γ–ray beam diagnostic for the GF@CERN

A. Musumarra and M.G. Pellegriti

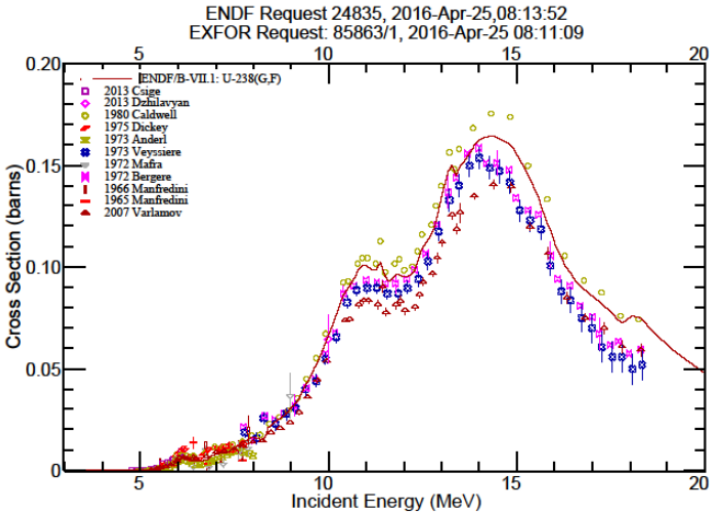
Example of gamma (neutron) flux characterization

Gas detector (IC-Micromesh-PPAC)

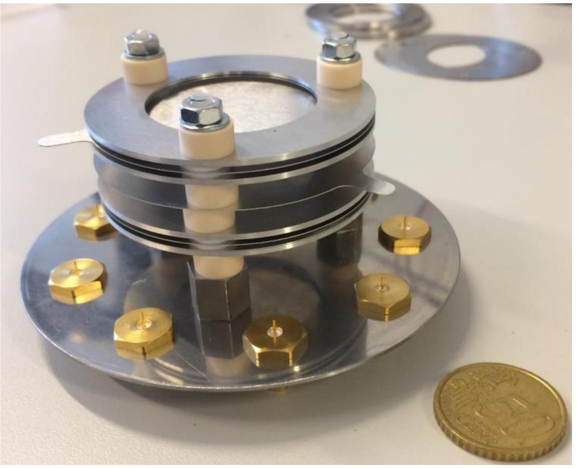
PTB *CEA-Saclay* *Orsay*

Reaction	Standard energy range
$^{6}\mathrm{Li}(n,t)$	0.0253 eV to 1 MeV
$^{10}\mathrm{B}(n,\alpha)$	0.0253 eV to 1 MeV
$^{235}\mathrm{U}(n,f)$	0.0253 eV and 0.15–200 MeV
$^{197}\mathrm{Au}(n,\gamma)$	0.0253 eV and 0.2–2.5 MeV

