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The Absurd Muddle that is Carlo Rovelli's "White Holes."

ABSTRACT

Carlo Rovelli has recently made available a book entitled "White Holes" Inside the Horizon (publisher, Allen Lane). In this he gives his explanation of how these phenomena are formed from the remains of Black Holes.
Rovelli provides several quotes from the first part of Dante Alighieri's 14th-century epic poem "Divine Comedy", with Virgil (clearly representing reason and wisdom), being the perfect guide through the Inferno, with Rovelli seeing himself as the perfect guide through the 'hell' of a Black Hole.
It is disappointing to find that Rovelli's convoluted reasoning provides the most unlikely and unconvincing route for this as-yet-to-be-accepted spectacle.

KEYWORDS

Carlo Rovelli, Karl Guthe Jansky, Einstein, Minkowski, Henri Poincare, Black Holes, White Holes, Virgil, Dante, Inferno, Time, Spacetime, Metric, Grandfather Paradox, Time Dilation.

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INTRODUCTION

In introducing *Black* Holes, Rovelli begins by referring to Karl Guthe Jansky's apparatus, that in 1932 recorded a 'hiss' from space.
"Ninety years later," Rovelli tells us, "We know what the mysterious hiss is... It is the radiation emitted by incandescent matter that, before falling into it, whirls furiously around a colossal Black Hole at the centre of our galaxy"

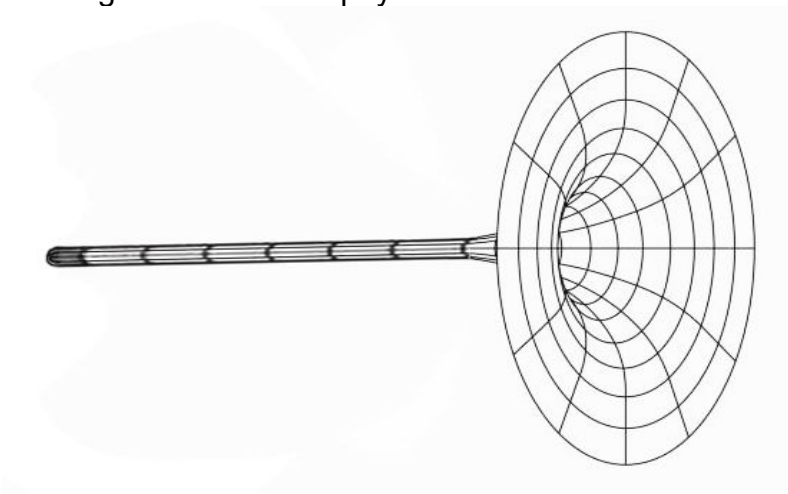
Throughout this essay everything in double inverted "commas" are direct quotes from the Book.

Next, Showing the Event Horizon Telescope's (EHT) image of a Black Hole, Rovelli confirms that "the image shows the burning material that whirls around the hole, generating the same radiation captured almost a century ago by Jansky's antenna".

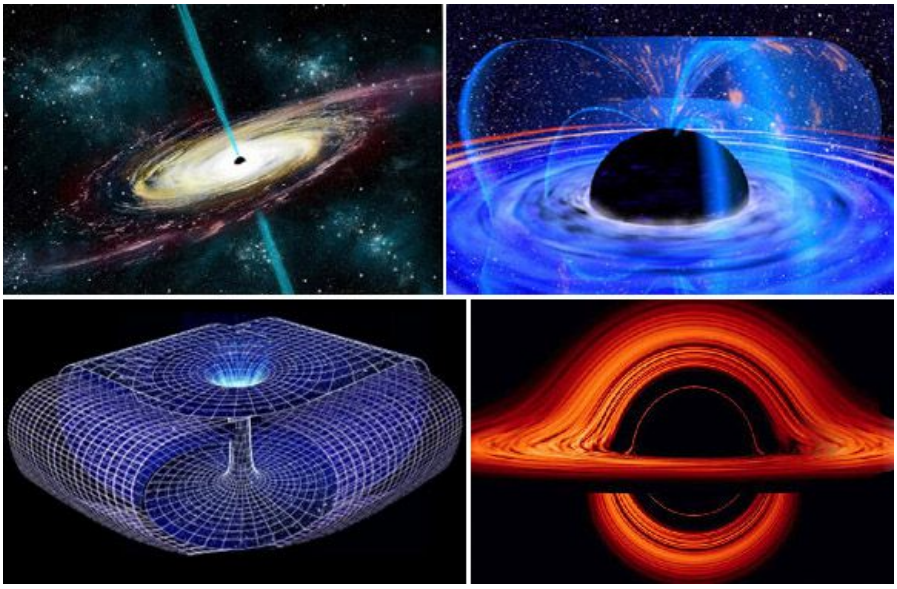
For the current assertion that the EHT's procedure was seriously flawed, and that the famous 'first image' is merely a computer generated simulation of the general conception of what a Black Hole should likely resemble, please see; "THE EVENT HORIZON TELESCOPE and its PROCEDURE", https://www.gsjournal.net/Science-Journals/Research%20Papers/View/9591 Pages 19 to 25

Also note that both the EHT and Rovelli do not comment on the extraordinary coincidence that this image has the Black Hole *exactly* centred on Earth. Especially as Rovelli notes that " it is the 'horizon' we see in the EHT image, the bizarre surface enclosing the Black Hole (which) is a small dark disc in the centre, in the heat of the fiery matter that revolves around it"

Nevertheless the object of Rovelli's journey does *not* reflect the EHT image at all, nor other images from current physics.

