

# Development of Multi-Tubes Detectors at the ILL

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## The D22 detector project (2000-2004)

The D22 SANS Multiwire Proportional Chamber was made with 2 orthogonal frames of sensing wires with 7.5 mm pitch.

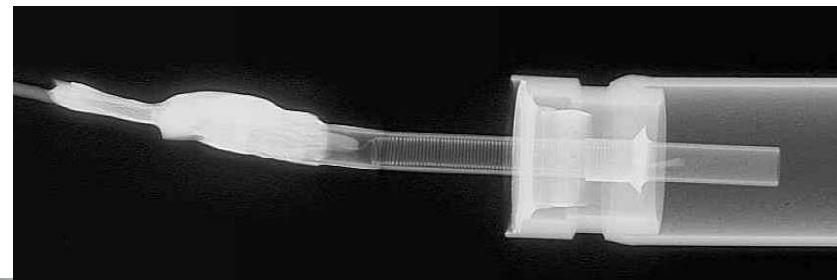
The detector dead time was about 1 microsecond due to the coincidence time of the signals of the X and Y wire planes, the shaping time of the amplifiers and the communication time of the data acquisition system

Max counting rate: few hundreds kHz

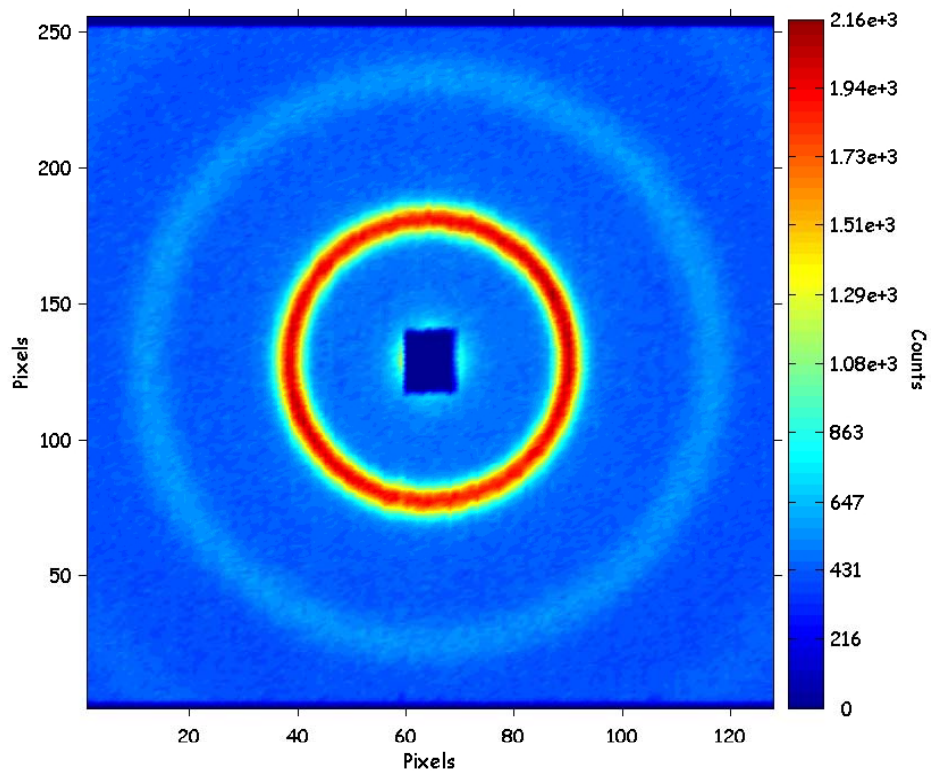
The new one (viewed from the front side) has been made of 128 independent PS counter tubes (Reuter Stokes)

Position measured by recording the signals on both ends of the resistive anode

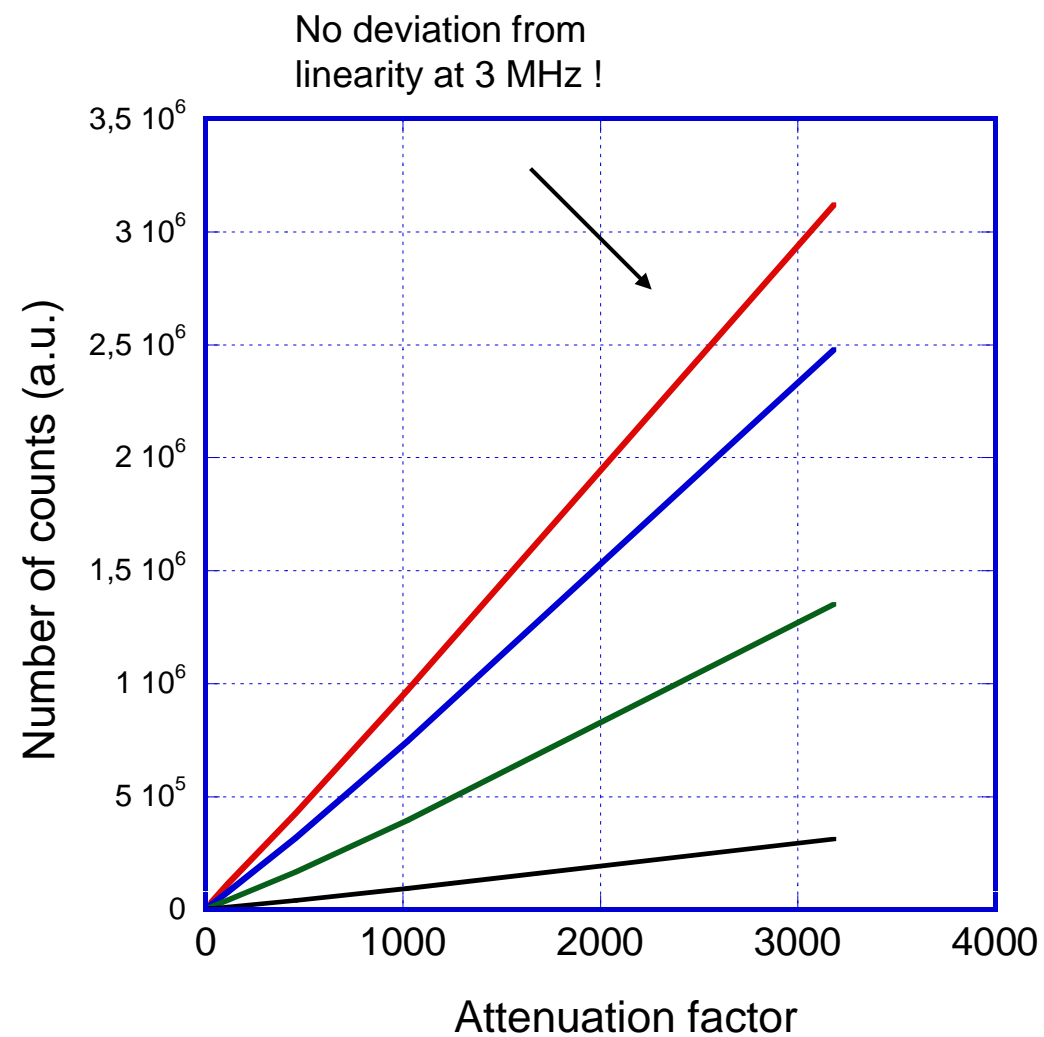
→ increased counting rate



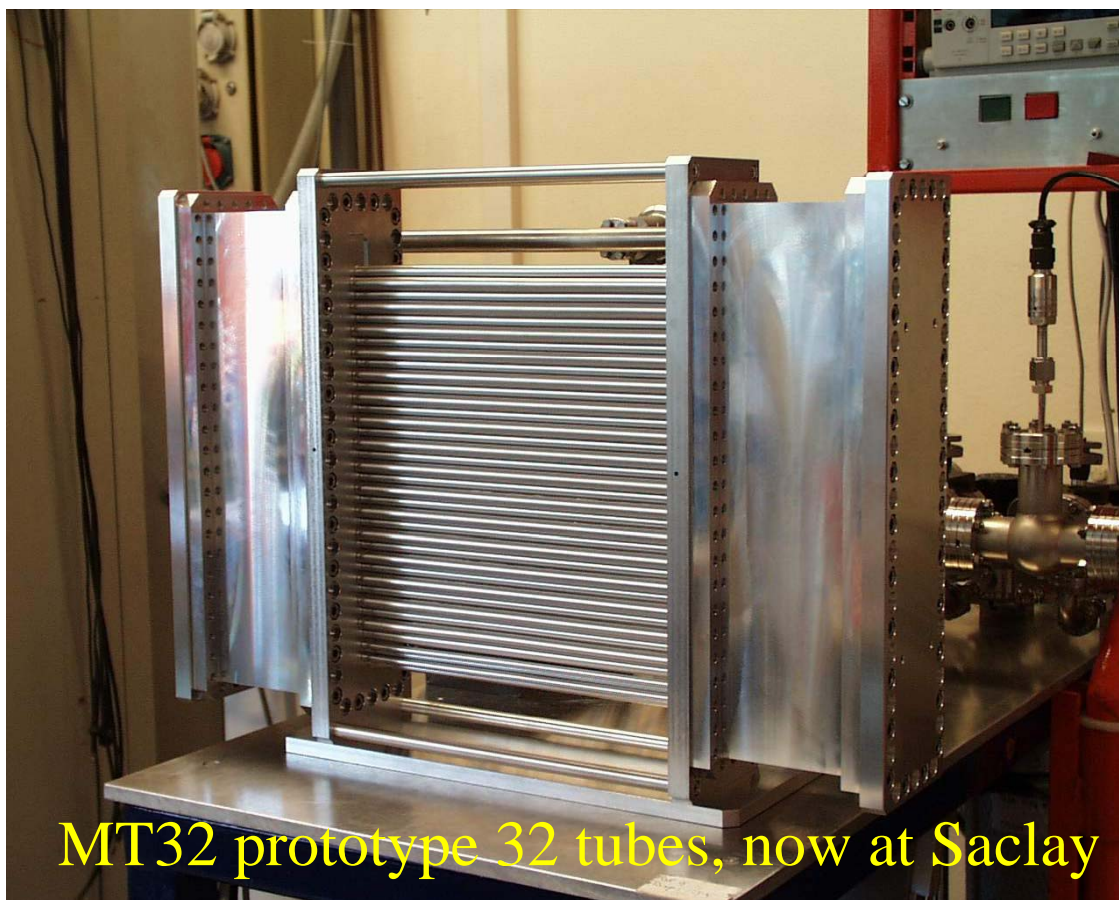
Supported by  
TECHNI  
(FP5)



