Electron Acceleration in the Field of the Low Frequency magnetospheric R-Wave Packets

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Low frequency R-waves of various types originate during thunderstorms. More generally, whistlers, lion roars, chores and other types of these important waves are present in the Earth's magnetosphere over time of magnetic substorms. They were observed for the first time by Heinrich Barkhausen in 1918 as accompanying phenomena of classical lightning strikes.

R-waves propagate along magnetic field lines and the electric field vector rotates in the same direction as electrons orbit on their helical trajectories. If the cyclotron frequency is close to the R-wave frequency, resonant phenomenon occurs and the electron can be accelerated to relativistic velocities. Its synchrotron radiation can be observed experimentally. Nonlinear interaction of the electrons with the R-wave packets is thought to be responsible for the acceleration mechanism of the so called killer electrons and gamma bursts observed during storms.

We numerically calculated trajectories of the Maxwellian ensemble of electrons interacting with various R-wave packets. The change of the Maxwellian distribution shape was studied as well as the ratio of the electrons accelerated to significant energies. The trajectories were calculated both from Lorentz and Loretz-Dirac equations (the second includes self interaction processes in the high energy region). The corresponding spectrum and the amount of energy lost by synchrotron radiation and were also estimated.

Some preliminary comparison of our calculations with the van Allen Probe measurements of the electrons with the energies up to the 10 MeV is outlined in the conclusion. We have confirmed that energetic electrons can be produced by such electron-wave interactions and we have forecasted parameters of the corresponding radiation bursts.

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