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Physics
and Applied
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Report on the new AI-MGAS detector

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$^{25}Mg(n,\alpha)^{22}Ne$

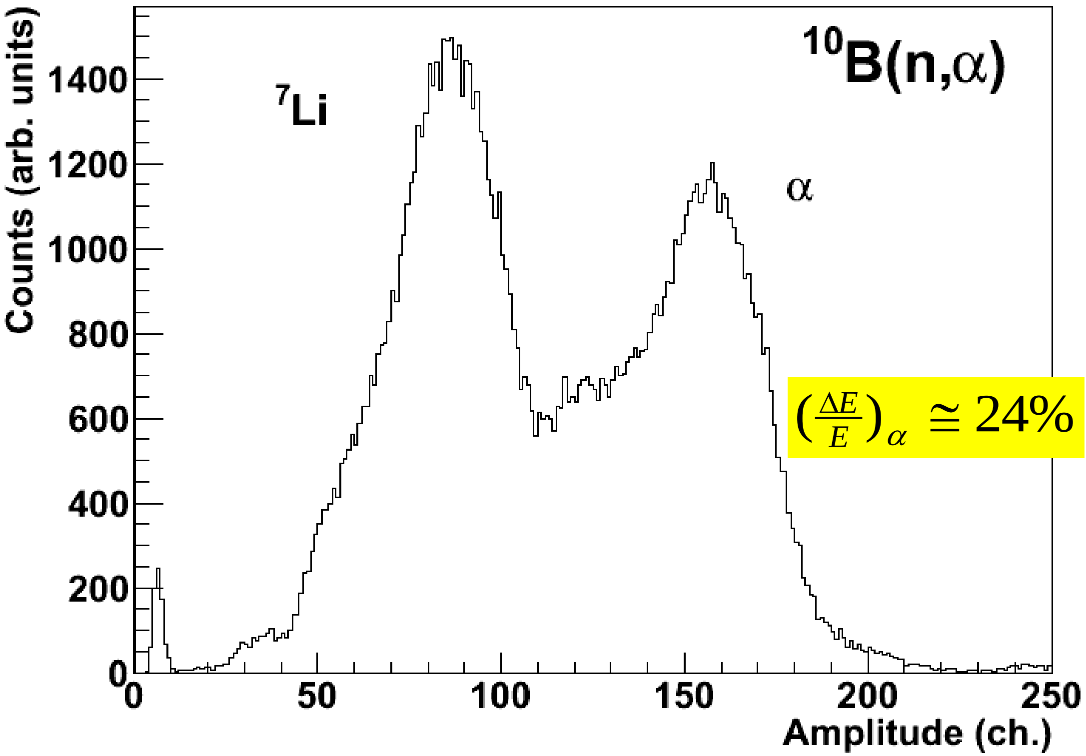
Reaction	Q-value (MeV)
$^{25}Mg(n,a)^{22}Ne$	0.48
$^{25}Mg(n,p)^{25}Na$	-2.5
$^{25}Mg(n,D)^{24}Na$	-9.8
$^{25}Mg(n,t)^{23}Na$	-10.5

Energy region of interest:
$0 < E_n < 300$ keV

Detector ?

- Diamond
- MicroMegas
- Silicon
- Compensated ionization chamber
- …

Energy resolution of Mgas



Good overall **energy resolution** has been obtained:

- 10.5% at 5.9 keV of the Fe-55 X- ray source,
- 5.5% at 22 keV of the Cd-109 X- ray source,
- **<1.5% with Am-241 a source.**

Pulse height spectrum from ^{10}B(n,α) reaction

(the use of the premixed gas of Ar + CF_4 + C_4H_{10} allows to distinguish clearly the contribution of the two components (1.47 MeV alpha and 0.83 MeV ^{7}Li) of the reaction products of the neutrons on ^{10}B).

