Baffling quasar alignment hints at cosmic strings

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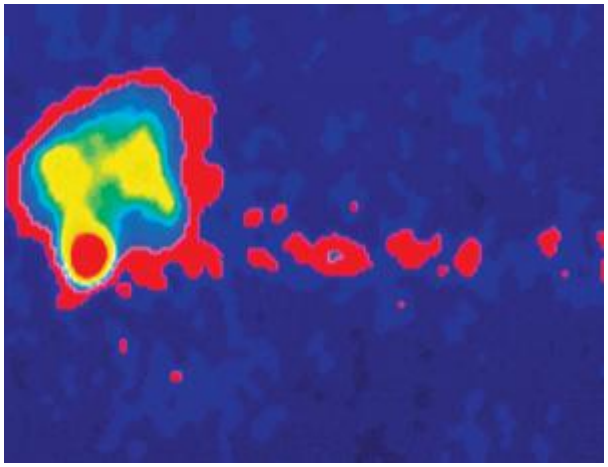

Strung out in space (Image: NRAO/AUI/NSF/SPL)

SOMETHING has made neighbouring quasars in the distant universe point in a similar direction when their orientations ought to be random. Could this be the signature of cosmic strings - gigantic kinks in the fabric of space-time?

In 2005, Damien Hutsemekers at the University of Liège, Belgium, and colleagues reported an unusual effect in observations of 355 quasars. They found that light from these quasars tended to be polarised, with the electromagnetic oscillations confined to a particular plane that can be described by a polarisation vector. Though there is no obvious reason to think these vectors should be oriented in a special way from one quasar to the next, Hutsemekers's team found that the orientations were not random. If they took any two adjacent quasars, the polarisation vectors pointed in much the same direction.

If they looked at any two adjacent quasars, the light from each was polarised in much the same direction

What's more, as the team looked at ever more distant quasars, they saw this vector rotate by about 30 degrees with every 3.26 billion light years from Earth. The vector turned clockwise when they looked in the direction of the north galactic pole of the Milky Way and anticlockwise looking towards the south pole (arxiv.org/abs/astro-ph/0507274v1).

Last year, the team showed that the direction of the polarisation vector is correlated with the axis of rotation of the quasar itself. That means that adjacent quasars tend to have roughly the same orientation - again, not something anyone would have expected to see.

Now, Robert Poltis and Dejan Stojkovic of the State University of New York in Buffalo say they have an explanation. It's all down to events that occurred about 10^{-12} seconds after the big bang. At that time the universe went through a phase transition, causing the electroweak force to separate into the electromagnetic force and the weak nuclear force. The standard model of particle physics suggests that this would also have resulted in the formation of cosmic strings, which are topological defects in the fabric of space-time and can take the form of giant loops.

Cosmic strings can cause magnetic fields to form along their lengths, says Poltis. The strings are unstable and quickly decay, but the magnetic fields remain and would have become stretched to cosmological scales as the universe expanded. Poltis and Stojkovic modelled how two giant loops of magnetic field lines could affect galaxies as they formed. A proto-galaxy contains charged particles - electrons and hydrogen ions - which acquire angular momentum from the magnetic field. The net effect is that the proto-galaxy acquires an overall angular momentum, aligning its axis in a certain direction. Two neighbouring proto-galaxies forming in the vicinity of the same magnetic field would end up with their axes pointing in the same direction.

The researchers also showed how the twisting of the magnetic field lines on cosmic scales could cause the axes of quasars to rotate the further out you look (arxiv.org/abs/1004.2704).

"This explanation can indeed reproduce our observations quite well, even the possible rotation of the polarisation angle," says Hutsemekers. "Moreover, the possibility that the imprint of strings can be detected through the study of galaxy or quasar orientations is exciting."

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