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Supermassive black holes: magnetosphere, energy extraction, and high-energy radiation

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Magnetic fields in regions of strong gravity play a crucial role in the explanation of various astrophysical phenomena, such as e.g. the formation and collimation of relativistic jets observed in black hole systems of different mass scales. In this presentation, I will discuss the influence of magnetic fields on dynamical environments of supermassive black holes from both theoretical and observational perspectives. In particular, I will present a new solution to a black hole magnetosphere, which can be related to jet launching/switching-off scenarios, two new black hole energy extraction mechanisms of high efficiency, and related cosmic ray acceleration scenario. I will describe the multiwavelength and multimessenger predictions of the new mechanisms and discuss the observational implications of theoretical predictions for various known supermassive black hole candidates, including the closest one, Sagittarius A*, located at the center of our Galaxy.

Primary author: Dr TURSUNOV, Arman (Max Planck Institute for Radio Astronomy)

Presenter: Dr TURSUNOV, Arman (Max Planck Institute for Radio Astronomy)

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