

The role of the Weibel instability at the reconnection jet front in relativistic pair plasma reconnection

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We investigate the role of the Weibel instability in the context of the magnetic reconnection problem. The Weibel instability [Weibel 1957, Yoon 1987], an anisotropy-driven electromagnetic instability, has been attracting recent attention in various astrophysical problems of relativistic shocks/jets. Although recent study [Daughton & Karimabadi 2007] reports that plasma anisotropy may arise the firehose type instability, no one has discussed the Weibel instability in the reconnection context.

We have carried out two-dimensional particle-in-cell simulations of magnetic reconnection in relativistic pair plasmas, and we found rapid growth of out-of-plane magnetic fields in downstream of the weak shock region, where reconnection jet piles up magnetic fields in front of dense plasmas. We found that this is due to the two-dimensional extension of the relativistic Weibel instability. We discuss the linear property of the instability by using relativistic fluid theories, and then we discuss how the Weibel instability changes the global evolution of magnetic reconnection.