“Technology transfer of microstrip detectors; from Particle Physics to medical and synchrotron applications”

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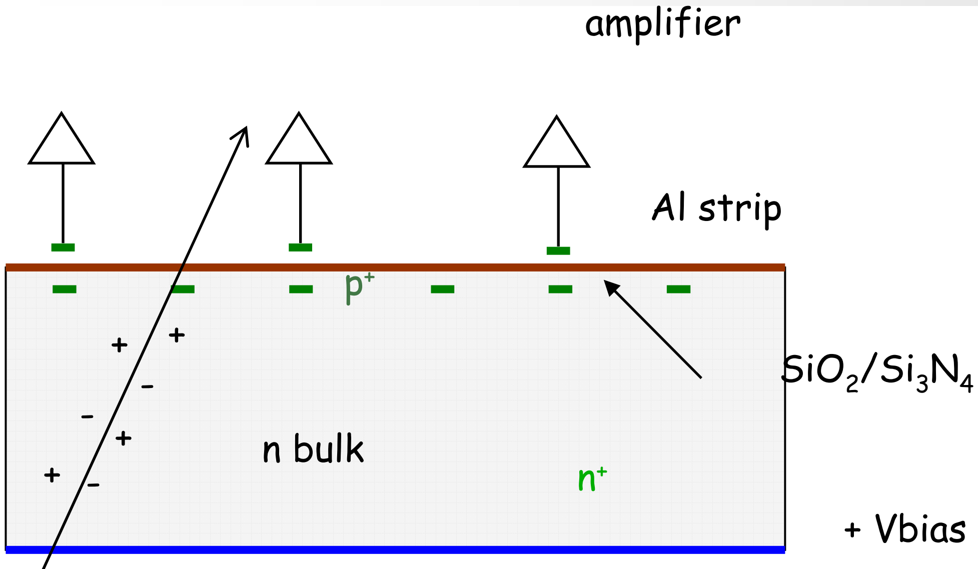
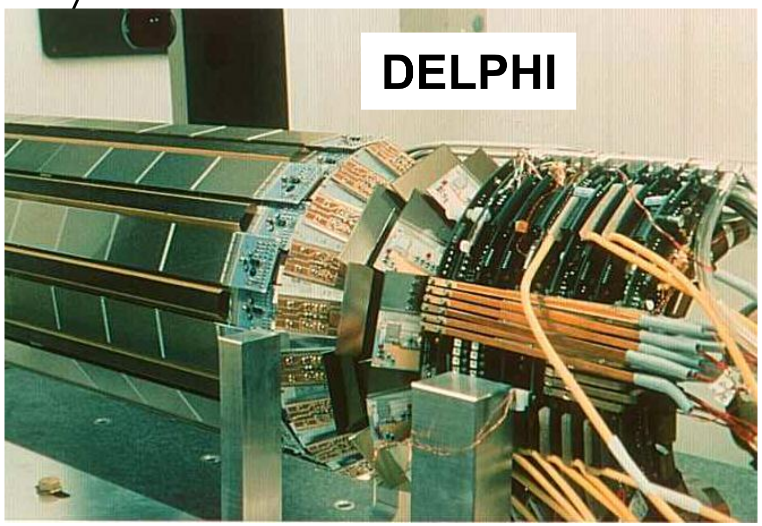
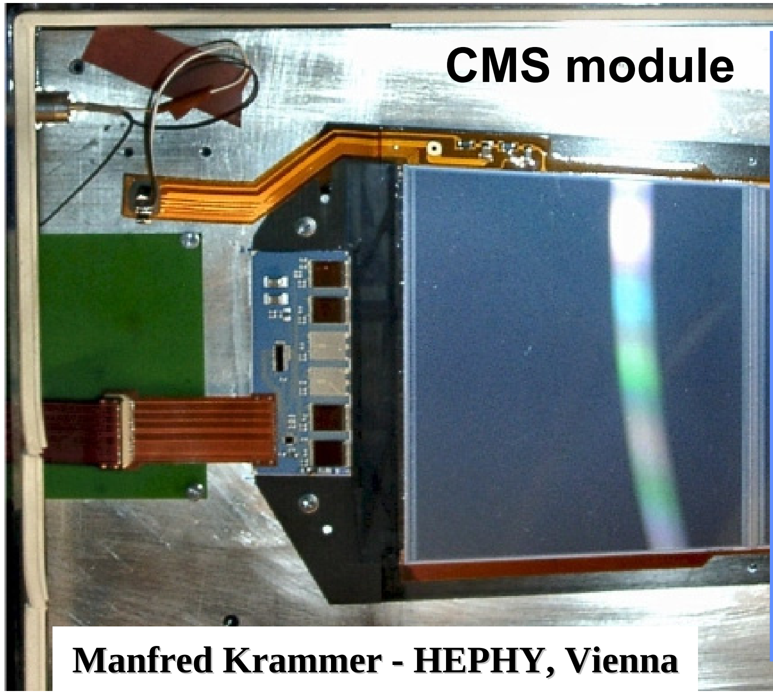
HEP detectors - The microstrip



- High resistivity (n) silicon
- Ion implants + Surface passivation
- AC or DC coupling
- Single sided (x) or double sided (x,y) r/o
- Integrated biasing schemes
- Intermediate (floating) strips for precision
- Double sided double metal line





- 210 m^2 of active silicon strip sensors
- 24,244 single silicon sensors
- 15 different sensor designs
- 16,000 modules
- 9,600,000 strips = electronics channels
- 75,000 APV chips
- 25,000,000 Bonds

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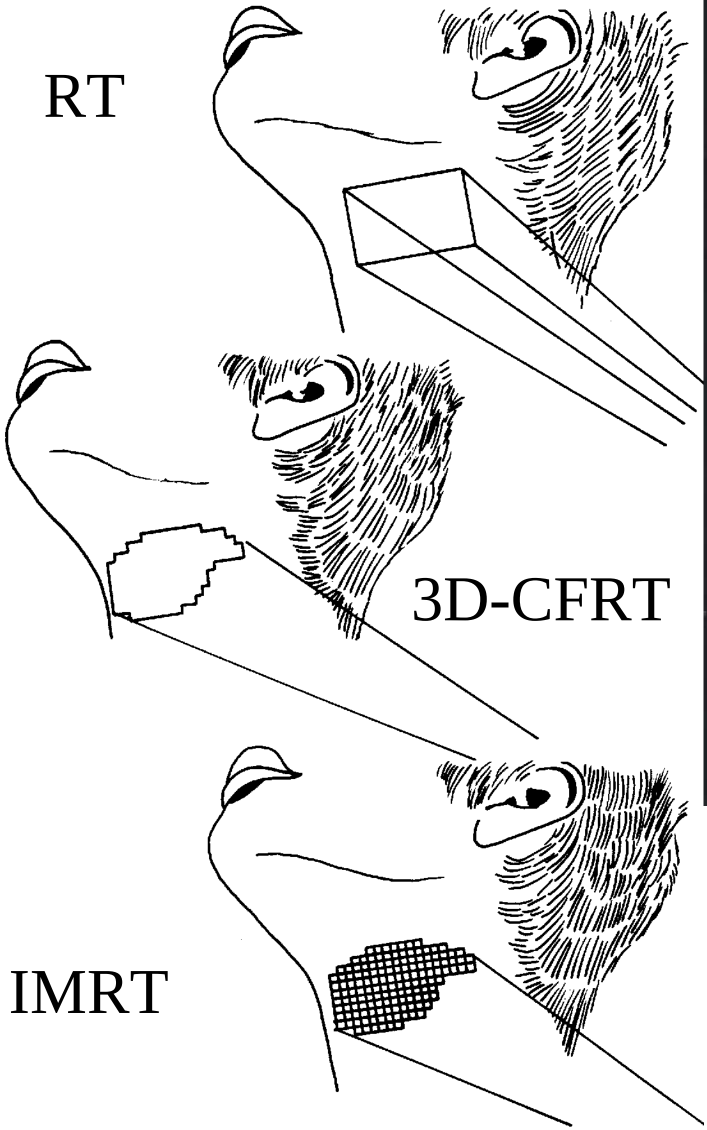
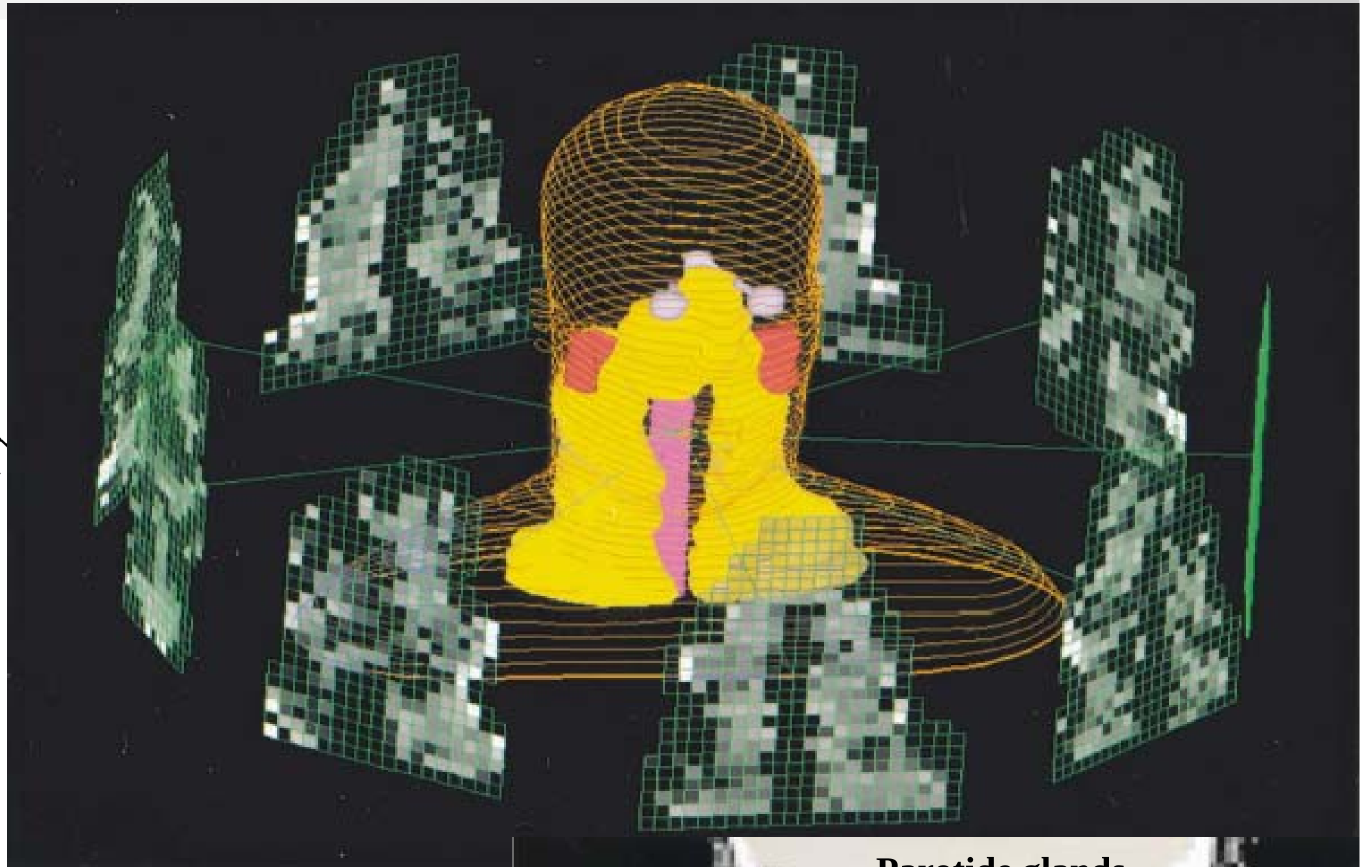
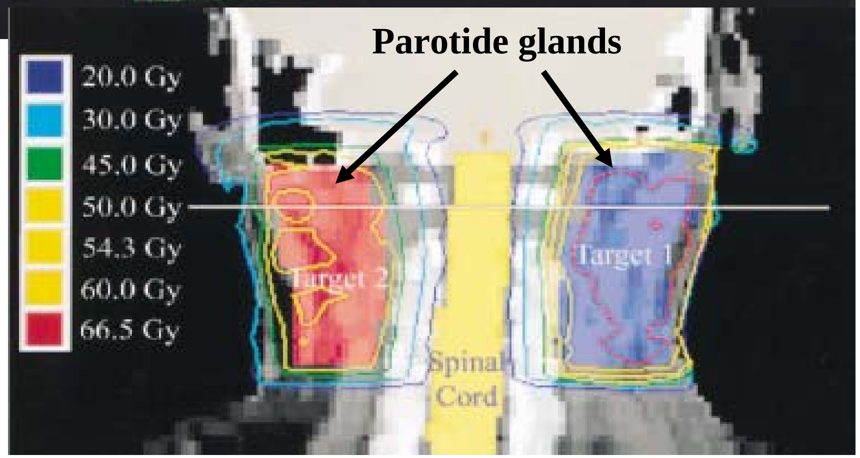
Radiotherapy







