

PRELIMINARY TESTS WITH PICTURES FROM MIRABELLE

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1. GENERALITIES

The analysis of bubble chamber pictures with dark background introduces difficulties quite different from those for pictures with light background.

We have designed a circuit to follow the photomultiplier which regulates the potential corresponding to the film background and amplifies the signals coming from tracks in order to detect them.

When looking at pictures from MIRABELLE, we have observed that the background varies very much and that the signals coming from certain fiducials represent a modulation of only 6% of the total light flux.

Furthermore, when observing track signals in different regions with varying backgrounds, no relationship between the amplitude of useful signals and the opacity of the background could be found. The amplitude of useful signals in certain parts of the chamber is comparable to that of noise in other parts.

2. PRINCIPLE OF REGULATION

The block diagram is shown in Fig. 1. All circuits were made with operational amplifiers.

The variation of the photomultiplier anode current is 100 microamps when going from black to white. For this the amplifier A1 outputs a potential variation of 3 volts.

The peak detector suppresses the pulses due to tracks and keeps only the slow variations. By comparing in C1 the signals from the peak detector and the amplifier A1, we get track pulses and a d.c. component. These pulses are then amplified, the gain of the amplifier A2 depending on the light flux.

3. TESTS

The picture used for tests was taken on camera 8 of MIRABELLE and is shown in Fig. 2. The track widths vary between 12 and 20 microns. They are wider in the lighter regions of the picture. Tracks in some regions have small black dots on them and it is often difficult to see the bubbles.

In these pictures the large fiducials with circles around them in the lower part are 14 microns wide, and the background around them has a density of 3. In the upper part of the right, the background has a density of 0.6. On each side of the tracks and at a variable distance, there is a shadow which will be digitized given its contrast.

In order to analyse such a picture we had to amplify greatly the pulses due to tracks and fiducials. It is then possible to decrease the amplifier gain in light regions (large noise), which diminishes the number of digitizings due to noise. The main disadvantage of this procedure is that noise signals, although less amplified than track signals, still have large amplitudes. The possibility of only amplifying useful signals was considered, but given their small amplitude, this is difficult to implement. Suppressing track signals in the peak detector diminishes the amplitude of the useful signal at the output of the comparator C1. This is so, because during the useful signal, a capacitor is charged which gives at the output of the detector a small potential variation. We are obliged to choose a large enough time constant for charging this capacitor so as not to distort the track pulses, even of low amplitude, and low enough to follow the slow variations of the light flux.

4. CONCLUSIONS AND RESULTS

Figures 3, 4, and 5 show digitizings from the H.P.D. of the picture shown in Fig. 2, at different levels.

The variable gain of the output amplifier allows us to diminish the amplitude of noise signals versus that of track signals, although this does not seem sufficient because digitizings due to noise are still numerous.

A filtering of the signals, is being considered because we observe that there is little variation in the shape of useful signals (in particular their width at half-height). The modification of the level during the measurement should yield fewer noise digitizings.

