

## WEEKLY DIGEST: PHYSICAL & EARTH SCIENCES

# Innovations in Quantum and Material Sciences Propel Research Forward

Recent advancements in quantum chemistry and material sciences have made significant strides, showcasing the potential of new technologies. A collaboration between the University of Osaka and Fixstars has achieved a major milestone in quantum simulations, while researchers at the University of Rochester have developed a phonon laser for enhanced precision in measuring gravity. Additionally, discoveries in fluid mechanics and the behavior of materials under stress challenge existing theories, paving the way for innovative applications in various fields. These breakthroughs highlight the intersection of quantum mechanics and material properties, driving forward our understanding of the physical world.

### KEY FINDINGS

- ✓ University of Osaka and Fixstars executed a major quantum chemistry simulation on 1,024 GPUs.
- ✓ A new phonon laser developed can measure gravity with unprecedented precision.
- ✓ Drexel University researchers found that viscous liquids can fracture like solids under stress.

### IMPLICATIONS

- Enhanced quantum simulations could lead to breakthroughs in drug discovery and materials science.
- Improved gravity measurement techniques may advance our understanding of fundamental physics.
- New insights into fluid mechanics could revolutionize industries relying on liquid materials.

Key Metrics: 1,024 GPUs used for quantum chemistry simulation.; 7.5 gigawatts of power planned from Meta's natural gas plants.

## 1. University of Osaka and Fixstars Advance IQPE Quantum Chemistry Simulation on 1,024 GPUs

**Category:** Research  
**Departments:** Physics, Computer Science, Chemistry & Biochemistry, Electrical & Computer Engineering  
**Topics:** Quantum Computing, Iterative Quantum Phase Estimation, Quantum Chemistry Simulation, Classical Computing Resources

**Impact Score:** 25.0

### Rubric Scores

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 5 | Educational Value: 4           | Innovation / Novelty: 5          |
| Practical Impact: 4   | Interdisciplinary Potential: 5 | Ethical / Policy Implications: 2 |

A collaborative research effort between the Center for Quantum Information and Quantum Biology at The University of Osaka and Fixstars Corporation has achieved a significant milestone by executing one of the largest classical simulations of iterative quantum phase estimation (IQPE) circuits for quantum chemistry, utilizing up to 1,024 GPUs. This advancement highlights the potential of classical computing resources to simulate complex quantum processes, which could have implications for the field of quantum chemistry. The results contribute to the understanding of quantum systems and may facilitate further research in quantum computing applications.

<https://www.hpcwire.com/off-the-wire/university-of-osaka-and-fixstars-advance-iqpe-quantum-chemistry-simulation-on-1024-gpus/>

## 2. This new "phonon laser" could measure gravity more precisely than ever before

**Category:** Research  
**Departments:** Physics, Electrical & Computer Engineering, Computer Science  
**Topics:** Quantum Sensing, Squeezed Phonon Laser, Nanoscale Vibration Control, Gravity Measurement Precision, Quantum Compass Development

**Impact Score:** 22.0

### Rubric Scores

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 4 | Educational Value: 3           | Innovation / Novelty: 5          |
| Practical Impact: 4   | Interdisciplinary Potential: 4 | Ethical / Policy Implications: 2 |

Researchers at the University of Rochester and Rochester Institute of Technology have developed a new type of squeezed phonon laser that enables precise control of nanoscale vibrations. This advancement addresses the challenge of noise, which has historically limited the accuracy of laser measurements, by employing a technique called squeezing to reduce thermal fluctuations. The enhanced precision of these phonon lasers could facilitate more accurate measurements of gravity and other forces, potentially advancing the development of quantum compasses as alternatives to GPS. The findings were published in Nature Communications and were supported by the National Science Foundation.

<https://www.sciencedaily.com/releases/2026/03/260331001058.htm>

### 3. Scientists stretched a liquid and it snapped like a solid

**Category:** Research  
**Departments:** Civil, Environmental & Construction Engineering, Aerospace & Mechanical Engineering, Industrial, Manufacturing & Systems Engineering, Biological Sciences, Physics  
**Topics:** Science & Research, Viscoelastic Fracture Mechanics, Fluid Dynamics, Hydraulic Applications, 3D Printing Materials

**Impact Score:** 21.0

**Rubric Scores**

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 4 | Educational Value: 3           | Innovation / Novelty: 5          |
| Practical Impact: 4   | Interdisciplinary Potential: 4 | Ethical / Policy Implications: 1 |

Researchers at Drexel University have discovered that certain viscous liquids can behave like solids and fracture under sufficient stress, challenging existing notions in fluid mechanics. Published in *Physical Review Letters*, the study reveals that simple liquids, such as tar-like hydrocarbon blends and styrene oligomer, can reach a "critical stress" point of approximately 2 megaPascals, leading to sudden fracture. This behavior, previously attributed only to solids, indicates that viscosity plays a significant role in the mechanical properties of liquids, potentially impacting various applications in hydraulics, 3D printing, and biological systems. The findings suggest that many simple liquids may exhibit similar fracture characteristics, fundamentally altering the understanding of fluid dynamics.