Diffraction pattern of a AgBe powder sample







Tubes of different diameter can be made, from 1 inch to 4.5 mm, length vary from 25 cm to 5 m.

A Multitube detector works the same way as an arrangement of PSCT, but its fabrication is different : the tubes are welded on a common gas vessel on both sides. This detector does not require the precise mechanics of a multi-PSCT arrangement.





## The IN5 project (2005)

12 modules of 32 tubes each, 3 m long, 1 inch diameter (384 detectors)

Total surface 30 m<sup>2</sup> (2,5 m<sup>2</sup> per module)

Volume <sup>3</sup>He: 2850 l

Volume CF<sub>4</sub>: 570 l

Weight: 3500 Kg

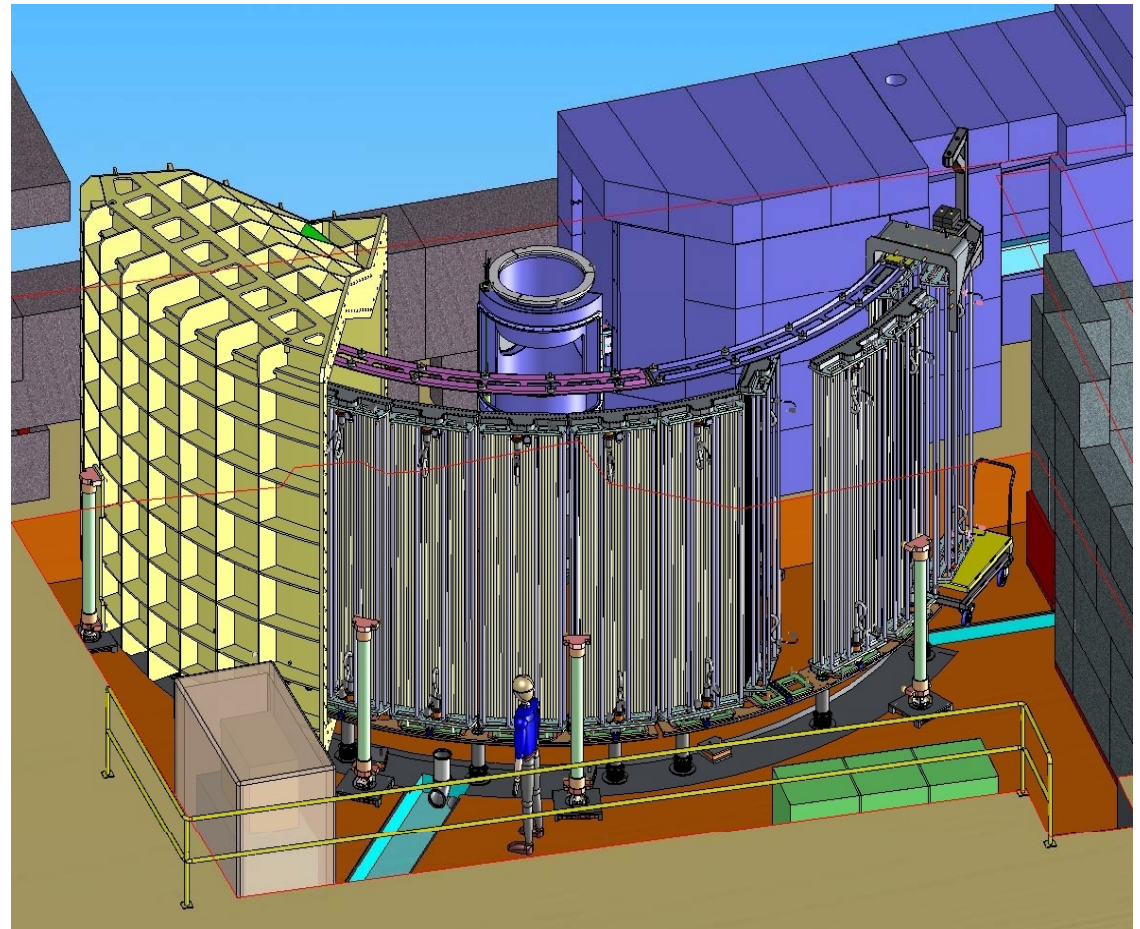
Resolution : 26 mm x ~26 mm

Radius of curvature : 4 m

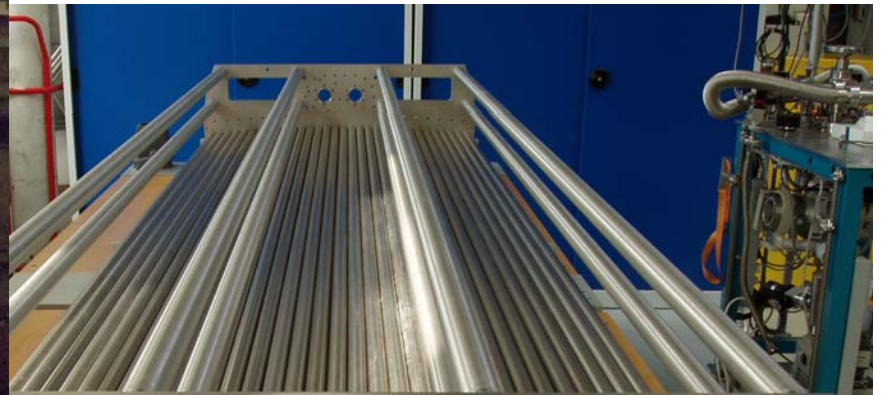
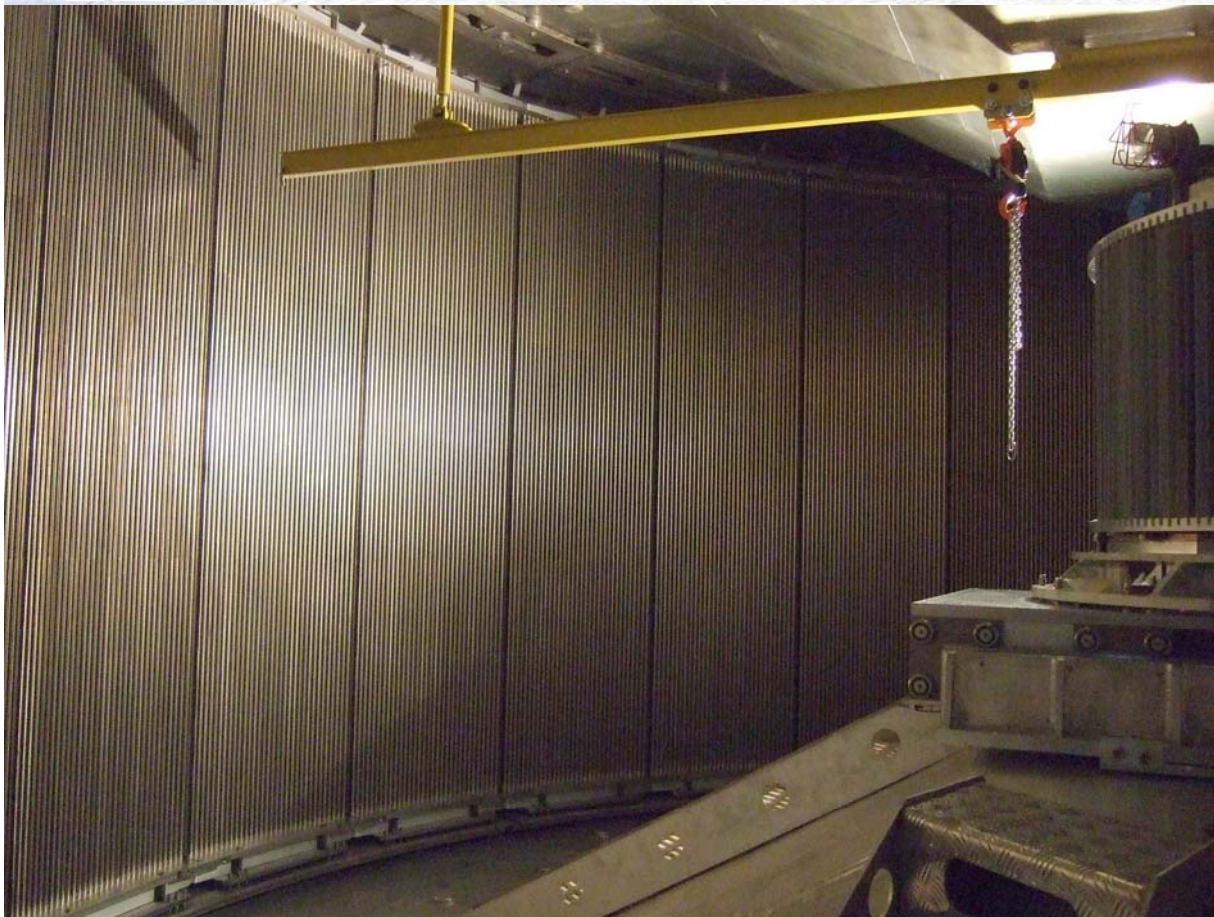
4 km of SS wire (25 μm)

