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Simple theory says Newton is wrong, Einstein can be improved and dark matter does not exist.

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While recent studies have managed to throw light on dark matter, a new theory postulates that dark matter does not exist at all, and that while Newton's theories do not work for the vast majority of the universe, Einstein was mostly right, although his theories could benefit from improvements.

Dr Hong Sheng Zhao from the University of St Andrews in Scotland and Dr Benoit Famaey from the Free University of Brussels have developed a modest new theory and formula to explain gravity. Should the theory be accepted, we will once again have to re-evaluate the way we look at the universe.

Newton 'discovered' gravity when the apocryphal apple fell on his head, making gravity the oldest known recognised force. However, as Newton was quick to point out - how gravity actually works is unknown. 'I have not yet been able to discover the cause of these properties of gravity from phenomena and I frame no hypotheses [...]. That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it,' he wrote in 1687.

While Newton's theories were excellent for describing the motions of bodies on Earth or in space accurately in the late 17th Century, closer inspection of the motion of stellar bodies reveals shortcomings. Einstein in his general theory of relativity was the first to successfully improve on Newton in 1905. The general theory of relativity now allowed light to bend, but still did not explain some of the observable universe, and by how much light should bend.

For example, when observing the rotation of stars about a galaxy, the stars are moving too quickly to be held by gravity, and ought to be hurled apart. But they are not. This has led to two competing theories. The first, dark matter, is in the ascendancy and postulates an invisible substance and force which makes up the majority of the universe. The dark matter holds everything together and compensates for the high speeds of stars.

The second, less well known theory, proposes that the understanding of gravity is simply not correct. While we think of gravity as a constant, this theory proposes that gravity can be increased, allowing objects to move more quickly than they should. This second theory provides good models for both gravitational and relativistic views of the universe.

The 'simple theory', developed by Zhao and Famaey, builds on the second theory, initially developed by Moti Milgrom and later Jacob Bekenstein. Drs Zhao and Famaey have developed a formula which allows gravity to change over various distances. So far, the formula fits the observations of galaxies, something not achieved easily in the study of dark matter.

Dr Zhao explains how using today's measurements, Newton's calculations are not practical: 'It is not obvious how an apple would fall in a galaxy. Mr. Newton's theory would be off by a large margin [...]. There has always been a fair chance that astronomers might rewrite the law of gravity [...]. It is consistent with galaxy data so far, and if its predictions are further verified for solar system and cosmology, it could solve the Dark Matter mystery. We may be able to answer common questions such as whether Einstein's theory of gravity is right and whether the so-called Dark Matter actually exists.'

'A non-Newtonian gravity theory is now fully specified on all scales by a smooth continuous function. It is ready for fellow scientists to falsify. It is time to keep an open mind for new fields predicted in our formula while we continue our search for Dark Matter particles,' said Dr Zhao.

However, neither of the two researchers believes the gravity question is necessarily solved, and they are convinced of the need to keep searching for more complete answers. Dr Famaey commented: 'It is possible that neither the modified gravity theory, nor the Dark Matter theory, as they are formulated today, will solve all the problems of galactic dynamics or cosmology. The truth could in principle lie in between, but it is very plausible that we are missing something fundamental about gravity, and that a radically new theoretical approach will be needed to solve all these problems. Nevertheless, our formula is so attractively simple that it is tempting to see it as part of a yet unknown fundamental theory. All galaxy data seem to be explained effortlessly.'

The research was published on 10 February in Astrophysical Journal Letters, and will be presented at an international workshop held at Edinburgh's Royal Observatory from 20 to 22 April.

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