ERG 卫星搭载低エネルギー粒子分析器 (LEPe/LEPi) の開発

Development of low-energy plasma particle instruments (LEPe/LEPi) onboard ERG

低エネルギー電子・イオンの軌道

1. 低エネルギー電子およびイオンの測定
2. 連続時間計測法 (TOF) を適用して粒子の速度を推定する
3. パーティクル・マター相互作用

低エネルギー粒子の誘導放射線の影響

1. ヒトゲイン: 300 km (高度)
2. ISAS/JAXA, 香港, 台湾, 名古屋大学
3. 宇宙研、(1) 宇宙科学研究所, (2) 台湾ASIAA, (3) 名古屋大学

A TOF (time-of-flight) method is applied to measure particle velocities. Particle velocities can be deduced by measuring a time difference between two signal detections (the ions and the electrons). STOP anode: 
\[ C_{\text{stop}} = 2600 \text{ [counts/s/sector]} \]
START anode: 
\[ C_{\text{start}} = 380 \text{ [counts/s/sector]} \]

Countermeasure for High-Energy Background

1. Small detector area
2. Passive shield
3. Radiation count estimation

LEPi specs

1. Power Consumption: 7.3 W
3. Mass: 5.92 Kg
4. Energy resolution: 8.8 % FWHM
5. Angular resolution: 5 x 22.5 deg EL x AZ, FWHM
6. Small detection area

ToF (Mass) Analysis

1. Particle velocity can be deduced by differences of appearance timings between ROI and TOF signals
2. Small detection area
3. Electron-induced gamma rays
4. High-energy electrons and gamma rays are a good compromise, because the flux of electrons decreases as the energy increases. The flux of photons also decreases as the energy increases

Photon Suppression

1. Photon suppression is important because MCPs are sensitive to UV photons as well as particles.
2. MCP assembly and part of the electronics are being developed now.
3. Fine 1.51e-4 cm2 sr keV/keV @ 3.75 deg
4. G-factor 2.0e-3 cm2 sr keV/keV @ 22.5 deg

Analyzer Response

1. Analyzer response for incident particles is sensitive to UV photons as well as particles.
2. The lower part is being manufactured.
3. The energy analyzer part including its electronics is being developed now.
4. The area is separated 4-5 x 106 cm2 sr keV/keV
5. Fine 1.51e-4 cm2 sr keV/keV @ 3.75 deg

Noise Reduction with TOF Coincidence

1. The lower part of LEP-e is being manufactured.
2. MCP assembly has been manufactured.
3. The upper part is being manufactured.

Test Model Manufacturing

1. Test model manufacturing is in progress.
2. The energy analyzer, MCP assembly and part of the electronics are being developed now.
3. ESTER has a set of particle detectors for each 22.5 deg sector.
4. Test model manufacturing is in progress.

LEP-e Spec

1. Parameter Unit Remark
2. Power Consumption 7.3 W w/o PSU's efficiency
4. Mass 5.92 Kg
5. Energy resolution 8.8 % FWHM
6. Angular resolution 5 x 22.5 deg EL x AZ, FWHM
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ERG Mission

1. 基本的な計測器形状
2. 基本的な計測器形状
3. 基本的な計測器形状

Current Status

1. No contamination expected on detector plane due to low-energy plasma particles in the orbit, sensitive design and primary ionization.
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Designing the Analyzer

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Radiation Count Estimation

1. Due to external radiation environment of the radiation belts, radiation counts are frequent near high electron counts.
2. By calibrating radiation, electron counts can be estimated.

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