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# Where does the "God" within the "God particle" come from? Cultural sociological analysis of the Higgs boson research

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# Declaration

I hereby declare that this thesis I submit for assessment is entirely my own work and has not been taken from the work of others save to the extent that such work has been cited and acknowledged within the text of my work.

5th January 2015

Signature

# Acknowledgements

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# Table of Contents


Abstract ... 7
Abstract in Czech ... 8
1. Introduction ... 9
2. Theory and methodology ... 13
   2.1 Writing a comprehensible story ... 13
   2.2 Structural hermeneutics ... 15
3. The story of "The Boson" ... 18
   3.1 Motivation ... 18
   3.2 CERN ... 19
   3.3 Quantum mysticism ... 21
      3.3.1 Czech media discourse ... 21
      3.3.2 Worldwide media discourse ... 23
   3.4. Little bit obscure, little bit science: two examples of liminal "realities" ... 24
      3.4.1 Educational video by the National Science Foundation ... 24
      3.4.2 Angels & Demons by Dan Brown and Ron Howard ... 27
4. Into the "laboratory" of quantum physics ... 31
   4.1 Quantum physicist's everyday life at CERN ... 31
   4.2 Discourses: apophantic theology ... 34
   4.3 The "myth" of QM ... 37
5. QM as a phenomenon *per se*: phenomenological perspective ... 40
   5.1 Classical mechanics ... 40
   5.2 The "advent" of QM ... 41
   5.3 Phenomenological approach to QM "adventism" ... 42
   5.4 As if it has always been here ... 45
6. Inbetweenness: between mystery and reality ... 49
   6.1 Liminality ... 49
   6.2 Not so disenchanted science ... 52
   6.3 The "God particle" as a teleological icon ... 55
7. Conclusion ... 64
References ... 69
Internet and public media resources ... 74


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## Abstract

In the thesis I examine activities and speeches included within the meaning-making process of the quantum physics research at CERN, Geneva. A particular focus will be put on the research of the Higgs boson, the so called "hunt for the God particle". The "God particle" is a symbolic entity connected to an extensive spectrum of meanings and audiences. The notion of "God" does not stick here with the usual conception of religious beliefs, however, it somehow connotes beliefs and religion. Rather than to a particular institution of a church, it refers to the idea of religion as something more general. Something that is above us, that transcends our directly experienced reality, something that is even enigmatic and mysterious. Here, the notion of "God" is grounded in the way in which certain actors relate to the "God particle", respectively the Higgs boson, in which they make it meaningful for themselves. In order to investigate various aspects of this relation, I employ the method of structural hermeneutics as proposed in the *Strong Program of Cultural Sociology*. To provide a convincing interpretation, I have been working with various types of resources, including public media outputs (the Internet and printed newspapers), official scientific statements, historical resources, scientific presentations, public courses, TV shows, and also popular culture artifacts (movies, songs, etc.).

## Abstract in Czech

V této práci analyzuji aktivity a promluvy uvnitř procesu tvorby významů v rámci výzkumu v oblasti kvantové fyziky v CERN v Ženevě. Konkrétně mě zajímá výzkum tzv. Higgsova bosonu, neboli „hon na Božskou částici“. „Božská částice“ je symbolická entita napojená na rozsáhlé spektrum významů a publik. Pojem „Boha“ zde přitom neodkazuje na klasický koncept náboženské víry – i když je s náboženstvím a vírou jinak silně spojen. Spíše než k církevní instituci odkazuje zde idea náboženství k něčemu více obecnému. K něčemu, co se nachází nad námi, co přesahuje námi bezprostředně zakoušenou realitu, k něčemu, co je dokonce jaksi tajuplné a mysteriózní. Odkaz k něčemu „božskému“ zde přímo vychází ze způsobu, jímž se aktéři k „Božské částici“, a potažmo k Higgsovu bosonu, vztahují, jak ji osmyslňují. Abych mohl prozkoumat rozličná hlediska tohoto vztahu, tohoto osmyslňování, použil jsem v práci metodu strukturální hermeneutiky tak, jak je navržena v *silném programu kulturní sociologie*. Abych byl schopen poskytnout přesvědčivou interpretaci, pracoval jsem s nejrůznějšími typy pramenů, jako jsou veřejná média (internetové a tištěné noviny, televize, rozhlas), oficiální vědecká prohlášení, odborné články z oblasti kvantové fyziky, historické prameny, vědecké prezentace a veřejné přednášky, a v neposlední řadě zábavné pořady a rozmanité artefakty z oblasti populární kultury.

# 1. Introduction

> If it is the fulfillment of man's primordial dreams to be able to fly, travel with the fish, drill our way beneath the bodies of towering mountains, send messages with godlike speed, see the invisible and hear the distant speak, hear the voices of the dead, be miraculously cured while asleep; see with our own eyes how we will look twenty years after our death, learn in flickering nights thousands of things above and below this earth no one ever knew before; if light, warmth, power, pleasure, comforts, are man's primordial dreams, then present-day research is not only science but sorcery, spells woven from the highest powers of heart and brain, forcing God to open one fold after another of his cloak; a religion whose dogma is permeated and sustained by the hard, courageous, flexible, razorcold, razor-keen logic of mathematics. (Musil 1995[1940]: 35-36)

Scientific knowledge has played a privileged role throughout the history of human civilization. Its aim has always been characterized as the search for "the truth". The importance of "the truth" as the main object of scientific discovery is somehow well-known to every human being. Although we can "feel" the ultimate relevance of this entity, we are scarcely able to grasp it, to describe it, or to come up with a clear definition. For humankind, "the truth" is a great business which is nevertheless shrouded in the mysterious veil of an age-long puzzle. Science takes part in the "ultimate relevance" of its subject and transforms it into an authority. Consequently, we face this authority knowing that science is indispensable for the world but also that we are unable to simply explain "what science is" at all. While modern science goes hand in hand with technological progress bringing "light, warmth, power, pleasure [and] comforts", perception of it as a "hard" and "razorcold" instrument of truth-searching is narrated as a process of modern disenchantment. This tenuous concern for "mechanical and unmeaningful" character of science results in nostalgia for "re-enchantment", for a new form of "recaptured sacrality"; though perhaps there is no need to *re*-enchant anything, "perhaps [enchantment] has never disappeared" (Alexander and Mast 2006: 9-10). Perhaps it has only changed its appearance.

On the following pages, I am going to investigate a specific scientific setting in the empirical context of the ongoing research in the field of quantum mechanics (abbreviated to QM) in order to show how the "truth" quest is complex and entangled within variety of diverse activities and how this research is connected to a symbolic (yet strongly materially anchored) layer of cultural meanings. I will try to connect a microsociological level of a daily scientific routine with a more abstract level of culturally transferred communication. I will be exploring the creation, the transformation, and the re-creation of scientific claims in the context of information flows between scientific actors, the filter of media practices and the lay audience. Although the public receives the information mostly in a one-way process (as a recipient of the message), actors and decision-makers in the media sphere are an inherent part of social space *per se* and as such, their activity both stems from social structure and reshapes social structure in a dialectical way (Giddens 1984). Also, members of the institution of science are subject to broader social influences beyond the rigid and explicitly defined regulations of academia (Kuhn 1970, 1996[1962]).

Also, it would be highly misleading to separate the categories "abstract" cultural level and "empirical" level of everyday practice. Since culture "is not a power, something to which social events, behaviors, institutions, or processes can be causally attributed; it is a context, something within which they can be intelligibly – that is, thickly – described" (Geertz 1973: 14). For information to successfully penetrate into the broad public discourse it is important to *resonate*, to be perceived with interest, with emotions and passion, to be re-interpreted in concrete social relations of practical action (Schudson 2002). Nobody, even with a full support of broad media apparatus, is able to simply "impose culture" from above.

According to this assertion, I examine actors, their activities and speeches included within the meaning-making process of the quantum physics research at CERN, Geneva. I especially focus on the research of the Higgs boson (abbreviated to HB), the so called "hunt[1] for the God particle[2]". In line with the title of the thesis, my research question is *Where does the "God" within the "God particle" come from?* By the "God particle" I mean a symbolic entity connected to the extensive spectrum of meanings and perceiving groups. Most evidently, the

[1] The expression "hunt for Higgs boson" is a widespread metaphor amongst both experts and lay audience referring to the project of the Higgs boson discovery. It is mostly used as simplified labeling of long-term research, e.g. "40-year hunt for the Higgs boson" ("Prof Peter Higgs" 2013). The scientist Ian Sample (2011) named his whole book "Massive: The Hunt for the God Particle".

[2] The name "God particle" was firstly used by the physicist Leon M. Lederman in his book *The God Particle: If the Universe Is the Answer, What Is the Question?* in 1993.

term has been used as a nickname for the subatomic particle, HB, referencing to the currently ongoing research within the field of quantum physics. For the research is of an exceptional character, it appears in the headlines, in the TV news, shows and debates, in online discussions. We can also come across the "God particle" in regard to the discourse of science; in speeches of scientists, on scientific blogs, even on the official websites of scientific institutions like CERN. Yet, scientists use the term in a different manner than journalists and lay audience do, they are more skeptic and prudent about it. What I find crucial in this point is that the notion of "God" has its deep grounds in regard to the way in which certain actors relate to the "God particle", or the Higgs boson, in which they make it *meaningful* for them. The notion of "God" does not stick here with the usual conception of religious beliefs, however, it somehow connotes beliefs and religion. Rather than to a particular institution of a church, it refers to the idea of religion as something more general. Something that is above us, what transcends our directly experienced reality, something that is even enigmatic and mysterious. The "God" within the "God particle" stands for the sacred ideas of unearthly good which we are pleased to follow. At the same time, it represents something in front of which we are obliged to bow, something oppressive and distant. It delegates us the ultimate quest we are predestined to fulfill. But also, it is the uncontrollable force which makes our quest bitter and harder. And, since the "God" within the "God particle" cannot be dissociated from the "particle", we have to bear in our minds that this ultimate quest as well as mischievous obstacles laid in front of us are very closely connected to the world of quantum physics, the world of science. Thus, in order to follow the research question, in Robert Musil's words, I will try to show how the "sorcery, spells woven from the highest powers of heart and brain, forcing God to open one fold after another of his cloak" and "the hard, courageous, flexible, razorcold, razor-keen logic of mathematics" together give rise to a very complex, most ambiguous, and far-reaching set of meanings within the "God particle".

The structure of the thesis, as I develop it more in the chapter 2, follows my personal experience – the way in which I was step by step untangling the complex relations within the process of meaning-making of the "God particle" phenomenon. In the chapter 3, I present my general assumptions which led me to certain decisions about the investigative journey I went on; also I confront these assumptions with several practical examples. While I was immersed in the midst of cultural artifacts of various kinds, I tried to reflect the investigated material using heterogeneous theories. First of them is concerned with an anthropological study conducted in CERN by Karin Knorr-Cetina (1999), observing the meaning-making process among the CERN scientists themselves, in the framework of their everyday research routine; detailed in the chapter 4. A more metaphysical and historical excursion into the principles on which the tradition of QM is based I develop in the chapter 5, with the help of theoretical apparatus of phenomenology. Following Edmund Husserl (1970[1936]), I try to point out what is the role of the meaning regarding the long-term conception of QM research and how it contributes to the fostering of ambiguous interpretation of the Higgs boson. In the last analytical chapter, I try to describe and capture the aspects of the "God particle" as a cultural fact circulating within diverse symbolic universes.

# 2. Theory and methodology

## 2.1 Writing a comprehensible story

From a literary piece, like the one stated in the opening quote of this thesis, readers typically expect some kind of a coherent insight into the reality – a *Zeitgeist* condensed into the form of a story. For the scope of every text is necessarily limited by the number of pages, the coherent insight can only be completed by a particular art form, by depicting only a limited amount of fundamental characteristics. The resulting picture is thus always in a sense *reductive*: it shows only a certain part of the reality. This aspect was developed in the field of history by the philosopher and historian Hayden White. White (1975) pointed to the fact that, to a large extent, historical writing is based on the *narrativity* which embraces reduction for the sake of the intended message. According to Balon and Szaló (2012), this is also the case of sociological writing. It is not enough to examine and report certain relevant relations of social reality, but these are about to be reported in a concrete written form, which implicitly interacts with a reader in an aesthetic way. As a whole, a compilation of examined "data" and the "form" in which they are communicated to the reader leads to the "specific form of historical experience" (Balon and Szaló 2012: 8).

My intention in this text, then, is to provide a specific form of historical experience which will introduce the specific nature of social reality related to the "God particle". For the sake of a comprehensible and plausible but also interesting and informatively valuable text, I investigate the phenomenon from the views of several different theoretical perspectives. I decided for such an approach with respect to the complexity and multilayeredness of social facts I considered the most revealing for the case. Although I work with media representations of the "God particle", I do not intend to provide a detailed discoursive analysis. Even though I focus also on the meaning-making process within the everyday lives of CERN scientists, I do not provide a thorough and deep analysis of their practices. Rather, it is the investigated phenomenon – the "God particle" – which I made the central and decisive point of my thesis. I adapt particular methods in relation to the specific aspects I want to emphasize at certain parts of the text. At each step, it should be clear why I choose particular empirical material and a particular theoretical approach.