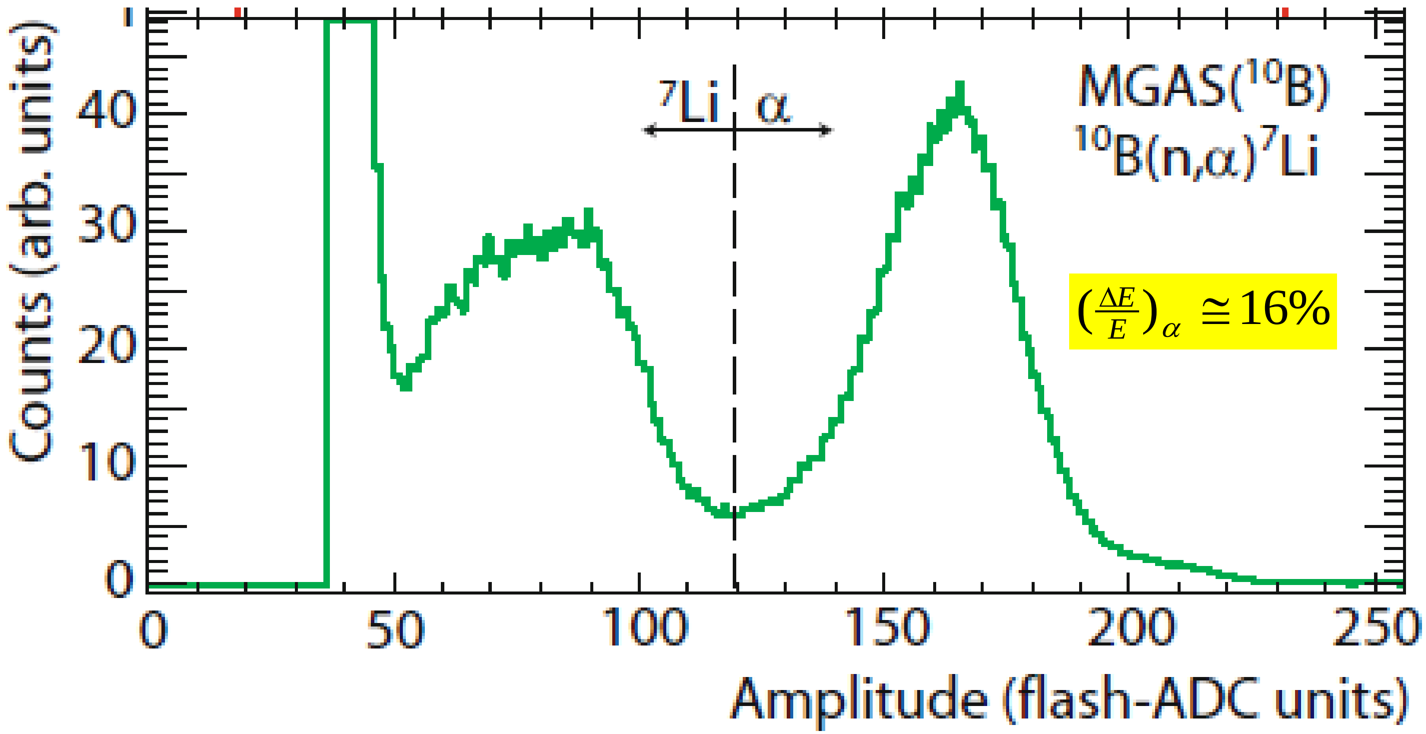
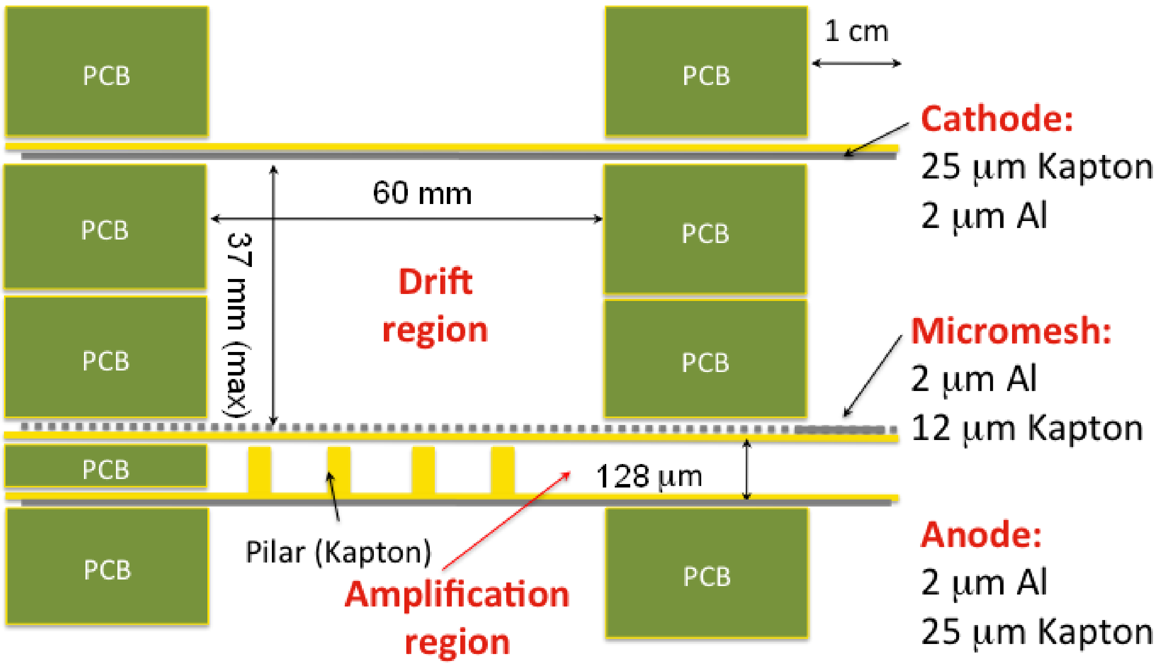


Fig. 5. Distribution of pulse heights corresponding to some of the detectors (and covering the three reaction types of interest) involved in the experimental determination of the n_TOF neutron flux.

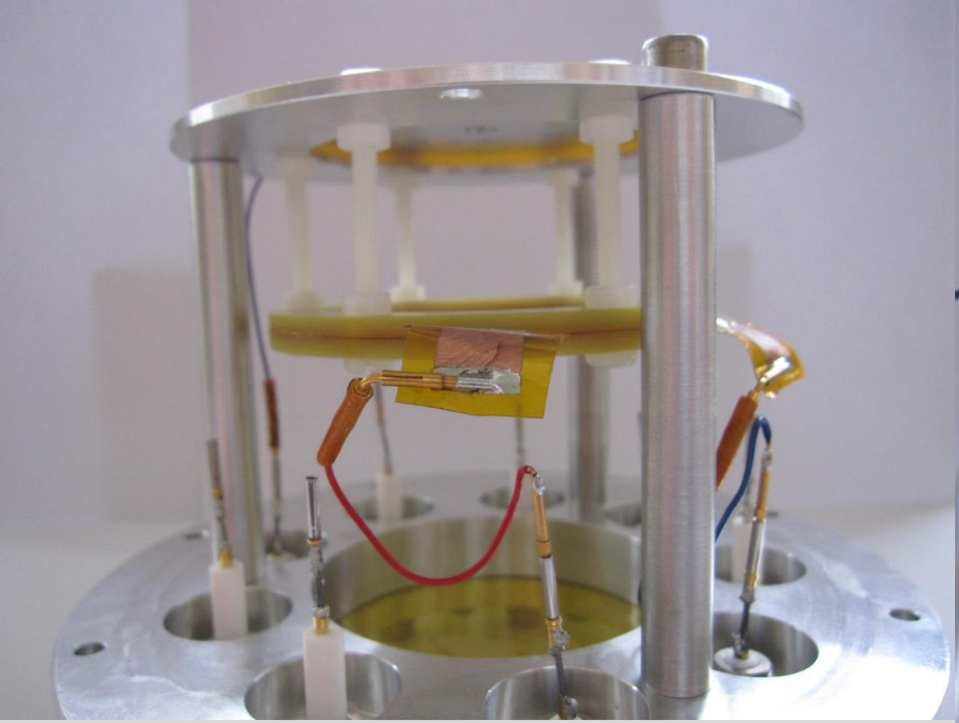
C. Guerrero *et al*., Eur. Phys. J. A (2013) 49: 27

