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Astronomy

Black hole image reveals its swirling magnetic fields

Leah Crane

THE first picture of a black hole's shadow just got more interesting. Polarised light has been added to the image (shown below), giving us an idea of how magnetic fields around a supermassive black hole create powerful jets of matter.

The Event Horizon Telescope (EHT) team released the first direct image of a black hole in 2019, and while the picture was impressive, it wasn't the scientific smorgasbord some had hoped for. "It was not a lot of information about the actual physics of the gas around the black hole," says Sara Issaoun, an EHT team member at Radboud University in the Netherlands.

The EHT uses a network of eight telescopes around the world to turn Earth into one giant radio telescope, giving us an unprecedented view of the supermassive black hole at the centre of the M87 galaxy, 55 million light years away.

Electrons accelerated by magnetic fields emit light, and the polarisation of the light depends on the direction of the magnetic field. EHT measurements of the polarised light near the black hole showed that the magnetic field's strength is between 1 and 30 gauss (*The Astrophysical Journal Letters*, doi.org/f3jr). This is about 50 times the strength of Earth's magnetic field at the poles, where it is strongest.

"The polarised light has these curved swoops like a spiral," says Issaoun. "This tells us that the magnetic field around the black hole is ordered, and this is really important because only an ordered magnetic field can launch jets."

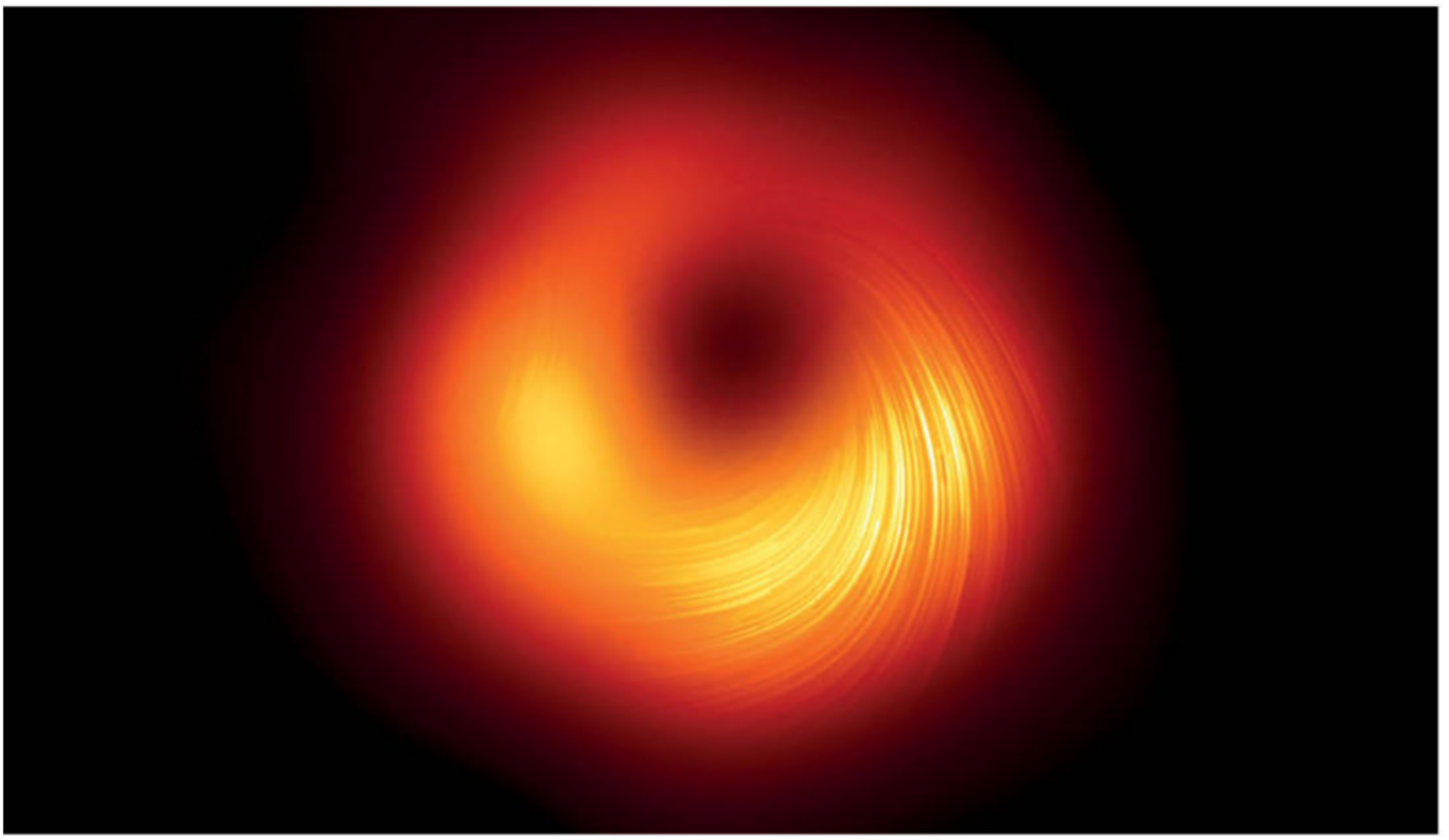
Some black holes spew enormous jets of matter, but how exactly they do so is still a mystery. Researchers think the jets are launched and shaped by magnetic fields, but evidence is limited.

"The magnetic field around the black hole is ordered, which means it can launch powerful jets of matter"

"Something the size of our solar system can shoot out a jet that pierces through entire galaxies and even galaxy neighbourhoods," she says. "Now we're really seeing the magnetic field close to the black hole for the first time, and that's connecting it to the jet, which is the most powerful process in the universe."

The measurements allowed the researchers to significantly cut down on the number of possibilities for how the black hole and its jet work. They compared the observations with simulations of 120 different theoretical models, and only 15 of the models fit what we actually see. In all 15, the black hole's magnetic fields are relatively strong and divert matter away from the black hole itself, starving it in favour of launching the material into the jet.

It isn't yet clear whether the possibilities are similarly narrowed for all supermassive black holes or if it is specific to this one in particular. Adding just a few more telescopes to the EHT array – which the researchers already plan to do – could help nail down exactly how the black hole is launching its jet. ▮



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