

Do we need dark matter?

November 12 2009, by Pete Wilton



Illustration showing the proposed Square Kilometre Array telescope, image: Xilo Studios

It's the biggest problem in physics: the matter we can see in the universe accounts for just five per cent of the observed gravity that holds galaxies together.

The conventional explanation is that enormous amounts of invisible [dark matter](#) make up the missing 95 per cent but some have argued that it's Einstein's theory that's at fault.

In a review in this week's *Science* Pedro Ferreira of Oxford's Department of Physics and Glenn Starkman of Case Western University assess how alternatives to dark matter are shaping up.

'For over 25 years there has been a proposal that there is no dark matter, that we are simply misinterpreting the data and that what in fact is

happening is that we don't understand [gravity](#),' Pedro tells me.

‘A rudimentary alternative was proposed in the early 80s but only recently were a few complete theories constructed that modify Einstein's theory of general relativity and that could in principle solve the dark matter problem without dark matter.’

Israeli physicist Mordehai Milgrom got the ball rolling in 1983 with a proposal that became known as modified Newtonian dynamics (MOND). Other alternatives build upon this work, such as Jacob Bekenstein's TeVeS.

Pedro comments: ‘In the review we emphasize two main things. First of all that all of these theories seem to bring in something akin to dark matter through the back door. It is not that they need dark matter as well as modifications to gravity but that any attempt to modify gravity necessarily generates something dark.’

‘The second point is that, even though waters seem to be muddied, there should be observational tests which can distinguish between the two paradigms. By looking at how [galaxies](#) are distributed and how they distort any background light, it should be possible to pick out clues for modified gravity, i.e. to test whether Einstein was indeed correct.’

The hope is that galactic surveys, such as those carried out by the Joint [Dark Energy](#) Mission or Square Kilometre Array, will be able to see if the telltale signs predicted by these alternative theories really are out there.

More information: Einstein's Theory of Gravity and the Problem of Missing Mass, *Science* 6 November 2009: Vol. 326. no. 5954, pp. 812 - 815; [DOI: 10.1126/science.1172245](https://doi.org/10.1126/science.1172245)

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