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Models for Sgr A* flares: from a general analytical to magnetic reconnection model

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Despite the growing amount of observational data, the physical conditions in the vicinity of supermassive black holes (SMBH) are still poorly understood. Thanks to its proximity, Sgr A*, being the SMBH located in the center of our Galaxy, represents an ideal target to probe physical processes in the surroundings of massive compact objects, including details of accretion/advection flows, particle acceleration, general relativity (GR) effects, etc. In our work, we aim at investigating the physical origin of infrared (IR) flares of Sgr A*, observed by the GRAVITY instrument, and typically occurring on time-scales of around 30 minutes. We develop here a new model for Sgr A*varying emission, improving previous theoretical developments from the literature. In our model, we consider that the flaring emission arises from a plasmoid that gradually grows with time. High-energy particles are injected into the plasmoid via magnetic reconnection process producing a kappa particle distribution. Relativistic particles emit synchrotron radiation and cool. We numerically calculate the time evolution of the electron spectrum in the plasmoid and the associated broadband synchrotron emission spectrum, as well as the IR light curve at 2.2 micrometers, with a dedicated time-dependent radiative code. The effects of GR are taken into account using a separate numerical code performing backward ray-tracing following null geodesic and integrating the radiative transfer equation. We find that the simulated time-dependent IR flux behavior appears to be qualitatively similar to recent Sgr A* flare data obtained by GRAVITY.

Abstract field

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