Black Holes in Science and the Arts

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Welcome to Einstein's World
Mass–Energy Curves Space–Time
Gravity Slows Down Time
When a massive star exhausts its fuel, if the core is more than three times the Sun’s mass no force can resist the contraction.
Black Hole Basics

singularity

event horizon not even light can escape

here objects feel the gravity of the black hole, but light can still escape
“Stars, hide your fires; 
Let not light see my 
Dark and deep desires.”

William Shakespeare 
Macbeth (1606) 
Act 1, Scene 4
“The edge of the whirl was represented by a broad belt of gleaming spray; but no particle of this slipped into the mouth of the terrific funnel, whose interior, as far as the eye could fathom it, was a smooth, shining, and jet-black wall of water...”

Edgar Allen Poe (1841)
A Descent into the Maelstrom
“Hawking understood black holes because he could stare at them. Black holes mean oblivion. Mean death. And Hawking has been staring at death his entire adult life.”

Martin Amis (1997)  
Night Train

“Suicide is the night train,  
Speeding your way to darkness.”
Vantablack
Anish Kapoor

Descent into Limbo
Anish Kapoor
Hole
Levi van Veluw

Line Abstract
Vasilj Godzh
Physical Illusion

Optical Illusion
RUG

Black Hole Illusion

3D Vortex

Black Hole Illusion
Welcome to Hawking’s World
Virtual particle and antiparticle pairs are always being created from radiation, then turning into radiation.

Hawking realized that one of a pair could pass into the event horizon, so black holes radiate, and will eventually evaporate.
**Image of the disk's far side**
The black hole's gravitational field alters the path of light from the far side of the disk, producing this part of the image.

**Photon ring**
A ring of light composed of multiple distorted images of the disk. The light coming out of these images has resisted the black hole two, three, or even more times before escaping from it. They become thinner and fainter closer to the black hole.

**Doppler beaming**
Light from glowing gas in the accretion disk is brighter on the side where material is moving toward us, fainter on the side where it's moving away from us.

**Accretion disk**
The hot, thin, rotating disk formed by matter slowly spiraling toward the black hole.

**Black hole shadow**
This is an area roughly twice the size of the event horizon—the black hole's event horizon—that is formed by its gravitational lensing and capture of light rays.

**Image of the disk's underside**
Light rays from beneath the far side of the disk are gravitationally "fouled" to produce this part of the image.
MUS

Black Hole

House Music 11-20

Trance Music 12-20

Black Hole

House Music 05-21

Trance Music 08-19
Fifty black holes have measured masses in binary systems. They’re nearest among 10 million in the entire galaxy.

Intermediate mass black holes exist in globular clusters. There is a 4 million solar mass black hole in the center of our galaxy.
Dancing with Death

Supermassive black hole (4 million solar masses)

Orbital period 16 years

20 billion kilometres = 120 x Earth–Sun

Orbit of S2

Maximum speed > 25 million km/h

Closest approach 19 May 2018.
Black Hole Orbits Gallery
Pamela Davis Kivelson
Black Hole
Charles Burns

black hole

Film of the Graphic Novel
Screenplay: Neil Gaiman
Director: David Fincher
The detection of space-time ripples from a merger of two black holes a billion light years away has opened up a new window onto the universe.

LIGO, the Laser Interferometer Gravitational Observatory, will soon be detecting roughly one black hole merger every week.
Detecting Space-Time Ripples
The LIGO Orrery

Time: -0.63 seconds
Falling into a black hole resulting from a massive star’s would be a nasty fate: “spaghettification” at the level of muscles, bones, and tissues. The tidal forces are extreme.

But passage into a black hole over 1000 solar masses would be survivable. As seen from afar, time would slow asymptotically. In spinning black holes, the singularity is a ring, a time-like curve where you could meet previous and future versions of yourself.
The End