DISTRIBUTED ENERGY STORE RALGUNS

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Work has been completed on the two distributed-energy-store railguns constructed, operated and analyzed as part of the UT-TAERF fusion program. The interest in these railguns stems from their potential for producing high enough macroparticle velocities to produce impact fusion. The object of the study, completed and reported in a dissertation,[1] was to identify the key parameters affecting the performance and to describe those parameters with theoretical models suitable for the design of improved railguns.

The study resulted in several important findings:

1. The inductance per unit length of the rails is the most important parameter in determining the accelerating force and several techniques, some experimental and some theoretical, were devised for finding this parameter for a specific geometry.
2. Even though the skin effect on current in the rails is severe, rail resistance does not affect significantly how a railgun performs except for ohmic heating in the rails.
3. The armature voltage drop does not have a major effect on the railgun performance.
4. When the railgun operates at atmospheric pressure, account must be taken of shock heating in the air in front of the projectile. The resulting retarding force can have a major effect on projectile velocity above about 2 km/sec.

5. When the driving force exceeds the compressive yield strength of the projectile material, the frictional drag between the projectile and the wall significantly reduces attainable velocities.

These findings, expressed quantitatively, constitute a theoretical model suitable for the design of distributed-energy-store railguns for a variety of applications including impact fusion.

Reference

1. L.D. Holland, "Distributed Energy Store Railguns - Experiment and Analysis," Ph.D. Dissertation, Department of Electrical Engineering, The University of Texas at Austin, May 1984.