Z103a The origin of hotspots around Sgr A*: Orbital or pattern motion?

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The Gravity Collaboration detected a near-infrared hotspot moving around Sgr A* during the 2018 July 22 flare. They fitted the partial loop the hotspot made on the sky with a circular Keplerian orbit of radius $\simeq 7.5\,r_{\rm g}$ around the supermassive black hole (BH), where $r_{\rm g}$ is the gravitational radius. However, because the hotspot traversed the loop in a short time, models in which the hotspot tracks the motion of some fluid element tend to produce a best-fit trajectory smaller than the observed loop. This is true for a circular Keplerian orbit, even when BH spin is accounted for, and for motion along a RIAF streamline. A marginally bound geodesic suffers from the same problem; in addition, it is not clear what the origin of an object following the geodesic would be. The observed hotspot motion is more likely a pattern motion. Circular motion with $r \simeq 12.5\,r_{\rm g}$ and a super-Keplerian speed $\simeq 0.8\,c$ is a good fit. Such motion must be pattern motion because it cannot be explained by physical forces. The pattern speed is compatible with magnetohydrodynamic perturbations, provided that the magnetic field is sufficiently strong. Circular pattern motion of radius $\sim 20\,r_{\rm g}$ on a plane above the BH is an equally good alternative; in this case, the hotspot may be caused by a precessing outflow interacting with a surrounding disk. As all our fits have relatively large radii, we cannot constrain the BH spin using these observations.