Is dark matter composed of sterile neutrinos?

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“If you ask the question, ‘What is the content of the universe?’ the answer is not so simple,” says Mikhail Shaposhnikov, a scientist associated with the École Polytechnique Fédérale de Lausanne and CERN, both in Switzerland. Shaposhnikov explains to *PhysOrg.com* that only seven or eight percent of the universe is composed of what we term “regular” matter.

About 70 percent is dark energy, and around 22 percent of the universe is made up of dark matter. “Dark matter makes up a substantial part of the universe,” Shaposhnikov says. “Knowing what it is would answer a crucial question about the universe as a whole.”

Shaposhnikov and a team of scientists from Switzerland and France have a suggestion for how to determine whether or not sterile neutrinos are the main particles that make up dark matter. “Nobody knows what dark matter is made of,” he says. “Some scientists say that it is related to supersymmetry and believe it is made from WIMPs.

Others put forth axions as the most promising dark matter candidate. We think that sterile neutrinos make a good candidate.” Shaposhnikov and his colleagues have a specific suggestion for finding out whether sterile neutrinos are the particles that make up dark matter. Their ideas are found in a Letter titled “Strategy for Searching for a Dark Matter Sterile Neutrino” in *Physical Review Letters*.

In order to test the idea of sterile neutrinos as dark matter, Shaposhnikov and his co-authors suggest that a strategy that uses the particular

astrophysical objects, as well as adequate detection instruments, be implemented. Their strategy is based the fact that, while sterile neutrinos do last a long time, they are unstable. “Sterile neutrinos can decay into ordinary neutrinos and photons,” explains Shaposhnikov, “and photons from sterile neutrino decays can be seen at X-ray laboratories in Space.” This is what the team says needs to be detected.

“First,” Shaposhnikov says, “we would need to find the astrophysical objects to look at. Dwarf galaxies are good choices.” He points out that the signals that come from dark matter decay are weak, and easily hidden. But dwarf galaxies have a high ratio of dark matter to “regular” matter. “This means that there are fewer sources for the weak dark matter signals to hid behind.”

Next, better X-ray instruments are needed to analyze the information. “The current X-ray telescopes were not constructed to find dark matter,” says Shaposhnikov. “They show us very interesting things, and have good angular resolution. But they do not have the spectrometer needed to find dark matter.” He says that sterile neutrino decays produce a monochromatic line that is difficult for current instruments to detect. “We need devices with energy resolution of one or two orders of magnitude better than we have.”

Unfortunately, such a detector is not in the works. “Cosmic research is very expensive, so there are no concrete plans to make such a high resolution spectrometer that can scan a wide range of energies. But, we are trying to convince our experimental colleagues that this is a good direction to go in,” Shaposhnikov says. “There are programs that search for dark matter decays, but in order to make real progress, something better is needed.”