

# COUNTING GAS BEHAVIOR IN THE USE OF $M_N$ K X-RAY FROM $^{55}Fe$ FOR ESTABLISHING $\beta$ -COUNTING THRESHOLDS

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(recibido noviembre 8, 1984; aceptado abril 29, 1985)

## ABSTRACT

A radioactive source of  $^{55}Fe$ , used in the proportional region, with  $CH_4$  and  $CH_4 + Ar$  mixture as counting gases for low energy thresholds determination, allow to obtain the calibration curves from the correspondent spectra.

## RESUMEN

Se usa una fuente radiactiva de  $^{55}Fe$  en la región proporcional de conteo, utilizando  $CH_4$  y  $CH_4 + Ar$  (Gas Q), para la determinación del umbral en la región de baja energía de rayos X, lo que permite obtener las curvas de calibración de los espectros correspondientes.

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## 1. INTRODUCTION

It is the purpose of this work to give further information of a previous work done at NPL in the use of Mn K-x-ray-from  $^{55}\text{Fe}$  for establishing B-counting thresholds<sup>(1)</sup>.

In this paper it is described the behavior of  $\text{CH}_4$  and Q-Gas (90% Argon, 10% Methane Mixture) when used as counting gases in a proportional counter for energy calibration measurements.

## 2. SOURCE PREPARATION

Sources were prepared as described in our previous report<sup>(1)</sup>, by depositing a few drops of a solution of  $^{55}\text{Fe}$  in dilute HCl, total activity  $10^3 - 10^4$  Bq, on an aluminium disc, thickness 0.5 - 1.0 mm. The dried deposit is covered with an aluminium foil of  $400 \text{ ug/cm}^2$ .

## 3. METHANE COUNTING GAS

A typical x-ray spectra produced by a  $^{55}\text{Fe}$  source is shown in Fig. 1, from which an energy calibration curve using  $\text{Mn}\alpha_{1,2}$ ,  $\text{L}_{\text{III}}$   $\text{M}_{\text{IV},\text{V}}$ ,  $\text{Al}\alpha_1$   $\text{KL}_{\text{III}}$  and  $\text{Mn}\alpha_1$   $\text{KL}_{\text{III}}$  x-ray peaks is obtained and presented in Fig. 2.

## 4. ARGON-METHANE MIXTURE

In a similar manner, the spectra from the  $^{55}\text{Fe}$  source using Q-Gas is shown in Fig. 3 and the relative energy calibration curve with observed peaks of 1.48670 KeV  $\text{Al}\alpha_1$   $\text{KL}_{\text{III}}$ , 2.95770 KeV  $\text{Ar}\alpha_1$   $\text{KL}_{\text{III}}$  and 5.89875 KeV  $\text{Mn}\alpha_1$   $\text{KL}_{\text{III}}$  x-ray is shown in Fig. 4.

## 5. INSTRUMENTATION

The electronic block diagram used in this work is shown in Fig. 5. The output from first amplifier is into the PHA system, the second amplifier is used to set discrimination level at the delay/gate generator on the scaler channel.

