

Black Holes and The Information Paradox

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 - ▶ It's **black**, because it's heavy enough to trap light.

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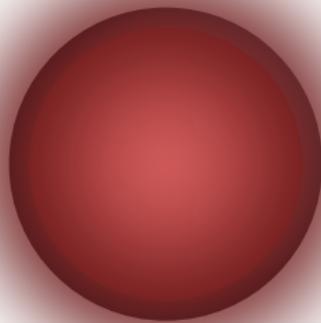


- ▶ Common wisdom:
 - ▶ It's **black**, because it's heavy enough to trap light.
 - ▶ Since it traps light, **it traps everything that falls in**.

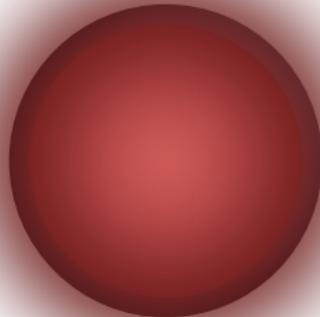
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- ▶ No! Stephen Hawking discovered **black holes glow**.

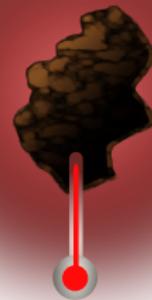
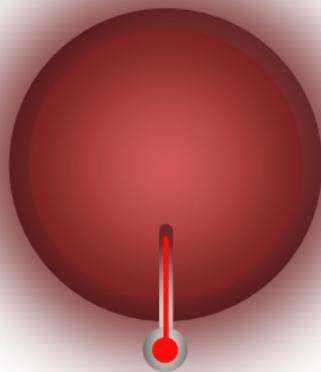


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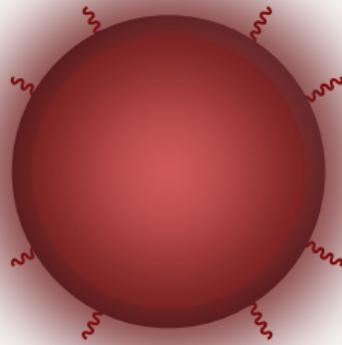
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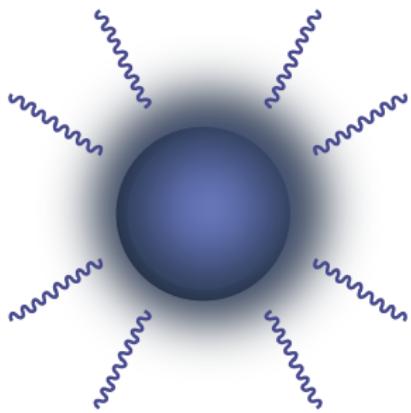


- ▶ They're like **lumps of coal heated to some temperature**.

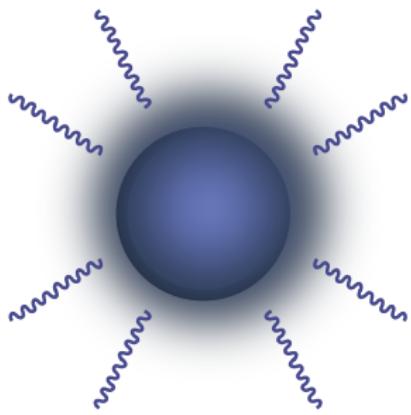
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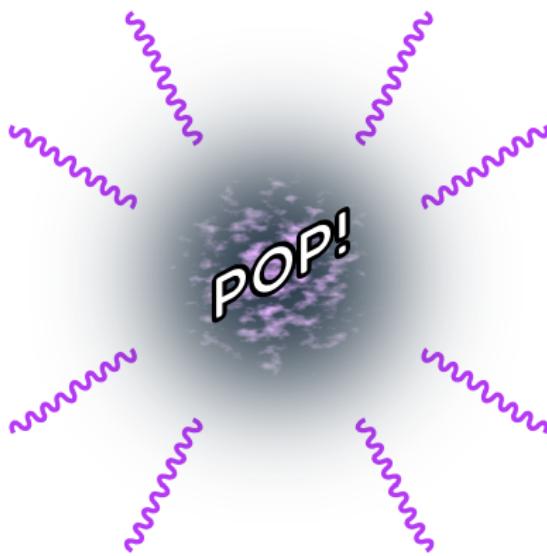


