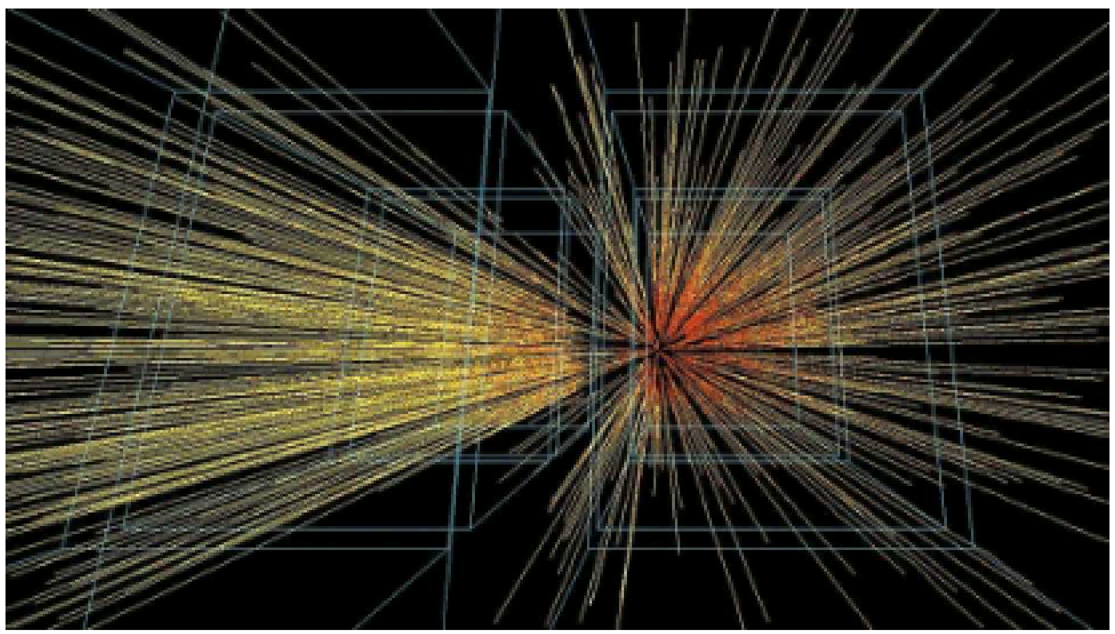
Science & technology | Collision course

AI is helping expand the frontier of theoretical physics

It is blurring the line between tool and collaborator

March 12th 2026



IN 2025 A GROUP of theoretical physicists studying the behaviour of fundamental particles called gluons hit a brick wall in their calculations. In search of a fresh perspective, the physicists teamed up with OpenAI, an artificial-intelligence lab, to see whether an AI assistant might be able to help. Two preprints, published in early 2026, report the results of this collaboration. The AI's role was central, say the researchers, enabling them to complete in weeks what would have typically required months. The long-touted idea that AI could help with work at the frontiers of theoretical physics is now a reality.

What makes the interactions of subatomic particles so difficult to model is the fact that they obey the probabilistic laws of quantum physics. That means that when two particles enter a collision, it is impossible to definitively predict how many particles will leave. All physicists can ever do is determine the probability of various outcomes, which is done with the help of mathematical quantities called scattering amplitudes.

These quantities are challenging to compute, often involving many hundreds of intricate mathematical terms. In certain cases, however, mathematical patterns emerge that collapse these mammoth equations into simple, elegant forms. This simplicity is particularly striking for gluons—fundamental particles that transmit the strong nuclear force. A subset of their scattering amplitudes, known as single-minus tree-level, appear to vanish completely, implying that the associated processes could never occur. The authors of the new studies, however, suspected this conclusion was too strong.

The researchers had noticed that if the momenta of the particles entering and leaving a collision are made to take certain values, the amplitudes become non-zero. Calculating the simplest examples, involving only a few gluons, was straightforward. But as the number of particles increased, so did the complexity of the maths.