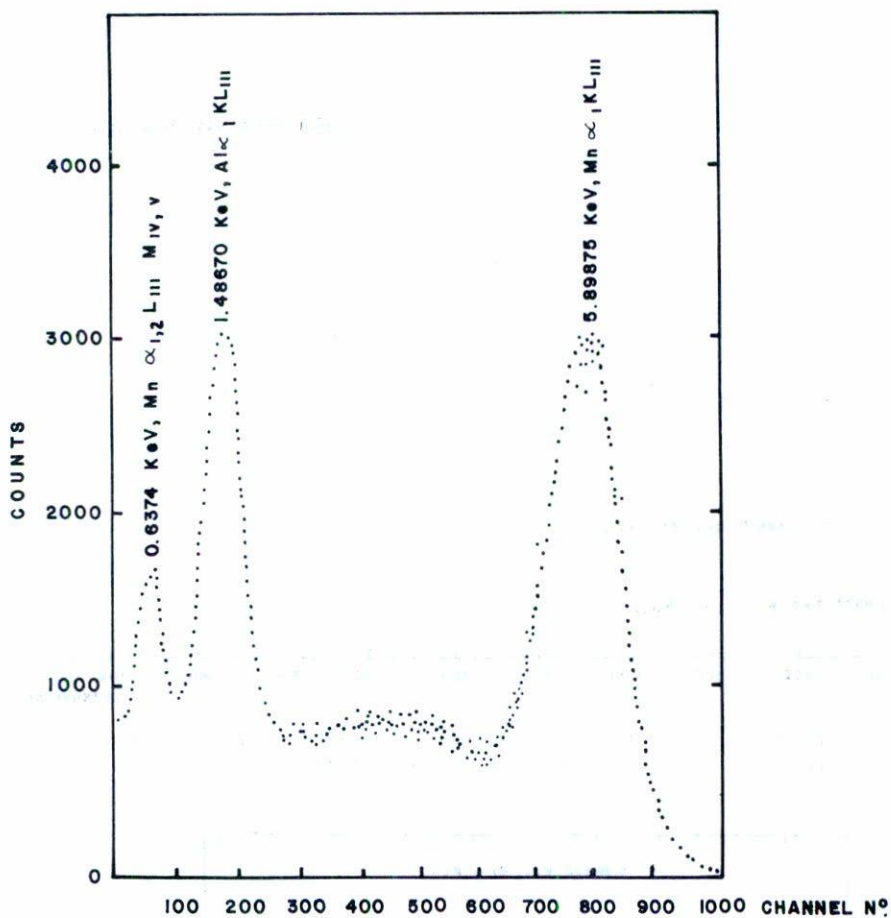


Fig. 1. Spectrum of a  $^{55}\text{Fe}$  source covered with Al, obtained in a  $2\pi$  proportional counter using  $\text{CH}_4$ .

#### 6. SPECTRA BEHAVIOR OF THE COUNTING GAS SELECTED

It is interesting to compare both spectra shown in Figs. 1 and 3, that leads to the following information regarding the counting gas used:

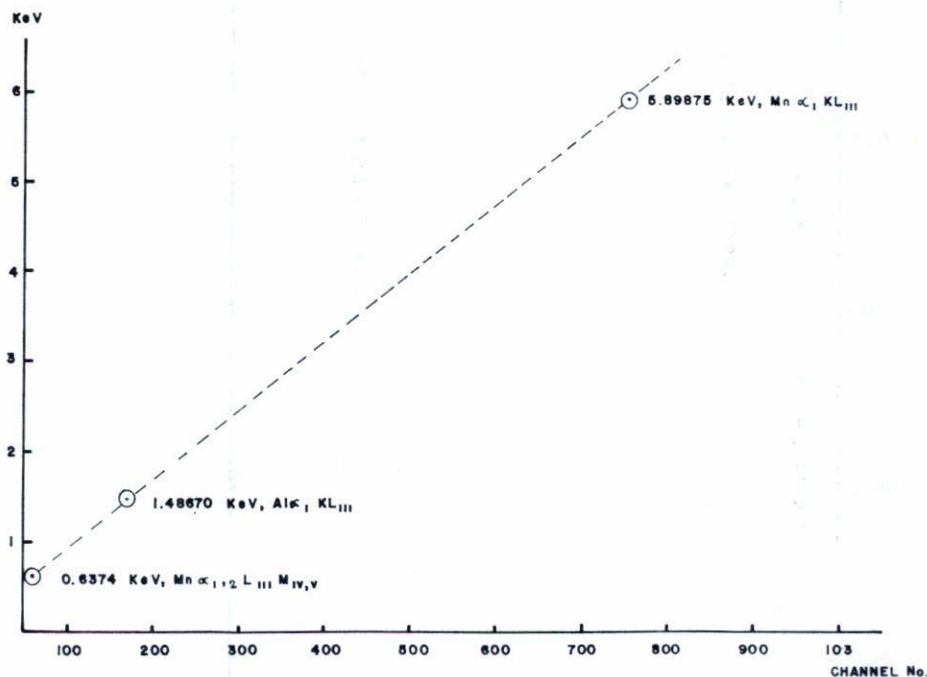


Fig. 2. Energy calibration curve determined by MnL, AlK and MnK x-ray peaks of a  $^{55}\text{Fe}$  source with  $\text{CH}_4$  as counting gas.

