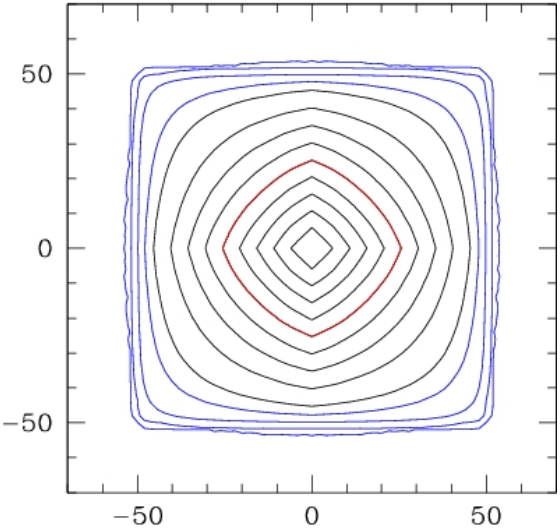
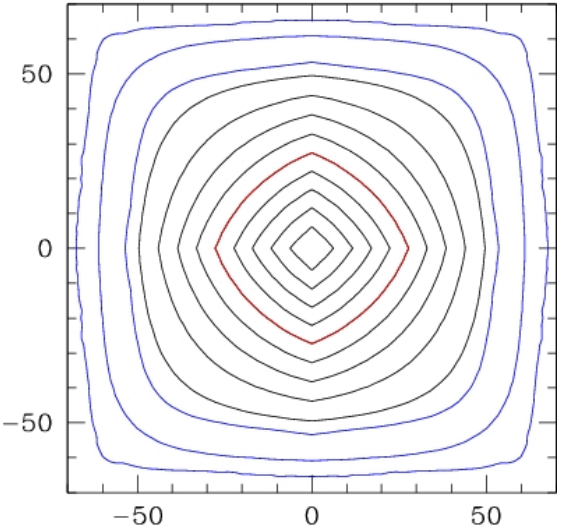
GEANT4 Simulations of the LAXPC Detector

