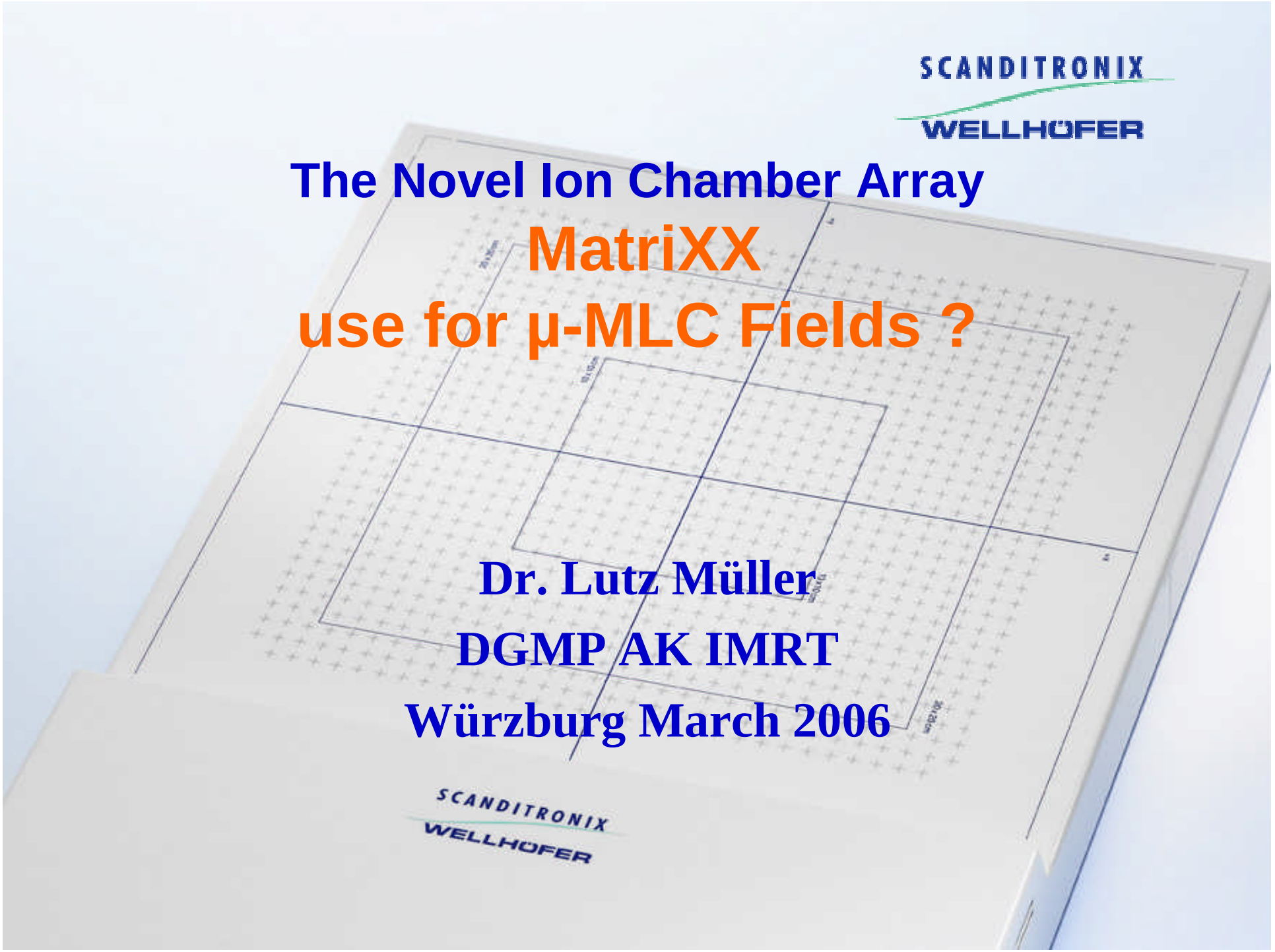


The Novel Ion Chamber Array

MatriXX

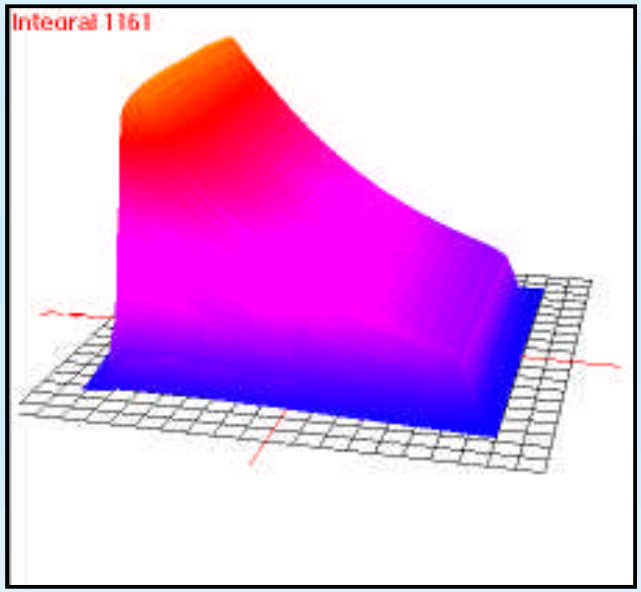
use for µ-MLC Fields ?