3500 nuts and bolts

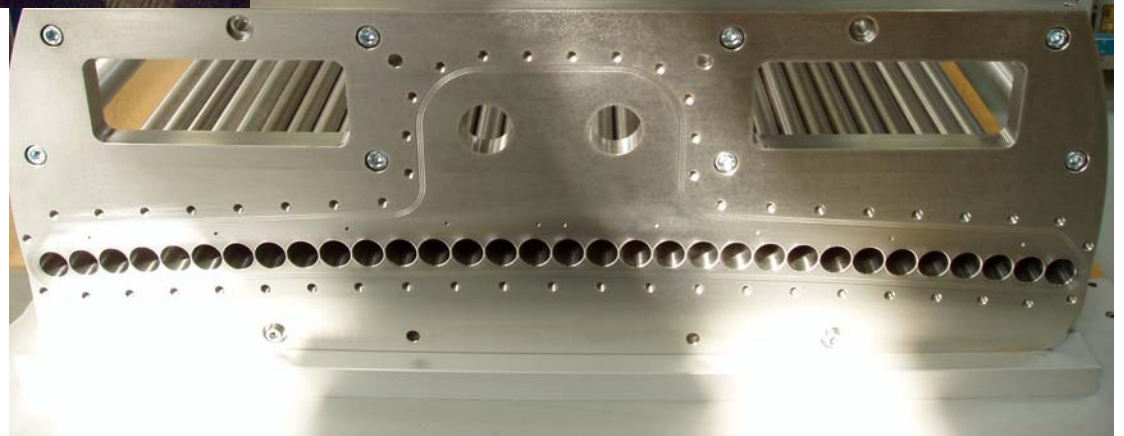
1000 amplifiers







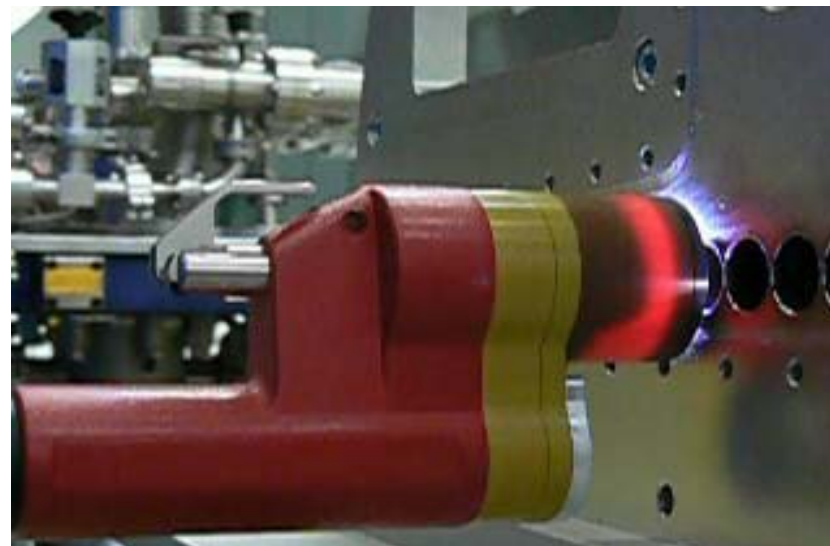
The 12 modules are installed in the flight chamber, while the electronics is mounted outside, in air





## Technical challenges:

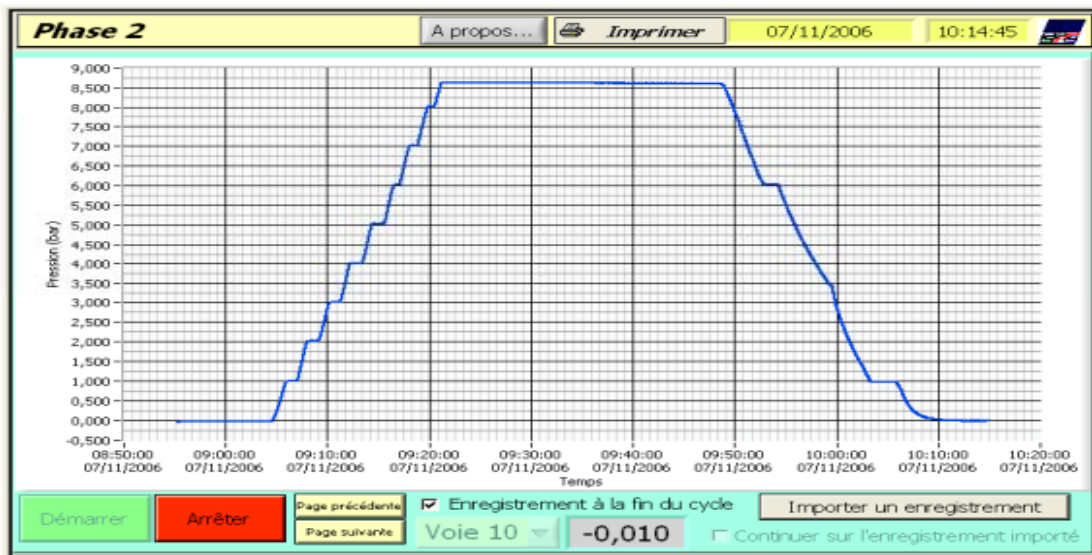
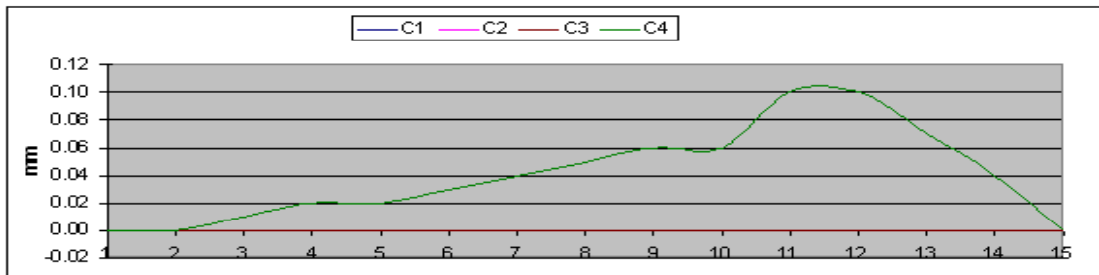
- Tubes welding
- Gas tightness
- Electrical connections
- Detectors in vacuum
- Quality control



## Management challenges:

- Lab equipment, production tools
- Orders following
- Safety issues
- Project time scale
- Detectors handling

Pression absolue (en bar)	manomètre M1 (en bar)	manomètre M2 (en bar)	Compresseurs (mesures en mm)			
			C1	C2	C3	C4
0 bar	0.00	0.00	0.00	0.00	0.00	0.00
1 bar	1.06	1.00	0.00	0.00	0.00	0.00
2	2.07	2.00	0.00	0.00	0.00	0.01
3	3.05	2.99	0.00	0.00	0.00	0.02
4	3.91	4.00	0.00	0.00	0.00	0.02
5	4.92	4.99	0.00	0.00	0.00	0.03
6	5.90	5.99	0.00	0.00	0.00	0.04
7	6.91	7.00	0.00	0.00	0.00	0.05
8	7.91	8.00	0.00	0.00	0.00	0.06
8,6	8.60	8.60	0.00	0.00	0.00	0.06
8,6 (après 10 minutes)	8.60	8.60	0.00	0.00	0.00	0.10
6	0.00	6.01	0.00	0.00	0.00	0.10
1 bar	0.00	0.99	0.00	0.00	0.00	0.07
0 bar	0.00	0.01	0.00	0.00	0.00	0.04
0 bar (après 30 minutes)	0.00	0.00	0.00	0.00	0.00	0.00



Every module is tested for gas tightness and deformation under the gas pressure.



