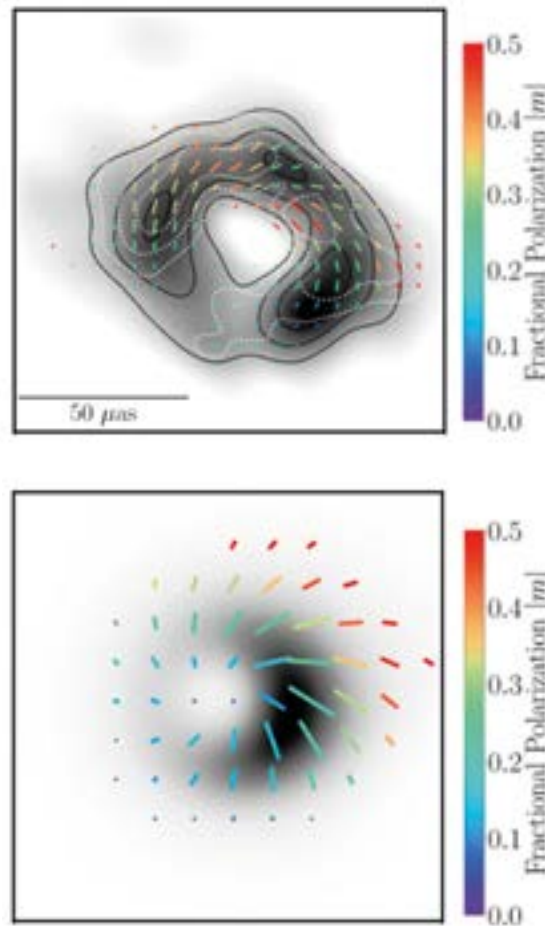


First Sagittarius A* Event Horizon Telescope Results. VIII. Physical Interpretation of the Polarized Ring

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In 2017, the Earth-sized array of radio-telescopes known as the Event Horizon Telescope (EHT) observed for the first time two supermassive black hole (SMBH) candidates at sufficient resolution to observe their shadow (a prediction of general relativity). These were M87* (53 million light years away) and Sagittarius (Sgr) A*, located 27000 light years away at the center of our own Galaxy. These images captured not only the light intensity, but also its polarization. This publication from March 2024 is the eight part of a series on these observations, and presents the theoretical interpretation of the first image of Sgr A* in polarized light (Figure 1). To learn about the environment of this SMBH, observations were compared to a library of thousands of simulated models. These models simulate the behavior of the plasma and magnetic fields in the curved spacetime surrounding the black hole by solving the equations of general relativistic magnetohydrodynamics (GRMHD) and predict the observable emission by solving the equations of polarized general relativistic radiative transfer (GRRT). One of the GRMHD codes used for this study (BHAC) is maintained and used at the Department of Mathematics of the University of Aveiro. The comparison favors a rapidly rotating black hole (with spin parameter 0.94 of a maximum possible value of 1), an clockwise-rotating accretion disk, an inclination of the spin axis of 150° with respect to the line of sight, and very strong coherent magnetic fields capable of regulating accretion. This confirms previous findings that employed light intensity only. The paper also discusses how future observations at higher frequency and movies (planned for future campaigns of the EHT) can mitigate present uncertainties in the modeling.



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FIGURE 1
Observed image of Sgr A*: total intensity (gray scale), fractional polarization (color), and polarization direction (tick angle).

FIGURE 2
Best-fit simulated model of Sgr A* (same plotting style as for Fig. 1).