6 February 2014

Calibration of the Field of View

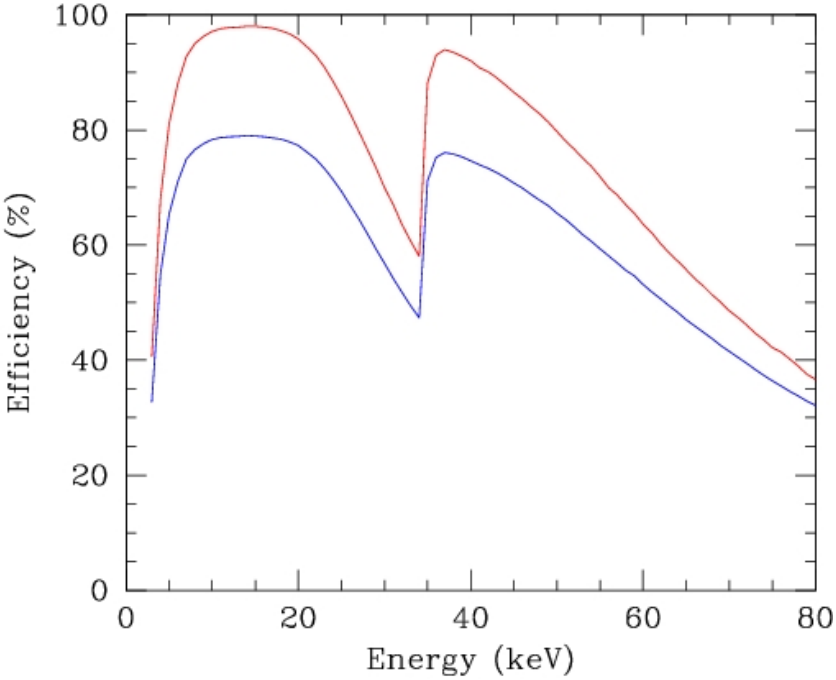


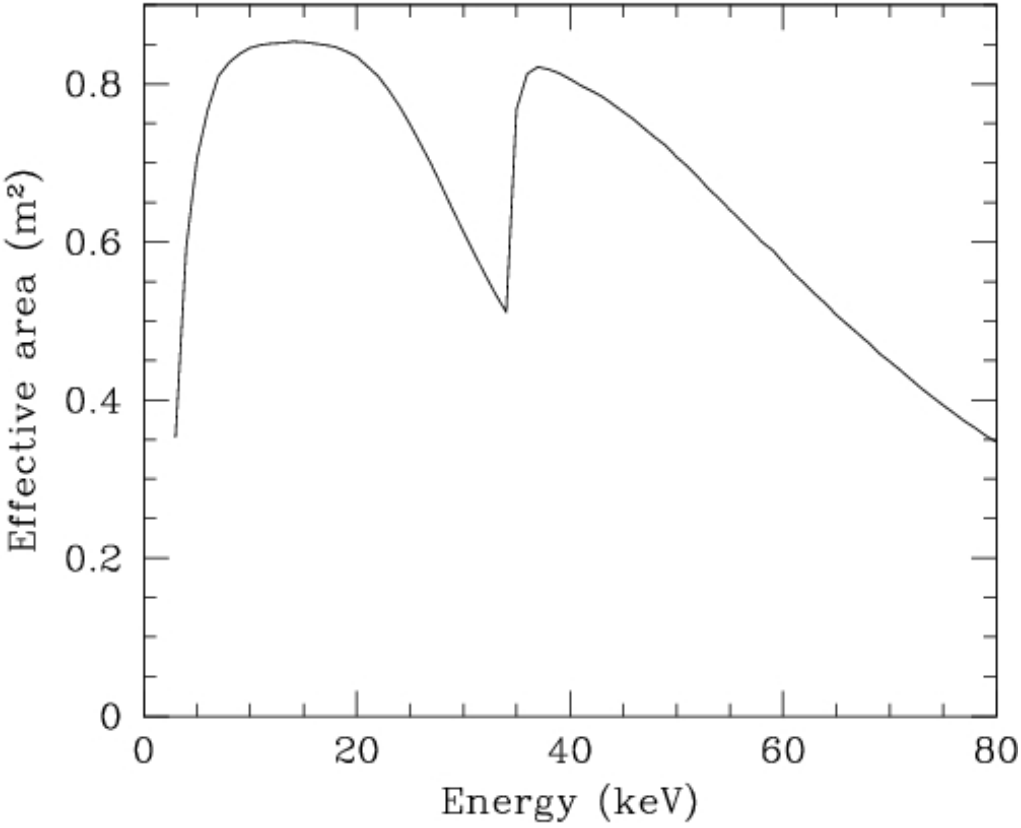


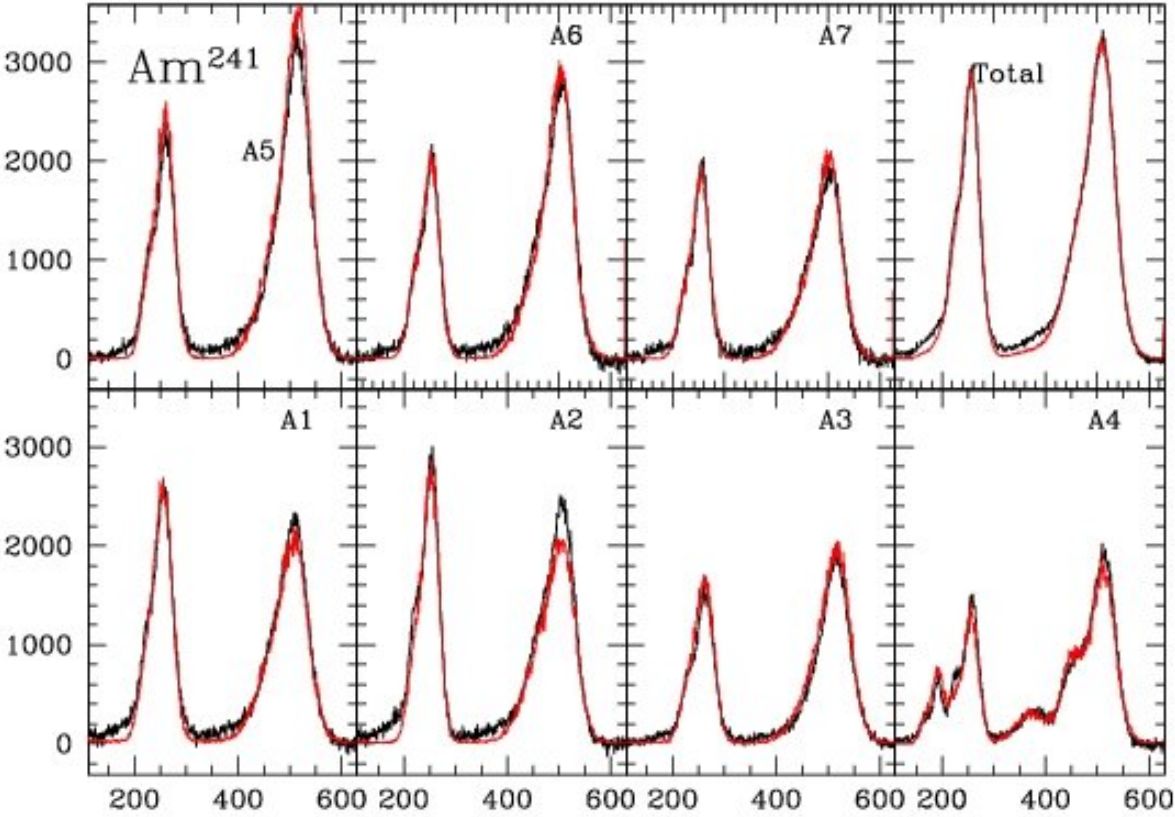
15 keV: FWHM $= 43' = 0.72°$

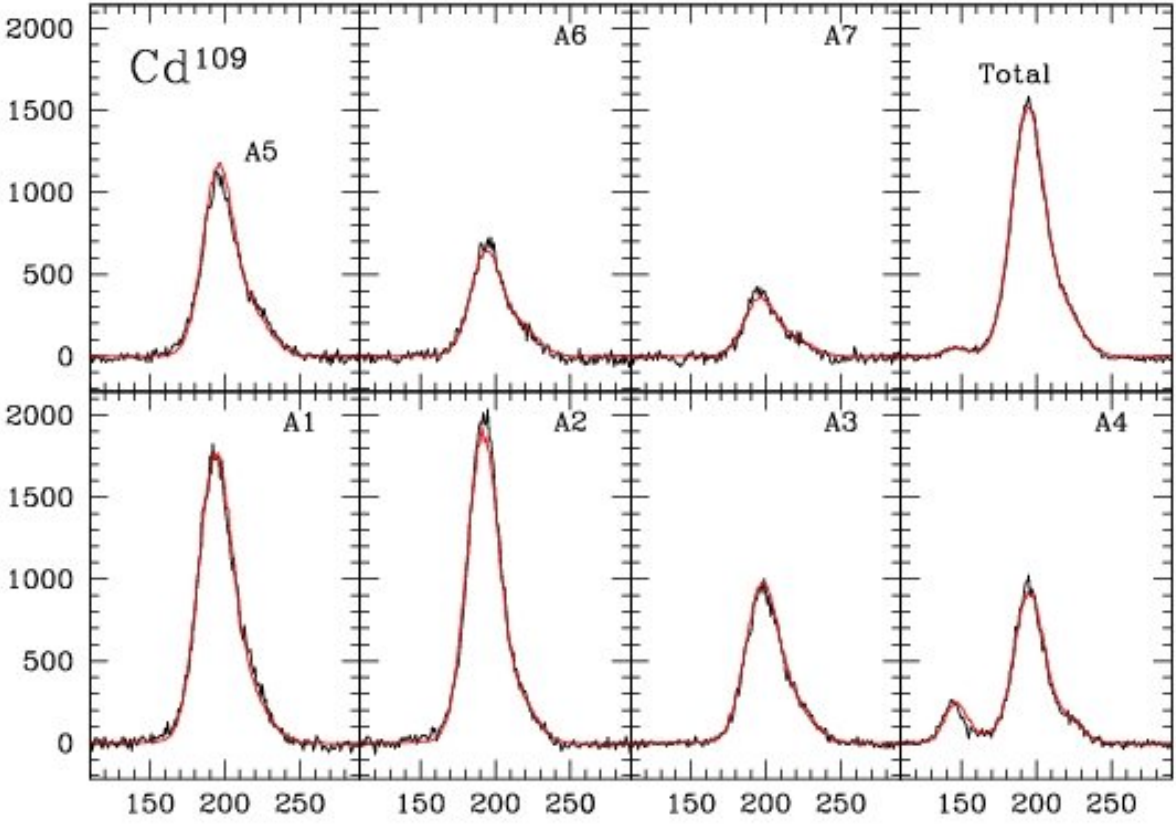
