The importance of recognising fringe science

Gerard 't Hooft

Institute for Theoretical Physics
Utrecht University

Postbox 80.089
3508 TB Utrecht, the Netherlands

e-mail: g.thooft@uu.nl
internet: http://www.staff.science.uu.nl/~hooft101/

Abstract

In book stores and on the internet, numerous expositions can be found of what could be called 'fringe science'. They generally consist of theories and ideas that run against long-accepted wisdom in science. Some of these concoctions are easily recognised as such, but some do have the air of displaying important oversights of standard theories, in what sounds like a professional language. For young, beginning students of science these may be dangerous traps, and falling for them might bring real damage to their careers. We attempt to describe what we mean by 'fringe science', how to recognise it, and also where it borders to real science.

The direct cause for this paper is a rather vicious recent resurgence in theoretical physics, a field where recognising fringe science should be easy. We are worried about the situation in other doctrines.

This is not a scientific paper in the usual sense. We try to avoid belligerence.

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1 Introduction

Modern science is seen as a gigantic intellectual edifice comprising all that is known about the natural world, including its lifeless as well as its living inhabitants. All scientific findings hang together, and whenever an apparent contradiction is spotted, scientists relentlessly investigate the situation for as long as is needed to figure out what the true situation is. We are not happy with incomplete or dubious answers; as long as there is no absolute clarity, we continue to doubt until we might feel satisfied that we are completely in control. Even then, doubts may reappear every now and then, and it may even happen that newcomers and amateur scientists manage to punch a hole in established knowledge.

This does not happen often, but it is not excluded, and all sincere concerns about our understanding are reacted upon meticulously.

Such concerns must be well-motivated and well documented. In the case of amateur scientists, the professionals often immediately notice the weak spots in their stories, and in a vast majority of cases, no further reactions are needed at all. We receive letters and mails all the time, and the senders often fail to comprehend the reasons for the immediate rejection of their ideas and findings. They often blame the scientific establishment, suspecting them of some sort of malice. What then happens differs from case to case. This author usually advises amateur scientists to take their subjects more professionally, by getting hold of university lecture notes, or better still, by entering universities and following regular courses from beginning to end.

These should be good advices, but the practitioners of science come from many different places and not all recommendations apply to all of them. They certainly cannot all be cured from having ill-motivated beliefs, including the belief that they are the victims of malicious actions by the "scientific establishment".

In reality, they are the victims of their own ignorance, but this, of course, is difficult to explain. The ignorance is viciously denied. Now one might have thought that such things should not happen often in theoretical physics. Our field is completely controlled by solid mathematical analysis, so it may be surprising that, even here, we have to deal with a number of cases. Amazingly, these amateurs form groups in mutual admiration, and appear to form a mighty, and indeed quite colourful, army against the sturdy edifice of what is seen as an evil empire, called mainstream science.

If this can happen in theoretical physics, what will the situation be like in other fields of science? I can only imagine that the situation in biology, medicine, or history, will be far worse. Many fields of science are not upheld by solid mathematical constructions; these hardly exist in many circumstances. The life sciences proceed by careful examinations of the innumerable life forms found on this planet, and perceived suspicions concerning the existence of evil powers here, will be a lot more difficult to combat. And what about political science and law? Here, the subject itself is about the feelings of well-being by humans. In this, the border between fringe political principles and really valid ideas will be much more difficult to locate, if even it exists. I would be interested in comments from that side.

Back to physics. One might argue that a serious student, equipped with functional amounts of common sense and intelligence, will be able to steer away from the numerous accounts on the internet by misled amateurs. But in some cases this is not quite so easy. The authors of fringe papers on the net appear to be amazingly intelligent, and they succeed to hide the shortcomings of their self-proclaimed theories very well. I noticed in some occasions that they widely receive warm applause by an audience of equal-minded enthusiasts on their weblogs. I find this worrying. Can't these people punch holes in the ill-conceived concoctions? Apparently not. How can beginning students select the right papers to read and study? We should advise them. This motivated this paper.

2 Characteristics

There are a number of characteristics that will enable one to judge whether a paper that appeared on the web is real science or not. Papers not to be taken seriously often share the following:

- Polemics. Fringe papers often claim that a whole gang of practitioners of mainstream science are defending "wrong" notions, and that they conspire just to ensure their university positions and their salaries.

- Arguments are employed that are quite unconventional as compared with the standard theories, while they nevertheless may sound professional.

- The major parts of these arguments explain why the standard theories are completely untenable, and how they should be replaced. Quantitative analysis as to how one should replace the standard theories is rarely provided; they think that it suffices to state that the standard theories are wrong, so that the things they replace them with need no further justifications.

