NASA TECH BRIEF

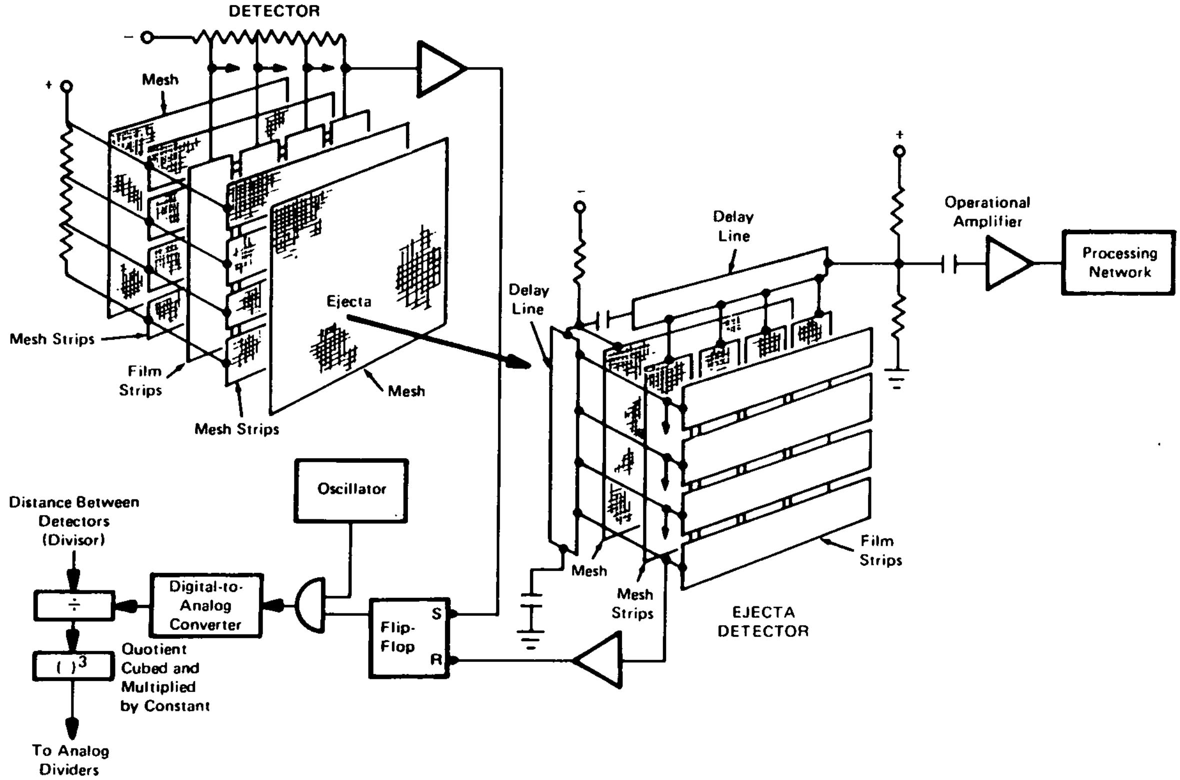
Goddard Space Flight Center

Particle Impact Location Detector

High-energy microscopic particles are studied with the aid of particle detectors. One of these detectors, described in NASA Tech Brief 73-10282 (GSC-11291), is used to determine the locations of particles striking its surface. When particles strike its surface, some have sufficient energy to penetrate it and emerge as ejecta continuing downstream.

The flight paths of these ejecta can be determined using a similar detector. The detector has to be modified because ejecta come in larger numbers than the original particles, often striking its surface simultaneously. Unfortunately none of the existing detectors is capable of locating several particle impacts at the same time. Instead an imaginary impact point is indicated, concealing the actual impact sites.

A newly-designed particle detector includes delay lines connected to each detector surface strip. When several particles strike different strips simultaneously, the pulses generated by each strip are time delayed by certain intervals. The delay time for each strip is known. Therefore, by observing the time delay in a pulse, it is possible to locate the strip that is struck by a particle.



Particle Detector System

(continued overleaf)

The detector as shown in the illustration is located on the common axis behind the particle detector. It includes three electrodes: the first one is a negatively biased mesh, the second consists of positively-biased mesh strips, and the third is an array of negatively-biased metal film strips. The last two are connected to the delay lines and detect the negatively and positively charged particles, respectively. Negative particles are recorded as positive pulses and vice versa.

Both delay lines are capacitively coupled and share a common output to a processing network. The output is terminated by a resistor which has the same characteristic impedance as the delay lines. This prevents undesirable pulse reflections. The opposite end of the other delay line is shorted to ground. Negative pulses feeding into it from the film strip electrode are reversed in polarity.

Both the positive and negative pulses are fed through a high-input-impedance operational amplifier to the processing network. The processing network determines the respective delay times of the arriving pulses to indicate which strip was struck by a particle.

A separate circuit is used to determine mass and velocity of the ejected particles. When a particle strikes the central electrode of the first detector, the resulting pulse sets the flip-flop in a binary one state while the ejecta are propagating to the second detector. After the ejecta reach the film strip terminal of the second detector, another pulse resets the flip-flop. In the interim when the ejecta are moving between the two detectors, the AND gate produces output in response to the clock pulses from an oscillator. Pulses from the AND gate are fed to a digital-to-analog converter. The resulting output is a dc analog signal having a magnitude directly proportional to the travel time between the electrodes. This time is divided by the magnitude of the distance to provide velocity information. The result is then cubed and multiplied by a constant and is applied to an analog divider to determine the mass of the particle.

Note:

Requests for further information may be directed to:

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Reference: TSP74-10230

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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