

Detecting Dark Matter Decay

The first measurements from a newly built gamma-ray observatory have been analyzed for signs of the decay of heavy dark matter, putting a lower limit on the hypothetical particles' lifetime.

By **Marric Stephens**

High on the edge of the Tibetan Plateau, in China's Sichuan Province, the Large High Altitude Air Shower Observatory (LHAASO) searches for gamma rays from the Milky Way and beyond. Because even the clearest mountain air is opaque to these high-energy photons, astronomers infer their presence by measuring the bursts of secondary particles that gamma rays create when they collide with the atmosphere. Now the LHAASO team has sifted such measurements for signs of gamma rays produced by the decay of heavy dark matter within our Galaxy [1]. Finding no such signs, the search puts an upper limit on the decay rate of dark matter particles with masses in the PeV range.

Some models predict that dark matter could exist in the form of particles with masses of 100 TeV or greater. If those dark matter particles have a finite lifetime, and if they decay into standard-model particles, they should generate gamma rays with energies above 10 TeV.

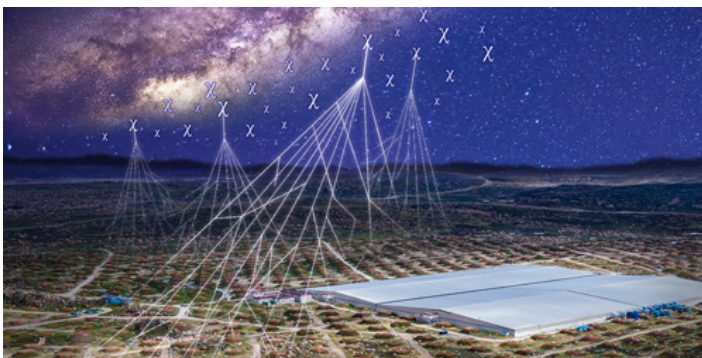
To look for evidence of such heavy dark matter, the team

analyzed data collected by LHAASO's Kilometer Square Array (KM2A) during its first 570 days of operation. They searched for gamma rays in five areas of the sky away from the Galactic Plane. According to mass models of the Milky Way, dark matter density should be greatest near the Galactic Center. Thus, if decaying dark matter produces high-energy gamma rays, the measured flux should vary between survey areas. As no such difference was detected, the researchers conclude that PeV-mass dark matter has a lifetime of at least a billion trillion years.

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REFERENCES

1. Z. Cao *et al.* (LHAASO Collaboration), "Constraints on heavy decaying dark matter from 570 days of LHAASO observations," *Phys. Rev. Lett.* **129**, 261103 (2022).



Credit: LHAASO Collaboration