50 keV: FWHM $= 47' = 0.78°$

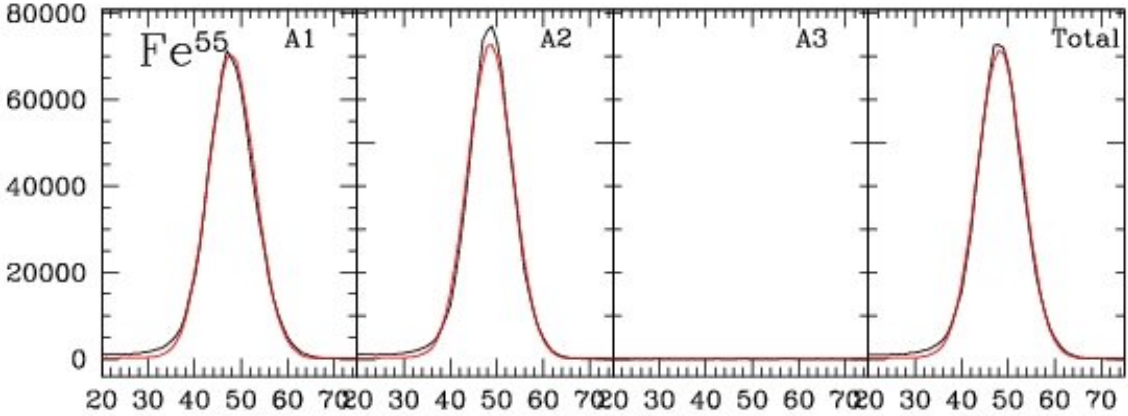
Detector Efficiency and Effective Area

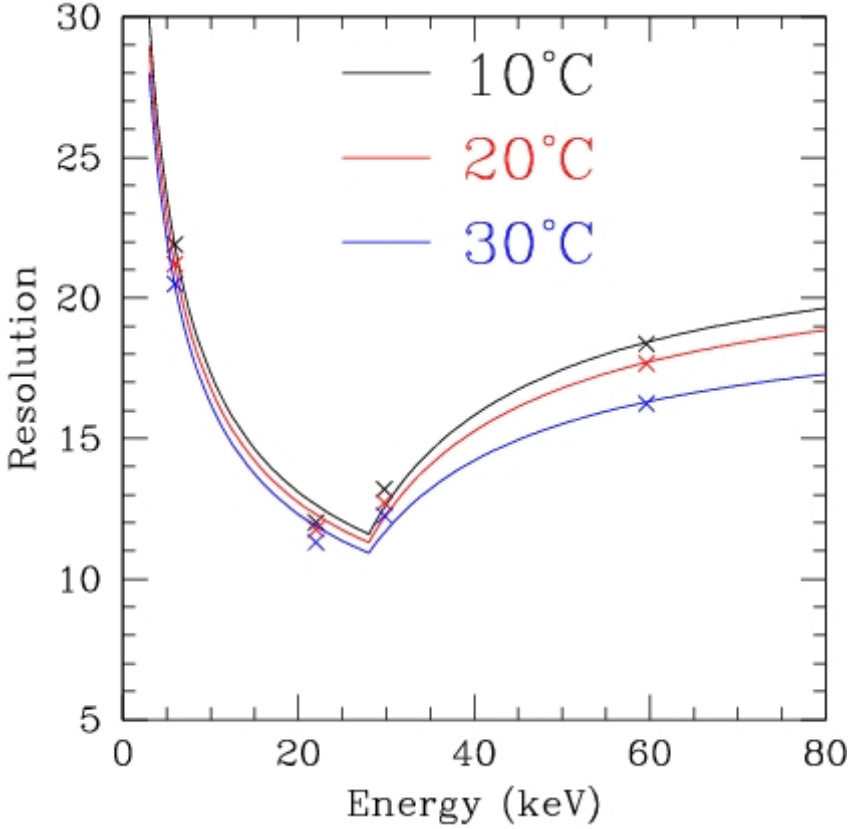


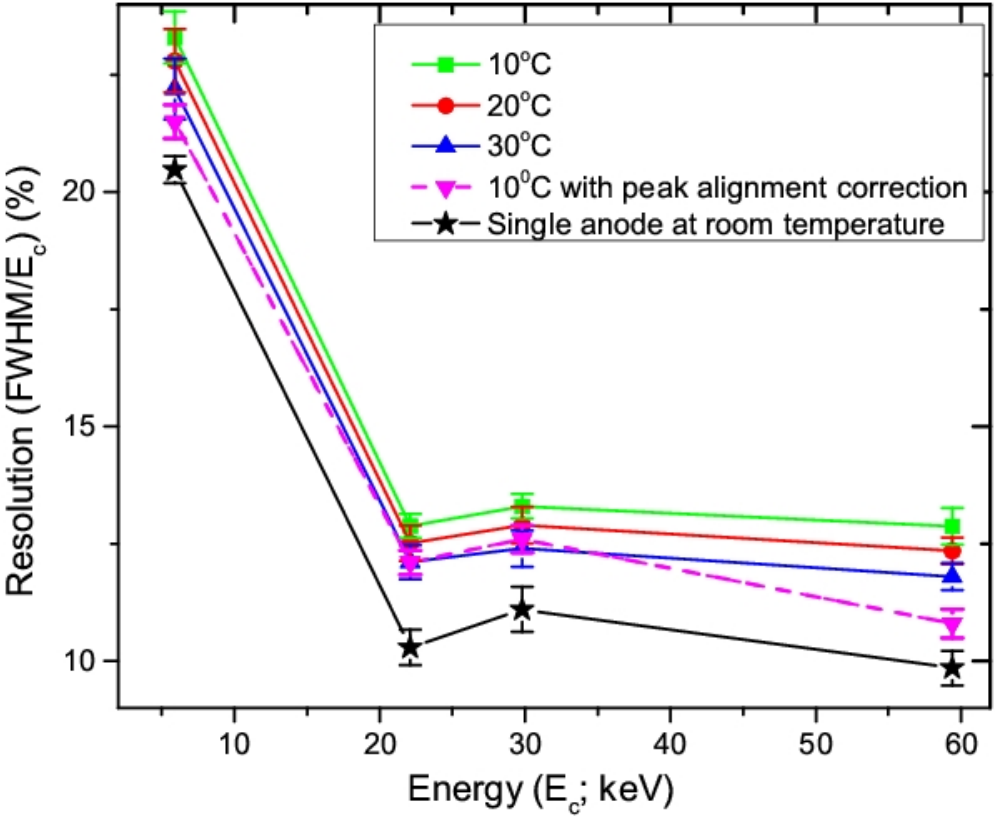

Effective area (m²)
0.8
0.6
0.4
0.2
0
0
20
40
60
80
Energy (keV)