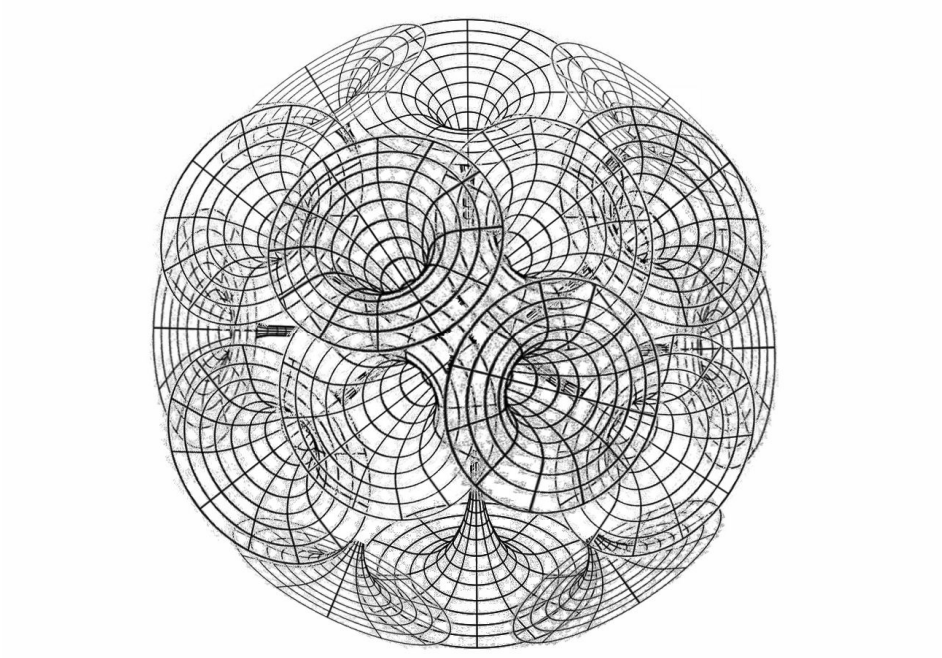


Rovelli's Black Hole



Other current artist's impressions.

The image that Rovelli offers is the concept suggested a few years ago, which even then was poorly thought out. Here, the gravitational mass at the narrowest point, (of Rovelli's funnel) that has caused the Black Hole to form, would clearly attract *everything* from *every direction*. His funnel only attracts from a single direction.
I do note however that the presenter on the YouTube Subscription Video, for Rovelli's "White Holes", attributed to a 'Bob Ross Style', *does* take this notion further, adding that the long funnel-like tube is a *part of a sphere*. Which would probably give us this;



A sphere of funnels.

Even so, this doesn't quite describe a sphere *entirely* made from funnels, as that would have *no space* between the throats, as the 'horizon' would actually have to be the *whole surface area*. That is, no gaps at all between the funnels. Either way Rovelli's journey, throughout the book, as we shall see, deals solely with the first image of a Black Hole's single funnel, with a single horizon.

In this essay I am going to add (!!!) when I'm astonished, and (???) when I'm confused. Also, because of his misuse of the word "spacetime" (explained later) I will underline each error, Furthermore, as there is no *privileged direction* in space, I add two asterisks each time Rovelli forgets this.

ROVELLI's JOURNEY into a BLACK HOLE

Rovelli opens with; "The horizon is our way in", explaining that the horizon of a Black Hole can be compared with "what we might see from land when a ship 'disappears' beyond the Earth's horizon"
He observes that, similarly, *visual* information disappears as one passes the Black Hole's horizon, saying light is "trapped within the shell of the horizon".

Oddly, comparing the additional time it takes for a letter (on Earth) to get from him to his Father, the further he travels into areas with poorer postal services, this allows Rovelli to assert that messages home, in space, would also "slow down" as he approaches a Black Hole's horizon.
"No post available" "represents the *inside* of a Black Hole", and for the Father; "It is as if time stops" .
"Information will be frozen at the 'desert's' edge," Rovelli asserts.

By page 30; "we are about to cross the horizon of a Black Hole, having discovered something disconcerting about time".

TIME

Rovelli takes a moment from describing his journey further, to tell us about time.
Although the author, in his illustrations, always includes an upright straight line for time, (perhaps indicating that time is universal?) he appears to contradict himself in the sentence; "The irresistible *flow of time* is similarly a reflection of the way in which things happen to be arranged."

