New measure of gravitational constant higher than expected

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(Phys.org) —A trio of researchers working in France, along with a colleague from the U.K. has re-measured the gravitational constant using the same apparatus they built 12 years ago and have found a small change. In their paper published in *Physical Review Letters*, the team describes how they reconfigured their original equipment to re-measure the gravitational constant and this time came up with a slightly higher number than before.

The gravitational constant, denoted by *G* in math equations, has proven to be far more elusive than scientists imagined after it was first measured by Henry Cavendish approximately 200 years ago. The problem is that it's far weaker than other forces such as electromagnetism. Fluctuating stronger forces acting on measurement equipment can cause changes to readings, leading to an inaccurate result. For that reason, scientists have been striving to come up with a way to definitively measure exactly how much force *G* exerts. In this new effort, the research team went back to the same apparatus they constructed 12 years ago—one that simultaneously measures *G* in two different ways. This time around, however, they reconfigured their device in ways they believed would make it more accurate—and in so doing found a slightly different result, but now, aren't sure which of their measurements is actually more accurate.

Modern researchers use two main types of methods to try to measure *G*, the first is a more advanced way to do the same thing Cavendish did two centuries ago, using lasers instead of candle light—it's based on measuring the amount of torque applied to a thin ribbon set between heavy balls. The other involves applying voltage to a wire using a servo to counteract twisting due to *G*. In this renewed effort, the researchers ran both types of measurements in their device and averaged the results. In so doing, they discovered measurements revealed a value of 6.67545(18)x10^{-11} m^3 kg^{-1} s^{-2}, with 27PPM standard uncertainty. This value is 21PPM lower than the last time they ran the experiment (measurements by others have ranged as far as 241 ppm lower). The team is unable to explain why they found a difference, and cannot say with confidence which of their measurements is likely closer to *G's* actual value.

Research into ways to better measure *G* will continue of course, with the hope that one day a method will be devised that will not be subject to other more powerful forces, or interpretation.

More information: Improved Determination of G Using Two Methods, *Phys. Rev. Lett.* 111, 101102 (2013)
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Abstract
This Letter describes new work on the determination of the Newtonian constant of gravitation, G, carried out at the BIPM since publication of the first results in 2001. The apparatus has been completely rebuilt and extensive tests carried out on the key parameters needed to produce a new value for G. The basic principles of the experiment remain the same, namely a torsion balance suspended from a wide, thin Cu-Be strip with two modes of operation, free deflection (Cavendish) and electrostatic servo control. The result from the new work is: G=6.67545(18)×10-11??m3?kg-1?s-2 with a standard uncertainty of 27 ppm. This is 21 ppm below our 2001 result but 241 ppm above The CODATA 2010 value, which has an assigned uncertainty of 120 ppm. This confirms the discrepancy of our results with the CODATA value

and highlights the wide divergence that now exists in recent values of G. The many changes made to the apparatus lead to the formal correlation between our two results being close to zero. Being statistically independent and statistically consistent, the two results taken together provide a unique contribution to determinations of G.

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