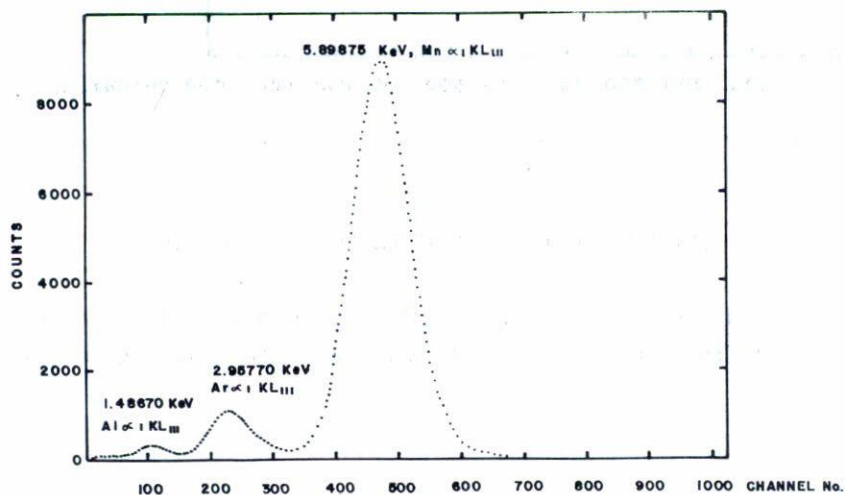


Fig. 3. Spectrum of a  $^{55}\text{Fe}$  source covered with Al, obtained in a  $2\pi$  proportional counter, using Argon-Methane Mixture (Q-Gas).

