Mr. Jones goes across the Horizon

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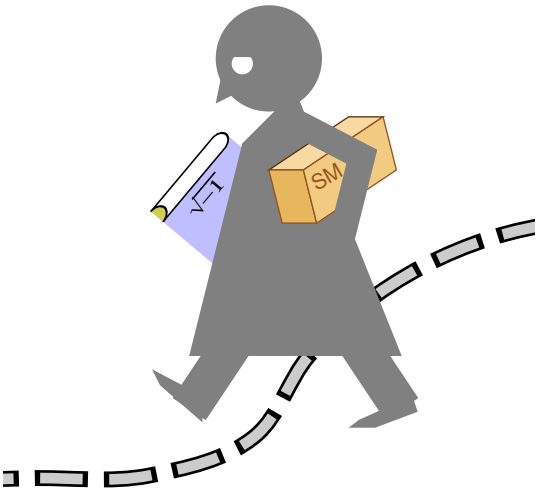
A short story about Mr. Jones' adventure inside a black hole, and about how weird horizons are.

For children between 10 and 90 years old.

Mister Jones is a daring investigator and adventurer, who wants to experience what happens if you enter a black hole. He makes a wonderful journey, full of surprises. Just to make this story possible, he was handed a little magic wand, but there isn't much he can de with it – just speed up to go a bit faster than light. Mr. Jones lives on a planet that looks like Planet Earth, but it has a large black hole at its center. He plans to dig a tunnel towards the entrance, called 'horizon'. The horizon will look like a giant door, that leads to an other world, or so it may seem. What exactly is this world? Is it an other universe that Mr. Jones will enter? Or is it some other part of his own universe? His findings will very much surprise him. They surprise almost everybody, the scientists of his country, his world, and us. We know that black holes exist far away in the universe. Are those black holes, which we have detected using sensitive instruments – but without any magic – as strange as this? Scientists do not know for sure ...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Mister Jones carefully inspects his magic wand. It enables him – occasionally – to go faster than light. This is extraordinary. He, and his advisor Professor Peeters, are the only ones who can go faster than light. Just a little bit. For any other person, for rocks, stars, planets, or any other objects, it is forbidden to go faster than light. It is the only magic that he can do, and it is just because he wants to go, and to return to tell us what he will see. This would otherwise have been impossible. Black holes are indeed very strange corners of our universe.

Mister Jones lives on a planet that, from the outside, looks like Planet Earth. It has continents and rivers and towns like on the real Earth, but at its center, there is a giant black hole. The hole came there long ago, when lots of particles inside the Earth began to attract one another so strongly that they all came together, forming a hole, and they all fell in. It became what scientists now call a 'black hole'.

Very strange things happen there. This story is based on much phantasy, but what Mr. Jones discovers when he tries to enter the black hole, resembles much of what real black holes may be like. Black holes do exist in the universe. If you already thought that the universe is a strange place to be, then continue reading, because those black holes are well beyond what most people can imagine.

The horizon that will be crossed by Mr. Jones, physically connects two worlds, but at the same time it separates them, as they are two worlds that in many respects are each other's extreme opposites. As I said, Mr. Jones is using some magic, since the path across the horizon cannot be walked upon as told in this story. The only way to understand this story is by trespassing, by ignoring just a few laws that are standing in our way. Nature's laws have not been made by humans, but by Nature itself, and therefor you can't ignore them. Mr. Jones apologises to God, to Nature, or whatever he believes in. The laws that he is dealing with are the real ones, but they are strange, too strange even for most scientists.

Words of Warning

The hero of our story is a comic figure. This is the only reason why he survives this dangerous trip. **Do not, under any circumstances, try to enter the horizon of a black hole yourself.** It would most certainly be a fateful experience.

The world that Mr. Jones calls his home, is an impossible mixture of a black hole and Planet Earth, even though it resembles the Earth. The continents are the same as the ones on Earth, oceans, islands, and custom officers are just like on Earth.

The black hole that Mr. Jones will investigate is at the center of his Planet Earth.

