Car batteries powered by relativity

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Scientists found that 80-85% of the voltage of a lead-acid battery is due to relativistic effects. Image credit: Wikimedia Commons.

(PhysOrg.com) -- French physicist Gaston Plante invented the lead-acid battery in 1859 – almost 50 years before Einstein developed his theories of relativity. Now scientists have found that the lead-acid battery, which is commonly used in cars, strongly relies on the effects of relativity. Specifically, the scientists calculated that 1.7-1.8 volts of the lead-acid battery's 2.1 volts (or about 80-85%) arise from relativistic effects.

The physicists and chemists who performed the study – Rajeev Ahuja, Andreas Blomqvist, and Peter Larsson from Uppsala University in Uppsala, Sweden, and Pekka Pyykkö and Patryk Zaleski-Ejgierd from

the University of Helsinki – have published their results in a recent issue of Physical Review Letters.

"This is a new, well-documented case of 'everyday relativity,'" Pyykkö told *PhysOrg.com*. As the scientists noted in their study, the finding essentially means that "cars start due to relativity."

The lead-acid battery is the oldest type of rechargeable battery, with the main component being lead. With an atomic number of 82, lead is a heavy element. In general, relativistic effects emerge when fast electrons move near a heavy nucleus, such as that of lead. These relativistic effects include anything that depends on the speed of light (or from a mathematical perspective, anything that involves the Dirac or Schrödinger equations).

The lead-acid battery contains a positive electrode made of lead dioxide, a negative electrode made of metallic lead, and an electrolyte made of sulfuric acid. Through their calculations, the scientists found that the battery's relativistic effects arise mainly from the lead dioxide in the positive electrode, and partly from the lead sulfate created during chemical reactions.

The discovery of relativistic effects in the lead-acid battery also sheds some light on why no corresponding "tin battery" exists. In the periodic table, tin is located directly above lead and has an atomic number of 50, making it lighter than lead. According to the scientists' calculations, a tin battery would basically be a lead battery with very minimal relativistic effects. Although tin and lead have similar nonrelativistic energy values, tin's small relativistic effects prohibit it from being used in an efficient battery.

As the scientists noted, relativistic effects have been found in other areas, such as the perennial yellow color of gold and the liquidity of

mercury, although the latter is still not very well proven.

Overall, the scientists predicted that this understanding of relativity's importance to the lead-acid battery will probably not help researchers improve the battery; however, the insight could be useful for exploring better alternatives, especially those that involve any sixth period element (found in the sixth row of the periodic table, like lead).

More information: Rajeev Ahuja, et al. "Relativity and the Lead-Acid Battery." *Physical Review Letters* 106, 018301 (2011). DOI:10.1103/PhysRevLett.106.018301