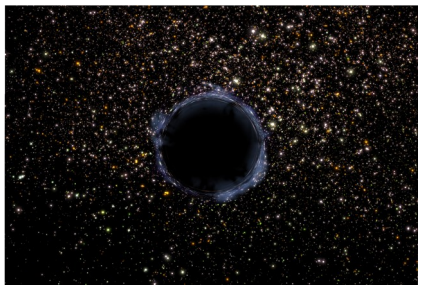

Black Holes

prepared by:

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1. ***Intoduction***

I am going to tell you something about black holes.I know that I can not write everything but I am trying to explain the main information and I hope that the pictures give you a idea about what I have written.There are not every single thing about black holes,but I think enough to get a idea what black holes are.

2. *What are Black Holes ?*

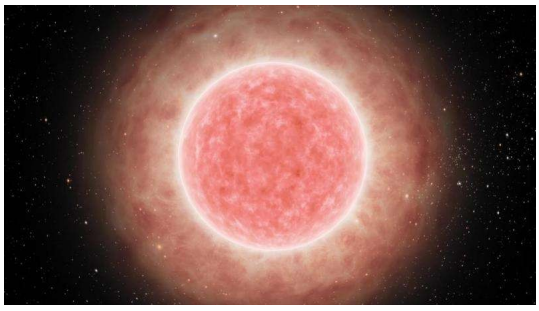
Black holes are very discussed phenomenon. They are strangest and most fascinating objects found in outer space with such powerful gravity,that nothing can escape from inside it,not even light,when it comes near enough.
When the matter is squeezed into a very,very very tiny place,then the gravity is so strong.
This takes place even in a Black hole.At Black holes it happens when a star is dying,so the dying of a special star is the begining of a Black hole (later more).

Black holes are invisible for us,because there is only one direction in them,it is the way to the singularity,so the light can not come out and when it can‘t come out it means it can not fall into our eye.
But space telescopes with special tools can see Black holes.They just only look at the stars ,that are very close to a Black hole and know how they act differently than other stars.

3. ***John Michell***

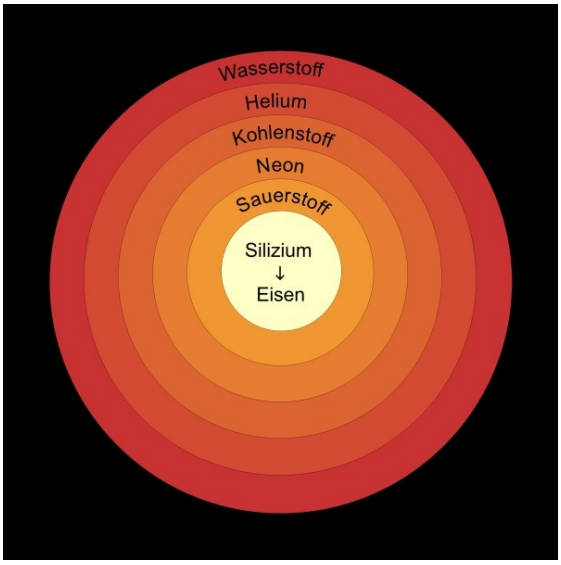
John Michell was the first (known) person who talked about black holes,from Cambridge,in 1783.
He was born 25 th December 1724.
He commended that a star that had a greater gravitation than light could not be seen by anyone,because the light would never be able to leave that star itself.
Later the scientist expanded on this idea.
A star that had collapsed,because his own gravity, which could not be upheld by the star forever.Finally it would lose its nuclear fuel and thus not be able to hold up the needed pressure,which make it collapsed.
Then the collapsed star would suck everything, that come near it with a small enaugh mass and velocity into itself.At the moment when its escape had come a radius over 300,000 kilometers,then the light would not be able to escape anymore.

