

Superman's solar-powered feats break a fundamental law of physics

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It goes without saying that Superman can accomplish some pretty spectacular feats. But according to students, the Man of Steel actually achieves the impossible – by breaking the fundamental physics law of conservation of energy.

As Comic Con 2014 draws to a close in San Diego, University of Leicester physics students have now discovered Superman would not be able to get all the energy he needs to fly from the Sun alone, as is suggested in the DC Comics.

The MPhys students have shown that the superhero is able to use 6,560 times more energy than he would feasibly be able to absorb from the sun's rays.

They published their findings in a final year paper for the *Journal of Physics Special Topics*, a peer-reviewed student journal run by the University's Department of Physics and Astronomy.

According to comic lore, the Krypton-born cape wearer gets his energy from the electromagnetic radiation contained in the light from our sun – giving him various super powers here on Earth, including superhuman strength and the power of flight.

The students therefore decided to test his solar cell efficiency – the measure of how much energy output solar cells give out for each unit of energy they absorb from the Sun.

This equation is used to calculate the efficiency of regular solar cells – such as photovoltaic panels you might find on the roofs of buildings.

The efficiency is worked out by dividing the total amount of energy used – the work done - by the total energy provided by the sun over a given length of time.

The most efficient [solar cells](#) on Earth have a 44.7 per cent efficiency, according to this equation.

To work this out in the case of Superman, the students needed to calculate the total energy used by Superman during a day of solar-powered flight.

Using a rough estimate of the area of Superman's body in contact with the sun's rays, the team was able to work out that he absorbs 1096 joules per second from the Sun.

The team then needed to calculate the amount of energy Superman actually uses in flight to overcome drag forces. They found that – for an eight hour flight at an altitude of 30 km - he would use 207 billion joules of energy to overcome drag forces and stay in the air over the course of the journey.

Based on the two figures, the students calculated that Superman has a solar cell efficiency of 656,000 per cent – in other words, he used far more energy in flight than he can possibly absorb from the Sun.

According to the law of conservation of energy, energy cannot be created or destroyed within a closed system – it can only be converted. It would therefore be impossible for him to be getting all of his energy from the Sun.

The students note that he must be obtaining energy from alternate sources. Alternatively, they said it is possible that instead of immediately using all energy he obtains, he stores the energy for future use.

But even with a solar cell efficiency of 100 per cent, Superman would soon reach a depletion of energy - especially given that the paper's calculations only deal with one of his many powers, they said.

Student Jason Watson, 21, from Oxfordshire, said: "We wanted to look at how much energy Superman uses when he is flying – and how much more efficient he would need to be.

"To put it into context, a normal solar cell would need to be twice the size of a football pitch to acquire the amount of energy Superman would use during flight.

"There are other ways that he could be getting his energy. As well as [electromagnetic radiation](#), the sun emits neutrino particles. Millions of these pass through our bodies all the time. Maybe he is somehow able to use energy from the neutrinos – but we don't know how he would do this.

"As Superman is so efficient, it would be good if he could use one of his other powers – such as his ability to fire lasers from his eyes – to supply us with [energy](#) here on Earth."

Course tutor Dr Mervyn Roy, a lecturer in the University of Leicester's Department of Physics and Astronomy, said: "The aim of the module is for the students to learn about peer review and scientific publishing.

"The students are encouraged to be imaginative with their topics, and find ways to apply basic physics to the weird, the wonderful and the everyday."

More information: "The Solar Cell Efficiency of Superman" is available online: [physics.le.ac.uk/journals/inde ... article/view/647/472](https://physics.le.ac.uk/journals/index.php/physorg/article/view/647/472)
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