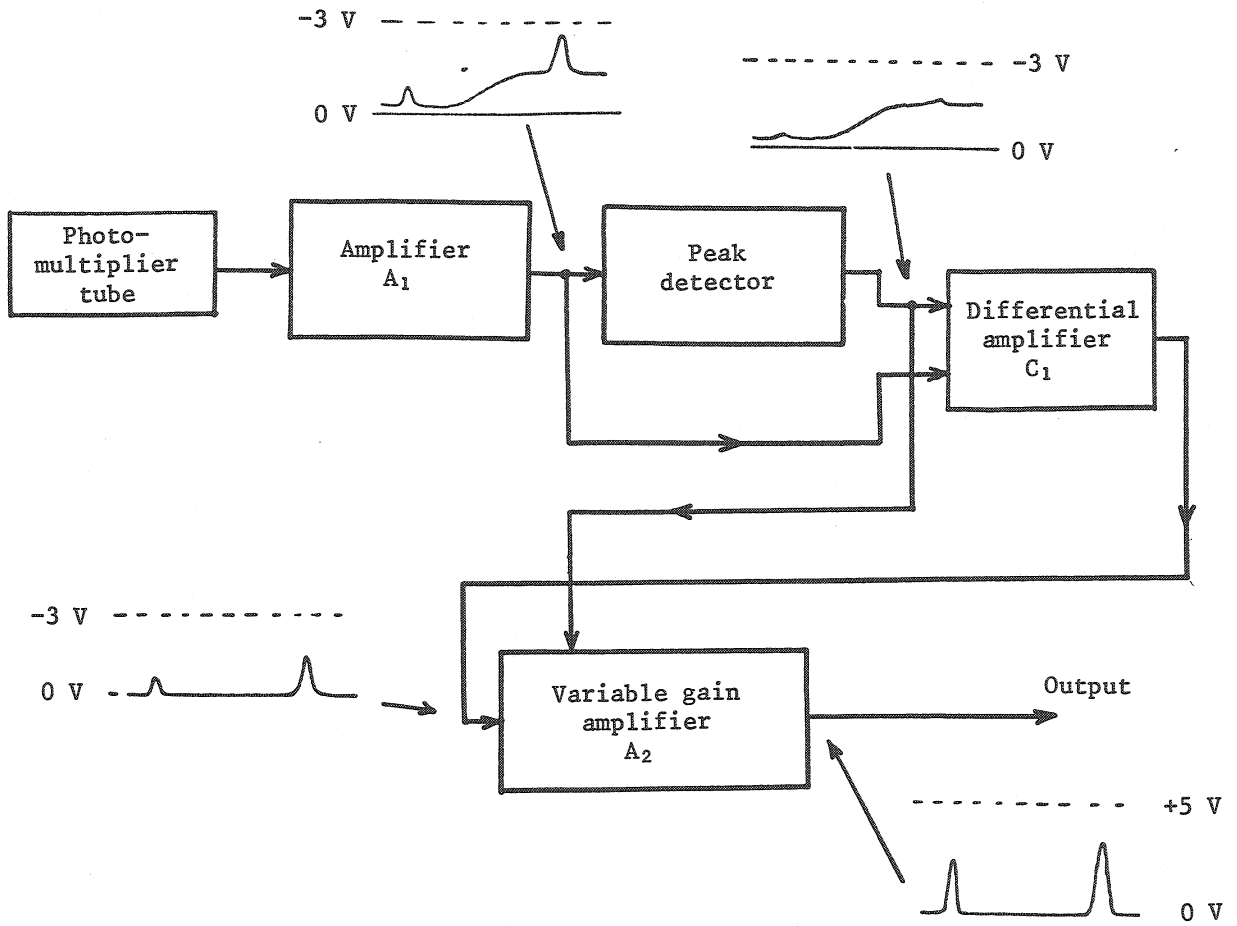


Fig. 1 Automatic gain control for H.P.D.