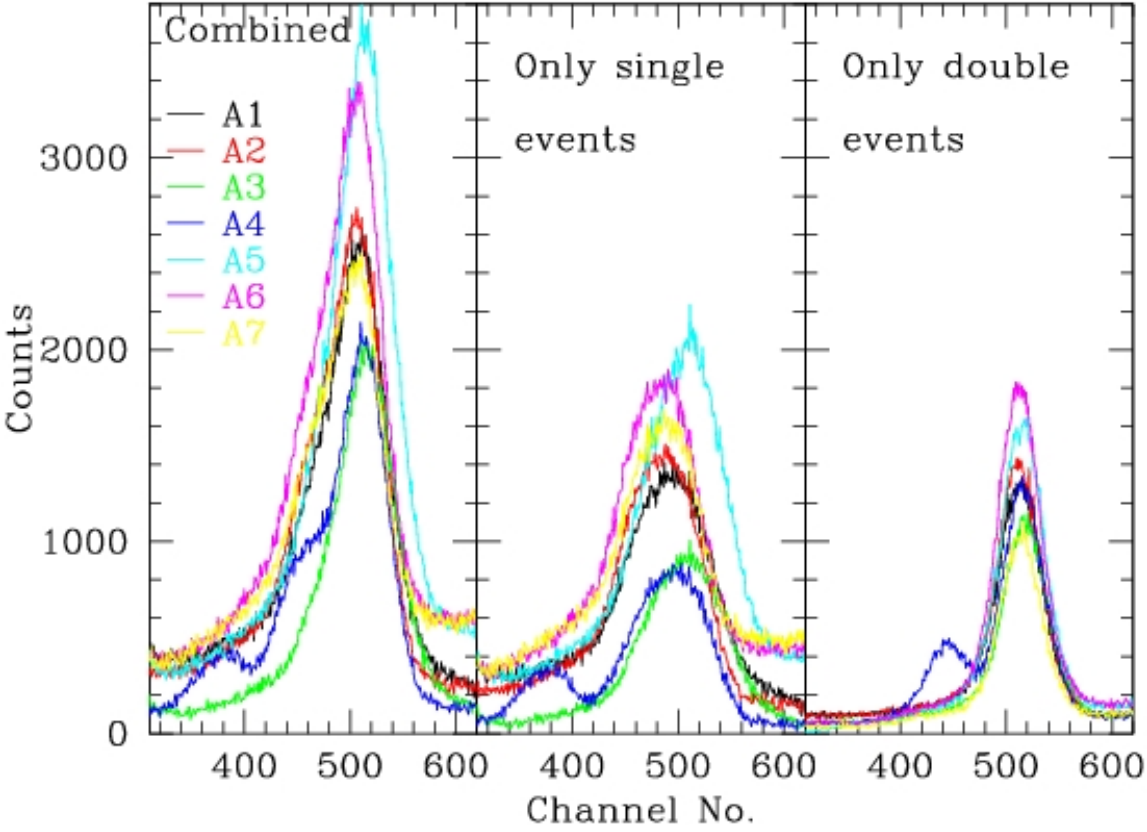

Am241
A5
A6
A7
Total
A1
A2
A3
A4
3000
2000
1000
0
200
400
600


Cd109
A5
A6
A7
Total
A1
A2
A3
A4
2000
1500
1000
500
0
150
200
250

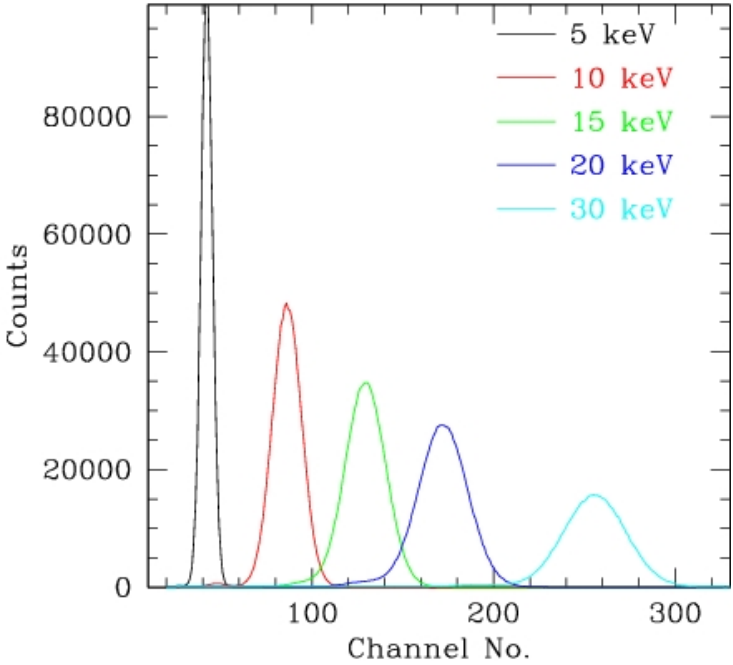

Fe55
A1
A2
A3
Total
80000
60000
40000
20000
0
20 30 40 50 60 70
20 30 40 50 60 70
20 30 40 50 60 70
20 30 40 50 60 70

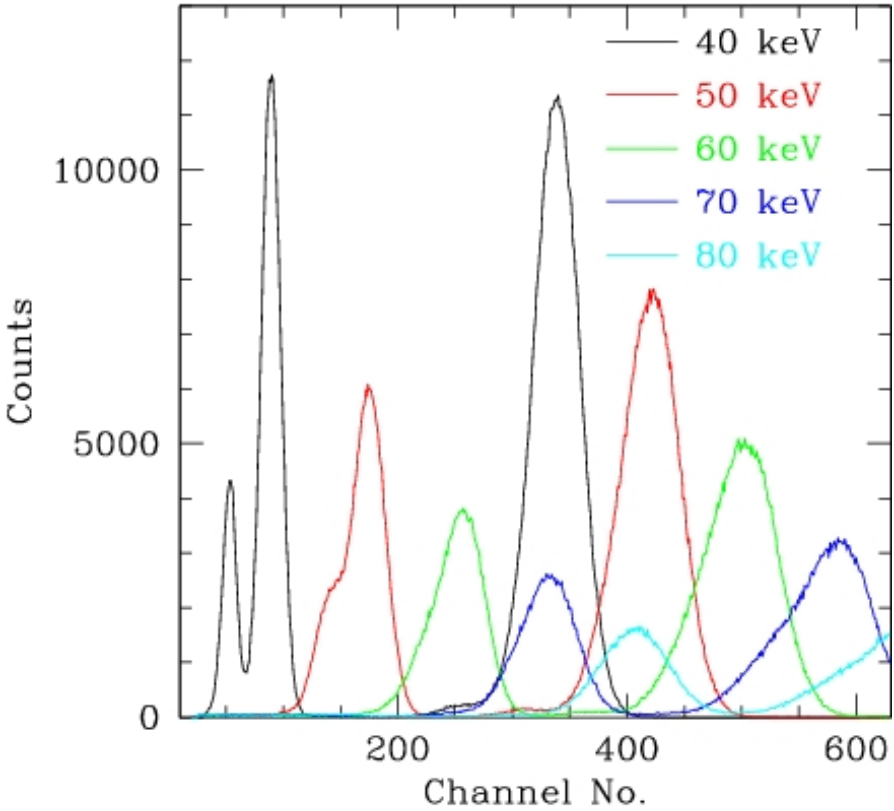

10°C
20°C
30°C
Resolution
Energy (keV)
30
25
20
15
10
5
0
20
40
60
80


10°C
20°C
30°C
10°C with peak alignment correction
Single anode at room temperature
Resolution (FWHM/E_c) (%)
Energy (E_c; keV)
10
15
20
10
20
30
40
50
60


Combined
Only single events
Only double events
A1
A2
A3
A4
A5
A6
A7
Counts
0
1000
2000
3000
400
500
600
Channel No.