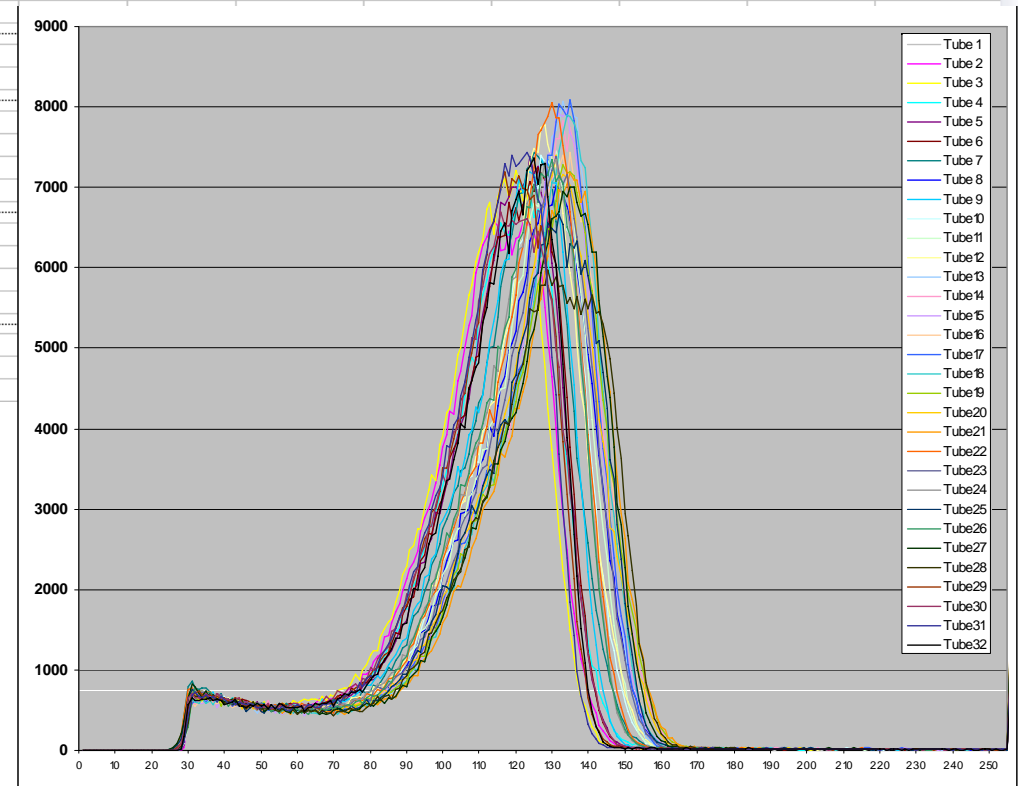
Microsoft Excel - Mod8-Final-Spec2100V-250mV-Avec Cadmium

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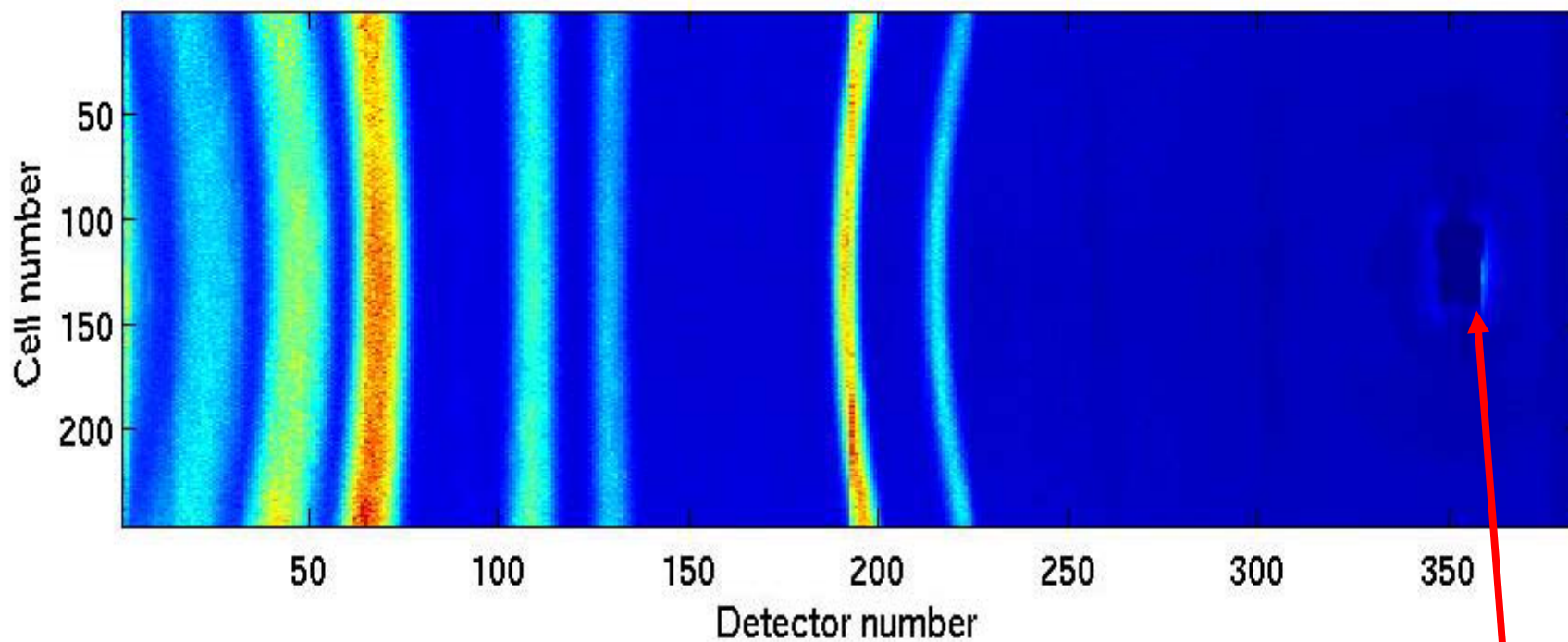
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O		
1	<b>DETECTOR IN5</b>																
2																	
3																	
4	<b>Module :</b>	8															
5	<b>USERNAME :</b>	Harang										<b>DATE :</b>	7/2/07 18:42				
6	<b>DATAFILE :</b>	D:\RésultatsTestsModulesIN5\Module8\Test Final avec Cadmium\ Mod8-Spec2100V-AvecCadmium-250mV.xls															
7																	
8	<b>Comments :</b>	Vitesse TrX = 1% Hauteur Source : Source à 2cm du Cadmium															
9																	
10																	
11																	
12	<b>EXPERIMENT</b>																
13		<b>Acq. Duration --&gt;</b>		2	<b>Heures</b>	17	<b>mn</b>	44	<b>sec</b>								
14		<b>ROI for Peak Pos. &amp; FWHM Calculation</b>		70	<b>To</b>	170											
15																	
16																	
17	<b>AXIS : (mm)</b>	<b>TR_X</b>	<b>X repeat</b>	<b>X speed</b>		<b>Y begin</b>		<b>Y end</b>									
18		0 to 1000	0	0.85 mm/sec		0		2800									
19																	
20																	
21																	
22	<b>Electronics</b>																
23		<b>Ampli :</b>	17V/pC														
24		<b>HT:</b>	2100 V														
25		<b>Seuil discri</b>	250 mV														
26																	
27																	
28	<b>Gas parameters</b>																
29	<b>Date of Gas Filling :</b>	1/9/2007															
30	<b>CF4 :</b>	1.25		<b>bars</b>													
31	<b>He3 :</b>	4.5		<b>bars</b>													
32																	
33																	
34	<b>Neutrons Source</b>		<b>Type</b>	<b>H pos (X=0 &amp; Y=0)</b>		<b>Colimation</b>											
35	Grosse Source GERM		AmBe	20mm		Y											
36																	



All the test parameters are recorded in a spreadsheet for a complete following of the detector performances

