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TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS Astrophysics & Relativity Seminar (HYBRID)

Title : Mahakala: a Python-based Modular Ray-tracing and Radiative Transfer Algorithm for Curved Space-times

Speaker : Aniket Sharma (IISER Mohali)

Date : Thursday, 25th May 2023

Time : 03:00 pm (IST)

Abstract : We introduce Mahakala, a Python-based, modular, radiative ray-tracing code for curved space-times. We employ Google's JAX framework for accelerated automatic differentiation, which can efficiently compute Christoffel symbols directly from the metric, allowing the user to easily and quickly simulate photon trajectories through non-Kerr metrics. JAX also enables Mahakala to run in parallel on both CPUs and GPUs and achieve speeds comparable to C-based codes. Mahakala natively uses the Cartesian Kerr-Schild coordinate system, which avoids numerical issues caused by the "pole" of spherical coordinates. We demonstrate Mahakala's capabilities by simulating the 1.3 mm wavelength images of general relativistic magnetohydrodynamic simulations of low-accretion rate supermassive black holes. The modular nature of Mahakala allows us to easily quantify the relative contribution of different regions of the flow to image features. We show that most of the emission seen in 1.3 mm images originates close to the black hole. We also quantify the relative contribution of the disk, forward jet, and counter jet to 1.3 mm images.

Publication - Sharma, A., Medeiros, L., Chan, C.-k., et al. 2023, arXiv e-prints, arXiv:2304.03804

Venue : **Offline:** Emmy Noether Seminar Room (ICTS)

Online: Please click the below link to join the seminar.

https://icts-res-in.zoom.us/j/81984541711?pwd=UndHd0Q5ZVlqT0I5UlFqemIvZy9hUT09
Meeting ID: 819 8454 1711
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