Novel mechanism of Magnetic field generation in a finite beam plasma system

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When an energetic electron beam propagates in a plasma it produces return shielding currents from background electrons. The combination of forward and return shielding currents are conventionally believed to be unstable to the Weibel instability which generates magnetic field at the electron skin depth scales. We have demonstrated by Particle - In - Cell (PIC) as well as fluid simulations, laser plasma experiments and analytic theory that a hitherto unknown instability (distinct from both Weibel and Kelvin Helmholtz) is excited in the beam plasma system where the beam has a finite transverse size. This instability is responsible for the generation of magnetic fields at scales comparable to the transverse beam dimension which can be much longer than the electron skin depth scale. This counter-intuitive result arises due to radiative leakage associated with finite beam boundaries which is absent in the infinite and/or periodic systems considered in all earlier simulations.