INVERSE COMPTON MODEL OF GAMMA RAY BURST SPECTRA*

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ABSTRACT. We study gamma ray spectra produced by the inverse Compton upscattering of soft photons by relativistic electrons with a one dimensional momentum distribution, which is relevant to gamma ray burst if the source magnetic field is strong enough so that the synchrotron cooling time of transverse energy becomes much shorter than isotropization time via couloub or Compton collisions. We find that for high electron longitudinal temperatures the output power is strongly beamed in the momentum direction and the spectrum softens rapidly with increasing view angle from the momentum direction.

Even if the gamma rays of gamma bursters originate from regions of magnetic fields as low as 10^{10} - 10^{11} G, the synchrotron cooling time of transverse momentum ($\sim 10^{-14}$ s$(10^{11}$ G/B$)^2$) may still be much shorter than the isotropization time via coulomb or Compton collisions. In that case the electron momentum distribution will be essentially 1-D along the field lines. The hardest photons will be produced by inverse Compton upscattering of synchrotron and other soft photons by these 1-D relativistic electrons. We have computed the inverse Compton spectra with Monte Carlo techniques for Maxwellian electron distributions, varying the scattering depth, longitudinal temperature and input soft photon spectrum. The major findings include:

a) upscattered power is strongly beamed along momentum direction;
b) beam narrows with increasing electron temperature, with half angle less than 2° for temperatures above 1 MeV;
c) for a given temperature, beam narrowest near unit scattering depth;
d) spectrum softens rapidly for increasing view angle away from momentum direction. For further details refer to Ref. 1.

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Reference

1. W. M. Howard, E. P. Liang and E. Canfield, Astrophys. J. submitted (1986).

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