Dr. Lutz Müller

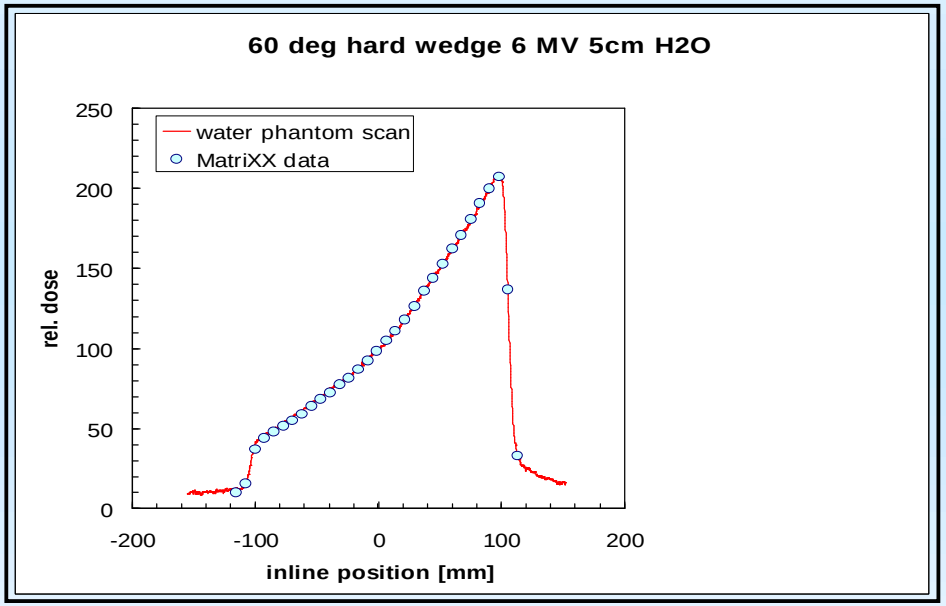
DGMP AK IMRT

Würzburg March 2006

Machine QA – Hard Wedge

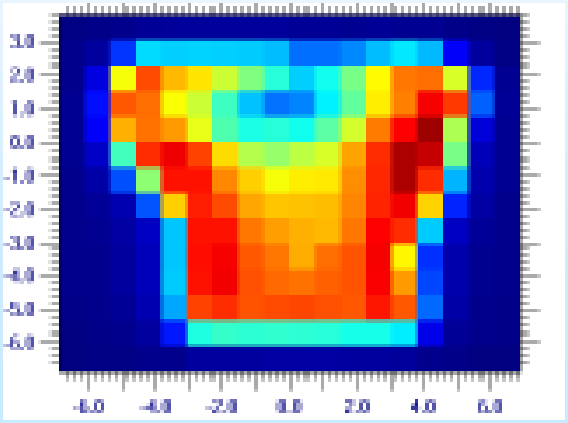


3D view

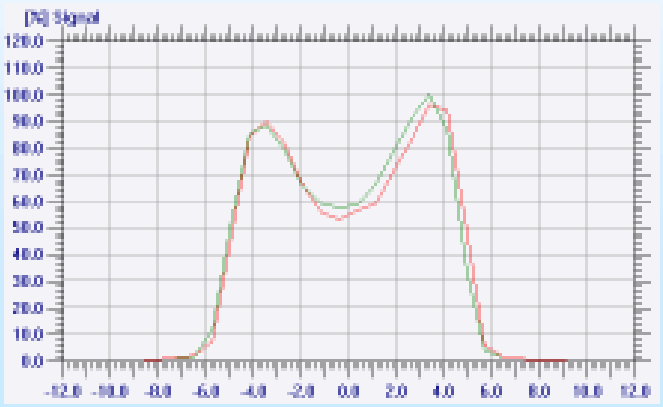


MatriXX vs. Water Phantom Scan

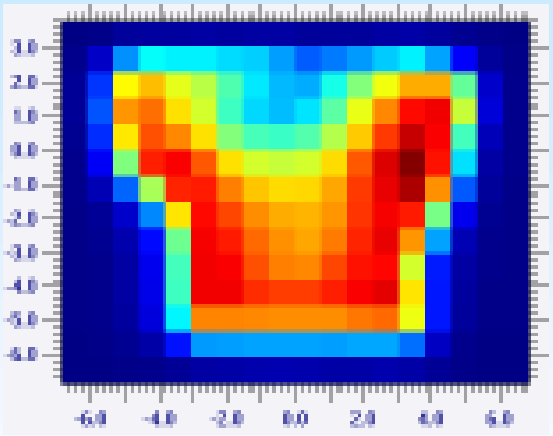
Direct comparison



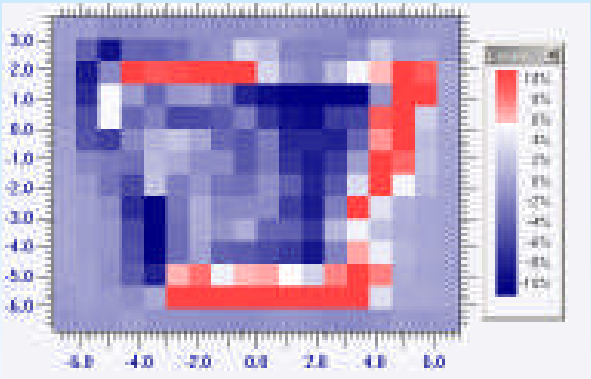
MatriXX measurement



Profiles comparison

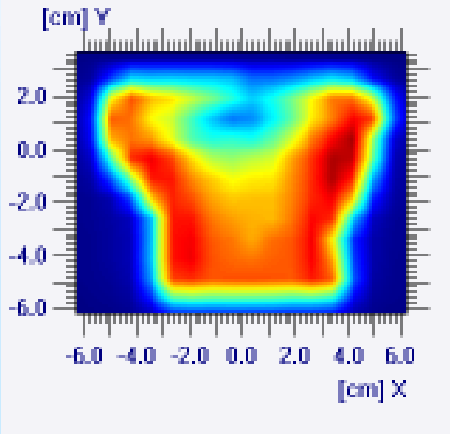


Plan data

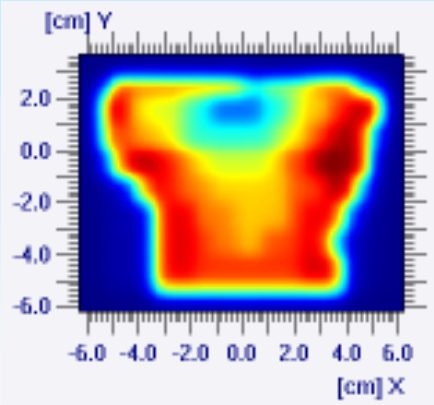


difference

