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. Alberigi, C. Bernardini, C. Infante, I. F. Quercia: A SINGLE CHAN-
EL PULSE-HEIGHT ANALYZER EMPLOYING LINE CODING.

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A. Alberigi-Quaranta, C. Bernardini, C. Infante and I.F. Quercia: A SINGLE CHANNEL PULSE-HEIGHT ANALYZER EMPLOYING LINE CODING.

The need for fast and drift-free pulse-height analyzer in nuclear physics hardly requires to be stressed: conventional forms of single channel discriminators (1) - (5) usually resort to 'kicksorting': i.e. two threshold discriminators followed by an anti-coincidence, while, of course, defining channel width by means of a standard pulse is also widely employed (6) - (8).

The present analyzer differs radically from the abovementioned ones and is a development of the ideas set forth in a recent article (9): the incoming pulse is attenuated and delayed by a matched lenght of line: both the

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(1) - Amado R.D. and Wilson R.; Journ. Sc. Instr. 34,205,1957
(2) - Fairstein E. and Porter F.M.;Rev. Sc.Instr. 23,650,1952
(3) - Fairstein E. and Porter F.M.;Rev. Sc.Instr. 27,549,1956
(4) - Farley F.J.M.; Journ. Sci. Instr. 31, 241, 1954
(5) - Park F.C.; Journ. Sci. Instr. 33, 257, 1956
(6) - Gatti E. and Piva F.; N. Cim. Ser. IX, 10, 984, 1953
(7) - Gatti E.; N. Cim. Ser. IX, 11, 153, 1954
(8) - Colombo S., Cottini C. and Gatti E. N.Cim.Ser.X,5,748,1957
(9) - Alberigi-Quaranta A., Bernardini C. and Quercia I.F.; Nucl. Instr. 3, 201, 1958.

original pulse and the delayed one are injected into a threshold discriminator: this means that for every input pulse, <u>two</u> pulses are fed to the discriminator at different times: the first of amplitude V_0 at a time $t = 0$, the second of amplitude $V_0\ e^{-\gamma L}$ at a time $t = \tau$ where τ and γL denote delay and attenuation respectively. If we denote the discriminator bias by V_t, the discriminator will trigger

twice if $V_t < V_0\, e^{-\gamma L}\ V_0$
once if $V_0\, e^{-\gamma L} < V_t < V_0$
never if $V_0\, e^{\gamma L} < V_0 < V_t$

In other words, every time the discriminator fires only once we know that input pulse had an amplitude V_0 such that $V_t < V_0 < V_t\ e^{\gamma L}$. Subsequent circuitry is designed to give an output pulse if, and only if, the discriminator fired only once.

The block diagram of the analyzer is shown in fig. 1: its operation may be summarized as follows: an input pulse reaching IN is cathode followed and delayed reaching the threshold discriminator also through a variable-gain C.F. so as to control the channel width; two pulses thus reach the discriminator as outlined previously. The discriminator output is fed to an anti-coincidence both directly and through a delay τ. This insures an output pulse from the anti-coincidence at a time τ after the <u>last</u> pulse coming from the discriminator, i.e. if the discriminator does not trigger there is no pulse in A, if the discriminator triggers once a pulse appears in A time τ after the input pulse; finally, if the discriminator fired twice a pulse appears in A at a time 2τ. Neglecting the paralysis circuit for the moment, one sees that the input pulse is cathode followed, amplified, shaped and delayed by 2τ before it reaches the coincidence input (point B). The coincidence will therefore produce an output pulse only if the discriminator triggered only once. The coincidence (resolving power is about 10 mμsec) output is shaped again before being allowed to reach the output terminals.

A novel feature of this circuit is a 'paralysis' device which shuts the analyzer off during its dead time (about .15 μ sec). This proves useful in analyzing random pulses because the discriminator might not be able to differentiate between an artificially delayed pulse and a second input pulse occurring soon after the first one. Accurate knowledge of dead time is also of help in making theoretical corrections. Paralysis is introduced in the non-linear channel by V_{16} in the following manner: positive pulses coming from the dynode of V_{12} are stretched, cathode followed, delayed and inverted by V_{16} and subsequently applied to the grid of V_{12}: the latter is thus kept well below cut-off during dead-time and consequently will not respond to any further input pulse. The complete diagram of the discriminator is shown in fig. 2.

