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WHAT IS A BLACK HOLE?

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In mathematical fluid dynamics, a shock wave (a “sonic boom”) is a spatial singularity in the density of the fluid—an abrupt discontinuity. In nature (reality), something (specif.: viscosity or internal air friction) intervenes to give the shock wave a finite thickness so that the derivative of the density function remains everywhere finite and never actually becomes infinite as in the mathematical idealization.

I believe that the same thing happens in the case of real black holes (which have been observed; a quite spectacular specimen has been discovered lately [1]), which are probably related to the mathematical idealization of black holes by a mechanism similar to viscosity (it may even be viscosity in this case too) that prevents the mathematical idealization from being realized in nature.

In the mathematical idealization, the escape velocity at the surface of the black hole is the speed of light, and the space of the interior of the black hole is receding at superluminal velocities. The interior region of the black hole is therefore a singular region of space-time.

There have been all sorts of wild-eyed fantasies about what goes on in this interior region: reverse time travel, wormholes connected to another region of space and baby universes in which matter infalling into the black hole gives rise to a newborn universe.[2,3]

But it seems doubtful that these exotic possibilities actually exist in nature. Something probably intervenes to keep the singular region of space-time from actually forming. The interior of any actual black hole is probably merely extremely dense matter, the radius of

which slightly exceeds the Schwarzschild limit. An actual “event horizon” probably never actually forms and the black holes that have been observed in nature could probably more accurately be described as incredibly massive and dense neutron stars. The science-fiction fantasies of time machines, wormholes and baby universes probably do not exist.

I’m sorry, Dr. Hawking.

REFERENCES

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- [3] Hawking, Stephen, *Black Holes and Baby Universes*, Bantam Books, New York (1994)