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Institute of Physics
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I n v i t a t i o n

to the seminar of Division of Elementary Particle Physics
of the Institute of Physics of the Czech Academy of Sciences

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Supermassive Black Holes as Power Engines of Ultra High Energy Cosmic Rays

Abstract: Origin of ultra-high-energy cosmic rays (UHECRs) with energy exceeding GZK-cutoff limit remains unclear. Recent detections of extragalactic high-energy neutrino may indicate the source of primary UHECRs being an extragalactic supermassive black hole (SMBH). It appears 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 neutron beta-decay, skirting close to some of the SMBH candidates located in the centres of the nearby galaxies can energize protons to over 10^{20} eV. Applied to a supermassive black hole at the centre of the Milky Way, we get proton energy of the order coinciding with the knee of the cosmic ray spectra, supporting thus the presence of a PeVatron at the Galactic centre. It is remarkable that the process requires neither extended acceleration zone, nor fine-tuning of accreting matter parameters and relies purely on the properties of the black hole magnetosphere. Further, this leads to certain verifiable constraints on the black hole mass, magnetic field strength and the distance to potential UHECR source. I will also discuss the observational consequences of synchrotron radiation of charged particles in the ergosphere of rotating black holes, which lead to the formulation of an interesting new mechanism of the black hole energy extraction – the radiative Penrose process.

Seminar will take place online only on **Thursday, October 1, 2020 at 2PM** via **ZOOM video conference** system, for more information, please see: <https://indico.fzu.cz/event/9/>

R. Lysák

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