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What Supports the Parallel Electric Field in the Birkeland (Field-Aligned) Current Regions of the Earth's Magnetosphere JOHN JASPERSE, BAMANDAS BASU, Air Force Research Laboratory, ERIC LUND, University of New Hampshire, NEIL GROSSBARD, Boston College — Quasi-steady electric fields parallel to the geomagnetic field exist in both upward and downward Birkeland (field-aligned) current regions above the aurora. These fields, together with the turbulence found on auroral field lines, energize the plasma particles as they flow either away from or toward the earth. In general, these parallel electric fields are supported by one or more strong double layers, mirror force, generalized pressure gradient, and anomalous resistivity due to the turbulence. Recently, and for the first time, we have developed a new kinetic and multi-moment fluid theory for the Birkeland current system that contains the effect of turbulence for the inhomogeneous, non-uniformly magnetized plasma. Applying the new theory to observations in a downward-current sheet, we show that anomalous resistivity accounts for only a small portion of the parallel electric field and that contributions from the double layer, mirror force, and generalized pressure gradient terms in the generalized Ohm's law for the problem are more important. These results have important implications in other regions of space such as magnetospheric reconnection sites and solar coronal loops where parallel electric fields are likely to exist.

Bamandas Basu
Air Force Research Laboratory

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