Secrets

Black holes are hiding secrets, and Mr. Jones wishes to find out about them. That is why he goes to the horizon. But, while homing in to his target, he prepares to enter into an infinitely hostile environment. Will he survive his own audacity? Which strange things

will happen with his notion of time?

Mr. Jones is well-prepared. He is going to make an important trip. In his suitcase he has several items that may be useful underway. One is a large toy box. It says *The Standard Model Particles* on the cover. If you open it, you see, neatly packed, three big boxes, with the words *Generation I*, *Generation II*, and *Generation III* engraved on their lids. The box *Generation I* has electrons in it, neutrinos, and some brightly coloured objects called *Up* quarks and *Down* quarks. The other two large boxes have more exotic things in them, some also with the same bright colours. His toy box also contains strange force carrying particles in them, and a round box saying *Higgs*, which he hasn't yet bothered to study.

"You know", he says, "My assignment is to find out how these particles behave when you go through the horizon. Physicists say that, when they move, these particles come in distinct states of motion. I want to study these states. I also want to count them."

"Yes," his wife says, "and why should they behave any way different from what they do right here? What's so special about this horizon that you want to cross?"

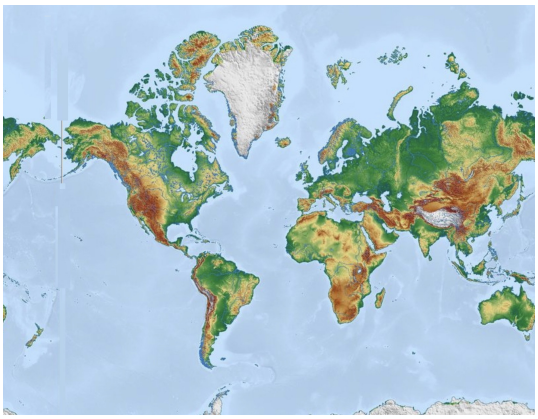
"I don't know", Jones replies, "Some scientists, called string theorists, say they behave different. They say that the gravitational force will feel like the forces of heat. As if you are pushed and pulled around by steam engines. I wonder what I will see. But more importantly, I want to *count* all these possible states of motion. From where I am now, it looks as if there should be infinitely many such states. But that can't be true; our world would explode".

"Or implode," his wife says. "Maybe everything will then collapse into nothing."

"And that is not happening, it seems," Mr. Jones says. "I want to understand why not". "Well, because if everything would implode," Mrs. Jones says, "then you would not have been here to ask the question".

"Right," Mr. Jones says, "So why am I here? I want to find out."

Mr. Jones also brings along an expensive watch. He knows that a proper time keeping would be important during his trip. His wife has brought him a lunch box. "But be home in time for dinner", she urges.



Mr. Jones' map of the world

He also takes along a detailed map of the world. “I never know where my next journey may take me,” he apologises.

And Mr. Jones brings along a book about mathematics. “How to draw the square root of minus one”, it says on its cover. “You never know, maybe I will need it.”

He has a short chat with his friend and advisor, Professor Peeters. “I will make the same trip that you are going to do”, Mr. Peeters says. “I will depart 10 minutes after you.”

“Are you sure of the time?”, Mr. Jones asks, “Then I know when to expect you at our point of arrival”. Mr. Peeters solemnly acknowledges. “Ten minutes later”, he says.

Where should Mr. Jones go first? “I can start right here in London”, he says. “Here, I take off for the horizon”.

“What direction is that?”, Peeters asks. But he already knows the answer: “The horizon is down, from here. Down under. I am going to dig.”

And so he does. Mr. Jones is digging. He goes deeper than anyone has ever gone before. But, unlike the Earth, the force of gravity becomes stronger and stronger the deeper he goes. And not only that. The deeper he goes, the slower his watch is running, but Mr. Jones does not notice this. His own heart beat, his own thinking, everything slows down just as his watch does. So Mr. Jones thinks his watch is doing fine. He is coming closer and closer to the horizon.

