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Arman Tursunov / Acceleration of ultra-high-energy cosmic rays by supermassive black holes

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Production and acceleration mechanisms of ultra-high-energy cosmic rays (UHECRs) with energy exceeding EeV remain unclear. Energy range of UHECRs beyond the GZK-cutoff limit points to exotic nature of the phenomena. I will show that extraction of rotational energy of a black hole by the novel, ultra-efficient regime of the magnetic Penrose process could indeed foot the bill. Ionization of particles, such as beta-decay of neutron, skirting close to the black hole horizon energizes protons to over 10ˆ20 eV. It is remarkable that the process requires neither extended acceleration zone, nor fine-tuning of accreting matter parameters. Further, this leads to a certain verifiable constraints on the black hole mass and magnetic field strength as UHECRs sources. Applied to the Galactic center supermassive black hole we have proton energy of orders coinciding with the knee of the cosmic ray spectra. I will also discuss the results of numerical studies related to the acceleration of primary cosmic rays and energy losses along the propagation distance.