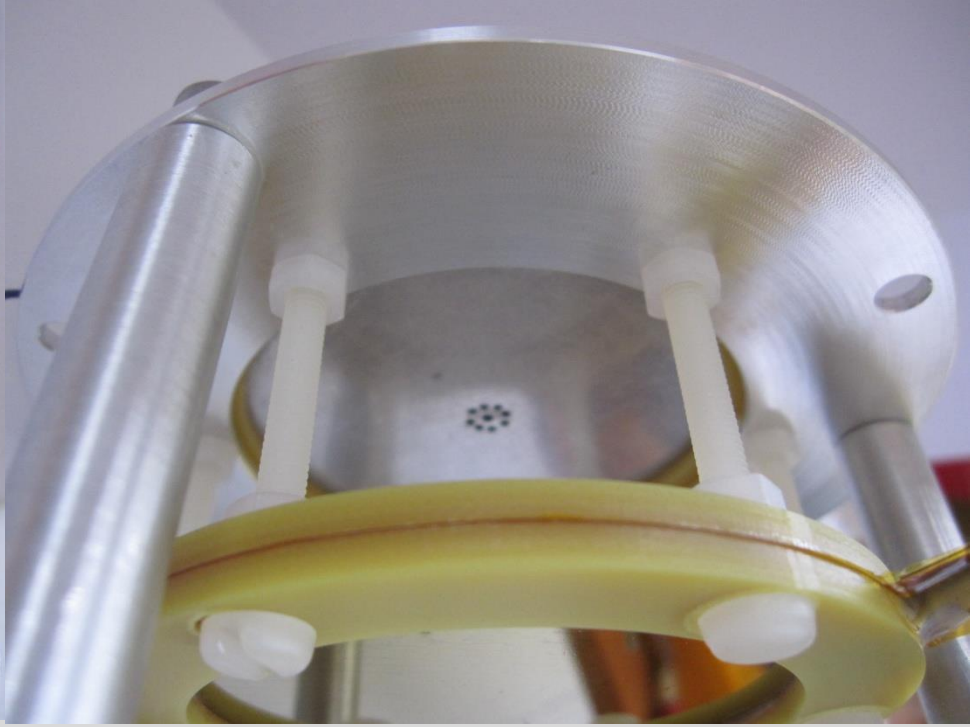
Micromegas detector has been proposed for neutron-induced cross-section measurements with charge-particle emission.



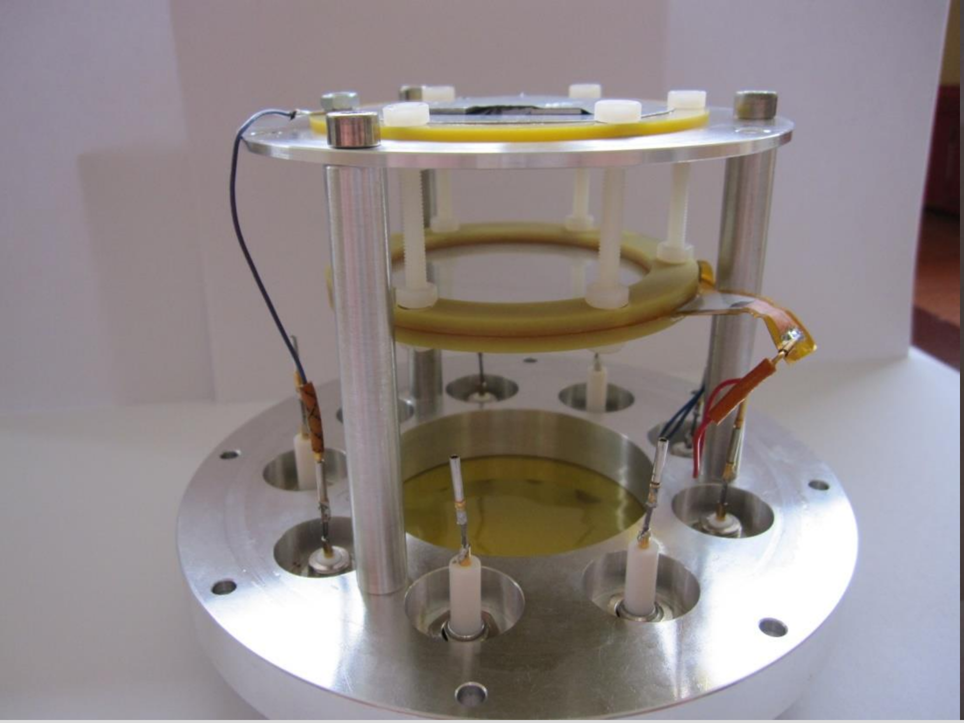
A schematic view of Micromegas detector

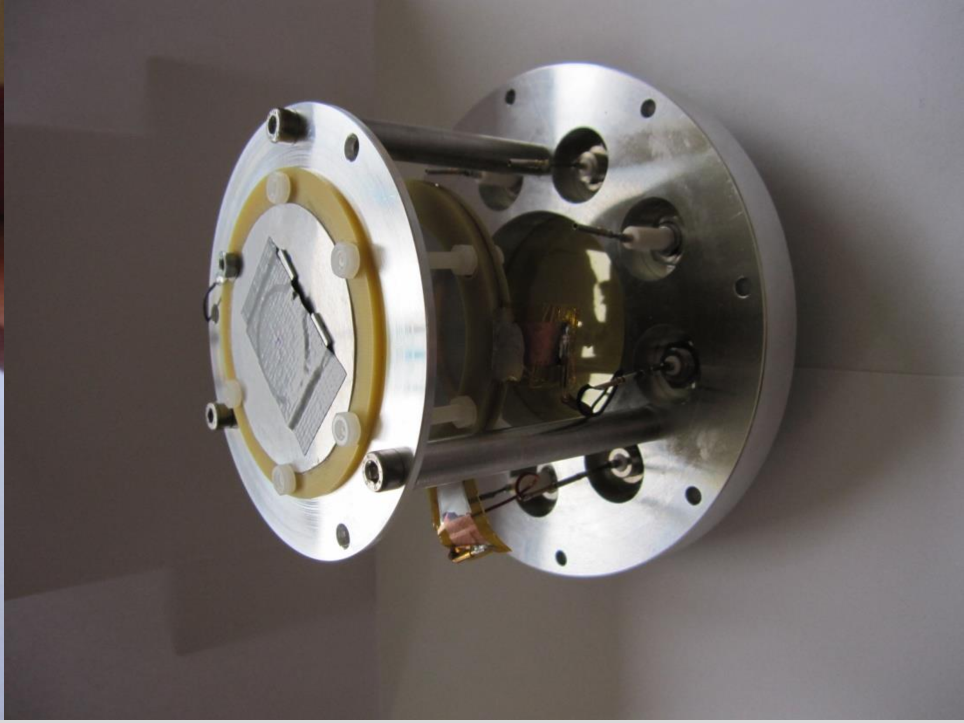
Q-values in MeV			
reaction	^{25}Mg	^{63}Cu	^{27}Al
(n,α)	+0.5	+1.7	-3.1
(n,p)	-3.1	+0.7	-1.8