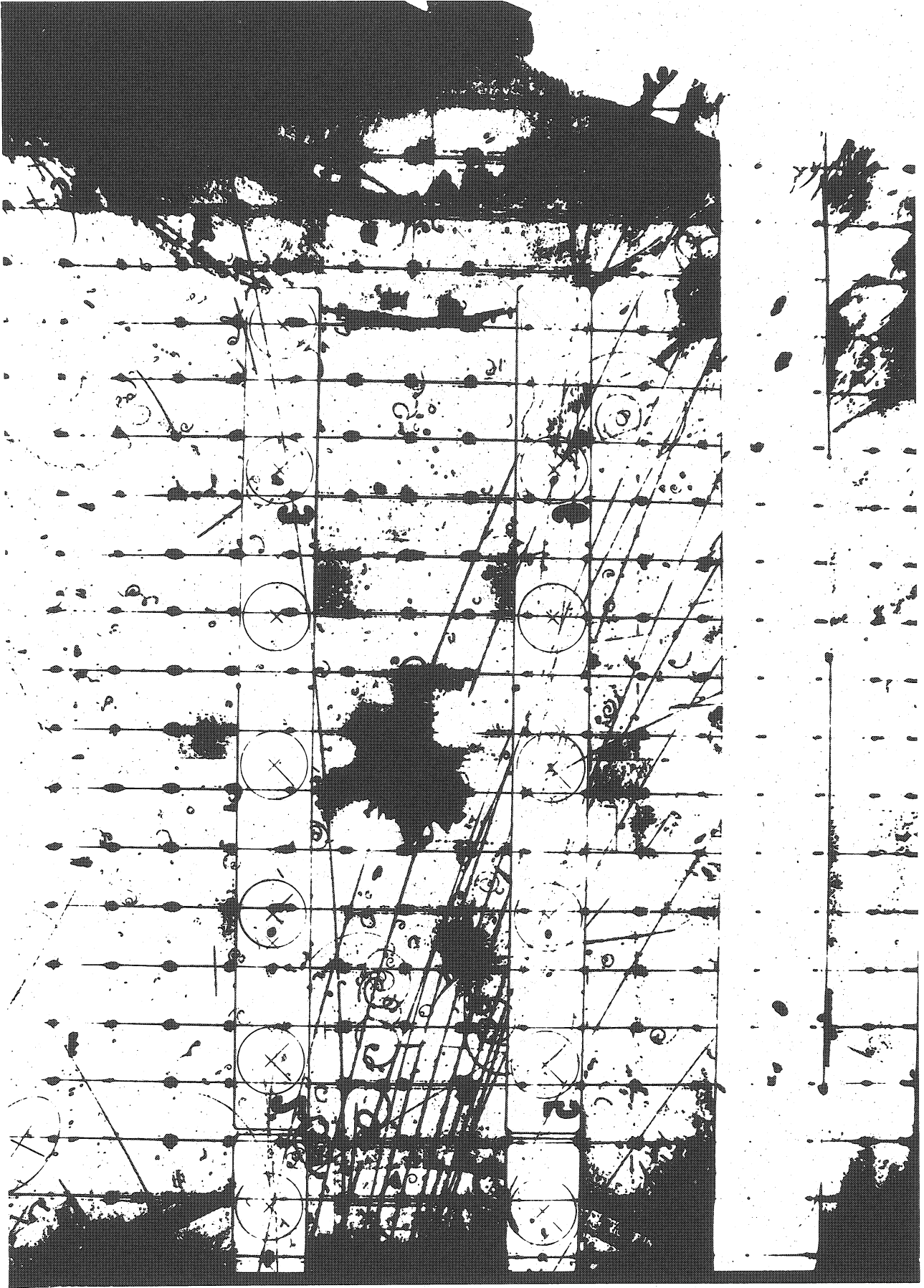


Fig. 2 Large fiducials with circles cannot be seen on this photo (at bottom)

