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Oscillations With Periods Outside The Micropulsation Range, Various Auroral Zone And Typical Micropulsation Period Bands

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Abs tract:-*Conspicuous micropulsations in the auroral zones with periods from 0.03 to 10 seconds have been studied using data obtained by the Pacific Naval Laboratory and Stanford University during January 1961. For periods less than 0.3 second bursts of oscillations frequently occur superimposed on the background level of ELF noise. These bursts are considered to be of extra-atmospheric origin because of their conjugate relationships. For periods between 0.3 and 10 seconds four typical classes are defined: (1) Burstlike micropulsations, with quite a wide range of frequencies, which appear at the onset of a polar storm or bay (noise burst). (2) Pearl, beating-type micropulsations, occurring intermittently so that they form separate bunches (PP). (3) Continuous micropulsations, typically found in the forenoon, with periods from 0.3 to 3 seconds (CPsp). (4) Continuous micropulsations, typically found in the afternoon, with periods from 3 to 10 seconds (CPlp). Not every polar storm or bay is accompanied by noise bursts. Noise bursts are found only at the onset of polar storms or bays occurring around or before local midnight. Separate bunches of pearl, beating-type micropulsations are attributed to a bouncing agent whose bouncing period of a few minutes can be determined from the time lag of their occurrences in conjugate areas. If the agent repeatedly excites micropulsations, they are continuous, although sometimes a correlation analysis between conjugate points indicates a bouncing period similar to that of PP. Possible physical mechanisms are suggested for these four classes of micropulsations. A significant summer time micropulsation band at 4sec period is revealed in the several years of continuous micropulsation recording at College. The band contains mainly Pc-type activity, but is also seen in certain weak Pi 1 bursts. A small diurnal variation in band mid period was observed, with periods near 4 sec in day and near 3 sec at night. The 4-sec events are usually less well structured than higher frequency pearl-type events, and the frequency-time elements are often irregularly spaced. The possibility exists that the 4-sec band is due to the principal exospheric resonance.*

Keyw ords:Burstlike micropulsations, Continuous micropulsations, Geomagnetic, Oscillations with period, auroral zone.

INTRODUCTION

In papers I and 2 [Parks et al., 1968; Mc-Pherrone t al., 1968, respectively] it was shown that the forms and temporal characteristics of energetic electron precipitation and micropulsation activity are determined by the local time of occurrence The purpose of this paper is to present evidence that these various types of activity do not occur randomly but occur primarily at times when an auroral substorm [AkasoJ'u1,9 64] is in progress Balloon X –ray and micropulsation data obtained by the Berkeley group during parts of August1965, and September 1966 will be used to show that whenever an electron precipitation and micropulsation event occurred, regardless of the local time of observation, an auroral substorm is in some phase of its development on the night side of the earth. Standard magnetograms from various auroral-zone stations are used to ascertain the occurrence of an auroral substorm No attempt will be made to relate a particular form of energetic electron precipitation and micropulsation to a specific phase of an auroral substorm nor will the problem of possible systematic time delays between stations at different local times be discussed.

Before presenting the observational results, the question arises as to the appropriate terminology to describe the complicated physical processes occurring in the magneto sphere that produce an auroral substorm. The concept of the auroral substorm was introduced by Chapman and Akasofu [Akaso), 1964] to describe the characteristic disturbed forms of the auroras at different times and different longitudes after the breakup of the auroral arcs around

local midnight. The term substorm indicates that auroral disturbances are a fundamental part of the long-lived geomagnetic a in phase storms. In view of recent satellite and balloon observation [Anderson et al., 1966; Parks et al., 1966], we suggest that the concept of the auroral substorm be generalized to, include all of the associate magnetospheric phenomena. To emphasize this point, we will review some of the magnetospheric observations that relate to auroral substorms. Several correlation studies between magnetospheric fields and particles measurements and auroral disturbances have appeared in the recent literature. Anderson [1965] observed that the 40-kev electron islands in the tail of the magnetosphere occurred more frequently during times of high Ap.Behannon and Ness [1966] found that the magnitude of the magnetic field in the tail of the magneto sphere generally increases during the main phase storm and that it decreased during a substorm. Heppner et al. [1967] also found that the magnetic field in the region1 0-16R decreased after the occurrence of a negative bay. Consistent with this evidence, Anderson and Ness [1966] correlated an increase in the electron island fluxes with a decrease in the tail magnetic field.