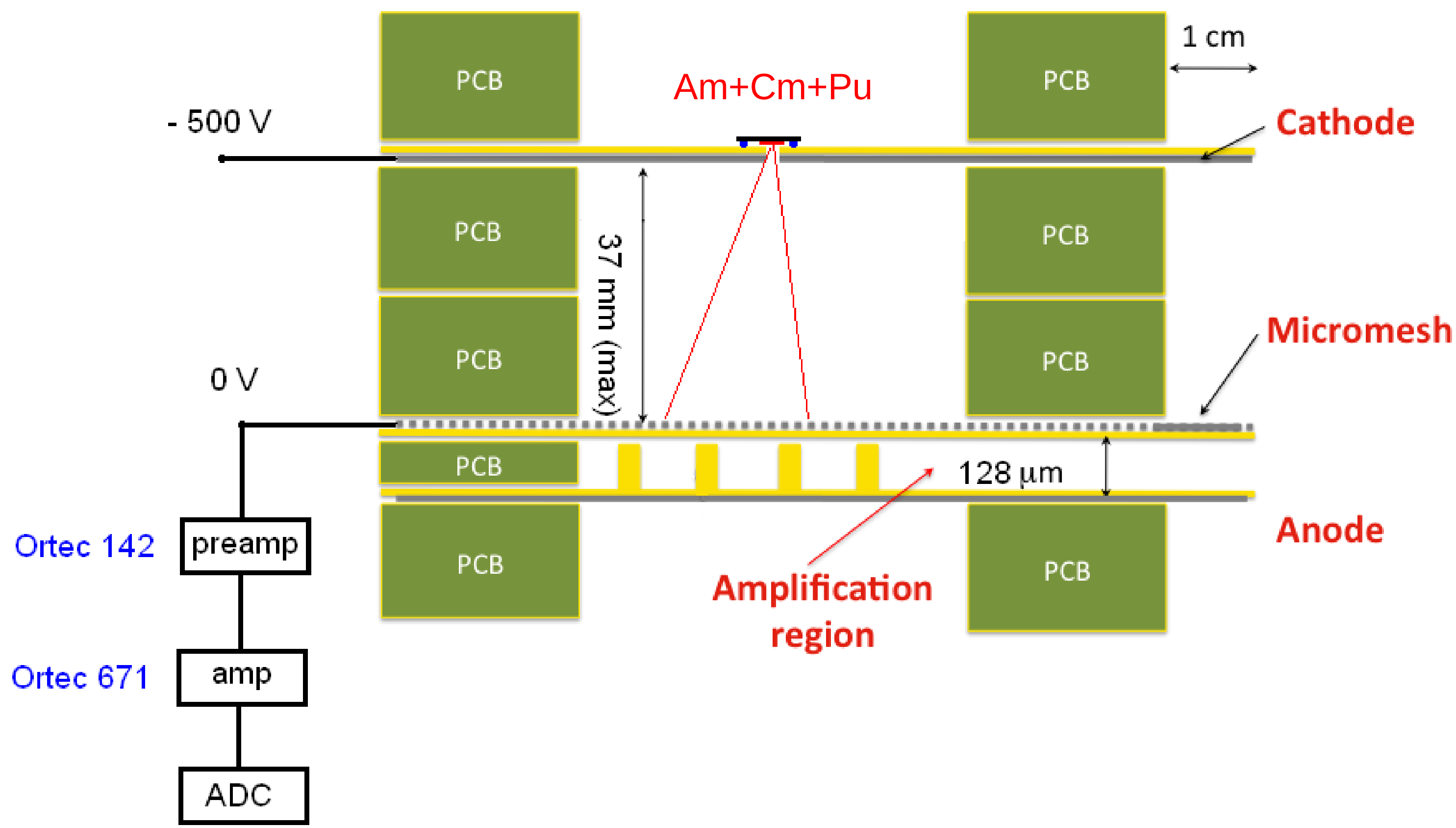
Detector configuration with maximum distance between cathode – mash = 37 mm



