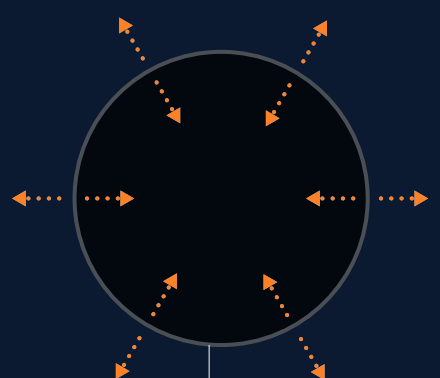
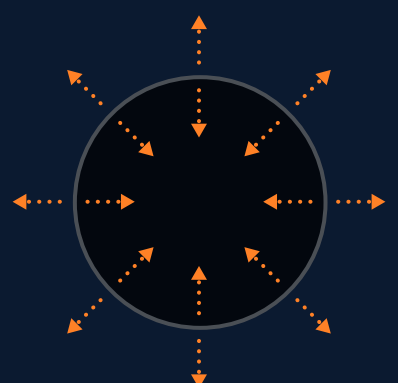
The Great Black Hole Information Escape

As black holes radiate, information appears to be lost. But this can be avoided if the "entanglement entropy" of the radiation rises then falls. Recent calculations have shown how this happens via a "quantum extremal surface" that appears just inside the black hole's event horizon. Everything inside of this surface is suddenly not part of the black hole. Exactly how this happens, and what it all means, is still an enormous mystery.

1 Black holes radiate by forming entangled particle pairs. One particle flies out, the other in.

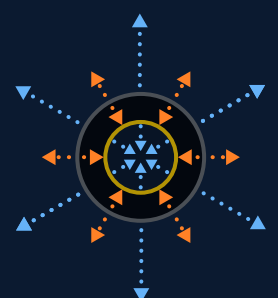


2 As the number of entangled particle pairs grows, so does the entanglement entropy.



3 A quantum extremal surface appears just inside the horizon, making the black hole into something like a shell.

4 The innermost particles are no longer part of the black hole. Their entanglement no longer counts toward the entropy.



5 As the black hole radiates the last of its energy, the total entanglement entropy drops to zero.