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Statistics of the Radiating Relativistic Electrons

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We report the statistical consideration of the radiating electrons. At the statistical stage, the spectrum of radiating electrons moves toward a stable distribution. The stability parameter gradually increases when the average number of recoils increase, from unity (the Landau distribution) asymptotically approaching two (the Gaussian distribution). A concrete dependence of the stability parameter upon the average number of the recoils is determined by the profile of the recoil spectrum. The results of this consideration reveal that the width of the electron spectrum is increasing with the number of recoils according to the power law, with the power being inverse to the stability parameter. Increase of the spectrum width limits the ability of the beam to generate coherent radiation in hard x-ray and gamma-ray region. A heavy tail in the electrons spectrum, inherent in the stable distributions with the parameter less than two, causes an increase in the quantum losses of the beam in the Compton sources based on storage rings, and reduces the recovering efficiency of the ERL based ones.

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