Optimised beams to deliver the **prescribed** dose with maximum **sparing** of the healthy tissue

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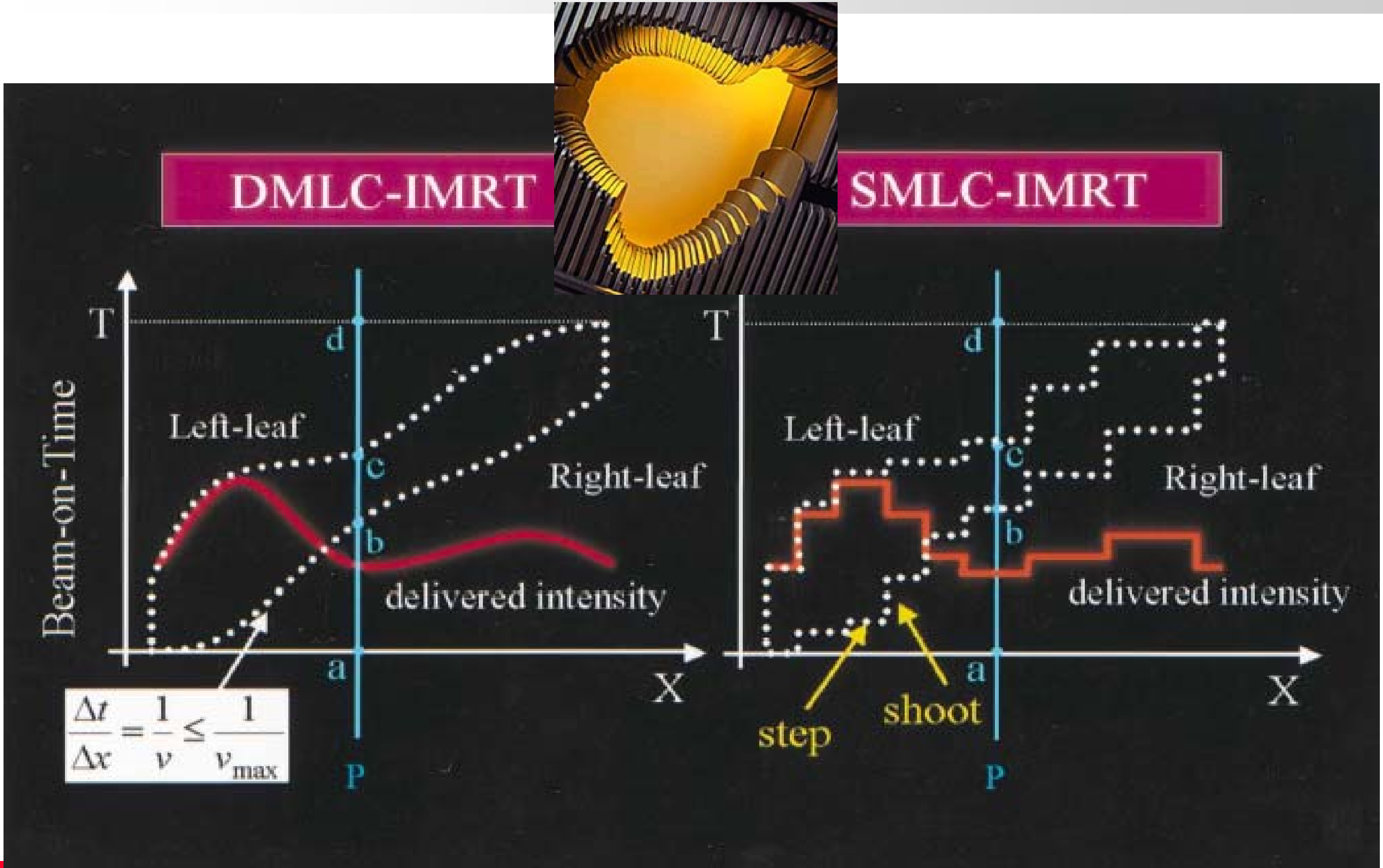
IMRT modalities



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Dosimetric QA - IMRT

"..In the early days .. it was ***feared*** *that the concept of moving components greatly* ***jeopardised*** *the* ***safety*** *of radiation therapy.."*
[IMRT, Webb]

3D CRT ⊕ fwd R.T.P. = define beam ⇒ calculate dose

Vs

IMRT ⊕ inv. R.T.P. = define (3D) dose ⇒ calculate (**optimum**) beam

"..Currently, no single dosimeter is capable of providing all the necessary dose measurements; thus, compromises must be made.."
[IMRT-CWG, J Rad Onc v.51, 2001]

Technical Solutions

Aplic.	Type	Pros	Cons
IMRT	Ionisation Chambers	• absolute dose • H_20 equivalent • direct r/o	• $\sigma_x \geq$ mm • single point • *no time info. (?)*
	TLDs	• cost • in-vivo measurements	• single point • Indirect r/o • no time info.
	Film	• σ_x << mm • cost • 2D	• Indirect r/o • no time info • non linear response
	GEL	• cost • volumetric meas. (3D)	• r/o cost (MRI unit, single use) • Integrating mode
	EPID	• 1 - 2D • direct r/o • real time • σ_x < mm	• cost • σ_x , dead space (?) • E, angle dep. (? : Ploeger et al. see [Webb]) • dead time - r/o speed (? : James et al., Williams et al., see [Webb])
Stereo.	Film	• σ_x << mm • cost	Indirect r/o , no time info
	Diodes	direct r/o	single point measurements

