How to make mobile batteries last longer by controlling energy flows at nano-level

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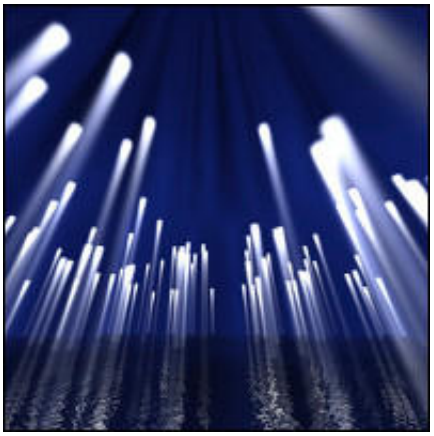

Electronic devices waste a lot of energy by producing useless heat. This is one of the main reasons our mobiles use up battery power so quickly. Researchers at University of Luxembourg have made a leap forward in understanding how this happens and how this waste could be reduced by controlling energy flows at a molecular level. This would make our technology cheaper to run and more durable.

Until now, scientists had just an average view of energy conversion efficiency in nano-devices. For the first time, a more complete picture has been described thanks to University of Luxembourg research. "We discovered universal properties about the way energy efficiency of nano-systems fluctuates," explained Prof. Massimiliano Esposito of

Luxembourg University's Physics and Materials research unit. Using this knowledge it will be possible to control energy flows more accurately, so cutting waste.

These energy controls could be achieved by a technological regulator which would prevent the natural process whereby heat generated in one part of a device is lost as it spreads to cooler areas. In other words, this adds interesting nuances to the Second Law of Thermodynamics, one of the fundamental theories in physics. This theoretical understanding of how to regulate of energy flows brings to life "Maxwell's demon", a notion introduced by the major 19th Century mathematician and physicist James Clerk Maxwell. He imagined that this "demon" could overturn the laws of nature by allowing cold particles to flow towards hot areas.

Two recent papers published in highly respected scientific journals (*Physical Review X* and *Nature Communications*) describe these findings. The research team under Prof. Esposito used mathematical models to arrive at these conclusions. These ideas will be put into practice in the laboratory before any eventual practical technological applications are developed.

More information: Jordan M. Horowitz, Massimiliano Esposito. "Thermodynamics with Continuous Information Flow". *Physical Review X*, Volume 4, Page 031015, 28-Jul-2014. DOI: 10.1103/PhysRevX.4.031015

Gatien Verley, Massimiliano Esposito, Tim Willaert & Christian Van den Broeck. "The unlikely Carnot efficiency". *Nature Communications* 5, Article number: 4721, 16-Jul-2014. DOI: 10.1038/ncomms5721

Provided by University of Luxembourg

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