4. The birth of a black hole



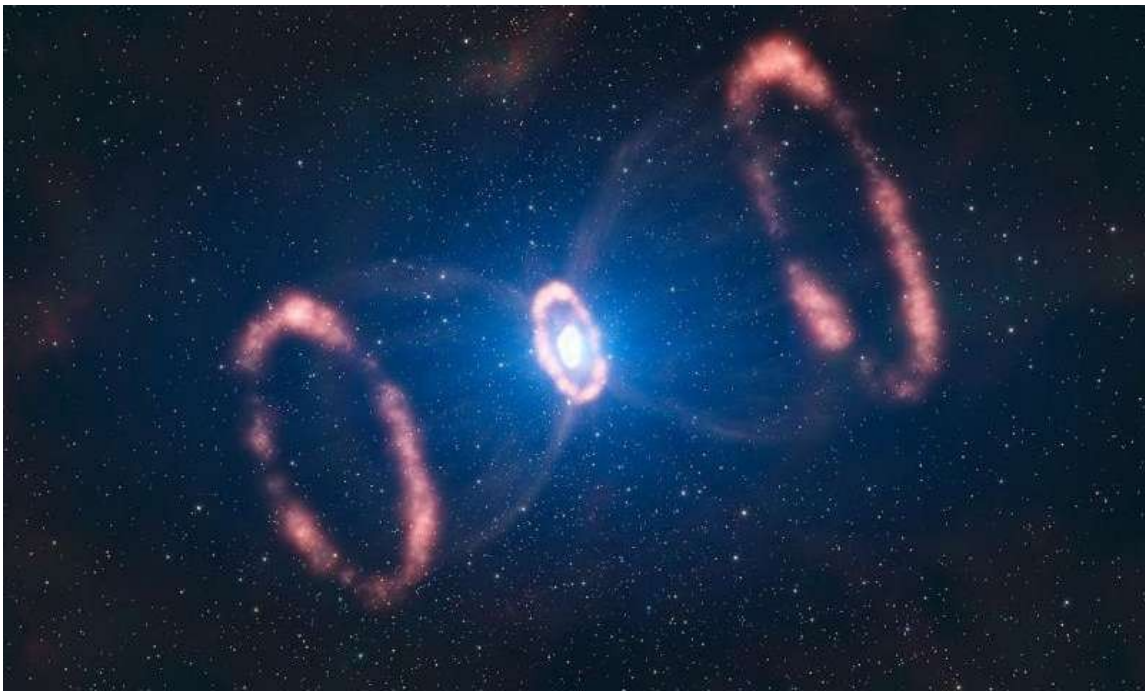
I can not tell you about black holes,without that you not know how they are born.In the first capter I tell you,that the dying of a special star is the birth of a black hole,and this is right.But we must look carefully I wrote,that it must be a special star but I not mean a star which is far away.We must look in the catagory “mass“. So this is the birth of a black hole.
Stars are very large accumulations of mainly hydrogen atoms, caused by the breakdown of gas clouds due to their own gravity. In their nucleus, helium is formed by fusion of hydrogen, which fusion releases a great quantity of energy. This energy in the form of radiation, presses against gravity and thus maintain the balance between the two forces. As long as the fusion takes place in the nucleus, the star remains stable enough.
A slightly different kind of supernova explosion occurs when even large,hotter stars (blue giants and blue supergiants) reach the end of their

short,drammatic lives.These stars are hot enough to burn not just hydrogen and helium as fuel,but also carbon,oxygen and silicon.Eventually,the fusion in these stars forms the element iron (which is the most stable of all nuclei,and will not easily fuse into heavier elements) ,which effectively ends the nuclear fusion process within the star.A black hole with the mass of our Sun,for example,would have a radius of just three kilometres (roughtly two hundred million times smaller than Sun) ,while one with the mass of the Earth would fit in the palm of your hand!