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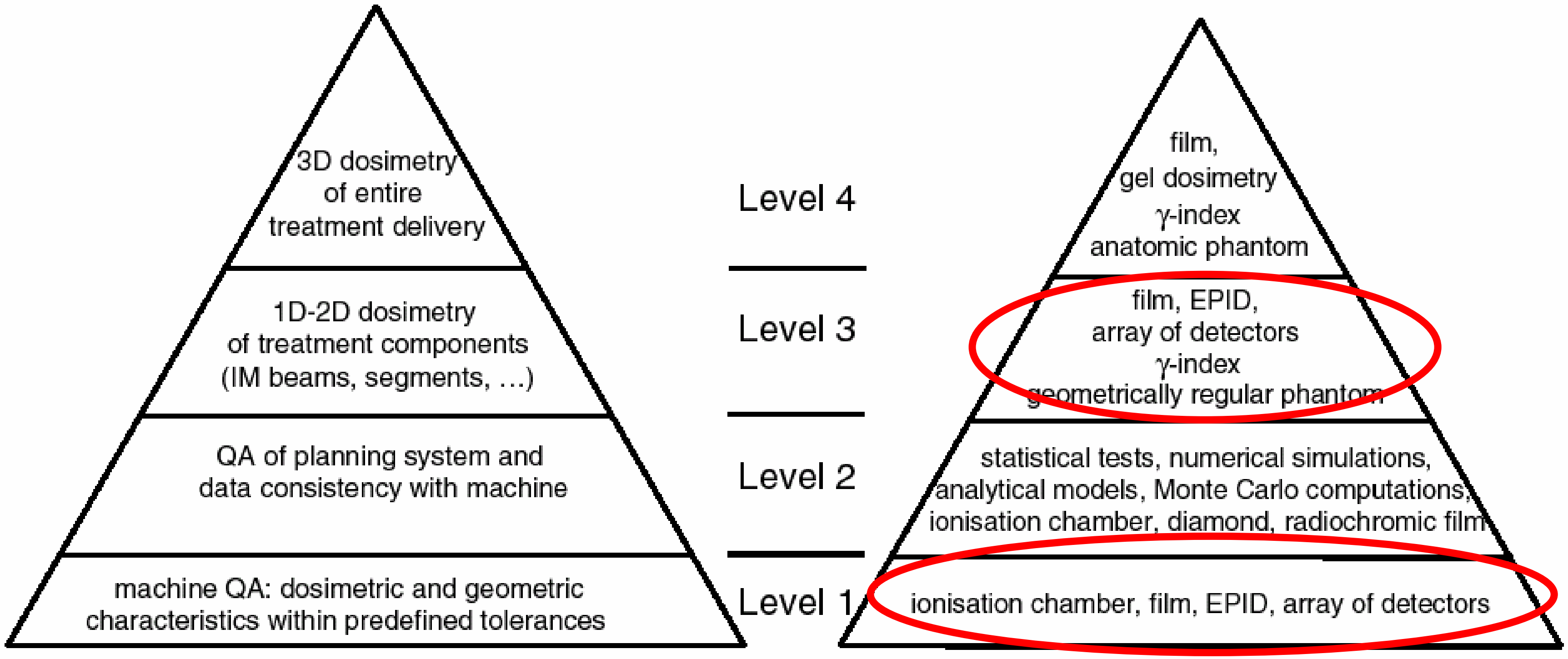
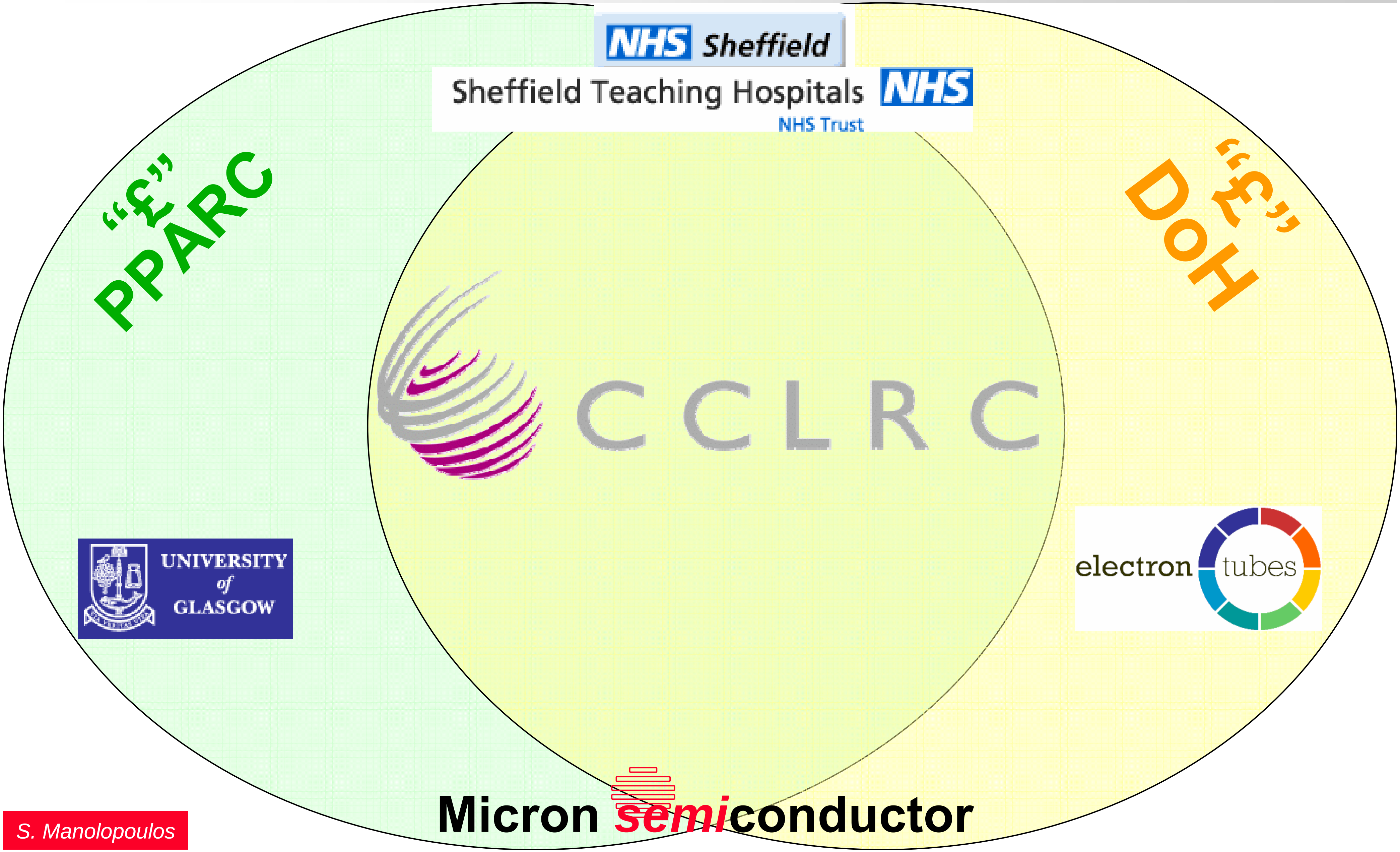
Dosimetric QA - IMRT



C De Wagter, J Phys: Conf. Series 3 (2004) pp/4-8

Scope to use linear arrays...

Project δOSI



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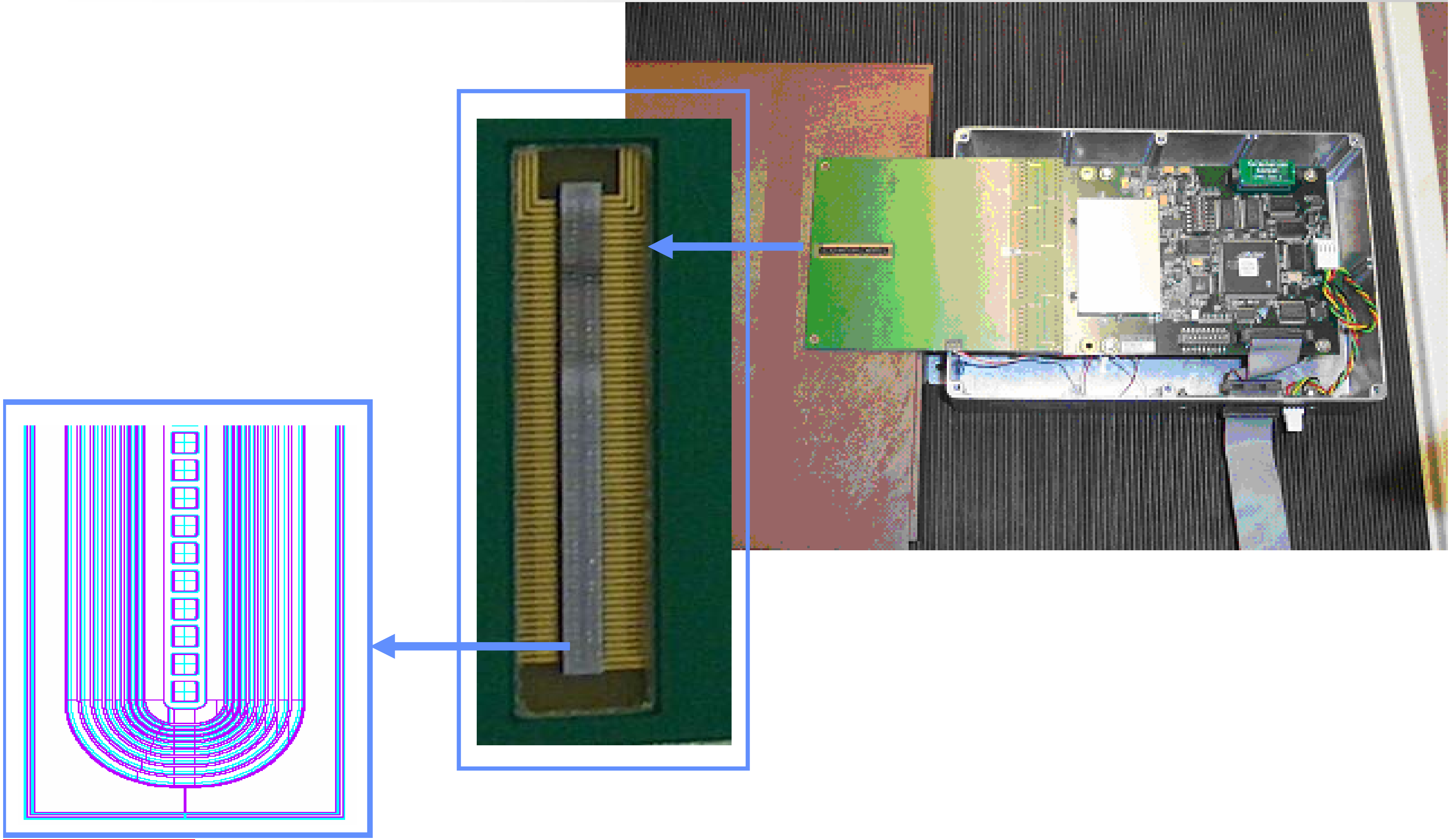
1D detector



