



1  
00:00:00,701 --> 00:00:03,971  
Check out this Hubble image of a  
galaxy 8 billion light-years

2  
00:00:03,971 --> 00:00:09,776  
away. Notice anything unusual  
about it? This super bright spot

3  
00:00:09,776 --> 00:00:13,080  
is not a star in the foreground  
blocking our view, but is

4  
00:00:13,080 --> 00:00:17,618  
actually a quasar named 3C186  
that's inside the pictured

5  
00:00:17,618 --> 00:00:21,188  
galaxy. A quasar is the  
extremely bright light that's

6  
00:00:21,188 --> 00:00:25,259  
emitted by hot gas surrounding a  
supermassive black hole. A

7  
00:00:25,259 --> 00:00:28,195  
supermassive black hole is a  
type of black hole that's at

8  
00:00:28,195 --> 00:00:31,632  
least 100-thousand times more  
massive than our Sun and is at

9  
00:00:31,632 --> 00:00:35,402  
the center of almost every  
massive galaxy. But the center

10  
00:00:35,402 --> 00:00:40,274  
of this galaxy is over here, in  
this green circle. This galaxy's

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00:00:40,274 --> 00:00:43,543

quasar, and therefore its  
supermassive black hole, for

12

00:00:43,543 --> 00:00:46,947

some reason is more than 35,000  
light-years away from the

13

00:00:46,947 --> 00:00:51,018

galaxy's center, and the  
redshift, a spectral signature

14

00:00:51,018 --> 00:00:54,388

of the gas in the quasar, shows  
that the black hole is flying

15

00:00:54,388 --> 00:00:58,659

away from the center at over  
1,300 miles per second. [over

16

00:00:58,659 --> 00:01:00,694

2,000 km/s] For reference, our  
Sun is moving through our galaxy

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00:01:00,694 --> 00:01:04,431

at about 15 miles per second.  
[24 km/s] This particular black

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00:01:04,431 --> 00:01:09,169

hole is over one billion times  
more massive than our Sun - what

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00:01:09,169 --> 00:01:13,307

could have possibly moved  
something so enormous? A team of

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00:01:13,307 --> 00:01:16,443

astronomers led by Marco  
Chiaberge at the Space Telescope

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00:01:16,443 --> 00:01:19,780

Science Institute think they've found the most plausible

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00:01:19,780 --> 00:01:23,250

explanation. Taking a look at the Hubble image, there is some

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00:01:23,250 --> 00:01:27,220

faint material surrounding the galaxy called tidal tails, and

24

00:01:27,220 --> 00:01:29,823

these are produced by a gravitational tug between two or

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00:01:29,823 --> 00:01:34,828

more colliding galaxies. If this galaxy is actually two galaxies

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00:01:34,828 --> 00:01:38,198

that merged, then it's possible their two central supermassive

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00:01:38,198 --> 00:01:41,735

black holes also merged. As enormous objects like

28

00:01:41,735 --> 00:01:45,372

supermassive black holes are merging, they create ripples in

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00:01:45,372 --> 00:01:50,043

the fabric of spacetime called gravitational waves. The two

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00:01:50,043 --> 00:01:53,246

black holes whirl around each other, getting closer and

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00:01:53,246 --> 00:01:55,782

closer, and fling out  
gravitational waves like water

32

00:01:55,782 --> 00:01:59,720

from a lawn sprinkler. If the  
two black holes are a bit uneven

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00:01:59,720 --> 00:02:03,657

- maybe one's more massive,  
maybe one's rotating a little

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00:02:03,657 --> 00:02:05,659

faster - then they fling out  
these gravitational waves more

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00:02:05,659 --> 00:02:09,196

strongly along one direction.  
Once the two black holes finally

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00:02:09,196 --> 00:02:12,432

collide, the newly merged black  
hole shoots off in the opposite

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00:02:12,432 --> 00:02:15,168

direction from the strongest  
gravitational waves. And that's

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00:02:15,168 --> 00:02:18,739

what astronomers think happened  
to this supermassive black hole.

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00:02:18,739 --> 00:02:22,342

Based on its enormous mass and  
velocity, the energy needed to

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00:02:22,342 --> 00:02:25,512

jettison this black hole was  
equivalent to something like 100

41

00:02:25,512 --> 00:02:30,384  
million supernovas exploding  
simultaneously. So while this

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00:02:30,384 --> 00:02:32,986  
may not go on your list of the  
top prettiest Hubble images,

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00:02:32,986 --> 00:02:37,391  
just think - you're looking at  
the light emitted 8 billion

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00:02:37,391 --> 00:02:41,228  
years ago from gas orbiting a  
1-billion-solar mass black hole

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00:02:41,228 --> 00:02:43,897  
that is flying through its  
galaxy because it was shot off

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00:02:43,897 --> 00:02:46,266  
like a rocket from the  
gravitational waves produced by

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00:02:46,266 --> 00:02:50,037  
the merging of two supermassive  
black holes - and if that's not