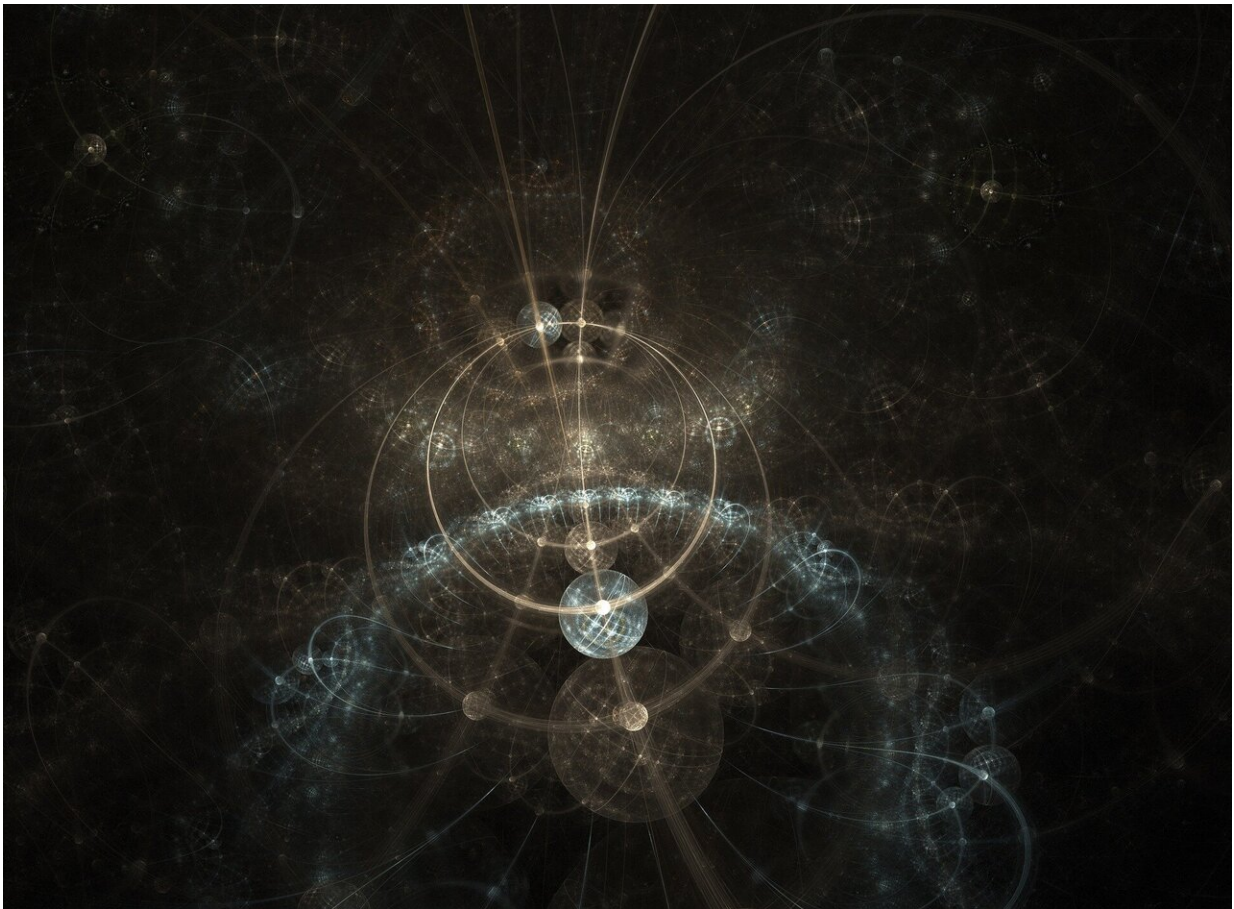


# World's fastest information-fueled engine designed by university researchers

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Simon Fraser University researchers have designed a remarkably fast engine that taps into a new kind of fuel—information.

The development of this [engine](#), which converts the random jiggling of a microscopic particle into stored energy, is outlined in research published this week in the *Proceedings of the National Academy of Sciences (PNAS)* and could lead to significant advances in the speed and cost of computers and bio-nanotechnologies.

SFU physics professor and senior author John Bechhoefer says researchers' understanding of how to rapidly and efficiently convert information into "work" may inform the design and creation of real-world information engines.

"We wanted to find out how fast an information engine can go and how much energy it can extract, so we made one," says Bechhoefer, whose experimental group collaborated with theorists led by SFU physics professor David Sivak.

Engines of this type were first proposed over 150 years ago, but actually making them has only recently become possible.

"By systematically studying this engine, and choosing the right system characteristics, we have pushed its capabilities over ten times farther than other similar implementations, thus making it the current best-in-class," says Sivak.

The information engine designed by SFU researchers consists of a microscopic particle immersed in water and attached to a spring which, itself, is fixed to a movable stage. Researchers then observe the particle bouncing up and down due to thermal motion.

"When we see an upward bounce, we move the stage up in response," explains lead author and Ph.D. student Tushar Saha. "When we see a downward bounce, we wait. This ends up lifting the entire system using only information about the particle's position."

Repeating this procedure, they raise the particle "a great height, and thus store a significant amount of gravitational energy," without having to directly pull on the particle.

Saha further explains that "in the lab, we implement this engine with an instrument known as an optical trap, which uses a laser to create a force on the particle that mimics that of the spring and stage."

Joseph Lucero, a Master of Science student, adds, "In our [theoretical analysis](#), we find an interesting trade-off between the particle mass and the average time for the particle to bounce up. While heavier particles can store more gravitational energy, they generally also take longer to move up."

"Guided by this insight, we picked the particle mass and other engine properties to maximize how fast the engine extracts energy, outperforming previous designs and achieving power comparable to molecular machinery in living cells, and speeds comparable to fast-swimming bacteria," says postdoctoral fellow Jannik Ehrich.

**More information:** Tushar K. Saha et al, Maximizing power and velocity of an information engine, *Proceedings of the National Academy of Sciences* (2021). [DOI: 10.1073/pnas.2023356118](https://doi.org/10.1073/pnas.2023356118)

Provided by Simon Fraser University

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