## Diffraction pattern from a Yttrium Iron Garnet Powder Sample

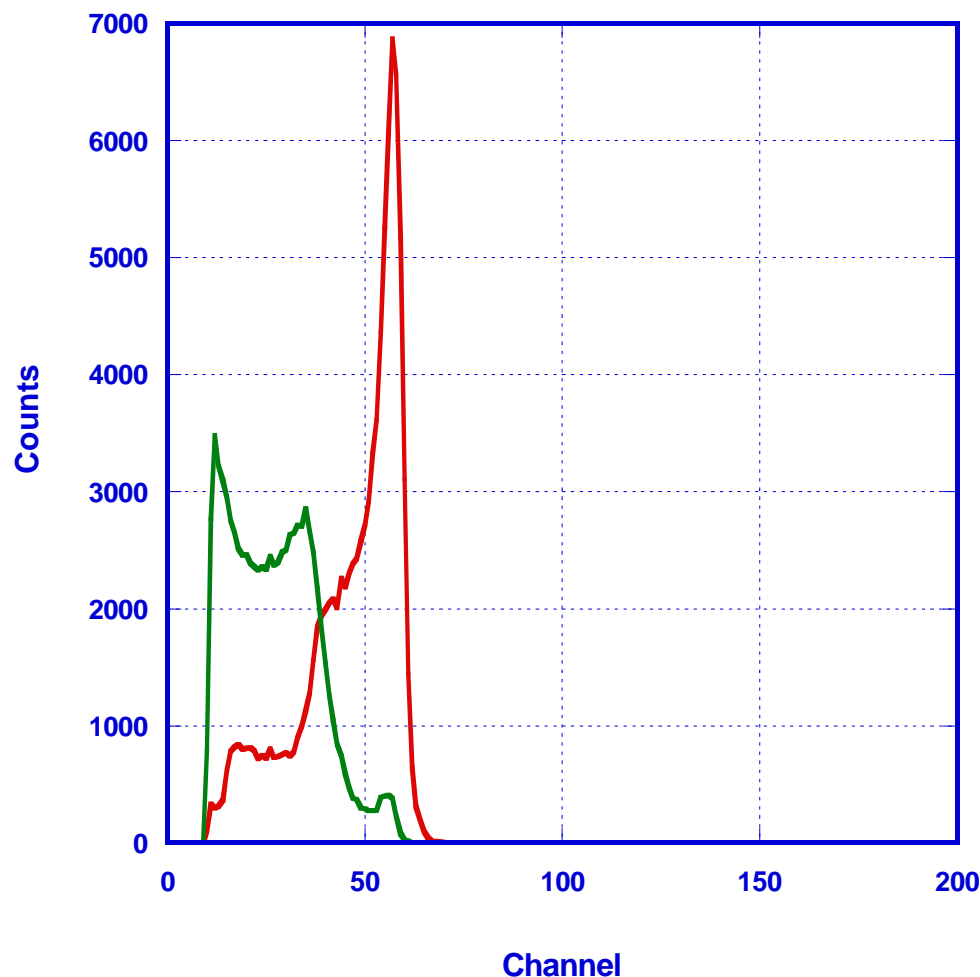
Sample: YIG 4.5A



25 x 30 cm<sup>2</sup> beam stop

Angular coverage: - 11.5 to 140 degrees

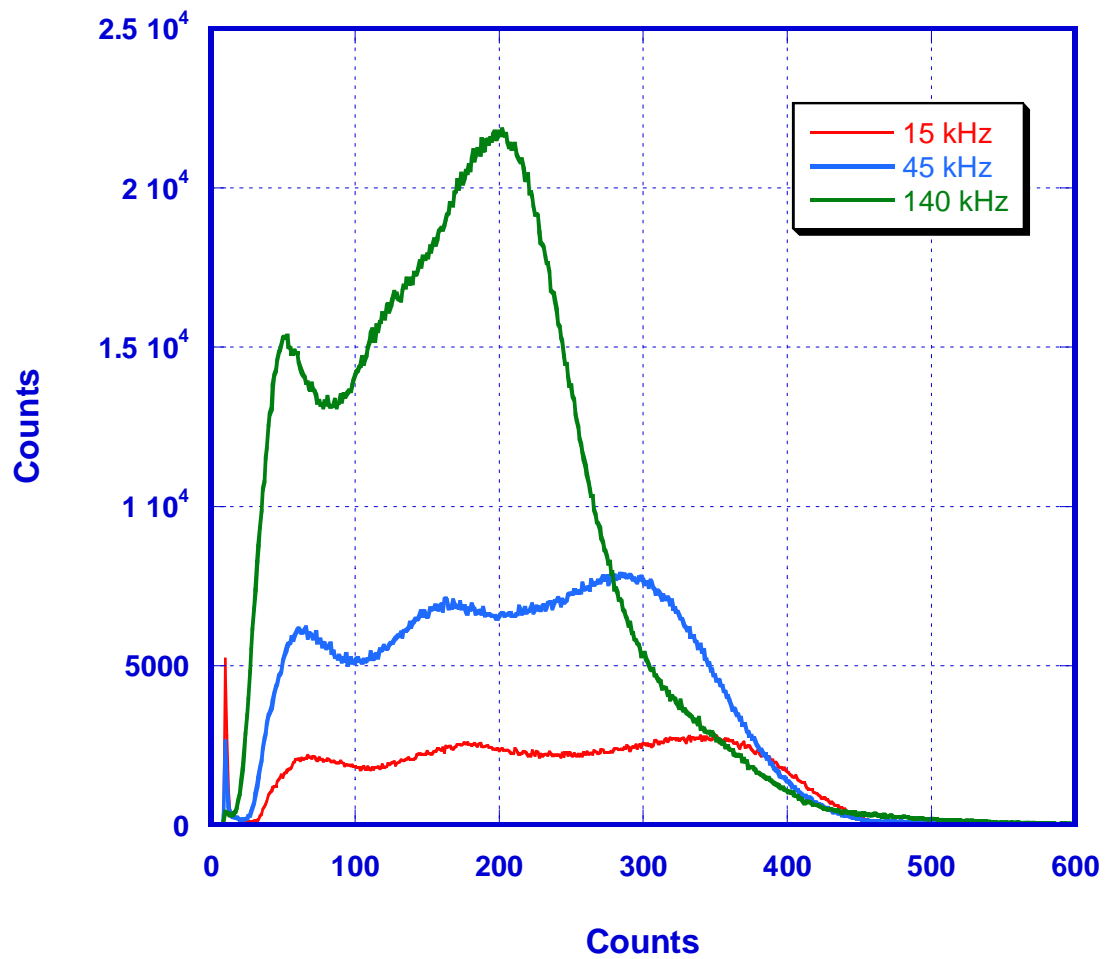




**Problem of charges accumulation**

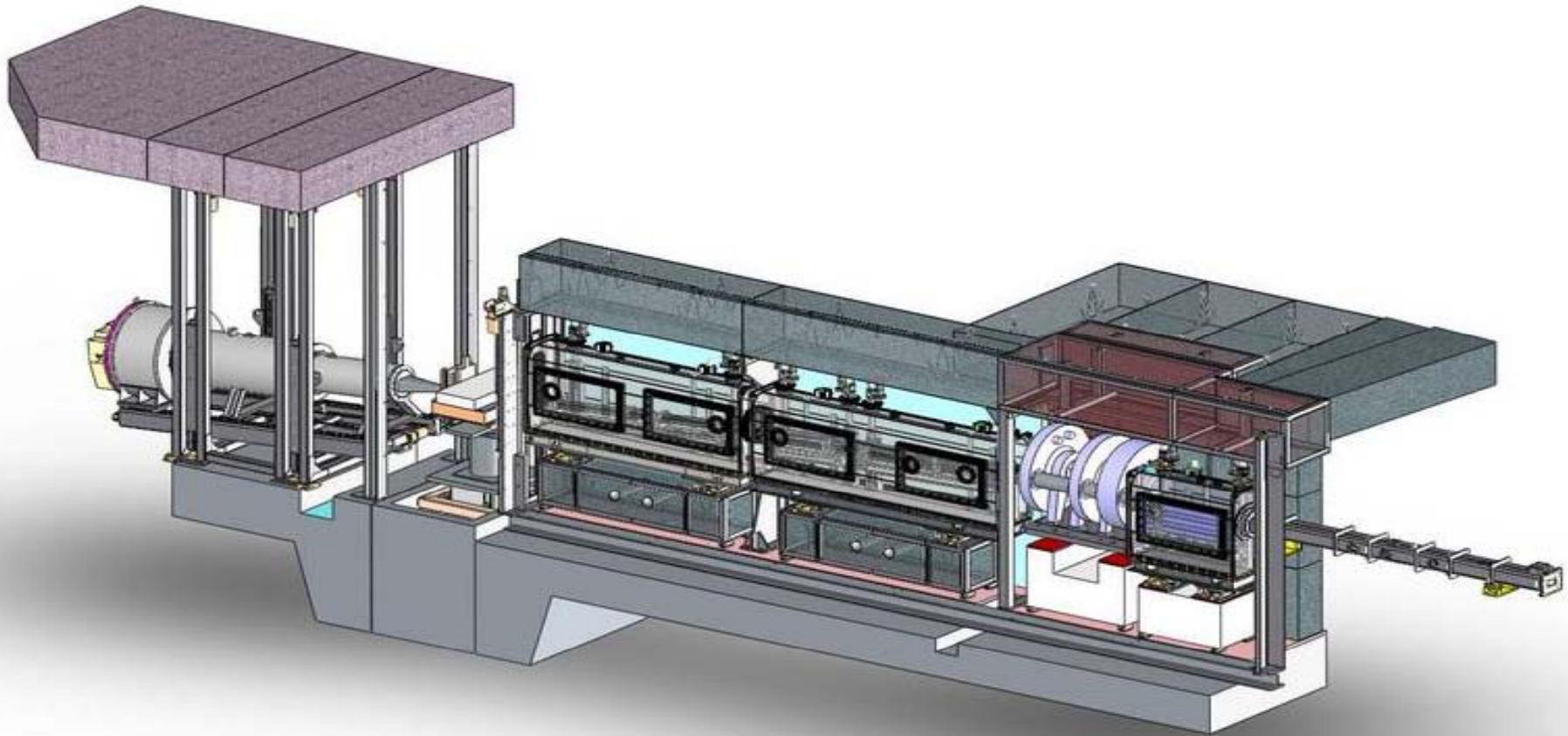


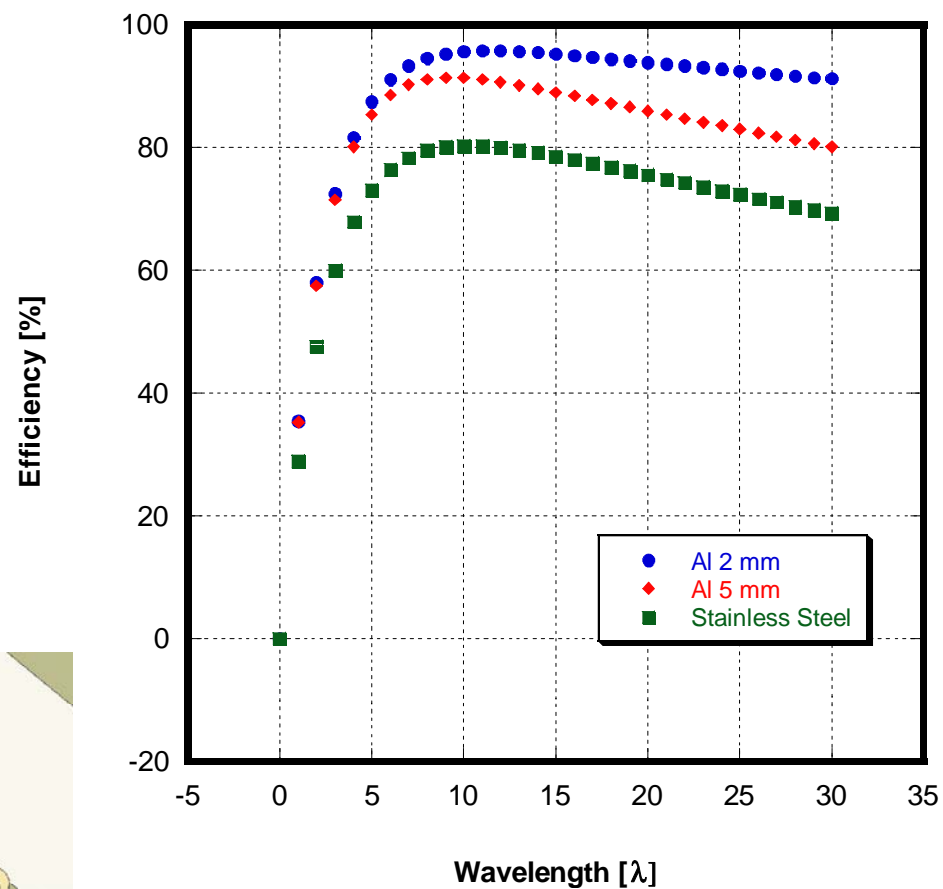
