Gerard 't Hooft

PROFESSOR of PHYSICS • NOBLE LAUREATE

Institute for Theoretical Physics • University of Utrecht

Email Correspondence

May 20 – 24, 2015

PREFACE

As a youngster, Nobel Laureate 't Hooft's goal in life was quoted as being "a man who knows everything." In his Nobel Prize Autobiographical essay, 't Hooft explains that all he meant was that he wanted to be a "scientist."

Virtually all of 't Hooft's work is so abstract and abstruse as to defy any brief summary explanation, much less any clearcut connection to physical reality. As in the Preface to my correspondence with Carlo Rovelli, I reiterate my standard of judgment: Does the new work purporting to be about gravity (dark Planck-scale holographic string-brane, divide-by-zero-land inflatonic multiverse) help to explain our actual *experience* of gravity? What does matter *do* to make spacetime curve? What does matter *do* to produce non-zero accelerometer readings at Earth's surface and zero readings for falling accelerometers?

't Hooft is but one member of a vast community of academic scientists who never ask such questions. From their work and, I think, from the following correspondence, it becomes clear that—at least in 't Hooft's case—he thinks of himself as being *above* such elementary concerns; he thinks of himself as such a superior scientist that he regards those who ask simple questions as authors of "babyish ignorance."

In the course of flaming—er, "explaining"—this to me, 't Hooft reveals his own ignorance of, for example, the Schwarzschild *interior* solution. By misquoting me as referring to "the interior of a Schwarzschild solution," he seems to construe my concern as being about the never-neverland of what lies within the geometrical "event horizon" of a Schwarzschild *exterior* solution. (That is what the entertainment industry of gravitational PhDizzix is largely concerned about.)

My attempt to re-direct from this misunderstanding to more concrete matters reveals that 't Hooft *intends* only to miss the point. Readers are given ample evidence from which to decide whether or not 't Hooft has fulfilled his dream of becoming a scientist, or perhaps just a smartypants bully.

Finally, note that 't Hooft's concluding assessment of documents that I attached or cited for him implies that he thinks their *age* contributes to making them "totally wrong." Those references are entirely consistent with Schwarzschild's highly acclaimed 1916 original—as well as more modern ones, of which 't Hooft is evidently unaware. Their age is obviously irrelevant. If they are incorrect, the onus is on 't Hooft to identify the errors.

As though the Pythagorean theorem has a shelf-life. *Oiy vay!*

NOTE: The Mr. Natural postcard that 't Hooft replied to was not sent to him. I suspect it was given to him by his colleague, Tomislav Prokopec—at the same institution, in the same department—to whom I sent a card a few weeks prior to the following correspondence. Both front and back sides of the card to Prokopec are attached at the end.

Hooft, G. 't, 5/20/15 12:33 AM -0800, wrong experiment **1**

From: Hooft, G. 't <G.tHooft@uu.nl>
To: rjbenish@comcast.net <rjbenish@comcast.net>
Subject: wrong experiment
Date: Wed, 20 May 2015 08:33:53 +0000

L S ⁂ L S is a common Dutch salutation, which means "Lectori Salutem."

I found on my desk a postcard with on it a childish idea for an "experiment" by a "Mr. Natural." Before placing this postcard where it belongs (the trash can), let me just explain a few of the misconceptions that it displays.

First misconception is that modern science could be helped by any such experiment: Experiments of many kinds, including table-top experiments, have been done thousands of times by school kids and students. There are two possible outcomes: wrong ones (the majority, after all, these are school kids), and ones that confirm what we already know about nature's forces.

Second misconception: "easy" and "cheap" experiments won't contribute to science at all. If, for instance, one would want to know what Newton's gravity theory says about the outcome, one finds forces that cause motion on the one hour time scale, far too weak for any school kid to detect. One *can* detect such forces (the Cavendish experiment) but those are very sophisticated, difficult experiments. They have been done much better than the set-up suggested on the post card. For instance, what science is really interested in is how gravity may work at scales below a small fraction of a mm. Such experiments have indeed been done but they are very difficult. No deviation from Newton's law was detected.

