



Acceleration of ultrahigh-energy cosmic rays in the early afterglows of gamma-ray bursts

BACKGROUNDS:

The origin of UHECRs remains a mystery. It has been suggested that UHECRs can be produced by the stochastic acceleration in relativistic jets of GRBs at the early afterglow phase.

METHODS:

We take into account the concurrence of GRB jets dynamics (Runge-Kutta method) and the kinetic descriptions of wave-particle interactions (central difference method) including stochastic acceleration process of particles and the damping of MHD fast-mode waves.

RESULTS:

Compared to the traditional acceleration model by relativistic shocks, our model not only alleviates the energy budget problem, but also provide a mechanism to generate the hard injection spectrum as required by explaining the measured UHECRs spectra above the ankle and the chemical composition of UHECR as measured by the Pierre Auger Observatory.