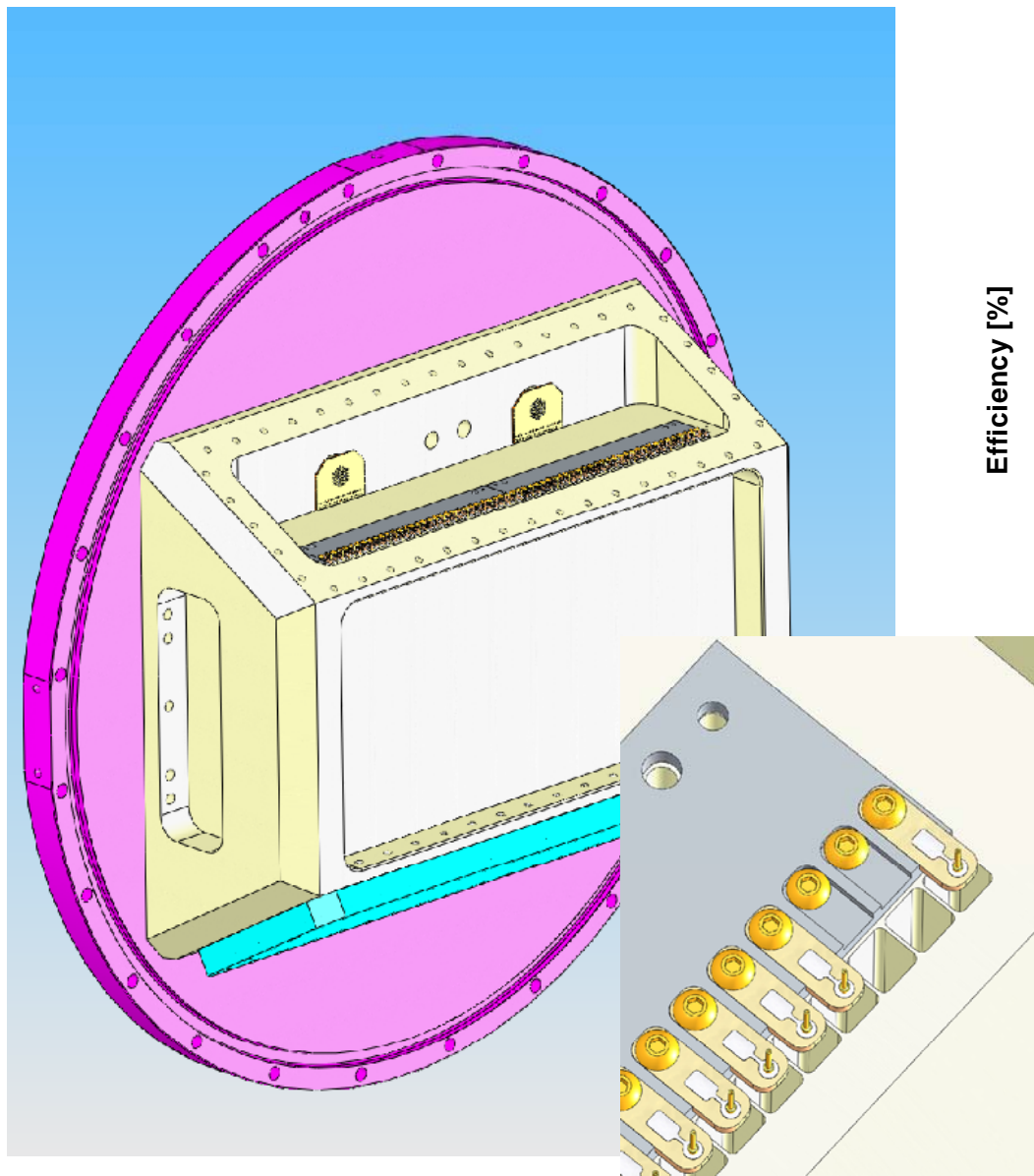
Grooves machining generates an insulating layer inside the tubes which causes charges to accumulate on the inner surface. As a result, the gain drops rapidly, with a time constant proportional to the neutrons flux. An additional surface treatment (polishing + anti-oxidant) allows to solve the problem.