So please don't think that science "does not know" what the outcome will be from a stupid, ill conceived idea such as on the post card. The statement "we do not have any physical evidence" confirms the babyish ignorance of the author.

G. 't H

Hooft, G. 't, 5/20/15 9:57 AM -0800, Re: wrong experiment **2**

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments: <Galileo's-Belated-Experiment.pdf>

> Dear Professor 't Hooft,
>
> Many thanks for your comments on the Mr. Natural postcard.
>
> One of its purposes, of course, is humor: to "Lighten Up!" and laugh at ourselves. Your colleagues Carlo Rovelli and Matt Strassler were kind enough to convey that, to them, the card fulfilled this purpose.
>
> As for its scientific content, this is based on the fact that, with regard to gravity-induced MOTION, General Relativity's (Schwarzschild's) INTERIOR solution has never been tested.

> Specifically, Galileo's kinematic experiment would test GR's prediction that the rates of clocks inside matter get slower toward, and have a local minimum at, the center.
>
> Also, I just think it would be a cool experiment to see. I'd guess that Galileo—perhaps because he was a child at heart—would have liked to see it too. (See attachment.)
>
> Cheers,
>
> Richard Benish
>
> PS,
>
> I am reminded of a comment by one of your fellow Laureates:
>
> "No experiment is so dumb that it should not be tried." —
>
> [Walter Gerlach, Physics Today, Dec. 2003, p. 54.]
>
> RB

Hooft, G. 't, 5/20/15 10:01 AM -0800, Re: wrong experiment 3

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Wed, 20 May 2015 18:01:20 +0000

> Maybe I receive too much crackpot mail. Sorry. But you still seem to think that this might be real science…

Hooft, G. 't, 5/20/15 12:42 PM -0800, Re: wrong experiment 4

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Cc: warshafsky@comcast.net
Attachments:

> > Dear Professor 't Hooft,
> >
> > Apology accepted.
> >
> > According to the astronomer, Bradley Shaefer, "Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."
> >
> > Since we have not yet empirically explored the motion of falling bodies through the centers of larger bodies, and standard wisdom is to pretend to know what we would find if we did, how would doing Galileo's experiment NOT be "real science"?
> >
> > Best regards,
> >
> > Richard Benish

Hooft, G. 't, 5/21/15 12:20 AM -0800, Re: wrong experiment **4**

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Thu, 21 May 2015 08:20:01 +0000

Because much more accurate experiments have been done — many times. ✻
No unexpected forces were found.

Your mass-with-a-hole-in-it is not exactly an interesting case of "the interior of a Schwarzschild solution." It is scientifically very uninteresting. Because any expected force, even any unexpected force, would not be detected that way. ✻

G. 't H.

✻ The logic of 't Hooft's first sentence is like this: **Q:** How deep is the ocean? **A:** We don't need to measure the ocean because we've done "much more accurate" measurements of the depth of swimming pools

Note also that MIT professor and Nobel Laureate, Rainer Weiss, proposed a similar experiment to look for *changes* in the the gravitational force. This proposal was the Master's Thesis of one of his graduate students in 1968. (See Weiss Correspondence.) It required extreme long-term stability, unlike what would be needed to simply demonstrate the predicted oscillation, which is my much more humble goal. Any change in the "expected force" would certainly be as "scientifically very interesting" as an unexpected force *per se*. Weiss' more stringent demands were too difficult to achieve, so the experiment was never done. Galileo's experiment is no less interesting because *no human has yet seen gravity-induced radial motion of one body through the center of another.* It's unexplored territory.

Hooft, G. 't, 5/21/15 9:10 AM -0800, Re: wrong experiment **5**

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

Dear Professor 't Hooft,

I understand your reasoning, I really do.

