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 10²0 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 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.