As a threshold discriminator, the Moody circuit(10) was found to give stable and reliable operation: the linearity of the single-channel discriminator is evident from the calibration curves, where one can also see that the fractional channel width of the analyzer is constant as was shown in (9).

Acknowledgments

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(10) - Moody N.F., MacLusky G.J.R. and Deighton M.O.: Elec. Engng. 24, 214, 1952.

Summary

A single channel pulse-height analyzer with a dead time of about .15 μ sec is described. The channel width is determined by the passive characteristics of a delay line and is a constant percentage of the discriminator setting. A novel feature of the device is a paralysis circuit. Circuit diagrams and calibration curves are given.

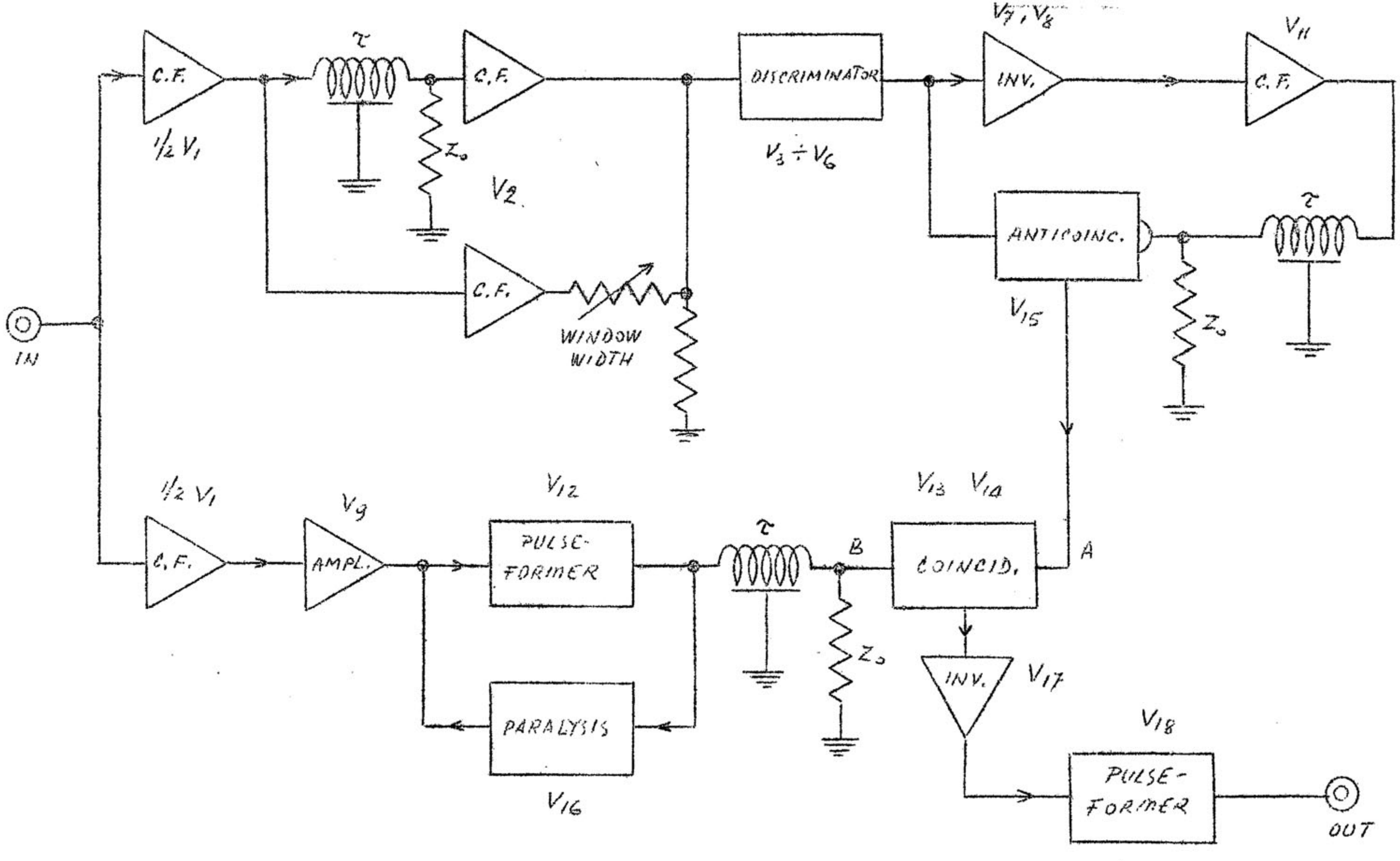

FIG. 1 - BLOCK DIAGRAM OF THE PHALCO PULSE-HEIGHT ANALYZER

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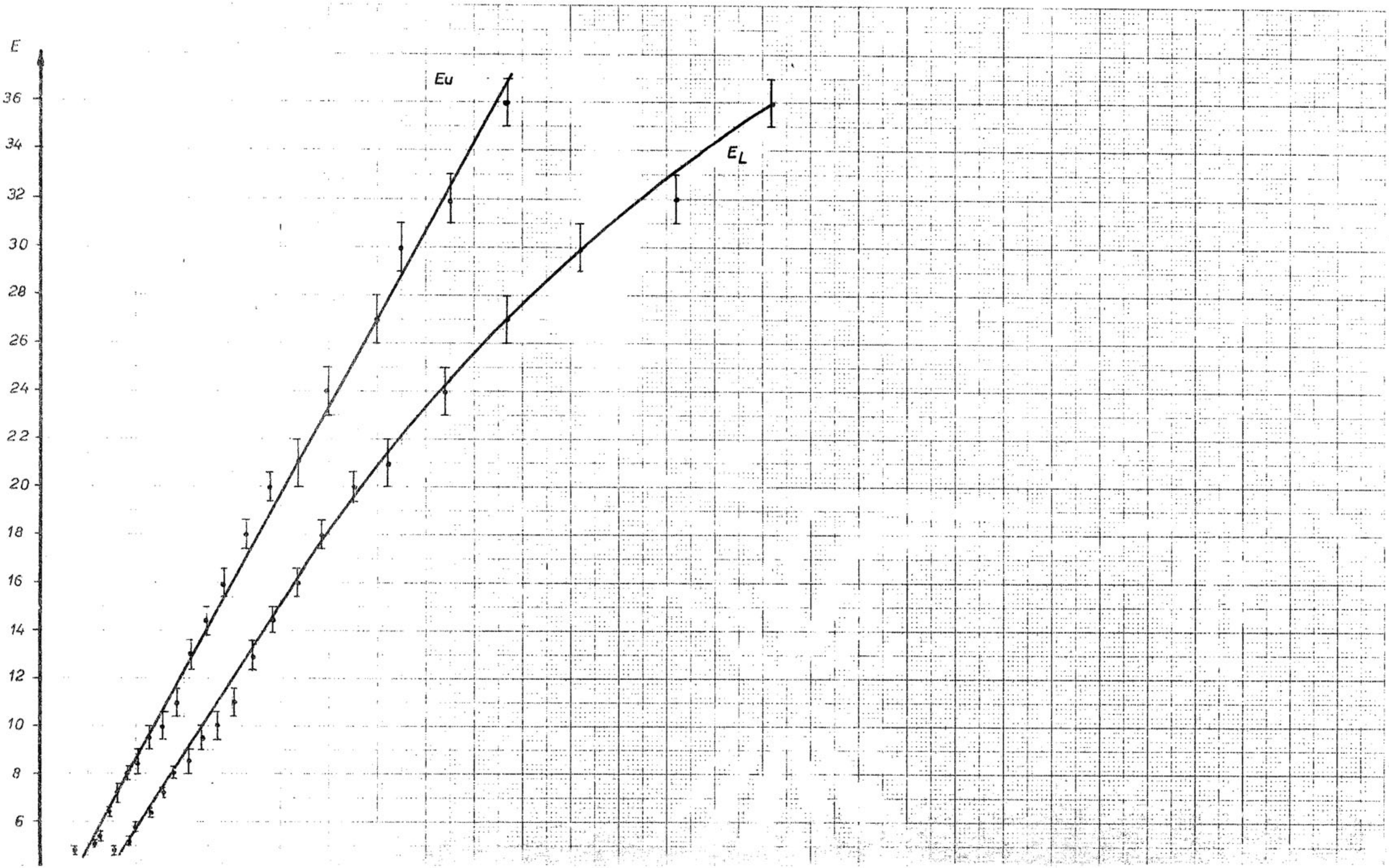
CALIBRATION OF PHALCO : UPPER AND LOWER THRESHOLD VS. HELIPOT READING

1) PULSE DURATION 100 mμsec.



CALIBRATION OF PHALCO: UPPER AND LOWER THRESHOLD VS. HELIPOT READING

1) PULSE DURATION 10mμsec.