At the horizon

Arriving at the horizon, the inevitable happens: Mr. Jones’ watch stands still. Mr. Jones himself stands still as well. So what now? Actually, a lot is happening. Mr. Jones seems to fade away. Only the energy in his body and in his mind, leaves gravitational fields and forces behind. They are like foot prints in the snow, and these footprints are going to live their own lives onwards. But all this is not what Mr. Jones thinks is happening to him. He doesn’t think he is standing still at all, but now he has to use his magic wand.

Faster than light, but just for some small moments, he escapes. Across the horizon he goes, and what he now sees startles him.

What a busy place this is. There are particles everywhere. Well, he realises, that’s what I should have expected when travelling faster than light; you then also go backwards in time a bit. Just enough to encounter all particles that caused the birth of this black hole, ages ago. So this is where they all went ...

Not only all particles that ever went into the black hole are there, but also all particles that plan to leave, while waiting for eternities, are all flying around his ears. This is not at all like the world he just left, which had been relatively quiet and empty. But before he continues, Mr. Jones has to pass the custom’s office.

“Welcome to this side of the horizon,” the custom officer says, “isn’t it nice and quiet here, compared to that world where you came from, where all those particles are flying about! Do you have something to declare? What is this box in your luggage?”

Mr. Jones is a bit confused. "This box contains some Standard Model particles", he says, and he explains the three boxes with generations of quarks and leptons in them. "Let's see," the officer says, after opening the first box. "There is an error here. Where the Generation I box says it contains up-quarks, down quarks, electrons and neutrinos, it actually is full of all sorts of particles, but a few quarks, electrons and neutrinos are *missing !*"

Same comments were made on the boxes called Generation II and Generation III. "Lots of particles of all sorts here too," the customs officer says, but actually what is written on the lids is missing!"

Slowly, the truth dawns in Mr. Jones' mind. "Oh, I see," he says, "When you people talk of particles, I just see empty space, and the converse also holds: what you call empty space is actually filled to the rim with particles, from my point of view," he explains to the officer. When I look up, I see loads of particles ..."

"No no," says the customs officer, "what you see there is the sky. Further upwards you see the universe. It is almost empty there." An other thought crosses Mr. Jones; mind. "My colleague, Professor Peeters will be coming in a few minutes; I'll wait for him here," he tells the officer. " Mister Peeters will soon arrive."

'No, Mr. Peeters arrived here ten minutes ago," the customs officer corrects him, "Look. There he is."

"I have been looking for you", Mr. Peeters exclaims. "I expected that you arrived ten minutes before me, but you are late ..."

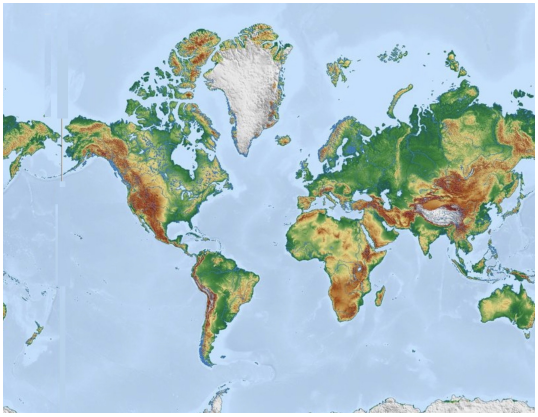
Mr. Jones and Mr. Peeters now look at their watches. They show twenty minutes difference now. What happened here? The custom officer follows their conversation. "I recommend", he says, "that you both go to a watch maker. This is a tourist place, called 'Antipodes Island, but one of the tourists here knows all about watches. Both your watches are running backwards in time!"

The antivacuum. Where are we ?