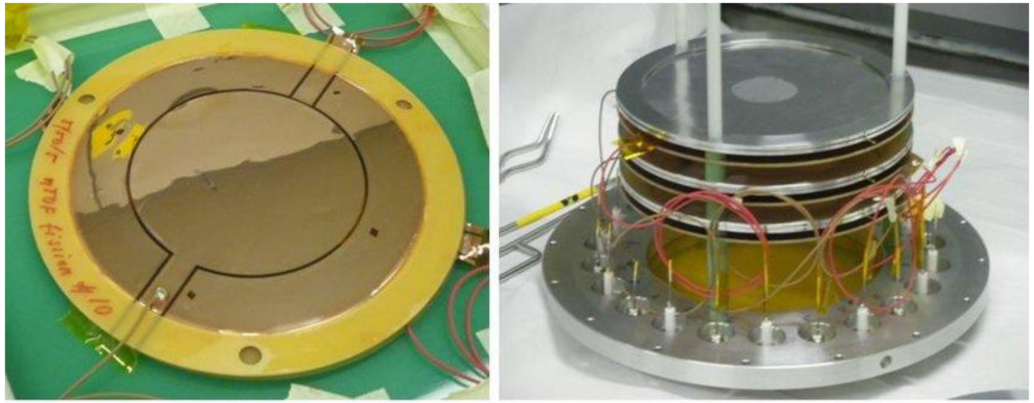
PTB Fission Chamber and Micromegas



Photofission cross-section for U-238



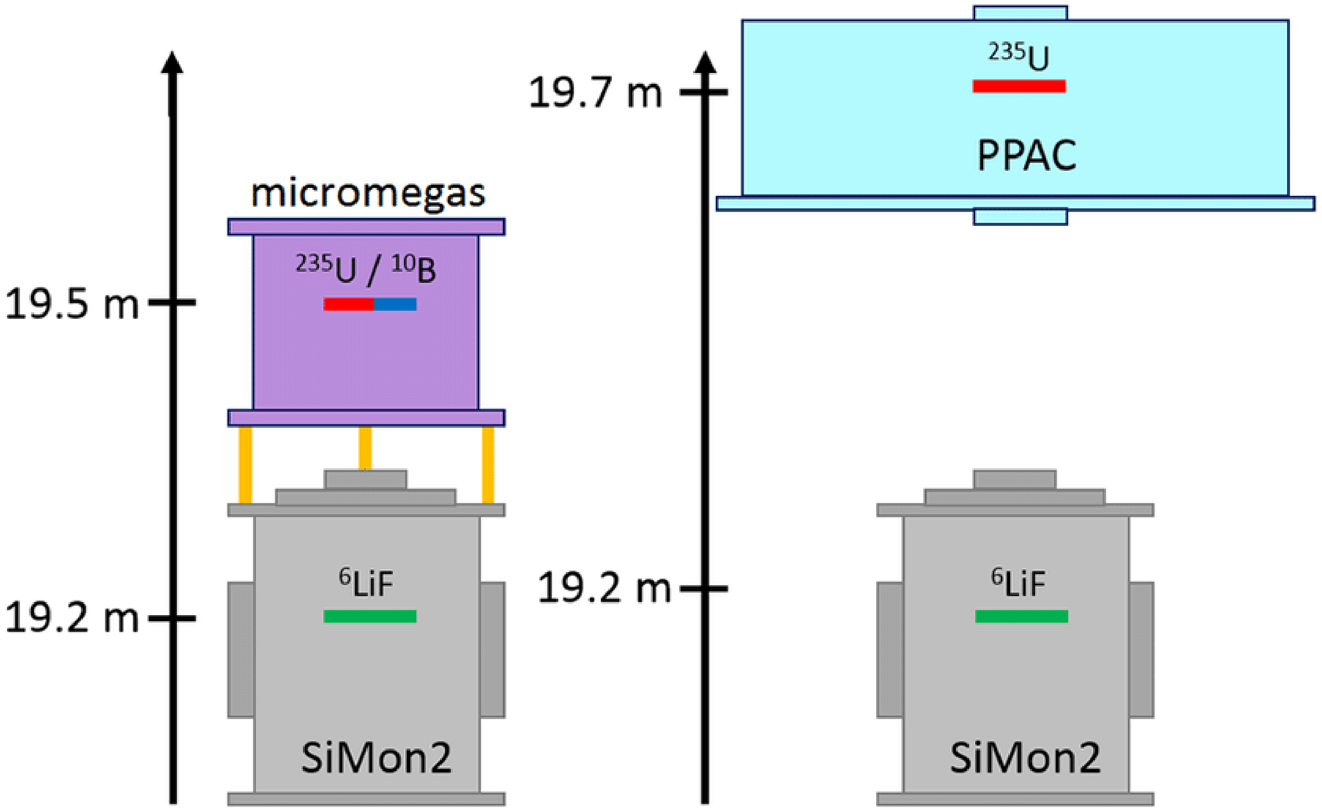
ELI-NP fission chamber



(a) (b)

Micromegas@n_TOF

n-flux characterization routinely performed by PTB fission chamber, MGAS and SiMon detectors (**also stacked)**