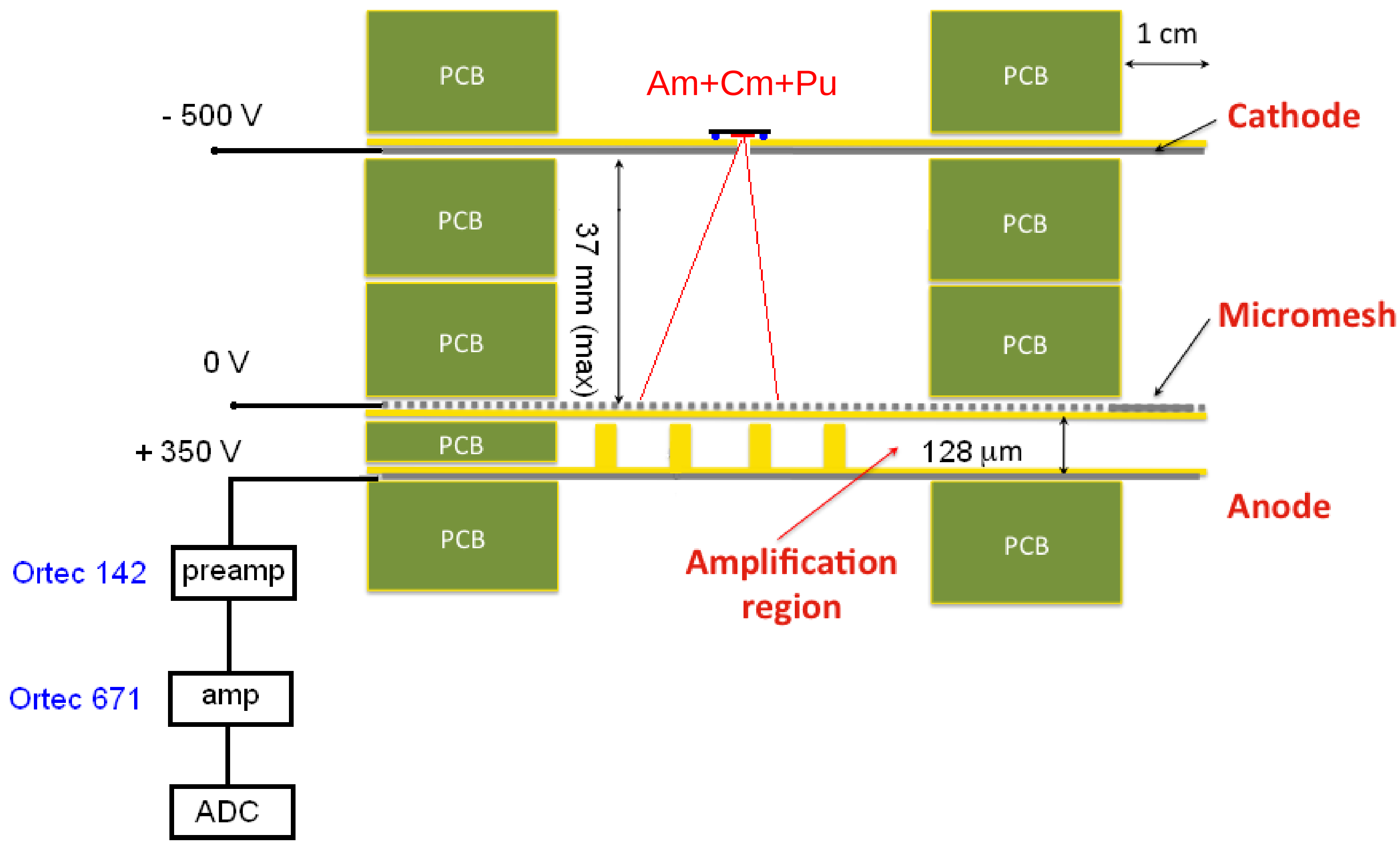


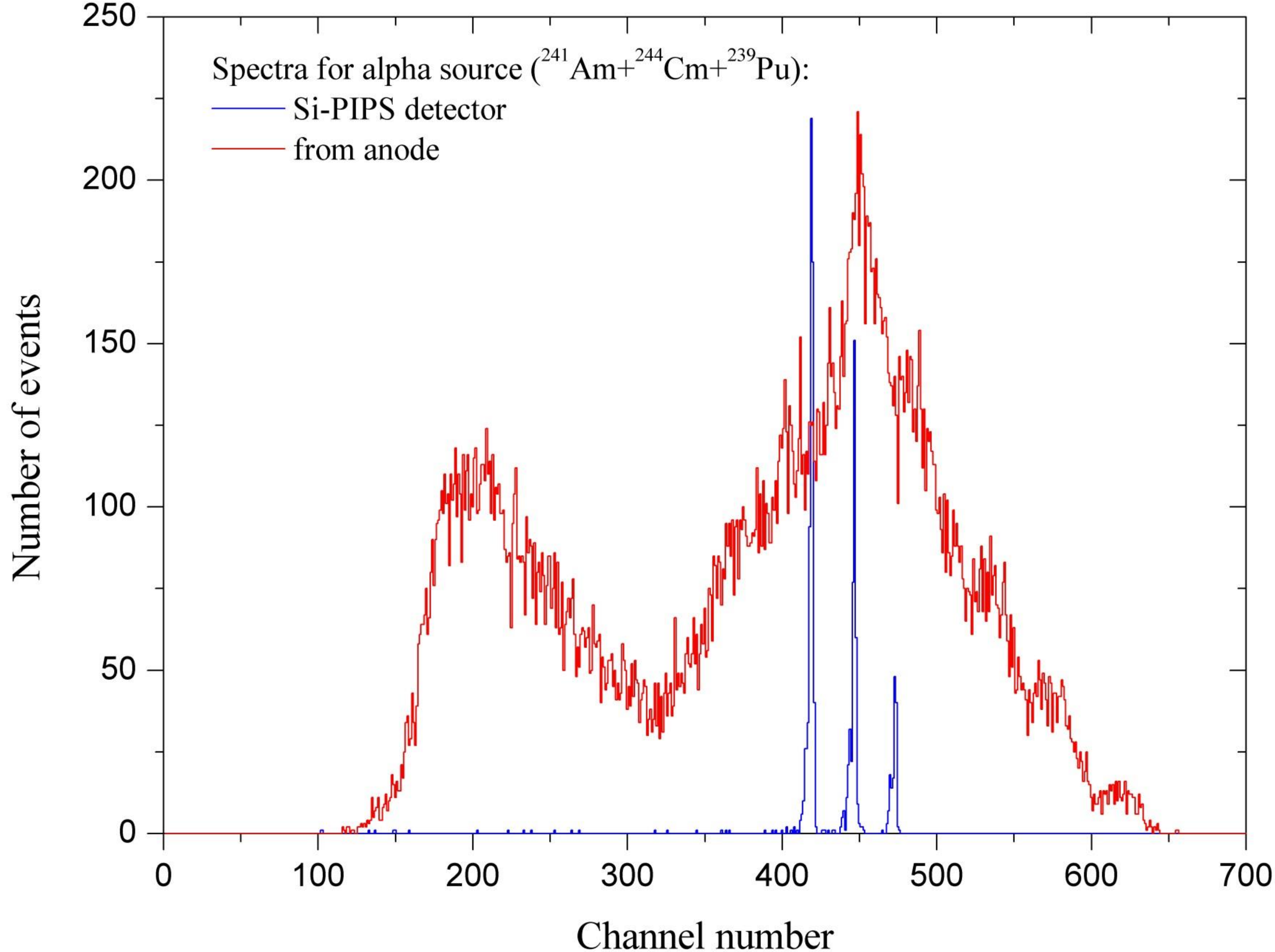
The same configuration with Am + Cm + Pu alpha source, seen on top of cathode.