The resulting product of my scientific inquiry is a narrative text. It is a "story about a story" of the "God particle". The story of the "God particle" is not straightforward, nor chronological. It is a heterogeneous network of circulating symbols, utterances and meanings. It is even courageous to talk about a "story", since there are certainly plenty of the stories – narrated by lots of various story-tellers and listened to by a number of various audiences. The story I am going to tell is "just" one of many: it has been created by the chain of selective, and reductive, moves (Emerson, Fretz, and Shaw 1995: 105-7). Anyway, in accordance with White's (1975) conception of reductivity, these moves should be seen in the best possible sense as a way of saying what I actually intend to say.

Inasmuch as I am well aware of epistemological and ontological questions (Guba and Lincoln 1994) which inextricably link my own biography to the research I have been conducting, I explicitly define my position during the investigation. It is my own curiosity which brought me to the amazing topic of quantum physics and the "God particle". So I do not hide that I am also in a sense "enchanted" and enthusiastic about the investigated phenomenon. Therefore I try to be as much explicit about the decisions I have made during the research as possible. My research is of a qualitative character. The question of *validity* thus, to a great extent, depends on me as a researcher (Maxwell 1996). The way of seeing things "scientifically" does not provide me with any "higher" epistemological status. It does not allow me to learn something "deeper" or to approach the "God particle" more "truthfully". It is rather a set of written and unwritten practices I have been trained to use to observe social phenomena *differently*. In order to pinpoint various field of aspects, to relate certain attributes in such a way that the new connections allow me to think about the phenomenon in a new and maybe interesting way.

Now, resulting from the principles stated above, I will clarify which concrete methods I utilize in my story of the "God particle". As I have already stated, for the investigation of the "God particle" to be sound and convincing, I have decided to develop several different ways of looking at it and to connect these views in a new and creative way. During my investigation I encountered a spectrum of interesting information which led me to a number of different interpretations. Later, when I started to write my conclusions in the form of the thesis, I discovered that I had to handle a kind of a *cubist painting*. My conclusions created an interrelated network in which every single finding was linked not to one or two, but to the many others. A cubist art form which articulates the examined phenomenon from several points of view at a single moment would be perfect for depicting such a network. However, since I am limited by the form of a written text, I will guide you through this network along the path which I think is the most appropriate. I will do this using my biographical experience from the process of getting in contact with the "God particle".

### 2.2 Structural hermeneutics

For it combines the broad and creative technique of hermeneutics with the explanatory power of sociological theories, I embrace the method of *structural hermeneutics.* Structural hermeneutics was proposed by Jeffrey Alexander and Phillip Smith (2003) in the *Strong Program of Cultural Sociology*. By developing the "strong program", Alexander and Smith (2003: 15) react to a "numbness toward meaning" from which, according to them, sociology "has suffered" for "most of its history"; "caught up in the ongoing crises of modernity, the classical founders of the discipline believed that epochal historical transformations had emptied the world of meaning". The modern project and its processes were held to unsettle the meaningful conception of life-world. Egoistic individuals belonging to fragmented and atomized human society were supposed to fall under the rule of disenchanted rationalization. A task of the research program of cultural sociology is to bring the meaning back under the scope.

To fulfill this task, the "strong program" puts emphasis on three main domains: 1/ "[c]ommitment to a cultural-sociological theory that recognizes *cultural autonomy*"; 2/ "commitment to *hermeneutically reconstructing social texts* in a rich and persuasive way" by the means of Geertzian *thick description*; and 3/ suggestion to try to "anchor *causality* in proximate actors and agencies, specifying in detail just how culture interferes with and directs what really happens" (Alexander and Smith 2003: 13-14, emphasis added).

By a "cultural autonomy" is meant an assumption that the sphere of culture is not only a product of social activity, but it is also an active agent. Inspired by the "strong program" in science studies (Bloor 1976; Latour and Woolgar 1986), Alexander and Smith suggest that cultural and linguistic conventions are not simply results of more "objective" actions and procedures. Rather, they are collective representations which have own power to structure social life, independent of more material or instrumental forces.

The second domain highlights the importance of "mov[ing] from analytic to concrete autonomy" (Alexander and Smith 2003: 14). The strong program treats the social reality as a text (in line with Barthes 2004). These social texts, then, are to be hermeneutically reconstructed using *thick description* as proposed by Clifford Geertz (1973). The goal is to pinpoint the processes of social production, reproduction, and interpretation of a multilayered hierarchy of meaning structures. The commitment of a researcher should be to recognize the patterns of social facts without omitting their uniqueness. With utmost emphasis on the *verstehen*, the strong program adopts the method analogous to the *phenomenological reduction* elaborated by Edmund Husserl (1965[1910]). By "bracketing-out of wider, nonsymbolic social relations" we are able to realize a "reconstruction of the pure cultural text" (Alexander and Smith 2003: 14, see also Alexander 1987: 244). Further in the thesis, I work with conceptions introduced by Sokolowski (2000) for he provides clear and useful insights into the broad field of phenomenology.

Thirdly, the anchoring of causality allows me to establish proper analytical connections between investigated phenomenon in order to "specifying in detail just how culture interferes with and directs what really happens" (Alexander and Smith 2003: 14). Thus, according to the geological metaphor used by Claude Lévi-Strauss (1974), I pay attention to visible symptoms as well as to "deeper generative principles, just as geomorphology explains the distribution of plants, the shape of hills, and the drainage patterns followed by rivers in terms of underlying geology" (Alexander and Smith 2003: 11).

The decision, which I made on the basis of the explorative and explanative character of my goal and which is underlying for the whole work, leads me to adapt a spectrum of methods to the continuously developed findings. According to the principles of the *grounded theory* (Strauss and Corbin 1998), I try to find the most appropriate explanations during the analysis, reflexively confront them with a suitable sociological theory, and use the result of this confrontation within searching for the additional data.

For to bring up a convincing interpretation, I have been working with various types of resources, including public media outputs (the Internet and printed newspapers), official scientific statements, historical resources, scientific presentations, public courses, TV shows, and also popular culture artifacts (movies, songs, etc.). It should be clear why I use particular pieces of data from the context of their use within the text. For example, I start with the Respekt magazine since it was the first place where I found the information leading me to the "God particle" phenomenon. Similarly, in the chapter 5, I quote several scientific articles from the journal of physics, because they allowed me to see some general principles of historical development of QM.

# 3. The story of "The Boson"

## 3.1 Motivation

My interest in this topic is based on several basic observations. Firstly, it is the simple fact that the first information I got about HB research appeared in the "independent political weekly publication" Respekt, which is mostly focused on "domestic and international news, politics, business, [and] finance"[3]. The news about a conference occurring at CERN was included among ten most influential events of the previous week – among news from politics and financial markets.

Secondly, organizers of the conference called "The Big Bang and the interfaces of knowledge: towards a common language?" held at CERN in October 2012 did not stay inside the field of quantum physics, as one might believe, but they invited "scientists from a range of disciplines to dialogue with philosophers and theologians from the world religions about the nature of the Big Bang Theory" (Wilton Park 2012). Theologians and philosophers such as Gary Wilton, the Archbishop of Canterbury's representative to the EU, were discussing the issue with quantum physicists. Discussants were supposed to deal with questions like "Is it scientific to make truth claims?", "What are the implications of the Big Bang Theory for religious or theological understandings of the genesis or creation of the world?" (Wilton Park 2012).

Thirdly, and most strikingly, shortly after I began my investigation I discovered the nickname the "God particle" and immensely widespread discourse of religious, transcendental, mysterious, hazy and obscure utterances related to the nickname. Scientific speech of quantum physics enhances itself with a kind of religious framing, linking the authority of fact-based knowledge to transcendence and mysticism; and, maybe a bit surprisingly, this happens within mass-media (including popular culture) communication with respect to the lay audience as well as in the case of official and erudite rhetoric of experts.

What is the impulse to ask such a sort of questions by persons who are involved in the research of *nature*[4]? Most intuitively, everyday routine of these physicists consists of measuring, assembling, programming, calculating, etc. Why do they need to ask about such *meta*-physical problems, when the *physical* seems

[3] "Culture, science and technology" are also mentioned, however in the last place.
[4] "Physics" originally comes from the Greek *phúsis*, which means *nature*.

to be more than enough for the purpose of rigid investigation within natural science?

And where does the "God particle" come from? Is it a kind of a journalistic buzzword invented to make the science more popular? Or is it rather a contribution of the church, which wants to improve its public image in the age of rationalization? Or maybe it is even an invention of scientists themselves? If you are as curious as I am, dear reader, follow me to the place where everything began: to the place firstly known as *Conseil Européen pour la Recherche Nucléaire*, currently by the acronym CERN.

### 3.2 CERN

> At CERN, the European Organization for Nuclear Research, physicists and engineers are ***probing the fundamental structure of the universe***. They use the ***world's largest and most complex scientific instruments*** to study the basic constituents of matter – the fundamental particles. The particles are made to collide together at close to the speed of light. The process gives the physicists clues about how the particles interact, and ***provides insights into the fundamental laws of nature***. ("About CERN" N.d., emphasis added)

If you are passing through the cultivated and peaceful landscape alongside the Franco-Swiss border near Geneva, you will most likely meet some quantum physicists, because it is the locality with the highest concentration of quantum physicists all over the world. There is constantly situated about 15 thousand[5] of them: representing over 600 universities from 21 member states and over 100 non-member (associated) states – which is a half of the world's scientists dealing with particle physics. On the surface, they live their daily lives within the northwest suburbs of Geneva. They sleep, eat, travel, shop, go to the hairdresser's, play rugby or football on a special CERN rugby or football pitch – just like anyone else. However, under the surface they collaborate in an "incredibly important experiment" (Dusic in Bloom 2008), the "biggest project of everyone's career" (Green in Bloom 2008).

In order to understand necessary basics of QM research held in CERN, let me guide you through the fundamental features of technical setting. The main and

[5] This number also includes engineers, programmers, and technical staff.

biggest part of the facility is located underground. That is because of the special needs of particle accelerators – devices used for increasing the energy of particle beams, which are delivered to the particular experiments. Particle accelerators are of several types and are differently spatially demanding. The most powerful particle accelerator, the Large Hadron Collider (LHC), was put into operation in 2008, after eight long years of modification of its less efficient predecessor. The LHC lies *175 meters beneath the surface* in a tunnel *27 kilometers in circumference*. The LHC is employed for different experiments characterized by its detectors, "the biggest of these experiments [...] use general-purpose detectors to investigate the ***largest range of physics possible***" ("LHC experiments" N.d., emphasis added). The description of LHC from the official CERN website says:

> Inside the accelerator, two high-energy particle beams ***travel at close to the speed of light*** before they are made to collide. The beams travel in opposite directions in separate beam pipes – two tubes kept at ultrahigh vacuum. They are guided around the accelerator ring by a strong magnetic field maintained by superconducting electromagnets. The electromagnets [...] [require chilling] a ***temperature colder than outer space***. ("The Large Hadron Collider" N.d.)

So as we can see, CERN concentrates not only the highest number of quantum physicists in the world, but also strives to reach few other "best ofs", like the "coldest" temperature, the "fastest" particle beams, the "largest" range of physics investigated, etc. To put it simply, we are dealing with nothing less than with "the world's largest and most powerful particle accelerator" ("The Large Hadron Collider" N.d.). With such a description of human and technical apparatus we can now return to the introductory paragraph of this chapter and outline a connection to the high expectations/objectives stated on the CERN website: to ***probe fundamental structure of the universe*** and to ***provide insights into the fundamental laws of nature***. This might give us the first simple clue of why the topic of HB research is articulated far behind the sphere of academia: it is a business of *everyone*. For *everyone* is a part of the "universe" and *everyone* has to deal with "fundamental laws of physics". Not only the actively engaged scientists, but all the people, whether they want or not.

But what about the *Godly* part in the “God particle”? Where does the religious part of the story come from?

## 3.3 Quantum mysticism[6]

> Imagine LEP[, an accelerator preceding the LHC,] as a ***searchlight probing into the darkness of our ignorance***. During the past year its range has been stretched ***further than had been thought possible***. Then, at the extremes of its range where the beam had faded to little more than a flicker, it glanced upon what appeared to be ***the shadow of the yeti***. Three, maybe four, possible sightings of the ***phantom in the darkness*** are all the scientists have seen. (Close 2000, emphasis added)

At first, the term “God particle” might sound, let us say, as a kind of a tabloid trick – to use a resonant “megalomaniacal” look of particle physics among the people who are familiar with the modern science mostly through impressive headlines and sketchy descriptions in public media. Nevertheless, this is not entirely the case. If you let me to guide you through the mysterious world of the *divinization of science*, I will try to show you.

### 3.3.1 Czech media discourse

Firstly, let us trace media outputs dealing with the “God particle”. I will start with the media space of Czech Republic, which is more transparent to me. There we can read the titles in the bestselling nationwide (non tabloid) newspapers: “Finding of the ‘God particle’? Shock for the prophet”[7], MF Dnes (“Nález ‘božské částice’” 2012); “Discovery of the ‘God particle’ – the Higgs boson becomes more and more evident[8], Právo (“Objev ‘božské částice’” 2013); “Scientists come closer to proving the existence of the ‘God particle’”[9], Lidové noviny (“Vědci se blíží” 2013); “Standard model of the universe and a long search for the God particle”[10], Hospodářské noviny (Hudema 2012)[11].