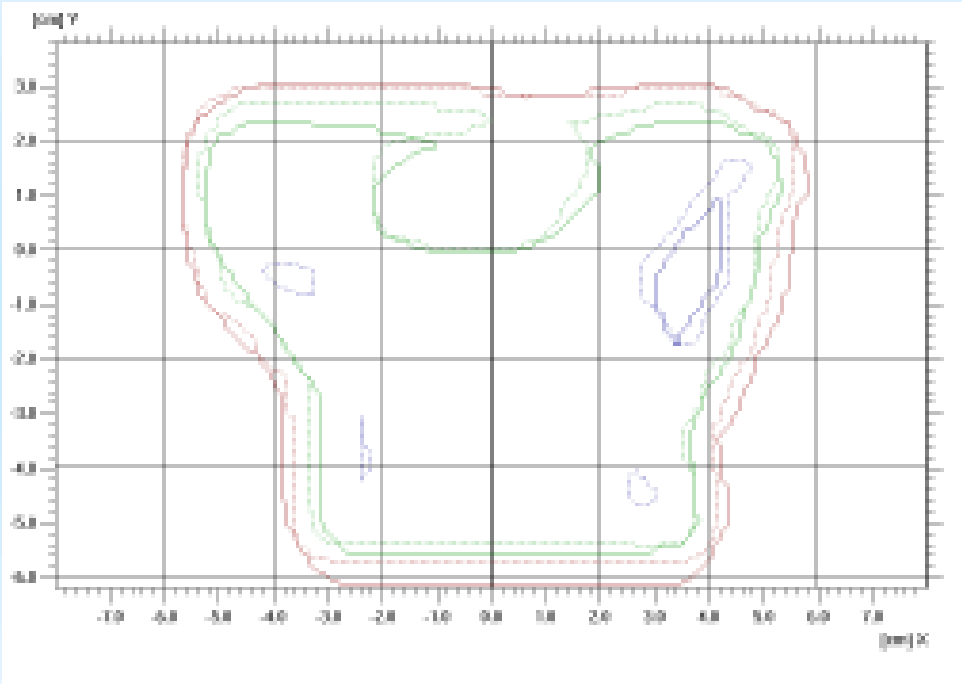
Interpolation to 1mm grid



MatriXX measurement

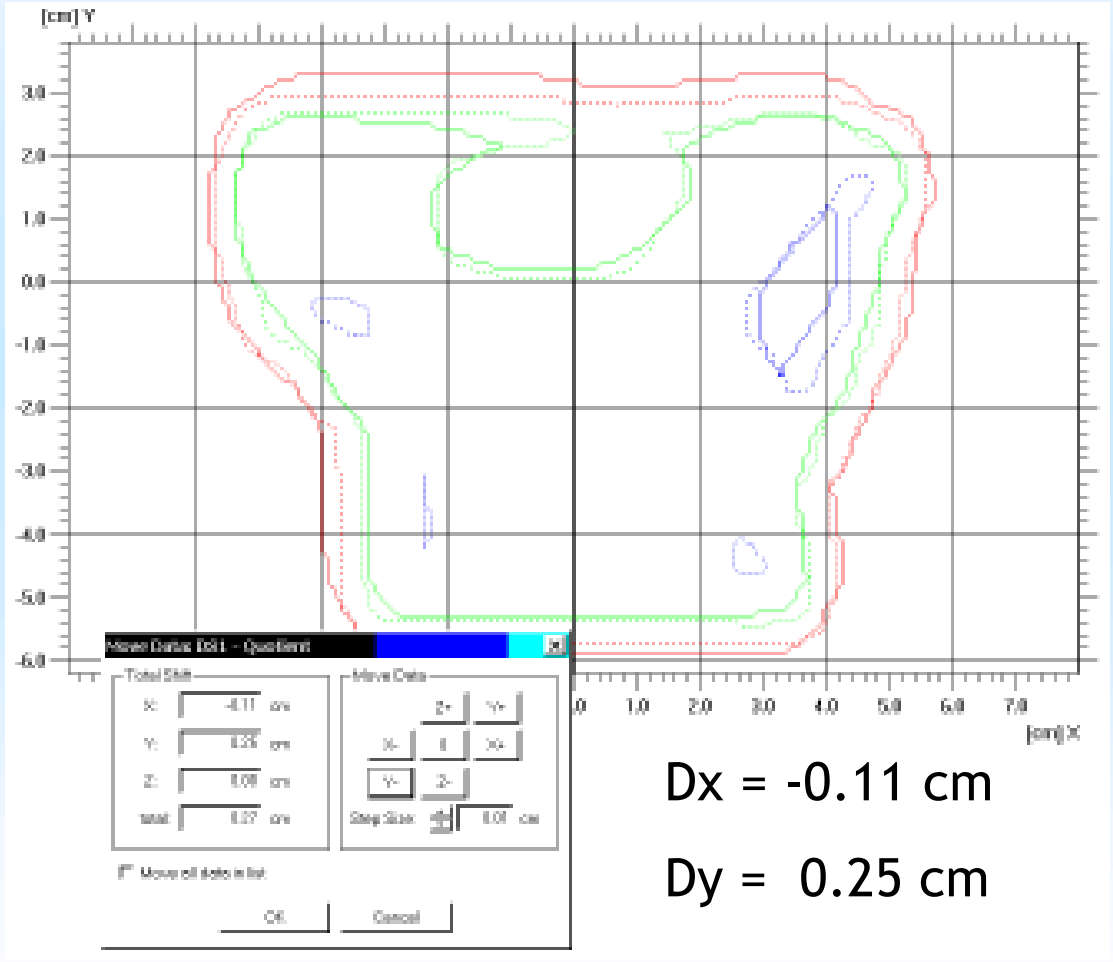


Plan data



Isodoses ___MXX .....Plan

Position adjustment



Dx = -0.11 cm

Dy = 0.25 cm

Pixel spacing

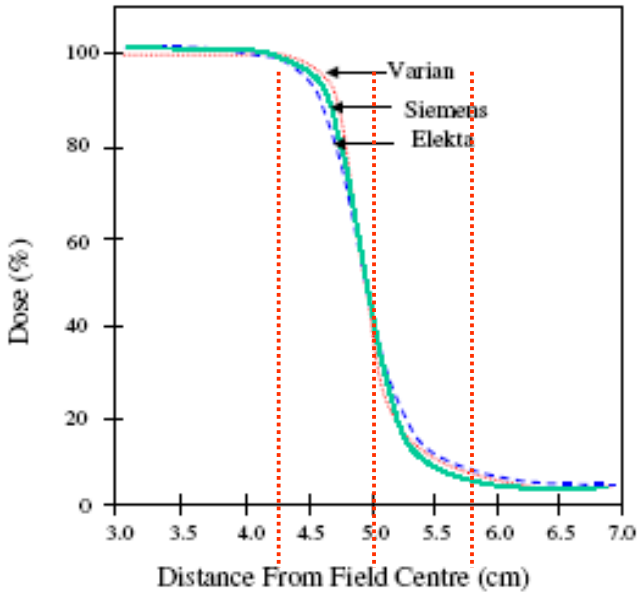


Figure 3. Comparison of the penumbra for the three collimators when the leaves are positioned at the edge of a centred 10 × 10 cm^2 field for 6 MV beams. Note that there is no appreciable difference between all three systems though designs are different.