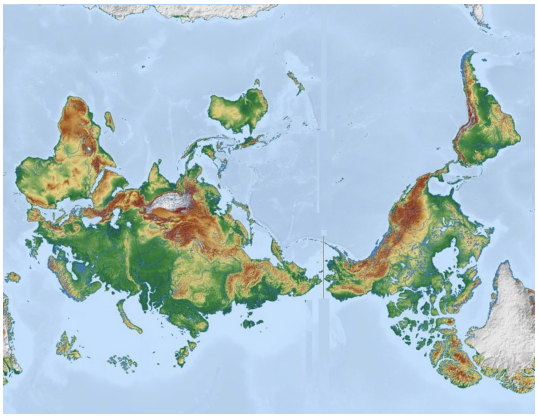
"My watch is brand new", Mr. Jones looks puzzled. "And it is malfunctioning already! Good that I have the guarantee certificate here." But then he reads what is written in small print: Warrantee expires if watch is transported across a horizon, the certificate says. But they need their watches to be repaired. The watch maker knows the problem: "This happens when people cross horizons, but I know how to repair it. The watch gets confused when it tries to follow the arrow of time."

Jones and Peeters do not quite understand what the watch maker is saying, but when they get their watches returned to them, they show the time correctly, although there still seems to be something odd with the hands of the watches.

"Why is this place called 'Antipodes'?", Mr. Jones asks the watchmaker. "Oh," the watchmaker says, "It has something to do with the location of this island ... "



Mr. Jones' map of the world.



The local's map of the world

"What?", Mr. Jones says, "an island? Did I dig that far? I went deep, but not that deep. And the only islands in the vicinity of where I live are Guernsey, or Jersey, or... Which planet did I arrive at?"

The question is still bothering Mr. Jones very much: *where am I? This must be an alien planet. I can't read the signs here!* Indeed, the road signs here look unreadable, though somewhat familiar. He shows to a passer-by his map of the Earth. "How come you don't know where you are? "The passer-by wonders. "Well, be that as it may, you are on one of a small group of islands, off the coast of New Zealand, the one you are on here, is called Antipodes Island .... But this map you have, it is all wrong!"

He then shows his own map to Mr. Jones. It looks somewhat familiar. "This could be Planet Earth!", Mr. Jones is all excited, but New Zealand, that is ... Antipodes? He turns the map around, but no matter how he holds it, something stays wrong. Then, he looks at the back of this map, holding it against the light. At the back, shining through the paper, the map looks more familiar. "This is a mirror image of my own map!", he concludes. He compares with his own map. Everything is mirrored! And we are on Earth after all!

Now it is the passer-by who looks confused. "How can this be anything else than planet Earth?", he wonders, You didn't wear any space suits ...".

"No," Mr. Jones admits, "we went through the black hole horizon, but some scientists say that that leads you to other black holes, or even other universes .... But now I understand why I could't read the signs here. Could you show me your left hand? ...

... No, that is your right hand."

The two try to shake hands now, but they use the wrong hands. Just in time, Professor Peeters intervenes. "Stop!", he yells, "It is better not to shake hands at all, "Professor Peeters explains to Mr. Jones and the passer-by. "If our matter is antimatter to you, touching each other will annihilate us all!"

That is true. Matter particles and antimatter particles will annihilate one another as soon as they touch. Terrible explosions will take place. And then Professor Peeters gives a short lesson in physics: "Matter does not quite behave as antimatter, unless you look at

it in a mirror. So seeing everything mirrored may mean that we are looking at antimatter ...".

Mr. Jones continues, "Yes, but there are still some deviations in these laws, unless, let me think. Oh, yes, unless you reverse the arrow of time as well."

Indeed, that figures. The world that they entered has time going in the wrong direction. This explains why, against their expectations, Mr. Peeters had arrived 10 minutes earlier instead of later.

"Now, it gets really complicated. But it is all in the math book I brought along. It says that the laws of quantum mechanics relate the time it takes for anything to happen, with the energy the object has. But to do this right, you need the square root of -1. We call it i."

"Wait", says Professor Peeters. "If you do this, there are two square roots, there is i and there is $-i$. If you want time to run backwards, you need the other root ...".

"Or you just change the sign of the energy," says Mr. Jones. Creating a particle costs energy, and so does the creation of an antiparticle. But if you invert the energy of an antiparticle ..., and replace i by $-i$ ...".

They all get excited by this discussion. "Let's ask the mathematicians when we are back home, " Mr. Jones suggests. But it seems to me that if we call an empty region of space a *vacuum*, then, well, it seems to be very full for the people here." They turn some pages in the book.