## Fluid Interfaces Grazing Angles Reflectometer



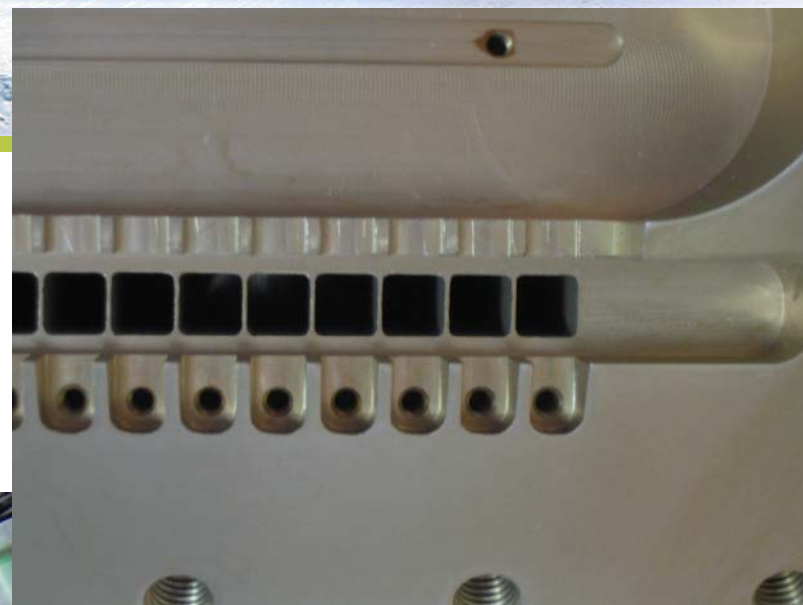
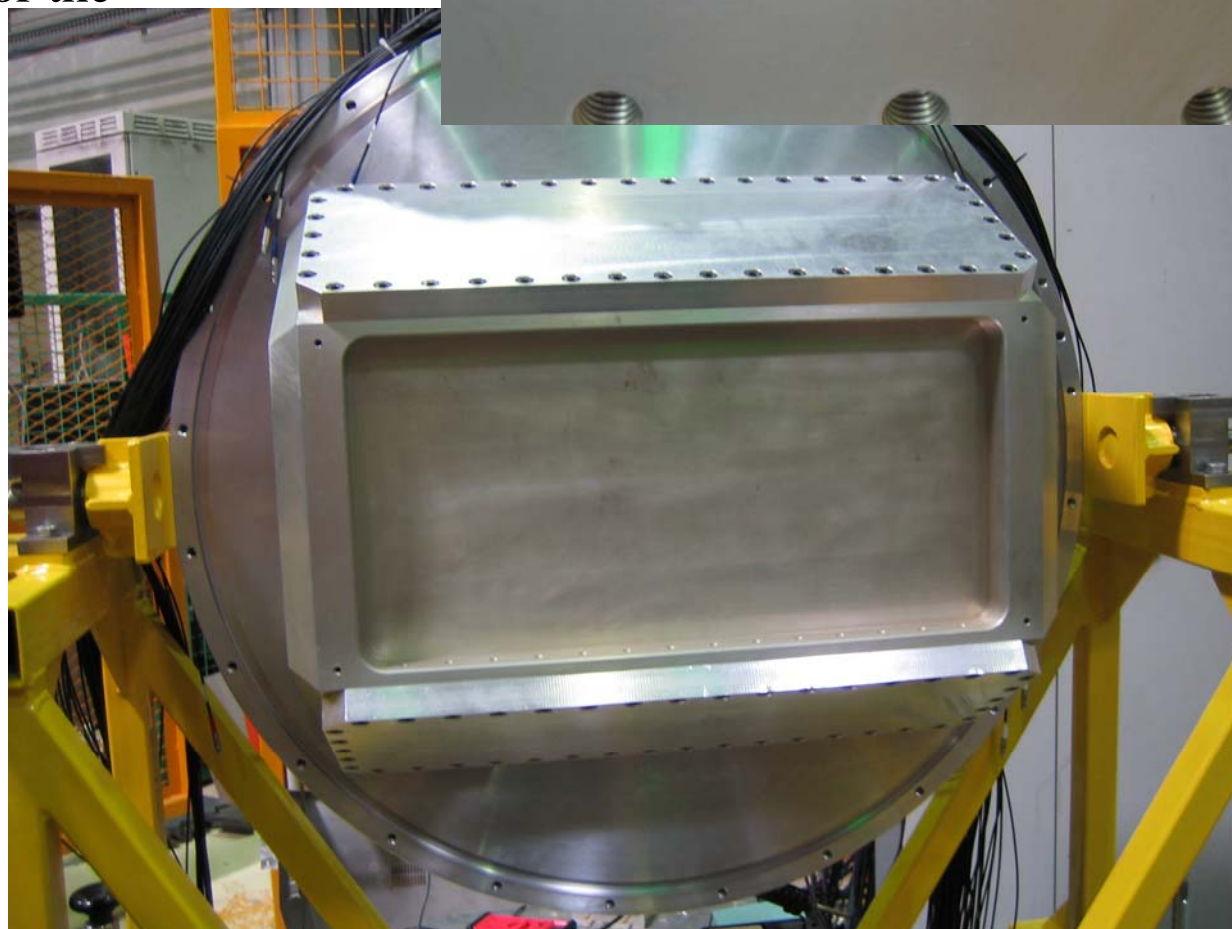
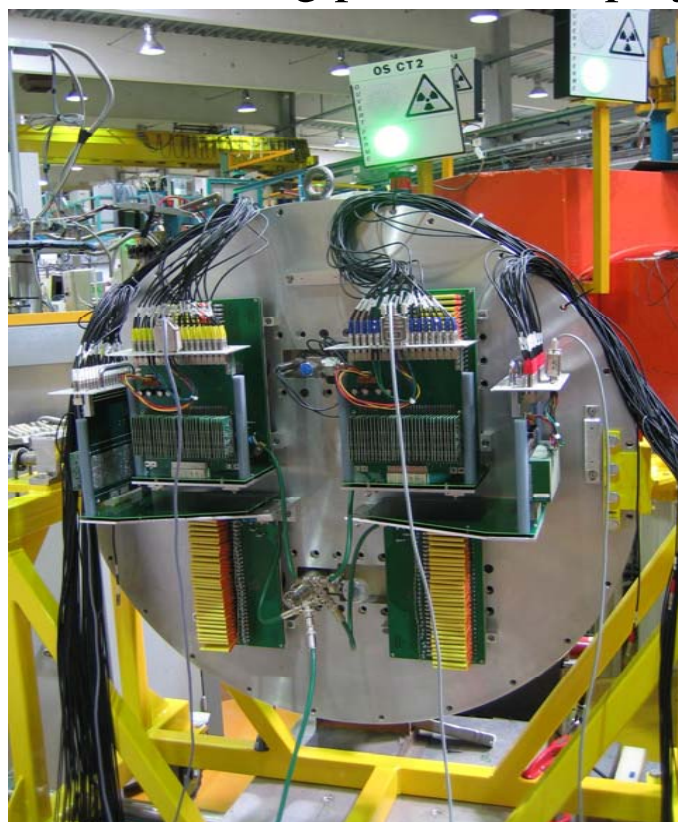


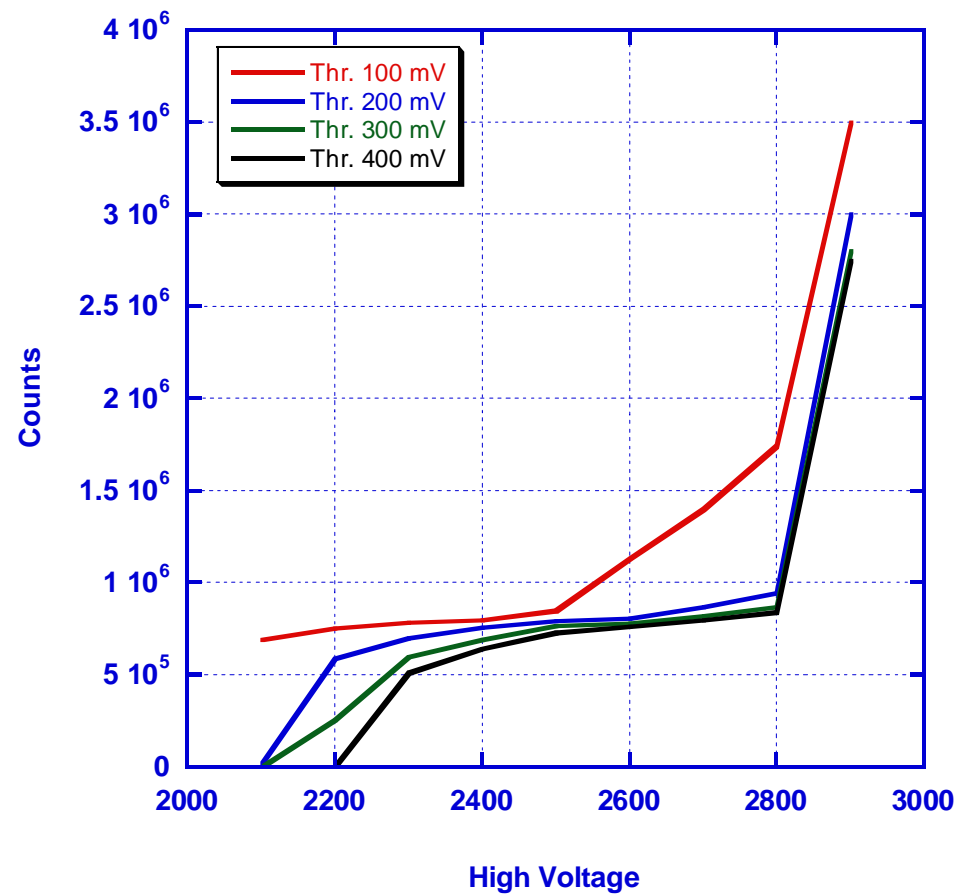
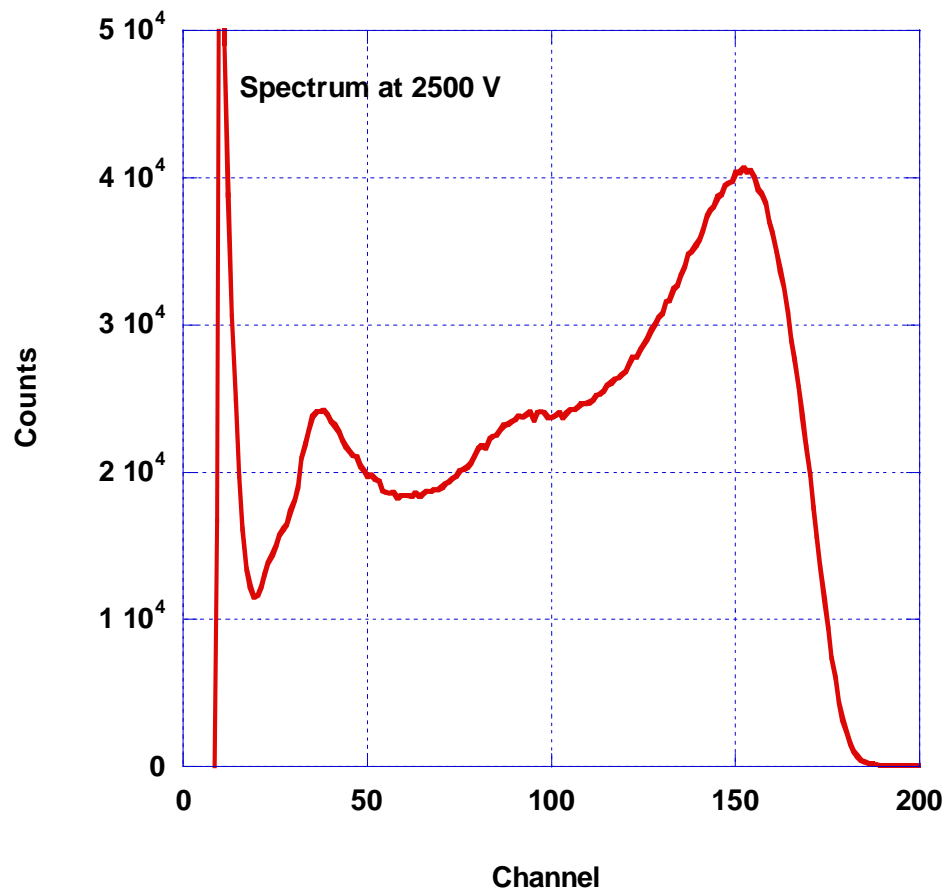
Al Monobloc design:  
 64 square channels machined by wire cutting, 30 mm long (25 mm active),  
 7 mm side  
 0.05 mm thick walls



