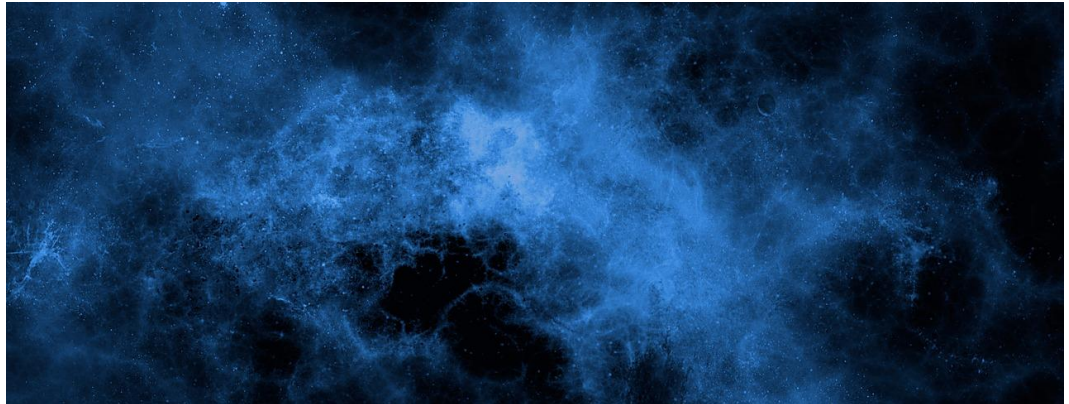


PRESS RELEASE

Revealing the secret language of dark matter

Shedding light on the interplay of dark matter with standard matter, a new SISSA study suggests a possible solution to one of the greatest and long-standing mystery of astrophysics. The theory proposes a new property, called "non-minimal coupling," that would shed light on this mysterious interaction. The research has been published in "The Astrophysical Journal"



Trieste, 29 aprile 2022

In the Universe, dark matter and standard matter "talk" to each other using a secret language. This "discussion" happens thanks to gravity, scientists say, but not in a way they can fully comprehend. A new SISSA study published in "The Astrophysical Journal" sheds light on this long-standing issue.

The authors of the research, Ph.D Student Giovanni Gandolfi and supervisors Andrea Lapi and Stefano Liberati, propose a special property for dark matter called a "non-minimal coupling with gravity". This new type of interaction can modify dark matter gravitational influence on standard 'baryonic' matter.

According to the authors, the 'non-minimal coupling' could be the key to decrypt the enigmatic dialogue between the two components, possibly solving one of the biggest open questions about dark matter's nature.

To prove the hypothesis, the assumption has been tested and then confirmed with experimental data from thousands of spiral galaxies.

The mysterious interplay with standard matter



“Dark matter is everywhere” says the research’s authors. “Like a cosmic scaffolding, it interconnects the Universe and holds galaxies together. Dark matter is as important as mysterious, though. Possibly, one of dark matter's greatest enigmas is its interplay with standard matter, or 'baryons'”. We know that in this dialogue gravity has an important role, but scientists still don’t entirely understand the phenomenon. “For this reason” say Gandolfi, Lapi and Liberati “we asked ourselves: is gravity wrong or are we just missing something crucial about dark matter's nature? What if dark matter and standard 'baryonic' matter do not communicate in the way we have always imagined?. With our research, we have tried to answer these intriguing questions”.

The 'non-minimal coupling'

The new study suggests the existence of a new feature of dark matter, named 'non-minimal coupling', which “can be described as a new type of interaction between dark matter and gravity” the authors affirm. “It tells us a lot about the way the two components “communicate”. If the non-minimal coupling is present, standard matter “perceives” spacetime in a way which is different from the one “experienced” by the dark matter. And this is a very interesting point. Usually, in fact, dark matter and baryonic matter perceive spacetime in the same way. For this reason, our theory, that we have proven to be in remarkable agreement with present experimental data, could represent a crucial issue in understanding the essence of dark matter”.

For a global comprehension of dark matter

The new study proposes a solution to one of the most discussed problems in astrophysics, researchers say: “Among other things, the positions of those who argue that dark matter does not exist, and therefore gravity must be modified, are based on the difficulty of finding an explanation to this problem, which is one of the last missing pieces for a global comprehension of dark matter”. But there is more. “This feature of dark matter is not a piece of new exotic fundamental physics” the author say. “One can explain the existence of this non-minimal coupling with known physics alone”.

The future looks brighter...

“The future of dark matter looks brighter” the authors conclude. “Further studies will be carried out to explore all the interesting implications of this proposed new feature of dark matter. We wouldn't be surprised to discover that this non-minimal coupling could solve other unanswered questions of the Universe”.

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