- To calculate detector response for other energies we need to get $\sigma(E,T), n_c(E,T)$




40 keV
50 keV
60 keV
70 keV
80 keV
10000
5000
0
Counts
200
400
600
Channel No.

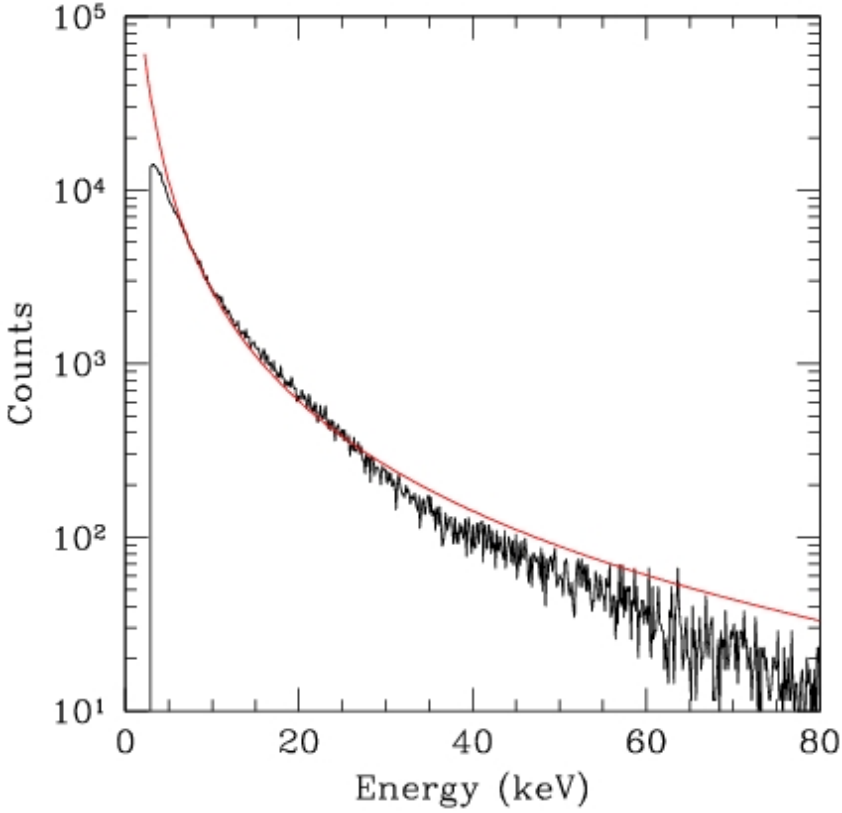
- For Crab X-ray source, the simulated spectrum calculated when the input spectrum of $N(E) = N_0 E^{-2.1}$

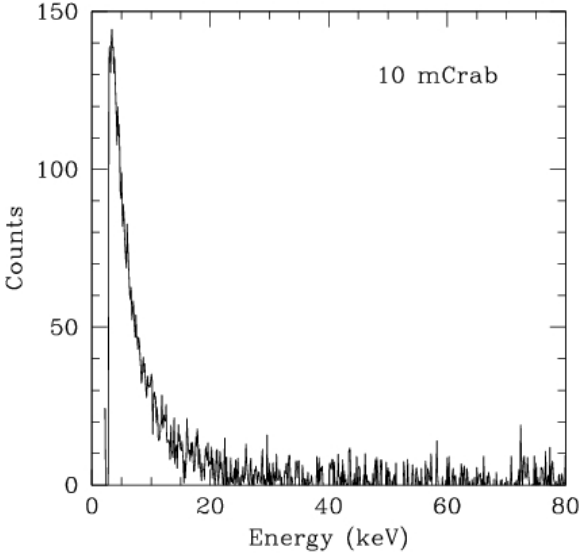
- The expected count rate is about 6000 s^{-1} in each detector. At this rate the dead-time of the system will reduce the count rate by about 25%.

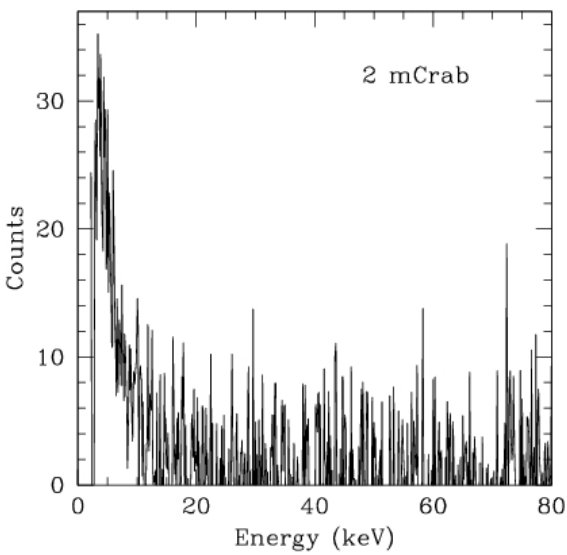
  Net count is expected to be about 13000 s^{-1}.

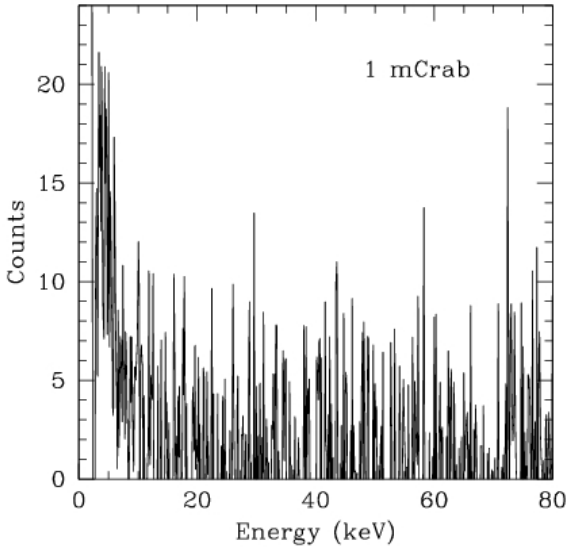
- For 1 mCrab source in 100 s the detection is at level of 8σ in total counts.