He states; "True time is meaningless. It is like asking which regions of the Earth are *above* and which are truly *below*. Every place on Earth determines a different above and below, its only a question of perspective"
But then he offers the opposite, as an example.
"On the Italian side of the Monte Bianco (sic) upwards is north; whereas on the French side it is South.(!!!)

And- returning to space...

."If we approach the Black Hole's horizon, linger in its vicinity, and then turn back, the time elapsed for us between last seeing our Father and embracing him again, will be shorter than the time that has passed for him"

"This is a *real* distortion of time *effected by gravity*". He assures us.

"Time effectively passes at different rates in different places. This is what we mean by saying spacetime is curved. There is less of it (less of what exactly?) near the horizon and this fact bends spacetime. The way taking away some stitches bends a piece of knitting". (!!!)
"Time slows at the horizon in the sense that anyone observing us from afar would see us moving in slow motion".
"For us, near the horizon, no slowing down is felt. For us time passes normally".

Rovelli "Reminds us" "That Einstein realised that the geometry of time and space, as measured by rulers and clocks is determined by the gravitational field; the field that carries the force of gravity." (not speed?)
"This then is gravity, a distortion of time and space influenced by things (!!!) the distortion includes the slowing of clocks".
Arriving at;
"Gravity makes heavy things fall. Falling is therefore a direct consequence of the slowing of time"
And;
"A stone falls precisely because it follows a straight trajectory in spacetime distorted by a local slowing down of time".

By page 55 he is asking "What should we leave behind and what should we take with us, to be light enough to pass through the mirror, beyond the end of time, predicted by General Relativity".(???)

"There is no universal time. Temporality is the network formed by many local times and the possibility of exchanging signals".
"From a distance the horizon is a place where time stops. This is what David Finklestein understood."
Rovelli adds. "The relativity of time is an established fact"

Just out of interest you may be interested in the flaws in many experiments claimed to prove 'time dilation'.
(See NOTES 1)

Although eschewing the notion of Universal Time Rovelli does use a forward moving arrow-of-time in his diagrams.

However a very good case for accepting a *common* passing of time for everyone and everything, can be found here;
https://www.gsjournal.net/Science-Journals/Research%20Papers-Quantum%20Theory%20/%20Particle%20Physics/Download/9693

SPACETIME;

Moving on from this muddle, we will see that Rovelli refers to "spacetime" on many occasions throughout the book, and by including a flat map of the Earth on page 22, he states the obvious "the surface of the Earth is not flat" so that he can conclude "Spacetime is not flat either".

However, Spacetime is the word used to refer to the *values* in the field equations of General Relativity, which are considered to be able to predict the degree of curvature of *paths* based on the strength of the field *relative* to the mass, momentum and vector of a moving object.

Spacetime doesn't move; it doesn't *do* anything at all, because it is only a metric*; it does not exist* as a *physical* field. Spacetime is not a tangible, physically real thing, (It is reminiscent of the nostalgia for the 'luminiferous aether' by physicists who wish it hadn't been shown to be non-existent).

So Spacetime is *solely* mathematical, *not* physical. It serves as *a context* our imaginations must conjure, so that we can visualize, and think about, the existence and motion of *real* objects. The two individual metrics of space and time can be combined for use in equations, but the downside is, that it is common, even for physicists and mathematicians, to *conflate* the Spacetime metric with *the field of action* being measured by that metric.

This conflation of the imaginary with physical reality is known as 'reification', the transformation - in our minds only, of course - of an *abstract concept* into a *tangible thing*. It skews the discourse and is the source of much misunderstanding about how physical reality actually works.

The process of reification began with the two mathematicians, Henri Poincare and Hermann Minkowski, who discovered that even though space and time are categorically different metrics, the values derived from measurements, can be combined in maths equations, for great predictive power.

This gave birth to the concept of the 'Spacetime Metric' - after which, Minkowski's maths student Albert Einstein recognized the potential of this Metric to be combined with Riemannian geometry.
This is where 'Geodesics', appear curved to observers, because we visualize space in Euclidean terms of flatness and straightness. The two hypotheses, together, were thus combined to establish General Relativity, and a geometric theory of gravity.

Since then the word "metric" has been dropped from the discourse, allowing for very misleading phrases like "the curvature of Spacetime", as if it was Spacetime that was being curved by the gravitational field, when it is just - *imaginary lines* - that objects, moving in gravitational fields, are considered to follow.

Spacetime cannot curve; we can't curve an idea.

There are those who predict that, at the smallest scale, below the Planck volume, Spacetime (Quantum Foam) is like soap bubbles whereby each separate bubble is the minimum volume to which Spacetime can be reduced. Of course, this has not been detected.

So Spacetime is theorized, yes. But detected, no. Spacetime is merely a talking point; we could dispense with it completely and nothing in our toolbox of predictive equations would change.

Which is why I underline the places where spacetime is misused.

