

# Bayesian Information Engine that Optimally Exploits Noisy Measurements

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We have experimentally realized an information engine consisting of an optically trapped, heavy bead in water [1]. The device raises the trap center after a favorable “up” thermal fluctuation, thereby increasing the bead’s average gravitational potential energy. In the presence of measurement noise, poor feedback decisions degrade its performance; below a critical signal-to-noise ratio, the engine shows a phase transition and cannot store any gravitational energy. However, using Bayesian estimates of the bead’s position to make feedback decisions can extract gravitational energy at all measurement noise strengths and has maximum performance benefit at the critical signal-to-noise ratio.

[1] T. K. Saha , J. N. E. Lucero, J. Ehrich, D. A. Sivak, and J. Bechhoefer, Phys.Rev. Lett. **129**, 130601 (2022).