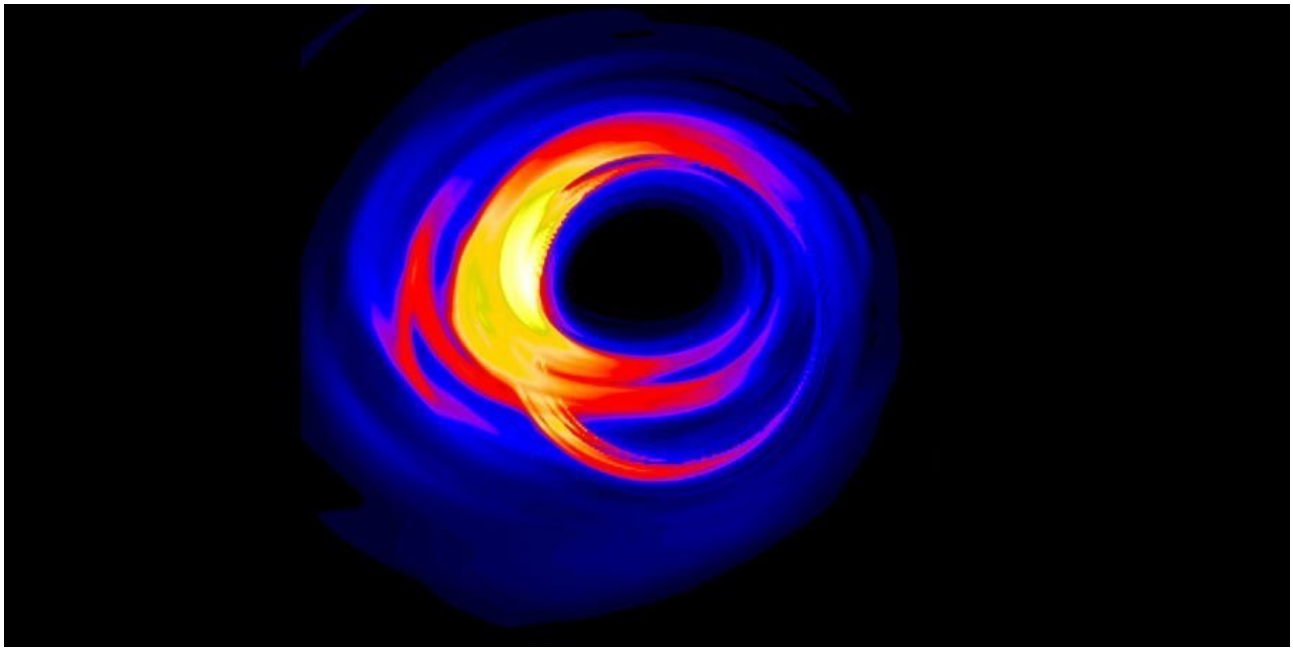


So in the middle there forms iron, until it is present in a critically high mass, is destroyed by the balance between radiation and gravitation.
The core breaks together. Within a fraction of a second, the star impulses, with a quarter of the speed of light, whereby the mass in the nucleus continues to rise. This is the moment when all the heavy elements in the universe have developed, at the death of a star in the form of a supernova.

This creates either a neutron star, or when the star is massive enough, a black hole through the collapse of the whole mass.



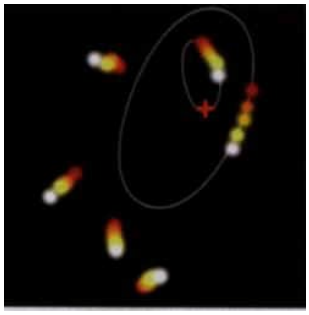
5. *Do black holes really exist*



Do black holes really exist,or are they just only invented ?
Nobody knows it exectly,but we already know from the first chapters,that black holes are invisible,no light can escape from theme,so we can not see black holes.And that is not mean that they are not there.There is no way to see theme dierectly with the naked eye,but scientists have noticed strange motions of stars in certain zones. So they have supposed that there is something unseen present there,that interacts with the other stars.Even if we can not see black holes directly

we can derive their presence by observing other stars.
Scientists have found 4 clues guiding them to think that black holes do exist.

1.) <u>The higher velocity of stars around black holes :</u>



Following the trail of 6 different stars over a period of 4 years (from 1995 “whithe points“ to 1999 “red points“), two scientists,Andrea Ghez and John Kormendy,declared that there is a galactic black hole in the center of our Milky way (red cross).

Pulled by the black hole,some stars go around it as fast as 1,500 km/s and can not stop speeding up.

2.) <u>The emission of powerful X-rays :</u>

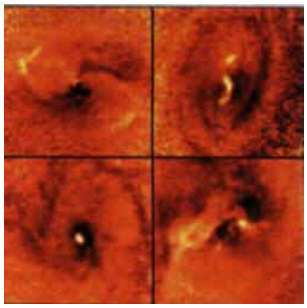
The cone of many galaxies seem to be very bright,emitting very powerful

X-rays,because as matter falls into a

black hole ,it gets extremly hot.

On this picture of Centaurus a galaxy taken by Chandra (a satellite abel to detect the presence of X-rays),the orign from were we can see a steram of light is likely to be a black hole.All around,white spots are probablly smaller black holes.

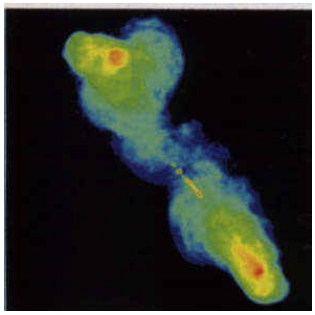
3.) <u>The presence of masses of gas and dust around the black hole :</u>



Powerful maelstroms of star dust appear in the center of galaxies.Their diameter can be as large as multiple thousend light years.Here they are watched by the infra-red detectors of Hubble,a space telescope build in 1990.The presence of this dust is very unexpected,unless it is the result of the attraction

of some matter by another body,which could be a black hole.