Meanwhile, we continue with Rovelli's journey;

On page 50, he tells us, "we know what to expect in a Black Hole, we have used the equations of Einstein to predict the geometry".
And without explaining how, Rovelli says;
"so here we go... we are *within* the Black Hole With good maps of the stars which remain visible from the inside, we are able to recognise that we have crossed the threshold beyond which we can no longer send letters home".

As suggested earlier, I am marking with two asterisks** where Rovelli fails to follow the key-note of physics; that being there is *'no privileged direction in space'*, no up, nor down, no left, nor right, no backwards, nor forwards etc. Words like 'fall', bottom, top, imply a direction.

"However many powerful rocket engines we might have taken with us there is now no way of avoiding a fall** towards the centre" **

"Here space is spherical, just like it is outside, around the horizon, but outside with powerful enough rockets we can move upwards** towards larger spheres. Inside, on the contrary, we will find ourselves in smaller spheres".

Below we have the first of several visits to the world of Dante's Inferno.

"Einstein's equations are our faithful guide, like the good Virgil for Dante, showing us the way down** further, and ever further, into the 'blind world'.

.....Before continuing the journey;

"Deep down** where we are falling** there are regions where the distortion of spacetime is extremely strong. Here we expect quantum effects to intervene as always happens in extreme conditions." (!!!)
"We reach regions with their spikes, cusps and folds (which) we call 'singularities.'

Still in the realms of Black Holes, we travel down Rovelli's funnel, via 'Dante' again,;
"The geometry inside of the space inside a Black Hole is actually surprisingly similar to that of Dante's Inferno." (!!!)

"Think of a funnel, a very long funnel; the interior of a Black Hole can be imagined as being like this funnel. The older the Black Hole the more elongated its interior".
"The length of the funnel is not infinite at the bottom** there is still a star inside of a Black Hole which is fully accounted for in Einstein's equations".

This of course is wrong.
In 1916, almost immediately after Einstein released his theory of General Relativity, the German physicist Karl Schwarzschild found an exact solution to the equations that describes what we *now* know as a Black Hole.
However in a paper written in 1939, Albert Einstein actually rejected the notion of Black Holes, that his theory of General Relativity and gravity, seemed now to predict.

Rovelli continues;
"The more the funnel narrows the greater the distortion of spacetime**.**
this is the fateful Planck scale".
"The zone where the distortions become infinite, (where) the equations of Einstein stop. The interesting zone is not there, its *in the future*".

Rovelli illustrates this with a repeat of his first funnel diagram, but with a dark grey area at the narrowest end.
"So the region of the singularity, the quantum region, is *in the future"***.**
"The long tube gets longer and thinner and in the future is squeezed into a line"
"It appears that we can no longer see the stars; our guide!; we can neither reach, or observe, anything at the bottom** of a Black Hole if no light can escape from it".

Rovelli's analogy follows;

"A marble... inside a Black Hole is able to cross the zone forbidden by Einstein's equations." (the dark grey zone in his illustration) "and to jump by tunnel effect" (???) "to the other side".

It's page 70 and we have yet to read anything about a White Hole.

"The quantum properties of space and time allow the inside of a Black Hole to leap beyond the singularity, when classical equations would have time stop." (???)
This is, we are told is; "More radical than a particle hopping around from one location to another; here it is spacetime that jumps".
"It is an instantaneous quantum transition from one configuration of space to another"
And this is; "Loop quantum gravity" apparently.

"Crossing the zone where Einstein's theory predicts the end of time, time and space do not exist."

"We can cross what Einstein's theory defined as the edge of reality, we can pass to the other side. The leap beyond the end of time, predicted by General Relativity (???) can happen- it is predicted by quantum theory".

"And yet it is described by equations which we have- quantum gravity equations describe a world more complex than a simple spatiotemporal continuum." (!!!)

Again with the help from Dante "we fly to the other side of space and time." (Where is that exactly?)
"In the centre of the funnel there is only the falling** star, we are not in 'singularity' territory."

Rovelli asks; "Shouldn't an old Black Hole- the star- (have) finished falling** a long time ago". (???)
As "a star that collapses on itself is crushed to a point in a very short lapse of time. But time is the crux of the matter".
"Down the bottom** time has slowed tremendously.
"Outside a Black Hole millions of years will have passed, whilst inside only a few fractions of a seconds (will have passed)".

(contradiction about whether time is slow or actually absent)