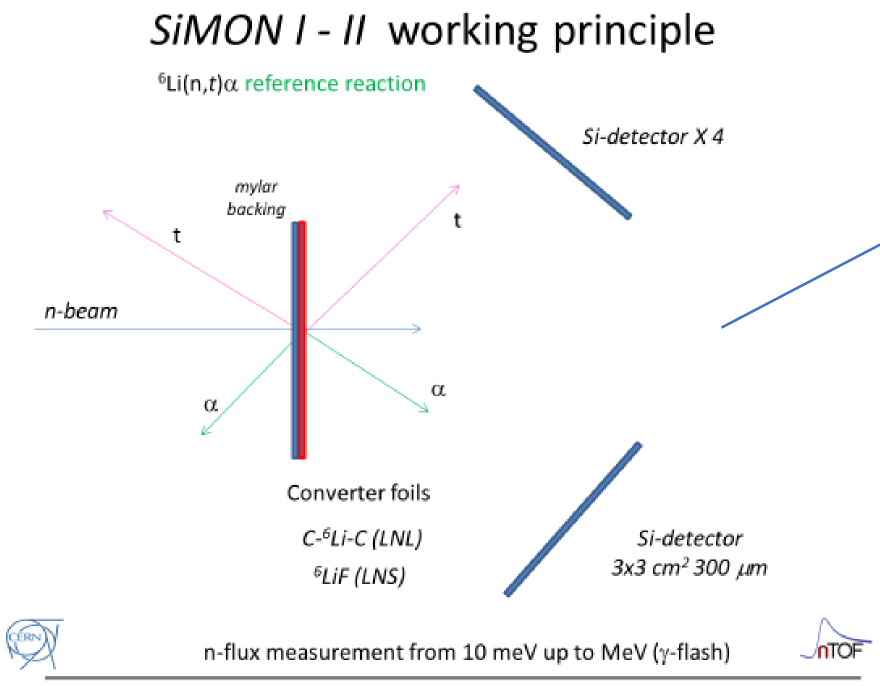
The European Physical Journal A volume 49, Article number: 156 (2013)

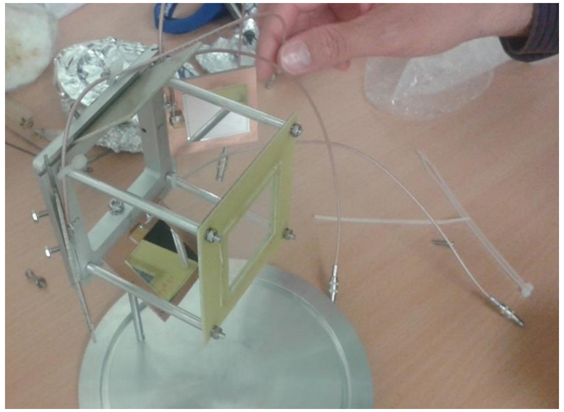
EAR2@ n_TOF

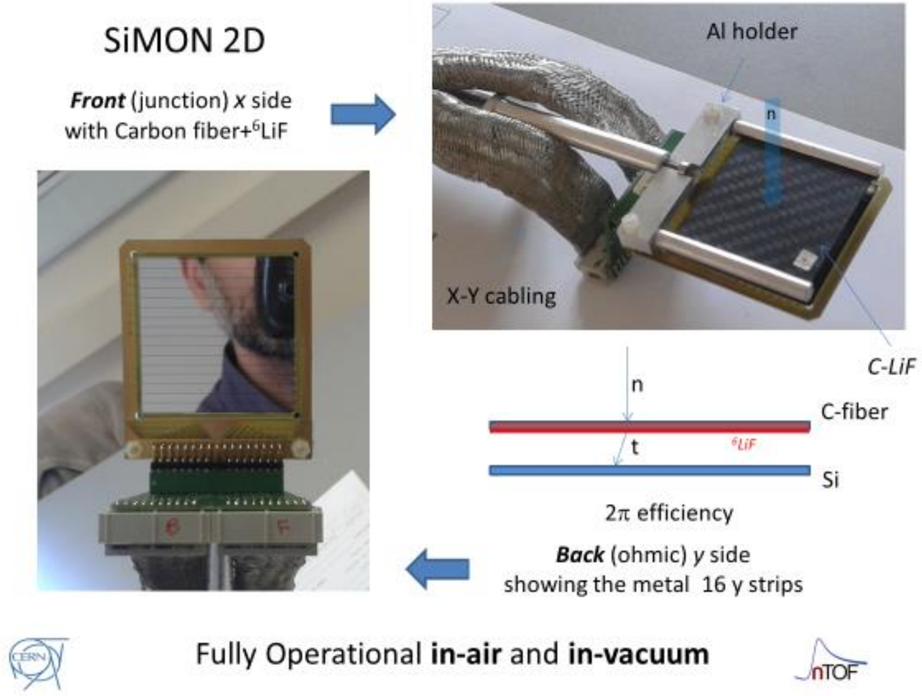
https://cds.cern.ch/record/1746358

Some example of neutron flux characterization n_TOF@CERN (INFN)

