Did the LIGO gravitational waves originate from primordial black holes?

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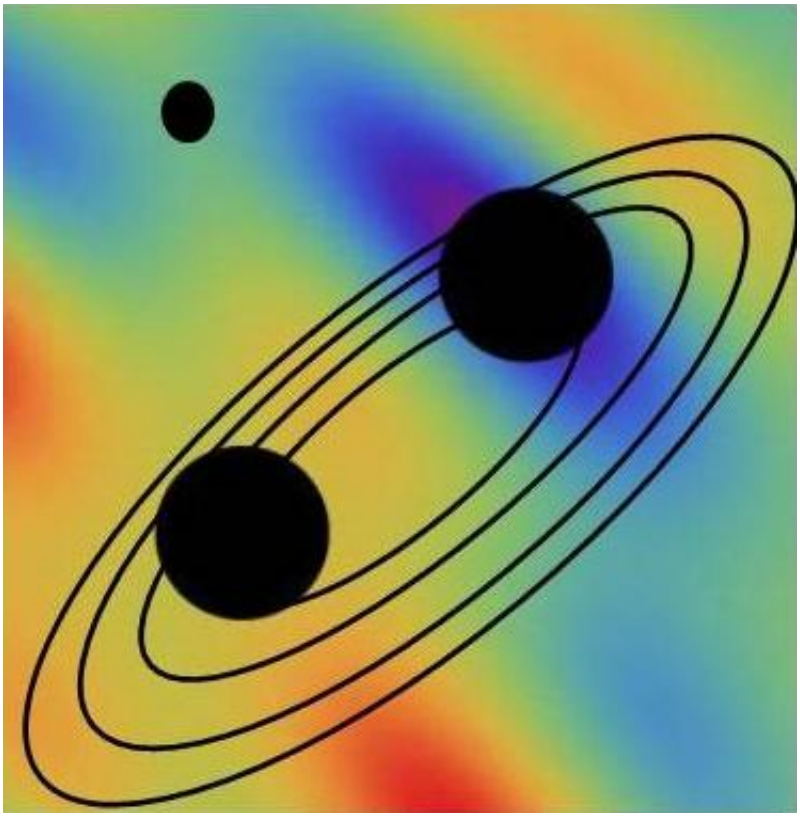

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Binary black holes recently discovered by the LIGO-Virgo collaboration could be primordial entities that formed just after the Big Bang, report Japanese astrophysicists.

If further data support this observation, it could mark the first confirmed finding of a primordial black hole, guiding theories about the beginnings of the universe.

In February, the LIGO-Virgo collaboration announced the first successful detection of gravitational waves.

"The detected gravitational waves were created from a merger of two black holes thirty times the mass of the Sun. It's extremely rare for such massive black holes to form in the present-day universe," says study author Takahiro Tanaka of Kyoto University.

"After this announcement, many astrophysicists started considering how such heavy black holes were created, and how such black hole binaries were formed."

As a starting point, the team hypothesized that primordial black holes —formed following the Big Bang—were distributed randomly in space.

"The universe was extremely hot and dense when it was first born. Primordial black holes came into being when gravitational collapse happened in regions which were especially dense," explains Tanaka. "They have a completely different origin from black holes that form from celestial bodies."

Based on general relativity, the research team evaluated how often black holes merge in the present epoch. They found that the LIGO-Virgo team's observational data on merger frequencies would fall in to place if the binaries were primordial, and if they constitute a thousandth of all

dark matter in the universe.

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"Theoretical models about the beginnings of the universe are still hotly contested. Some models necessarily predict the existence of primordial black holes, so their discovery could help unlock important clues about the universe's early days," says Tanaka.

"When enough observational data related to black hole binaries has accumulated, it will become possible to confirm whether these are truly primordial."

More information: The paper "Primordial black hole scenario for the gravitational wave event GW150914" will appear 28 July 2016 in *Physical Review Letters*.

Provided by Kyoto University