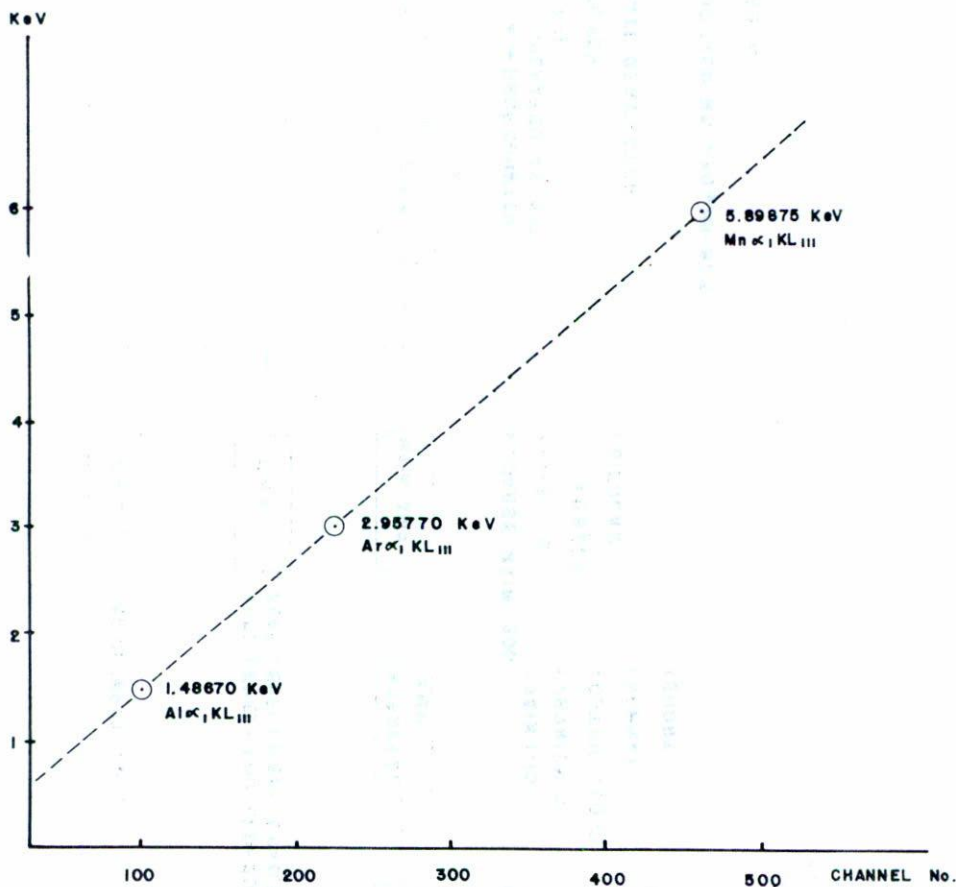


Fig. 4. Energy calibration curve obtained by AlK, ArK and MnK x-ray of a  $^{55}\text{Fe}$  source with Argon-Methane Mixture.

Counting Gas	Observed x-ray peaks (KeV)		
Methane	Mn $\alpha_{1,2}$ L <sub>III</sub>	M <sub>IV,V</sub>	Al $\alpha_1$ KL <sub>III</sub>
	0.6374		5.89875
Argon-Methane Mixture	Al $\alpha_1$ KL <sub>III</sub>	Ar $\alpha_1$ KL <sub>III</sub>	Mn $\alpha_1$ KL <sub>III</sub>
	1.48670	2.95770	5.89875

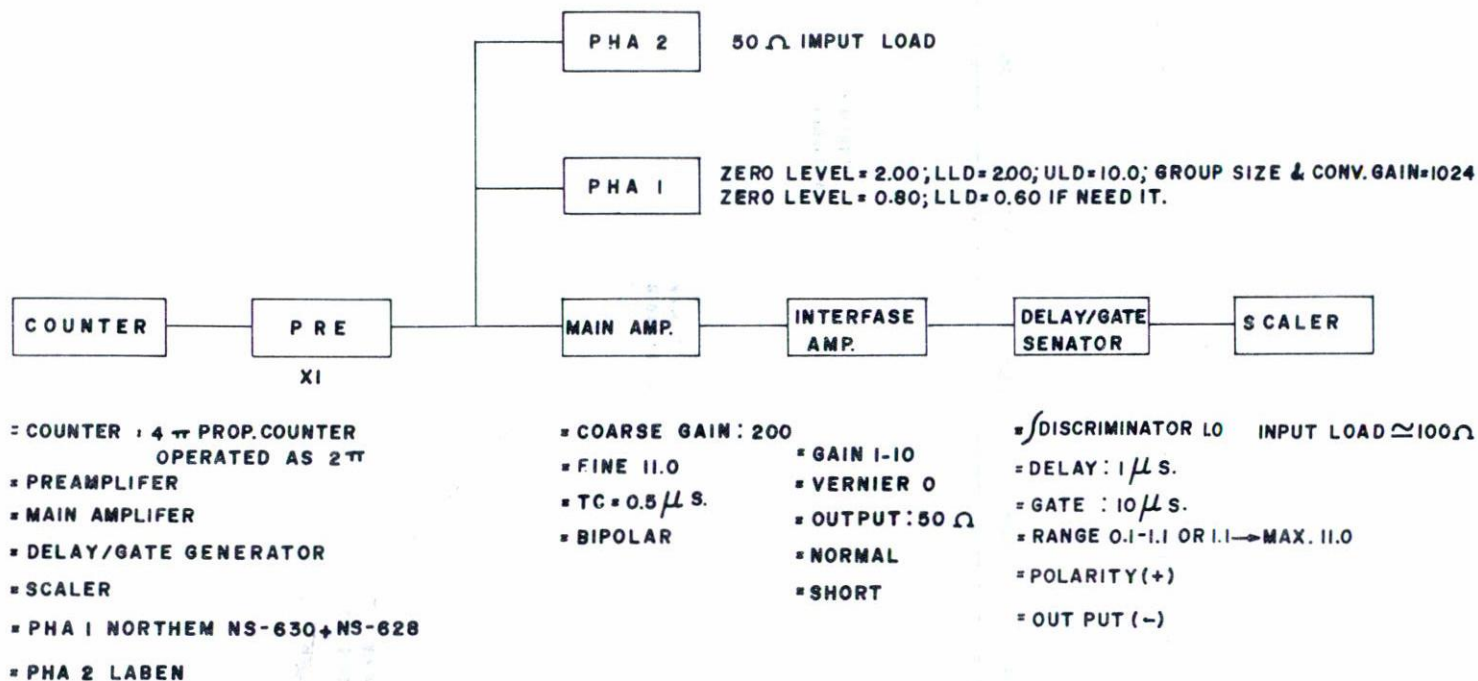


Fig. 5. Electronic block diagram. (Interfase amplifier is omitted when Argon-Methane Mixture as counting gas is used).