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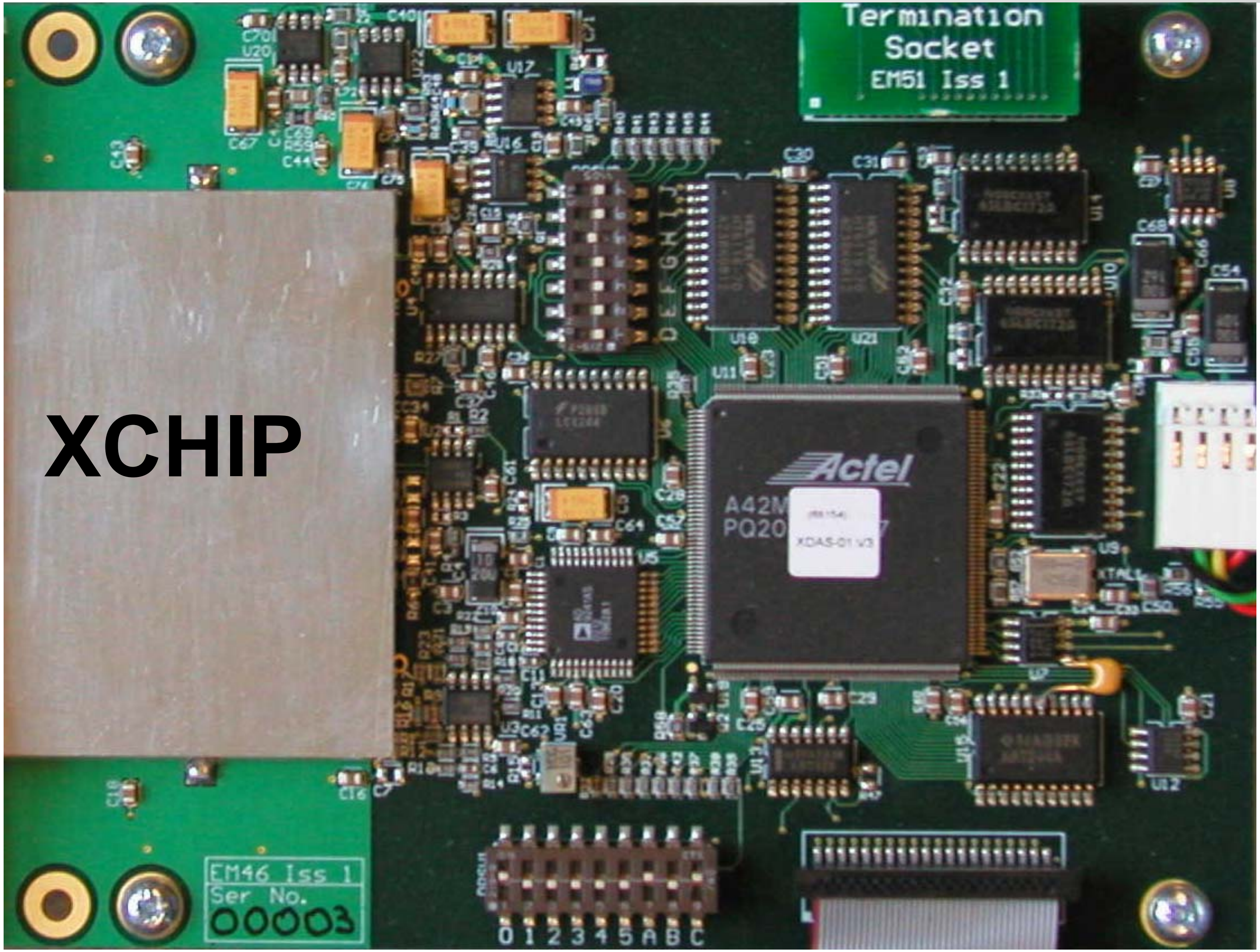
XDAS



Spec's

- t_{int} = 10 μs - 1sec
- dead time = 1 μs
- dyn. range = 15 pC
- sub-sampling
- Linearity > 99.9%
- read-out = 5 Mb/s
- Multi-module r/o
- N_{mod} < 63 (8064ch)
- 1000 £/module

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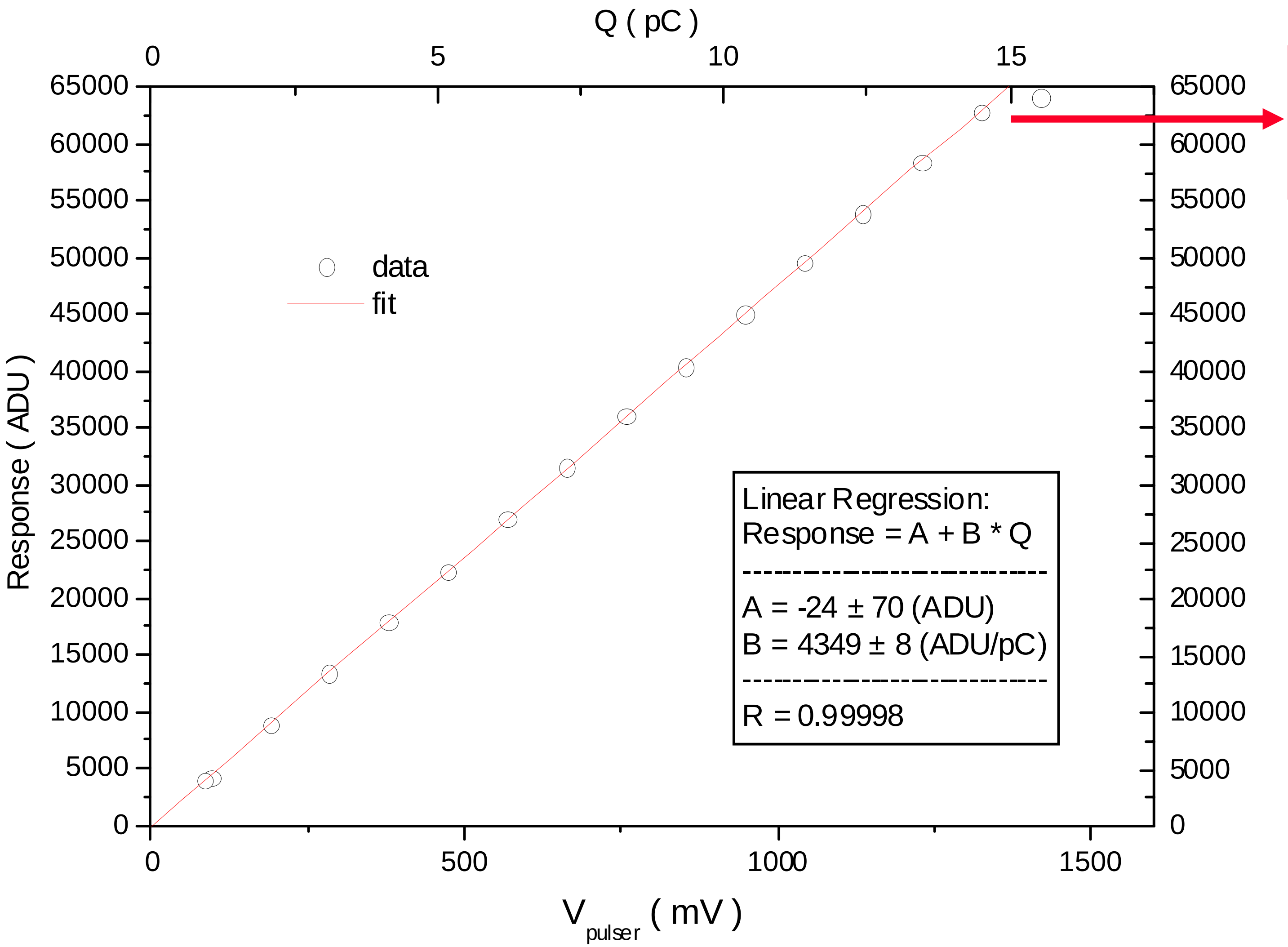
ΔOSI - 1st Lab. Tests