When Alexandru Lupsasca, a physicist at Vanderbilt University and OpenAI, invited the researchers to test the physics capabilities of OpenAI's latest models, the single-minus gluon scattering amplitudes seemed like the perfect problem. Given the physicists' formulae, GPT-5.2 Pro both spotted simplifications they had missed and conjectured a generalisation—an expression valid for any number of gluons. The researchers then asked a more capable OpenAI model—one not publicly available—to confirm it. After 12 hours of thinking, the AI handed them a proof. The physicists checked through the mathematics; the AI's working was correct.

The researchers posted their findings, which have not yet been peer reviewed, on arXiv on February 12th. But that was not the end of the story. They immediately wondered if the results could be extended to gravitons—hypothetical particles thought to carry the gravitational force. Gravitons have not been observed, but calculating their theoretical scattering amplitudes allows physicists to investigate how gravity might behave at the smallest scales.

Graviton calculations are even more complex than those for gluons. Yet on March 4th the researchers released a second paper. Using only the gluon results and some gentle prompting from the physicists, GPT-5.2 Pro was able to construct the analogous single-minus scattering amplitudes for gravitons. All that was left for the physicists to do was check its working. "The physics problem now is not the hard part. The hard part is verifying the results and writing it up," said Dr Lupsasca. "This feels surreal to me."

The physicists are now working with the models to investigate what these results mean for their theories. But the true significance of these two preprints may lie in their means, rather than the ends. For the researchers, the AI model has begun to blur the line between tool and collaborator. "It came back to me and said 'Well, the obvious generalisation is…' and wrote down the whole formula," said Andrew Strominger, a physicist at Harvard University and co-author of the studies. "Which is just the kind of thing some of my more obnoxious colleagues would say." ■

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We tell you how to find out

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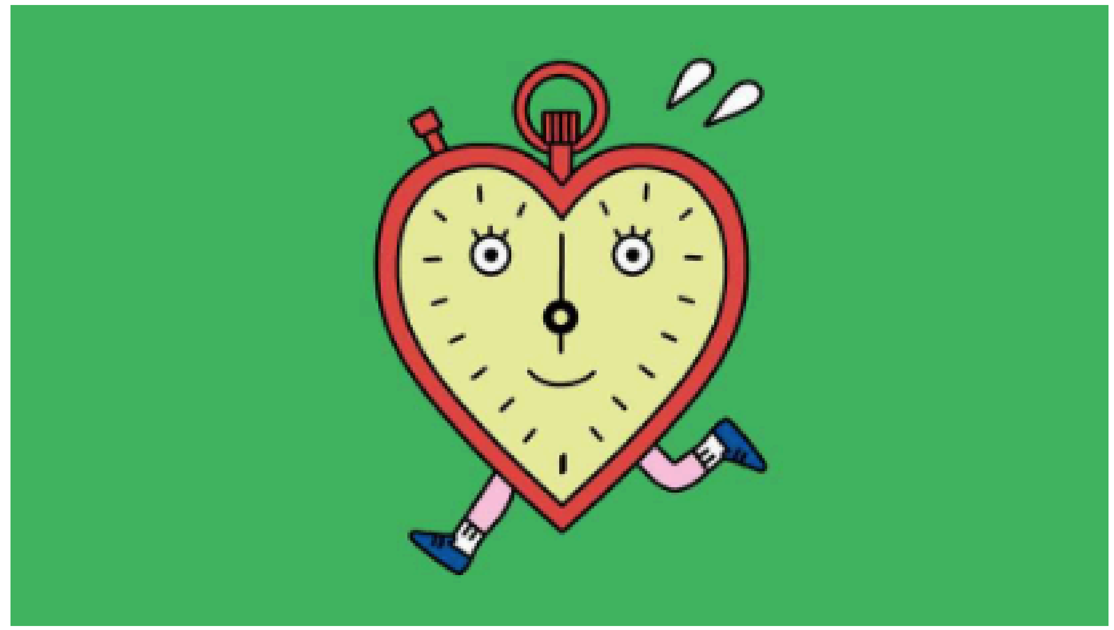

PRINTED ON TREADMILLS and exercise bikes in gyms around the world is a simple method for estimating the maximum rate at which your heart should safely beat, in beats per minute: 220 minus your age. This neat formula is endorsed by august bodies like the American Heart Association and the British Heart Foundation. By this calculation a