THE WHITE HOLE

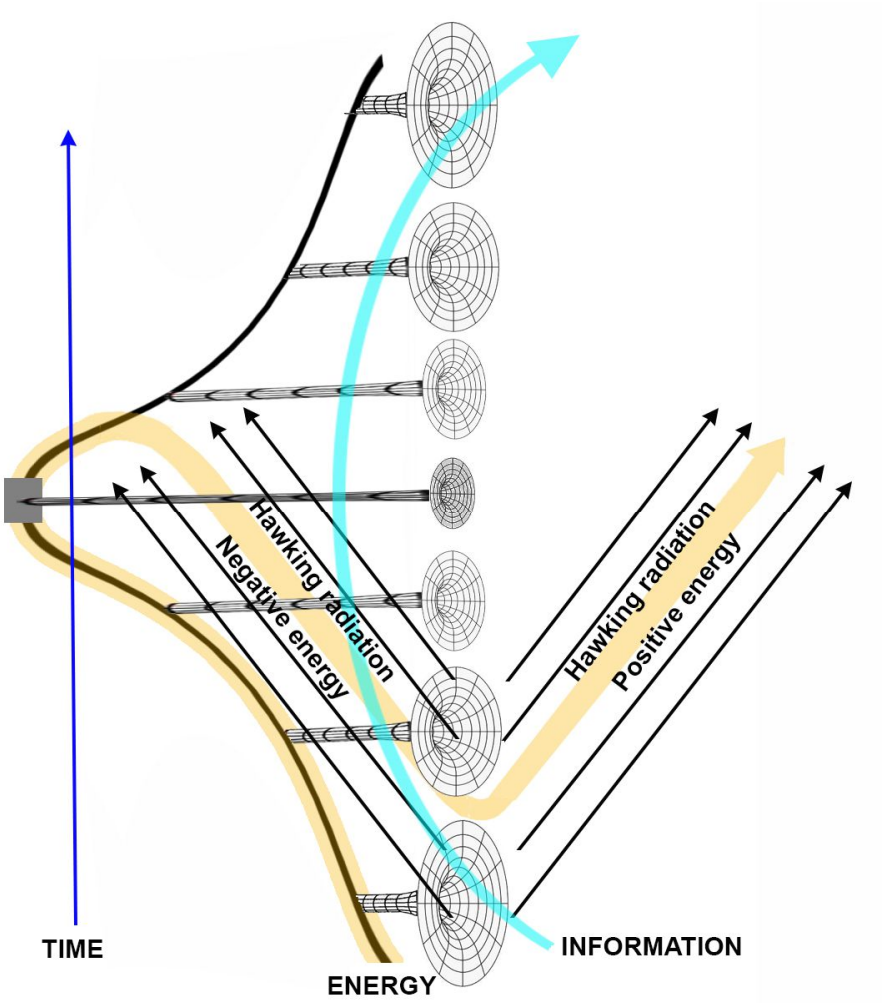
At last we arrive at the crucial moment, the formation of a White Hole.
"A star that has finished burning falls in upon itself. An object that enters a Black Hole falls**."

"But what happens to falling** objects when they reach the bottom**?. They *bounce* and head back upwards**
"The singularity of a Black Hole is not in the centre**; it is at the end of its fall**".(still asserting a direction)

He then wrongly asserts that a film of a bounced basket ball, when played backwards, would repeat, in reverse, the first falling action, thus ignoring both energy absorbed and friction.
.
But this leads Rovelli to ask; "Could the star and the whole of spacetime not simply bounce, but come back like a bouncing ball, as if time were reversed? We would then see a White Hole." (!!!)

"A White Hole is how a Black Hole would appear if we could film it and run the film in reverse". (!!!)

We are also assured that "Finkelstein is keystone to our past-future asymmetry."



Rovelli's map of the Black Hole / White Hole path.

I have copied this diagram from Rovelli's book which seeks to explain the Black Hole / White Hole transition. Apart from my complete failure to understand it, it does appear that if the whole time progression is *up*-the-page with a Black Hole becoming White, then nowhere does time seem to have been reversed.

Rovelli's explanation is as follows.

"Hawking radiation has a component of negative energy that goes inside a Black Hole. This eats away at the mass of a Black Hole and ends up on the star annihilating its energy. Very little residual energy reaches the White Hole horizon. This is the flow of the major part of the energy. Information entering the horizon on the other hand, remains trapped until after the quantum leap. The leap frees it, to return to the world of light".

"When finally all of the information and residual energy inside has left, the long happy life of the rebound of a Planck star is over, and the White Hole horizon dissipates".

FURTHER INFORMATION regarding a WHITE HOLE

"Spacetime is falling** in upon itself in a Black Hole".
"Time dances backwards." (!!!)
"The inside of a Black Hole cannot be squashed any further than the size of the individual grains of spacetime."

Rovelli's assistant, Hal, suggests; "Reversing time; linking 2 spacetimes with a quantum tunnel" (!!!).
"The trajectory of a star which forms a Black Hole around itself, *bounces* and in the end** comes out of a White Hole. The star always remains at the bottom** of the long funnel."
"It is quantum gravity that causes the pressure that turns a collapse into a bounce".

"A PLANCK star is the name given to the entire phenomenon; the star that collapses into a Black Hole; the rebound; the White Hole- up until the point where everything comes out again".
"Very little residual energy reaches the White Hole horizon."
"The bounce is permitted by the symmetry that comes from the reversal of time."
Confusingly again, Rovelli then says;
"But time maintains its direction nevertheless."