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[6] I borrowed this cogent term from Stenger (In Thurs 2009: 202), who used it for addressing the relation between metaphysical beliefs and quantum physics. In contrast to Stenger, however, I do not use it to connote quackery or fraudulent activities.
[7] Original headlines: “Nález ‘božské částice’? Šok pro proroka”
[8] “Objev ‘božské částice’ – Higgsova bosonu je stále zřejmější”
[9] “Vědci se blíží potvrzení existence ‘božské částice’”
[10] “Standardní model vesmíru a dlouhé hledání božské částice”
[11] According to the AnoPress media database, there were 30 entries for the keyword “God particle” among nationwide Czech newspapers from January 2012 to November 2014.

In comparison with newspapers, television and radio broadcasting utilizes an interactive format in which the news is combined with discussions and investigative practices. The Czech public service television Česká televize puts the "God particle" issue into the context. In the program "Události, komentáře" (2012) within the agenda "'God' particle discovered?", TV presenter Bohumil Klepetko discusses the issue with foreign correspondent David Miřejovský and quantum physicist Tomáš Davídek (also a member of the collaborative team at CERN), while quoting Peter Higgs (one of the "founders" of the "God particle" theory) and Director General of CERN Rolf Heuer. The "God particle" is introduced here as a part of a long-term story of a complex scientific research. Similarly, in the public service radio Český rozhlas in the program "Radiožurnál" on 4 July 2012, physicist Jiří Dolejší is asked about the "God particle" and answers that "the God particle [...] is very important, because it gives the evidence of theoretical mechanism which might look very unlikely but which, as it seems, shows that nature cooperates with us"[12].

As a convincing evidence of the "God particle" resonance within the media discourse can be considered the dissemination of the agenda among online newspapers and online platforms connected to the "classical" media like radio and television. Furthermore, online platforms foster the dissemination also due to the possibility of online discussion related to the concrete articles. To be more specific, under the article "Scientists surrounded the God particle. It either does not exist or it cannot hide anymore"[13] located on the online platform of the daily newspaper MF Dnes (Lázňovský 2011) there are 168 reader comments. They problematize the "God particle" agenda from several perspectives of interpretation: as a useless abstract "gibberish", as something "interesting" but "hardly understandable", as something which aims to "substitute God" or to "make God useless" – in both critical (pro-religious) and uncritical (pro-scientific) ways. There is also a discussion held by informed readers who discuss the link between the Higgs boson and its religious nickname with a reference to the different quotations of CERN scientists. It is thus apparent that the debate is *lively*

[12] Citation comes from the transcription provided by AnoPress media database. There were 16 entries for the keyword "God particle" for Czech television and radio broadcasting from January 2012 to November 2014.
[13] "Vědci obklíčili božskou částici. Buď neexistuje, nebo se už neschová"

and it *mobilizes broad spectrum of arguments from different areas of experience and meanings* (scientific rationality, daily-lives pragmatism, religion, practical usability, "marketability", mystery and secrets of the universe, etc.).

This I consider a decisive moment in this part of our journey in the footsteps of the "God particle" mystery. It is the very *ungraspable* character of QM, and HB research in particular, which enables and even stimulates the existence of extremely various, and often contradictory, utterances. The term "God particle" is not only a matter of infotainment: of information services mainly focused on entertainment. It is widespread and it circulates among the lay audience as well as among educated viewers and opinion leaders[14], and *among scientists themselves*. This I believe will be more obvious on the scale of the worldwide media.

### 3.3.2 Worldwide media discourse

"I think we have it. You agree?" announced Rolf Heuer (in Brumfiel 2012; Connor 2012; Davies 2012; Furness and Collins 2012; Overbye 2012; Than 2012; Vastag and Achenbach 2012)[15], the Director General of CERN, on Wednesday 4 July 2012 9:44 AM at the CERN laboratory. It was the long awaited message, for it reported the discovery of the Higgs boson. It was known all over the world the very moment Heuer announced it. From 9 AM, there was an online live stream going on. The video and audio record of the announcement was broadly shared and viewed by the public media as well as by the fans and bloggers. The global network of media and academia was watching the QM stage. The audience from all over the world held their breath for a moment. Why is that so and what does it mean?

CERN is typically spoken about as a place of incommensurable exceptionalism. On the global level, it has at its disposal an extraordinary research team, an extraordinary technical background and also an *extraordinary story* which is in the spotlight of a global audience. This story derives its mobilizing potential precisely from the fact that it is *global*. It makes people think on a

[14] The knowledge authority which is decisive for a referencing social group.
[15] The Heuer's speech was quoted globally on the day of the announcement, for example by BBC News, National Geographic, Nature, The Washington Post, Telegraph, The Guardian, The Independent, The New Yorker, and The New York Times.

"global scale". There is nothing so special, we might say, about CERN physicists asking "What is the universe made of? How did it start?" ("About CERN" N.d.), while these questions have been somehow in the center of scientific inquiry ever since the Greek philosophers. It is only the aspect of exceptionalism which raises scientific questioning to the level of a globally widespread discourse – the exceptionalism of historically specific constellation of technical and social setting.

This extraordinary setting makes our everyday lives a "tremendous and exciting time" (Tuts in Than 2012). It brings us "the biggest scientific breakthrough" (Gayle 2012), "momentous" ("Higgs boson: It was" 2012) and "historic milestone" (Heuer in Than 2012). "For almost a century, physicists have been searching for the mysterious particles, and the latest findings brought them a tantalising step closer" (Yuhas 2013). CERN physicists "met the highest standard humans have ever held up for knowledge" (Clayton 2012) when they "found the missing cornerstone of particle physics" (Heuer in "'God particle' likely discovered" 2012) – but still, they "needed the world's biggest atom smasher" (Heilprin 2013) to manage it. Truly the "LHC and experiments [within CERN] have been doing miracles" (Gianotti in Than 2012). With the most powerful "miraculous" tools scientists might "shed more light" on the "elusive, long sought after particle; the Higgs boson" (Malik 2013), which "may help unlock secrets of the universe" (NSF 2009). Success then "would constitute a rendezvous with destiny for a generation of physicists who have believed in the boson for half a century without ever seeing it" (Overbye 2012). The "glimpse" (Cox 2011) of the Higgs boson may have been "dramatic find which may end the 45 year hunt" (Jenkins 2012). Or on the other hand, "are we stuck debating over the number of angels dancing [...] on the head of a pin?" (Francis 2013).

## 3.4. Little bit obscure, little bit science: two examples of liminal "realities"

### 3.4.1 Educational video by the National Science Foundation

If you are really interested in quantum physics, and particularly in the "mystery of Higgs boson"[16] (O'Luanaigh 2013), there is nothing easier for you than to read an educational article or watch an educational video – educational

[16] The term comes from the official CERN educational program for kids.

materials made by scientists themselves. Let us try, for example, a video offered by the National Science Foundation (2009), an "independent federal agency created by Congress in 1950 to promote the progress of science" (NSF N.d.). If you play the video, in a few seconds you are struck by the gathering clumps of a fast moving flashy substance which appears in the environment of a dark and starry universe. In another few seconds flashy clouds fade into the shape of a blue and green ball, most likely the planet Earth. The introduction is clear about what you should expect in the whole video: clamorous, impressive and dynamic, here comes the modern science.

"Probably the largest scientific instrument that has ever been created," says a serious voice at the very beginning of the shot. The camera captures hardly identifiable details of several metallic constructions. The pictures switch every two or three seconds. We can only be sure about the enormous complexity and largeness of the pictured devices. Narrating voices also switch. As the two-minute and 31-second video goes on, we are able to identify one undeclared voice of the narrator and two voices of the scientists working at CERN (all three are men). They change one after another as if they competed which voice brings us the most fascinating information. Likewise, the background music has its own sophisticated rhythm. It starts with thrilling electronic drumming mixed with long tensional tones of strings, gradually accelerating to the moment of the first exciting exposure: "The real action happens underground in the cavern attached to the ring 17 miles in circumference".

The two scientists presented in the video are displayed in their "natural environment". Michael Tuts of Columbia University is sitting behind the desk brimming with scattered paper sheets, next to him on the wall there is a blackboard filled with incomplete equation fragments (parts of equations extend beyond the shot). "Three thousand physicists are working on this huge detector. This detector is 80 feet tall, 140 feet long, so imagine that!" he says, every word supported by passionately swinging moves of his hands, as if he wielded the detector just at that moment. His colleague Kyle Cranmer of New York University is obviously younger. He describes what the world would look like without the Higgs boson: "The universe would be a fundamentally different place, there would be no life, no stars". He is sitting in a room crowded with technical stuff, like the shelf full of boxes with buttons and sockets behind his head, or the metallic tower connected to a number of entangled cables next to his right hand. Although he does not have much opportunity to speak out, because the video leaves him just after a single sentence, you can feel the mighty power of his words. “The universe would be a fundamentally different place”, those are the words of *the science* itself.

Then the background music turns more dramatic and talking heads are followed by colorful flying balls and flashy light beams. “The Atlas detector works like a digital camera. It records collisions of hundreds of billions of protons at nearly the speed of light”, says the narrator. “Our digital camera takes forty million pictures per second”. Two flickering orange balls going against each other collide. Firstly, dozens of bright white lines appear in the place of the collision. Three seconds later we can watch green, purple, blue, red and yellow rays spreading around, filling the black space with shining colorful curves.

At the time around 2:00, the music changes to a kind of an unnerving composition reminiscent of Edvard Grieg’s *In the Hall of the Mountain King*, with the typical deep humming of bassoons. “The elusive Higgs, also known as the God particle, has captured the imagination of non-scientists too”, the narrator goes on. A moment later, scientist Kyle Cranmer appears for another three-second quote, short but resonating: “This is a triumph of human curiosity. This is a key to our understanding of the universe.” The video ends with fast switching scenes of rotating colorful circles, flashing lights, flames and incredibly quickly moving planets. Narrator’s last words are “Tuts and Cranmer say that at CERN, the Higgs is only the beginning. More exotic mysteries lie ahead. From figuring out what happened after the Big Bang to discovering extra dimensions of time and space.”

When the video is over, we might stay for a while with a prevailing sense of something tremendous and important, but also somehow inherently meaningful and even truthful. The language of science which spoke to us is a language of scientific facts, inventions and discoveries. It is a language of rational thinking, abstract papers and formulas and the most complex technological devices. Yet, at the same time, it is also a language of desire for progression. It is dynamic and passionate, excitedly shaking on the threshold of the unknown. It is anything but dull and boring research in an isolated laboratory.

### 3.4.2 Angels & Demons by Dan Brown and Ron Howard

"Don't blow us all to Heaven," says CERN scientist to Dr. Vittoria Vetra, the main female character in the movie *Angels & Demons* (Howard, Grazer and Calley 2009), while she is going to operate the LHC. "Protons are being loaded," comes as an answer from an anonymous scientist passing by. The movie is based on a novel of the same name by American author Dan Brown (2000). With nearly $500 million box-office worldwide (Box Office Mojo N.d.), it became the ninth-highest grossing film of 2009. Because the plot also deals with CERN experiments, I will compare the movie with the educational piece by NSF from the previous chapter.

What precedes the exclamation heard by Dr. Vetra as stated above is a short scene introducing the context of the plot in the Vatican: the Pope is dead and the conclave is about to elect a new one. At the time 3:53, an impressive switch sequence occurs when the Dean of the College of Cardinals staying behind the altar raises the body of Christ (sacramental bread) with a gentle and respectful move of his hands. The bread is illuminated by the light coming from a stained glass window, so it looks as if the cardinal bore a little sun. "[T]hey will choose a new leader for the world's one billion Catholics who now find their church at a crossroads, its ancient traditions threatened by a modern world", says the narrator. The camera then goes directly to this "little sun", and when the "sun" covers almost the whole screen, the shot switches to the interior of a huge technically equipped space of concrete and metal. A title on the screen informs us that suddenly we found ourselves at the "Large Hadron Collider, CERN laboratories, Geneva, Switzerland". The camera turns upside down and follows a bundle of metallic pipes within a white circular tunnel. "Attention, control group going online for LHC beam event", reports a voice with a French accent. "We are powering up". The camera rotates in the tunnel around its own axis, then it captures the overall view of an immensely spacious multilevel area near the collider. Further, we can see an open space office full of monitors (I counted 12 monitors in a single shot) and white-coated people, excited and talking in a lively way. The emotion in the air is apparent.

The distressing ambient background music is supported by a persistent noise of a warning siren. The situation is confusing. The scientists communicate among each other in three different languages (English, French and Italian), so it is even harder to follow. A randomly passing scientist says “Beam-on-beam stability is good. Take your places, people”, and moves out of the scene. The thrilling atmosphere of the scientists is followed by the steady, and somehow strange, power of the nonliving equipment. The camera goes through the concrete tunnel, steam rises from the metallic pipes. But the “real” visible world seems uninteresting now. The invisible world of subatomic particles is much more interesting: on the *screen* we watch a *screen* visualising the experiment. In the center of the screen there is a number with a percent sign. The number is growing. Faces of the scientists are like a solid stone. Suddenly, two lines going against each other appear on the screen, they collide and from the point of collision plenty of curved lines go all around. “We have a signal on the luminosity monitors,” says a voice from a speaker, “We have events”. The camera leaves the monitor screen and moves fast to the pipe of the collider. This is not a simulation, we can see the protons colliding with our own eyes. The little fiery balls created by the collision fly like tiny meteors. We pursue them through the pipe – the camera must go with the speed of light or even faster – until we hit a strange metal and glass container. There a miracle occurs just in front of us. As if from nowhere, we can see a pale blue sphere of mysterious energy emerging. “We have antimatter,” says an Italian voice. Behind a cloud of steam we can see a figure staring at this miracle of creation. The figure, a white-bearded wrinkled man, is somehow distracting. Wearing an archetypal white coat he must be a scientist, but also, under the coat, we are able to notice a black robe and on his neck – a clerical collar.

