The solar cycle dependence of auroral kilometric radiation and auroral particle acceleration regions

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[Introduction]

Based on the close correlation between auroral phenomena and auroral kilometric radiation(AKR), AKR has been generally believed to be active in the solar maximum period. However, based on the studies on seasonal variation of AKR [1,2], there arises new hypothesis that AKR phenomena become quiet in the solar maximum period as those in the summer polar region where ionization is enhanced compared with in the winter polar region. In order to solve the problem, we have carried out the statistical analyses by using the 13-years data observed by the Akebono satellite. In the recent study [3], we reported the seasonal dependence of upward flowing ion (UFI) events which is well recognized as the existence of auroral particle acceleration regions. In the present analyses, the solar cycle dependence of UFI events has been also investigated and compared with the results of AKR.

[Occurrence probability of AKR]

The occurrence probabilities of AKR in the summer and winter polar regions have been calculated based on the data observed by the PWS experiment onboard the Akebono satellite in the period from 1989 to 2002. The occurrence of AKR is identified by the intensity larger than -150 dBW/m^2. The results show clear anti-correlation between the occurrence probability of AKR in the summer polar region and the solar activities. The occurrence probabilities of AKR in the solar minimum period are three times larger than those in the solar maximum period. The same tendency is also seen in the winter polar region, though it is not so clear as in the summer polar region.

[Occurrence probability of UFI events]

The occurrence probabilities of UFI events in the summer and winter polar regions have been calculated based on the data observed by the LEP experiment onboard the Akebono satellite in the period from 1989 to 1998. The occurrence of UFI events are identified by following criteria; (1) number flux is larger than 1.4*10^6 /(cm^2*s*sr), (2) number flux of upward flowing ions with an energy above 343 eV is larger than 1.7 times larger than that with a lower energy range, and (3) the number flux in upward ions with an energy above 343 eV is 1.7 times larger than that of perpendicular and downward flowing ions. The results suggest that UFI events appear more frequently in the solar minimum period than in the solar maximum period.

[Discussion]

The anti-correlation between AKR and the solar activities suggests that the generation is controlled by the same mechanism as the seasonal variation of AKR. In the solar maximum, the ionization is enhanced as the case in the summer ionosphere where the solar zenith angle is small. As for the control mechanism of AKR, it is often emphasized that background dense plasma can violate the cyclotron maser process in the AKR sources. However, analysis results of UFI events suggest that dense plasma tend to hinder the auroral particle acceleration. Quiet activities of AKR and UFI phenomena are thought to be caused by the absence of the auroral particle acceleration process in summer or solar maximum condition of the polar ionosphere.

[References]

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