The PATH of a WHITE HOLE

Now; "we are done with the star, done with its interior, and done with the horizon".
"A White Hole is, in principle, indistinguishable from a Black Hole. You can fall** towards both. A White Hole is like a Black Hole rebounded. They are both masses that attract the force of gravity." (???)
Abstractly, Rovelli announces that; "A stone can exit from a White Hole and move away freely".....
....Before asking; "But can a stone move freely away from a Black Hole?"
"If someone throws a stone with great force *away* from the collapsing star, a moment before crossing the horizon, the stone will fly away.(Seen from afar as travelling in slow motion)."
"This is the magic of the *elasticity of time*."
"A Black Hole's "horizon is not invariant with the reversal of time; (but) the exterior is".

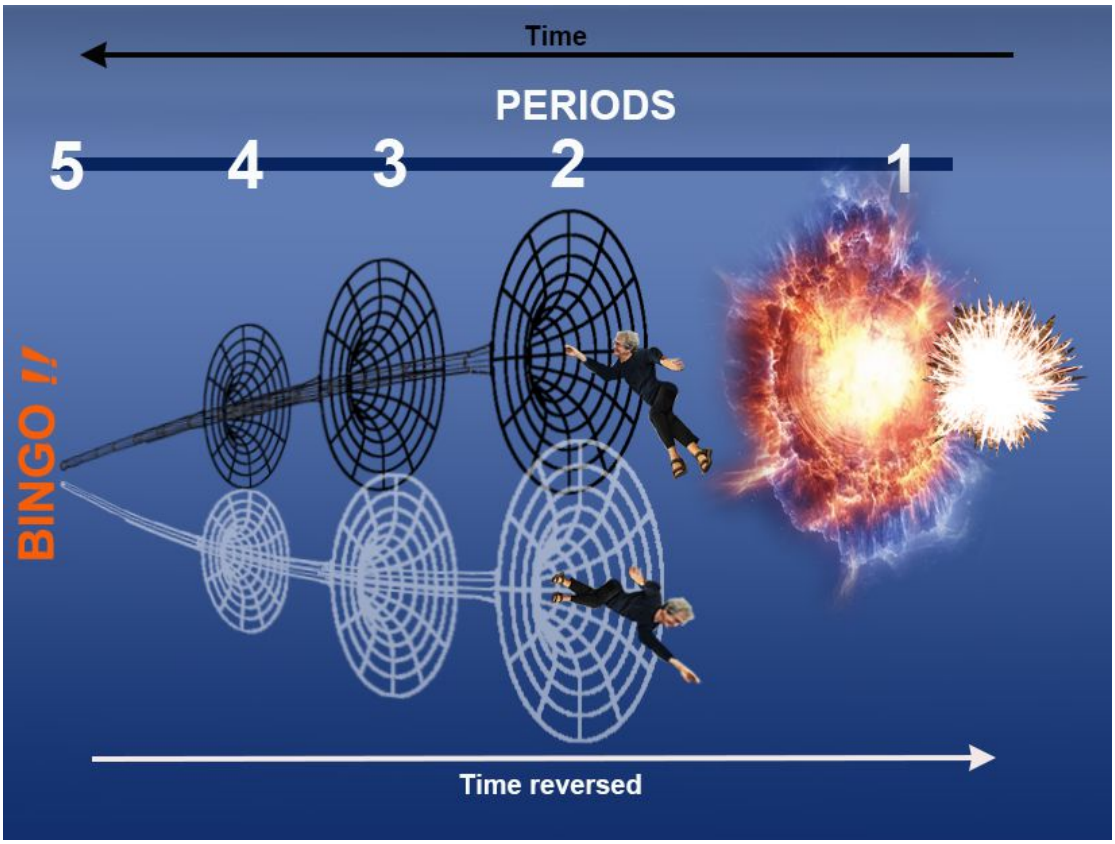
Rovelli is excited as he sums up;

"BINGO (his caps) we have found a plausible scenario for what happens inside Black Holes, beyond the stopping of time.
(My question; how do things move *outside* of time?)
"Beyond the singularity there is the solution *of time reversed* - the inside of a White Hole". "The black horizon, like Gandalf, has magically turned *white."*
Summing up he says;
"All of this seems almost incredible, but this is how nature works".

The GRANDFATHER PARADOX

Carlo Rovelli has a White Hole growing from the remains of a Black Hole.
He claims that it survives by growing *backwards in time*.

If we imagine that a star has collapsed to form a Black Hole in a "Period 1" and it continues to grow during "Periods 2" (when Rovelli crosses the horizon) and "3"; finally beginning to die in "Period 4", with the White Hole forming in "Period 5", then the White Hole will be growing back *through* Periods 4, 3, and 2.



Grandfather Rovelli

The White Hole will, therefore, be occupying *exactly* the space that the original Black Hole inhabited. So both the White Hole and the Black Hole have to be present at the same time!
But the White Hole *wasn't present* when this all started.
Rovelli, voyaging into the Black Hole, would be spotted by Rovelli exiting the White Hole.

The White Hole couldn't be present if the Black Hole had yet to have its lifetime through periods 1 through 5.
The "Grandfather Paradox" prevents Rovelli's naive suggestion of a White Hole's time being reversed.