Non-linearity

1.1 %

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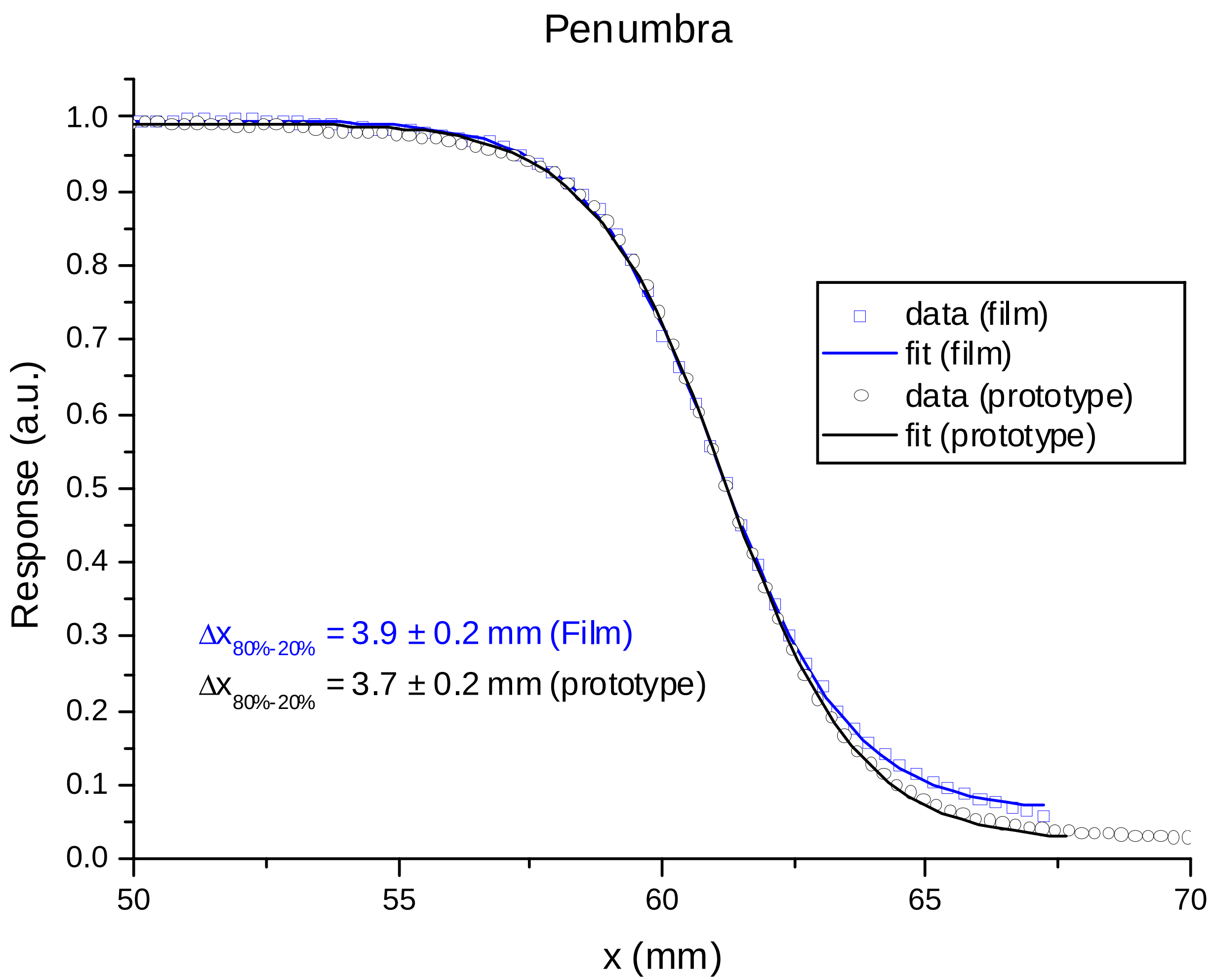
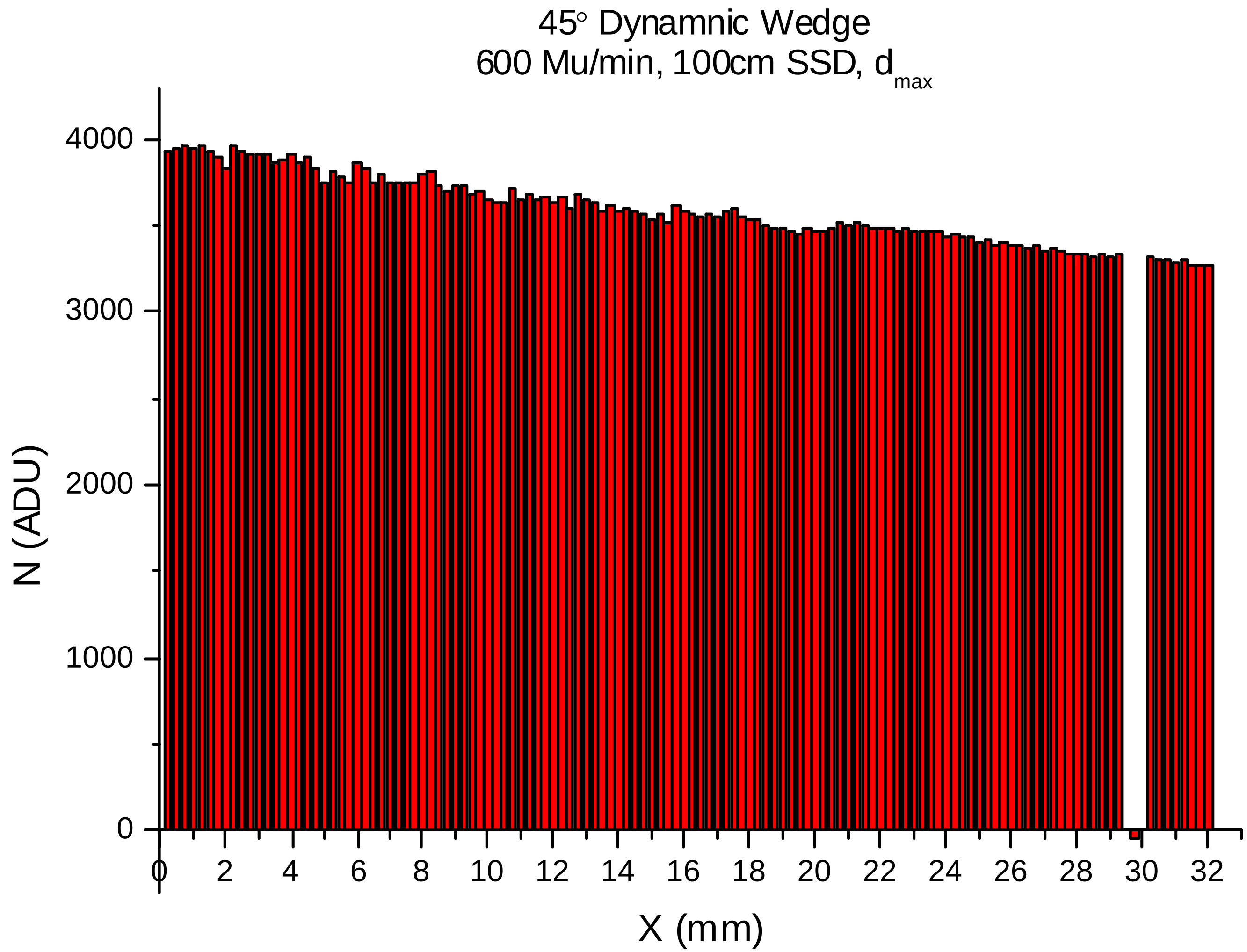
Hospital Measurements - static



Hospital Measurements - dynamic



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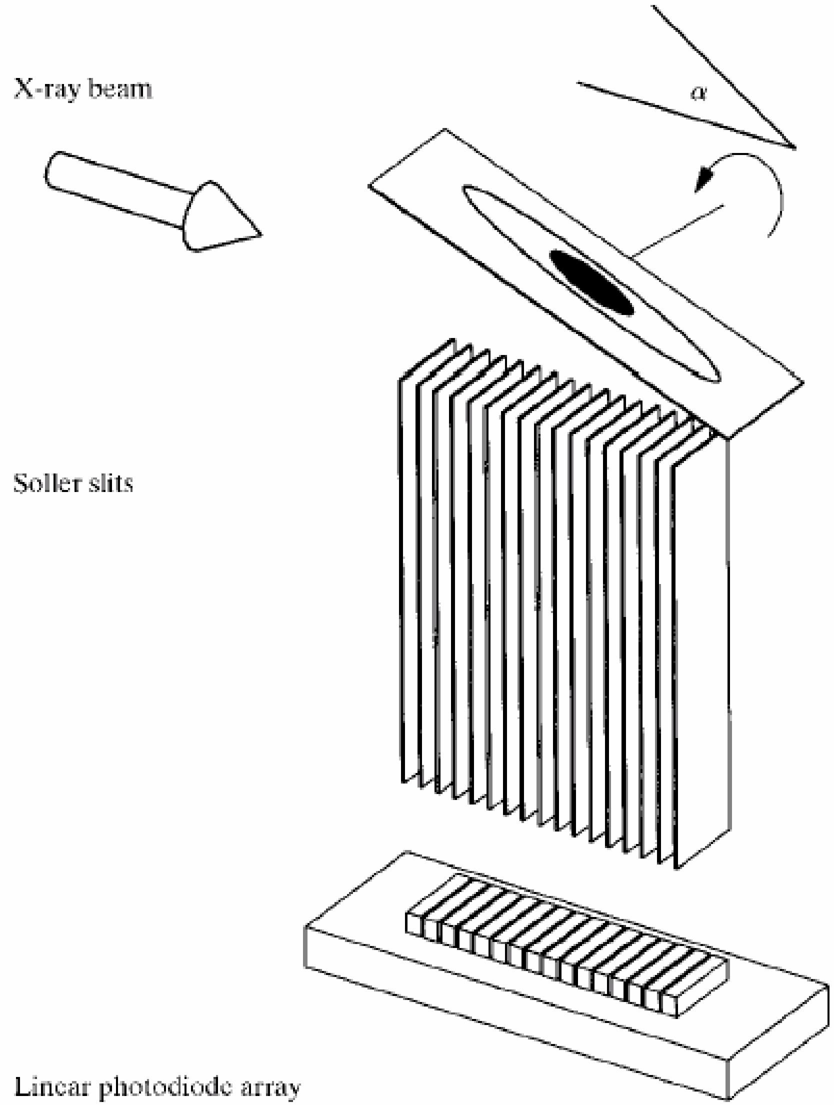
SR applic's - BPM



