CGMS-36, CMA-WP-04
Prepared by CMA
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# FY-2 ANOMALIES AND SPACE WEATHER

Summary of the Working Paper.

The CMA-WP-04 reports the finding in a study comparing the errors of FY-2C synchronizer with the high-energy electron flux events recorded by GOES satellite in the period from Feb. 2005 to July 2008. The occasional sudden jump of FY-2C synchronizer from one operational state to the other interrupts the ongoing data downlink, and needs CDAS instruction to restore it. The study at NSMC compares the happening of jumps with the solar-event record from the GOES satellite, and finds the errors happen when the high-energy electron flux is high. The study preliminarily concludes that the high-energy electron flux must be one cause for the FY-2C synchronizer error. The report also mentions that further study with simulation analysis is needed to verify the conclusion.

# FY-2 Anomalies and Space Weather

## 1. Space weather impact on FY-2 satellite

The FY-2 geostationary satellites operate in execrable space weather. Firstly, the geosynchronous orbit is within the outer radiation belt where the high-energy electron flux is very high: the E>2MeV electron background daily flux is up to $10^6$ / $cm^2$. Before and after the geomagnetic disturbances, high-energy electron fluxes enhance up to three orders of magnitude, being known as the high-energy electronic storm. In recent years, the electric-charge-effect events occurring inside spacecrafts have been reported. The attitude control of FY-2 used to be affected by deep electric charging effect in late July, 2004. Secondly, the magnetic field at the height of geo-orbit is so weak that it can't screen high-energy protons and heavy high-energy particles. The effect of high-energy particle radiation is very serious at this altitude, which is more obvious during the solar proton events. The impact of high-energy particles on satellite is mainly the single-particle event that can lead to chaos on microelectronics. Many such incidents have been reported.

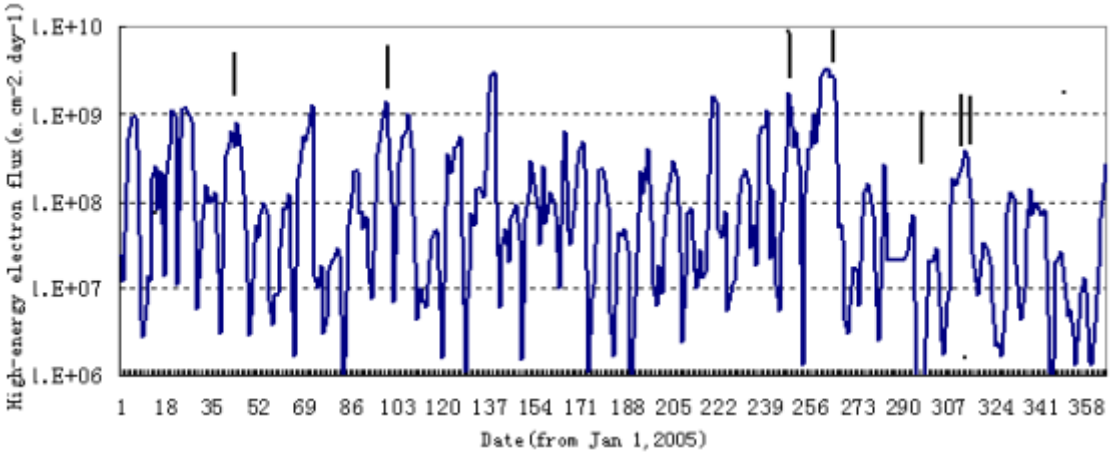
Surface charging is a major effect on the GEO satellites. The resulting discharge pulse may cause malfunction of satellite.

