

Astrophysics > High Energy Astrophysical Phenomena

Radiation from sub-Larmor scale magnetic fields

Mikhail V. Medvedev (IAS, NBI, KU), Jacob Trier Frederiksen, Troels Haugboelle, Aake Nordlund (NBI)

(Submitted on 27 Feb 2010 (v1), last revised 1 Mar 2010 (this version, v2))

Spontaneous rapid growth of strong magnetic fields is rather ubiquitous in high-energy density environments ranging from astrophysical sources (e.g., gamma-ray bursts and relativistic shocks), to reconnection, to laser-plasma interaction laboratory experiments, where they are produced by kinetic streaming instabilities of the Weibel type. Relativistic electrons propagating through these sub-Larmor-scale magnetic fields radiate in the jitter regime, in which the anisotropy of the magnetic fields and the particle distribution have a strong effect on the produced radiation. Here we develop the general theory of jitter radiation, which includes (i) anisotropic magnetic fields and electron velocity distributions, (ii) the effects of trapped electrons and (iii) extends the description to large deflection angles of radiating particles thus establishing a cross-over between the classical jitter and synchrotron regimes. Our results are in remarkable agreement with the radiation spectra obtained from particle-in-cell simulations of the classical Weibel instability. Particularly interesting is the onset of the field growth, when the transient hard synchrotron-violating spectra are common as a result of the dominant role of the trapped population. This effect can serve as a distinct observational signature of the violent field growth in astrophysical sources and lab experiments. It is also interesting that a system with small-scale fields tends to evolve toward the small-angle jitter regime, which can, under certain conditions, dominate the overall emission of a source.

Comments: 10 pages, 8 figures, submitted to ApJ (updated fig 5)

Subjects: **High Energy Astrophysical Phenomena (astro-ph.HE)**; Cosmology and Extragalactic Astrophysics (astro-ph.CO)

Cite as: [arXiv:1003.0063v2](https://arxiv.org/abs/1003.0063v2) [astro-ph.HE]

Submission history

From: Mikhail V. Medvedev [[view email](#)]

[v1] Sat, 27 Feb 2010 05:44:26 GMT (1448kb,D)

[v2] Mon, 1 Mar 2010 21:07:36 GMT (1448kb,D)

[Which authors of this paper are endorsers?](#)

Download:

- [PDF](#)
- [Other formats](#)

Current browse context:

[astro-ph.HE](#)

[< prev](#) | [next >](#)

[new](#) | [recent](#) | [1003](#)

Change to browse by:

[astro-ph](#)

[astro-ph.CO](#)

References & Citations

- [SLAC-SPIRES HEP](#)
([refers to](#) | [cited by](#))
- [NASA ADS](#)
- [CiteBase](#)

Bookmark (what is this?)