OTHER FEATURES OF A WHITE HOLE

The Tardis effect;
"Be careful. The shrinking of the horizon does not mean that the interior of the Black Hole becomes smaller. The interior largely remains what it is and the interior volume keeps growing (???)"
"A very old Black Hole turns out to have a particular geometry, an enormous interior and a miniscule horizon that encloses it".

(The interior; (i) remains the same; (ii) it grows, (iii) it's now vast! All at the same time. Fantastic!)

"At the moment of the leap from a Black Hole to a White Hole a Black Hole can therefore have an extremely small horizon and a vast interior. A tiny shell containing vast spaces. as in fables; (!!!) A vast space enclosed into a small sphere is concretely possible".
"The geometry of space is distorted by gravity. This distortion permits a gigantic volume to be enclosed within a tiny sphere. The gravity of a Planck star generates just such huge distortion".

COMPARISONS MADE

"A Planck mass is the mass of a small hair; a speck of dust".
"A White Hole in the sky is like a floating speck of dust".
"Dark matter may be made up, perhaps in part, of billion upon billion of these tiny, delicate White Holes that reverse the time of Black Holes and float lightly throughout the universe like dragonflies".

QUANTUM BEHAVIOUR EXPLAINED (by Rovelli and Hal)

"The simplest quantum property is granularity. Applied to space this basic idea implies that there should be elementary grains of space, of finite size.
"A net is a set of nodes connected by links, the nodes denote the elementary grains of space. They are the quanta of space. The quanta of space are the grains that weave the net that is itself space."

VARIOUS OTHER ERRORS

"A particle does not always have a position. sometimes it can be *nowhere*, disembodied, like a wave, *before* materialising somewhere else"..
"Today we see even atoms through a microscope".

Nevertheless Rovelli criticises many other physicists for failing to see his point of view.
Re the 'information paradox' he dismisses their "dogma" that "information cannot vanish." adding that "(it) must escape though "mysterious and baroque ways" "like Ulysses and his companions escaping from the cave of the Cyclops by hiding beneath sheep."

For those readers who, perhaps didn't quite understood all that has gone before, Chapter 6 repeats it all.

ROVELLI's CONCLUSION

"You can enter a Black Hole but not leave it. You can exit a White Hole but not enter it. So anything that enters a Black Hole can cross the *grey zone;* pass into a White Hole and come out again, allowing what was trapped inside to come out".
"The pieces of the puzzle fit together. (i)The tunnel effect; (ii) the solution of Einstein's equations with White Holes; (iii) the solution with Black Hole's; (iv) the existence of a lower limit to the dimensions of space: (v) the strange behaviour of white and Black Holes, (vi) the *scandalous temporal differences* between what happens on the horizon; and (vii) what happens from afar; (viii) the intuition that things that fall** rebound and (ix) that Planck stars can do that too". (My numbering for clarity!)

"The piece of the puzzle to jettison is (are?) the ideas that events in nature can always be imagined as if they were taking place in space and time".
"Those who are far away from a Black Hole will see what is outside or what is right on the horizon, for them the interior does not exist. but the interior does exist, not only for those who dare to enter, but also for those who have the patience to wait for the black horizon to become white."

"Loop quantum gravity calculations can reveal the number of components by counting the number of quanta of space on the horizon. String theory does the same".

DANTE's contribution

"The relativity of time is an established fact, but a fact that's difficult to digest. Dante too has difficulty facing three, fierce, wild beasts before he crossed the threshold to the inferno".
"Because Dante stepped through a gate and, after a long trip came out alive, so do not worry we too will come out alive- via a White Hole".
"The geometry inside of the space inside Black Hole is actually surprisingly similar to that of Dante's Inferno."
"Unlike Dante's Inferno, which as far as we know stays the same, the funnel here lengthens and narrows with time".
"Einstein's " equations are our faithful guide, like the good Virgil for Dante, showing us the way down further and ever further into the 'blind world'."

MY CONCLUSION

I find the whole work both muddled, repetitious and unconvincing, with the references to Dante unnecessarily pretentious and inappropriate.

I think the translation of the book by Simon Carnell would have benefited by a proper proof-reading, as the early capitalisation, grammar and spelling issues definitely require attention.

NOTES 1

Because Rovelli has been quite disingenuous, not to say careless, regarding the attributes of time, I list below many of the pertinent experiments, the results from which claim to prove Time Dilation. Here are some that fail- as they are flawed.

i) Muon decay
Muons that are taken to speeds close to that of light, in a particle accelerator, and those muons which actually streak down to reach Earth from space, all appear to live longer than otherwise expected; before decaying. This is put down to the fact that their lives are extended by 'time dilation'.

However, as an object increases speed so it also increases its energy; it acquires kinetic energy- energy of motion. Energy is assumed to possess *mass*. Any object *cannot* take on extra energy without, at the same time, taking on the extra *mass* that goes with kinetic energy. And that *extra mass* must take *longer* to decay.