R. G. van Silfhout

J. Synchrotron Rad. (1999). **6**, 1071–1075

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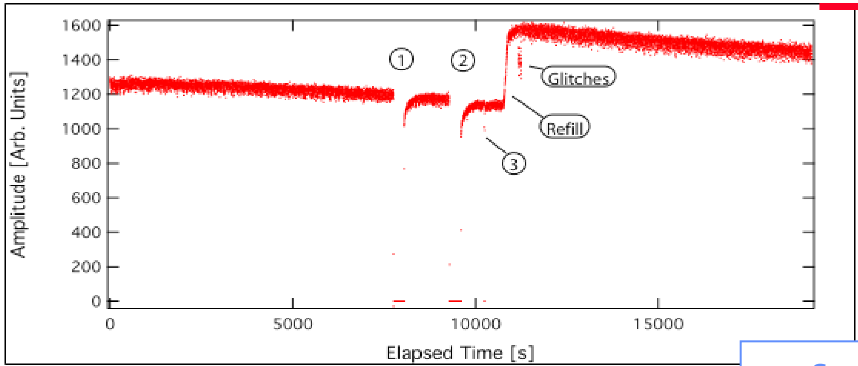
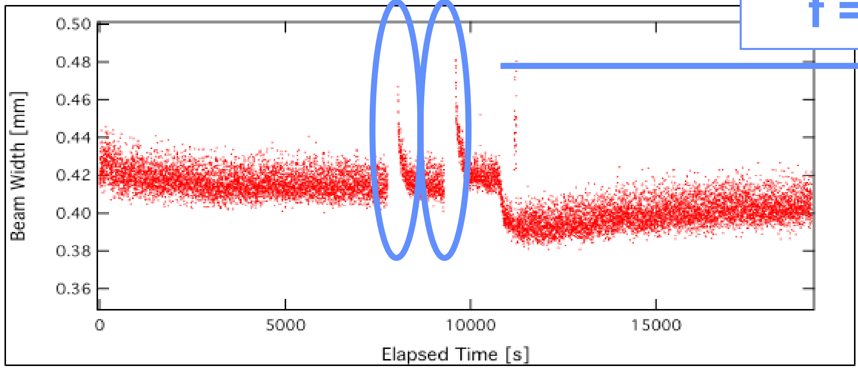
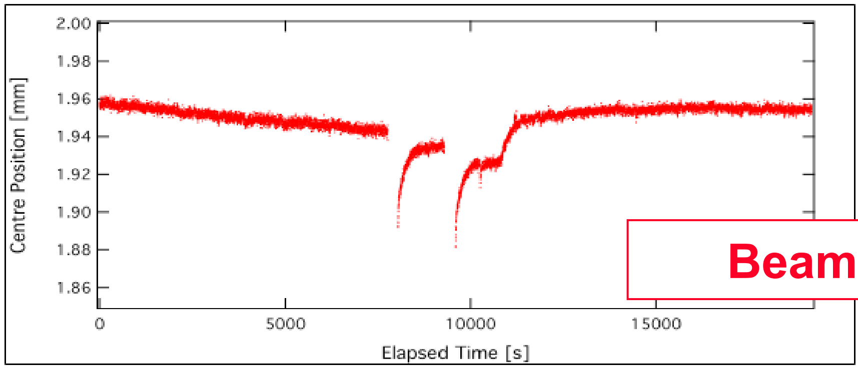
Beam Stability





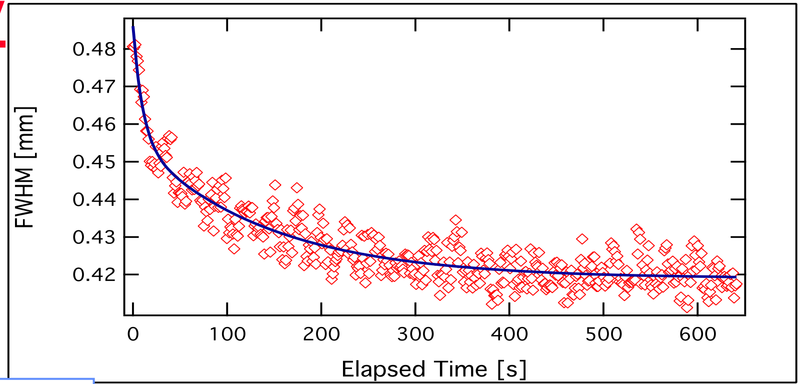


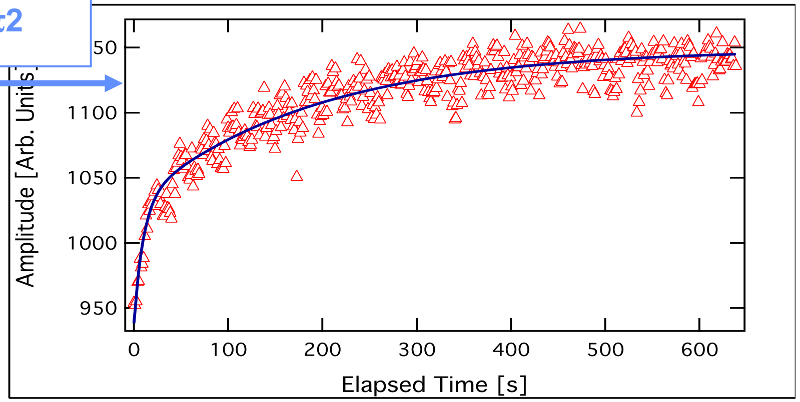
$$f = a + b*e^{-t/\tau 1} + c*e^{-t/\tau 2}$$

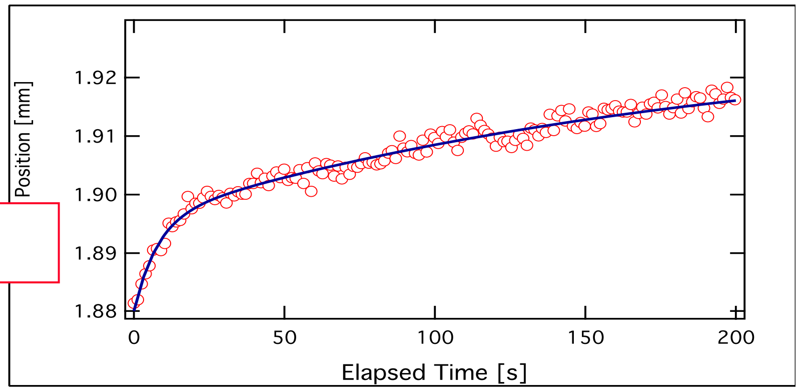
τ_1 = 11 sec

τ_2 = 158 sec

Beam drift = 30 μm/hr







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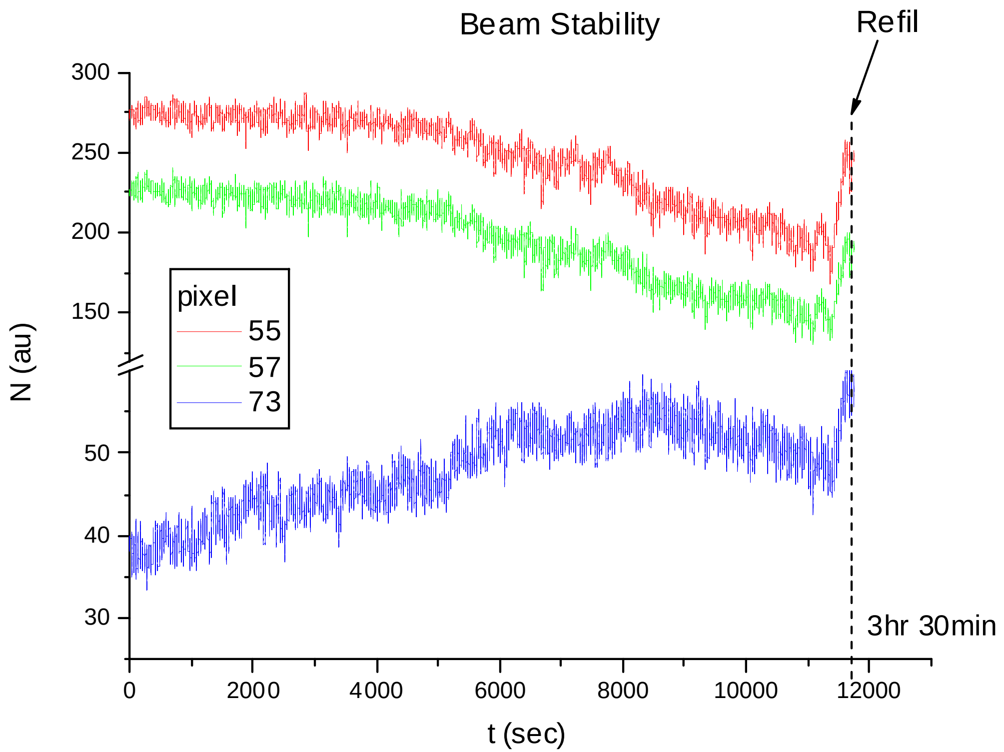

