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ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ НАУКИ
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Proton acceleration in the active galactic nuclei

A model of the mechanism of origin of the main UHECR particle, a high-energy proton, is proposed. The proton gains the greatest energy on the surface of the light cylinder of the SMBH magnetosphere. However, due to the special ratios and behavior of the toroidal and poloidal magnetic fields, the total energy in the magnetosphere is only partially achieved (E ^ 2/3). The total energy (E ^ 1) is acquired by a proton as acceleration continues in a relativistic jet, where acceleration can occur according to different scenarios and trajectories at different ratios of the electric and magnetic fields.

Main questions

- UHECR origins and mechanisms efficiency
- High energy proton (HEP) acceleration scenarios
- HEP acceleration energy distribution between the supermassive black hole magnetosphere and the relativistic jet (in the AGN case)
- HEP acceleration scenarios in the relativistic jet

Key results

- The most powerful and efficiency UHECR acceleration mechanism is the stationary acceleration by polar electric field E_θ in the AGN supermassive black hole magnetosphere + radial electric field E_ρ in the relativistic jet.
- Bulk of the energy proton achieve near the light cylinder surface Δr of the magnetosphere
- Because of the special relations between toroidal B_φ , poloidal B_ρ magnetic fields the total energy doesn't achieve by protons in the central black hole magnetosphere.
- In the case of "no AGN" system achieved energy ($\gamma_{max}^{(1/2)}$) is only square from total energy ($\gamma_{max}^{(1)}$) but total energy isn't achieved at all.
- In the case of AGN system total energy ($\gamma_{max}^{(1)}$) is achieved with consistent and continuous acceleration in the magnetosphere ($\gamma_{max}^{(2/3)}$) + relativistic jet ($\gamma_{max}^{(1/3)}$)
- The proton acceleration occurred by the different scenarios in the relativistic jet. The general reason is the relation between electric and magnetic fields jet parameters which leads to trapped or untrapped proton motion and acceleration in the jet.