1. We registered signals from drift part:

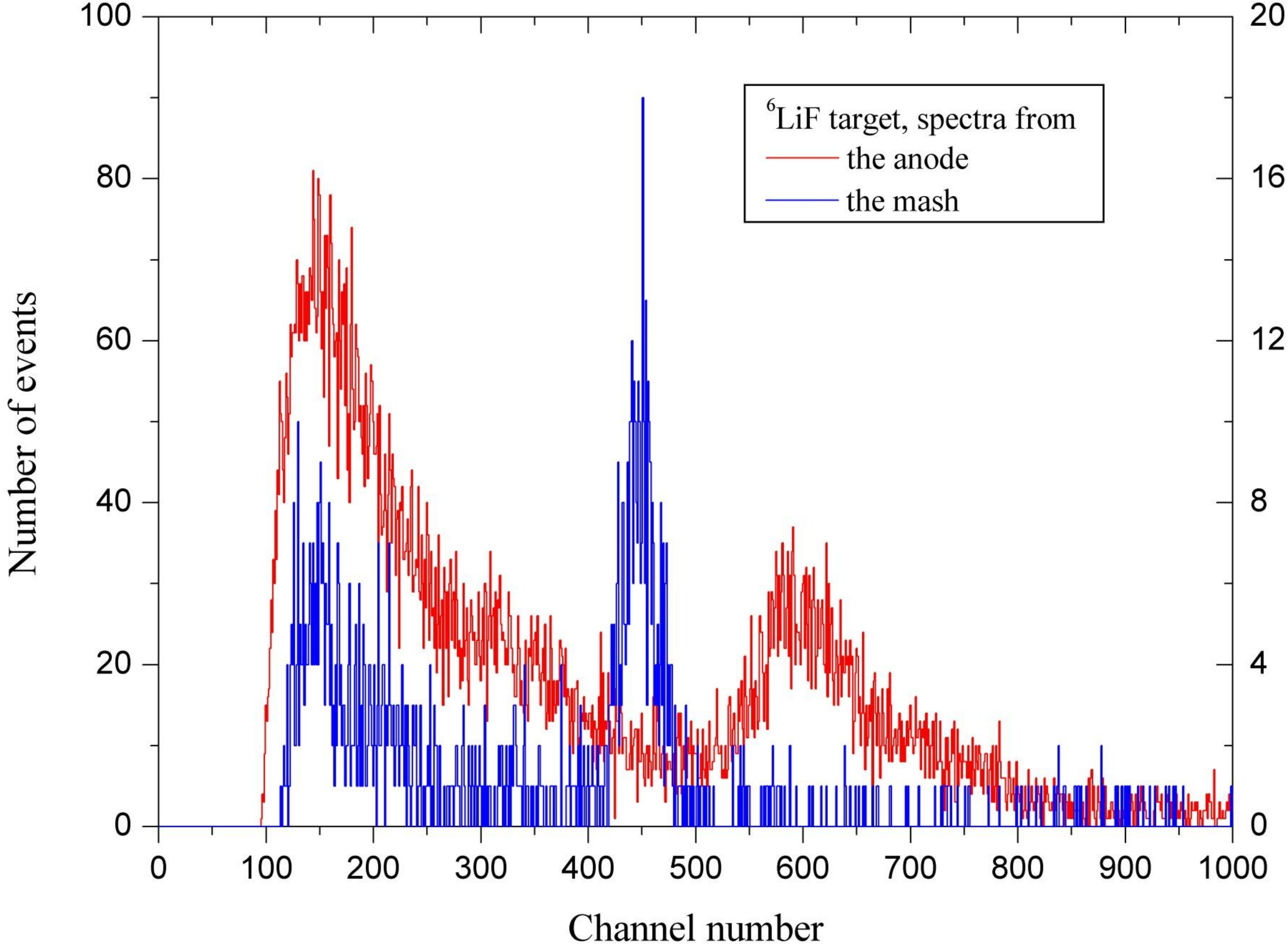


2. Registeration of signals from anode:

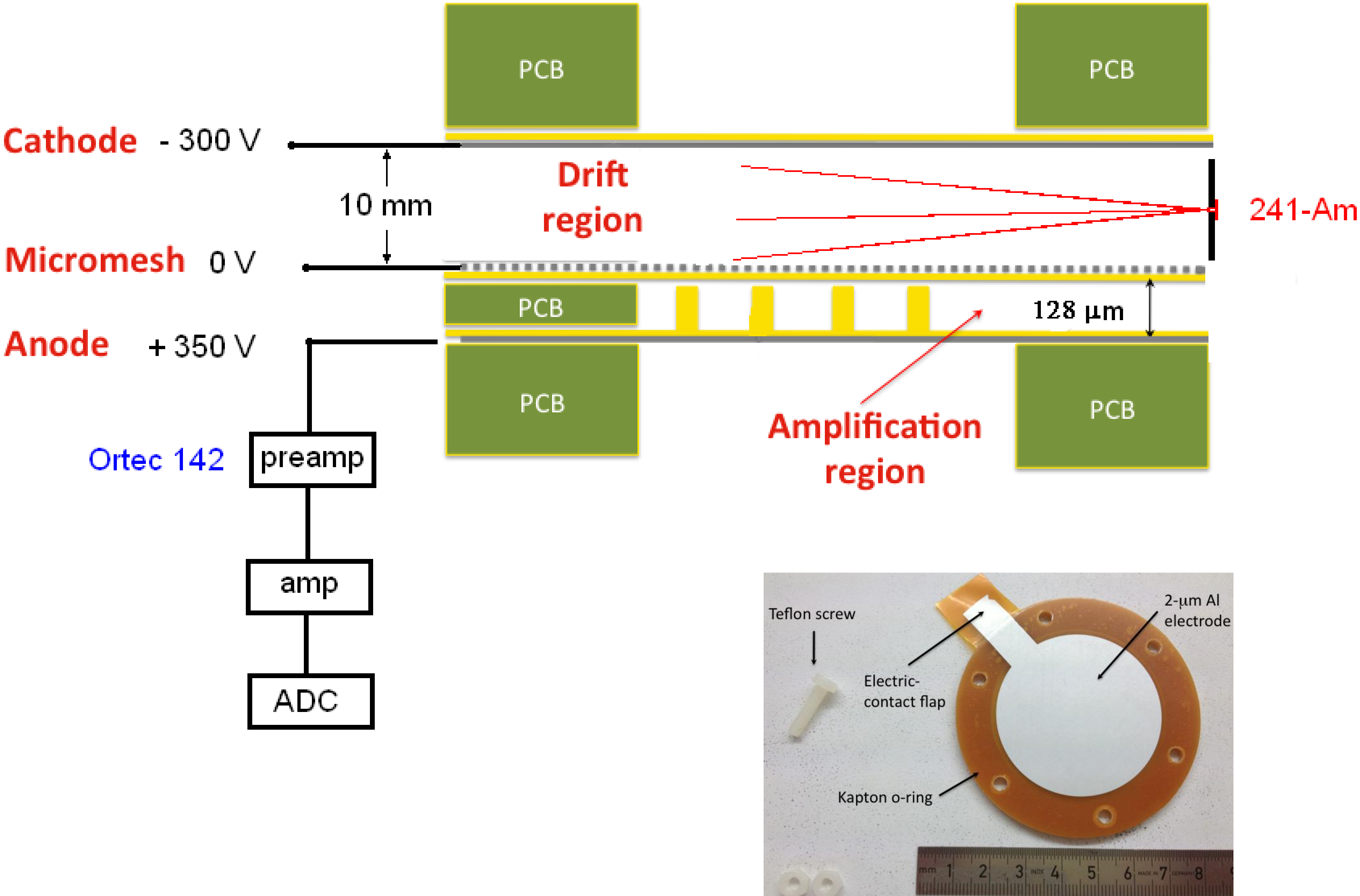


