BLACK HOLES

Shapes on the horizon

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Using a network of millimetre-wave telescopes spanning Northern and Southern hemispheres, Ru-Sen Lu and collaborators have detected plasma structures around the Galaxy's supermassive black hole (SMBH) Sagittarius A* at distances of three Schwarzschild radii (3 R_S; ~0.3 au). The *uv* coverage of the six very-long-baseline interferometry (VLBI) stations was not sufficient to determine the details of the structures, but they are consistent with two-component asymmetric models and not with a single symmetric Gaussian model.

The 230 GHz (1.3 mm) data were taken in March 2013 using five telescopes in the United States, and the APEX telescope in Chile — the addition of which almost doubled the length of previous VLBI baselines and delivered a spatial resolution of just 30 microarcsec. An emitting region around Sgr A* was seen on the expected scale of the SMBH's shadow (5 R_S). General relativistic magnetohydrodynamic models of accretion flows around SMBHs exhibit a variety of structures slightly smaller than these size scales: crescents are indications of highly turbulent magnetic fields in the accretion flow (disk-dominated model), whereas compact filaments at jet footprints are indicators of well-ordered, strong magnetic fields (jet-dominated model). Fitting slightly favours a disk-dominated model, but a jet-dominated model cannot be ruled out for Sgr A*. Both models show a brightness asymmetry and a northeast–southwest orientation.

The April 2017 1.3-mm VLBI campaign, which additionally included the ALMA telescopes, should have sufficient *uv* coverage to distinguish between the two types of model, and probe the physical processes much closer to the black hole boundary.

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