SCHOOL ON INSTRUMENTATION IN PARTICLE PHYSICS; AND DETECTOR APPLICATIONS

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PROPORTIONAL COUNTER

1. INTRODUCTION

Detection medium is gas. Mostly it is rare gas and quencing gas mixture. Examples Ar-CO2(10%), Ne-CO2(10%), Xe-CO2(10%). Other typical quenching gases are CH4, C4H10.
X-rays interact mainly via photoelectric effect and result is energetic photoelectron which will loose its energy by ionizing the gas.
Charged particles ionize directly the gas and leavy usually long ionization track.
In neutron detectors (eg. He3) interaction is nuclear reaction

Usually in proportional counter is a tube having positive wire in the axis of the tube.

Primary electrons from the photointeraction and ionization process are collected to the wire and positive ions are drifting towards the cathode. Near the anode electric field is high enough to cause electron multiplication process. Quencing gas prevents secondary avalances and multiplication remains stable. Positive ions from the multiplication process start to drift towards cathode. This drift will induce the obtaided pulse from the detector.

2. PHYSICS AND PHENOMENA

a) Mean ionization energy W, Fano factor, efficiency, photoelectron track, escape peak
b) Electron collection, drift velocity, electron attachment
c) Gas amplification
d) Energy resolution

3. SHAPE OF THE SPECTRUM

a) Gaussian part
b) Low energy tail

3) How to eliminate low energy tail
a) Rise time analysis
b) Optimization of gas pressure and efficiency
c) Cathode grid anticoinsidence method

EXPERIMENT:

a) Measure Fe-55(5.9 keV) spectrum
b) Make single point energy calibration
c) Measure energy resolution (FWHM)
d) Study overlapping of Ka and Kb of Manganese (Fe-55)
e) Determine tail countrate/photopeak countrate
f) Determine tail countrate/photopeak countrate when anticoinsidence is on
g) Study X-ray fluorescence spectrum when air is irradiated by Fe-55

DISCUSSION

Low energy tail is not completely eliminated using cathode grid method. What phenomena could cause background counts what are not eliminated?