

FR-0 jetted active galaxies: extending the zoo of candidate sites for UHECR acceleration

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Fanaroff Riley (FR) 0 radio galaxies form a low luminosity extension of the well established ultrahigh energy cosmic ray (UHECR) candidate accelerators FR-1 and FR-2 galaxies. Their much higher number density – up to a factor 5 more numerous compared to FR-1 with $z \leq 0.05$ – makes them good candidate sources for an isotropic contribution to the observed UHECR flux. Here, acceleration and survival of UHECR in prevailing conditions of the FR-0 environment are discussed.

First an average spectral energy distribution (SED) is compiled based on the FR0CAT. These photon fields, composed of a jet and a host galaxy component, form a minimal target field for the UHECR, which will suffer from electromagnetic pair production, photo disintegration, photo-meson production losses, and synchrotron radiation. The two most promising acceleration scenarios based on Fermi-I order and gradual shear acceleration are discussed as well as different escape scenarios.

When gradual shear acceleration is preceded by an efficient acceleration mechanism, e.g., Fermi-I or others, FR-0 galaxies are likely UHECR accelerators. This scenario requires a jet Lorentz factor of $\gamma > 1.6$ to yield gradual shear acceleration which is faster than the corresponding escape. In less optimistic models a contribution to the cosmic-ray flux between knee and ankle is expected relatively independent of the realized turbulence and acceleration.

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Collaboration

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Theoretical Results

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