Solid-state: Silicon detector (SiMON)







A. Musumarra et al. Int.J.Mod.Phys.Conf.Ser. 44 (2016) 1660210

Same technique to be used for (γ,cp) reactions

POP First option: fast scintillator crystal with dedicated PM

Try to achieve

2-3 ns signal length

10-100 MHz

EJ-232 plastic scintillator is intended for very fast timing applications or when very high pulse pair resolution is required. Due to the small emission wavelength, the optical mean free path of this scintillator is approximately 10 cm. Therefore, to achieve the best light collection and to optimize the timing performance, EJ-232 should be used in a small size with the largest scintillator dimension less than 10 cm to minimize photon scattering effects. The use of light guides is best avoided.

EJ-232Q plastic scintillator is a quenched variant of EJ-232 specifically formulated for ultra-fast counting applications. The introduction of small amounts of benzophenone to EJ-232 significantly shortens the timing properties for purposes of achieving very high counting rates or improved coincidence timing. The quenching does not affect the emission spectrum but does reduce the scintillation efficiency (see table below). While it is recommended to keep the scintillator size and shape small in order to achieve the best timing performance, it is not recommended to use EJ-232Q in thin films (thicknesses ≤ 3 mm) due to the vapor pressure of benzophenone.

PROPERTIES	EJ-232	EJ-232Q (% BENZOPHENONE)				
		0.5	1.0	2.0	3.0	5.0
Light Output (% Anthracene)	55	19	11	5	4	3
Scintillation Efficiency (photons/1 MeV e^-)	8,400	2,900	1,700	770	610	460
Wavelength of Maximum Emission (nm)	370	370	370	370	370	370
Rise Time (ps)	350	110	105	100	100	100
Decay Time (ps)	1,600	700	700	700	700	700
Pulse Width, FWHM (ps)	1,300	360	290	260	240	220
H Atoms per cm³ ($\times 10^{22}$)	5.13	5.12	5.12	5.12	5.12	5.12
C Atoms per cm³ ($\times 10^{22}$)	4.66	4.66	4.66	4.66	4.66	4.66
Electrons per cm³ ($\times 10^{23}$)	3.30	3.38	3.38	3.38	3.38	3.38
Density (g/cm³)	1.023	1.023	1.023	1.023	1.023	1.023

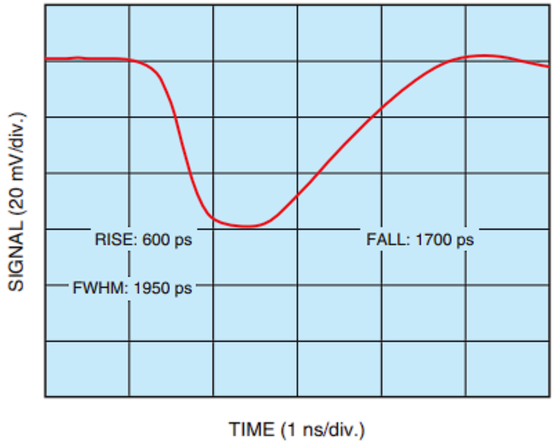
HAMAMATSU
PHOTON IS OUR BUSINESS

HIGH-SPEED RESPONSE PMT MODULES
FOR UNDERWATER OPTICAL COMMUNICATIONS

Photomultiplier already at INFN-CT scintillator will be delivered by SCIONIX on january 2024