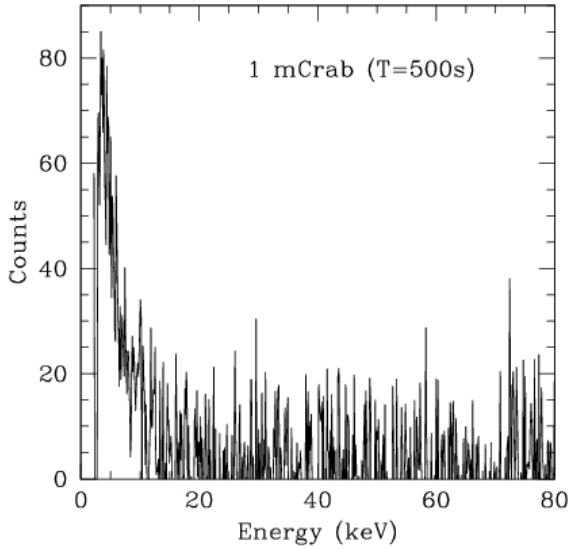
  If counts in 3–20 keV are used it improves to 16σ.


Counts
Energy (keV)
10^5
10^4
10^3
10^2
10^1
0
20
40
60
80

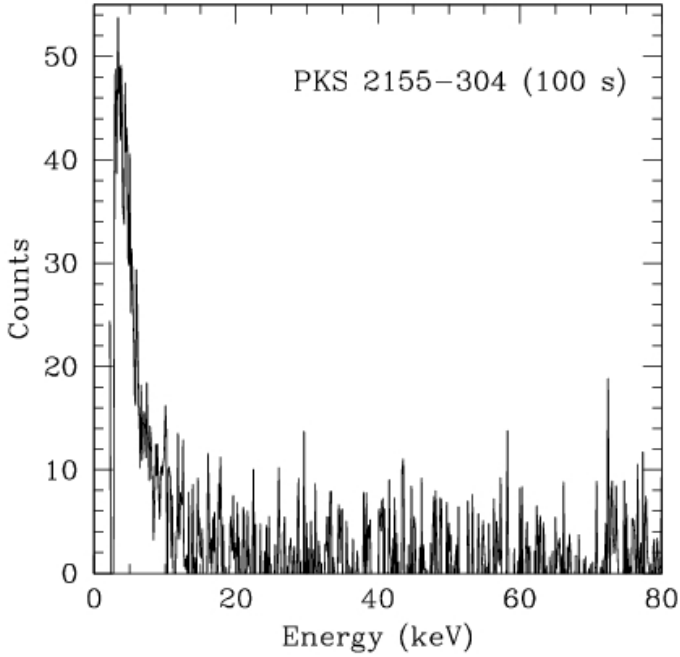

10 mCrab
Counts
Energy (keV)
0
50
100
150
0
20
40
60
80


2 mCrab
Counts
Energy (keV)
0
10
20
30
0
20
40
60
80


1 mCrab
Counts
Energy (keV)
0
5
10
15
20
0
20
40
60
80

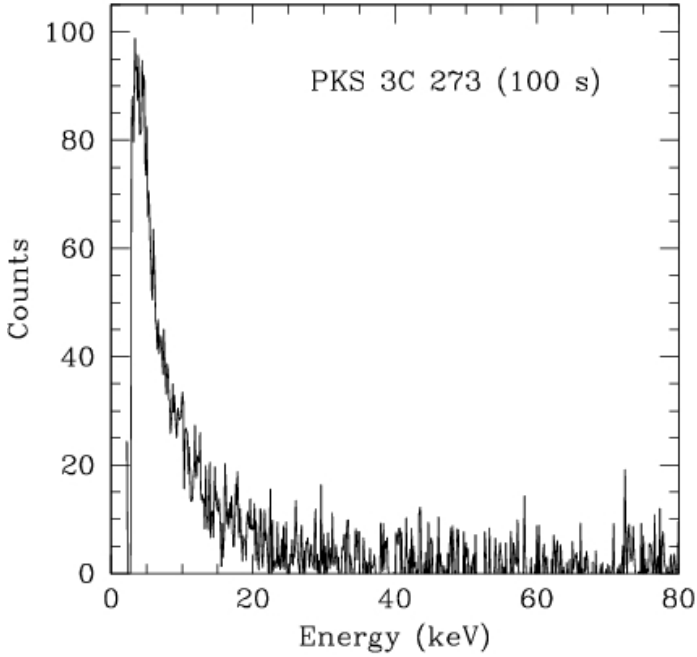

1 mCrab (T=500s)
Counts
Energy (keV)
0
20
40
60
80
0
20
40
60
80

PKS 2155–304 $\alpha = 2.4$



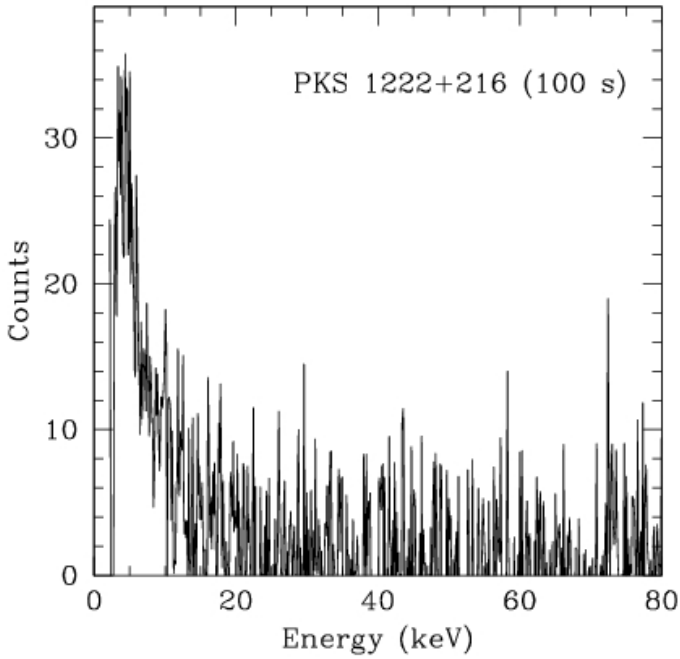
Counts: 18 s^{-1}, 14σ detection in 100 s

