Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Hard Synchrotron Spectra from Magnetically Dominated Plasma Turbulence LUCA COMISSO, EMANUELE SOBACCHI, LORENZO SIRONI, Columbia University — Synchrotron emission from astrophysical nonthermal sources usually assumes that the emitting particles are isotropic. By means of large-scale two- and three-dimensional particle-in-cell simulations, we demonstrate that the dissipation of magnetically dominated turbulence in pair plasmas leads to strongly anisotropic particle distributions. At modest Lorentz factors, of the order of the plasma magnetization, the particle velocity is preferentially aligned with the local magnetic field. On the other hand, the highest-energy particles are preferentially oriented in the plane perpendicular to the magnetic field. This energy-dependent anisotropy leads to a synchrotron spectral flux that is much harder than for isotropic particles. Remarkably, for large values of the plasma magnetization, the angle-integrated spectral slope is nearly independent of the level of the turbulence fluctuations, despite significant variations in the power-law energy spectrum of nonthermal particles. This is because weaker turbulence levels imprint a stronger degree of anisotropy, thereby counteracting the effect of the steeper particle spectrum. Our findings may help explain the origin of hard synchrotron spectra of astrophysical nonthermal sources, most notably the radio spectrum of pulsar wind nebulae.

Luca Comisso
Columbia University

Date submitted: 02 Jul 2020 Electronic form version 1.4