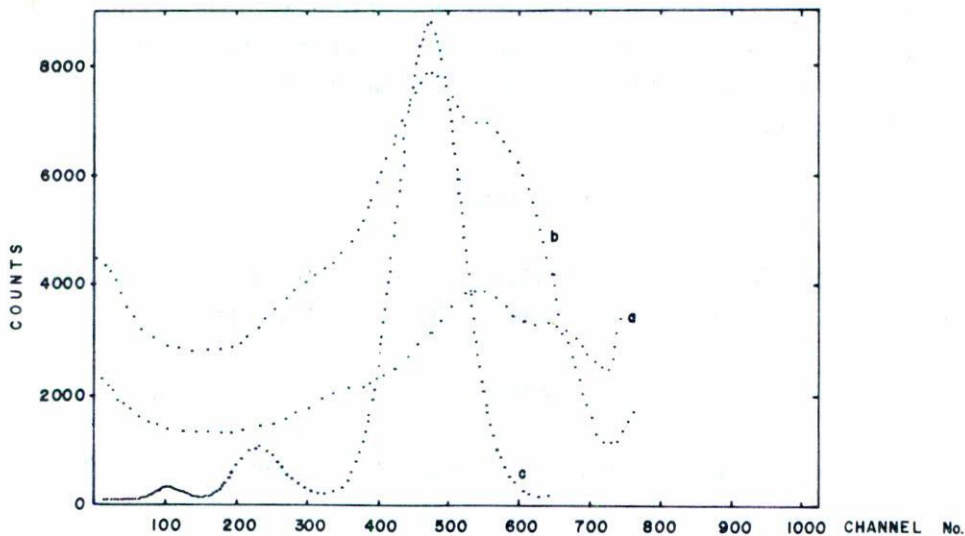
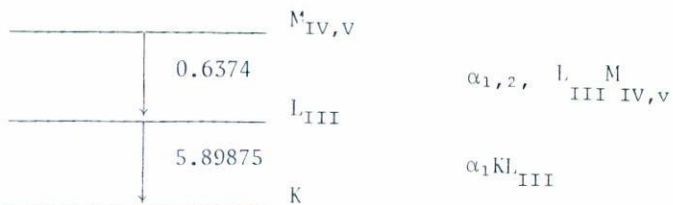


Fig. 6. Spectra of a  $^{55}\text{Fe}$  source:  
(Q-GAS).

- a) on a plastic foil.
- b) on a plastic foil + Al support
- c) on a plastic foil + Al support + Al foil of.  
400  $\mu\text{g}/\text{cm}^2$ .

The observed peak of 0.6374 KeV  $\text{Mn}\alpha_{1,2} \text{L}_{\text{III}}\text{M}_{\text{IV},\text{V}}$  it is considered to correspond to the transition:



This information is essential and must be considered when work on low-energy x-ray spectroscopy using proportional counters is performed.

The effect and need for the proper support and absorber for an x-ray source using Q Gas is shown in Figs. 6a, b, c. In Fig. 6a it is presented a spectra from  $^{55}\text{Fe}$  deposited on a plastic gold conducting foil, the presence of Auger Electrons is covering the characteristic Mn peaks.

The effect of the Al support and Al absorber are shown in Figs. 6b and 6c respectively.

#### ACKNOWLEDGEMENT

Technical help was all the time kindly offered by the scientific staff of the DRSA of the NPL for the completion of this work.

#### REFERENCES

1. R.A. Mercer and A. Moreno, *Int. J. Appl. Radiat. Isol.*, Vol. 34 No. 10, (1983) 1481-1482.