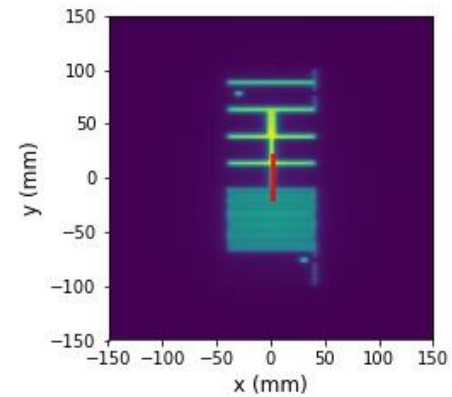
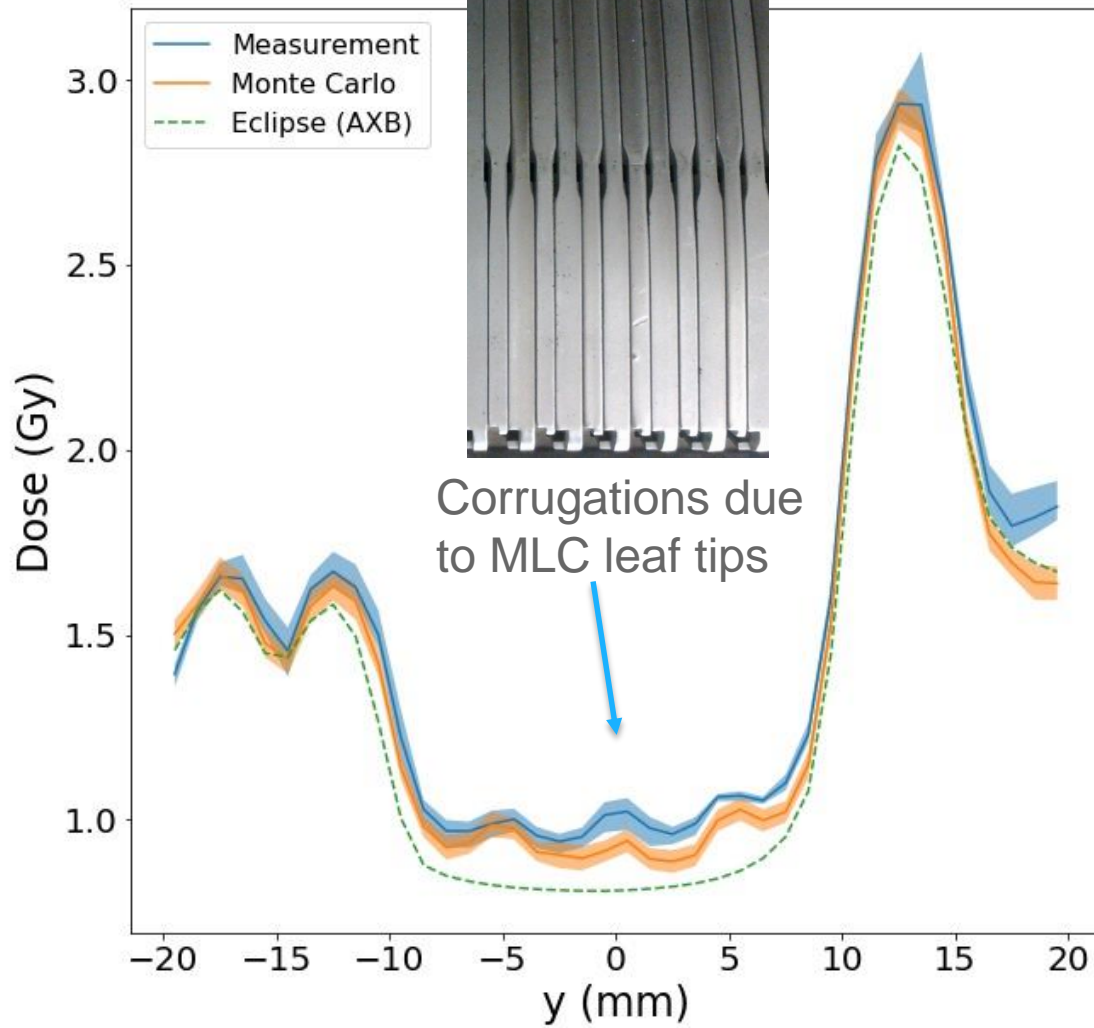


