An Overview Of A Black Hole

On 10 April, this year scientists were finally able to do the unthinkable: they allowed humanity to look straight into the abyss of a super-massive black hole and take a photo like it's some kind of tourist attraction! Today it turns out, that even after such accomplishments we still don't know much about black holes at all, as one of them challenges all scientific community with new impossible feats. In the middle of July 2019 black holes puzzled astronomers once again. New observations made possible thanks to famed Hubble telescope by the team of European scientists. Their study showed that a relatively small and starving of consumable matter black hole situated at the core of NGC 3147 contradicts all of our expectations by mimicking its much bigger siblings almost completely. To show you how exceptional this discovery is, I will have to start up from the basic question.

What is a black hole? It's the tiniest and heaviest object possible in the Universe, it can swallow entire stars with ease and appears absolutely invisible to a human eye. But wait a minute! What was that giant definitely visible orange thing on pictures then? Did scientists deceive us with another computer simulation? No. Not at all. The photos are as real as it gets. Except the image on photos is not of a Black Hole itself. Let me explain. Every black hole once was a shining star just like any other you can see in the night sky. At the end of its life, a star can collapse onto itself and condense all of its enormous mass into a tiny dot of space. Such an incredibly dense object will produce a gravitational force that will almost tear a hole in time-space itself and bend the sole matter of reality around it. Since the moment of collapse, this monstrous gravity will attract and eagerly consume every piece of matter around it. Even the lightest and the fastest particles in the Universe like photons of which light consist would not be able to escape this unstoppable force. The core and the center of mass this virtualized black hole has is called a singularity. This is the single cause of all madness that's going on around near black holes. The mass of this thing can go from hundreds of millions of the Sun's mass to hundreds of billions! And it takes so little space in volume, that its density is almost infinite. No wonder this thing seemingly breaks all the laws of physics!

In fact, it's the density that is most exciting about black holes. You see, it turns out that any object can become a tiny black hole if compressed enough. For example, our planet will have to become no more than a third of an inch to become a tiny singularity of its own kind and start to bend reality around itself. Of course, this can't happen at all, but it happens to exhausted stars. The surrounding space near the singularity is the notorious event horizon. This is exactly why black holes are called black, though it's not entirely true. Normally, you can tell that something is black because this color doesn't reflect light at none of its wavelengths. The event horizon of black holes is black because none of the light that gets in them can escape it at all. Black holes

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are not black, they are completely absent from the visible world, they are not just invisible – they are more than a tangible manifestation of nothingness for any light-sensitive device. The one and only of its kind in the whole Universe. The thing that makes black hole visible and is depicted in the recently released photos of one lies beyond the event horizon. It's called the accretion disk. This brightly luminous disk of matter, swirling towards the center of a black hole like in a giant drain forms a quasar. Quasars have their place among the oldest celestial bodies known to humanity because their immense brightness can outshine a total light of a whole bunch of stars put together. This brightness is achievable because all the mass, that surrounds a black hole is rotating around it on a tenth of the speed of light. A movement so fast leads to constant outbursts of radiation and some of it shows itself in the visible specter as light and heat.

Accretion disks consist mostly of superheated gas and space dust and the speed of its movement is the bigger the closer it gets to the event horizon. The biggest and the shiniest accretion disks are considered to have supermassive black holes situated in cores of the biggest and brightest galaxies. And it's fairly easy to guess why. The more matter a black hole has to feast upon the bigger its mass. Its event horizon also gets bigger and accretion disk forms around it. This is exactly the reason why the NGC 3147's black hole is so unique. It isn't supposed to have one, but it has. Let's compare some galaxies and black holes in their centers to further elaborate on this glaring difference. The brightest in every way example can be the black hole in the middle of the largest galaxy known to us in existence and also the brightest galaxy of its cluster. This galaxy is so large that it would be pretty hard to imagine it using just numbers. Imagine if this colossus would replace our own galaxy. If that would happen it would not only take a place of the Milky Way but also of several neighbor galaxies we have around altogether. This colossus is the IC 1101 galaxy. When it was first discovered, it was taken for a huge orange nebula – an aftermath of the supernova explosion. It took several years to get to the shocking truth – the orange color we see is the light of probably 100 trillion stars collected in one elliptical galaxy. Most of them were looking like ancient red dwarf stars, giving away their tired yellow and orange light. But the biggest surprise was hiding in the middle of it. The supermassive black hole in the core of IC 1101 suits its huge galaxy well. This terrifying monster is heavier than about 40 billion masses of the Sun. The accretion disk is as huge and luminous as it can be expected. It is pretty similar to this one black hole from the photos. Only such huge black holes sometimes called ultramassive, give us a rare chance to visibly detect them.

Let's move closer to our home for a minute. Our galaxy is much, much smaller than IC 1101 and not as luminous. The Milky Way is just 100,000 light-years across – sounds like nothing when compared to supposed 6 million light-years of IC 1101 diameter. But our galaxy is still rich enough to feed its black holes properly. The most notable black hole in the Milky Way is in the Sagittarius constellation, right in the middle of the spiral of stars that our galaxy basically is. We are 26,000 light-years from it and it is more than 4 billion times heavier than the Sun, which

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makes it a supermassive black hole. Although Sagittarius A-Star black hole is shrouded by gas clouds from our point of view, and we can't see it, scientists were able to get an image based on radio spectrum eradiation coming from its accretion disk. And then we have spiral galaxy NGC 3147 130 million light-years away from us. This galaxy is considered to be small and not dense enough to constantly feed something as big and powerful as supermassive black-hole in the other two examples. Black holes in these galaxies are often called starving black holes for a reason. It is expected, that black holes in the position this unfortunate can't have furious swirling accretion disks around them. It's far more probable that it would have some concentrated gas around it in a shape more akin to a donut and of course it won't be nearly as luminous. Still, against all odds, NGC 3147 has the same kind of accretion disk as its bigger siblings. According to our knowledge, this is almost impossible, and this galaxy was selected precisely to find a black hole with no accretion disk. As they say, there is no negative result in scientific research. Sometimes unexpected findings can teach us a lot more than pure success.

For now, no one knows how this starving black hole can support this disk in its shape while being malnourished. To uncover this secret Hubble gets busy searching for other galaxies with lesser luminosity to find black holes in it and look if they show similar abrupt qualities. It will not only allow astronomers to study accretion disks of starving black holes but also will present a unique opportunity to test Albert Einstein's theories of relativity. The disk of NGC 3147's black hole placed so deep near the event horizon, that light it emitting is twisting like nowhere else. This is exactly what scientists had been looking for. There is no better place to delve into the fabric of laws, ruling the relations between time and space than a reality-bending black hole with such rare properties.

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