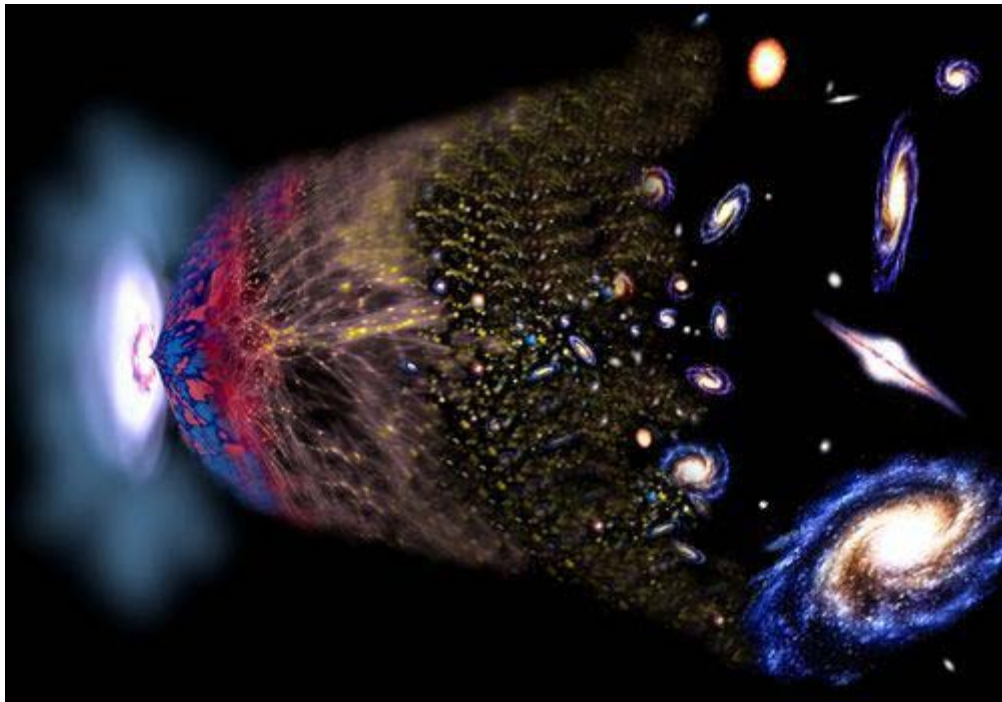


Shape-Shifting Neutrinos --Another Challenge to the Prevailing Standard Model of Physics

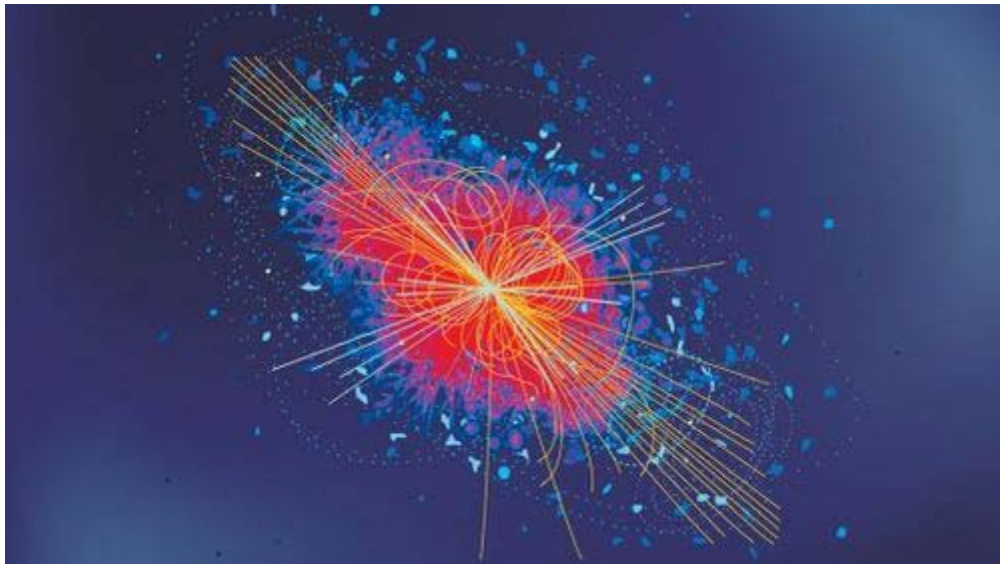
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Among the unsolved mysteries confronting 21st century physics from gravitational waves to dark energy, neutrinos -the "ghosts of the cosmos"- are near the top of the list. These awesomely low-mass subatomic particles, less than a millionth of the mass of electrons, play a key role in weak interactions and come three flavors: electron, muon, and tau. Stars actively flood the universe with new neutrinos along with ancient particles created some two seconds after the Big Bang. CERN announced this week that a muon-type neutrino dispatched from the CERN research laboratory near Geneva had arrived as a tau neutrino at the INFN Gran Sasso Laboratory in Italy, 730

kilometres (450 miles) away. It is only the third time that the mutation has been observed by the OPERA experiment, an international project launched in 2001 specifically to detect the bizarre change.

This finding follows the announcement on March 21 that the most detailed map ever created of the cosmic microwave background – the relic radiation from the Big Bang – revealed the existence of features that challenge the foundations of our current understanding of the Universe. When compared to the best fit of observations to the standard model of cosmology, the Planck Space Telescope's high-precision capabilities reveal that the fluctuations in the cosmic microwave background at large scales are not as strong as expected.



The neutrino—an electrically-neutral subatomic particle that rarely interacts with matter, passing through gases, liquids, and solids with little probability of ever interacting with anything in the universe. According to the current Standard Model of physics, neutrinos cannot have mass, but the outcome of the experiment suggests that in fact they do.

"Its observation confirms something scientists have been studying for more than 40 years: the fact that neutrinos induced by cosmic rays impinging on the Earth atmosphere arrive far fewer than expected," said the statement. A Nobel-winning 1969 hypothesis shed light on the mystery by suggesting the subatomic particles were in fact changing type.

For the CERN OPERA experiment, a beam of neutrinos produced at CERN is sent to the Gran Sasso underground laboratory, which houses a 4,000-ton detector that scans the arriving particles for tau neutrinos, knowing that only muons had set out from CERN. Finding a tau neutrino proves that "oscillation" or change happened along the way.

OPERA detected its first tau neutrino in 2010 and the second in 2012. The observation of a third tau neutrino "is an important confirmation of the two previous observations", OPERA scientists Giovanni De Lellis said in a statement. "From a statistical point of view, the observation of three tau neutrino candidates provides the evidence of oscillations in the muon-to-tau neutrino channel." The search for tau neutrinos will continue for another two years, said the statement.