4.) <u>The emission of Plasma jets :</u>

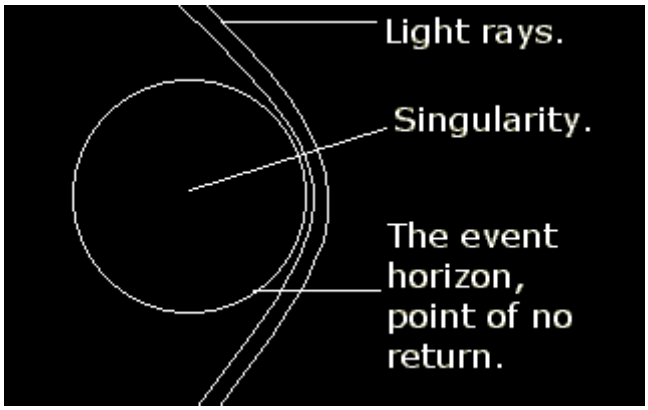


Many distant galaxies just like this one can be “seen“ (thanks to radio radiation) to emit two huge jets projected in opposite directions.These plasma jets,which travel as fast as the speed of light on very long distaces but do not exist anywhere on the univerese,except where there are other signs of the presence of black holes.

So,I named you four clues,that scientists leading that there can be a black hole,
but a another problem starts here:
IT IS JUST ONLY A THEORY !!!
Everything that we know now,about black holes was never really demonstrated.This is

the most facineted thing for me about black holes, you do not know it exactlly,mabey there is something and mabey it is a black hole,but if not.Mabey we all know the black holes diffrent as they really are.
Later I tell you what Hawking,a British physiker and astrophysiker,think about black holes.But first you need to know the “points“ in a black hole and what also happen there.

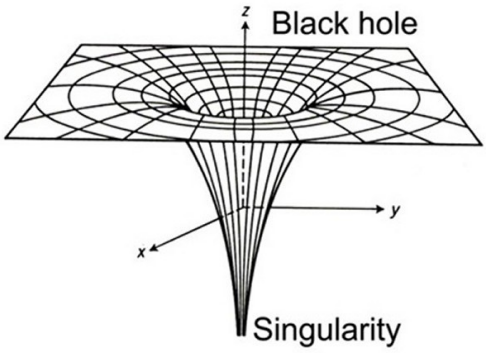
6. *The Event horizon*



The event horizone of a black hole is the boundary (`horizon`)between its `outside` and its `inside`;those outside can not know anythings (`events`) which happen inside.An event horizon its behavior.Its described by applying the equations of Einstein`s theory of General Relativity (GR).If the black hole is not rotating,its envent horizon has the shape of a sphere;it`s like a 2D surface over 3D ball.Expect,not quite ;GR is a theory about spacetime,and contains many counterintuitive aspects.For example the location of the event horizon of a black hole depends upon who is doing the observing,and as you fall (freely) into a black hole,the event horizon is always ahead of you. If you watch -from afar !-something fall into a black hole,you´ll see that it gets closer and closer,and light from it gets redder and redder

(increasingly redshifted),but it never actually reaches the event horizon.And that´s the closet scintiest have come to testing the theoretical predictions of event horizons;we see
stuff-mass ripped from the normal star in a binary,say-heading down into its massive companion,but scintiest never see any sign of it hitting anything(like a solid surface).In the next decade or so it might be possible to study event horizons much more closely,by imagine SgrA*(the supermassive black hole-SMBH-at the center of our galaxy),or the SMBH in M87,with extremely high resolution.

7.*The singularity*



In the center of a black hole is a gravitational singularity,a onedimensional point which contains a huge mass in an infinitely small space,where density and gravity become infinit and space-time curves infinitely,and where the laws of physics as we know them cease to operate.As the eniment American physicist Kip Thorne describes it,it is ´´the point where all laws of physics break down´´.
The existece of singularity is often taken a proof that the theory of general relativity has broken down,which is perhaps not unexpected as it occurs in condition where quantum effects should become important.It´s conceivable that some future combined theory of quantum gravity (such as current research into superstrings) may be able to describe black holes without the need for singularities,but such a theory is still many

years away.According to the ´´cosmic censorship´´hypothesis,a black hole´s singularity remains hidden behind its event horizon,in that it is always surrounded by an area which does not allow light to escape,and therefore cannot be directly observed.The only expectation the hypothesis allows (known as a ´´naked´´ singularity) is the initial Big Bang itself.It seems likely,then,that,by its very nature,we will never be able to fully describe or even understand the singularity at the center of a black hole.Although an observer can send signals into a black hole,nothing inside the black hole can ever communicate with anything outside it,so its secret would seem to be safe forever.

