8.5 RADIATION BEAMING IN PULSARS

V. CANUTO
Institute for Space Studies,
Goddard Space Flight Center, NASA, New York, N.Y., U.S.A.

It is usually considered that the beaming of the radiation coming out of a pulsar has to be strictly connected with the mechanism producing the radiation itself. We want to show that even when the emitting mechanism gives rise to an isotropically distributed radiation, the presence of a strong magnetic field will automatically beam the radiation preferentially along the magnetic field line rather than in any other direction. We have computed the Compton scattering and from that the opacity K_H (K_0 is the opacity for zero field). In Figure 1 the ratio K_H/K_0 is given vs. θ, the angle between the propagation vector and the magnetic field axis. H_q is a critical magnetic field numerically equal to 4.41×10^{13} G; N_e is the electron density. For the ordinary wave the opacity is reduced at $\theta=0$, while it is unaffected at $\theta=\pi/2$ where $K_H \to K_0$.

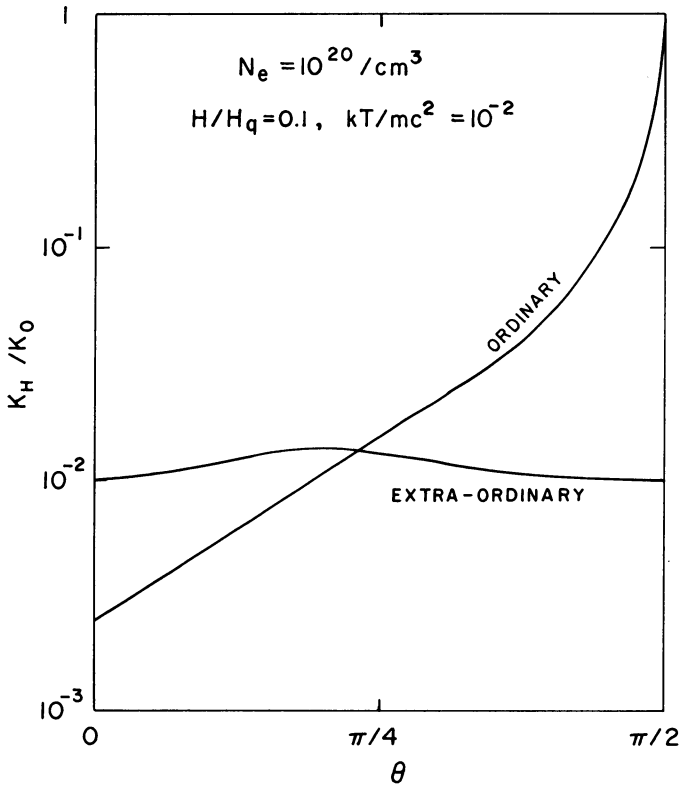

Fig. 1.

Davies and Smith (eds.), The Crab Nebula, 455–456.

Even at $\theta = \pi/4$ the ratio K_H/K_0 is still $\simeq 10^{-2}$, and a good beaming is still present. The values of the parameters are proper for a neutron star surface. It is to be noticed that the ratio K_H/K_0 is of the order of $(\omega/\omega_H)^2$ or $[(kT/mc^2)/(H/H_q)]^2$. One therefore can conclude that the presence of a magnetic field itself assures the beaming of radiation along the field lines.

https://doi.org/10.1017/S0074180900007816 Published online by Cambridge University Press