Another sequence from the movie which I consider useful to pay attention to deals with the “God particle”. As the plot unfolds, we find out that a group of terrorists tries to blow up the whole Vatican using a canister of stolen antimatter. At the Vatican at the “Swiss Guard Headquarters” Dr. Vetra is called upon as an expert consultant. She is about to explain the scientific matters of the terrorist threat to the Commander of Swiss Guard. Let us follow Dr. Vetra’s speech:

> [The dark matter is] a way of studying the origins of the universe, to try to isolate what some people call the “God particle”. [...] What

> we call it isn't important. It's what gives all matter mass. The thing without which we could not exist. [...] Yes. In a way, I am [talking about the moment of creation].

Again, the expert setting of the "Headquarters" allows no doubt that we are in the middle of something phenomenally important: dramatic voices, emotions flowing among the characters, thrilling background music, camera moving and changing quickly. In the speech we can see how the most essential and all-embracing terms like "origins of universe", "all matter", "thing without which we could not exist", "the moment of creation" are on the one hand subjected to scientific inquiry and at the same time they are blurred with an ungraspable veil of mysterious entities like the "dark matter" and the "God particle".

We can see that certain messages which were also present in the educational video by NSF are now articulated in an exaggerated form. Because of the "fictional" character of the movie, it is possible to literally say what in "non-fiction" might only be suggested: connection of ultimate human will to conquer the powers of the universe and humility before a transcendent force which exceeds us. On the one hand, there is a dynamic and progressive world of knowledge-equipped physicist craving for even more knowledge, on the other hand, we face something bigger, something which can "blow us to heaven", which "gives all matter mass", which relates to the moment of creation. Science and religion are not somehow subtly, let us say implicitly, connoted – they are interlinked in a very explicit way.

I will develop the Angels & Demons example more in the chapter 6.1, regarding the concept of *liminality*. Right now, however, this tension between the world of science and the world of mystery and enchantment leads us back to the article in the Respekt magazine. Where does the motivation arise for scientists to organize a conference asking the questions "What are the legitimate aims of scientific endeavor? How should scientific results be interpreted? Is it scientific to make truth claims? What is the relationship between faith and reason?" (Wilton Park 2012)? It seems that physicists are interested in things which somehow go beyond experimental measuring and formalized calculations however it might seem enigmatic within the framework of their everyday practice. So what is it that forges this kind of obscurantism in the realm of “razor-keen logic of mathematics”? In order to find it out, we have no other option than to ask the quantum physicists themselves: let us now move to the “laboratory” of quantum physics where all the “quantum mystery” occurs, let us move to the vast research facilities of CERN.

# 4. Into the "laboratory" of quantum physics

So far, after we observed several occurrences of the symbolic entity of the "God particle" within various contexts of its use, it seems that the general idea lies at the heart of the nickname itself. The discourse of the "God particle" comprises the "God" and the "particle" – physics and religion – at the same time. The "particle" stands for the fascinating and dynamic world of white-coated experts running the largest and most powerful machines of the world for the sake of discovering the unknown. The "God" stands for the world of what we do not know and probably cannot know at all, and for the "omnipotent" that creates the world. It is not only a matter of the newspapers and news and diverse information circulating within the public media and popular culture. The ambiguous discourse of the "God particle" is broadly diffused on a more "empirical" level too: among the CERN scientists themselves, in the framework of their everyday research routine while maintaining the "normal science" (Kuhn 1996[1962]). "Mystery" and "hard facts" meet each other in a setting of the most complex assemblage of humans and technical devices; yet, the ambivalences, however uncommon and extraordinary they might seem to us, are deeply rooted within the physicists' mundane daily practice.

## 4.1 Quantum physicist's everyday life at CERN

> [The objects of researchers' interest] are in a very precise sense ***"unreal" – or, as one physicist described them, "phantasmic" (irreale Gegenstande)***; they are too small ever to be seen except indirectly through detectors, too fast to be captured and contained in a laboratory space, and too dangerous as particle beams to be handled directly. Furthermore, the interesting particles usually come in combination with other components that mask their presence. Finally, most subatomic particles are ***very short-lived, transient creatures that exist only for a billionth of a second***. Subject to frequent ***metamorphosis and to decay***, they "exist" in a way that is always already past, already history. (Knorr-Cetina 1999: 48)

For I am hardly able to arrange a plausible research within the walls of CERN by myself, I have found help of a sociologist who adopted this task with due care. Karin Knorr-Cetina (1999) in her book *Epistemic Cultures* claims that scientists at CERN follow their everyday routine on the background of their own *epistemic culture*, the way of categorization and knowledge acquisition *of its kind*. Because of the very delicate and specific character of the object of their research, they need to overcome a series of methodological complications. What is very problematic in the empirical research in the field of QM is the way of representing the observed phenomena. Subatomic particles may only be tested in a statistical manner, they comprise a specific amount of uncertainty directly in their definition. Yet, the scientific conclusions are still subject to very precise measurement, categorization and generalization.

Knorr-Cetina was conducting an anthropological research inside the facility from 1987 (at least until the release of her book in 1999). Her research concerns different experiments and a different particle accelerator (since LHC did not exist yet). Nevertheless, thanks to the incremental character of the development of CERN devices, the principle of research practices is the same. New accelerators are not built from scratch but they rather emerge from the old ones, and also newly started projects are directly linked to the old ones. With Kuhn (1996[1962]) we might say that CERN holds the same scientific *paradigm*[17]. The tendency to continuity of research is well evident from Knorr-Cetina's (1999: 20) text: "size of experiments alone multiplied by a factor of 15 during our stay in the field [...] from approximately 100 participants" in 1987 "to more than 1,500 physicists" in 1996, she writes, and experiments "do not divide into separate projects that produce and publish experimental results on their own", so they keep up the "core" of a particular research. Let me now describe some of the key principles of the CERN epistemic culture by following Knorr-Cetina's arguments.

Let us now look in more detail at what Knorr-Cetina writes in the paragraph I cite above. The objects of researchers' interest "are in a very precise sense 'unreal' – or, as one physicist described them, 'phantasmic'" (Knorr-Cetina 1999: 48). Maybe a bit paradoxical connection between the adjectives "phantasmic" and "unreal" with the term "in a very precise sense" stems from the very foundation of Knorr-Cetina's (1999: 46-78) conception of *negative*

[17] By choosing the term "paradigm", Kuhn (1996[1962]: 10) means to "suggest that some accepted examples of actual scientific practice – examples which include law, theory, application, and instrumentation together – provide models from which spring particular coherent traditions of scientific research; [...] traditions which the historian describes under such rubrics as 'Ptolemaic astronomy' (or 'Copernican'), 'Aristotelian dynamics' (or 'Newtonian')", etc.

*knowledge*. The conception of negative knowledge stands for the way in which CERN scientists operate in order to get as much of *useful* knowledge as possible. On the other hand, subatomic particles are inherently unpredictable and obscure – they put obstacles so as to stay profoundly camouflaged. Negative knowledge, then, is an epistemological approach that mobilizes "strategies and practices assumed to promote the 'truth'-like character of results" in the world where "phantasmic, historical, constantly changing occurrences can be established only indirectly, by the footprints they leave" (Knorr-Cetina 1999: 46-48) within the immensely complex and spatially gigantic setting of CERN "laboratory".

If we return back to the chapter 3.2 where the LHC is introduced, we can see that it is not an easily manageable device. Two protons charged with a huge amount of energy are launched against each other and, as they collide, the automatic detector registers all occurrences of their encounter. The goal is, in a word, to capture some kind of anomaly – nonstandard behavior within the prepared conditions of this laboratory. Daily, the LHC goes through about 500 trillion collisions (the number with 14 zeros). Everything is automated, the output of such an operation is a vast amount of data to analyze.

The empirical work of nearly 10,000 scientists consists mostly of operating machines and analyzing their outputs. "The laboratory's scientific and technical staff designed and build the particle accelerators and ensure their smooth operation; [t]hey also help to prepare, run, analyze and interpret data from complex scientific experiments" ("Member states" N.d.), which points to the fact that besides quantum physicists, CERN also hosts a variety of technicians, programmers and engineering staff.

In order to point out certain enigmatic quality of this huge organizational structure Knorr-Cetina (1999: 46) describes how it creates a "shadowland of mechanically, electrically, and electronically produced negative images of the world: fictional reflections, shimmering appearances of bygone events". According to the negative knowledge principle, scientific procedures conducted within the LHC do not *discover* things that are *somewhere out there*. Rather, they *narrow the field of possibly truthful outcomes* by stating what *is not true*. The scientists are only able to delineate what the object of research *is not* rather than what *it is*. The goal of the negative knowledge approach is then to reach the "knowledge of limits of knowing" (Knorr-Cetina 1999: 64).

One of the most basic attributes of QM is *uncertainty* which intervenes into every single action of measuring, testing, calculating, etc. At the same time the "shadowland" of high energy physics is, to a high extent, a part of its own world. Knorr-Cetina (1999: 47-48) builds an analogy to the human brain and the eyesight function: huge detector devices in the CERN laboratories act like a retina – they recognize and filter a signal coming from within the colliders (like the LHC). The brain – the computational sets – then obtains processed information and starts to manage it for the sake of usefulness by means of purely internal, self-provided capacities – computational devices in combination with human power. Its only contact with the "outer" world happens via the retina – the detectors. The once acquired information is thus repeatedly subjected to examination, the main effort is concentrated on the data which are already in the brain. The information originally taken by the detectors finds itself within a self-referential network of computational fields and algorithms. The researchers are preoccupied "with the experiment itself, with observing, controlling, improving, and understanding its components and processes", "[c]onfronted with a lack of direct access to the objects they are interested in, ***caught within a universe of appearances***" (Knorr-Cetina 1999: 56, emphasis added). A scientist interviewed by Knorr-Cetina (1999: 54, emphasis added) uses the term "meaningless"; "this number [I work with] is totally dependent on the detector configuration", he says, "[i]t is a purely experimental ***number which says nothing in itself***[; i]t is ***absolutely meaningless***". The acquired data which is processed in the "brain" of the CERN facility is so "unreal" and "phantasmic" that it literally *lacks its own meaning*. It is *meaningful only in relation* to the theory and to the whole referential network created by the CERN laboratory elements.

## 4.2 Discourses: apophantic theology

This leads us right to the notion of circulating discourses, by which scientists give meanings even to the "meaningless" entities. In accordance with Knorr-Cetina (1999: 64) I will use a religious metaphor of the *deus absconditus,* the "apophantic theology". The principle of this approach in Christian theology is that it prescribed addressing God without the possibility of making any positive assertion about his essence. Rather, believers were studying him with regard to what he *is not*. As I tried to show above, the epistemics of negative knowledge works similarly in the world of QM: scientists are not able to conclude what the object of research *is*, they can only make assumptions about what *it is not*. The "liminal" (see more on the concept of liminality in the chapter 6.1) character of studied phenomena – neither empirical, nor totally unknowable – "cultivates a kind of negative knowledge" (Knorr-Cetina 1999:64). The best possible knowledge which apophantic theologians are able to maintain about God consists of all the negative assertions they ever concluded about him. Although the path to the knowledge of God himself is inevitably closed, believers try to get as close as possible to the unachievable ideal type. This ideal type becomes their *telos*, the purpose of their lives; the center of their life-worlds around which other meanings are centered.

Within the *shrine* of CERN, the situation is very similar. Scientists step by step collect "meaningless" information in order to designate uninteresting perspectives of possible further research. Useless perspectives are not thrown away, but scientists use them to display the most comprehensive image of the field possible. In the process of acquiring negative knowledge of the subatomic world, useless perspectives are included in the current assemblage of the existing data and used as a base for decision making about next steps in the research. The whole spectrum of negative knowledge then becomes decisive for the rest of the laboratory assemblage. The constellation of machines and scientists is constantly being changed and re-defined according to the growing set of outcomes of the research – according to *their telos*.

> [I]n addition to the technical language, [there exist] ***imaginative terminological repertoires*** that reclassify technical distinctions and components[, which] ***constitute a symbolic universe*** superimposed upon the technical universe; a repertoire of categories and distinctions ***from the everyday world that are extended into the scientific world***, where they reformulate, elaborate, and at times fill in for technical categories and distinctions. (Knorr-Cetina 1999: 112, emphasis added)

This notion of a telos has crucial consequences for the organization of experimental work. In the normal mode of everyday science the research in CERN is much more focused on the "content" or the "object" of the research rather than a rigid organizational structure. Methods of QM have no more been able to guarantee a single coherent system of reference for natural science as a whole. But nevertheless, they still allow scientists to perform their practices effectively and pragmatically "because they promise opportunity for the fruitful elaboration of an accepted paradigm" (Kuhn 1996[1962]: 126); the paradigm which is centered around the telos of acquiring negative knowledge. The experiment becomes in a sense a scientists' "drug", "they [appear] engrossed in their project, entranced by the thing they were doing" (Knorr-Cetina 1999: 170). The cooperation of a heterogeneous, yet well-motivated group of workers is maintained by a "natural way", in a sense that everybody simply wants to effectively reach the research goals. This fluid way of collective labor, subordinated to the *shared collective definition of telos*, is according to Knorr-Cetina (1999: 172-186) defined by shared "discourse" which is oriented towards investigated objects.

