

Physicists theorize entangled quantum batteries could be almost perfect

November 9 2012, by Bob Yirka

(Phys.org)—Theoretical physicists Robert Alicki and Mark Fannes of the University of Gdansk and the University of Leuven respectively, have uploaded a paper to the preprint server *arXiv* where they theorize that it should be possible to build an almost perfect entangled quantum battery. They suggest that as the number of entangled batteries increases, their overall performance approaches the thermodynamic limit.

The teams' ideas are based on work that has shown that some [quantum systems](#) possess some amount of energy while others do not, i.e. those in a passive state. The difference between the two is considered to be extractable work. In their paper the two show that under normal circumstances, the work extracted from such a system isn't perfect, but when [entanglement](#) is considered, things can be improved. They suggest that if a [quantum battery](#) were made that was also entangled, more work could be extracted from the system as more of the entangled batteries are added to the system. Such work could theoretically be extracted instantly, because of the properties of entanglement, which they say, would mean that as more batteries are added, the closer the whole system would come to being a perfect battery, i.e. one that doesn't lose any energy when it's transferred.

Their theory is not without its flaws, the pair acknowledge, the main one being that no one knows how to build such a battery using current technology. Another is that even if there were a way, the practicalities of building a real battery would likely introduce inefficiencies into the system, removing its perfection.

On the other hand, as some have noted, nature seems to have found a way to overcome the problem of building such a battery as, biologists have shown that the process of photosynthesis achieves perfect [energy transfer](#), though nobody has been able to explain how.

If ever an entangled quantum battery were made with nearly perfect energy transfer, it could be used to power atomic or even subatomic devices, or perhaps more practically, allow for the creation of batteries that are far superior to those used in everyday applications such as lithium-ion battery packs.

More information: Extractable work from ensembles of quantum batteries. Entanglement helps, arXiv:1211.1209 [quant-ph] arxiv.org/abs/1211.1209

Abstract

Motivated by the recent interest in thermodynamics of micro- and mesoscopic quantum systems we study the maximal amount of work that can be reversibly extracted from a quantum system used to store temporarily energy. Guided by the notion of passivity of a quantum state we show that entangling unitary controls extract in general more work than independent ones. In the limit of large number of copies one can reach the thermodynamical bound given by the variational principle for free energy.

via [Arxiv Blog](#)

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