Supernova Jets, GRB Jets, and Implications of Iron Lines in the X-ray Afterglow

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Abstract

The origin of the iron emission line in the X-ray afterglows in some GRBs is a big mystery and, at the same time, a clue to understand the system of the GRBs. Of course, it is difficult to construct a model that reproduces the GRB and Fe line at the same time. This is because clean environment with high entropy is required for making a GRB, in which iron nuclei will be hardly synthesized. In this study, we present a model for explaining the Fe Kα line and the continuum in the afterglow of GRB000214. We pose the importance to seek the physically natural environment around GRB000214. For reproducing the observation, we need a ring-like remnant around the progenitor, like that of SN 1987A produced by the mass-loss of the progenitor. The observation of GRB000214, in which the continuum power-law spectrum decreased faster than the line, motivated us to consider two independent systems for the line emission and the continuum spectrum. At first, the continuum spectrum can be fitted by the afterglow emission of the fireball pointing toward the observer, which does not collide with the ring because the emission of GRB and the afterglow are highly collimated to the observer by the relativistic beaming effect. Secondly, the line can be fitted by the recombinations of the ionized electrons in the ring illuminated by the X-ray afterglow. It is shown that the observed intensity of iron emission line can be reproduced well by our model, which suggests that the progenitor of the GRB may be a massive star.

Subject headings: gamma-rays: bursts — gamma-rays: individual (GRB000214) — ISM: supernova remnants — line:formation — X-rays: general

References

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