However "phantasmic" and "unreal" these objects might seem to be, they are treated in a most practical and fruitful way. This gives rise to "a symbolic universe", in which "categories and distinctions from the everyday world [extend] into the scientific world" (Knorr-Cetina 1999: 112), technological complexity is translated into practically usable repertoires. Knorr-Cetina (1999: 111-123) within her thorough anthropological elaboration shows how the most complex sets of machineries are classified within the everyday discourse: they are addressed as "physiological beings with behavioral states and idiosyncrasies" which also possess strong "moral and social" "individualities"; depending on their current operability, the detectors are identified[18] as "alive", "dead", "killed", "blind", "sick", etc.; their "physiological conditions" also change through the time: they "grow older", and therefore they have to "be monitored" and "diagnosed" in order to be provided with "first aid" and "antibiotics"; consequently, detectors are supposed to bear the "responsibility" for a proper behavior as if they were living organisms with social and moral capabilities: they might be "good", "bad",

[18] These terms were used by the interviewed scientists.

"playing up", trustworthy or distrusted, they "communicate" with other devices, check and consult each other, cooperate; generally speaking, researchers and detectors are "symbionts" and "trustful" "friends". On the other hand, there is an "enemy" as well: it is the "background" the scientists "are fighting against" because it "threatens the experiment" (Knorr-Cetina 1999: 123-126). The background consists of noises, smearing, "ghosts" and uninteresting information from which the useful data is (according to the *apophantic theology*) tried to obtain. The background is addressed as "nasty", "ugly", "malicious", "bad", "worst", "dangerous", something from which one could "get a beating". In return, the background is "killed", "suppressed", "beaten down", "eliminated", "cut", and "rejected" – in a war against its regressive anti-knowledge resistance.

Within such a constellation, physicists "draw their strength – their identity, expert status, the attention they get from others, their position, and their very raison d'être – from the symbiosis" (Knorr-Cetina 1999: 129-130) with the machines. The "practical rationality" (Kuhn 1970) which is incorporated by the CERN scientists within the boundaries of everyday work "construes, and accounts for, ***a new kind of epistemic subject***, a procurer of knowledge that is collective and dispersed" (Knorr-Cetina 1999: 178, emphasis added); the ***conscience collective*** (Durkheim 1984[1893]) stemming from participants involved in the goal-oriented discourse.

### 4.3 The "myth" of QM

> The traditional definition of a knowledge society puts the emphasis on knowledge seen as statements of scientific belief, as technological application, or perhaps as intellectual property. The definition I advocate switches the emphasis to ***knowledge as practiced-within structures***, processes, and environments that make up ***specific epistemic settings***. (Knorr-Cetina 1999: 8)

The *collective consciousness* formed by the assemblage of scientists and machineries operating within CERN experiments maintains and is woven into a specific *culture*: "a system of inherited conceptions expressed in symbolic forms by means of which men [and women] communicate, perpetuate, and develop their knowledge about and attitudes toward life" (Geertz 1973: 89). For the *telos*, the center, around which this system is primarily built, concerns the scientific seeking for knowledge, Knorr-Cetina (1999: 1-6) calls it the *epistemic culture*; it is a "production context in its own right", which to a high degree not only characterizes the scientific field, where knowledge production is of privileged importance *per definitionem* – but it also describes a contemporary ("modern") society in its wholeness.

The notion of *culture* is of special importance here. If the rational ethos within "reflexive", "technological", "information" and "risk" society (Knorr-Cetina 199: 5) puts main emphasis on knowledge-acquiring, we cannot omit a specific *social text* within which this knowledge-acquiring is practiced (Alexander and Smith 2003). Although scientists behave rationally, it does not mean that their practice is emptied of meaning (cf. Habermas 1984[1981], technological colonization of the life-world). There exists no fundamental distinction between rational activities concerning technical settings and symbolic processes by which scientific practice is encapsulated. "The imagination and 'enchantment' that experts like physicists bestow on their machinery and their experience" is linked to "technically installed signaling, imaging, and 'echoing' systems with maximum indirectness, and the many kinds of artifacts and ambiguities this involves": the "phantasmic", "meaningless", and "unreal" confront the lived stream of complex epistemic culture *which becomes "real" and "fictional" at the same time* (Knorr-Cetina 1999: 248-253). Ambiguity is at the very core of scientific practices associated to the field of QM; *the world of quantum physics is essentially ambivalent*.

But where does the ambiguity appear? Is it primarily caused by the scientists who are not able to maintain a strictly rational mode of work? Or rather by the logic of the machinery and the character of measuring and calculating procedures which are way too rational? And, more generally, where does such a strange and dubious relation – the relation between the "unmeaningful" laboratory setting on the one hand and the physicists searching for even the slightest glimpse of meaning on the other hand – come from at all? Fortunately, since analogical questions have already been asked before, we are not alone to answer them. Alfred Schütz (1967[1932]), who introduced the phenomenological concept of *life-world* into the sociology, drew attention to the ambiguity which is perceived by actors within their everyday interaction. Ambiguity from Schütz's perspective is not something extraordinary, unwanted, or even something which is desired to be removed. Rather, it is a common product of the clash between sedimented schemes of action and an ongoing stream of experience. From that point of view, a social actor constantly struggles so as to make the continually changing world around him meaningful (see also Giesen 2012: 790-791). We will nevertheless go further back in time, to the discipline of phenomenology as developed by Edmund Husserl (1970[1936]), whose philosophical work Schütz adopted. The ambiguity which is at the center of our interest does not concern just any kind of experience, but the experience of scientific inquiry, and regarding that, as I will try to show in the next chapter, phenomenology holds sovereign analytical position.

# 5. QM as a phenomenon *per se*: phenomenological perspective

"For phenomenology, there are no 'mere' appearances, and nothing is 'just' an appearance. Appearances are real; they belong to being" (Sokolowski 2000: 15). It is crucial that phenomenology looks at events, objects and living beings as unique and tries to withdraw from universalizing categories. Yet, phenomenology also has to deal with practical human thinking and it is thus at hand that we need to cope with ambiguities and uncertainties. These, however, do not come to us out of nothing. Ambiguities have their causes, which, although we cannot follow them to some kind of a fixed point of origin[19], we can, and we should, unravel just like an archaeologist unravels stories of material artifacts. With a kind help of phenomenological thinkers, I will try to make an archaeological inspection regarding the field of quantum physics and a few of dominant principles that have a profound impact on our "God particle" case.

## 5.1 Classical mechanics

> The highly mathematical form of science that was introduced by Galileo, Descartes, and Newton led people to think that the world in which we live, the world of colors, sounds, trees, rivers, and rocks, the world of what came to be called 'secondary qualities', was not the real world; instead, ***the world described by the exact sciences was said to be the true one***, and it was quite ***different from the world we directly experience***. (Sokolowski 2000: 146, emphasis added)

In *The Crisis of European Sciences* Husserl (1970[1936]) problematizes the rational positivist dogma of the nineteenth century. As a heritage of the era of Enlightenment, he says, European science petrified in its movement, in *a priori* set up direction, presupposed by the formal systems of Descartes and Galileo. According to Husserl, natural sciences had been caught in a trap of their own progression: the existence of success pre-determined the following steps of self-enforcing scientific method, which was "true" in itself, because it was effective in fulfilling defined goals. This "true direction" was set up in advance by certain

[19] In this sense, phenomenological inquiry is strictly anti-foundationalist (Rokstad 2013).

historical conditions of modern thinking which privilege the doctrine of performativity.

"'The numbers, the predicative complexes of affairs, the goods, the ends, the works present themselves because of the hidden ***performance***; they are built up, member by member[;' i]t is precisely because they are so ***effective*** that 'the intentional performances from which everything ultimately originates remain unexplained'" (Husserl in Alexander 1987: 244, emphasis added). This critique was later on followed by a growing number of thinkers. One of the most subtle insights was made by Adorno (2002[1947]: 18), who puts it simply using a mathematical metaphor: "When in mathematics the unknown becomes the unknown quantity in an equation, it is made into something long familiar before any value has been assigned". The use of equation itself, as a method, determines what we find as a result. The Cartesian system is then application of such a metaphor to the whole set of world-describing laws.

Of course, the phenomenological approach to modern thinking stems from the very heart of what Husserl calls the "crisis". It was developed "in the midst of an acute sense of social and intellectual crisis" experienced by Europeans not merely as "instability but a stultifying sense of rigid objectivity, so much so that the period has been called 'the age of anxiety'" (Alexander 1987: 241). The idea was to respond to the overwhelming confusion by looking at the world sensing the uniqueness of what is seen. Though I do not adopt the phenomenological critique of modern science, its point of view allows me to accentuate some interesting attributes of QM discipline. Further on, I am going to compare the dominant *way of seeing* of QM field with an illuminating view of physicist and phenomenologist François Lurçat (2007).

### 5.2 The "advent" of QM

The common picture of "the advent" of quantum physics puts a clear contrast between the "good old" universal theory on the one side and a disorganized searching for new patterns in the newly emerging system on the other side. With the expansion of QM, the situation seems to get complicated within the field of science and even beyond it. The old well-known constituents of people's world, the Euclidian space and the Newtonian time, start to lose their privileged position. QM experiments bring up exceptions and anomalies. The strength of the original basis which came from its unity, wholeness and formal coherence seemed to become replaced by heterogeneous layers of sedimentation. The mathematical system of traditional physics "encompasse[d] everything which, for scientists and the educated generally, represent[ed] the life-world, dresse[d] up the life-world as 'objectively actual and true'" (Husserl 1970[1936]: 51). QM was about to radically shake the "truth".

The main problem seemed to lie in the lack of the universal theory. For example, the famous article from 1935 called "Can Quantum-Mechanical Description of Physical Reality Be Considered ***Complete***?" (Einstein, Podolsky and Rosen 1935, emphasis added) starts with the sentence "***In a complete theory there is an element corresponding to each element of reality***". Authors of this article investigate the options for QM theory to provide a complete description of particle behavior, or in a word, a complete description of reality. Their conclusion is negative and QM is thus considered incomplete.

This kind of unfulfilled seeking for completeness creates discontinuity between the old and the new mathematical model. Phenomena described by the model – by QM – are unexplainable in a deterministic way, they are said to belong ***"somewhere" between the reality and the possibility*** (Heisenberg 1966, emphasis added). The growing number of anomalies[20] gradually ascertained by quantum physicists undermines the stability of the world with "mysterious dualities" (Lurçat 2007: 239) and "spooky actions" (Einstein 1971[1947] in Lurçat 2007: 250). For it considerably complicates the old way of knowledge acquisition, this state of affairs is substantially unwanted.

### 5.3 Phenomenological approach to QM "adventism"

> In geometrical and natural-scientific mathematization, in the open infinity of possible experiences, we measure the life-world [...] for a well-fitting *garb of ideas*, that of the so-called objectively scientific truths. That is, through a method which (as we hope) can

[20] Also the notion of Kuhnian conception is interesting here, since Kuhn (1996[1962]) claims that when the normal mode of science reaches a certain level of anomalies, the revolution occurs and the prevailing paradigm is substituted by a new one. It seems that the paradigm of QM is somehow immune to this assertion. Rather the suggestion might be raised that anomalies are so inherent to the QM field that they create a new rule: instead of paradigmatic revolutions, we face slow unveiling of negative knowledge within one robust paradigm.

> be really carried out in every particular and constantly verified, [...] we ***obtain possibilities of predicting concrete occurrences in the intuitively given life-world***, occurrences which are not yet or no longer actually given. ***And this kind of prediction infinitely surpasses the accomplishment of everyday prediction***. (Husserl 1970[1936]: 51, emphasis added)

The phenomenological approach to QM and to modern science in general is quite different from the one introduced in the previous chapter. For it tries to sense various phenomena in their uniqueness, the vision of a single all-encompassing theory is unacceptable for it. Nevertheless, it concerns the "classical vs. quantum" mechanics distinction in order to show that they are both based on wrong assumptions. From the early modern period when pioneers like Galileo, Kepler and Newton laid the foundations of classical mechanics – when they started to "measure the life-world" in order to obtain "so-called objectively scientific truths" (as stated by Husserl in the paragraph above) – they also, according to Lurçat (2007: 234), laid the foundations of the "confusion [which] now hinders us from understanding quantum mechanics". A blurred picture of QM which made the new system incoherent was perceived within the old frame. The idea that the confusion started with the "advent" of QM would then be an illusory one.

