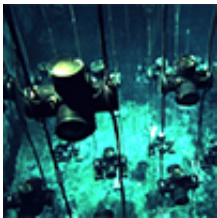


# Russian scientists on the verge of solving the 'muon puzzle'

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Credit: National Research Nuclear University

It may only take scientists a few more years to solve one of the biggest puzzles in modern elementary particle physics, the so-called "muon puzzle." Russian scientists from the National Research Nuclear University (MEPhI) will make a significant contribution to this research.

Cosmic ray particles in the Earth's atmosphere undergo a series of transformations and, as a result, produce elementary particles or [muons](#). Muons reach the Earth's surface and can therefore be registered by ground-based detectors. Several years ago, scientists noticed that the number of registered muons is by tens of percentage points higher than it should be, according to existing theories. This phenomenon was called the muon puzzle.

The first clue to the muon puzzle was found in 2002-2007 during a long series of experiments on the DECOR facility in MEPhI. Later, the excess of muons was confirmed by experiments at the Pierre Auger

Observatory in Argentina.

NEVOD Scientific and Educational Center, which is a subdivision of the Institute of Nuclear Physics and Engineering of MEPHI, is studying muons with the world's only multi-purpose neutrino water detector, which is used to research all cosmic ray components near the Earth's surface. MEPHI researchers spoke about the latest results of the [cosmic ray](#) experiments with NEVOD at the National Cosmic Ray Conference in Dubna, Moscow Region.

"In the past several years, we have increased the amount of experimental data three- or four-fold and, as a result, improved the precision of measurements. One of the tasks in the muon puzzle experimental research is to count not only the number of muons but to measure their energy characteristics. We started the experiment of measuring the energies of muons back in 2012, and it is still in progress. First, we used the coordinate-tracking detector DECOR to register a group of muons. Then we measured what energy they deposited in the NEVOD Cherenkov water detector," said Rostislav Kokoulin, NEVOD Senior Research Associate.

The scientists intend to find out whether the mean energy of muons has changed, in addition to their excess number.

"When the experiment proves the excess of energy exists, it will become clear what changes in the theoretical model are required. Now MEPHI is building new facilities that will operate alongside DECOR and NEVOD. This will allow the scientists to expand the set of characteristics under observation and make the measurements more precise."

Kokoulin added that the solution to the "muon puzzle" is a question of three to five years..

"Once the muon puzzle is solved, we will have a more accurate idea of the nuclear cascade process initiated by interactions of ultra-high energy particles. This understanding is required for studying characteristics of the universe and the processes within it," the scientist stressed.

Provided by National Research Nuclear University

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