But please consider an analogy between Galileo's experiment and the kinds of gravity experiments that have been done inside matter. Galileo's experiment involves witnessing the MOTION produced by gravity from one extremity of the source mass to the other. Whereas, experiments inside matter such as you have alluded to may all be characterized as STATIC measurements, experiments that, as you have pointed out, measure FORCES on bodies that are somehow constrained not to move very far.

It may seem that measuring such forces suffices to deduce the motion they would produce. And yet we have never actually SEEN such motion unfold inside matter. Measuring the forces is analogous to hearing the sound and smelling the gun powder of a gun, but not seeing the bullet—never witnessing any effect of the bullet.

For the sake of completeness and to provide empirical support to the many references to this experiment (e.g., freshman physics texts), I think we need to PROVE that the gun (Newton's and Einstein's theories of gravity) is not shooting blanks. I know how unlikely that may seem, given their enormous success outside material bodies. But we have not yet conclusively established that the success with regard to gravity-induced motion extends inside material bodies.

Finally, note that your reasoning has the character of extrapolation: You extrapolate empirical success outside matter, and you extrapolate from the presence of static forces to the motion you expect these forces to produce. Therefore, I would like to close with some advice from Herman Bondi on the danger of being satisfied with such extrapolations:

Hooft, G. 't, 5/21/15 9:10 AM -0800, Re: wrong experiment **5**

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

> "It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is doing so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called speculation."

From all of the above, I'd say your judgment that actually doing Galileo's experiment (i.e., building and operating a Small Low-Energy Non-Collider) is not "real science" is rather harsh and inaccurate. On the contrary, isn't doing the experiment a way of being an especially thorough and conscientious scientist?

Respectfully,

Richard Benish

Hooft, G. 't, 5/22/15 1:19 AM -0800, Re: wrong experiment **6**

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Fri, 22 May 2015 09:19:33 +0000

> But your experiment is not at all about being "inside" matter: you're inside a hole in matter, but all the atoms are outside your measuring device, whatever it is. And the motion you talk about will be so slow that expecting any effect from that is unreasonable. I think it would be a fruitless exercise. Of course you'd be welcome to do such experiments, but don't expect anything unusual apart from errors
>
> G.'t H

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

Dear Professor 't Hooft,

If it's not about being "inside" matter, then I wonder why Schwarzschild and those who continue to call his solution for a uniformly dense sphere the "INTERIOR solution" have named it so. The hole, of course disrupts the uniformity, but only to a negligible degree for experiments that would clearly TEST this (to my mind) suitably named interior solution.

Should we not be grateful that Nature allows probing GRAVITY by such interior tests, as compared with atomic matter, which we never actually get to the center of? In the realm of atomic matter we rely primarily on COLLISION experiments (e.g., the Large Hadron Collider, Relativistic heavy Ion Collider, etc.). Gravity is evidently the only force of Nature whose essence may be probed by using a Small Low-Energy Non-Collider—no collision at all!

Slow though the motion may be, the whole point is that nobody really knows what that motion is, because nobody has ever SEEN it. Everybody agrees what Newton's and Einstein's PREDICTIONS are, but nobody has ever TESTED them. If you think testing the predictions of the theories of these illustrious scientists by performing an experiment proposed by the veritable Father of Modern Science would be "fruitless," then I would have to disagree with your conception of what science is supposed to be.

Best regards,

Richard Benish

PS:

The motto of the Royal Society is "Nullius in verba," which roughly means: "Take nobody's word for it." On the Royal Society's website they expand this meaning thus:

> [The motto]…is an expression of the determination of Fellows to withstand domination of authority and to verify all statements by an appeal to facts determined by experiment.

The idea thus reinforces Bondi's advice to not accept as "self-evident" that which authorities (or equations) suggest would be found where we have not yet actully looked.