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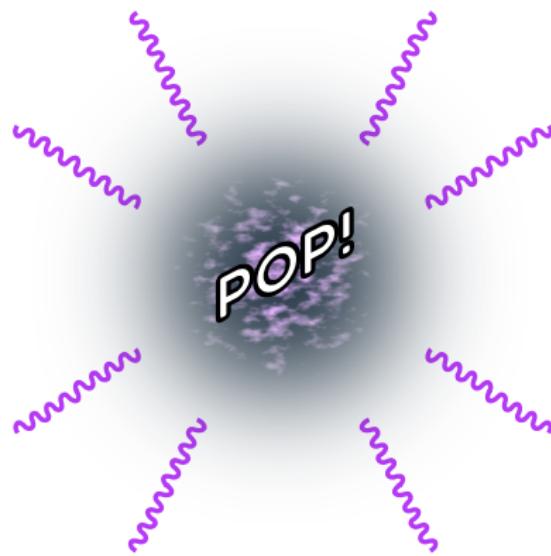
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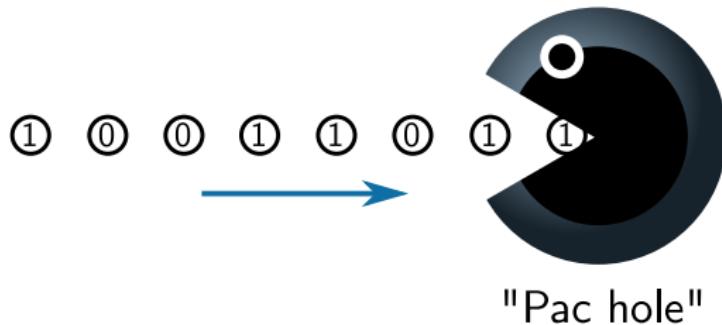


- ▶ Eventually, it disappears altogether.
- ▶ Hawking asked: what happens to the things that fell in?

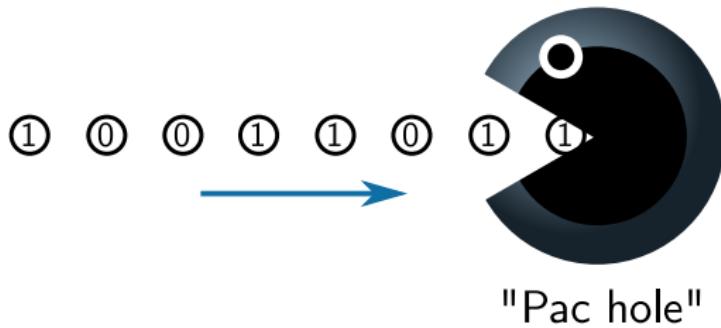
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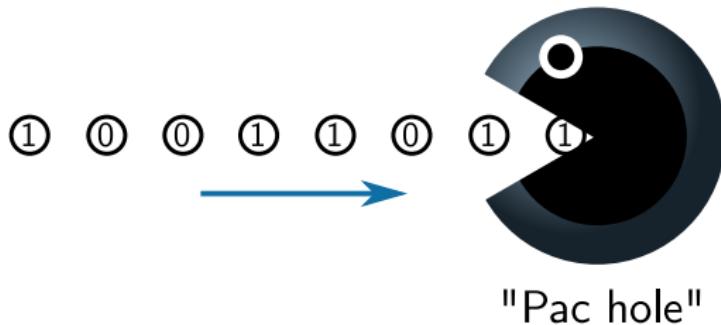


