A Manifest Failure of Grassmann's Force

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The growing interest in a thorough revision of the tenets of classical electrodynamics [1,2] compels us to reconsider the torque-production mechanism presently applied to homopolar machines founded – indistinctively – on Ampère or Grassmann's basis. Recent crucial experimentation [1] definitively rules out the latter rationale for its physical inconsistency.

1. Torque Production in Homopolar Motors

The disclosure of the motional induction physics applicable to homopolar machines was achieved as far back as in 2001 [3,4]. The essential homopolar-motor features are exhibited in Figure 1.

In the sketched arrangement the probe has been attached mechanically to the magnet. With a direct current injected in the probe as indicated, a counter-clockwise torque arises on the magnet whereas a clockwise torque is exerted on the closing wire. Until recent years, this simple observation gave rise to endless discussions about the origin of the magnet's rotational torque. Most physicists at that time endorsed the dragging hypothesis according to which a

torque applied by the magnetic field on the probe drags the magnet. This hypothesis, of course, keeps the device out of compliance with Newton's action and reaction third law. Nowadays we know [3,4] that:

Lemma

With the probe attached to the magnet, the reaction to the torque produced by the magnet on the closing wire is the only thing responsible for the observed magnet's rotation.

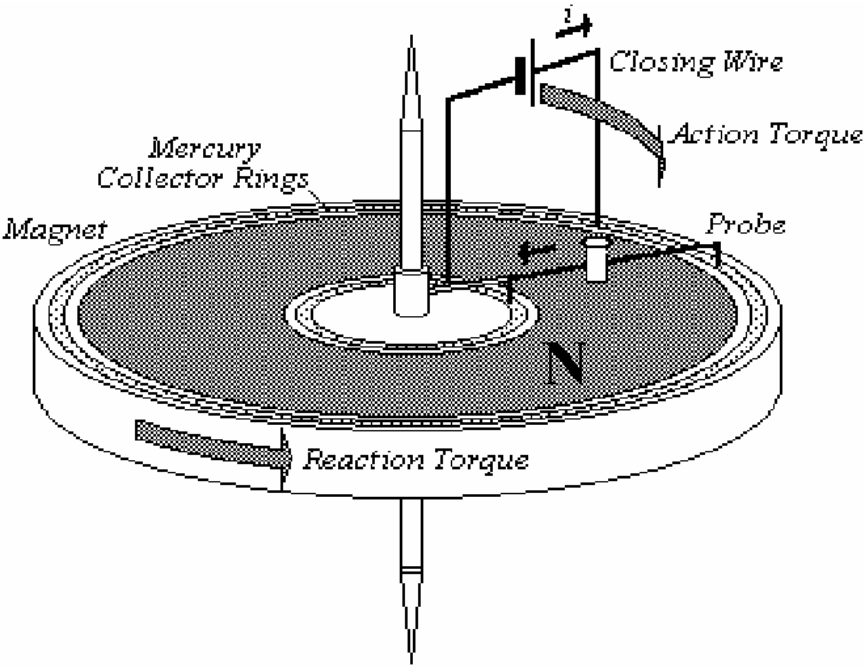

Figure 1 – Homopolar-motor magnet and closing wire torques

In the described case, the probe plays only a *passive* role: to close the current loop [3,4]. We can grasp the mechanism of torque production upon the magnet with the aid of Ampère's virtual

magnetizing currents [5,6,7]. At this point we only need to consider the interaction between each ohmic-current element of the closing wire and each virtual-current element of the magnet periphery. This analysis, based upon Ampère's force law, fully complies with Newton's third law.

On the other hand Grassmann's force, for acting at right angles to the peripheral Ampèrian current element [8], fails to explain torque production upon the magnet. Consequently, Grassmann's advocates are compelled "to move" the seat of the observed motional torque to the radial probe, in flagrant contradiction with our lemma. This unphysical trick violates Newton's third law and energy conservation for electrical machines. Electromechanical energy conversion is only made possible by the *relative motion* between the –at least two- machine parts absorbing or delivering mechanical energy (piston-cylinder, stator-rotor, etc.).

Besides, today plasma physics and MHD are fully based on a Grassmann-Lorentz force model. We feel that its reformulation founded on an Ampère-Weber rationale is unavoidable.

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