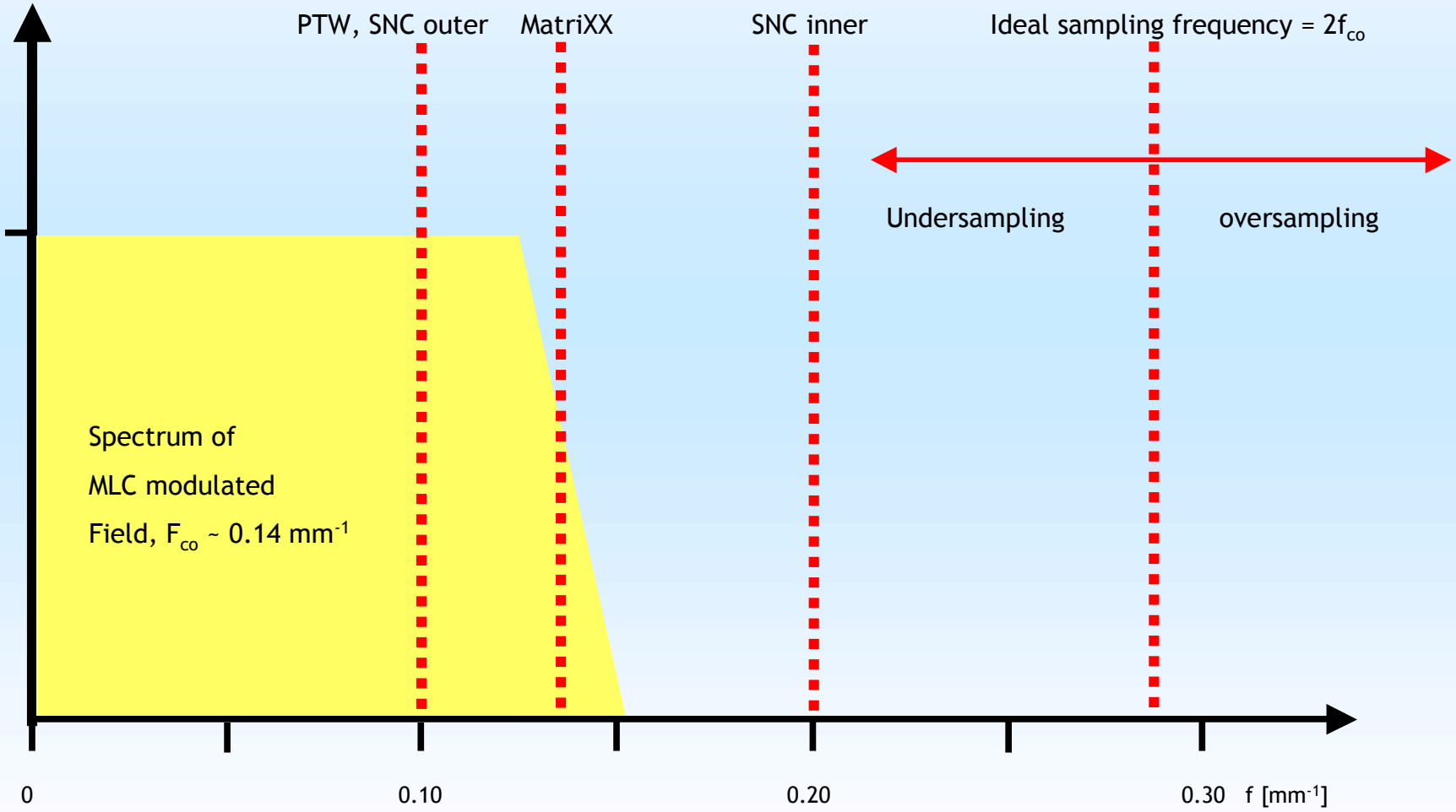
M Saiful Huq, Indra J Das, Todd Steinberg and James M Galvin

A dosimetric comparison of various multileaf collimators

Phys. Med. Biol. **47** (2002) N159–N170

Standard collimators produce a cutoff frequency of ca. 0.14 mm^{-1}

Nyqvist Sampling Theorem



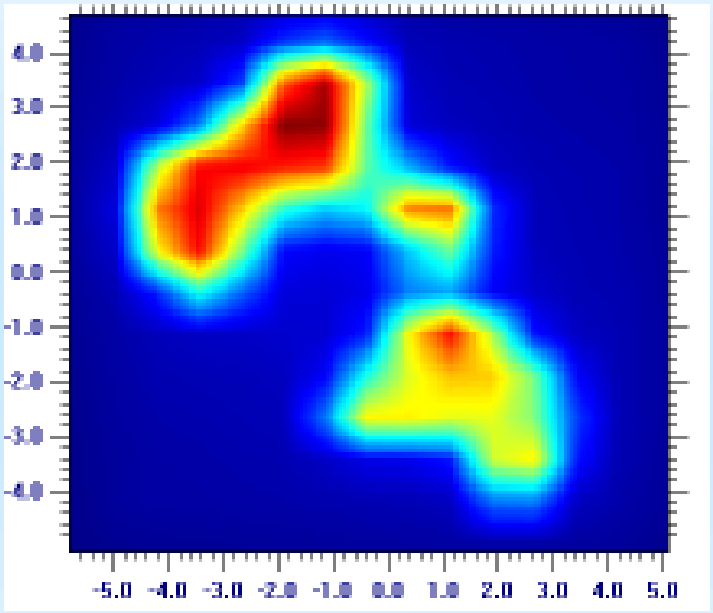
Anti - aliasing

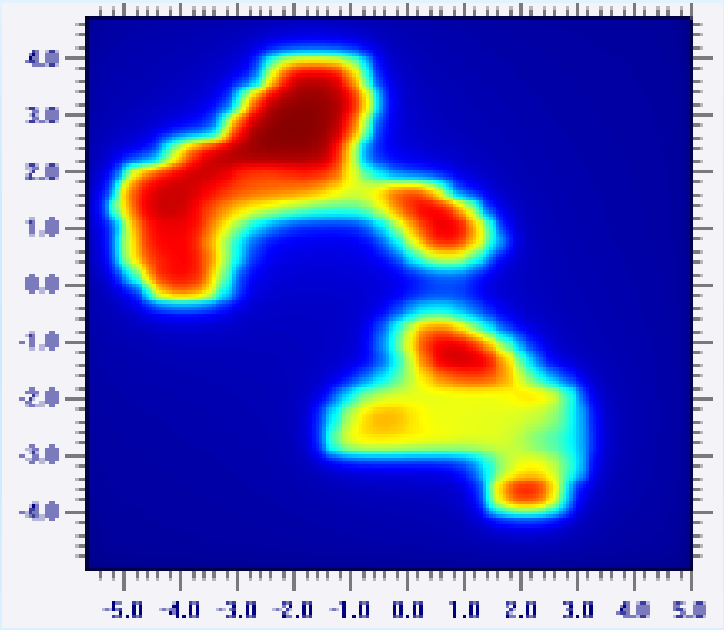
- All 2D devices work in the undersampling domain
- This causes aliasing effects, affecting isodose contours
- In order to improve contours, an anti-aliasing filter (low pass) is needed
- Cylindric ion chamber provides this low-pass intrinsically !

MatriXX for µ-MLC modulated fields

- BrainLab Novalis with 3mm MLC, BrainScan planning system
- Measurements in Kumamoto, Japan March 06
- 12-field IMRT plan
- MatriXX intended use: standard MLC
- Can it be used also for µ-MLC ?