"Here, it says that the vacuum is defined to be a place where you cannot extract any energy, because there are no particles carrying any energy present. It seems now that the people here replace the vacuum by an *antivacuum*, a place that is so full with particles that you can't add any more."

"And when we arrived here, we got confused by what the locals here call vacuum and antivacuum. Maybe the laws of physics will tell us that vacuum and antivacuum are completely identical. .... Do they?"

"The people we talked to are not just locals," Mr. Peeters adds, "They are ordinary people like you and me. We are simply at the antipodes of the spot where we departed. Look." And he points to the two maps. We are now 20 000 kilometers from home, but we are mirror reflected, time reflected and energy reflected. This island is called Antipodes Island because ..., let's ask this passer-by, he is still here.

"Sir," he asks, "This place is called Antipodes Island. What is it that lies at the antipodes?"

"That's a place between France and England, actually, it is close to London , says the passer-by.

"Then", Mr. Jones decides, "when we want to return home, the safest thing for us to do is to go through the black hole horizon again. I go some 10 minutes earlier than you, Professor Peeters, I still want to count the states of motion of the particles in my boxes. We past through the horizon so quickly that I missed the opportunity, but people say that I spent a lot of time there, so I'll try again on my way back ..."

"Don't forget your magic wand", says Mr. Peeters, you'll need it.

Back home

"I promised my wife to be back home in time for dinner," Mr. Jones says. He still has a dangerous trip ahead of him. But now they know what to expect. Mr. Jones begins digging. He inspects the particles in his Standard Model box. What are their states of motion? Don't they slow down already? As before, he does not notice how they change. They move slower because they have only a few states of motion left, but so does Mr. Jones himself. Again he fades away, while his gravitational footsteps go in a different direction. "While I go forward, towards the horizon, my footsteps go back", he ponders. Quickly, he draws his magic wand. He zips off faster than the speed of light. No time left to inspect the states of motion of his particles. Too bad, but he would probably not have detected any change. Anyway, his magic wand would possibly have interfered badly with the natural laws he wanted to inspect.

He passes the horizon again, without further difficulties. "This is a much faster route from New Zealand to London, even if you would do it by airplane," he realises. "And also if there hadn't been a black hole there, an ordinary tunnel would still stretch over nearly 13000 kilometers; I would not have been back in time for dinner," he muses. "horizons are remarkable features."

"O, there you are," his wife greets him. "Mr. Peeters arrived ten minutes ago", she tells him. "You probably missed an interesting item on the news while you were away. At an island near New Zealand, some aliens have been spotted. They said they were from Earth, but they couldn't read the signs, and said incomprehensible things about time and about antimatter." The news item also mentioned that some strange foot prints had been reported, both in London and in New Zealand. The foot prints are being investigated by scientists.

"But what is that map you got there? Those aren't the continents of the Earth, they look totally different. Where have you been?"

Mr. Jones tries to explain to his wife all about the adventures they went through. "O, I see," says his wife, "with a little bit of general relativity theory and quantum mechanics, it all becomes clear to me. I could have warned you in advance about what might be waiting for you there, but you wouldn't listen."

Epilogue

Like most Science Fiction stories, this story is not quite accutate, but it is more accurate than most when black holes enter the picture. Of course there cannot be a black hole inside the Earth, at least not one that would be big enough for people to pass through. That is because space-time curvature would be so strong that people would be torn to pieces even before they approach the horizon itself. Only a black hole that is so large that its mass would be thousands of times larger than the sun would be smooth enough to let you through, but such black holes would also not fit in this story.

Furthermore, Mr. Jones and Mr. Peeters needed magic wands to go faster than the local speed of

light, but such magic wands of course cannot exist. Consequently, Mr. Jones and Mr. Peeters would not be able to emerge from the black hole before the universe itself comes to an end. What, instead, would emerge out of the black hole would have been their *foot prints*, which is why these were mentioned here. The footprints would have carried, strongly encrypted, all the information about the boxes and the books Mr. Jones was carrying, as well as everything Mr. Jones was thinking ...

Welcome to the world of physics.