The predictions of Newton and Einstein concerning Galileo's interior solution test have not yet been "verified by appeal to facts determined by experiment." I would therefore guess that Galileo, Newton and Einstein would have not only "welcomed" an experiment such as Galileo proposed, they would more forcefully have ENCOURAGED those with the needed resources (modern technology) to not delay in actually performing it. If "nothing unusual" happens, then we will at last be able to justify asserting this as a physical FACT.

Finally, why not be more ENTHUSIASTIC about filling the conspicuous gap in our empirical knowledge of gravity? Is it because it's a little embarrassing that nobody has thought to do so before? If so, is this a sufficient reason?

R B

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Sat, 23 May 2015 07:36:19 +0000

First of all, you were thinking of an "experiment on matter," but all matter we can use is so extremely tenuous that all gravitational forces are linear in its density. This has been tested. It has NOTHING to do with Schwarzschild, which is non-linear. What shape your matter takes (be it a sphere with a hole in it) is immaterial, for the grav. force is trivial to compute. Actually, experiments that are of the type you suggest, are frequently carried out for the planet earth itself, when gravitational anomalies are measured (from space or from holes in the ground).

This is just a lie—a flagrant, ridiculous, Trump-like lie.

Please, it is known in meticulous detail how to do that. And we have a pretty good idea what motion is. How would you think NASA can shoot its space shuttle anywhere it likes to, if NASA didn't know what motion is?

I frequently get nonsense mail like this.

G.'t H

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments: < GR Interior Oscillator Taylor 1961.pdf >

Dear Professor 't Hooft,

It seems you are unaware that Schwarzschild derived two separate solutions to Einstein's field equations. The most well known one, the EXTERIOR solution is of course highly non-linear because it relates to the inverse-square gravity field over a body's surface—used by NASA and as the basis for most of the well known tests of GR.

Schwarzschild's INTERIOR solution, on the other hand, relates explicitly to the case of a uniformly dense sphere. This solution is the basis of N. W. Taylor's treatment (attached) of the harmonic oscillation predicted thereby, and the related effect on clock rates (one at rest at the center, one at rest on the surface, and one falling between the extremities).

[See also F. W. Tangherlini, 'Introduction to the General Theory of Relativity,' *Nuovo Cimento Supplement*, 1961, No 1, pp 66–68. And Adler, Bazin and Schiffer, *Introduction to General Relativity*, 1965, pp. 280–295.]

Experiments such as you have mentioned involving "gravitational anomalies" on or around Earth all relate to the EXTERIOR solution, and do not directly pertain to my immediate purpose.

Whereas Galileo's Small Low-Energy Non-Collider experiment, which has been the focus of the Mr. Natural postcard and most everything else I've written to you, has EVERYTHING to do with the Schwarzschild INTERIOR solution. As implied in the paper by Taylor, the central clock rate minimum, which this solution predicts, has a direct Newtonian counterpart in the simple harmonic motion prediction, as frequently discussed in freshman level texts.

In my opinion, readers of these texts (and everyone else) deserves to have the predicted pattern of motion VERIFIED by direct empirical evidence. To me, the act of performing Galileo's experiment would represent living up to the ideals of science, as stated in the Royal Society motto, by Bradley Schaefer, Herman Bondi (as quoted earlier) and many others. Doing the experiment would turn an assumption (a prediction) into a physical fact. This is desired—or even REQUIRED—because physical facts are the veritable currency, the FRUIT of science.

I think it is sad that you see this mission of seeking empirical evidence to back up a common prediction as "fruitless." You seem to regard the ASSUMED result of a test of the prediction as being sufficient. This strikes me as reflecting an utterly unscientific attitude.

Such is the difference between us. In spite of my earnest efforts to disregard your condescending tone, so that we might communicate about physics, you continue to find ways to misunderstand the simplest things I've said.

