

High energy charged particle experiment, a payload contributes to Quafu-B mission

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The goal of High Energy Charged Particle Experiment (HECPE) is to measure the fluxes of the high energy electrons with MeV order and protons with ten MeV order. The two satellites of Quafu-B are in the same polar orbit with apogee $7.0 R_E$, perigee $1.8 R_E$. They can sweep large L values and pass through the inner and outer radiation belts. The high energy electrons and protons in the radiation belts are principal sources for failures of satellites and spacecrafts in the earth orbits. The enhancements of the high energy electrons and protons, so-called energetic particle events, are important phenomena of the "Space Weather". The measurements of them are important for the "Linkage of causes and effects" in solar-terrestrial space.

The energy ranges monitored by HECPE are as

- For electron: $E \geq 0.5$ MeV, $E \geq 1.0$ MeV, and $E \geq 2.0$ MeV.
- For proton: $5 \sim 10$ MeV, $10 \sim 20$ MeV, $20 \sim 40$ MeV, and $40 \sim 80$ MeV.

The geometric factor of HECPE is designed from 0.001 to 0.01 ($\text{cm}^2 \cdot \text{sr}$). According to NASA AE8 and AP8 models, the maximum of the particle population among the energy bins of HECPE is in the order of $10^7 / (\text{cm}^2 \cdot \text{s})$. It is about $10^6 / (\text{cm}^2 \cdot \text{s} \cdot \text{sr})$ by assuming the distribution of pitch angle on the equator is in the function of $\sin^2 \alpha$. If one order has been reserved for activities, the maximum counter rate of the machine is about $10^4 \sim 10^5$ per second.

We try to use three identical sensor heads, which arrange along a meridian of the spin coordinates of the satellites. They divide the 180° by three sectors, and the resolution of polar angle is 60° . The satellites are spin stabilized with speed of 2 per minute. The rate of data sample is 5 seconds, so that the resolution on the azimuth angle is 60° too. The measurement needs a synchronous signal from On Board Data Handle (ODBH) to indicate the initial of the spin.

Another similar sensor head is put inside the satellites to monitor the particles penetrating the skin of the satellite. This head is for studying the inboard radiation which is harmful to the satellite.