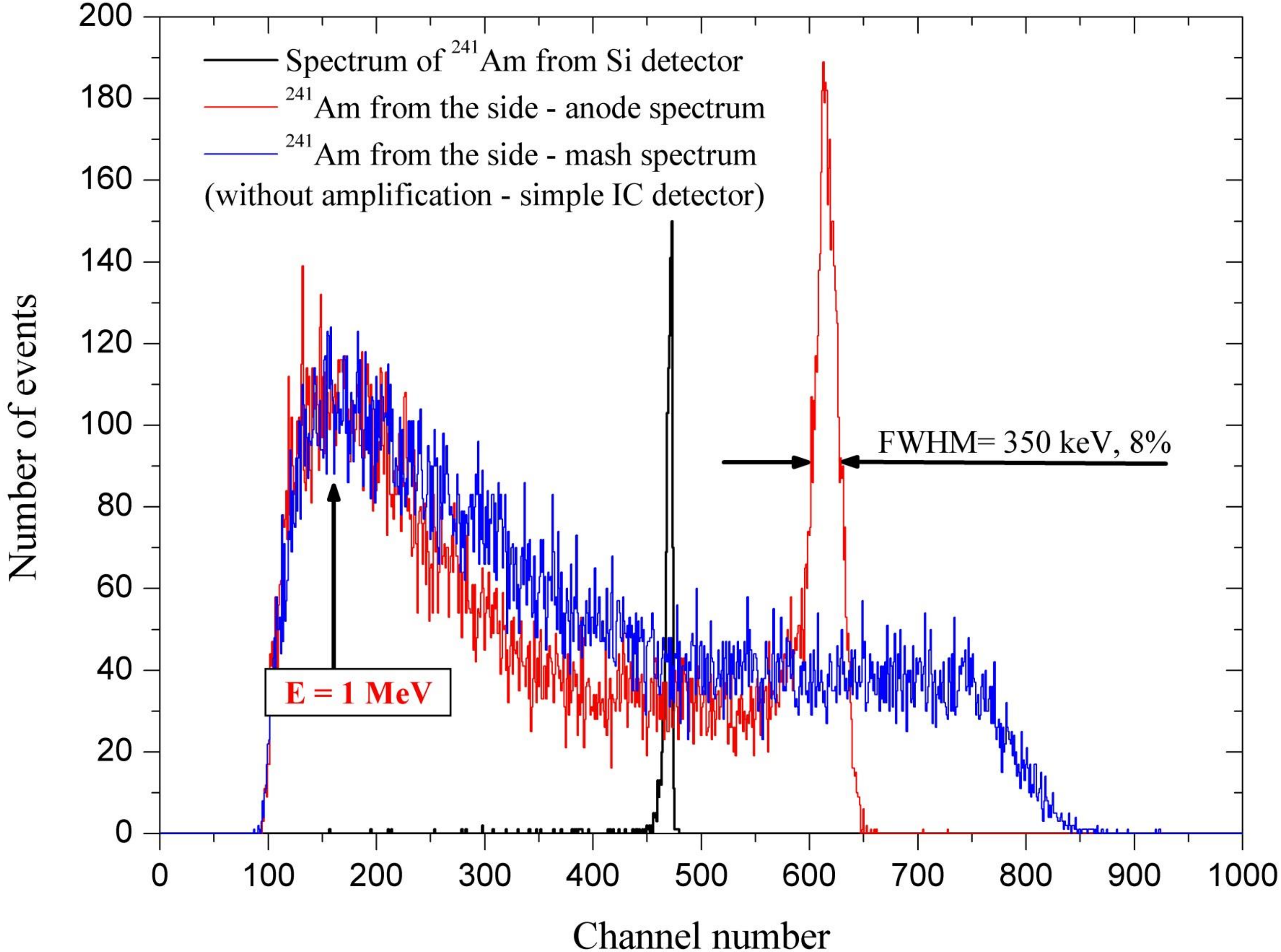


250
200
150
100
50
0
0
100
200
300
400
500
600
700
Spectra for alpha source (241Am+244Cm+239Pu):
Si-PIPS detector
from anode
Number of events
Channel number