<https://www.sciencedaily.com/releases/2026/03/260330001133.htm>

### 4. 'More is Different': Research shows scale alone does not explain AI's power-specialization and cooperation do

**Category:** Research  
**Departments:** Political Science & Public Administration, Sociology & Anthropology, Biological Sciences, Chemistry & Biochemistry, Mathematical Sciences  
**Topics:** AI Ethics, Emergent Properties, Complex Systems, Hierarchical Structure

**Impact Score:** 20.0

**Rubric Scores**

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 3 | Educational Value: 4           | Innovation / Novelty: 3          |
| Practical Impact: 2   | Interdisciplinary Potential: 5 | Ethical / Policy Implications: 3 |

The article discusses the concept of "More is Different," proposed by physicist Philip W. Anderson in 1972, which critiques the reductionist approach in science. It emphasizes that emergent properties of complex systems cannot be predicted solely from the fundamental laws governing their constituent particles. The article further generalizes this idea to suggest a hierarchical structure in science, indicating that properties observable at smaller scales do not necessarily inform predictions about larger-scale phenomena across various disciplines, including chemistry, biology, and social sciences.

<https://techxplore.com/news/2026-04-scale-ai-power-specialization-cooperation.html>

## 5. Physicists just solved a strange fusion mystery that stumped experts

**Category:** Research  
**Departments:** Physics, Aerospace & Mechanical Engineering, Electrical & Computer Engineering  
**Topics:** Science & Research, Plasma Rotation Effects, Tokamak Particle Distribution, Divertor Resilience Modeling

**Impact Score:** 20.0

### Rubric Scores

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 5 | Educational Value: 3           | Innovation / Novelty: 4          |
| Practical Impact: 4   | Interdisciplinary Potential: 3 | Ethical / Policy Implications: 1 |

Recent research published in *Physical Review Letters* has identified the influence of plasma rotation on particle distribution in tokamaks, addressing a longstanding imbalance observed in divertor systems. Previous models primarily attributed this asymmetry to cross-field drifts, but simulations incorporating both cross-field and parallel flows-driven by the rotating plasma core-were necessary to align with experimental data. The study demonstrated that accurate modeling of particle behavior, particularly the core's rotation speed, is crucial for designing more resilient divertors for future fusion reactors. This advancement enhances the predictive capabilities for particle movement, which is essential for optimizing reactor engineering.

<https://www.sciencedaily.com/releases/2026/04/260401071957.htm>

## 6. A surprising new idea about how the Big Bang may have happened

**Category:** Research  
**Departments:** Physics, Mathematical Sciences, Computer Science  
**Topics:** Science & Research, Quadratic Quantum Gravity, Primordial Gravitational Waves, Observable Cosmology

**Impact Score:** 20.0

### Rubric Scores

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 5 | Educational Value: 2           | Innovation / Novelty: 5          |
| Practical Impact: 3   | Interdisciplinary Potential: 4 | Ethical / Policy Implications: 1 |

Researchers at the University of Waterloo, led by Dr. Niayesh Afshordi, have proposed a new model for understanding the universe's early moments, suggesting that rapid expansion, or inflation, can arise naturally from a framework of Quadratic Quantum Gravity. This approach integrates gravity with quantum physics, addressing limitations of Einstein's general relativity under extreme conditions present at the universe's birth. The model predicts a minimum level of primordial gravitational waves, which could be detectable by future experiments, providing a means to test the theory. The findings, published in *Physical Review Letters*, aim to strengthen the connection between quantum gravity and observable cosmology.

<https://www.sciencedaily.com/releases/2026/03/260330001137.htm>

## 7. These "smart" crystals bend and snap back when hit with light

**Category:** Research  
**Departments:** Electrical & Computer Engineering, Physics  
**Topics:** AI Hardware, Photostriction Phenomenon, Light-Controlled Devices, Halide Perovskite Applications

**Impact Score:** 17.0

**Rubric Scores**

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 3 | Educational Value: 2           | Innovation / Novelty: 4          |
| Practical Impact: 4   | Interdisciplinary Potential: 3 | Ethical / Policy Implications: 1 |

Researchers at the University of California, Davis have discovered that halide perovskite crystals exhibit a reversible shape change when exposed to light, a phenomenon termed photostriction. This property allows the crystals to alter their internal lattice structure rapidly under illumination and return to their original configuration once the light is removed. The study, published in *\*Advanced Materials\**, highlights the tunability of perovskites, where their response to light can be adjusted based on their chemical composition and the characteristics of the light used. These findings suggest potential applications in light-controlled semiconductor devices, such as sensors and actuators, which could operate without electrical input.

<https://www.sciencedaily.com/releases/2026/03/260331001056.htm>

## 8. Meta's natural gas binge could power South Dakota

**Category:** Policy & Ethics  
**Departments:** Political Science & Public Administration, Earth, Environmental & Resource Sciences, Computer Science  
**Topics:** AI Policy & Regulation, Carbon Emissions Mitigation, Sustainability in AI Infrastructure, Methane Emission Monitoring

**Impact Score:** 13.0

**Rubric Scores**

|                       |                                |                                  |
|-----------------------|--------------------------------|----------------------------------|
| Research Relevance: 1 | Educational Value: 2           | Innovation / Novelty: 1          |
| Practical Impact: 3   | Interdisciplinary Potential: 2 | Ethical / Policy Implications: 4 |

Meta has announced plans to fund ten natural gas power plants in Louisiana to support its Hyperion AI data center, which will consume as much electricity as South Dakota. The combined output of these plants will be approximately 7.5 gigawatts, significantly contributing to Meta's carbon emissions, with projections estimating 12.4 million metric tons of CO<sub>2</sub> annually. This decision raises concerns about the environmental impact, particularly regarding methane leaks from natural gas, which could exacerbate the company's carbon footprint despite its previous commitments to renewable energy. Meta's sustainability reports have not addressed these methane emissions, highlighting a potential gap in its climate strategy.

<https://techcrunch.com/2026/04/01/metas-natural-gas-binge-could-power-south-dakota/>