

MEASUREMENTS OF VLF WAVE-PARTICLE INTERACTIONS AT THE SOUTH ATLANTIC MAGNETIC ANOMALY ON BOARD A BRAZILIAN GEOPHYSICAL SATELLITE

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ABSTRACT

A summary of the proposal for measurements of VLF wave-particle interactions, expected to occur at the South Atlantic magnetic anomaly, to be carried out on board a Brazilian geophysical satellite, will be presented. The expected domain of such interactions refers to electromagnetic VLF waves and to energetic-relativistic inner belt electrons, pitch angle diffusing into the atmosphere via cyclotron resonances. The detectors involve a tri-axial search coil magnetometer and a surface barrier silicon telescope. A modified and preliminary version of this proposed experiment will be carried out on board long duration balloon flights, well before the beginning of the intended satellite measurements. For the balloon flights the particle detector will be replaced by an x-ray detector, which can also monitor parameters related to the electron precipitation.

Recent work has strongly motivated a detailed study of VLF wave-particle interactions at the South Atlantic Magnetic Anomaly (SAMA) that could be responsible for important intensifications of particle precipitation in this region (e.g. Gonzalez et al, 1982, 1987; Pinto and Gonzalez, 1986, 1988; Pinto et al., 1987; Imhof et al., 1982, 1986; Nagata et al, 1985; Inan et al. 1989).

Since 1980 balloon borne measurements of atmospheric x-rays and electric fields were carried out in Brazil by INPE, through which some indication exists (e.g. Gonzalez et al., 1987) that relativistic electron precipitation at low L values (around  $L \sim 1.2$ ) may be occurring in narrow latitudinal bands, as a result of cyclotron resonances between  $\leq 1$  MeV electrons and plasmaspheric Hiss (e.g. Tsurutani et al, 1975).

In order to better test this hypothesis and to also extend previous measurements of x-rays due to precipitating electrons and of ELF waves, at low L values, we have recently started efforts at INPE for the preparation of such measurements using long duration balloon flights, in collaboration with the University of Washington-Seattle. The experiments are being planned for the interval 1989-1990. The ELF waves will be measured with a search coil detector<sup>a</sup>(Frandsen et al, 1969) in the range 100 Hz-1500 Hz. The x-rays will provide (indirect) information on the relativistic electron precipitation. During those flights there will be also electric field sensors with the capability of measuring VLF waves on a larger frequency domain ( 20.000 Hz) which can involve also waves due to lightning. In this way, waves originated in the plasmasphere as well as during lightning flashes will be studied, with the goal of also learning about their relative importance for inducing precipitation of relativistic electrons from the inner radiation belt (e.g. Imhof,1986; Inan et al., 1988).

However, our main objective at INPE is to extend in the future (>1992) those efforts to measure the precipitating electrons in situ, as well as the ELF-VLF waves, on board a brazilian satellite. For this purpose, we would like to use (tri-axial search coil) ELF and (electric field) VLF wave detectors, similar to those to be used during the long duration balloon flights, and a (silicon surface barrier) particle detector, similar to that already used in the OHZORA satellite (Nagata et al. 1985). For the construction of such particle detector, we have initiated contacts with the japanese scientists toward a joint brazilian-japanese collaborative project. Details about the particle detector and the related OHZORA observations will be given by the japanese team present in this workshop.

We hope that the brazilian satellite will have enough capabilities in order to incorporate the particle and wave detectors of our interest in order to define an interesting goal of study on wave-particle interactions at the SAMBA. A preliminary proposal with the scientific and technical descriptions of this project is already available.

In addition, during the expected lifetime of the satellite (~1 year) we hope to organize balloon campaigns, supported also by ground instrumentation, in order to study some ionospheric and atmospheric effects of particle precipitation events induced by waves.

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\* For the search coil detectors, to be used during the long duration balloon flights as well as on board the geophysical satellite, we have already started a collaboration with the Jet Propulsion Laboratory of NASA/CALTECH.