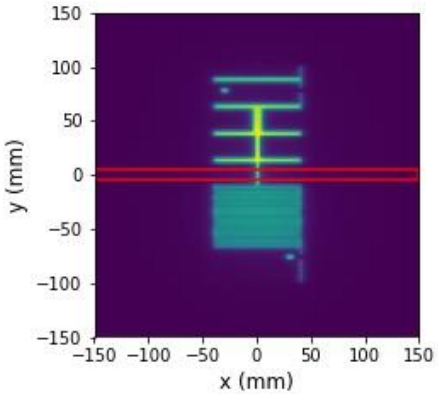
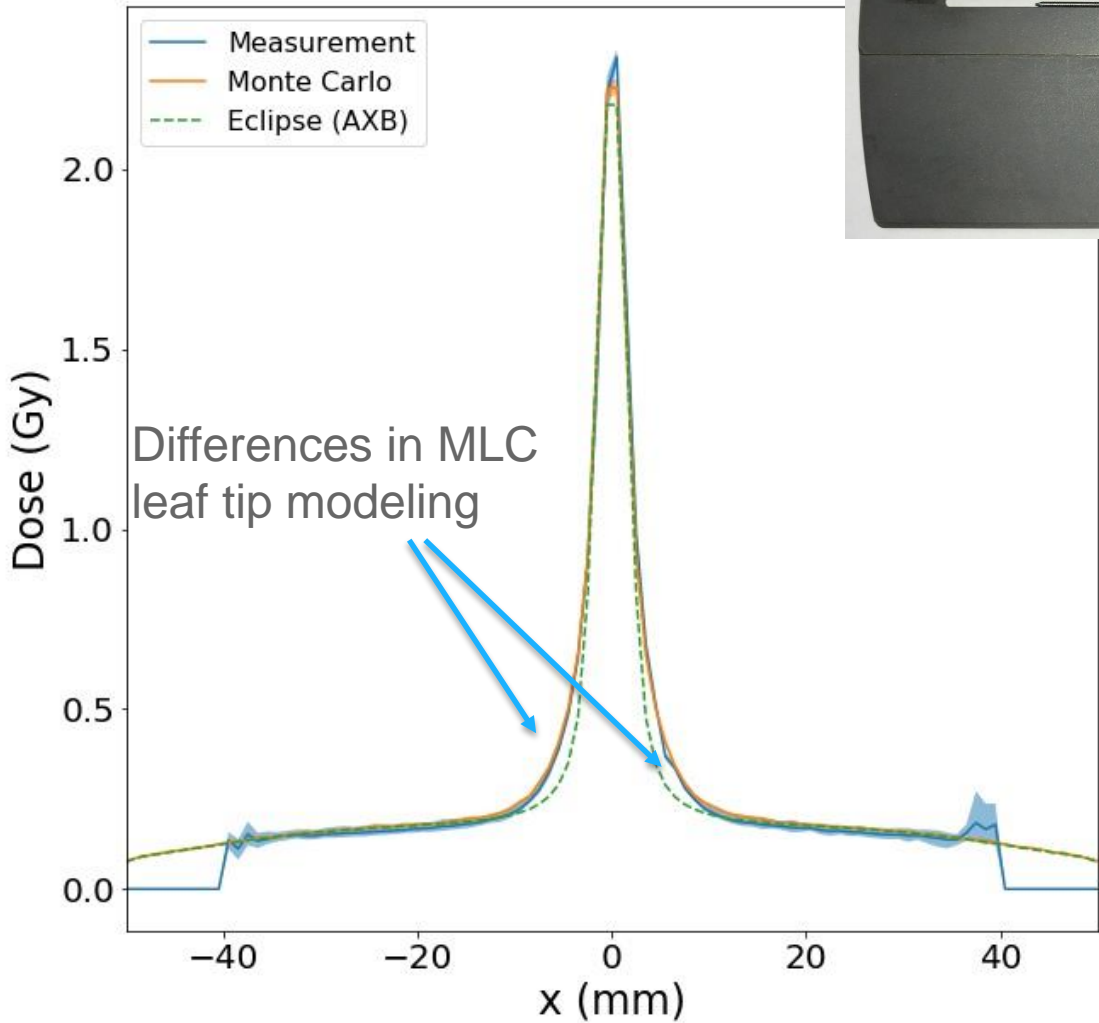
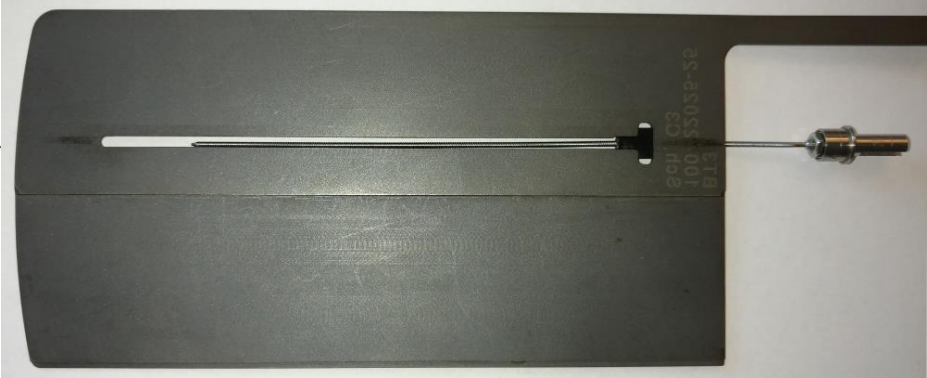












# Summary and outlook

---

- Varian has created a Monte Carlo simulation platform based on Geant4 for the simulation of the TrueBeam linac
- The Monte Carlo model can be used to interpret measurements and other computational results
- Initial results are encouraging and point to potential improvements in the computational in-house algorithms and the photon source model

Also thanks to:

Petri Hiltunen, Petri Kokkonen, Martin Ruprecht, Tuomas Torsti

**varian**

---

Questions?

**varian**