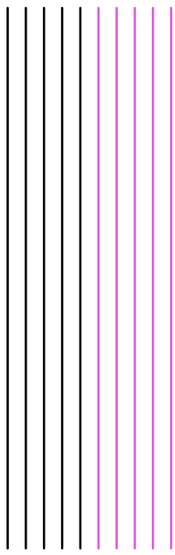
If you cannot provide references to empirical evidence proving the correctness of the gravity-induced radial simple harmonic oscillation prediction, and if you have no interest in having the experiment performed, then let's call this correspondence over, because it has become rather tiresome.

Thanks for your feedback.

Sincerely,

Richard Benish

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Sun, 24 May 2015 17:48:52 +0000



As far as I can see this is an ancient reference and totally wrong.

Secondly, your "experiment" will reveal nothing about the Schwarzschild solution interior or exterior, but just Newtonian gravity. Schwarzschild also does not refer to a solution with a solid sphere.

Please don't think that we don't know or have no information about, gravity inside matter. Think of the insides of a star or a planet. There, relativity *does* give observable corrections. All this has been investigated extensively.

Don't think Mr. Natural, or any such person, can measure departures from the clock rate inside matter—that would be an extremely difficult measurement considering the accuracy required.

If I misunderstand the simplest things you said it is because they are totally wrong. I'm sorry.

G. 't H

"Sorry" don't pay the bills.

***Sheesh*, wutta jerk!**

Mr. Natural SAYS:

If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...

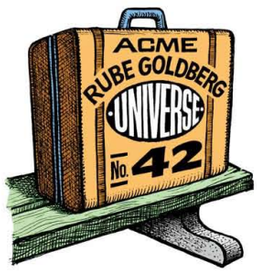
If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...

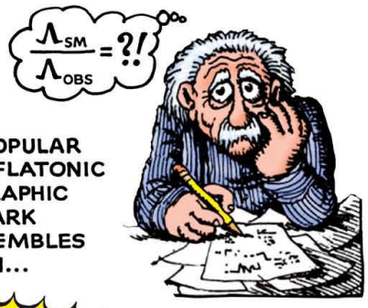
If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...

If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...

OR

If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...





Lighten Up!

Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of

MODERN SCIENCE

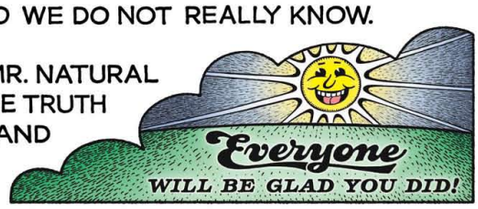
Galileo  Galilei

Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:

TWO UNDISTURBED BODIES OF MATTER  SMALL LOW-ENERGY NON-COLLIDER

Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET **OBSERVED** GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE **NO DATA,** SO WE DO NOT REALLY KNOW.

Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST **SMALL LOW-ENERGY NON-COLLIDER.**



GravitationLab.com • rjbenish@comcast.net

APRIL 20, 2015

Dear Professor Prokopec,

Einstein strongly advocated letting the imagination run wild, toward the extremes of "highest abstraction." [IDEAS & OPINIONS, p. 282] After decades of voluminous work in this direction, our efforts to quantize and unify gravity remain fruitless; the long sought evidence of gravitational waves remains elusive, and speculations about various invisible extreme conditions of the cosmos are well-characterized by literal and figurative darkness. Perhaps Einstein was too quick to dismiss the value of direct physical experience. Perhaps we have overlooked some crucial clue "hiding" right under our noses, our real physical noses.

It is commonly believed that GR has been well-tested on scales from mm to AU. True as this may be for the Schwarzschild EXTERIOR solution, it is not at all true for the INTERIOR solution.

The most physically significant feature of the interior field of a uniformly dense sphere is that the rate of a clock at its center is supposed to be a MINIMUM. So it is predicted. Humanity has not yet tested this prediction on any scale. The most ponderous half of the gravitational Universe (under our noses) thus remains to be empirically explored.

