Galactic nuclei offer some indication of axionlike particles

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(PhysOrg.com) -- “Axionlike particles are interesting because they come up regularly when scientists study string theory. By looking at their properties, you hope to learn about string theory, or some other unified theory of physics. From a cosmological point of view, axionlike particles are of interest because they could be connected to dark energy,” Clare Burrage tells *PhysOrg.com*. The main hiccup in this study of axionlike particles, however, is the fact that their existence - much like their cousins, axions - has yet to be proven.

Burrage is a scientist at Deutsches Elektonen-Synchrotron DESY in Hamburg, Germany. She believes that some cosmological evidence for axionlike particles might have been found. Along with Anne-Christine Davis at the Centre for Mathematical Sciences in Cambridge, U.K., and Douglas Shaw at Queen Mary University of London, Burrage has been studying luminosity relations in active galactic nuclei. The team believes that their results offer a good case for the existence of axionlike particles, which are thought to have low mass and weak interactions. Their work is available in Physical Review Letters: “Active Galactic Nuclei Shed Light on Axionlike Particles.”

“For a long time, it has been speculated that a magnetic field could be used to change photons into axionlike particles. It is possible to look for these particles in the laboratory, and it is also possible to look for them using astronomy. We are looking for axionlike particles in astronomy, first by comparing observations of active galactic nuclei to what we expect to be the effects of the presence of axionlike particles.”

Active galactic nuclei are compact regions at the centers of galaxies. These nuclei are characterized by higher than normal luminosity. Using galactic centers for reference has long been a practice when discovering distant objects and determining cosmic evolution. Burrage and her peers suggest that active galactic nuclei appear dimmer than they should, due to the presence of axionlike particles. “We have seen in the past that if photons pass through a magnetic field, like one might have near galactic nuclei, and they are converted to axionlike particles, you would lose a lot of light,” she explains. “You would see a much dimmer object than expected. That is what we are seeing when we look at the precision measurements we have studied.”

Burrage points out that, while the results of this data crunching are encouraging, they are not conclusive. “The problem with astronomy is that you can’t go out and poke the galaxy,” she says. “There’s a lot about the physics that we don’t understand. There could be another explanation that mimics the effects we are looking for. We need to see it in the lab as well, if we want to back up our assertion that we are dealing with axionlike particles.”

Right now, there are experiments going on in many laboratories, attempting to determine whether axionlike particles really do exist. One is happening at CERN, and that is the experiment Burrage is most interested in. “The experimenters are using what is called the CERN Axion Solar Telescope,” she says. “It has a cap on the end of a telescope pointed at the sun that would keep out photons. Axionlike particles, though, would pass through the cap. Then a magnetic field would be passed through the telescope, changing any axionlike particles into photons. If you could see light, even with the cap on, it would be a good indicator of the existence of these particles.” Other experiments are going on at Fermi Lab and at DESY, and involve a similar process that would result in the appearance of light “passing through” a thick barrier.

At the present time, though, Burrage and her colleagues are interested in looking at the dimming results of other astronomical objects. “We are interested in the lab results of the experiments with axionlike particles, but we are not involved. Instead, we are looking to see if other types of astronomical objects are affected as the way active galactic nuclei are. If these effects are seen in observations of other objects, the case for axionlike particles is strengthened.”

More information: Clare Burrage, Anne-Christine Davis, Douglas J. Shaw, “Active Galactic Nuclei Shed Light on Axionlike Particles,” *Physical Review Letters* (2009). Avialable online: link.aps.org/doi/10.1103/PhysRevLett.102.201101 .