MatriXX vs. BrainScan





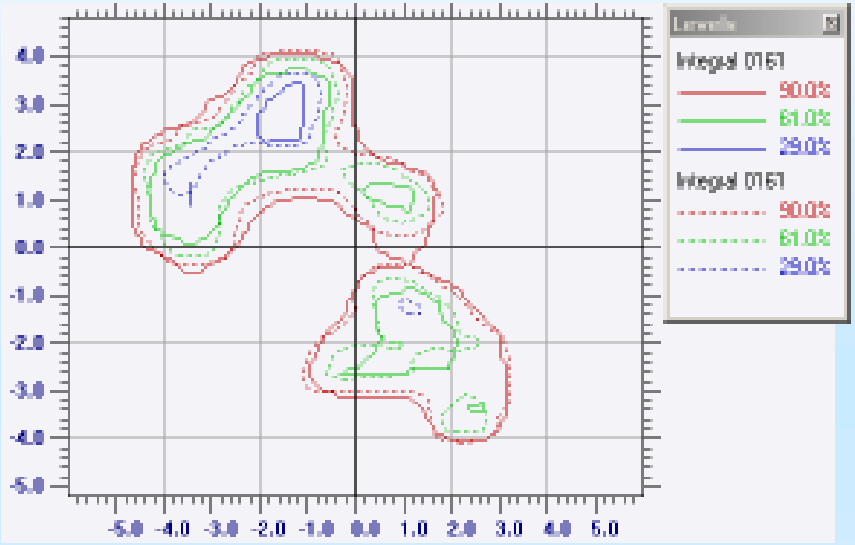
MatriXX measurement

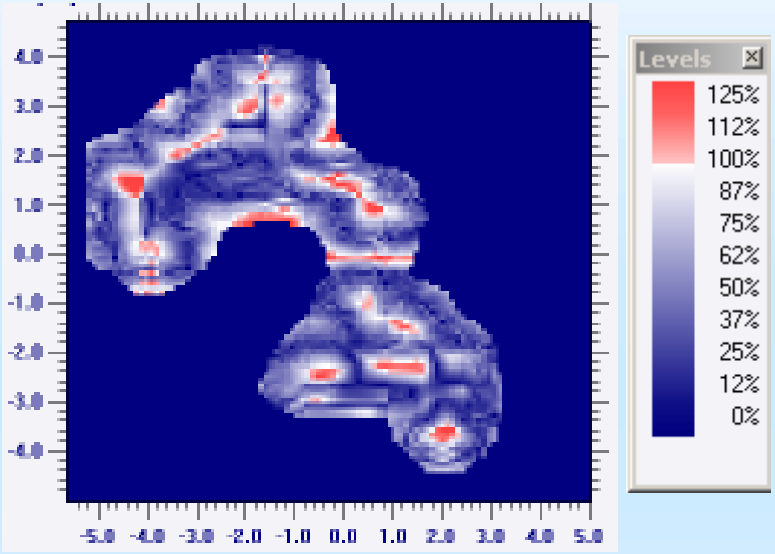
lin interpolation to 1mm grid

BrainScan Plan

res. 0.5 mm

MatriXX vs. BrainScan – 0.5mm res.





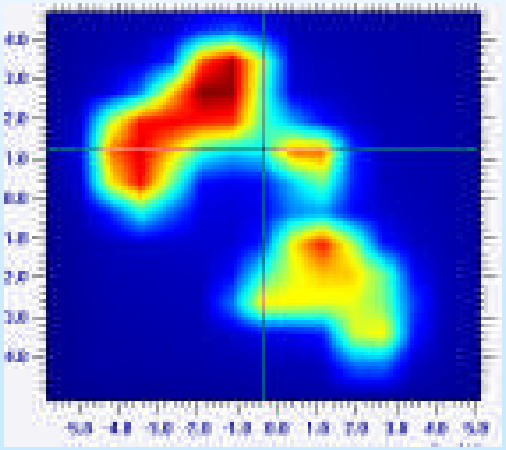
Isodoses MatriXX measurement

90% - 60% - 30%

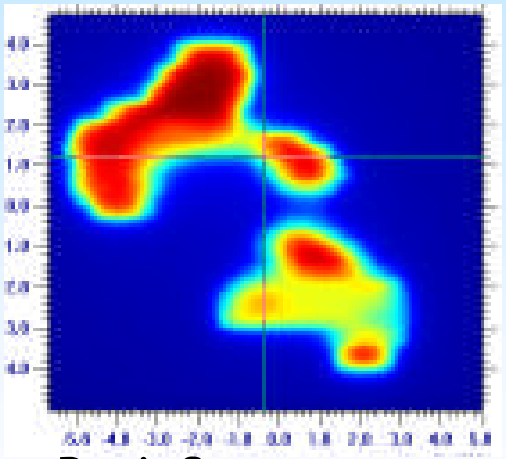
3%/3mm

Gamma

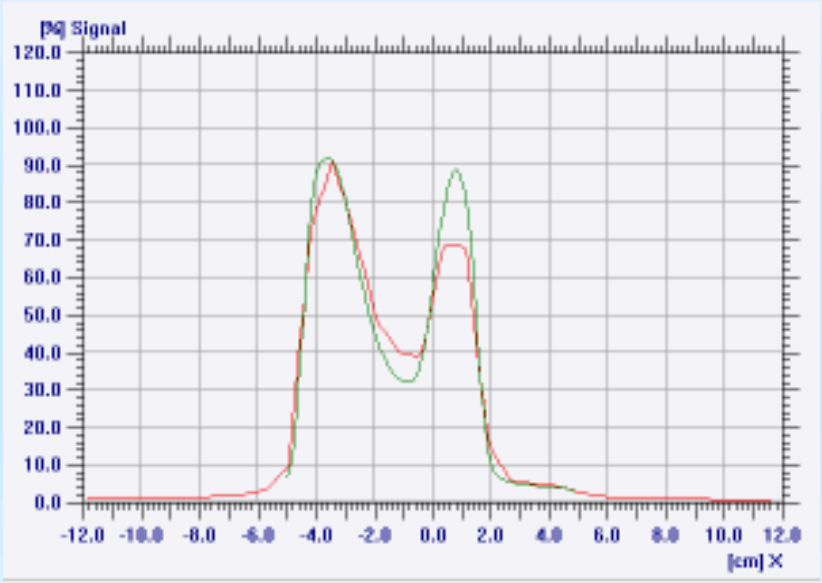
MatriXX vs. BrainScan – 0.5mm res.