"Both the ***obscurity*** of quantum physics and the ***clarity*** of classical physics are grounded in the same initial mistaking of mathematized nature for the world we live in" (Lurçat 2007: 234, emphasis added). For to demonstrate his thesis, Lurçat shows the distinction between approaches of two physicists, Werner Heisenberg and Niels Bohr; Heisenberg holds to position of an "adventist" of QM while Bohr has the same opinion as Husserl and phenomenology. "It was a different way of looking at the problem because ***Bohr would not like to say that nature imitates a mathematical scheme***, that nature only does things which fit into a mathematical scheme," says Heisenberg (in Pais 1991: 309-310, emphasis added) about his colleague; then he continues: "When we get beyond this range of the classical theory, we must realize that ***our words don't fit***. They don't really get a hold in the physical reality and ***therefore a new mathematical scheme is just as good as anything*** because the new mathematical scheme then tells what may be there and what may not be there. ***Nature just in some way follows the scheme.***"

We can see that while Bohr keeps in mind the principle of uniqueness of the experienced phenomena, Heisenberg insists on the necessity to enhance or develop a scheme which would be, "in some way", adequate to the reality "beyond this range of the classical theory" where "our words don't fit".

Bohr's (1928: 580) argumentation goes as follows: regarding classical physics, QM entails "a fundamental limitation in the classical physical ideas, when applied to atomic phenomena"; but on the other hand, "our interpretation of the experimental material rests extensively upon the classical concepts". While QM is built upon classical mechanics, at the same time it is fundamentally limited by it. As Lurçat (2007: 245) explains Bohr's opinion in accordance with phenomenology: "Concepts whose validity is subject to a fundamental limitation cannot be found in nature as one finds a character on a page. [...] Their privileged role stems, inseparably, both from the features of human knowledge and the nature of physical phenomena". Bohr (1928: 580, emphasis added) then expresses the quantum postulate which "implies that any observation of atomic phenomena will involve an interaction with the agency of observation not to be neglected", and consequently that "***an independent reality in the ordinary physical sense can neither be ascribed to the phenomena nor to the agencies of observation***". In contrast to Heisenberg's conception of mathematical nature, Bohr asks for clarification of the *meaning* of any concrete research question – because every such question defines a relation between atomic processes and experimental settings in a new, unique way[21]. These relations might, as QM has extensively showed, be mutually ambiguous and even exclusive. But since, according to phenomenology, "[t]he observer does not create or influence the phenomenon, but he creates the conditions of the phenomenon", since "physicists prepare an experimental arrangement and record the results"; or else, when they "prepare the arrangement for the automatic recording of the results" (Lurçat 2007: 253), the ambiguity cannot be perceived as a kind of flaw or anomaly within a general

[21] Compare to Bohr's (1949: 21-22, emphasis added) reaction to the Einsten-Podolsky-Rosen (1935) article calling for the completeness of a theoretical system: EPR article "in fact discloses only ***an essential inadequacy of the customary viewpoint of natural philosophy*** for a rational account of physical phenomena of the type with which we are concerned in quantum mechanics. Indeed the finite interaction between object and measuring agencies conditioned by the very existence of the quantum of action entails [...] ***the necessity of a final renunciation of the classical ideal of causality and a radical revision of our attitude towards the problem of physical reality***".

explanatory structure. Since every experiment is a uniquely experienced event, *their mutual ambiguity is not a weakness to be solved – it is the inherent quality of the modern scientific method*.

### 5.4 As if it has always been here

What has been criticized by Husserl and his followers is the way in which modern scientists approach the reality through the mathematical framework, implicitly reshaping our life-world as "objectively actual and true" (Husserl 1970[1936]: 51). In the case of classical physics, the link between a practically experienced life and its scientific counterpart was not problematized because its metaphysical foundations were generally accepted as "coherent" and "unambiguous". Then the investigation of the atomic processes started and the all-encompassing model was disturbed with anomalies; the "new era" of modern physics was identified as "the advent" of quantum mechanics. Because it was built on the same principle as classical mechanics, its main interest remained concentrated on the correspondence between mathematical model and observed reality. Since, from the perspective of phenomenology, physicists substitute the mathematical schema for the "real world", they also struggle also to substitute the occurring anomalies in the same way. Thus, their effort does not concern ambiguities appearing in the "reality" but rather the ambiguities stemming from the confrontation of the classical mathematical model and the "reality". The ambiguities result from the clash between "reality" and the general will to objectify "reality": they result from metaphysical foundations of classical physics.

I have no ambition to criticize any of the scientific approaches mentioned above. Rather, I use the highlighted contrast between the phenomenological and the dominant (above propagated by Heisenberg) view in order to show how so-called "ambiguities" are produced. The mathematical model of nature, as a kind of an analytical grid that is necessarily based on sedimented experience, is imposed onto the observed reality which on the contrary consists of a lived stream of experience. Mysterious "gaps" popping up between these two worlds as residuals of their clash are then the inherent products of a scientific method itself. The "spooky actions" (Einstein 1971[1947]) are inscribed at the very heart of modern science by its definition.

In accordance with Lurçat's exposure of Bohr's arguments elaborated in the chapter 5.3, I get along with the thesis that scientific knowledge is made up by a dialogue, or cooperation, between the *observed reality* on the one hand and the *artificial laboratory setting* on the other hand. The final product of scientific inquiry, typically a scientific paper, then comes out from the performance of a particularly arranged experiment. As I showed in the chapter 4, these performances might be so complex and indirect that even the scientists themselves have to cope with a huge amount of uncertainty – they are prompted to maintain special kinds of discourses and intricate strategies in order to achieve valuable results. However, the very fact which distinguishes their practice from some kind of transcendent shamanism is that for all the time there exists an unbreakable connection of even the most abstract exercise and the observed reality. Although the particles "seem to come out of nowhere" (Sample 2010), they possess an unquestionable position in relation to the "intuitively given life-world" (Husserl 1970[1936]: 51).

In his essay *Circulating reference*, Bruno Latour (1999) thoroughly demonstrates how it is possible that we can relate ourselves to the real world – the world we are experiencing in our daily business – through the contact with scientific results which are present mostly in the form of artifacts like articles and formulas. The process of creating scientific knowledge does not relate to some kind of "objective" reality[22] – it rather enables the new reality *sui generis* to arise, the reality which is measurable, classifiable and categorizable. The result of scientific inquiry is thus not some kind of discovered "true essence" in a Platonic sense of *a priori* given ideas, but rather a creation of a reality which is wholly new. Yet, what is important, this "aligned, transformed, constructed world" (Latour 1999: 79) of science is firmly linked to the reality of examined phenomena. However complex, indirect or counter-intuitive it looks, there must be a possibility for us to check this link through – from the beginning of an empirically observed reality to the end represented by a scientific article. The fact that an abstract thought of final result can be dealt with as the *scientific* one stems from its reference to the world we observe.

[22] "Knowledge doesn't reflect a real *external* world (…), but rather a real *interior* world, the coherence and continuity of which it helps to ensure" (Latour 1999: 57; italics added).

In the case of the Higgs boson, thus, we (or quantum physicists, more likely) should be able to follow the path from the state of currently ongoing discoveries made by the immense apparatus of machines and scientists at CERN in 2014 back in time to the early theoretical presuppositions proclaimed by Higgs in 1964, or even further back in time to the pioneer years of QM in the 1920s. And we truly *are* able to do it: possibility of making this journey is what confers a kind of truth-value to the past explorations and what legitimizes ongoing and further research. What is nevertheless specific about QM and the Higgs boson is that the referential chain of the research process is extraordinarily complex. Paradoxically, saying with Latour, although scientists build "extraordinarily long, complicated, mediated, indirect, sophisticated paths so as to reach the worlds [...] that are invisible because they are too small, too far, too powerful, too big, too odd, too surprising, too counter-intuitive, through concatenations of layered instruments, calculations, models" (Latour 2005: 36), science is usually presented as the unproblematic "grasp of the visible, the near, the close, the impersonal, the knowable" (Latour 2005: 37). The Higgs boson after its discovery in 2013, in a word, became *like it has always been there*, like it was at hand from the beginning of the universe.

> So if there was no Higgs, what would the universe be like? The one thing we can be sure of is that it would be a cold, dark, lifeless universe. So, the Higgs Boson has saved us from a cold, dark, lifeless universe, where there were no people to discover the Higgs boson ("So if there was..." N.d.).

A popular scientific website *The particle adventure*[23] states the pun pinpointing an interesting paradox: ***discovery of the Higgs Boson has saved us from a universe, where there were no people to discover the Higgs boson***. In this sentence we can see the very ambiguous character of the scientific practice regarding the Higgs boson. To a certain degree, it obscures the referential link between the observed reality and the scientific knowledge relating to it. Suddenly, it seems like the immensely challenging way towards the Higgs boson discovery, the whole "hunt for the God particle" lasting fifty or even more years, is forgotten

[23] The website is officially supported by the Department of Energy of USA and the National Science Foundation, a federal agency created by congress in 1950.

and we are facing the clear fact that without it "the universe would be a very different place [with] no galaxies, no stars, no planets, no life on Earth" (Peskin in Than 2012), that "the universe we live in could not exist" (Gayle 2012), or even that "all elementary forms of matter would zoom around at the speed of light, flowing through our hands like moonlight; [t]here would be neither atoms nor life" (Overbye 2012). Regardless of the existing link, we are no longer aware of the long and complex chain of references. Rather, we are tempted to isolate a single image of the phenomenon which is coherent with our world-view; as Latour (2005) calls it, we are tempted to "freeze-frame" the referential chain. Although it might be, as Latour writes, controversial to question basic aspects of modern scientific approach, once again it gives us an illustration of where the ambiguity comes from. The referential chain is implicitly taken for granted. Thus, while it is implicitly endowed with the status of "scientific", the gap between the "freeze-framed" picture of the final discovery and the observed phenomenon opens up the space for a broad spectrum of mysterious stories, paradoxical parables, fantastic metaphors and far reaching narratives.

# 6. Inbetweenness: between mystery and reality

In the last chapter I will elaborate and discuss the "God particle" phenomenon as a cultural fact circulating within the "world of meaning" (Alexander and Smith 2003: 15). After we completed our excursion to the "laboratory" of CERN and confronted some of the basic principles of QM scientific method with the discipline of phenomenology, we are now able to incorporate these conceptions into the pivotal cultural sociological analysis. I will guide you now, dear reader, back to the story of "The boson".

## 6.1 Liminality

In the chapter 3, I have introduced the fashion in which the "God particle" is portrayed within the public media discourse. We can see that particular utterances on the one hand aim to constitute an exact and coherent system of scientific knowledge – they promote a universal value of puzzle-solving *telos*[24] – but, on the other hand, they insist on preservation of a certain degree of the unknown, and even unknowable, mystery[25]. Symptomatically, both aspects often appear simultaneously and stick together – however contradictory and contra-intuitive their symbiosis might seem. We feel an amazing passion "to broaden [the] horizons [...] beyond the world we see and touch" and at the same time we admit that "[w]e are lumps of clay swirling on a little blue marble in an overwhelming vastness of universe" (Sample 2010). The "God particle" discourse draws the meaning both on the *domain of the knowledge* we strive to be in charge of and the *domain of obscurantism and mystery* we are forced to rely on. The "God particle" itself is a "liminal" (Alexander and Mast 2006: 11; Knorr-Cetina 1999: 63; both conceptions follow the original idea by Turner 1966) entity.

As we saw, the meaning-making process on the laboratory side works as an epistemological system *sui generis*. It combines the rational ethos of a knowledge-acquiring, "reflexive", "technological", and "information" society (Knorr-Cetina 199: 5) with new forms of modern enchantments (Alexander 2003). This is, to a high extent, symptomatic of the "liminal" character of the studied

[24] Typically terms like "tremendous and exciting time", "the biggest scientific breakthrough" or "historic milestone" leading to the *incommensurable exceptionalism* of the narrative.

[25] Denominations like "secrets of the universe", "rendezvous with destiny", "experiments doing miracles".

phenomena. Scientists at CERN have to deal with "things which are neither empirical objects of positive knowledge nor effects in the formless regions of the unknowable, but ***something in between***" (Knorr-Cetina 199: 64, emphasis added). Victor Turner (1980: 158) used the term "liminal"[26] to describe a state "between the formed and the indeterminate" orders. These states – such "liminal areas of time and space" – "are open to the play of thought, feeling, and will; in them are generated new models, often fantastic, [...] where suppositions, desires, hypotheses, possibilities, and so forth, all become legitimate" (Turner 1966: vii). Being "liminal", the entity no longer occupies the well-known categories, yet it is not classified within the new system; it is situated in the world of the possible.

The "God particle" perfectly fits this schema. If we return to *Angels and Demons* (Howard, Grazer, and Calley 2009) mentioned in the chapter 3, we can see quantum physicist Bentivoglio appearing in the movie wearing a white scientific coat – except his neck covered with a clerical collar. He is a scientist and a cleric in one person. This is a literal expression of what I consider to be present on the symbolic level: a CERN scientist is a special kind of a liminal character occupying two worlds. He or she has to cope empirically with measuring, detecting, etc. and at the same time "forge[s] a coalition with the evil that bars knowledge" (Knorr-Cetina 1999: 64) in order to struggle with "phantasmic" entities. Also one of these "entities", the dark matter, is presented in a very precise, literal way within the movie. At first, we can see it on the computer screens as a visualization. This way of picturing is typical for subatomic events and particles, since we do not have any direct access to them. But what happens after the experiment is run? The flickering and opalescent ball of antimatter comes out of the proton collision, appearing in the "real" world just in front of our eyes, blurring any difference between the visible setting of the laboratory and the invisible realm of subatomic particles. Although the official CERN website ("Does antimatter" N.d.) dedicated to the movie explicitly says that the dark matter produced there cannot be seen, we can watch orange fiery streams spreading all around the accelerator tube. The very emblematic aspect of these two representations is that in particular shots they both look exactly the same, however, what makes them distinctive is the context of depicting, the

[26] *Limen* means "threshold" in Latin.

background. Watching the particles on the screen, we "know" that the image points to the computer simulation. Seeing them in the tube of the collider, we "know" that the image points to what is happening right now – in the reality of the experiment. A newly created entity of dark matter is liminal: it lives in the scientific papers and on the computer screens, and yet it is heavily connected to the reality of the experimental setting, of the collider, the detectors, the physicists, etc. The fictional character of the movie gives us a unique opportunity to depict it in an explicit manner.

