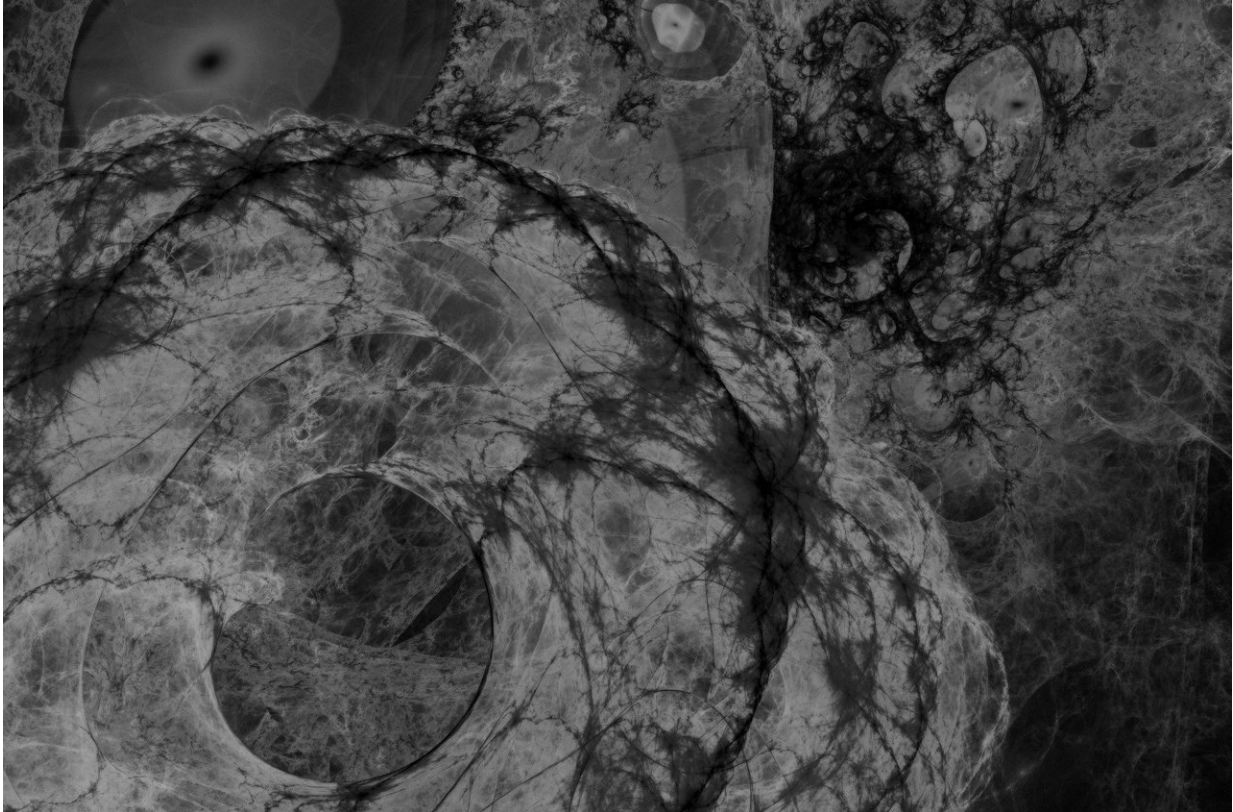


Taking the temperature of dark matter

January 15 2020



Credit: CC0 Public Domain

Warm, cold, just right? Physicists at the University of California, Davis are taking the temperature of dark matter, the mysterious substance that makes up about a quarter of our universe.

We have very little idea of what dark matter is and physicists have yet to

detect a [dark matter particle](#). But we do know that the gravity of clumps of dark matter can distort light from distant objects. Chris Fassnacht, a physics professor at UC Davis and colleagues are using this distortion, called [gravitational lensing](#), to learn more about the properties of dark matter.

The [standard model](#) for dark matter is that it is 'cold,' meaning that the particles move slowly compared to the speed of light, Fassnacht said. This is also tied to the [mass](#) of dark matter particles. The lower the mass of the particle, the 'warmer' it is and the faster it will move.

The model of cold (more massive) dark matter holds at very large scales, Fassnacht said, but doesn't work so well on the scale of individual galaxies. That's led to other models including 'warm' dark matter with lighter, faster-moving particles. 'Hot' dark matter with particles moving close to the speed of light has been ruled out by observations.

Former UC Davis graduate student Jen-Wei Hsueh, Fassnacht and colleagues used gravitational lensing to put a limit on the warmth and therefore the mass of dark matter. They measured the brightness of seven distant gravitationally lensed quasars to look for changes caused by additional intervening blobs of dark matter and used these results to measure the size of these dark matter lenses.

If dark matter particles are lighter, warmer and more rapidly-moving, then they will not form structures below a certain size, Fassnacht said.

"Below a certain size, they would just get smeared out," he said.

The results put a lower limit on the mass of a potential dark matter particle while not ruling out cold dark matter, he said. The team's results represent a major improvement over a previous analysis, from 2002, and are comparable to recent results from a team at UCLA.

Fassnacht hopes to continue adding lensed objects to the survey to improve the statistical accuracy.

"We need to look at about 50 objects to get a good constraint on how warm [dark matter](#) can be," he said.

More information: J-W Hsueh et al, SHARP – VII. New constraints on the dark matter free-streaming properties and substructure abundance from gravitationally lensed quasars, *Monthly Notices of the Royal Astronomical Society* (2019). [DOI: 10.1093/mnras/stz3177](https://doi.org/10.1093/mnras/stz3177)

Provided by UC Davis

Citation: Taking the temperature of dark matter (2020, January 15) retrieved 25 April 2024 from <https://phys.org/news/2020-01-temperature-dark.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.