One of the kinematic consequences of the central clock rate minimum (as commonly treated in Newtonian gravity) is the oscillation of a test mass dropped into a hole through the center of a larger, massive body. Evidence bearing on the kinematics and (indirectly) clock rate could be gotten by conducting Galileo's experiment, as described on the front of this card. It could be done in an Earth-based laboratory (with a modified Cavendish balance) or in an orbiting satellite.

I would therefore urge you to please help to generate interest in performing this experiment that Galileo proposed so long ago. To be truly diligent in our investigation of gravity and the physical world, should we not bring Galileo's proposal to fruition by building and operating humanity's very first SMALL LOW-ENERGY NON-COLLIDER?

Thank you very much.

Sincerely,
Richard Benish

Post Card

THIS SIDE FOR THE ADDRESS

To: Professor Tomislav Prokopec
Minnaertgebouw 405
INSTITUTE for THEORETICAL PHYSICS
Leuvenlaan 4
3584 CE Utrecht • The NETHERLANDS

WIKIPEDIA

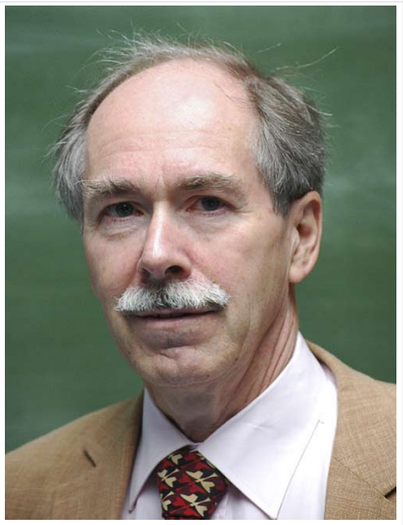
Gerard 't Hooft

Gerardus (Gerard) 't Hooft (Dutch: ['ɣeːrɑrt ət 'ɦoːft]; born July 5, 1946) is a Dutch theoretical physicist and professor at Utrecht University, the Netherlands. He shared the 1999 Nobel Prize in Physics with his thesis advisor Martinus J. G. Veltman "for elucidating the quantum structure of electroweak interactions".

His work concentrates on gauge theory, black holes, quantum gravity and fundamental aspects of quantum mechanics. His contributions to physics include a proof that gauge theories are renormalizable, dimensional regularization and the holographic principle.

Contents

Gerard 't Hooft



November 2008

Born	July 5, 1946 Den Helder, Netherlands
Nationality	Dutch
Alma mater	Utrecht University
Known for	Quantum field theory, Quantum gravity, 't Hooft–Polyakov monopole, 't Hooft symbol, 't Hooft operator, Holographic principle, Renormalization, Dimensional regularization
Awards	Heineman Prize (1979) Wolf Prize (1981) Lorentz Medal (1986) Spinoza Prize (1995) Franklin Medal (1995) Nobel Prize in Physics (1999) Lomonosov Gold Medal (2010)
Scientific career	
Fields	Theoretical physics
Institutions	Utrecht University
Doctoral advisor	Martinus J. G. Veltman
Doctoral students	Robbert Dijkgraaf Herman Verlinde

Personal life

He is married to Albertha Schik (Betteke) and has two daughters, Saskia and Ellen.

Biography

Early life

Gerard 't Hooft was born in Den Helder on July 5, 1946, but grew up in The Hague, the seat of government of the Netherlands. He was the middle child of a family of three. He comes from a family of scholars. His grandmother was a sister of Nobel prize laureate Frits Zernike, and was married to Pieter Nicolaas van Kampen, who was a well-known professor of zoology at Leiden University. His uncle Nico van Kampen was an (emeritus) professor of theoretical physics at Utrecht University, and while his mother did not opt for a scientific career because of her gender,[1] she did marry a maritime engineer.[1] Following his family's footsteps, he showed interest in science at an early age. When his primary school teacher asked him what he wanted to be when he grew up, he boldly declared, "a man who knows everything."[1]