

A potential glimpse of dark matter from gravitational waves

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The detection of gravitational waves has been an outstanding breakthrough of 21st century science, which has been delivering unprecedented information about the most mysterious objects in the Universe, such as black holes and neutron stars.

Yet, the promise of gravitational waves is even more formidable: can they give us a glimpse of new physics, in particular unveiling some of the deepest mysteries of current science, such as the nature of dark matter?

In this letter (Phys. Rev. Lett. 126 (2021) 8, 081101), one of the most intriguing gravitational wave transients, GW190521, is given a different interpretation, which presents a potential glimpse towards new physics and the nature of dark matter.

The letter shows that the unique features of GW190521 make it consistent with a merger of two exotic compact objects (named Proca stars) which are lumps of dark matter. This interpretation is shown to be statistically slightly favoured over the standard binary black hole merger interpretation, suggested by the LIGO-Virgo collaboration. Moreover, it determines the mass of a new fundamental dark matter particle, the fundamental constituent of the exotic Proca stars: an ultralight vector boson with mass of about 8×10^{-13} eV.

If this interpretation is supported by future events yielding population studies, gravitational waves have just started to unveil the nature of dark matter, becoming, in the process, the new generation of particle detectors.

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FIGURE 1

An artistic impression on the collision of two dark matter stars (Proca stars) and the corresponding emission of gravitational waves. Credit: Nicolás Sanchis-Gual and Rocío García-Soutomodel.