- The authors have not been able to get their work published in the scientific journals that would have been chosen by professionals. Such journals are peer reviewed, and no reviewer would have approved the work. This is because professional reviewers have no difficulty spotting fatal shortcomings.

Such authors even fail to get their work published on the web service that is freely accessible to investigators with a university affiliation. This service is referred to as the "arXiv"; respected scientists simply send their work to this archive before it is peer reviewed. Yet arXiv does have a safety shield: if you are *not* affiliated to a university you are requested to seek the support from an acknowledged scientist; if you get such support they will accept your papers. Fringe scientists are unable to pass this safety shield.

Now it so happens that they do have a way to get their work published on the web. It was a good idea by Philip E. Gibbs to institute a medium for those authors who otherwise cannot get their work published anywhere else. It is called "viXra" ("arXiv" spelled backwards). It is a repository for papers claimed to be scientific by their authors, but with no restrictions other than the use of proper language and decent scientific conduct. The scientific content is not judged at all, even if one can see right away that a paper does not contain acceptable science. So it is an outlet needed for people who do want to be heard. It does this job well, even if only few professional scientists ever download work from this source. When a paper is published in viXra, it is usually a sign that it is not likely to contain acceptable results. It may, but the odds against that are considerable (I do know some exceptions).

3 A case study

There are numerous examples of fringe science claims. In theoretical physics, there is a group of several authors who are holding together, supporting each other. A recent genius in this group has been putting you-tubes on the web explaining his brilliant ideas. One of his findings, also defended by other members of his group: *the sun is made of a liquid, with a gas envelope.* Liquid, at 3000 and more degrees? Yes, because gases only have discrete light spectra; to get continuous spectra, you need liquids or solids. The dark Fraunhofer lines reveal the gas enveloping the sun, but the continuum comes from a liquid surface, or so they claim.

The standard picture is that the sun consists of a gas, or more precisely, a plasma (a gas made of conductive material, showing special properties because of the intricate ways it reacts with magnetic fields). To see how the spectral lines come about, you need Kirchhoff's law. And therefore, according to this author, Kirchhoff's law is wrong. He does not say what it is to be replaced with. Why is this blatantly incorrect?

The properties of matter under the conditions valid at the sun's surface and at its interior, can to a large part be investigated in laboratories on Earth. So the sun is no mystery anymore; its behaviour is understood in great detail, unravelled even further by observations from outer space at various distances from the sun. Astrophysicists talk about the 'solar model'.

The solar model is a precise reconstruction of everything that happens on and inside the sun. Profiles of temperature and pressure distributions, as well as the chemical composition, are reconstructed. All chemical and nuclear interactions inside the sun are analysed, the heat production and the conduction of heat are computed. One of the more difficult features is turbulence that takes place inside parts of the sun. Subsequently, the model is tested in all ways available to science: seismic vibrations and their (quite complex) frequency distribution are monitored; neutrinos emitted by the sun are detected. Several decades ago these neutrinos still showed deviations from the expected rates, but these discrepencies disappeared when neutrinos were shown to have mass and they undergo flavor transitions. We end up with thousands of data that now agree. So, if someone says “it is all wrong”, indeed he is not heard – unless, of course, detailed arguments are also provided concerning the seismic and the neutrino data. Usually, the amateur authors are unaware of the existence of all these scientific checks.

We know how matter in it behaves, and we have detailed theories for that as well. The theories match with observations of matter on Earth, as well as the theories of the behaviour of atoms and molecules in terms of the sub-atomic particles they are made of. The fact that these things are known is simply dismissed by this author, who puts nothing in its place.

So, is matter near the surface of the sun liquid or gaseous? Actually, what is the difference between a liquid and a gas? What is the difference between water and steam?

This difference is not so great; in a liquid, as well as in a gas, particles move around chaotically. But a liquid has an almost constant density, while the density of a gas is approximately proportional to the pressure it is subject to. Now the density of a liquid is not totally independent of pressure, and if you heat a liquid, is does expand. For any liquid, one can find a special point in its phase diagram, called “critical point”, with the property that the gas phase can be well distinguished from the liquid phase at temperatures below the critical value, while above the critical value the gas just smoothly goes to the liquid phase when one increases the pressure. But exactly at what point above the critical temperature, the substance ceases to be a gas and turns into a liquid, one cannot say; it is ill-defined.

