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Radiation spectra from relativistic electrons moving in a Langmuir turbulence

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We examine the radiation spectra from relativistic electrons moving in a Langmuir turbulence expected to exist in high energy astrophysical objects by using numerical method. The spectral shape is characterized by the spatial scale λ, field strength σ, and frequency of the Langmuir waves, and in term of frequency they are represented by $\{$s:0188$_0$ 2πc/λ, ω_{st} = eσ/mc, and ω_p, respectively. We normalize ω_{st} and ω_p by ω_0 as a $\equiv$ ω_{st}/ω_0 and b $\equiv$ ω_p/ω_0, and examine the spectral shape in the a ? b plane. An earlier study based on Diffusive Radiation in Lang- muir turbulence (DRL) theory by Fleishman & Toptygin showed that the typical frequency is $\gamma^2\omega_p$ and that the low frequency spectrum behaves as Fω戸ω^1 for b $>$1 irrespective of a. Here, we adopt the first principle numerical approach to obtain the radiation spectra in more detail. We generate Langmuir turbulence by superposing Fourier modes, inject monoenergetic electrons, solve the equation of motion, and calculate the radiation spectra using Lienard-Wiechert potential. We find different features from the DRL theory for a $>$b $>$1. The peak fre- quency turns out to be $\gamma^2\omega_{st}$ which is higher than $\gamma^2\omega_p$ predicted in the DRL theory, and the spectral index of low frequency region is not 1 but 1/3. It is because the typical deflection angle of electrons is larger than the angle of the beaming cone ≈ $1/\gamma$. We call the radiation for this case " Wiggler Radiation in Langmuir turbulence " (WRL).

Keywords: Radiation mechanism, Relativistic particle, Turbulent electromagnetic field