Presentation script

Good morning. My name is Dmitriy Fedoriaka and today I'm going to tell you about possible method of axions detecting with LIGO. My talk is based on article from Science magazine published in February this year. It will last about 5 minutes, then you may ask questions.

Today we will learn about axions, their basic properties and attempts to detect them. Then we will discuss a hypothesis of Canadian scientists about axions' emission from spinning black holes. Eventually we will find out how axions can possibly detected on Laser Interferometer Gravitational-Wave Observatory.

To begin with, let's go back in time, in 1977, when two scientists, Peccei and Quinn faced a problem within Quantum Chromodynamics, called strong CP problem. It turned out that in QED CP-symmetry is conserved, but shouldn't. They introduced new hypothetic particle and called it axion. It should be uncharged and extremely light particle. Later other scientists suggested that axions can be a component of dark matter.

Of course, everyone wanted to detect those particles experimentally. And **it brings us to our next topic** – experimental detection of axions. One of approaches was to detect axions in sun radiation. There are Primakoff effect, in which photon in electromagnetic field can be transformed to another particle, probably axion. Such process can occur in Sun core. Created axions then can be transformed back to photons in reverse Primakoff effect and detected. Other explorers attempted to detect axions themselves from our galaxy, using special converting equipment. However, none of the experiments produced verified positive results.

And **now it's time for main part of my presentation** – superradiance of axions near spinning black holes. According to Asimina Arvanitaki and Masha Baryakhtar from Perimeter Institute for Theoretical Physics in Waterloo, axions can be produced in large quantities near spinning black holes. If an axion occurred near black hole, it begins to accelerate. But if it's wavelength is equal to black hole's diameter, a lot of new axions are produced. This effect is called superradiance. The same effect creates powerful light beams in lasers. Then, axions, colliding, annihilate producing gravitons. And those gravitons produce gravitational waves, which can be detected by LIGO.

Let's move to next slide and remember what LIGO is. LIGO, or Laser Interferometer Gravitational-Wave Observatory is two laser interferometers, located at great distance and able to detect smallest change in space properties, which can be cause by gravitational waves. It is currently used to detect mergers of black holes. According to Baryakhtar, axions, if exist, influence spin of such mergers, like it is shown on this chart from her article. And this effect will be noticed after sufficient number of observations.

To sum up my talk, today we talked about axions, which are hypothetical particles, introduce in QCD to solve particular problem. Their existence isn't proved or refuted yet. And if they exist, their existence possibly can be proven by LIGO data.

Thank you for your attention. Now you can ask questions.

by Dmitriy Fedoriaka