Experimental;

Statistical Characteristics of PP

General. Information obtained from the logging of the Flin Flon records has been processed on IBM tabulating machines, and average characteristics of PP have been determined. Data published by the Geophysical Institute, University of Alaska, have been handled in the same fashion. The data have been normalized whenever possible, and the results have been expressed as relative frequency or probability of occurrence These terms are loosely defined as

$$\text{Probability of occurrence} = \frac{\text{Number of occurrences}}{\text{Number of possible occurrences}}$$

The relative frequency with which pearl events of various period occurred in the intervals August 20 to September 16 at Flin Flon and January I to July I at College are shown in Figure8. The ranges of periods observed were mainly between I and 5 seconds. There is considerable difference in the two distributions the median periods being about 31 seconds at Flin Flon and 1.8 seconds at College. The similarity of the Flin Flon distribution to the characteristics of the filter pass band should be examined. As is shown below, the majority of PP events observed are of low amplitude. The rapid increase in attenuation (7-12 db) exhibited by the filter at periods shorter than 2.0 seconds suggests that a number of PP events in this range may be reduced in amplitude below the constant background of short irregular pulsations. Hence the lack of agreement with the College data may possibly be instrumental for periods shorter than 2 seconds. It However, the general trend of the Flin Flon data in the region 2.0-3.0 seconds in which attenuation is almost constant, does imply a peak at 2.7 seconds.

The frequency distribution of observed PP amplitudes is shown for Flin Flon in Figure.

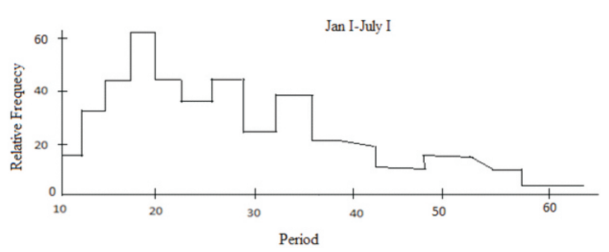

Fig. 8. Relative frequency of occurrence of various periods of pearl pulsations as a function of period for indicated intervals, Flin Flon and jan I –july I data.

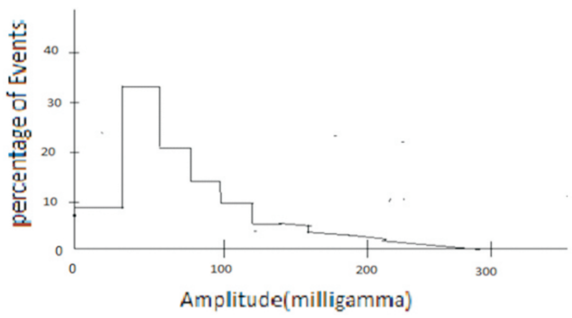

Fig. 9. Frequency of occurrence of various amplitudes as a function of amplitude for indicated intervals, Flin Flon .

The distributions show approximately exponential falloffs with amplitude. Twenty per cent of the PP events observed at Flin Flon had amplitudes between 25 and 50mγ, the largest-amplitude event observed being 800 mγ. The low probability of observing PP less than 25 my at Flin Flon is not instrumental. The system noise level was approximately 0.5 mγ. Instead this result is a consequence of the steady noise background of short irregular pulsations. Typically these have an amplitude of 10-20 mγ during quiet times. As a consequence, it becomes very difficult to identify a PP event on an amplitude time recording. A comparison of the two curves suggests that College telluric signals of 10 mγ/k in are comparable to100 mγ magnetic signals.. On the average, PP were observed during 17% of the possible 10-minute intervals at Flin Flon. The most active period was 1400-1500 lint with PP occurring 50% of the time. By comparison the most active period at College was 1500-1600 lmt with PP 25% of the time. The period of PP also appears to be a function of local time as shown in Figure 11 for both Flin Flon. A minimum period occurs before sunrise and a maximum period after sunset.

The observations of the Pc 5 wave event of July 14, 1982 (82195), reported here are unique due to the breadth of instrumental coverge. The event was observed near the magnetic equator at an L value of 4.7 by both the RIMS and EICS particle detectors aboard the DE 1 spacecraft over an energy range from spacecraft potential to several keV. The event was also observed by the P WI quasi-static electric field detector and the magnetometer on DE 1,

Together with simultaneous measurements by ground-based magnetometers located at Roberval and Siple near the foot points of the DE 1 field line. The results of the ground based and satellite magnetometer measurements reported by Cahill et al. [1984] indicate that the event began at 1832U T with a brief compressional pulsation. A transverse pulsation then developed with a period near200s and an amplitude of about5 nT. Near 1850 UT, this pulsation amplitude decreased and was replaced by a 240-s azimutha plulsation which grew rapidly and slowly decreased in amplitude after 1910 UT.

CONCLUSION;

The fact that the occurrence of an auroral substorm is present, not only in auroral disturbances, but also in electron precipitation and micropulsation activity throughout the auroral zone, indicates that it is the dynamical processes occurring in the magnetosphere That determine the local-time characteristics of the substorm. Recent satellite observations have shown that many magnetospheric phenomena are correlated with substorms To generalize the concept to f the auroral substorm to. include the worldwide disturbances.Characteristics and to emphasize the importance of the magnetosphere in auroral zone observations we have suggested the term, magnetopsherie substorm.

It should be noted that in the present study, the top end of the geomagnetic frequency range could not be studied at all due to limitations in both the temporal and amplitude resolution of the measuring equipment. Almost certainly, geomagnetic pulsations near the upper bound of measured frequencies (0.5 Hz) will be correlated with activity immediately above this range; so there is the possibility that the band 1 pattern is in fact due to this higher frequency activity.

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