MatriXX

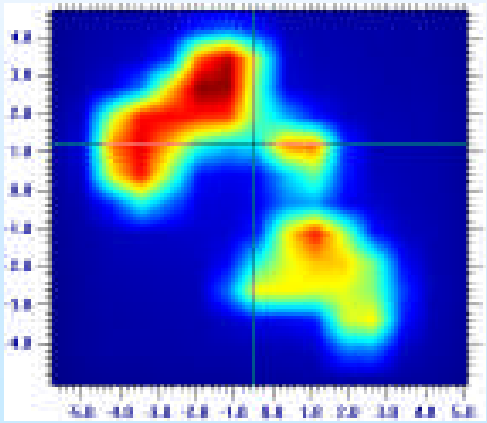


BrainScan

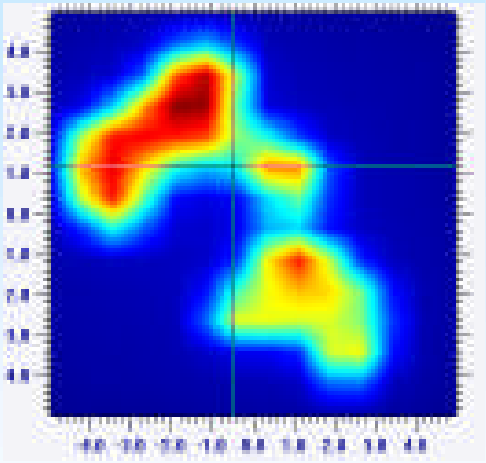


X-profile comparison

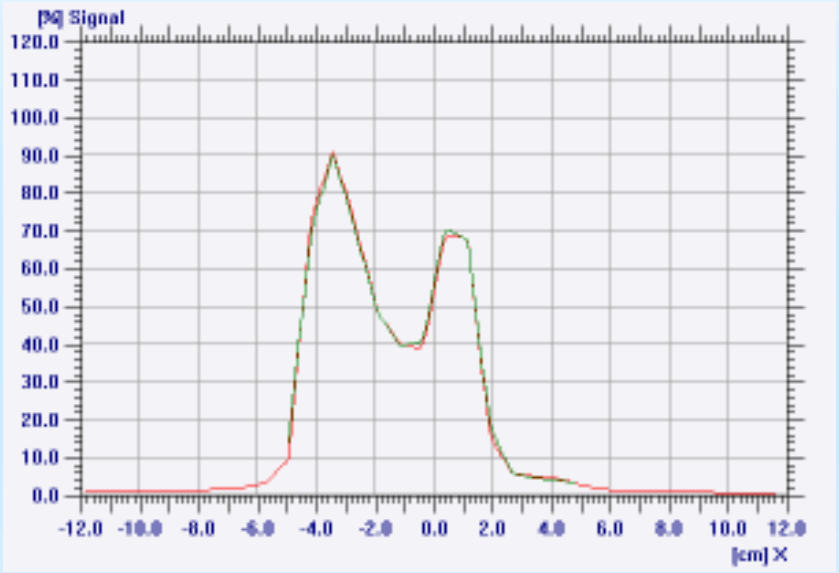
MatriXX vs. BrainScan – 7.62 mm res.



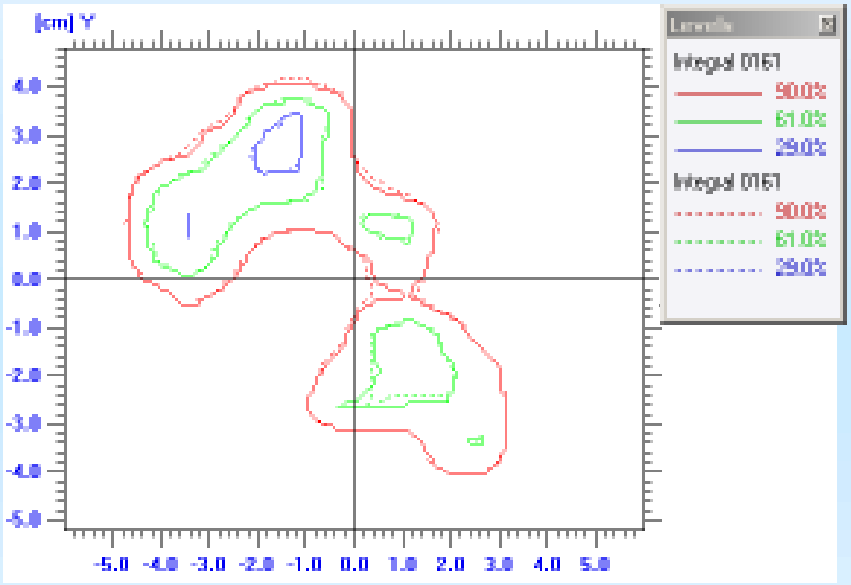
MatriXX

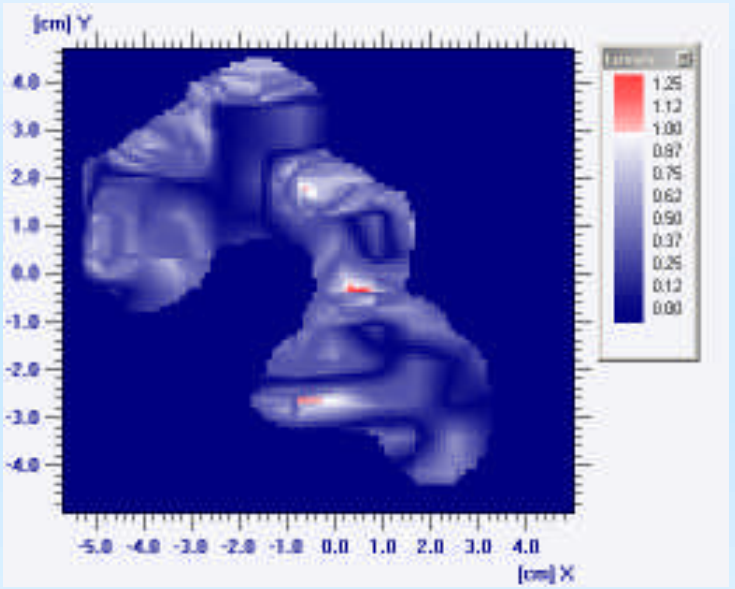


BrainScan



X-profile comparison





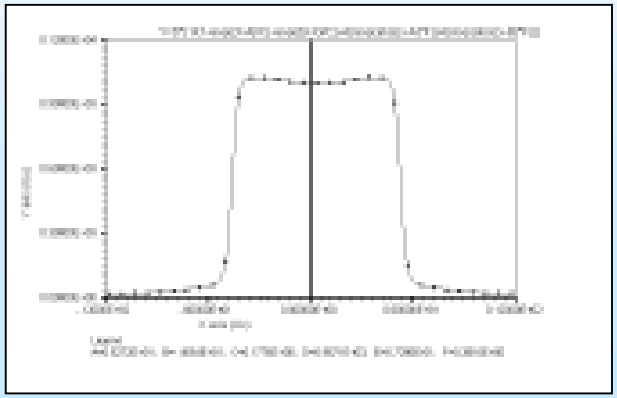
Isodoses MatriXX measurement

Gamma

90% - 60% - 30%

3%/3mm

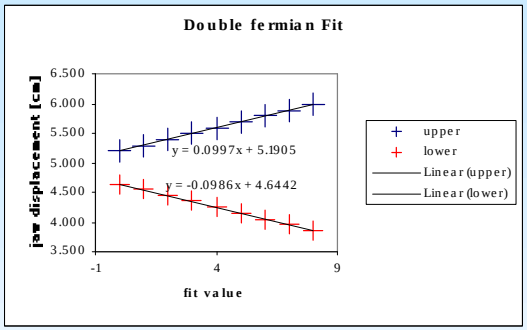
Double Fermian Fit

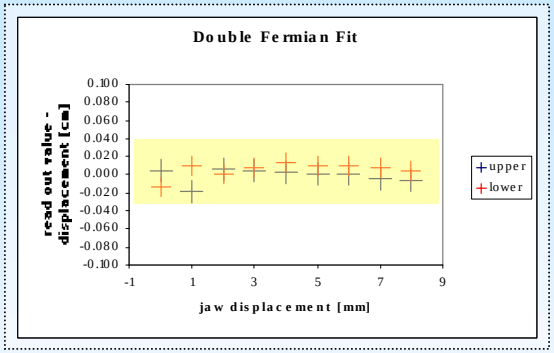


$$N = N_0 * \left(\frac{1}{1 + e^{\frac{x - x_l}{\sigma}} + e^{\frac{x_r - x}{\sigma}}} + \frac{\eta}{e^{\frac{(|x - x_l|)}{\varepsilon}}} + \frac{\eta}{e^{\frac{(|x - x_r|)}{\varepsilon}}} \right)$$