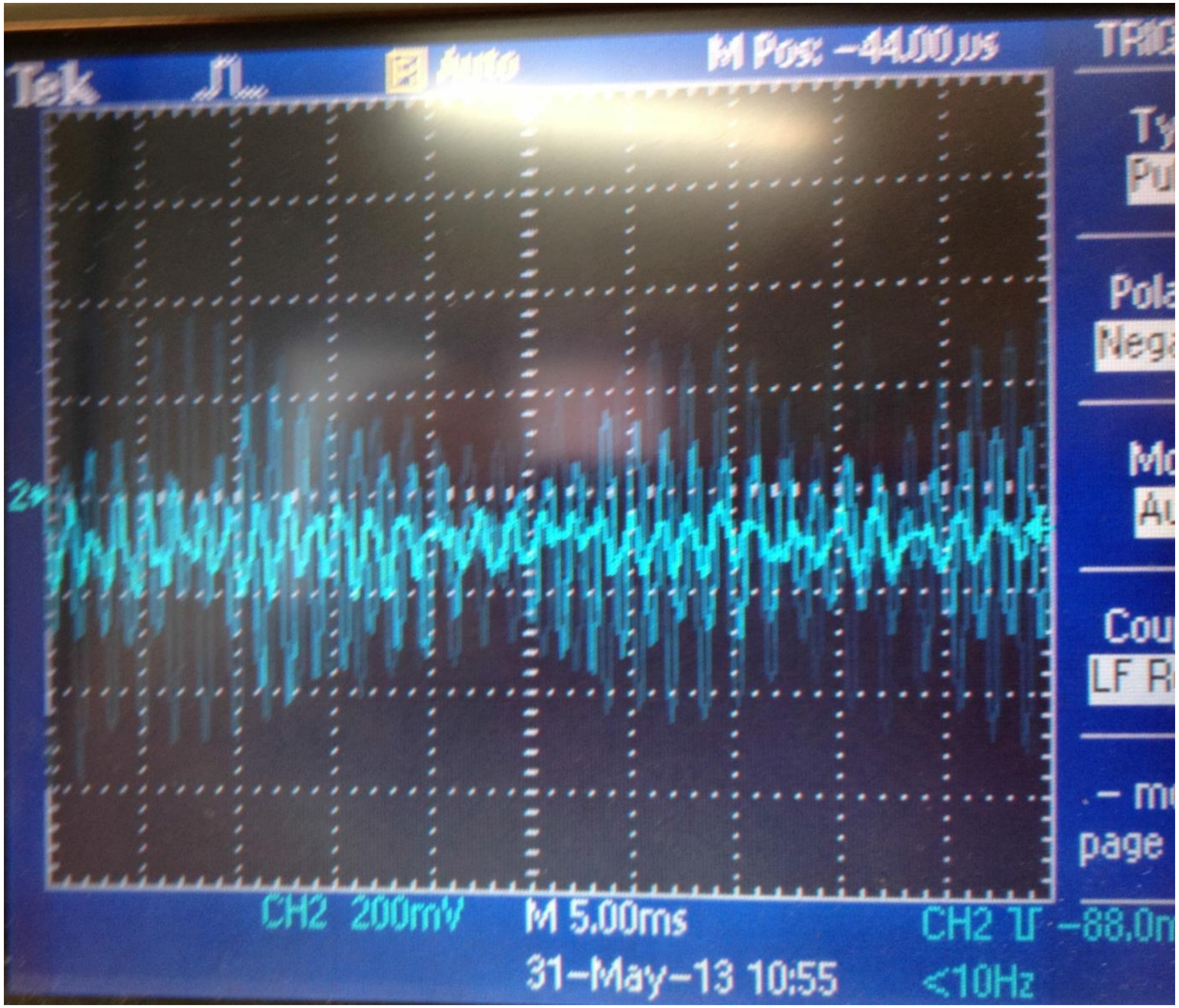


Number of events
Channel number
^{6}LiF target, spectra from
the anode
the mash
0
20
40
60
80
100
0
4
8
12
16
20
0
100
200
300
400
500
600
700
800
900
1000


Cathode - 300 V
Micromesh 0 V
Anode + 350 V
10 mm
PCB
PCB
Drift
region
241-Am
PCB
128 μm
PCB
PCB
Amplification
region
Ortec 142
preamp
amp
ADC
Teflon screw
Electric-
contact flap
2-μm Al
electrode
Kapton o-ring



Spectrum of 241Am from Si detector
241Am from the side - anode spectrum
241Am from the side - mash spectrum
(without amplification - simple IC detector)
FWHM= 350 keV, 8%
E = 1 MeV
Number of events
Channel number
0
20
40
60
80
100
120
140
160
180
200
0
100
200
300
400
500
600
700
800
900
1000



Microphone effect noise experienced by Al Mgas detector (May 2013, F. Mingrone)

Conclusions:

Micromegas detector is not optimal solution for our goal because:

1. energy resolution is bad for low energy charged particles,

2. amplification part is very sensitive on microphony (observed at CERN also).

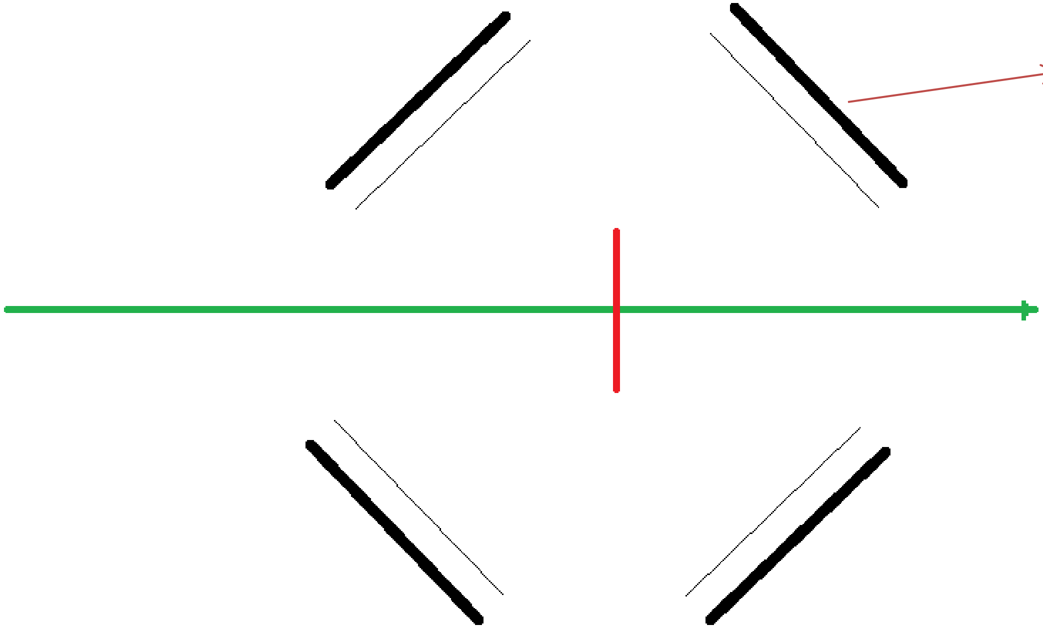
Second phenomenon strongly influences on energy resolution.

In situation when cross section and energy of emitted alphas are extremely low and other (n,cp) channels could be opened, **particle discrimination and good energy resolution are necessary.**

We propose to build **dE-E telescope setup** (segmented Si detectors ?) positioned out of neutron beam.

But the price of this choice is lower geometric efficiency = lower statistics.

Si-telescope setup



E detector will play a part
veto-detector

particle	range in Si	energy
alpha	20 μm	4.3 MeV
proton	20 μm	1.1 MeV
electron	20 μm	50 keV

Thank you

Dziękuję