H14601-200

■H14600-100

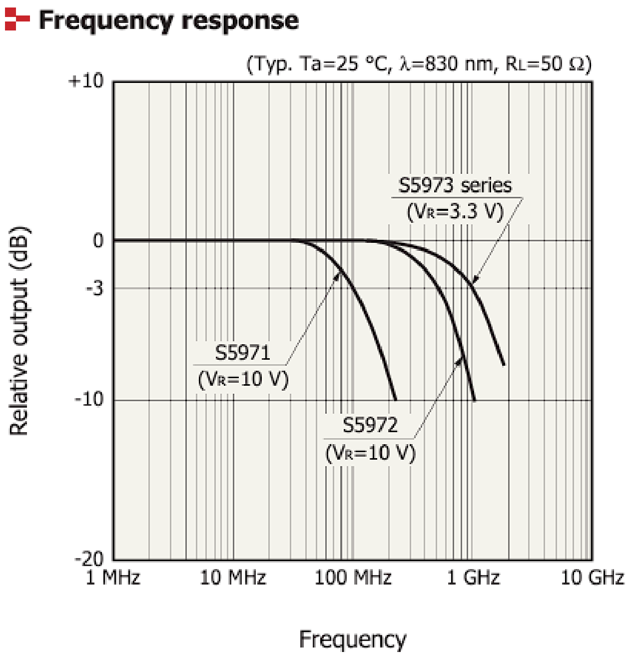


Parameter			H14600 / H14601 series				Unit
Suffix			-100, -103	-200	-01, -04	-20	—
Input voltage			+4.5 to +5.5				V
Max. input voltage			5.5				V
Max. input current *1			3.5				mA
Max. average output signal current *2			100				μA
Max. control voltage			+1.0 (Input impedance 1 MΩ)				V
Recommended control voltage adjustment range			+0.5 to +1.0 (Input impedance 1 MΩ)				V
Effective area			ϕ8				mm
Peak sensitivity wavelength			400	400	400	630	nm
Cathode	Luminous sensitivity	Min.	80	100	100	350	μA/lm
		Typ.	105	135	200	500	
	Blue sensitivity index (Blue filter)	Typ.	13.5	15.5	—	—	—
	Red/White ratio	Typ.	—	—	0.25	0.45	—
	Radiant sensitivity *3	Typ.	110	130	77	78	mA/W
Anode	Luminous sensitivity *2	Min.	30	40	40	140	A/lm
		Typ.	105	135	200	500	
	Radiant sensitivity *2*3	Typ.	1.1×10^5	1.3×10^5	7.7×10^4	7.8×10^4	A/W
	Dark current *2*4	Typ.	0.5	0.5	1	10	nA
		Max.	5	5	10	100	
Rise time *2		Typ.	0.6				ns
Ripple noise *2*5 (peak to peak)		Max.	0.2				mV
Settling time *6		Max.	10				s
Operating ambient temperature *7			+5 to +50				°C
Storage temperature *7			-20 to +50				°C
Weight			32 (H14600 series), 40 (H14601 series)				g

Second option: Si-junction (SiC/Diamond) for x-ray spectroscopy

Si PIN HAMAMTSU Photodiode 320-1000nm
Metal TO-18 available and tested with HG charge pre-amp

ϕ 0.4 mm



S5973 series

Contents lists available at ScienceDirect
Nuclear Inst. and Methods in Physics Research, A
journal homepage: www.elsevier.com/locate/nima

Repurposing a low-cost commercial Si photodiode as a detector for X-ray and γ-ray spectroscopy at temperatures up to 80 °C

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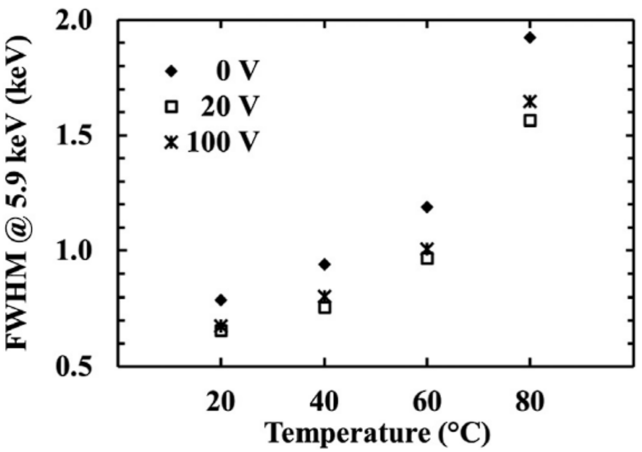
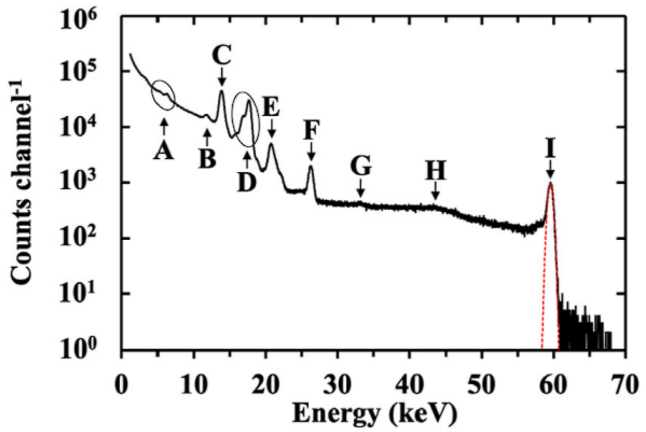
Space Research Group, School of Mathematical and Physical Sciences, University of Sussex, Falmer, Brighton, BN1 9QT, UK