PKS 3C 273 $\alpha = 1.82$



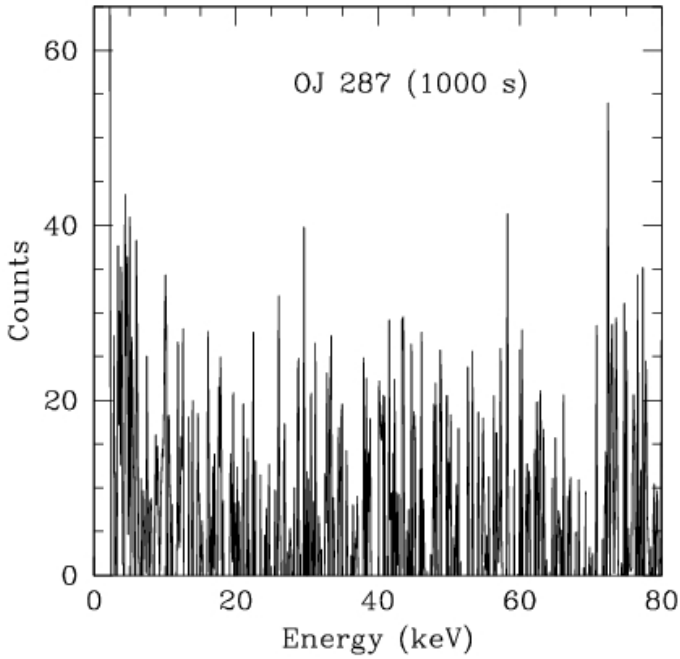
Counts: 53 s^{-1}, 42σ detection in 100 s

PKS 1222+216 $\alpha = 1.61$

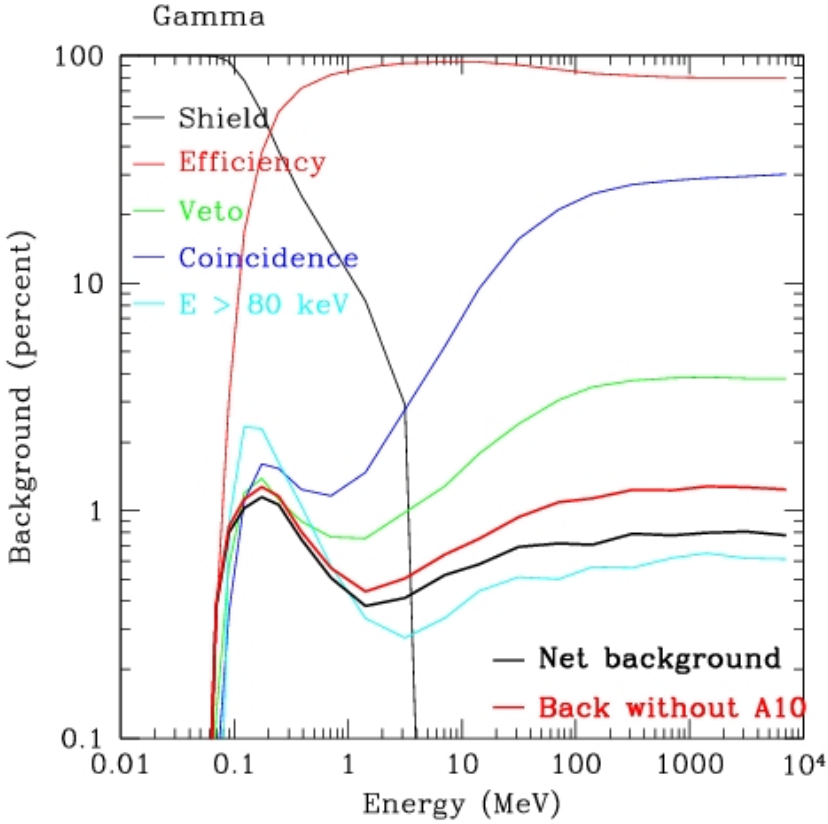


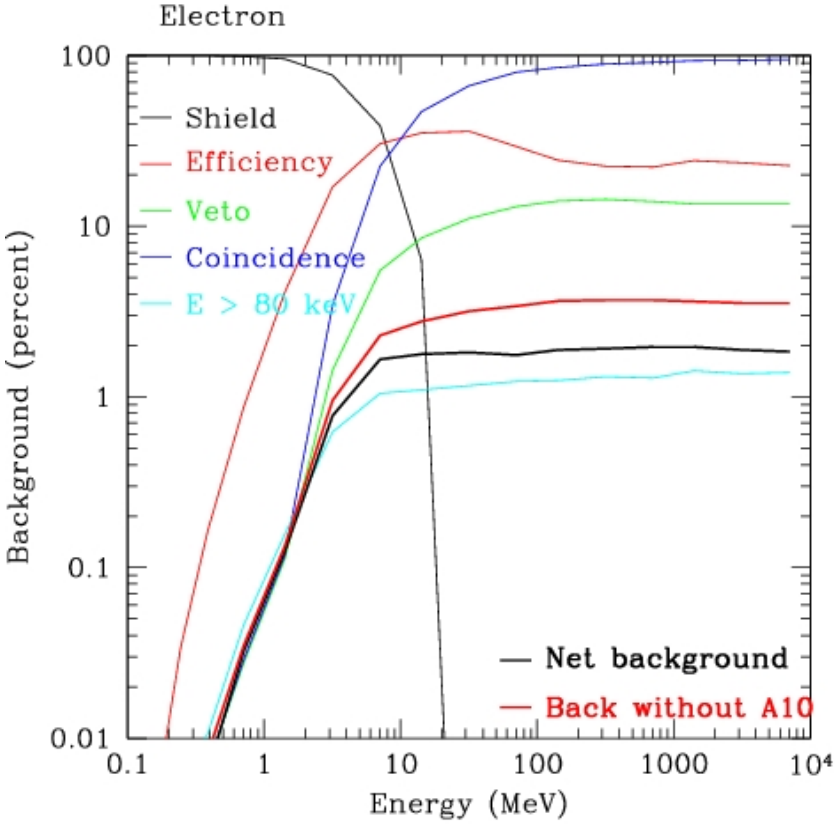
Counts: 18 s^{-1}, 14σ detection in 100 s

