THE EFFECTS OF INVERSE COMPTON SCATTERING ON THE PULSARS' RADIATION

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Our calculations show that the cross section of the inverse Compton scattering in strong magnetic fields may be larger than that of Thompson scattering by sevaral orders of magnitude in the case of polar cap surface of pulsars. We can also see that when the energy of $e^{\pm}$ exceeds a certain value, their energy loss caused by the inverse Compton scattering may be larger than the energy gain from electric field in the inner gap, which implies that the $e^{\pm}$ could not be accelerated to $\gamma = 10^6$. Meanwhile, the electrostatic forces acting on the electrons will be balanced by the radiative pressure if temperature $T > 10^8$ K.

It is beleived that the surface temperarure for most of pulsars is less than 10^6 K, in that case the ions of iron can not be emitted from the surface of pulsars. However, the temperarure at the polar cap can be increased to 3×10^6 through the bombardment of electrons to the polar cap according to R-S model. This quasi-equilibrium state by self-regulating must make the coherent radio emission unstable on the contrary.

If we take the inverse Compton scattering effect into account, however, this problem can be solved.

Taking $B = 10^{12}$ Gauss and $T = 3\times10^6$ K, the highest electron energy gained in the electric field is about $\gamma = 10^3 - 10^4$. Therefore, the polar cap can not be heated by those electrons directly. Because the energy of scattered photons is about $4\times\gamma^2$ times that of photons before scattering, those scattered photons with high energy will bombard the polar cap surface. It leads to the following results:

a. These photons will heat the polar cap.

b. They can directly kick out the ions of iron which in turn may produce γ-photons with energy of larger than 1 Mev by the inverse Compton scattering.These γ-photons then will give $e^{\pm}$ thru pair production, and the produced $e^{\pm}$ can produced high energy γ-photons by the inverse Compton scattering with thermal photons again and so on.

According to this process, we may have stationary ions of iron kicked out and the $e^{\pm}$ shower. then the radio emission can be kept stationary and avoid the difficulties in R-S model.

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