Falling Into a Black Hole: Five Even Odder Effects

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https://www.youtube.com/watch?v=PJ2QsqqQSeY&lc=UgwmJhLPuqzVMAWtDwd4AaABAg

A Comment on the YouTube Fermilab post:
What happens when you fall into a black hole?
https://youtu.be/PJ2QsqqQSeY?t=4m7s

4:07 "As the object gets very close to the event horizon, a distant observer can see the time between blinks take a thousand years, then a million, and eventually longer than the lifetime of the universe." Five other fun effects often overlooked when falling into a black hole are (1) tunnel vision, (2) UV obliteration, (3) quantum orbiting, (4) watching the universe end, and (5) watching the black hole evaporate before you.

(1) Tunnel vision: As you approach the event horizon, your line of sight is warped by the bending of light into parabolas, like baseballs tossed into the air. Parabolic light makes the black hole's horizon appear to rise as your line of sight bends more and more sharply back towards the surface of the black hole. Consequently, your view of the outside world becomes an ever-shrinking tunnel that ends in a pinprick of intense light.

(2) UV obliteration: Just as *rising* light increases in wavelength and fades in intensity, *falling* light does the opposite. It increases in frequency and amplitude until the light your distant friend helpfully shines toward you escalates not just into the ultraviolet but into the extreme gamma range. First, it obliterates you chemically. Next, it induces nuclear fusion. But those nuclei don't last since ever-higher gammas break down your nuclei into a neutron-proton plasma. Finally, even your protons and neutrons collapse into a quark-gluon plasma. You may want to ask your friend not to bother with the helpful light!

(3) Quantum orbiting: You might think higher gravity would overcome any "off-target" aiming. Not so! Angular momentum is a stubbornly conserved quantity that gets more, not less, extreme as you approach a target. Think instead of ice skaters pulling in their arms to spin ever faster. A particle with the slightest deviation from "straight down" must, eventually, transfer all that angular momentum into the black hole's rotation. It becomes a quantum issue for individual particles: How can the particle fall in if doing so removes its angular momentum from the universe? A more likely outcome for such a particle is to enter into an event horizon momentum state akin to ones Gerard 't Hooft has proposed in recent years. Even under such extreme conditions, the most minute units of sideways-moving angular momentum must quantize. For particles, the result is akin to an enormously scaled-up, gravity-bound version of an atomic *p* (or higher) orbital.

(4) Watching the universe end: Just as your outside friend sees your time slow down, you observe your friend's time speed up by symmetry. Near the event horizon, this gets extreme in both directions. In fact, in the split instant before hitting the event horizon, you see the end of the universe! Now, if you are a fan of paradoxes, think about that for a moment: How, precisely, does one "observe" the end of the universe if the black hole into which you are falling is, by definition, part of that universe? The counter to this — a good one — is that you, the infalling person *must* conserve linear momentum in your frame.

Thus you cannot stop at the event horizon and wait for the end of the universe. Relativity says you *must* plow through the event horizon smoothly from your perspective. The momentum-conserving smoothness argument is valid and brings up the final point, which is…

(5) Watching the black hole evaporate before you: Assuming all your particles are headed straight down — the black-hole equivalent of atomic *s* orbitals — you need not worry about slowing down to watch the universe end. That's because, due to Hawking radiation, even the most gigantic black evaporates at incredible speed just in front of you, doing so quickly enough not to slow you down. Your gravitational time dilation keeps increasing until it reaches a balancing point for preserving your inbound linear motion. You don't need to know how much you slowed down since it's a self-correcting loop: Slower evaporation means slower time flow for you, and faster evaporation means faster time flow. To you, it's all smooth: The black hole, no matter how big, goes *poof* just before you pass through its event horizon, removing any chance of you observing its interior. Singularities need not apply!

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