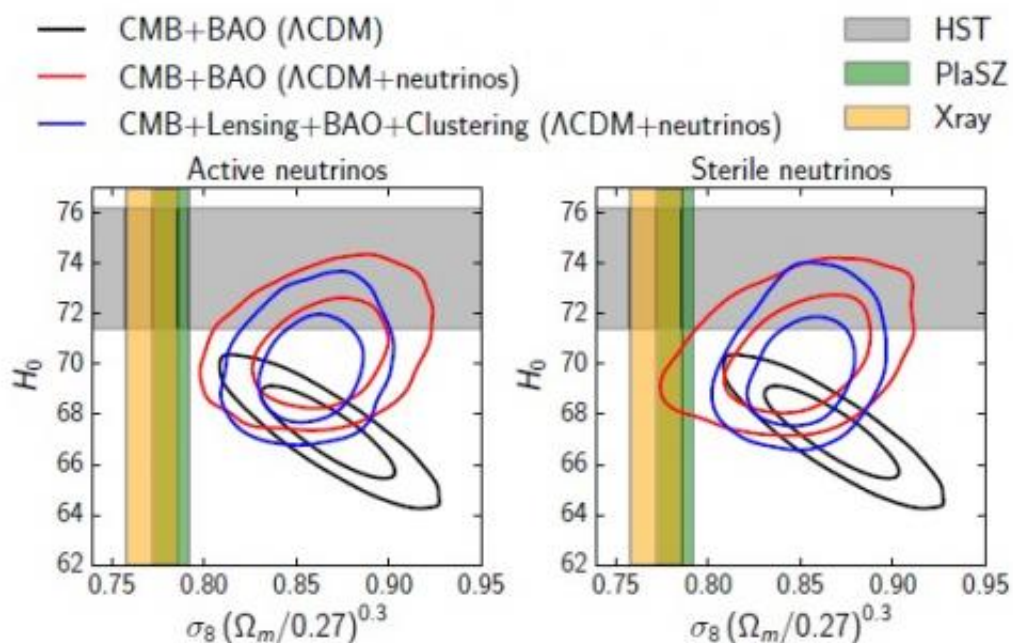


Massive neutrinos may not bring about cosmological concordance after all

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Scientists have found that tension among different data sets persists even after accounting for massive sterile neutrinos, possibly indicating systematic biases in the measurements. Credit: Leistedt, et al. ©2014 American Physical Society

(Phys.org) —Scientists have many tools for measuring the cosmic structures of the universe, which includes structures such as galaxies, galaxy clusters, and intergalactic gas. Cosmic structures can be observed directly, such as by observations of large-scale structure, or indirectly, such as with experiments that measure temperature fluctuations in the

cosmic microwave background. Although having multiple ways to measure cosmic structure is beneficial, there is one problem: the measurements don't agree.

Recently, several studies have suggested that this disagreement, or tension, in the data can be relieved by massive sterile neutrinos. Neutrinos were originally thought to be massless, but experiments later showed that they do have mass. Massive neutrinos suppress the growth of structures that lead to the formation of [galaxy clusters](#). For this reason, it has been claimed that fairly massive neutrinos resolve the tension between the experimental data and bring the different measurements into better agreement.

But in a new study published in *Physical Review Letters*, physicists Boris Leistedt and Hiranya V. Peiris from University College London, along with Licia Verde at the University of Barcelona and the University of Oslo, have shown that this may not be so.

The scientists demonstrated that massive neutrinos (as massive as has been proposed) do not bring about a new cosmological concordance between the measurements. Instead, the apparent concordance may result from systematic biases in the measurements. Overall, the results suggest that the tension between the measurements must be resolved either by considering systematics in one or more of the data sets, or—if further investigation shows that correcting systematic effects does not resolve the tension—then new physics other than the introduction of massive neutrinos must be considered.

In terms of a larger framework for viewing cosmic structure, the results here strongly favor the cold dark matter model with a cosmological constant over more complex models that are extended with massive neutrinos. Yet, as the researchers explain, the questions surrounding cosmic structure are still far from being answered.

"There is no evidence for significantly massive neutrinos in cosmology," Verde, on behalf of all of the authors, told *Phys.org*. "Therefore there is not yet the need for extending the standard cosmological model to include an extra parameter for neutrino mass."

Instead, future investigations will likely focus on finding exactly what the neutrino mass is.

"Particle physics experiments give a firm lower limit to the [neutrino mass](#), cosmology at present gives an upper limit," Verde said. "But there is not much wiggle room left. The next generation of cosmology surveys will have enough statistical power to really see neutrino masses if systematics can be kept under control. That is the real challenge but also the exciting prospect. Such a detection would have profound implications for both cosmology and [particle physics](#)."

More information: — Paper citation: Boris Leistedt, et al. "No New Cosmological Concordance with Massive Sterile Neutrinos." *PRL* 113, 041301 (2014). DOI: [10.1103/PhysRevLett.113.041301](https://doi.org/10.1103/PhysRevLett.113.041301)

— From Early Universe @UCL: Concordance or Contradiction?
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