There is another good example. *Decay* (Thompson, Mazur, and De Wilde 2012) is an independent low cost movie made by a group of PhD students working at CERN[27]. However simplistic it might seem regarding the technical level, the allegory provided is just brilliant for our purpose. The plot of *Decay* goes as follows. The Higgs boson research has been evaluated as "dangerous" and is about to be stopped. The Director General of CERN ignores the warnings and takes a risk as a necessary price for the sake of progress. "My research is too important!" he shouts. The Higgs boson then goes out of control and starts to turn people into "living deads", into "zombies". The main feature of this transformation lies in the fact that the uncontrollable particle eliminates people's power of rational thinking. In an effort to conquer the knowledge of the boson, the pride of eager physicists punishes them by turning them into nonthinking, animal-like creatures; half-living, half-dead. What I find particularly interesting here is not only the liminal character of the Higgs boson, but the new liminal character of the scientists who now find themselves between the world of dead and the world of living. The Higgs boson escapes its old definitional framework. It starts to behave in a new and unexpected way, yet its new position is not entirely determinable – "[r]eality itself provides no firm ground for [its] classification" (Giesen 2012: 788). As well as in the case of *Angels & Demons*, the allegory within *Decay* sheds illuminating light on the phenomenon which is only hardly visible within the real research. Yet it is very tempting and even "seducing" to slip from well-known worldly aspects of reality to the "realm of ambivalence" (Giesen 2011: 203). To turn ourselves towards the "fundamental questions [the "God

[27] Since its release in 2012 it has achieved more than 4 million views on Youtube and several million downloads (the movie is provided for free) from the website.

particle”] could answer about matter and the creation of the universe” (“'God particle' likely discovered” 2012). Within the Husserlian *Lebenswelt*, we are caught by the insuperable stream of experience which provides us with certainty of coherent and meaningful knowledge about life-world. Conflicts and discrepancies appear only if we make an effort to classify the stream – if we make an effort to “classify the unclassifiable” (Giesen 2012: 793-798); then, in order to fill the gaps *between* classified and unclassifiable, we come up with “symbolic figures”, “monsters” and “heroes”, we “tell the stori[es] of the uncanny behind the boundary”. We make the mysterious liminal entities meaningful by placing them into our life-world stories, narrations, metaphors, symbolic frameworks (Lakoff and Johnson 1980).

## 6.2 Not so disenchanted science

> “Faith can and probably does shape the context within which facts are understood. History seems to indicate some kind of correlation between cultures shaped by certain grand narratives of faith and corresponding scientific fruitfulness. Such cultures have a strong sense of covenant with God” (Wilton Park 2012).

Thomas Kuhn (1996[1962]: 187) developed a thesis that scientists during their professional training share “symbolic generalizations” which are represented by “the concrete problem-solutions that students encounter from the start of their scientific education, be it in laboratories, on examinations, or at the ends of chapters in science texts”. Alexander (2008b: 13, emphasis added) pinpoints such “emphasizing [as] the [attributing of] significance of ***iconic experience*** in the paradigmatic field of Western rationality”. By *iconic experience* we mean an extraordinary experience which provides a special insight into the life-world, both mystical and realistic at the same time. It is a kind of a liminal experience balancing between the known order of things and the territory yet unexplored. It is furnished by the *icon* which is also collective representation. In the case of Kuhn, thus, an iconic training represents a set of collectively shared meanings by which generations of new scientists are intellectually formed. As we saw in the chapter 5, the dominant framework in physics has for a long time – despite the confusion that emerged with the “advent” of QM – been the rational one. This, however, does not mean that quantum physicists’ relation to the world has been exclusively ordered by the doctrine of rationality. Alexander and Smith (1996) illustrate how even the doctrine that is proclaimed as "anti-mythical" constitutes myths of its own – the myths which assure us that there are no myths at all. This might be the case of the Ulrich Beck's (1992) conception of reflexive modernization, which Alexander and Smith critically point at, as well as the conception of the natural-scientific mathematized world I have been describing with Lurçat (2007).

Let us briefly look at the conception of *reflexive scientization* developed by Beck (1992: 155). Beck says that in the postindustrial society we have to manage a critical rate of uncertainty. The traditional view of science discovering a priori existing phenomena is replaced by *reflexive science*. This view of science based on reflexive condition looks at things as if they were shaped together with assistance of their observer. This constructivist position of the science demystifies the scientific practice and, what is crucial, its legitimization too. Now, according to Beck, the justification of scientific knowledge has to stand on complicated and intertwined evidence constructions lacking any really stable assurance of being truthful. The "truth" has to be understood as a result of competing powers in the particular field of actors and activities. In the process of r*eflexive scientization*, says Beck, it happened that just-the-scientists – discovering things which plainly *are* there – became not just-the-scientists but also socialized beings, highly integrated into their social environment. "[T]hey are targeted not only as a source of solutions to problems, but also as a *cause of problems"* (Beck 1992: 156, emphases added). However, a problematic part of the reflexive approach to science may appear when we start to look for the specific purposes of actors included within the discussion. If we focus on about 15 thousand scientists working at CERN and on their contribution to "the discussion", we notice, on the one hand, that they pursue a certain goal of knowledge acquisition, within their full consciousness and scientific self-confidence; but on the other hand, that they must also deal with a number of particular conditions resulting from the unique character of their highly specialized, abstract, but still routine everyday work.

The main argumentation of the critique by Alexander and Smith (1996) tends to pinpoint a mythical character of Beck's anti-mythical narration, i.e. that in order to break *the utopian discourse* of modern society, Beck comes with his own *dystopian discourse*, which is functionally equivalent to the utopian one, only located on the opposite side of opinion dichotomy. The authors refer to the analogy with the Bible, when pointing out some of Beck's narrative expressions: "Decrying 'the slave morality of civilization' (Beck 1992: 33), Beck foresees a 'maelstrom of hazards' (Beck 1992: 37) that will make 'the Earth uninhabitable' (Beck 1992: 38)" (Alexander and Smith 1996: 261). They argue that Beck's discourse "translates the cosmology of Satanism – a cosmology of mysterious all-embracing threats – into a modern and only superficially secular form" (Alexander and Smith 1996: 260).

For us, it is useful to pursue the line of "late-Durkheimian theory of discourses on technology and risk, [where] technology is coded as sacred or profane and is narrated as bringing salvation or damnation" (Alexander and Smith 1996: 251). In relation to risks, technologies and science, it is always a cooperation of human activities which marks them as appropriate or inappropriate, legitimate or illegitimate. Beck (1992: 156) comes with the claim that "[s]cience becomes [...] less and less sufficient for the socially binding definition of truth" and continues that "[t]his loss of function [...] arises as a consequence of the *triumph* and differentiation of scientific validity claims; it is a *product of the reflexivity* of techno-scientific development under the conditions of risk society". He defines this new mode of science as emerged from the "techno-economic development itself" (Beck 1992: 19). According to this, Beck's argument makes, regarding our Higgs boson case, both the CERN scientists and the lay audience, sort of skeptic actors in an unmerciful fight of rational objections and questioning. Alexander and Smith (1996: 251) say, in contrast, that "the role of culture and mythology in mediating perceptions and moral evaluations of technology, [science] and its impacts" let us examine more delicate nuances of symbolic interaction, where *ratio* plays just one of the roles. In his paper on narrative of technology, Alexander (2003) suggests that technology is meant to be "unmeaningful" because it undermines the possibility of its own cultural understanding by itself. It becomes an "antisign", purely material power, the mechanism of perpetual motion *sui generis*. Any evidence we want to seek in favor of technology is *inherently true*, because it is considered material and unmeaningful – i.e. objective – in its nature. Nonetheless, what we can see in public manifestations of the Higgs boson case shows us the opposite. The symbolic assemblage made up by complex interaction of scientific practice, philosophical overlaps of research, teleological message about progression of human civilization, etc. brings up categories of intersubjectively experienced reality which we can refer to as *the utopian narration*.

These categories are most strongly connected with progression of knowledge. "Knowledge" is already "vast" and it is still rapidly growing (Aczel 2014). It is not concrete knowledge of particular physical laws or descriptions; rather it is considered to be global and general in relation to the humankind as a whole. "The more apparently useless, the more interesting it becomes," (Brown 2011), because it has to operate "[o]n a longer time scale" – if the "physicists [at the end of the 19th century] had limited themselves to work of obvious practical importance, they would have been studying the behavior of steam boilers" (Weinberg 2012). It is thus a kind of an ungraspable, mysterious entity, which is desired for the sake of the "beauty" of the things themselves, for the "truth" itself (Sokolowski 2000: 174-5). Those are "[t]he scientific models and the observations [which] are based on our only true knowledge" – not any "descriptions of the ultimate reality" (Jennings 2013) – which lead us to "[e]xploring the outer frontier of our knowledge of nature [and] [...] push modern technology to its limits" (Weinberg 2012). "Knowledge" circulating around the Higgs boson is good in itself because it simply takes the civilization somewhere "further", to a better future. And due to the vagueness of its definition, it is also "mysterious" (Biever 2013). It relates to fundamental questions about the universe and its creation, though it is not able to reach definite answers to these questions. Effort put into its discovery is at least equally, if not more, connected with *believing* than with *knowing*. On the small scale of laboratory and everyday routine, it is scientifically rigid and precise; in overall orientation, it is *devotionally utopian*.

### 6.3 The "God particle" as a teleological icon

> And the whole universe was of many languages, and of many speeches. And it came to pass, as they journeyed from the east, that they found a plain in the land of Waxahachie, and they dwelt there. And they said to one another, Go to, let us build a Giant Collider, whose collisions may reach back to the beginning of time. And they had superconducting magnets for bending, and protons had they for smashing.

– The Very New Testament, 11:1 (Lederman 1993: 15)

The "God particle" research embodies a persistent quest for a holistic theory. The Higgs boson was theoretically predicted in 1964 by six physicists operating within three research teams[28], in articles published in the *Physical Review Letters* journal. One of them was Peter Higgs, after whom the subatomic particle has been named. Ten years later, the "Standard Model" (SM) of physics was developed and the Higgs boson was considered to be an essential missing part of it. SM is a theoretical assumption that "***everything in the universe*** is found to be made from a few basic building blocks called fundamental particles, governed by four fundamental forces" ("The Standard Model" N.d., emphasis added). This formula does not only allow to make physical conclusions about ***everything***, but, what is of no less importance, it is consistent with the theory of quantum physics and with the special theory of relativity too; it has been *built* upon these theories (see more in Lakatos 1970, the principle of "research programs").

SM is not just metaphorically a "formula" – in its compressed form, it is actually no bigger than four short lines of symbols. That, after all, we can see with our own eyes in front of the CERN Control Centre where SM has been carved into stone. The "Standard Model stone", according to the CERN official website, shows us the following:

> The top line describes the forces: electricity, magnetism and the strong and weak nuclear forces. The second line describes how these forces act on the fundamental particles of matter, namely the quarks and leptons. The third line describes how these particles obtain their masses from the Higgs boson, and the ***fourth line enables the Higgs boson to do the job***. ("The SM, set in stone" 2013, emphasis added)

The information is further commented: "Many experiments at CERN and other laboratories have verified the top two lines in detail [while] [o]ne of the primary objectives of the LHC is ***to see whether the Higgs boson exists and behaves as predicted by the last two lines***" ("The SM, set in stone" 2013, emphasis added). For a long time, the situation was such that the Higgs boson was

[28] The first team consisted of Francois Englert and Robert Brout (1964), soon Peter Higgs (1964) published his theory, and finally it was the team of Gerald Guralnik, Dick Hagen and Tom Kibble (1964).

being "hunted" by CERN scientists while its equation had already been materialized in a solid, yet non-extensive form which everybody could read and touch. The theoretical presupposition of the Higgs boson is somehow "living", it has been occupying the reality by its undeniable persisting presence, though the "real" evidence about the existence of the boson was lacking. The line of codified physics ***enables the Higgs boson to do the job***. The line of codified physics confronts the reality in order to come up with the "God particle" and with all the ambiguities which may join.

What I see as the crucial aspect of Higgs boson at this point is what I found within Binder's (2011) conception of the *secular icon*[29] (cf. Alexander 2008a), so-called *syntagmatic openness*. The secular icon, according to Binder (2011: 106), is a mixture of indexicality and iconicity in Peircean sense, it embodies the sacred and still has its "sensuous" (Bartmanski and Alexander 2011: 3), worldly aspect.