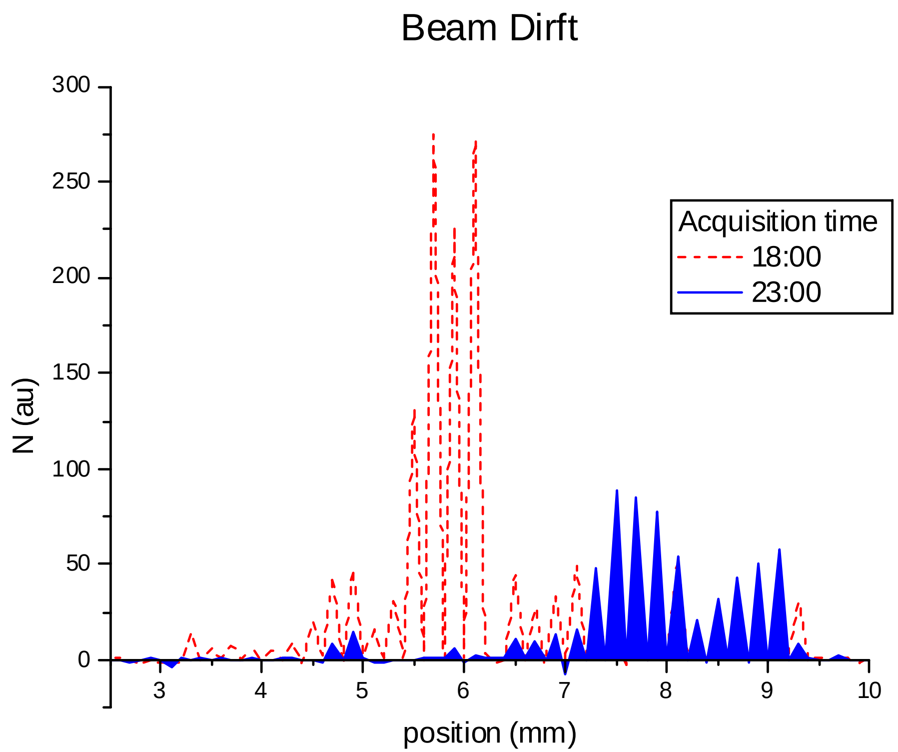

Drift ~ 2 mm/ 5 hrs ~ 400 μm/hr

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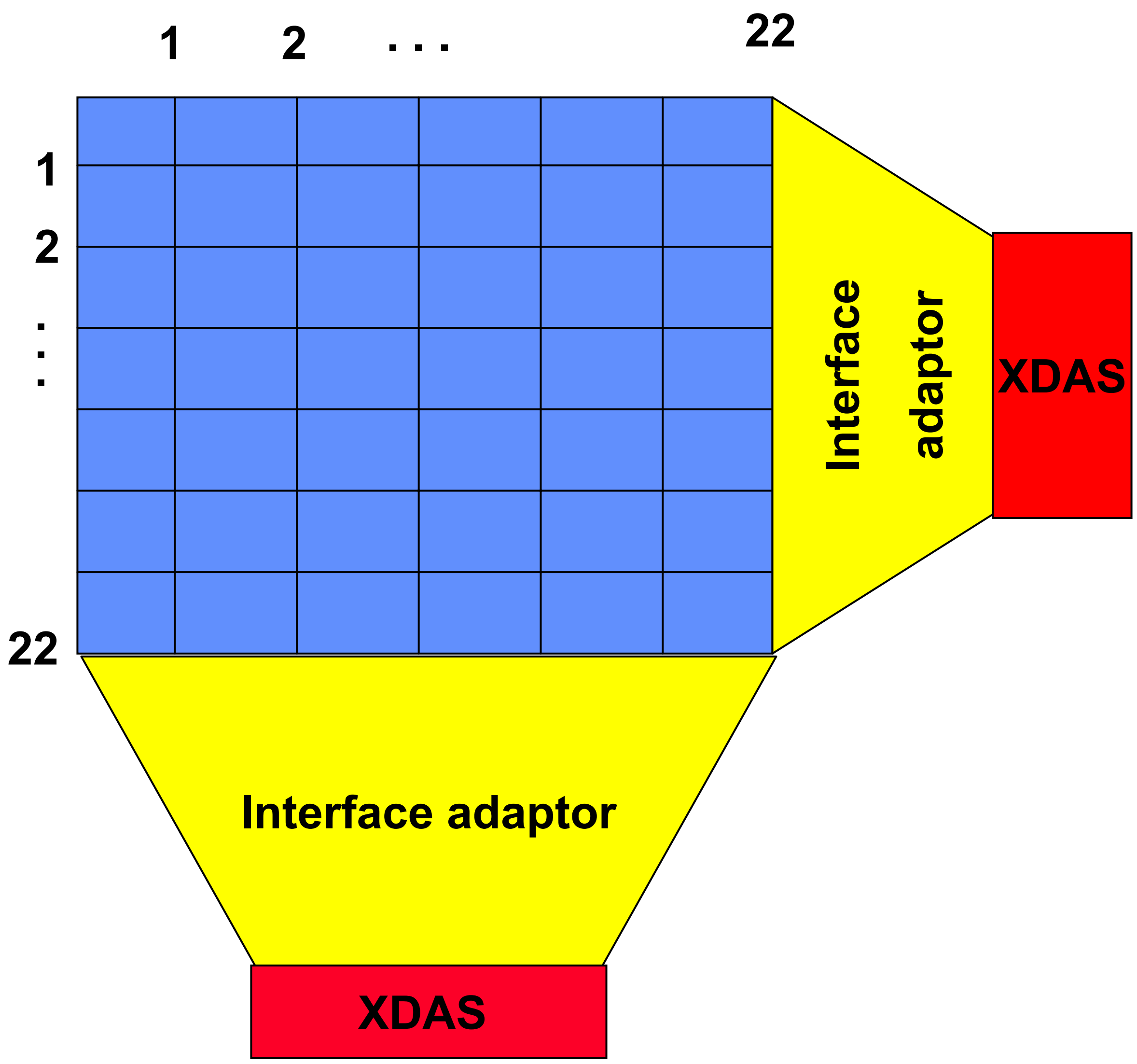
Summary & Conclusions

- **Technology transfer is a good thing**
  - The "δOSI" experience:
    - Improved performance over present "Au" standard (temporal info.) and best commercial systems (spatial info.) leading to...
    - ….Improved (NHS) services (treatment, throughput)...
    - ….Wealth creation (new markets for UK industry & RC…)
  - The ESRF experience :
    - More effective beam time use - less time 4 setting-up & problem solving...
    - ….Higher user throughput AND better experiments
- **Lessons learned - Useful tips :**
  - Needs a problem (its good to talk)
  - Needs an idea (or two..) *"I think there4 I am"*
  - Needs a "total" solution provider (call EID)

ΔOSI Options - 2D



Spec's :

- 22 x 22 matrix
- 484 pixels
- 4 XDAS boards
- pixel size = 0.455 mm
- Area = 1 cm

Aim = Stereotaxy

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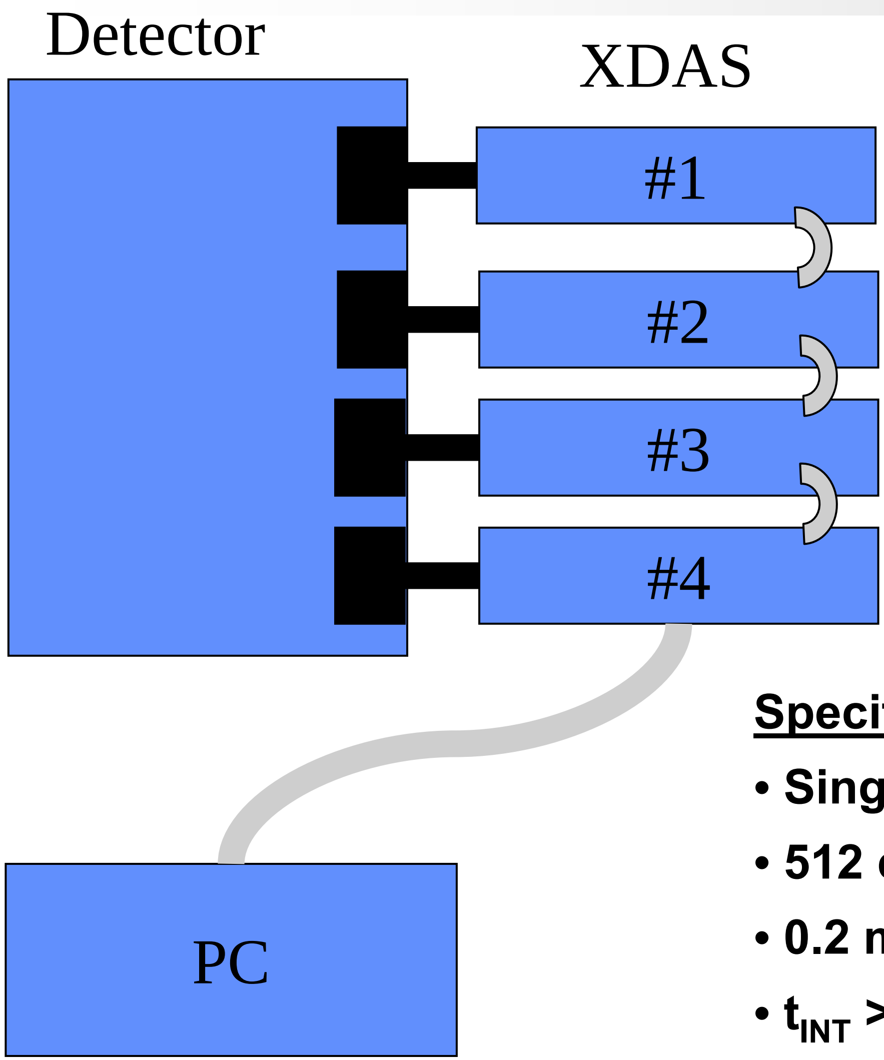
ΔOSI Options - 1D



