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Current sheets and filaments in relativistic collisionless plasmas: Exact solutions for a broad class of particle distributions VLADIMIR KOCHAROVSKY, Institute of Applied Physics RAS, VITALY KOCHAROVSKY, Texas A&M University, VLADIMIR MARTYANOV, Institute of Applied Physics RAS — A broad class of stationary current sheets and filaments in collisionless plasma is found analytically using integrals of particle motion in the self-consistent magnetic field. The solutions employ arbitrarily anisotropic particle distributions in both relativistic and non-relativistic plasmas, which can support magnetic structures produced, e.g., via Weibel instability. We consider the properties of newly found stationary structures and their possible applications to analysis of magnetic field configurations emerging in various astrophysical problems, including relativistic shocks and jets. In the latter cases quasistatic turbulence is present, and individual long-living filaments may be described on the basis of the obtained exact solutions. We discuss short-term stability and synchrotron radiation of such filaments, and show that their magnetic energy density can be comparable to that of particles, and the spatial scale can be arbitrary compared to typical gyroradius of the particles.

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