RECENT OBSERVATIONS OF AURORAL ROAR EMISSIONS: FLICKERING AND DIRECTION FINDING

J. W. LaBelle*

Abstract

We have applied two new instruments to the study of auroral roar emissions, which are mode–conversion radiation excited by auroral electrons in the Earth's ionosphere at frequencies near 3.0 and 4.5 MHz. A medium frequency interferometer (MFI) has been established in Sondrestrom, Greenland, to measure the direction of arrival (DOA) of auroral roar. We have analyzed one year of data, April 1999–April 2000. The MFI data reveal that individual auroral roar events often propagate to the MFI from multiple directions and that most events have a direction–of–arrival from the local magnetic south, with the latitude distribution of the source regions peaked near the poleward edge of the statistical auroral oval. Results from statistical analysis also shows that the source altitude distribution of auroral roar events has two well separated peaks, one on the topside F–region and one on the bottomside. Combined with electron density data from the Sondrestrom incoherent scatter radar (ISR), these DOA data provide a powerful test of the most–cited generation mechanism of auroral roar emissions, which requires that the relationship between the electron plasma frequency (f_{pe}) and the electron gryofrequency (f_{ce}) in the source regions is $f_{pe}^2 = (n^2 - 1)f_{ce}^2$ where $n = 2, 3$ is the harmonic number of the emission. For each of five auroral roar events studied, to within experimental uncertainty this frequency–matching condition is met throughout the source region of the emissions inferred from the MFI and ISR data. A second instrument recently applied to study auroral roar is a wideband (10 MHz) digitizing system which records 4–minute intervals on operator command. We operated this system during a two–week campaign in Sondrestrom, Greenland, in April, 2000. In addition to measuring the fine frequency structure of auroral roar, we discovered approximately pulsations in the amplitude of an auroral roar emission which vary in frequency from 7–11 Hz and occur in groups and last for about 1 sec with adjacent pulsation groups spaced from one to several seconds. We speculate that these pulsations reflect 7–11 Hz modulations in the distribution function of the auroral electrons, similar to those associated with flickering aurora. If so, the radio observations provide an additional means of probing this phenomenon and in particular may put constraints on the form of modulations of the electron distribution function at the auroral roar source height of a few hundred kilometers.

*Dept. of Physics, Dartmouth College; Hanover, New Hampshire 03755, USA