PRESSURIZED PROPORTIONAL COUNTER

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Large-area and box-type pressurized proportional counters have been developed for few years as a new detector to observe the celestial hard x-ray ranging from 20 to 100 keV. The flight model of this detector were used for the observation of the short-term variation of Cyg X-1 in hard x-ray on September 24, 1978. Results from a balloon-borne flight incorporating four detectors , including one with an effective area of 300 cm^2, are discussed.

1. Introduction.

A pressurized proportional counter, as a hard x-ray detector, has been studied[1),2),3)]. In order to observe the rapidly varying source, Cyg X-1, the x-ray detector is required to have large effective areas, low intrinsic background counts and minimum weight.

We have developed a narrow-field of view's balloon-borne detector to study such varying phenomena as Cyg X-1. This paper describes the pressurized proportional counter used in the balloon-borne array and includes the performance data during the balloon flight.

2. Instrumentation.

A shematic view of this detector is shown in Fig. 1. This detector is consist of 4 layers and 1 layer is aligned of five counters. So in operation two signals feed out this detector, namely one is inner part that consists of six counters and the other is outer part of fourteen counters. And the entrance window of this detector filled with a 2.0 atm's $Xe+CH_4$ gas is made from 1 mm thick alminum. So the counter efficiency as a whole is calculated and shown in Fig. 2. At about 35 keV maximum efficiency becomes nearly 80 %.

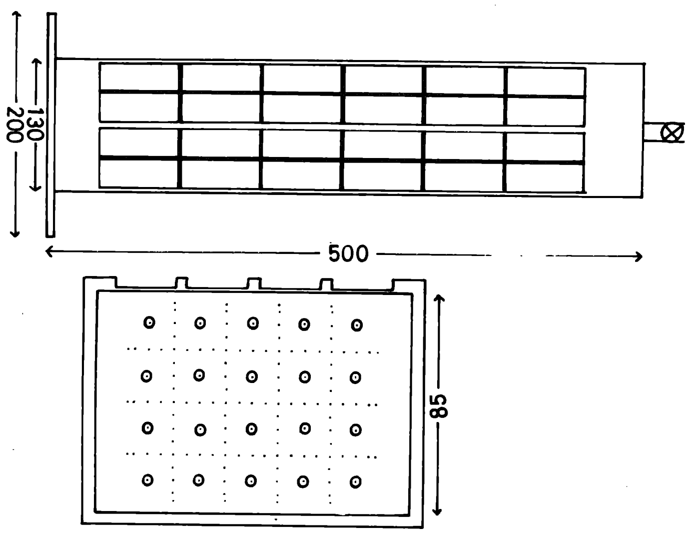

Fig. 1 A shematic drawing of this detector.

A balloon-borne detector, gas-filled proportional counter must be stable for a long time, for a example a few months, Fig. 3 shows the life of this engineering model. A decreasing counting rate becomes 1.94 %/month for 7 months.

Fig. 4 shows the temperature dependence of pulse height.

This pulse height means the out put signal's height from the detector itself. But, the variation of the totaly pulse height included the counter itself and pre amplifier is not seen.

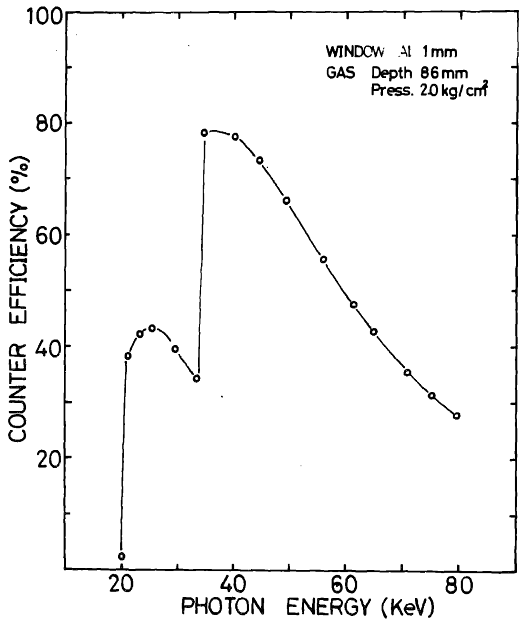

Fig. 2 The calculated efficiency of this detector

3. Flight results. The balloon-borne experiment is launched from Sanriku Balloon Center, Japan on 24 September 1978. It remains at float altitude, between 4.7 mb and 5.6 mb, for 12 hours.

The three pressuriezed proportional detectors and a 3"ϕ NaI(Tl) detector are positioned on the balloon gondola as shown in Fig. 5. The detector axes point in a same direction, tilt 4° from the vertical. This arrangement makes the check whether the detector is stable each other.

The shaped and amplifiered linear pulses from each detector are routed to a central digital processor as shown in Fig. 6. For rejection of charged particles, these signals feed to anti-coincidence circuit each other. Then in order to know the energy of the entrance photon, these signals are added and feed to ADC circuit. This is shown in this figure.

