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Inconsistency between Keplerian rotation and MHD induction equation; particle-based accretion dynamo PAUL BELLAN, Caltech — Keplerian rotation and the ideal MHD Ohm's law are shown to represent respectively the large gravity, small magnetic field and the small gravity, large magnetic field limits of the dynamical equation governing charged particle motion. Being a different limit of the same equation, Keplerian rotation therefore cannot be used in conjunction with the ideal MHD Ohm's law. Because the MHD induction equation is a consequence of the ideal MHD Ohm's law, the induction equation also cannot be used in conjunction with the assumption of Keplerian rotation. This realization invalidates the very large number of plasma astrophysics models that combine the ideal MHD induction equation or the ideal MHD Ohm's law with Keplerian rotation. Important examples of models that are invalidated are the Keplerian accretion dynamo and the magnetorotational instability. A new, particle-based dynamo model which avoids these problems is outlined. This non-MHD dynamo involves accumulation of certain specific types of charged particles falling down a gravitational potential to create a battery-like electrostatic potential suitable for driving the axial currents associated with bipolar astrophysical jets. Analysis of the particle motion shows that the infalling particles lose all their mechanical angular momentum as they descend down the gravitational potential. Thus, 'beads-on-a-string' models for astrophysical jet acceleration are also invalidated.

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