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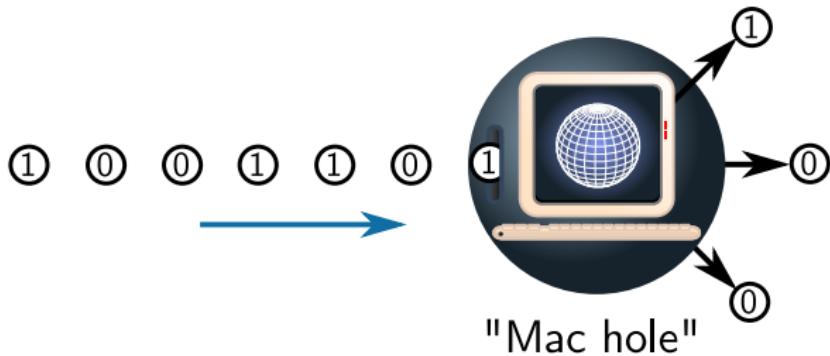
- ▶ Problem: this violates quantum mechanics!
A basic law is that information cannot be destroyed.

- ▶ Second option: information is encoded.

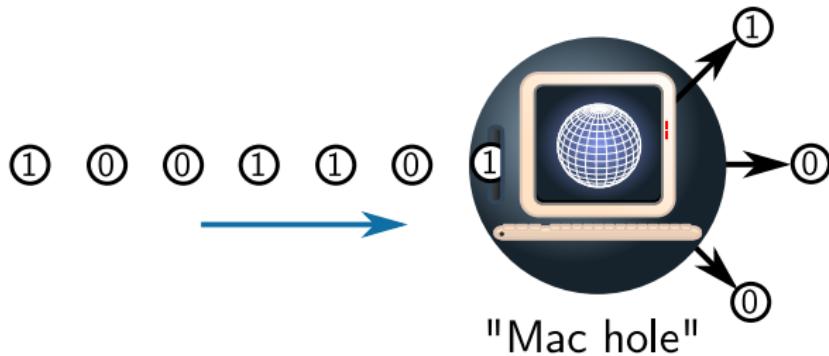
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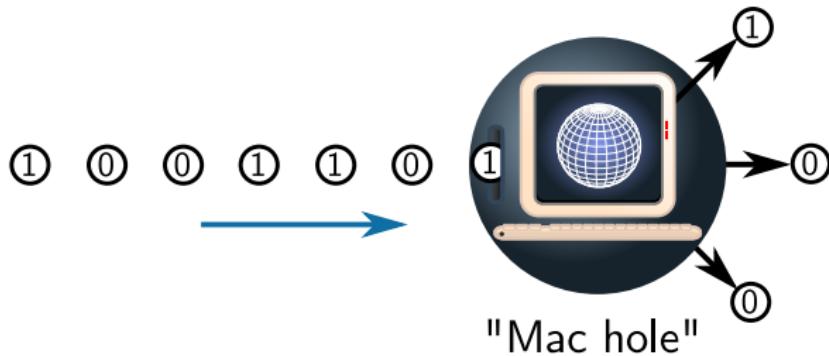


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- ▶ Problem: the radiation looks random!
It seems impossible to get information from randomness.

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astronaut

0		cat
1	donut	1
0	0	0
0	0	1

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astronaut

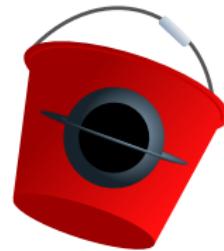
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- ▶ The black hole is the bucket. **Put the objects in!**

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astronaut

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0

0

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0

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0

1



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We **encoded it randomly** by dumping it on the ground.

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The black hole **evaporates into a bunch of random bits**.

- ▶ But we haven't destroyed any information!
We **encoded it randomly** by dumping it on the ground.
- ▶ To **recover what fell in**, just study dumping very carefully!

Well, that solves the Information Paradox.

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Looks like someone encoded some donuts for us.
How thoughtful!

THE END