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Doubt cast on source of universe's mightiest particles

17:44 13 May 2008
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The most energetic particles in the universe have regained some of their former mystery. Last year, it seemed that the origin of these particles had finally been tracked down to a set of giant black holes in nearby galaxies, but a new study casts doubt on that conclusion.

Ultra-high-energy cosmic rays, or UHECRs, are individual subatomic particles with energies up to about 10^{20} electron volts, far beyond anything achieved in particle accelerators.

When they hit the Earth's atmosphere, they produce a shower of other particles, and the [Pierre Auger Observatory](#) in Argentina has spotted more of these events than any other detector.

In November 2007, an Auger team looked at the arrival directions of the 27 highest-energy cosmic rays, and found that they fit a suggestive pattern. Most came from within 3° of the directions of nearby active galaxies, which hold supermassive black holes at their cores and emit many kinds of radiation. So it seemed that the [galaxies were emitting UHECRs too](#).

Now researchers led by Igor Moskalenko of Stanford University in California, US, have looked more closely at these particular active galaxies, as well as others along the same line of sight. They find that they are an unremarkable bunch. "The sample consists mainly of low-power active galaxies," says Moskalenko.

Such weak active galaxies are common – so common in fact that astronomers expect to find several within 3° of any random direction on the sky. "The correlation found by the Auger group is likely to be a chance coincidence," Moskalenko told **New Scientist**.

Too weak

Furthermore, Moskalenko believes that the small, weak active galaxies simply lack the firepower to generate the highest energy cosmic rays. For one thing, they show no signs of high-energy gamma-ray emission, which he believes should go along with cosmic-ray acceleration.

Instead, he suggests that UHECRs are more likely to come from the more energetic breeds of active galaxy, such as quasars and radio galaxies, especially those that squirt out [high-speed jets of material](#), which are already known to emit gamma rays.

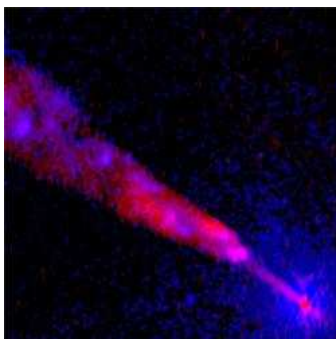
Some of the cosmic rays seen by Auger do coincide with examples of this toolled-up type of active galaxy. At least four of them could have been fired at us by Centaurus A, a radio galaxy only 12 million light years away.

Moskalenko and colleagues say the other UHECRs could also be from nearby active galaxies with jets, even if their arrival directions don't coincide with such sources.

Bent paths

That's because these cosmic rays are probably protons or heavier charged particles, whose paths are bent by magnetic fields. Moskalenko points out that the strength and alignment of intergalactic magnetic fields is not well known, so they might be able to bend the paths of cosmic rays beyond 3° . Then, radio galaxies such as Centaurus A could in effect be shooting around the corner at us.

But Auger team member Jim Hinton of Leeds University, UK, disagrees with Moskalenko's interpretation of the data. He says the fact that the galaxies are so plentiful suggests that Auger hasn't seen a single cosmic ray from most of them yet. "Which



A high-speed jet of material shoots out of Centaurus A, a nearby galaxy whose central black hole is devouring its surroundings. At least four of the 27 ultra-high-energy cosmic rays detected by Auger appear to originate in Centaurus A (Image: NASA/CXC/Bristol U/M Hardcastle et al/NRAO/AUI/NSF)

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ones are seen is largely a matter of chance," Hinton told **New Scientist**.

"This also implies that UHECR-accelerating [active galaxies] are common in nature – ie, they are not just the powerful radio galaxies," Hinton continued. "This implication is something that has surprised (and led to criticism by) many authors – but nature may just be like that!"

Even if the UHECR puzzle is not yet solved, it might be soon – the Auger Observatory, which released its **first results in 2005**, is almost completed and is amassing cosmic ray data faster than before.



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Plasma Explains Once Again VIEW THREAD >>

By [J. Parker](#)
Tue May 13 23:10:43 BST 2008

I think that plasma, from Intergalactic Birkeland currents, once again explains the energies observed. Do recall that on earth, particle accelerators use electricity to generate such tremendous energies.

'Nobel Laureate Hannes Alfvén described a double layer as"... A plasma formation by which a plasma - in the physical meaning of this word - protects itself from the environment. It is analogous to a cell wall by which a plasma - in the biological meaning of this word - protects itself from the environment.'

At times, a double layer may actually cutoff the current flow in the circuit causing a catastrophic rise in voltage across the double layer. The powerful energy release of the "exploding double layer" is sometimes observed in power transmission switchyards when a circuit breaker is opened incorrectly.

Alfvén, in a NASA sponsored conference on double layers in astrophysics in 1986 (NASA CP 2469) said:

"Double layers in space should be classified as a new type of celestial object (one example is the double radio sources). It is tentatively suggested that x-ray and gamma ray bursts may be due to exploding double layers. In solar flares, DL's with voltages of 109 V or even more may occur, and in galactic phenomena, we may have voltages that are several orders of magnitude larger. Examples are given of possible galactic DL voltage differences of 10² V. This means that by a straightforward extrapolation of what we know from our cosmic neighborhood, we can derive acceleration mechanisms which brings us up in the energy region of cosmic radiation."

Thornhill, in a recent IEEE paper suggested (following Alfvén's prediction of double layers occurring above the Sun's poles) that the two smaller axial rings of Supernova 1987a are actually glowing double layer phenomena. In other words, supernovae are a catastrophic stellar electrical discharge. A hallmark of double layers is their variability, or flickering, which would match the observation that "isolated points of x-ray emission have also been seen within the cloud that rise in intensity and then fade away rather quickly."

Meanwhile astrophysicists, untrained in the physics of double layers, treat supernovae remnants as a problem in fluid dynamics, using mechanical shock waves to provide the observed cosmic ray energies. It is an approach that Alfvén warned, more than half a century ago, is doomed to fail.

Here's a link:

<http://www.thunderbolts.info/tpod/2008/arch08/080513rayguns.htm>