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Ultrahigh-Energy Cosmic-Ray Nuclei from Radio Galaxies: Recycling Galactic Cosmic Rays through Shear Acceleration

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We propose an astrophysical scenario for ultrahigh-energy cosmic-ray production, in which galactic cosmic rays are reaccelerated by kiloparsec-scale jets in active galactic nuclei. We perform Monte Carlo simulations of transrelativistic shear acceleration dedicated to a jet-cocoon system of active galactic nuclei. A certain fraction of galactic cosmic rays in a halo is entrained, and sufficiently high-energy particles can be injected to the reacceleration process and further accelerated up to a few EeV for protons and around 100 EeV for irons. We show that the shear reacceleration mechanism leads to a hard spectrum of escaping cosmic rays, and the supersolar abundance of ultrahigh-energy nuclei is achieved due to injections at TeV-PeV energies. As a result, the highest-energy spectrum and mass composition can be reasonably explained without contradictions with the anisotropy data.

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