For most substances, the critical point is below 1000 degrees Celcius; for water it is 374 degrees Celsius; for hydrogen, the main constituent of the sun, is is way below the freezing point: –240 degrees Celsius. If the sun would be made of pure Caesium, the critical point would have been nearly 1700 degrees Celsius. The sun, consisting mainly of hydrogen with a little bit of Helium (critical point –268 Celsius) has a temperature of 3000 degrees at its surface, and millions of degrees inside. Under these circumstances, the difference between the liquid phase and the gas phase is nil.

How about that spectrum of light? Here, one has to understand Kirchhoff’s law. It states that the energy density of electromagnetic radiation inside any form of matter, is a smooth curve (continuum), which can be measured and calculated precisely, as soon as the temperature of the material is in equilibrium with the in-falling radiation. If the energy density of the radiation corresponds to a temperature that exceeds that of the material, the material will absorb radiation. If the radiation has a lower temperature than the material, so that its energy density is less, the material will pass on energy to the radiation field, cooling down in the process, while the radiation intensifies. One can see that the interaction between matter and surrounding radiation is always such that matter and radiation move towards matching each other's temperature. This is indeed what one would have expected from the second law of thermodynamics.

Now why does a gas have distinct spectral lines? We learn this, and we teach this, in our astrophysics classes. The atoms (or molecules) in a gas (or a liquid) vibrate at specific frequencies. Light of these frequencies interacts much more strongly with matter than light at different frequencies. In gases whose molecules consist of single atoms, there are only a few frequencies at which atoms can vibrate. If a gas is colder than the radiation going through, it absorbs the light mostly at these frequencies. This is why we see sharp, dark lines in the spectrum of the sun; apparently the sun has an outer layer of gas that is cooler than the region from where most of its light is emitted. But if you point the spectrograph away from the solar disk, directly to the corona, then the background radiation is mainly that from the surrounding vacuum, much colder than the gas, so there, we see bright *emission lines* instead of absorption lines.

All this gets more complicated if you realise that, further out from the sun's surface, the corona is actually very hot, but tenuous. So to explain the exact light spectrum from the sun and its surroundings, one has to go into many more astrophysical details, far too complicated for that author. He actually goes on to argue that the cosmic background radiation is also not what all mainstream scientists say. Blaming these observations to stray radiation from the surface of the earth he also only reaches deaf ears from the experts. These experts are quite aware of all possible background sources; it would be strange indeed if they had forgotten that Planet Earth is close by; it was even closer when the first observations were made from the ground, so naturally, these experimenters found it beneath their dignity even to react.

As a besides, Kirchhoff's law comes in combination with Max Planck's famous result on the actual shape of the radiation curve of the continuum, so according to that author, Max Planck had that wrong also. Many of the developments of the 20^{th} century were related to his expression for this radiation curve, so one century of theoretical and experimental physics was declared to be mostly wrong.

The image of science pictured here is that it looks like domino tiles standing in long rows. By throwing one of them over, the fringe scientist imagines that all others will topple as well. In reality, scientific information hangs together in a much more sturdy manner. You can't throw one tile over because it is held up by many surrounding tiles. Throwing two or more of them over is even more difficult. There are still too many left to prevent this from happening.

4 Recommendations

Most real scientists do not react at all when they get messages from members of any group of this sort, or from lone wolves, asking them to revise everything they know about science, because there are some features of modern science that they declared to be “wrong”. Scientists who do not react are called names, but they have to take in much worse insults when they do try to explain how their science works. Our motivation to try to explain this anyway is not so much our “fear” for fringe scientists themselves, but our wish to inform younger students about what science is and what it is not.

Thus; if we receive abusive mails we just ignore them. The point of concern is the followers they get. How do young people distinguish inferior science from the real thing? People who consulted the page “How to become a GOOD theoretical physicist”[1] were advised to consult lecture notes that we could select from sources at respectable universities, but we also had to advise them to search for more on the net. Rule number one is then that university based lecture notes must be given priority. Furthermore, if several unquestionable results from standard science need to be revised in one stroke, to justify one author’s claims, then it may be concluded that those claims must be taken with extreme skepticism.

Mainstream science will never stay unquestioned. Frequently, perfectly respectable tests are performed trying to detect deviations from standard wisdom. Even if the outcomes of such tests are easy to predict, these are nevertheless often approved by scientific majorities. Theories that require modifications in what we think we know, are proposed and discussed, also in the established and peer reviewed literature, but at the same time we do request that authors of such proposals give sound motivations for their ideas, explaining how their ideas might be reconciled with many earlier scientific findings. We must always remember that science forms one unity, with innumerable cross links.

References

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