8.*Travel into a black hole*

Who do not want to travel into a black hole and want to look the universe from inside a black hole.So I want it.But I also want to come save out of the black hole,but I woud not. Why ??? That I tell you now.
First be sure,which is the safty and dangerous area by a black hole.

Color	Zone
Green	Stable circular orbits
Yellow	Unstable circular orbits
Orange	No circular orbits
Red line	Horizon
Red	Inside the horizon

The first picture is a map of your orbit into the black hole. You follow a real free-fall orbit.

The green region is a “safe” zone where circular orbits are stable.

The yellow region is a “risky” zone where circular orbits are unstable. If you are on an unstable circular orbit, then a tiny burst on your maneuvering thrusters will send you into the black hole, or off into outer space.

The orange region is a “danger” zone where there are no circular orbits, stable or unstable. To remain in orbit in this zone, you must keep firing your rockets. The closer to the horizon you get, the harder you must fire your rockets to keep from falling in.

The red line is the horizon, from within which there is no escape.

Let`s jump into a black hole.

It is not beeing compatible,but it will be pretty fun.

A black hole is defined by the fact that its escape speed is greater than the speed of light. That means in the simplest way that one would have to be faster than light to escape the surface of a black hole in a thrust. In other words, it is with monstrosity -Relativity theory is not possible.Why, but can not man take a photo of a black hole? Clearly the gravity of a black hole is so strong that the escape speed is greater than the speed of light. That means it can escape nothing. The real reason why from a black hole nothing more can come out is that there is no"outside'more. As soon as one is in a black hole, there is only a guideline, inside.Hin to the singularität.But how is that possible? You can not just turn around and look outside again? This is a super exciting question, so we dare to jump and go through, leaving their eyes open, because

what they will see will be breathtaking and their last. The first border, which is on the way to the black hole, Is the photonensphere.which is the distance to the black hole, suf the photons in a stable orbit around a black hole. This sounds not only totally cool, it is auc.Denn that what it means among other things is that they theoretically You can see their own back. The light is reflected by your back and then instead of flying normally straight forward, forced from the black hole into a circular path until it has flown round once and falls into the eyes.Photons have no mass, but gravitation also does not affect mass , But our space-time.

Thus, if a photon flits past a black hole, it actually traces the lances of the curved space-time. From the perspective of the photon it is still flying straight, only the space around the photon is so strongly curved that it flies in a circle.

The next border on this trip is the event

horizon and that is the point from which you should be sure that you want to perform this whole action. When you are behind the event horizon, there is no way to escape , No force known to physics nowadays. Behind the event horizon, physically speaking, there is only one direction. The incredible gravitational force of the black hole has so much curved the space time that every direction points to its singularity. The universe is getting smaller and smaller until it becomes a bright point above our head. Also the light of the stars can only fall into the funnel, where it falls like a person on the slide into the black hole. Therefore, the complete universe is Now over the person.Unter the person is nothing, only dark emptiness. The light that is reflected back upwards is quickly redirected to the black hole because of the curved spacetime. At one time can not see your feet or body anymore, you can only look upwards.
In the vicinity of strong gravitation, the time passes from the outside, more slowly, which

means that one is traveling near the black hole in the future. But that only applies if one resists the gravitas quasi, In the film " Intelar " Instelar" are the actors on a planet, while this is about a black hole. Despite the strong attraction, they stay in orbit around the black hole and that is important. The ground of the planet Is accelerating away from the black hole, and that makes for her so-called time travel. But if you get into a black hole, you have to accelerate from these to slow down more slowly and to perceive the world around you faster.

After the event horizon has risen, what from our perspective looks quite unspectacular there is Spaggetti.Yes in a black hole there are Spaggetti, but do not look too early, the one who is in the black hole is the Spaggetti. Now they sit somewhere on the surface of the earth and read, only we have to thank the gravity of the earth that we are not simply floating away. The gravitation attracts them. But not all of us is attracted equally strongly.Your head is

likely Is at least far from the earth core and is with minimum force of attraction as your feet. Now here on the earth it is also no problem, since your body size porportional to the removal of the earth's core disappears. But with a black hole, which for its mass much smaller , Your feet will experience much more gravitation than your head. Your feet want to go down faster than the rest of your body. This power is different, the more you get closer to the center of the black hole Your legs become longer and the body is thinned. One is as long and thin as a spaggetti. The gravitation affects them differently until their molecules are torn apart. The official scientific concept of this phenomens is Spaggettisirung.

