Exotic stars may mimic big bang

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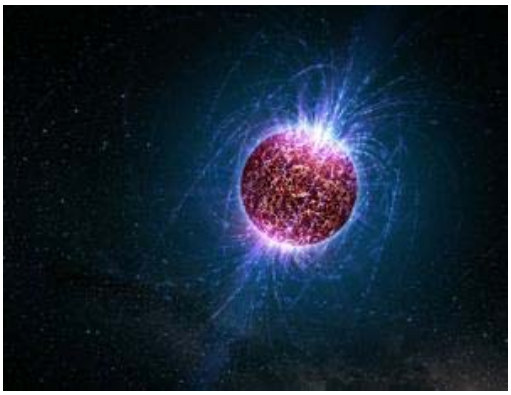
A new class of star may recreate the conditions of the big bang in its incredibly dense core.

Pack matter tightly enough and gravity will cause it to implode into a black hole. Neutron stars were once thought to be the densest form of matter that could resist such a collapse. More recently, physicists have argued that some supernovae may leave behind even denser quark stars, in which neutrons dissolve into their constituent quarks.

Now, a study led by De-Chang Dai of the State University of New York in Buffalo says the deaths of very massive stars may lead to "electroweak" stars that creep even closer to the black hole limit (arxiv.org/abs/0912.0520).



'Electroweak' stars may recreate the conditions of the big bang in an apple-sized region in their cores (Illustration: Casey Reed, courtesy of Penn State)

Enlarge image

The cores of these stellar corpses can reach the same density as that of the universe 10^{-10} seconds after the big bang. At that point, the distinction between the electromagnetic and weak nuclear forces breaks down. This allows quarks to turn into ghostly particles called neutrinos, releasing energy that props up the star against further collapse. The reactions would take place in an apple-sized region in the core weighing about two Earths.

Above the limit

The stars might show up in astronomical data as neutron stars that are heavier than theoretically allowed, the team says. And unlike neutron stars, their internal energy source would prevent them from cooling over time.

The stars could survive for at least 10 million years, the researchers calculate. But Sanjay Reddy of Los Alamos National Laboratory in New Mexico says the stars might not be stable against collapse. "The idea is interesting, but to determine if this is plausible, more work is needed," he told *New Scientist*.

If the stars do exist, their cores are the only places in the modern universe where matter naturally returns to this primordial state, says team member Glenn Starkman of Case Western Reserve University in Cleveland, Ohio. "Of course, there could be some advanced alien civilisations out there that know how to make it," he says.

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