Specifications:

- Single crystal - Si
- 512 chan. (128 x 4)
- 0.2 mm pitch
- $t_{INT} > 10\ \mu sec$
- 1 kHz frame rate
- External Trigger
- Qmax = 15 pC

"Performance" :

- FoV ~ 10 x 10 cm^2
- $\sigma_x <$ mm
- real time r/o
- Cost (…)
- Energy Independ.
- Angle Independ.
- *2D*
- *$H_2$0 eq.*

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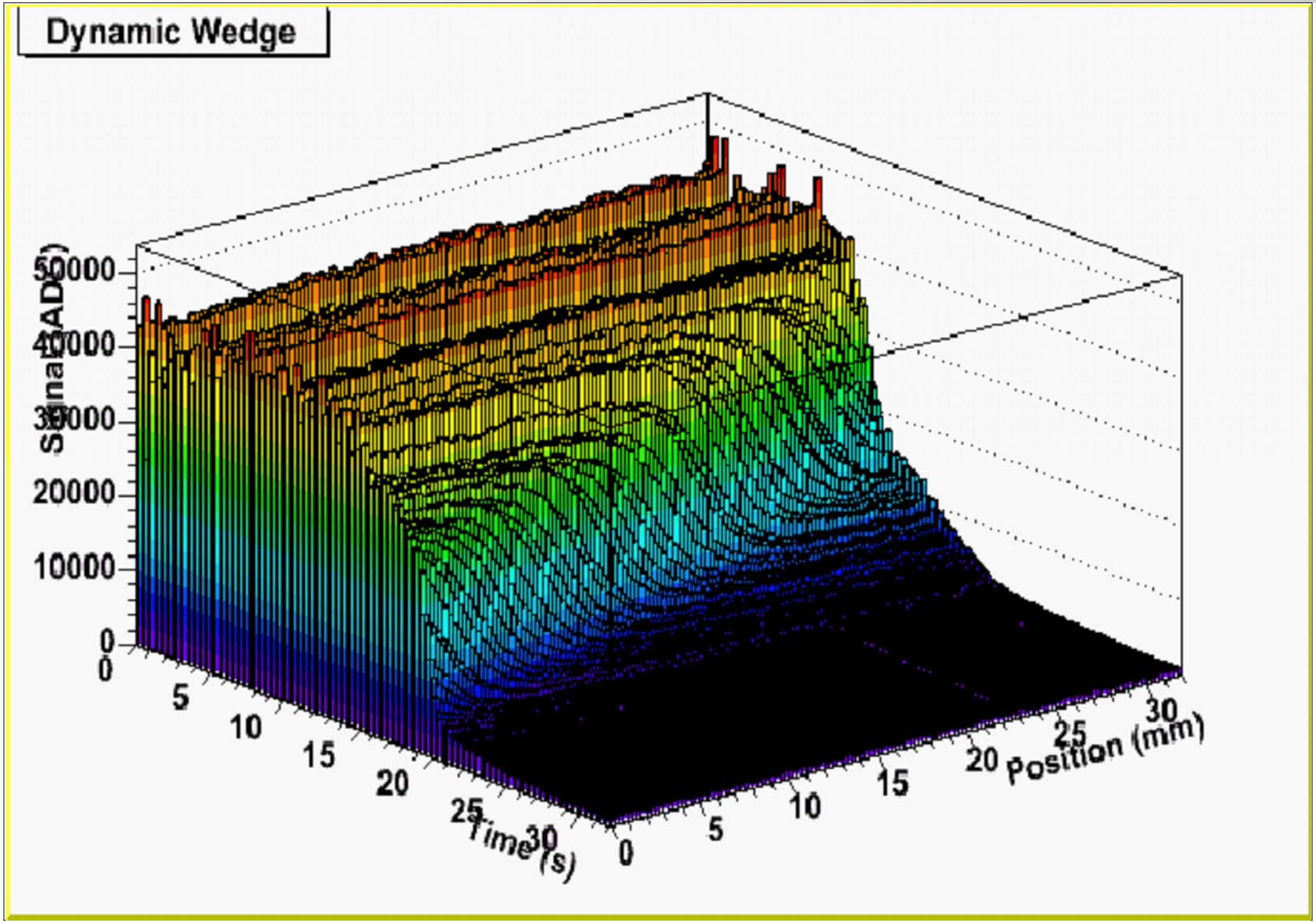
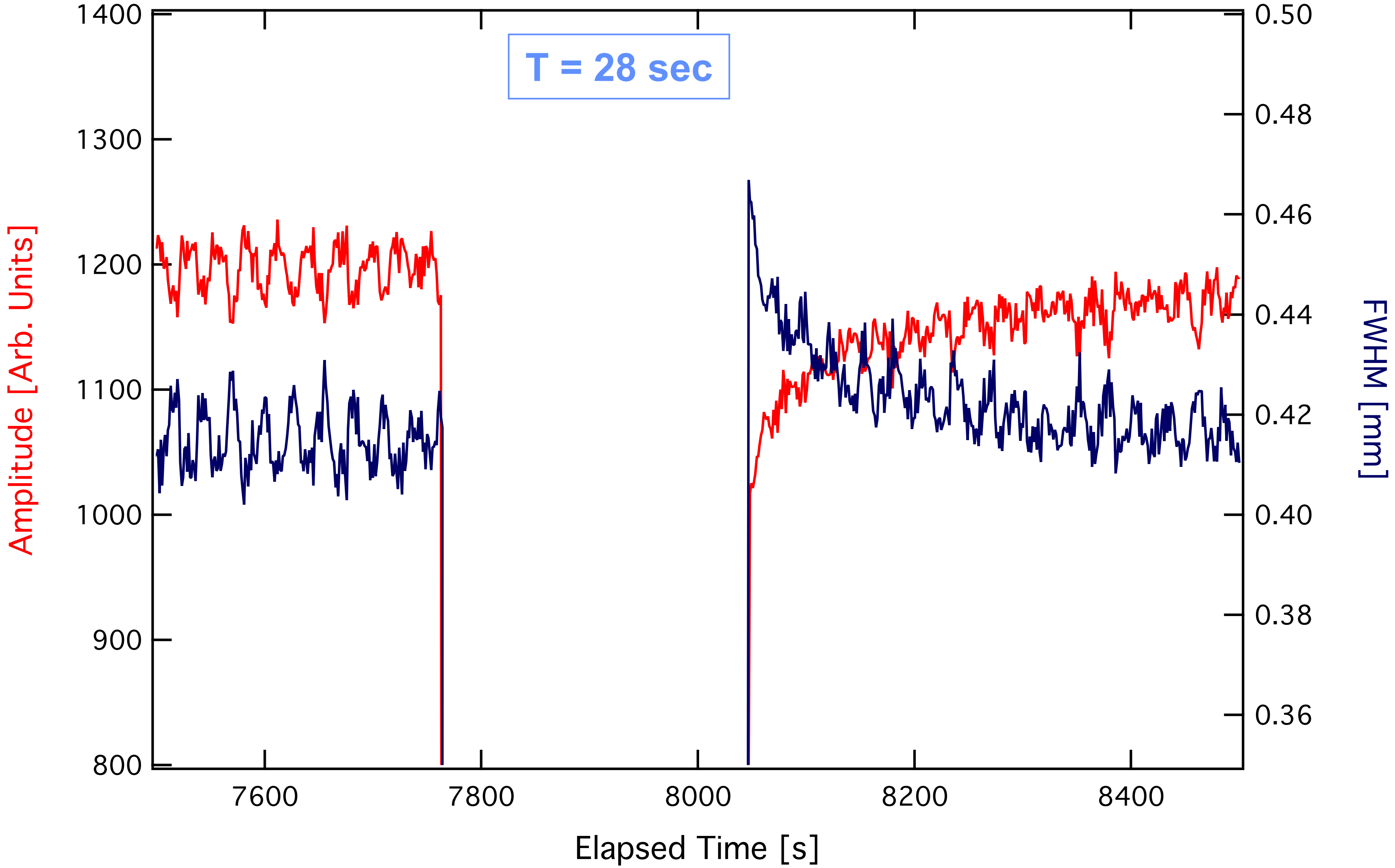
Hospital Measurements - dynamic



SR applic's - BPM

Beam Oscillations



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