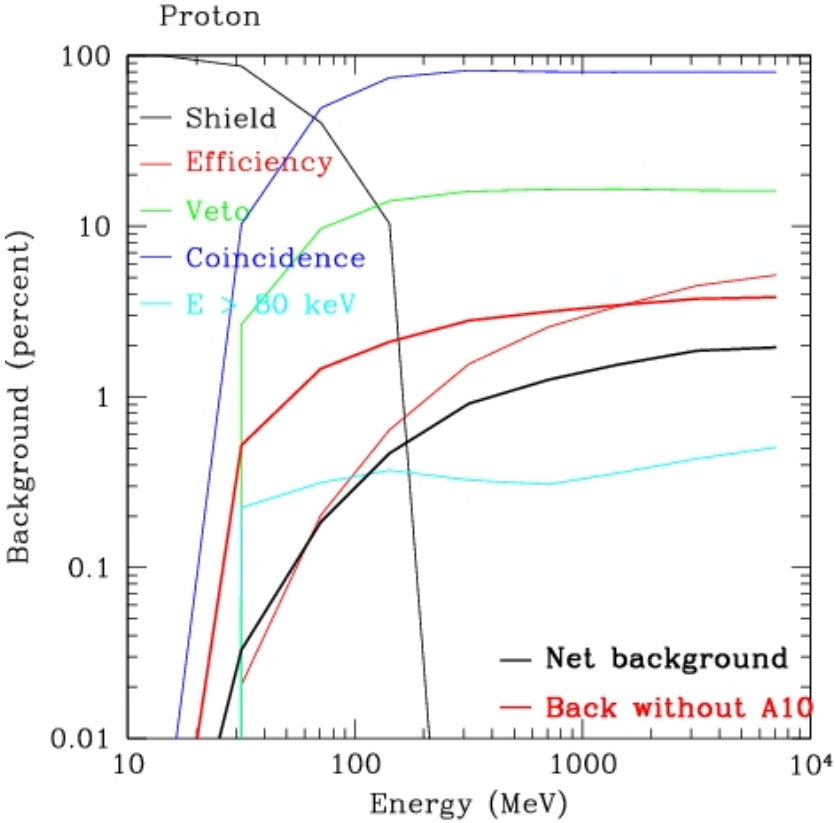
OJ 287 $\alpha = 1.65$

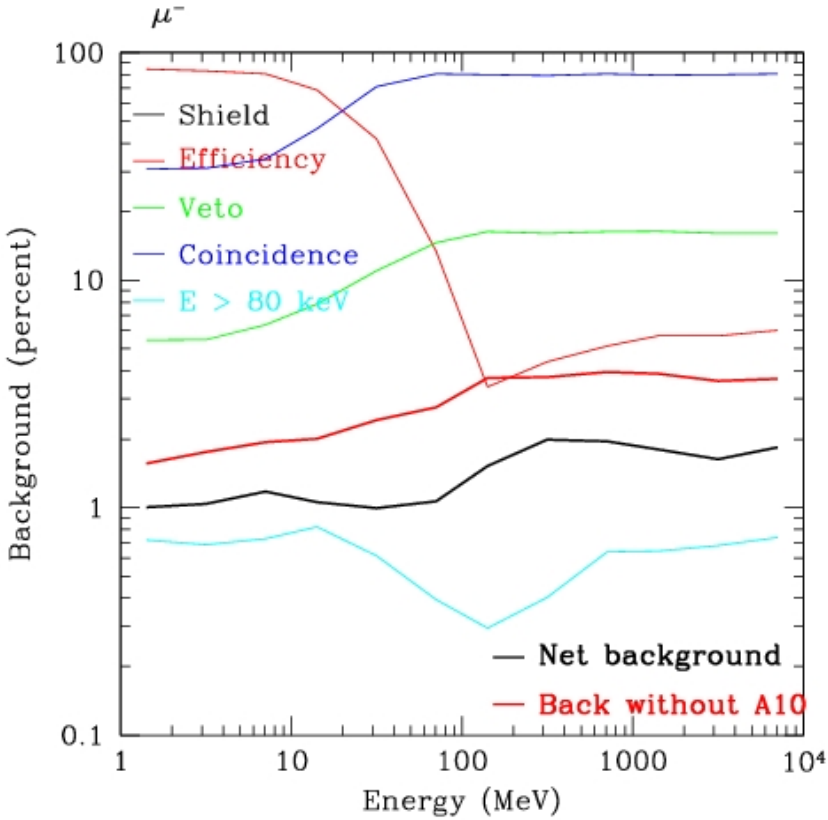


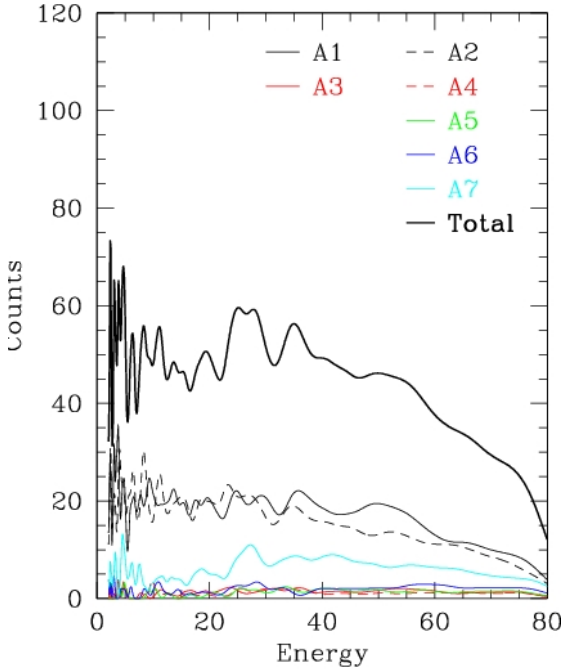
Counts: 0.6 s^{-1}, 3.7σ detection in 1000 s (3–20 keV)

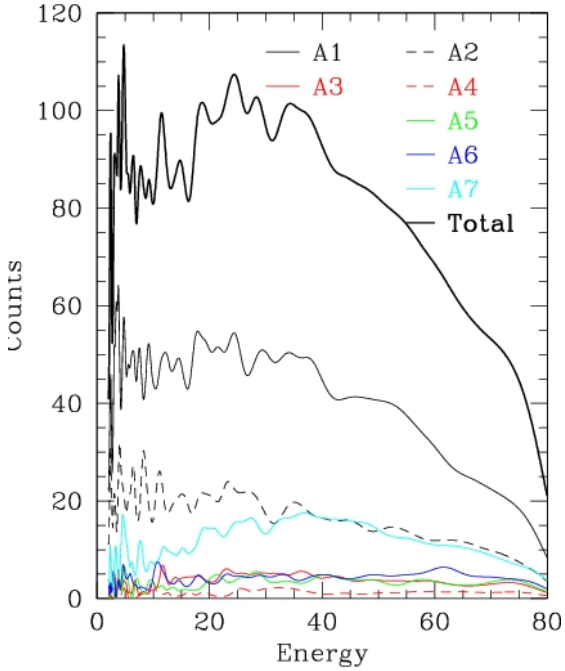

Gamma
Shield
Efficiency
Veto
Coincidence
E > 80 keV
Net background
Back without A10
Background (percent)
Energy (MeV)
100
10
1
0.1
0.01
0.1
1
10
100
1000
10⁴


Electron
Shield
Efficiency
Veto
Coincidence
E > 80 keV
Net background
Back without A10
Background (percent)
Energy (MeV)
100
10
1
0.1
0.01
0.1
1
10
100
1000
10⁴


Proton
Shield
Efficiency
Veto
Coincidence
E > 80 keV
Net background
Back without A10
Background (percent)
Energy (MeV)
100
10
1
0.1
0.01
10
100
1000
10⁴


μ^-
100
10
1
0.1
Background (percent)
Shield
Efficiency
Veto
Coincidence
E > 80 keV
Net background
Back without A10
1
10
100
1000
10^4
Energy (MeV)





with A10 without A10

Background from 1–2 GeV μ^-