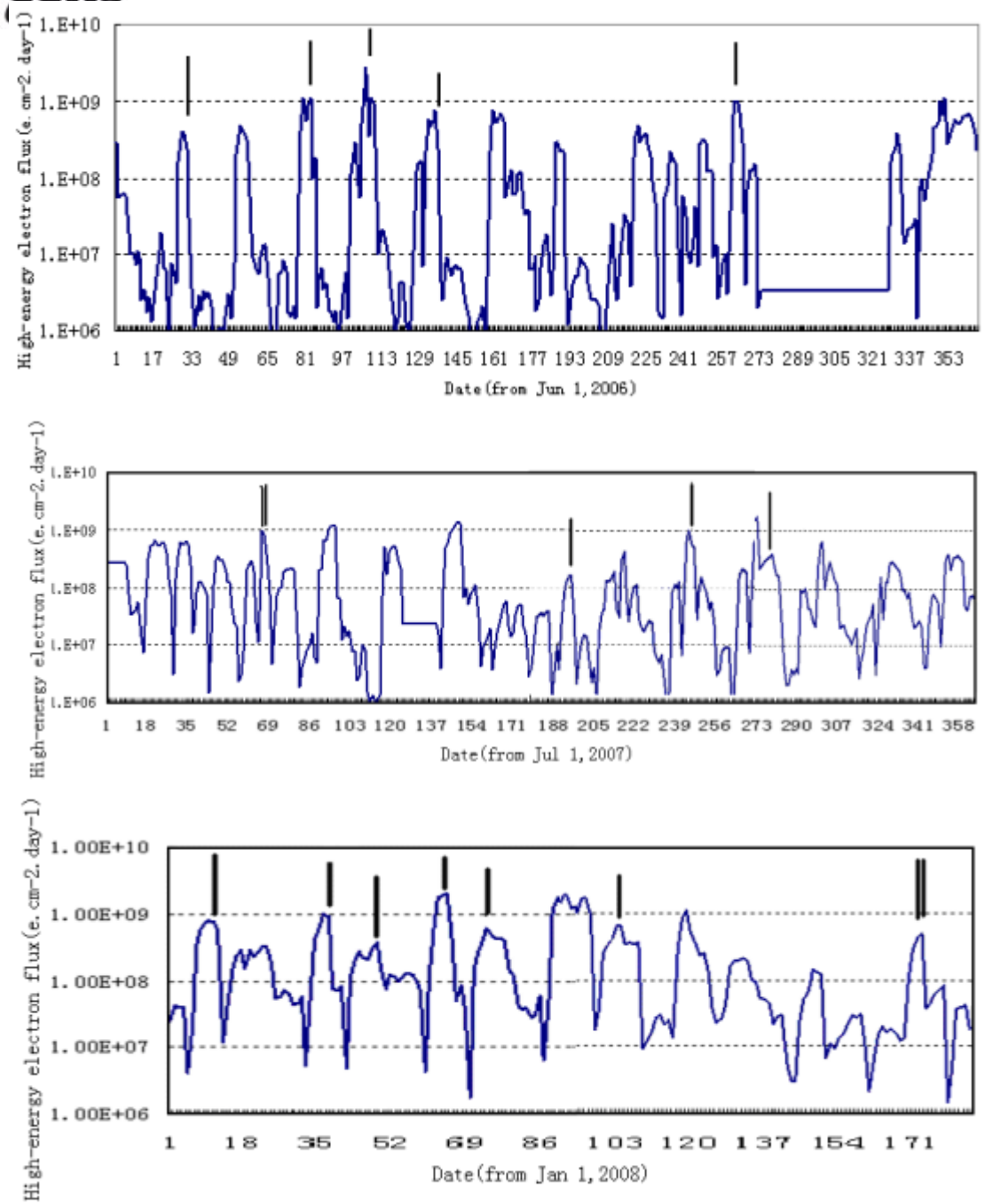
## 2. The 'Jump' of FY-2 data transmission

We call the occasional sudden change of spacecraft operation from one state to the other as "jump". Usually, the jumps happen to the synchronizer onboard FY-2C that often lead to interruption of ongoing downlink operation, and must be restored by the ground command.

## 3. Comparison and finding

We compared the jumps of FY-2C synchronizer with the high-energy electron flux levels at the GEO orbit (the source is from GOES). It finds that almost all jumping errors occur in the periods when high-energy electron fluxes are high. Jumps occurred when the high-energy electron fluxes is of the order of magnitude higher than ordinary times. There is no jump happening when the high-energy electron flux is at the lower levels. The comparison is made for the period from Feb.2005 to July.2008.






**The graphs give the comparison between the jumps of FY-2C and the high-energy electron (E>2Mev) flux. The upright lines point at the time of jump occurrence.**

We find that the jump errors appear at the peak of high-energy electron flux, it must have connection with the deep dielectric charging caused by high energetic electrons.

**4. Preliminary conclusion**

We have analyzed the synchronizer jumps on FY-2C from Feb 2005 to July 2008. Preliminary records show that the FY-2C synchronizer errors have strong relationship with high-energy electron fluxes. We tend to assert that synchronizer jumps connect with the effect of deep dielectric charging.

We only analysed the homologous features of errors on FY-2C with the space weather conditions, the conclusion is preliminary. Further analysis is needed with more historical data of FY-2's errors, and to combine them to develop the effect simulation to make further verification.