NA64 hunts the mysterious dark photon

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An overview of the NA64 experimental set-up at CERN. NA64 hunts down dark photons, hypothetic dark matter particles. Credit: Maximilien Brice/CERN

One of the biggest puzzles in physics is that eighty-five percent of the matter in our universe is "dark": it does not interact with the photons of the conventional electromagnetic force and is therefore invisible to our eyes and telescopes. Although the composition and origin of dark matter

are a mystery, we know it exists because astronomers observe its gravitational pull on ordinary visible matter such as stars and galaxies.

Some theories suggest that, in addition to gravity, dark matter particles could interact with visible matter through a new force, which has so far escaped detection. Just as the electromagnetic force is carried by the photon, this dark force is thought to be transmitted by a particle called "dark" photon which is predicted to act as a mediator between visible and dark matter.

"To use a metaphor, an otherwise impossible dialogue between two people not speaking the same language (visible and dark matter) can be enabled by a mediator (the dark photon), who understands one language and speaks the other one," explains Sergei Gninenko, spokesperson for the NA64 collaboration.

CERN's NA64 experiment looks for signatures of this visible-dark interaction using a simple but powerful physics concept: the conservation of energy. A beam of electrons, whose initial energy is known very precisely, is aimed at a detector. Interactions between incoming electrons and atomic nuclei in the detector produce visible photons. The energy of these photons is measured and it should be equivalent to that of the electrons. However, if the dark photons exist, they will escape the detector and carry away a large fraction of the initial electron energy.

Therefore, the signature of the dark photon is an event registered in the detector with a large amount of "missing energy" that cannot be attributed to a process involving only ordinary particles, thus providing a strong hint of the dark photon's existence.

If confirmed, the existence of the dark photon would represent a breakthrough in our understanding the longstanding dark matter mystery.

Provided by CERN