(The *rest mass* does not change. The mass implied by momentum, the so-called *relative mass*, depends, dramatically, on how close to the speed of light the muon is going. At the speeds with which muons go that are created by cosmic rays colliding with the upper atmosphere, the *relative mass* is about 10 times the rest mass.)

I offer the results gained by the experiment carried out at Stanford, California. (For details please see NOTES 2 below).
Stanford scientists accelerated subatomic particles, close to the speed of light, down a straight tube 3 kilometres long. By the time the particles emerged at the other end they had a mass *40,000 times larger* than when they began their journey.
Therefore one would *expect* the accelerated muons to be able to descend a greater distance, from the upper atmosphere, whilst their *additional mass* is taking a *longer* time to decay.

This repudiation also rejects the 'time-dilation / length-contraction 'proving' results from the Brookhaven AGS physicists on Long Island. Here, a muon, with an expected life of 2.2 microseconds was, when accelerated to near light-speed, able to complete 400 laps of the circular Synchrotron when only 15 were expected. Their assertion is that the muon's extended life.... is due to the size of the 14 meter tube *shrinking* for them. But, this is clearly the same error. It's that additional mass again.

ii) Hafele and Keating
The statement; "In 1971 a super accurate (for its time) atomic clock was flown around the world on an airliner, having been synchronised, with another at the at the US Naval Observatory on Earth. When the clocks were reunited, the experimenters found that the round-the-world clock had measured marginally *less* time than its stay-at-home counterpart. Hence time was dilated for the clock in motion".

However the truth is that *Four* atomic clocks were flown, to "even out" (average out) their time keeping! So a difference was *expected* anyway, between the flown and ground-based clocks!
The published results required all the atomic clocks to be precise to one, three and a half trillion, trillionths of a second, which, at that time, no caesium atomic clocks were.

The ground based clock was subjected to critical temperature and pressure *constraints*. However, the flown clocks experienced both temperature and pressure changes.
The whole experiment; the procedure and results, are now recognised to have been riddled with inaccuracies.

iii) The National Physical Laboratory
Both the National Physics Lab and the Paris Observatory have attempted to prove time dilation by comparing and analysing strontium clock's frequencies situated at different latitudes in different parts of the world. Synchronised lasers were employed through optical fibres in order to determine any frequency interruptions, having predicting a difference of 5 nanoseconds.

However, the latest results show that 'alpha' is less than 10^{-8}, which is not at all what 'relativity' predicts. Although these experiments were considered to be far more accurate than earlier tests involving the comparing of caesium clocks, and earlier still, by studying electronic transitions in lithium ions (moving at one-third the speed of light), the results are so inconsistent and woolly as to provide no proof of time dilation at all.

iv) University of Maryland
Now denied through the irregular use of atomic clocks.

v) Michelson Morley
Incorrect use of non-applicable results

vi) The Mössbauer experiment
This was an aether drift experiment, the drawbacks include the limited number of gamma ray sources and the requirement that samples be solid in order to eliminate the recoil of the nucleus.

vii) Ives Stillwell
Direct comparisons between the longitudinal and transverse mathematical predictions under the specified conditions of the experiment are invalid.

viii) GSI Helmholtz Centre
Flaws have been discovered in the procedure and results of this experiment as it exploits a weak decay involving the production of an electron neutrino where attempts were made to relate the observed oscillations to neutrino oscillations.

ix) The Paul trap experiment
Limited accuracy of figures; wrong decision about the 'stationary' ion.

x) GPS Satellites
Complete misunderstanding of the referential way these satellites work.

xi) 'Atomic Clock Ensemble in Space'
So far has no helpful data supplied.

xii Gravity Probe A and The Pound-Rebka
These were both questionable experiments to prove gravitational time dilation. Not relevant here.

xiii) NASA makes no use of time dilation equations in their interplanetary flights. All times are US ground based.

NOTES 2

Details of increasing muon mass experiments
https://content.wolfram.com/sw-publications/2020/07/physics-subatomic-particles.pdf
Extracts*; "the relativistic mass increase in high-velocity particles."*
"The similarity between linear accelerators and synchrotrons allows us to apply again the principle of phase stability . We see that, because of relativistic mass gains the frequency of the accelerating electric wave need only be increased by a factor of five in order to effect an energy increase of around five hundred times."
"At Ester they have been accelerated to 1 NeV, there will be little further increase in velocity, only in mass."
"Because of the relativistic mass increase in high-velocity particles, no more than 15 MeV particles can be produced with cyclotrons of the primitive Lawrence type "

Further MUON experiments from the Stanford Linear Accelerator Centre, Stanford University, Stanford, California;

https://www.google.com/search?client=firefox-b-d&q=stanford+muons+mass#ip=1
https://www.reed.edu/physics/courses/Physics332.s07/pdf/Muon_Mass.pdf
https://inspirehep.net/files/11ab7c7cc38f74ec11d4426f196a5783
http://www.inp.demokritos.gr/~rapidis/CVlong/Rapidis_all_pubs/a039.pdf
https://journals.aps.org/pr/abstract/10.1103/PhysRev.131.1782