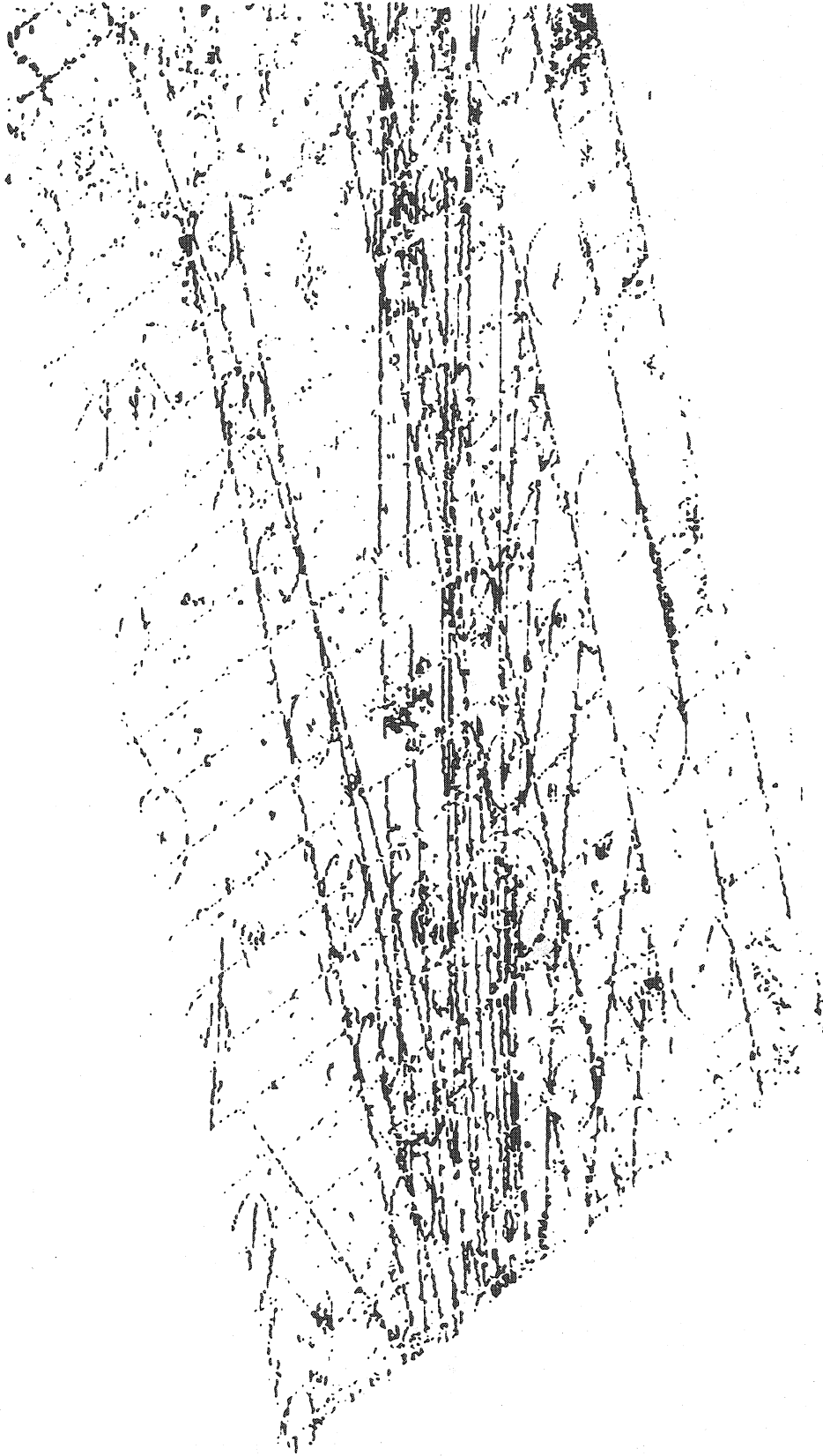


Fig. 3 Digitizings from HPD for the picture shown in Figure 2 - level 1



Fig. 4 Digitizings from HPD for the picture shown in Figure 2 - level 2

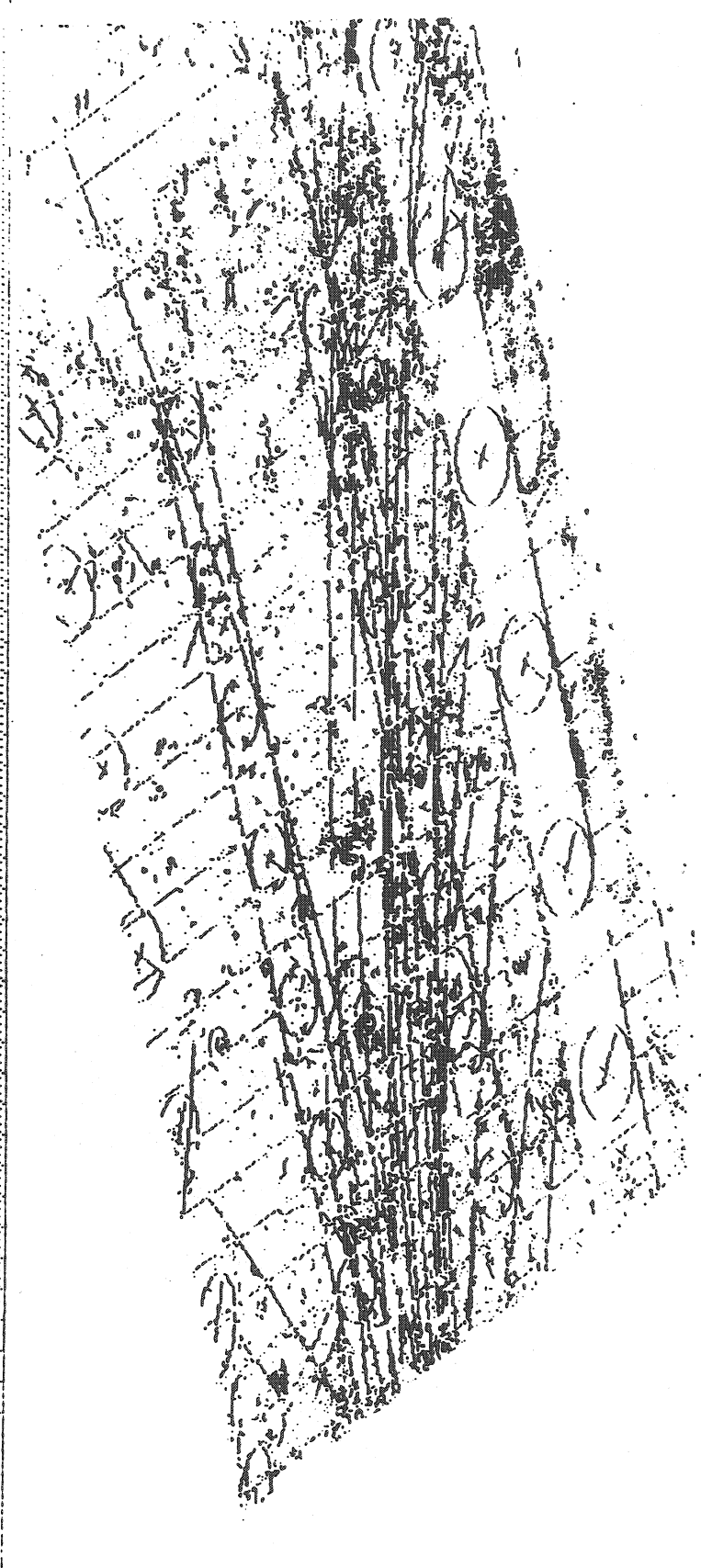


Fig. 5 Digitizings from HPD for the picture shown in Figure 2 - level 3.