Profile w/ double Fermi fit

plus exponential tail



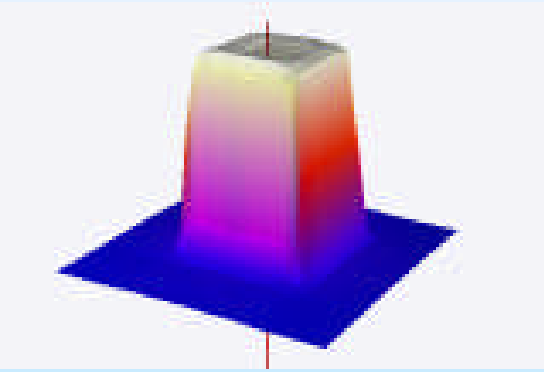


Accuracy of pennumra Position determination:

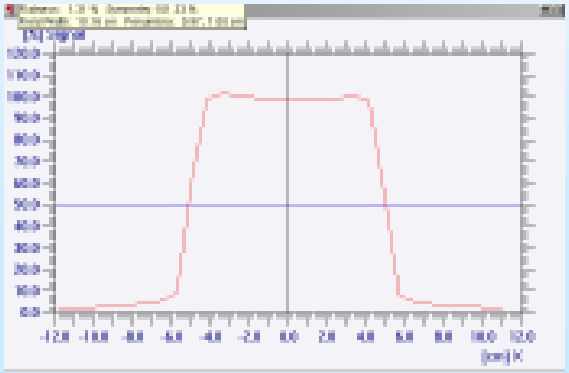
+/- 0.3 mm

Jaw displacement vs. Read-out deviation

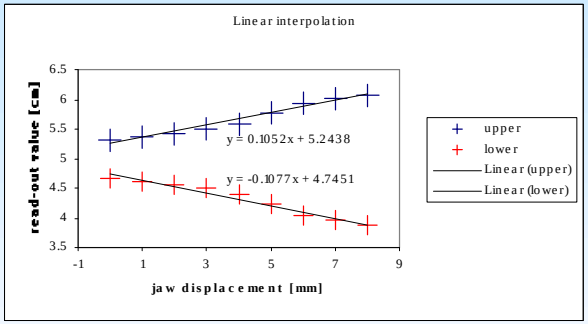
Linear interpolation & 50 % isodose

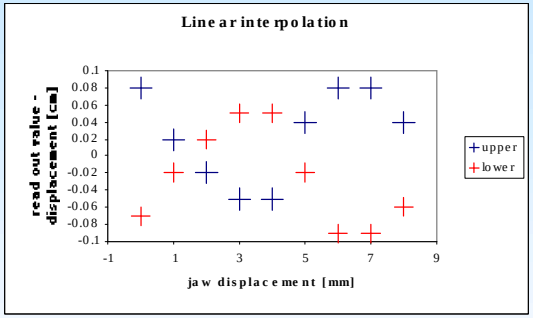


3D view



profile w/ lin interpolation





Accuracy of pennumra
Position determination:

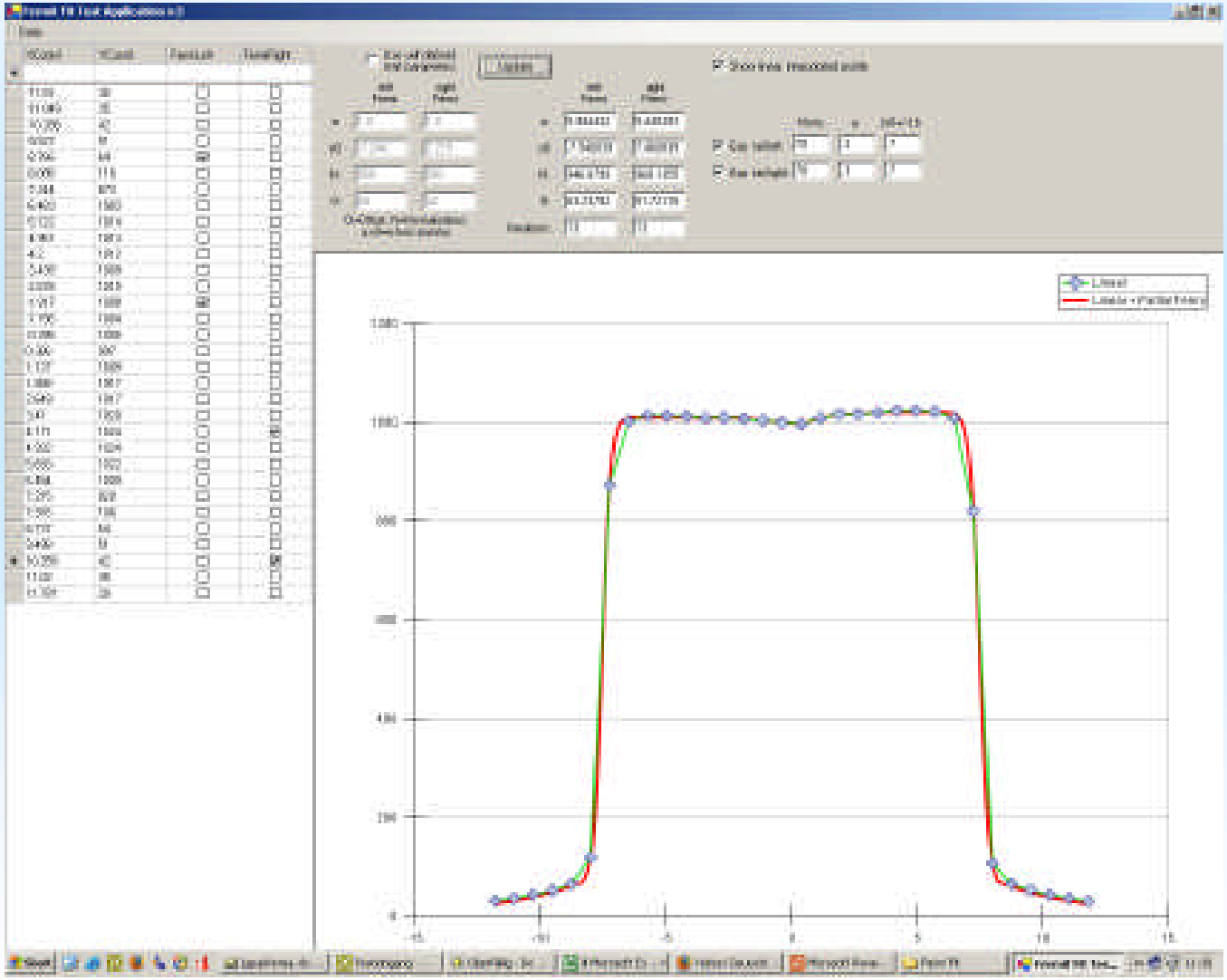
+/- 1 mm

Jaw displacement vs. Read-out

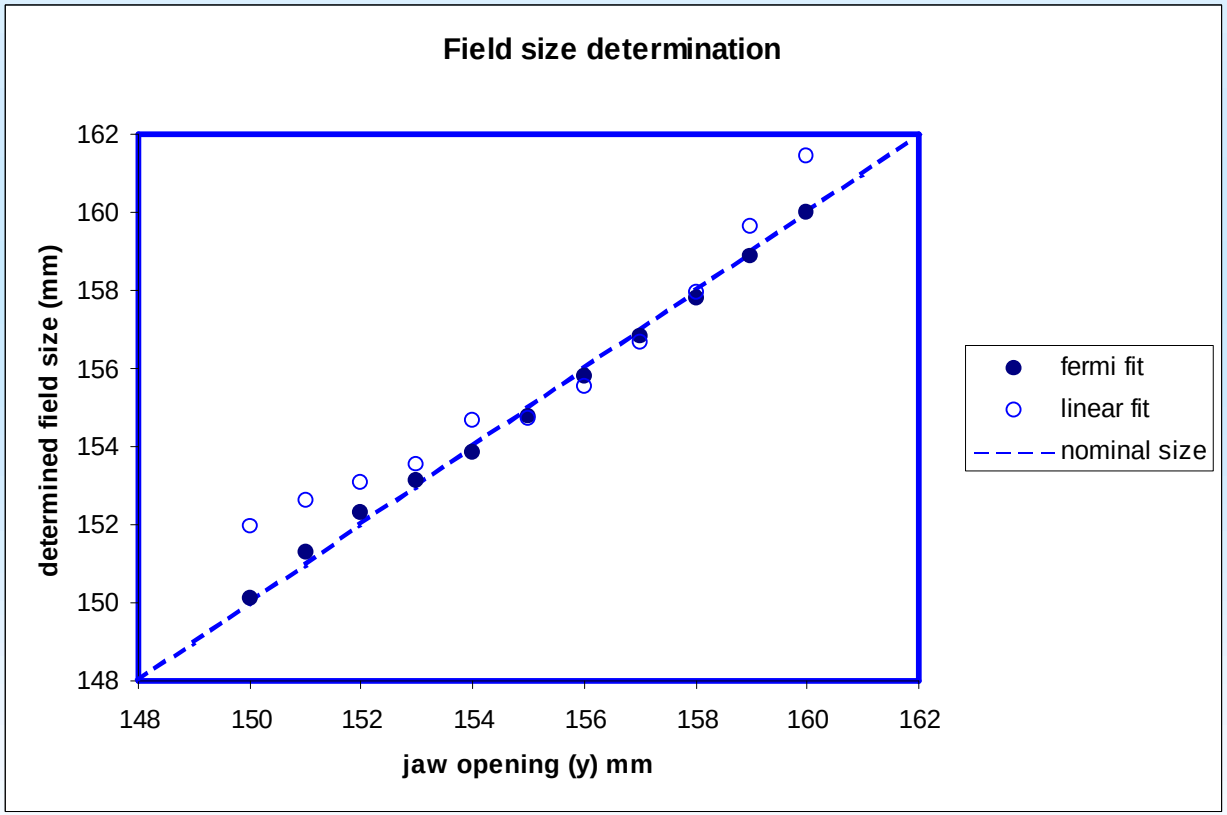
deviation

SCANDITRONIX WELLHÖFER

Fermi Fit application



Linear interpol vs. Fermian Fit



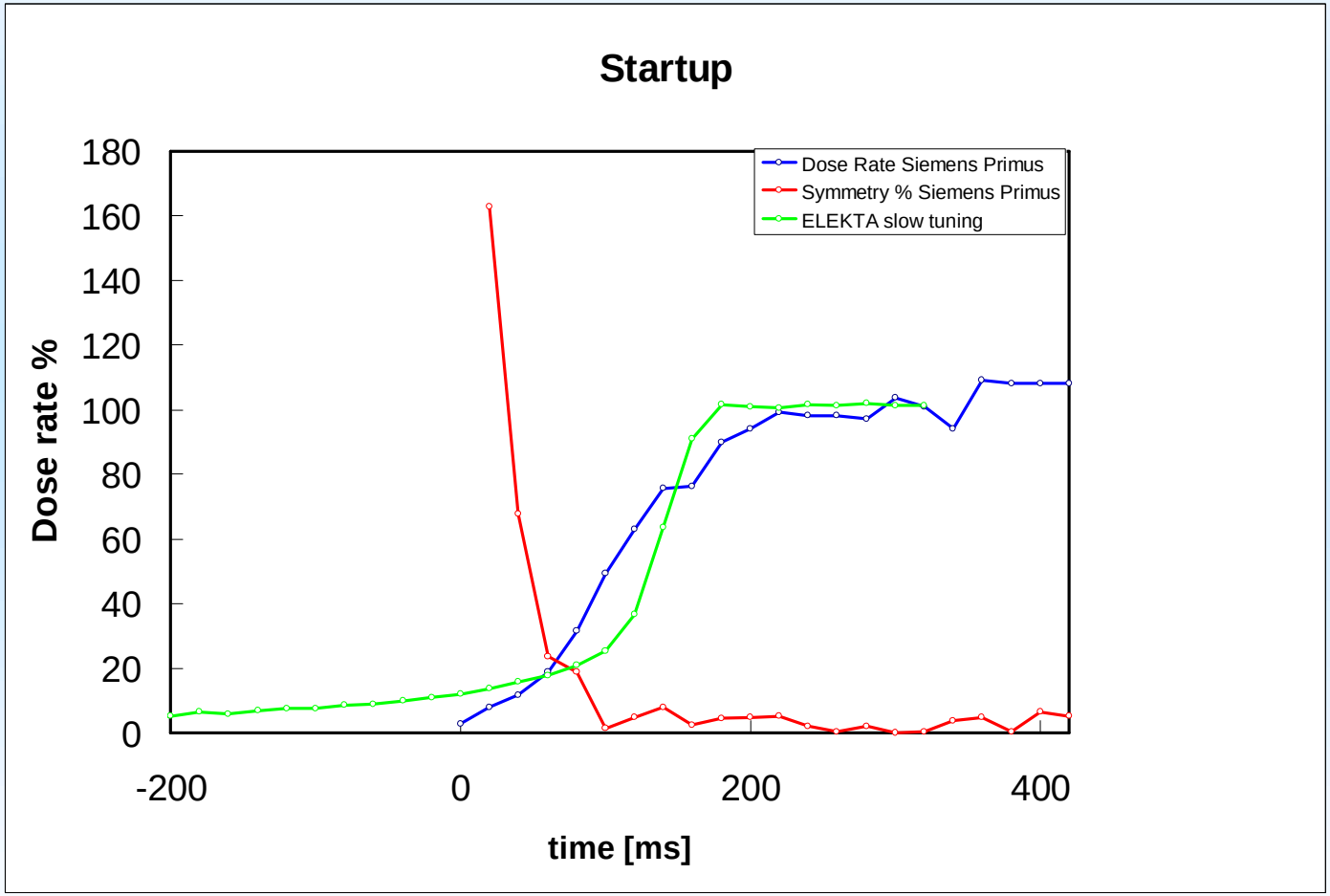
Data from D.Hahm, Bielefeld

SCANDITRONIX WELLHÖFER

Min sampling time of 20ms and no dead time between frames allow tracking of LINAC startup

Averaging over ROI improves signal/noise for these short sampling intervals

Linac startup




SCANDITRONIX
WELLHÖFER

Integration of highly modulated field