241Am

Second option: Si-junction front-end electronics

In-vacuum

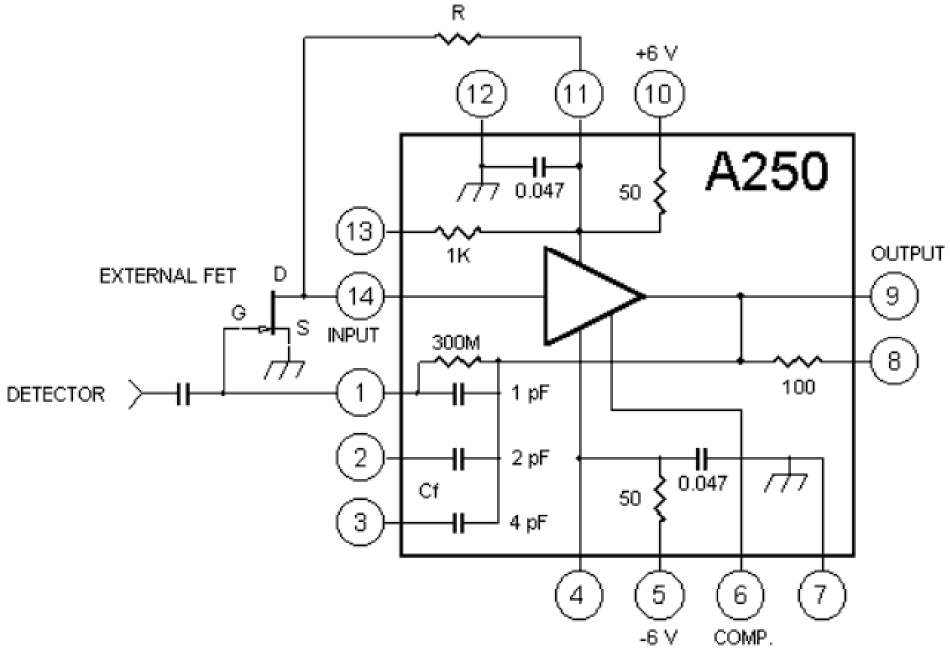
Specifications

Assume temp =20 °C, V_s = ±6V, unloaded output

	CR-110-R2.2	units
Preamplification channels	1	
Equivalent noise charge (ENC)*		
ENC RMS	200	electrons
	0.03	femtoCoul.
Equivalent noise in silicon	1.7	keV (FWHM)
Equivalent noise in CdZnTe	2.4	keV (FWHM)
ENC slope	3.8	elect. RMS /pF
Gain	1.4	volts /pC
Rise time **	3	ns
Decay time constant	140	µs
Unsaturated output swing	-3 to +3	volts
Maximum charge detectable per event	1.3 x10^7	electrons
	2.1	pC
Power supply voltage (V_s)		
maximum	V_s = ±13	volts
minimum	V_s = ±6	volts
Power supply current (pos)	9	mA
(neg)	6	mA
Power dissipation with no load	85	mW
Operating temperature	-40 to +85	°C
Output offset	+0.2 to -0.2	volts
Output impedance	50	ohms

Ready to use

A250 Connection Diagram amptek



New low noise scheme implemented by INFN-CT (FET close to the detector)

M. D'Andrea technical unit INFN-CT in charge