And what is coming now? Now that is one of the greatest questions of our time, the singularity is a too simple answer, because what exactly that does not really know. In the inner of a black hole break all laws of physics together.Nichts applies more.Kein space, no

time. It is a hole in our spacetime. It exists in this sense. This is also the answer to the question: Is a black hole infinitely dense? What do you get when dividing 1 by 0? Deeping on who you ask and in many ways that is true, maybe a black hole is infinitely dense, but the closing truth is we just do not know it, but maybe that is exactly why black holes are so exciting

9.*My questions*

I am thinking about black holes so many times and then I had a lots of question.

Finally I find the answer but there are also some question which I do not know.

I want to tell it to you,mabey you are thinking about this,too.

1: <u>Could a black hole destroy our earth ?</u>

Black holes do not wander around the universe. They follow the laws of gravity just like other objects in space. The orbit of a black hole would have to be very close to the solar system to influence Earth, which is not probably.

If a black hole with the same mass as the sun were to replace the sun, Earth would not fall in. The black hole with the same mass as the sun would keep the same gravity as the sun. The planets would still orbit the black hole as they orbit the sun now.But the human,plants or animals will be freez.

2:What happens if two black holes collide ?

It is possible for two black holes to collide. Once they come so close that they cannot escape each other's gravity, they will merge to become one bigger black hole. Such an event would be extremely violent. Even when simulating this event on powerful computers, we cannot fully understand it. However, we do know that a black hole merger would produce tremendous energy and send massive ripples through the space-time fabric of the Universe. These ripples are called gravitational waves.

Nobody has witnessed a collision of black

holes yet. However, there are many black holes in the Universe and it is not preposterous to assume that they might collide. In fact, we know of galaxies in which two supermassive black holes move dangerously close to each other. Theoretical models predict that these black holes will spiral toward each other until they eventually collide.

3:Could black hole be used as an energy source ?

There a great deal of information on the potential use of a black hole as a source of energy. (Of course, it should be mentioned that one must first acquire a black hole! At least in the case of the Sun, we already have the Sun!) An excellent source of information on black holes, written for the layperson, is Kip Thorne's excellent book: Black Holes and Time Warps. I suggest you consult it for "all the information [I] could possibly give" you.

In brief, a rotating black hole can store a huge amount of energy in its rotation. This energy is actually accessible since the rotation is imposed on the space outside the hole. In principle, therefore, energy can be extracted from the rotation of the black hole. Exactly what mechanism is used is a potentially complicated story.

4:Are black holes `door ways`to other parts of the universe ?

Deep inside of a black hole lies a region known as the gravitational singularity, where space-time curves toward infinity, and no matter passing through can survive – or so it's been thought.

In a new study, researchers suggest there may instead be a way out through a wormhole at the centre of the black hole, which acts as a 'back door.'

By this theory, anything traveling through the black hole would be ‘spaghettified,’ or stretched to the extreme, but returned back to its normal size when it emerges in a different region of the universe.

We do not know if they are door ways but they are we must travel faster then light to escape from it and we need a very,very stable rocket,because we can spaghettified and then the technic will be damaged.So we need pretty good machines.

10.*The end*

Whether wormholes or black holes have actually never been seen directly,even with the best equipment that scientest are useing today.

With every step forward we are understanding our universe better,but we just only found pretty less about the universe.Years ago where scientist stood and trying to understand what there is happening,now they realizing what it is and at somethings they know how it´s future look like.Mabey in a few years we had spaceships,which are traveling with the speed of the light,or we will inhabit exoplanets,we will be find bacteria of other plantes,…..

We just only know about this not much,but we found great things,who are helping us in our everyday life for example:a clock;

if we do not know that the earth is rounding the sun and that earth is needing 24 h to turn their own axis,we do not have the clock than.

Our curiosity about the space is so great that we have started researching it. We have begun to ask questions about where, why and where the universe and the living will be lead.
We do not know it yet, but I am sure that somewhere something incredible is waiting to be known and the mankind will found it.

Thank you to my parents,who participate me here.

Also thanks to my Physics Teacher and English Teacher,who adviced me.

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