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Latest measurement of a proton's mass has got physicists puzzled

By **Adam Mann**

SOMETHING isn't measuring up. For the second time, an extremely precise measurement of the proton's mass is different from its recognised value.

"It looks like there is a serious flaw somewhere," says Sven Sturm at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany.

The issue first raised its head in 2015, when a team led by Edmund Myers at Florida State University measured the difference in masses of the nucleus of a helium-3 atom and a deuteron – the nucleus of a deuterium or heavy hydrogen atom – with a single proton bound to it. Both contain two protons, one neutron and one electron, but because they are bound together differently, their masses are different.

Myers's team put the helium-3 and the proton-deuteron in a magnetic field and measured a property called their cyclotron frequency to find their masses. When they subtracted the mass of the helium-3 atom from that of the proton- deuteron, the difference was smaller than previous measurements by more than 3 standard deviations, which means such a result has a 0.3 per cent probability of occurring by chance.

It could be that either the published masses or the team's measurements for one or more of the fundamental particles was slightly off. Last July, Sturm's group measured the mass of the proton and found it lighter than reported, bringing Myers's results more in line with standard values.

Now Myers's team has rerun its experiment with twice the precision, measuring the masses of helium-3 and a proton-deuteron to one part in 10 billion. But with the higher precision and the new value for the proton, the discrepancy actually increased to 4 standard deviations (*Physical Review A*, doi.org/ch47).

Nobody yet knows the solution to this conundrum. More measurements for the fundamental particles are under way, and a new assessment for the mass of the

deuteron is expected later this year.

This article appeared in print under the headline "Proton gives mass measurers the slip again"

Article amended on 28 February 2018

We corrected the property of the protons that the researchers measured

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