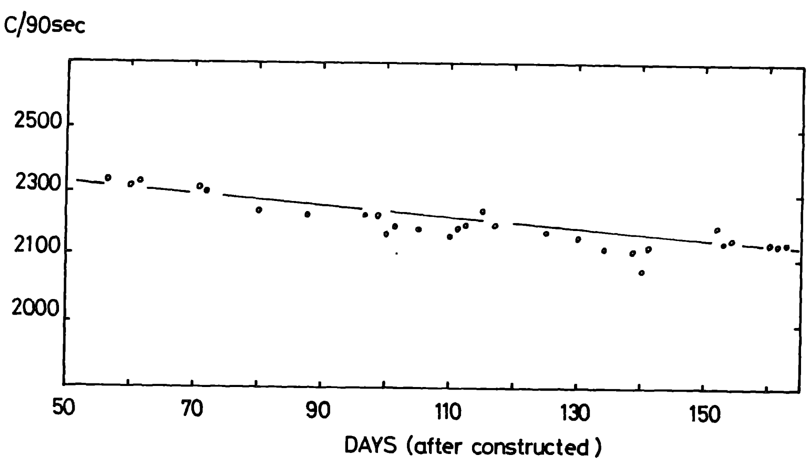

Fig. 3 A observed life time of this detector

At float altitude, the following background counting rates are recorded for a pressurized proportional counter and 3"ϕ NaI(Tl) crystal detector: pc 1, 42.8 $\pm$ 0.2 cts/s ; NaI 10.8 $\pm$ 0.1 cts/s. Whereas the effective area of pc 1 is 10 times of NaI's area, and the efficiency of pc 1 is 1/2 of NaI.

In next experiment, we use five detectors having the effective area of 500 cm^2.

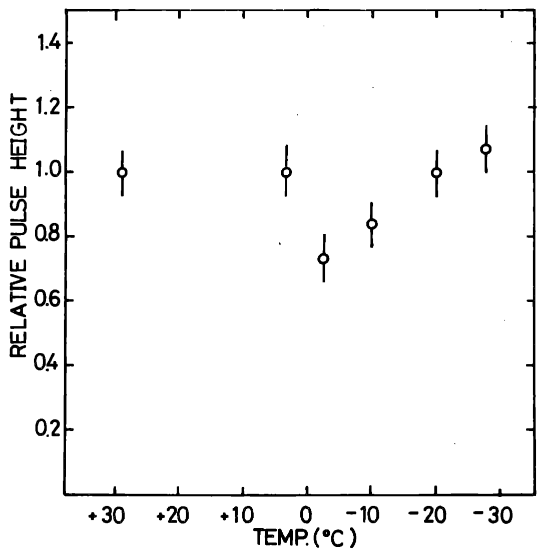

Fig. 4 The temperature dependence of this detector itself.

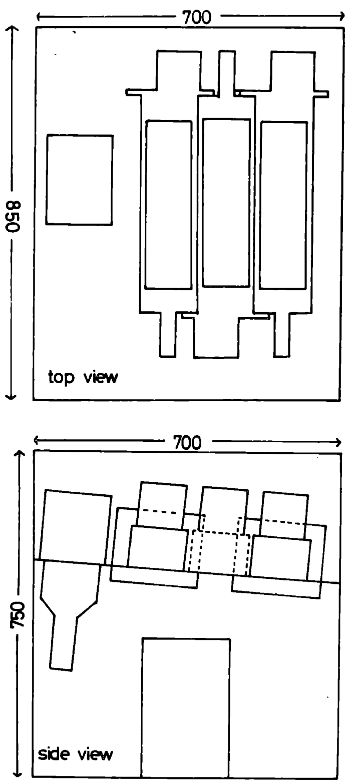

Fig. 5 The schematic drawing of B30-28's gondola.

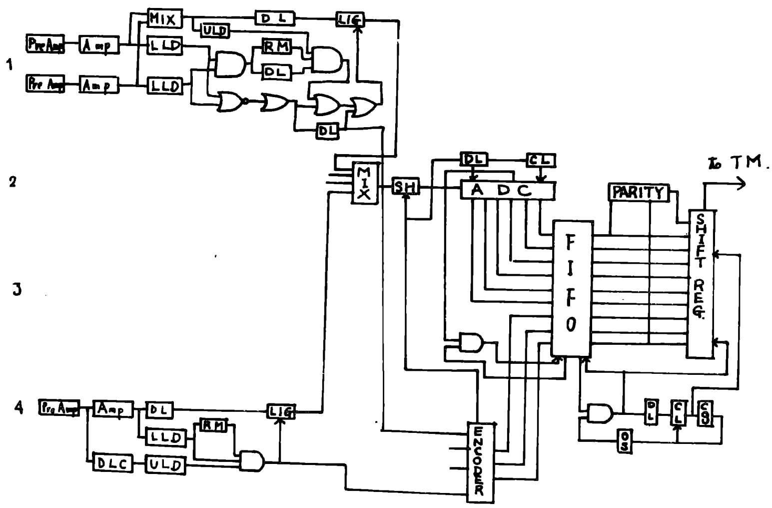

Fig. 6 The block diagram of this flight

So, total effective areas become 2500 cm^2, but enlarging from 300 to 500 of this detector is easy. And the weight of gondola except the ballast becomes about 100 kg.

4. Acknowledgement. The authors are deeply grateful to Prof. J. Nishimura and his laboratory's staffs for balloon facility and Profs. S. Ozaki and S. Higashi for help and encouragement.

5. References.

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