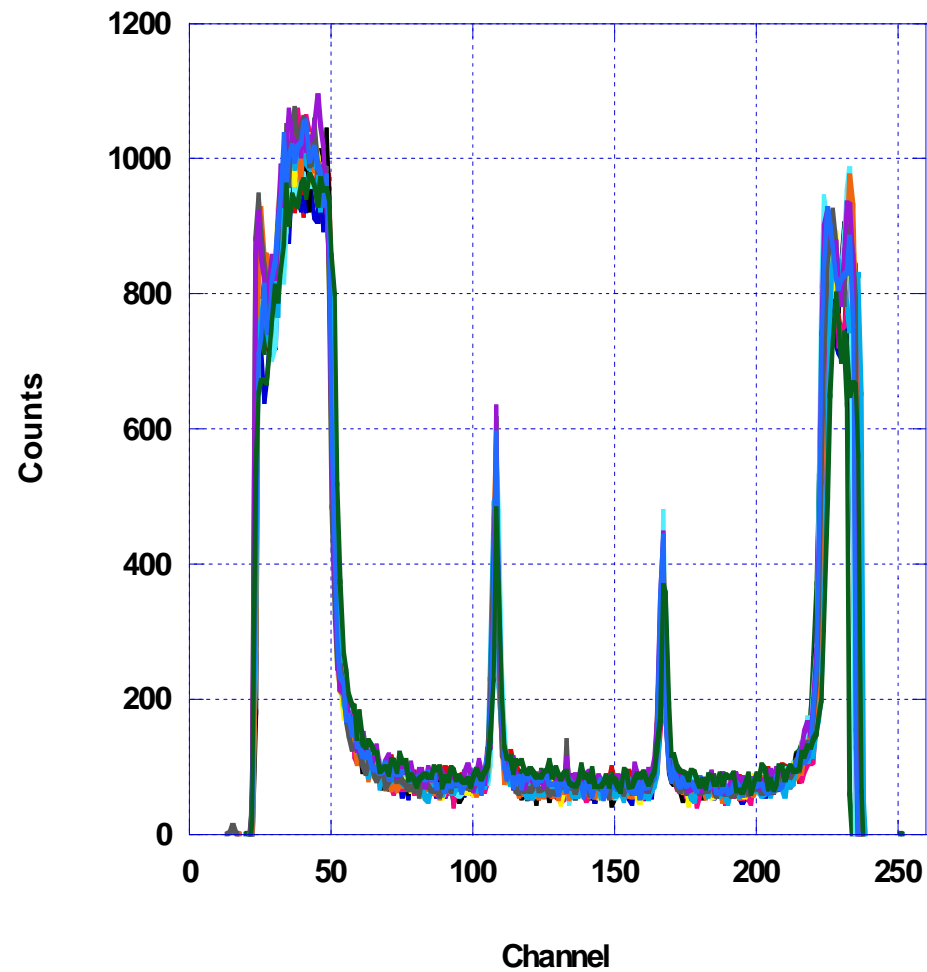
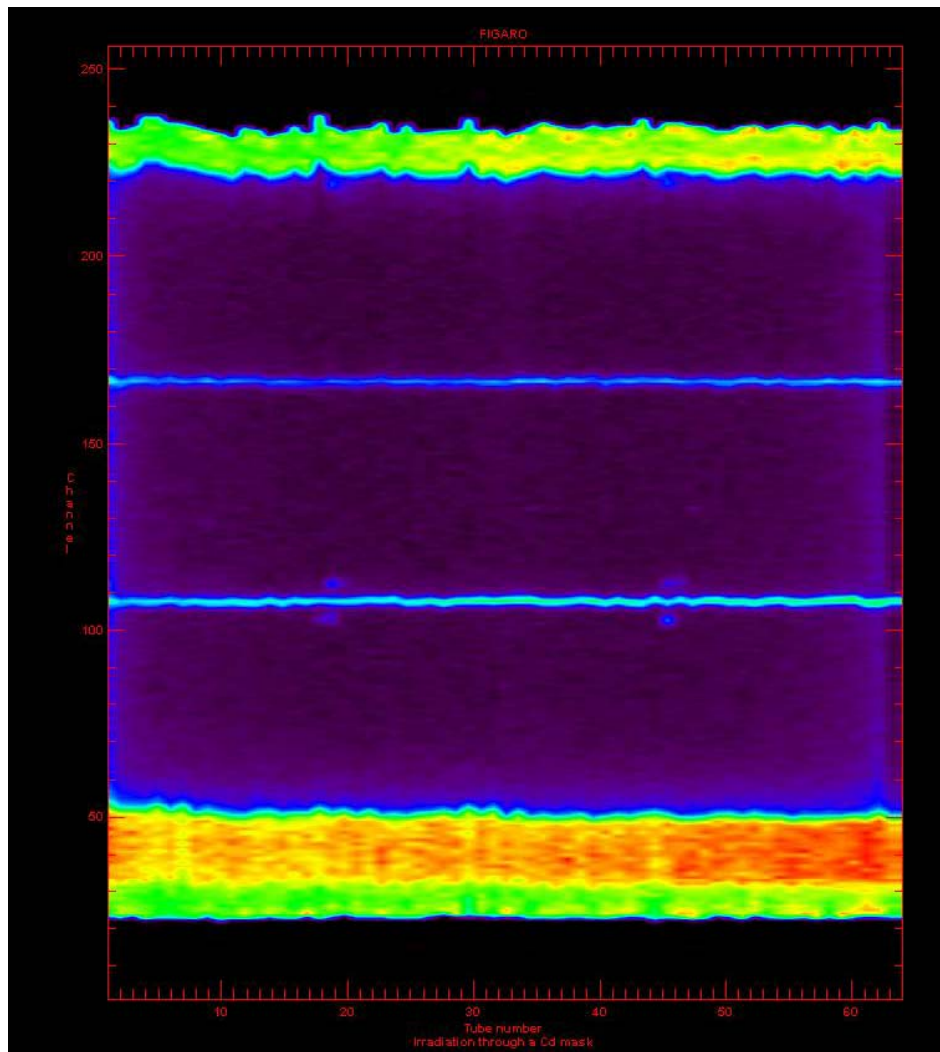
The detector can be rapidly assembled (no welding) .

Figaro has now been tested on the ILL CT2 test beam and is waiting to be installed on the instrument at the end of September for the commissioning phase of the project









Uniform irradiation through a 2.5 and a 2 mm  
Cd slits

## Conclusions

Multitubes detectors have proven to be a very valuable solution for several instruments, with rather varied requirements.

It is now a fully mastered technology, allowing the construction of systems that can satisfy the requirements of different instruments type, namely modular ones.

The Al version of the Multitube opens possibilities for further development; it offers all the advantages of the stainless steel Multitube solution, plus an extended robustness, reduced beam absorption, especially at the high wavelengths used in reflectometry .