As we have seen, the boson comes to our world in a very specific way, as a kind of scientific construction, which has been firmly – and is still being continually – rooted in the world which surrounds us. We can "sensuously" manipulate newspaper texts and computer-simulated pictures of the boson, we can talk about it with our friends, we can watch it in movies, we can even be scared to death by the fact that without the Higgs boson we would be utterly dead. What we are nevertheless not able to do is to have a "direct" experience with the Higgs boson itself. We cannot see it, touch it, nor smell it. Even the most educated and devoted scientists at CERN are not able to do such a thing. In a phenomenological sense of experiencing the Higgs boson sensuously, we can only do it artificially – with artificial constructions like mathematical equations, statistic tables, graphs and animations, and last but not least, metaphors. Thus, the case is not that the impossibility of displaying the Higgs boson in something like its "real form" (whatever we can imagine under this term) is the obstacle to relate to it, but it is just the opposite: the ungraspability of the Higgs boson is so *interpretation-friendly* that it "begs for closure and interpretation" (Binder 2011: 109). The amazingly extensive field of elements which are somehow a part of the secular

[29] Although the conception is based on work with visual symbols, I will utilize it in a broader form. With no loss, as I hope, of its explanatory value.

icon of the Higgs boson opens a widespread interpretative space. The “God particle”, one could argue, “requires and inspires an imaginative reading by the spectator” (Binder 2011: 109) in order for interpreters to be able to manipulate it in a meaningful form; e.g. in the form of equations and simulations within research, or in the form of a popularizing text or a movie while explaining its principles to the lay audience.

The syntagmatic openness is also followed by the *paradigmatic openness*, i.e. inclination to “symbolic overdetermination and polysemy” referring to the already existing “contexts as motifs” so as to create a “multitude of competing and coexisting interpretations” (Binder 2011: 107). The symbols, metaphors, and narrations called upon to interpret the Higgs boson stem from already established sets of meanings. The sensuous shape of the boson might then oscillate between highly sophisticated physical formulations and popularizing metaphors while – and that is important – both poles are equally “true” and meaningful in the specific contexts of their use. As an interesting illustration of paradigmatic overdetermination we can look at the way the Higgs boson is explained referring to diverse symbols from the sphere of popular culture and everyday life. “[A]s soon as scientists had completed their work, science journalists began doing theirs”, and so it happened that the subatomic particle became, for example, “Justin Bieber fans”, “giraffe”, and “Omar Sharif” (Soloway 2012). But still, however extravagant and ridiculous some parables might seem to us, within the particular framework of their use they make clear sense. And, maybe surprisingly, they often come from the scientists themselves – just like the metaphor putting the analogy between the Higgs boson and Justin Bieber. According to physicist Martin Archer (in Landau 2012), the phenomenon might be compared to “Justin Bieber in a crowd of teenage girls”: “[i]f he tries to move through them, they slow him down, and his speed decreases the more they're attracted to him”. The fact that we are not able to depict a subatomic particle in an easy way urges us to furnish useful interpretations in regard to already settled meaning-structures. “We think we have found these teenage girls,” (Archer in Landau 2012) said a quantum physicist to CNN. Taking also the “George Clooney” metaphor into account, which appeared on the website of the Forbes magazine (John 2012), we can see that the Higgs boson problem is explained with the emphasis put not only on the explanatory level of the metaphor (which might be seen as a primary purpose of its use), but also by comparing the boson with a celebrity, a secular icon *par excellence*. Is it possible, then, that Justin Bieber, George Clooney or other celebrities let the "God particle" enter their pedestal of glory? Since the concept of the boson is so abstract, the persuasive way to point at the global importance of its research is to point at other values of "global importance"; the ones which are well-known and present in people's everyday lives. The paradigmatic openness allows us to mobilize diverse sets of already existing meanings so as to make the "God particle" more understandable, more meaningful and more present to us – to bring it closer to our experience (see the chapter 4.2 where I describe how a similar principle also works also within the discourse of physicists who treated detectors as living beings).

Still, however ambiguous and polysemic the symbol of the Higgs boson might be, we have to bear in mind that it has been very strongly anchored in the lived world since the day it was predicted. However it might be called the "God particle", whether it is likened to a giraffe or George Clooney, or expressed by the most complicated computer algorithms, we are able to trace the whole way back to the year 1964 when it started to change the world. Analogically to Latour's (1999: 113-144) investigation of the process of Pasteurization, the particle was being disseminated gradually, step by step entangled within the network of people and nonliving objects like research papers, measuring devices, accelerators (cf. Kuhn 1996[1962])[30]. From the very beginning, from the state of almost "unrealness" when the Higgs boson was at most discussed as a highly abstract concept with a merely unstable relation to the lived world, with growing pace and intensity it has been developing into the form of a hardly questionable fact of practically tangible (although with the help of many mediations) character. Now the question is not whether the Higgs boson "is", but rather what it means to us, what it can bring to humankind, how it can change our civilization, etc. This I will call according to Binder's (2011: 106) conception a fusion "of reference and transcendence". Reference expresses the ability of the secular icon of the Higgs

[30] Kuhn (1996[1962]: 106) talks about "scientific revolution" referring to such a development within science which not only extends the amount of knowledge collected by scientists in a quantitative way, but which qualitatively "transform[s] the world", including epistemology and ontology. In contrast to Latour, the scientific revolution is an instant process of transformation.

boson to "manifest" what does the Higgs boson means in Lebenswelt, in the sensuous world which surrounds us, while transcendence aims to exceed entanglements with our sensuous experience of specific events, persons, or devices to rather abstract and more general notions like the "human dignity" (Binder 2011: 106). Thanks to the combination of both transcendence and reference, a secular icon has the ability to render these abstract notions as visible and concrete and yet authentic and truthful.

Now let us go back to the materialized formula of SM. We can see that the notion of the "God particle" set in stone is a little piece of the whole picture of how the scientific knowledge is negotiated between the two worlds: the material world and the world of abstract thinking, of metaphysics. Referencing to the scientific practice as to something "mysterious" might give us the impression that science, especially QM, is something ephemeral, disconnected from reality, existing only in the heads of highly specialized experts – something even transcendent. Yet, however the *transcendent* part plays an important role within the meaning-making process of the "God particle", it constitutes only one of its components. There is also the *real* part, which is tangible, sensual, which can be manipulated and which also, to a high extent, manipulates us – forces us to deal with it in certain ways. We can find an impressive example of how the synergy of the two constituents, the *physical* one and the *metaphysical* one, enabled constitution and widespread dissemination of a scientific discovery in the work of Peter Galison (2000). Galison investigates the case of no less importance than the one of Albert Einstein who, among others, laid the foundations of quantum epistemology later elaborated by physicists including Bohr and Heisenberg. What is at the center of Galison's attention is the way in which Einstein's thought work was influenced by his environment and by the context of his everyday life – especially his work in a patent office – and vice versa, how the daily work maintained by Einstein and other scientists and technicians fostered a certain kind of tendencies on the level of thoughts and imagination. The famous Einstein's 1905 article *On the Electrodynamics of Moving Bodies*, by Galison (2000: 356) recognized as "the best-known physics paper of the twentieth century", is usually understood as a radical departure "from the older, 'practical' world of classical mechanics that the work has become a model of the revolutionary divide" – "it has come to symbolize the irresolvable break of the twentieth-century physics from that of the nineteenth". Putting an emphasis on the discontinuity with the prior order, it became an icon of its kind[31]. And Einstein became an iconic person too. In this sense, what I consider an icon-forging narration *per se* is, as Galison (2000: 355) states quoting Einstein himself, the representation of a scientist as a solitary deep thinker totally severed from the society, though solving hardest philosophical problems of the world: the narration of a young scientist who finds an ideal opportunity to develop his or her thinking capabilities in solitude and isolation. Many factors lead us to think, then, that Einstein (and other thinkers) bears some kind of transcendent capacity to resist the pressure of his surroundings while maintaining theories which are about to change the course of history. Nevertheless, Galison's insight allows us to see the case from a more complex perspective.

Firstly, Einstein was definitely not able to come up with his ideas in some kind of silent contemplation, since his professional occupation of a patent-officer kept him deeply within "the office [that] was a grandstand seat for the great parade of modern technologies", within the "world in which the triumph of the electrical over the mechanical was already symbolically wired to dreams of modernity" (Galison 388-389). The world of science, where Einstein was at home, was at the same time the world of practical technology. The problem of clock synchronization, which Einstein was working at between 1902 and 1905, was constantly influenced by day-to-day technological progression. Einstein found his scientific puzzle (i.e. the clock coordination) as a "practical problem [...] demanding workable, patentable solutions" (Galison 2000: 388).

Secondly, the area where science was being practiced in this way did not concern only technological setting, but "human setting" – or more precisely "cultural setting" – too. The "material-economic necessity" of technological progress went hand in hand with "cultural imaginary" of those who were handling it in a practical life (Galison 2000: 367). Saying that "mechanical was already symbolically wired to dreams of modernity", Galison (2000: 387-388) points out the importance of both physics and metaphysics within the constellation of the

[31] It is also at hand to mention the popular quote by Albert Einstein "Everything is relative", which has been largely perceived as a call for release of old boundaries far beyond the borders of physics (Thurs 2009: 200).

single "universe of meaning" where Einstein's place was set. "Time coordination", which according to Galison (2000: 376-377) was the final step "in the development of special relativity", on the one hand "was no arcane subject; it was front and center for the clock industry, the military, and the railroad as well", though, on the other hand, it was at the same time "a symbol of the interconnected, sped-up world of modernity". "We find metaphysics in machines, and machines in metaphysics", concludes the historian (Galison 2000: 389).

Turning back to the "God particle", the "Standard Model stone" is only a little example of the metaphysics of QM embodied in a certain kind of a material object. In this particular case, reminding us that we do not need to go to the Mount Sinai in order to get the very new version of "ten commandments" on a stone tablet[32], the symbolic aspect plays its crucial role. "Commandments" of SM formula are nevertheless performed in a way described by Galison within the technical-and-human setting of CERN laboratory. Following the history line of CERN, we notice that it is marked out by CERN's most striking experiments and by the devices which take part in these experiments. According to the institution's official website, by the year 1959 the era of CERN as an important player on a global scientific level began – with launching of the "world's highest energy accelerator" and "the world's most versatile particle juggler" ("The history of CERN," N.d.), *The Proton Synchrotron* device. The control of devices of globally unique characteristics defined by superlatives of incommensurable capabilities also brought specific repertoires of meanings different from the specialized rhetoric of theoretical scientific results. As we saw, CERN scientists are, similarly to Albert Einstein, not imprisoned in some kind of a contemplative ivory tower. They are closely entangled within their daily practical routine, and, what is of no less importance, within the material setting all around them. The aspect of *artificiality* of scientific environment plays its role not only in the case of experimental settings, but also in the case of scientists themselves. Since their underground laboratory works, to a high degree, in a self-referential mode (see the chapter 4.1, the principle of eye retina), the interdependence of *physical* and *metaphysical* elements is even more fundamental. The story of the "God particle"

[32] Since modern science is a more efficient epistemological system, we only have to deal with four commandments instead of ten. We are nevertheless obliged to obey them just like Moses was told to by "the Lord his God" (Ex. 20:1-17).

– the all-encompassing passion for the scientific *telos* – finds itself embodied into colliders, detectors, computers and algorithms, and, vice versa, the most sophisticated scientific apparatus of extraordinary global qualities continually furnishes and lubricates the allegory of a new religion of its kind.

# 7. Conclusion

Seeing that our journey is about to end, within its final part I will try to confront you, dear reader, with the findings I consider crucial in order to answer my research question. Since every comprehensible and meaningful story has its proper ending (though not necessarily a happy one) the "story of the God particle" will be no exception. As I explicated at the beginning, the text you have been reading so far corresponds to my personal experience. My curiosity as well as my sociological training led me along various kinds of puzzles and obstacles which I struggled, more or less successfully, to overcome. Every single one of those obstacles rewarded me with other quests to cope with. The number of paths which could be, and still might be, followed seems infinite.

Although I was strongly tempted to explore all of them, I concentrated basically on the features I already recognized at the point of my departure: the short notice in the political weekly magazine Respekt. The news concerning a multidisciplinary conference at CERN was considered globally important information by Respekt. Then, when I found out more about the conference, I was bewildered by the broad range of topics the participants were to address. The Director General of CERN was sitting in the same panel with the Archbishop of Canterbury's Representative to the EU, opening the discussion on "What understandings might scientists and theologians share in common?" (Wilton Park 2012) and questions regarding the Big Bang Theory and religions. I encountered the notion of the "God particle" soon after. I found it strongly entrenched within the public media discourse in the Czech Republic and in the worldwide context too. The term was usually mixed with the original name of the desired subatomic particle, the Higgs boson, pointing on the one hand to greatness and sacredness of the phenomenon (the "God" part) and on the other hand, to the fact that it is a product of sophisticated scientific inquiry (the "boson" or "particle" part). It was regularly being uttered by journalists and the lay audience as well as by scientists themselves. "I don't like this expression", said Rolf Heuer, the Director General of CERN, in a TV show in Czech Television, "[h]owever, it has been quite good for us[, b]ecause it was raising the interest in the lay person[; ***i]t is a special particle, I agree***" (Heuer 2014; emphasis added).

Further on, what struck me in most of the articles and other media outputs was the strong connection of the "Godly" narratives with the discourse on the "scientific" research setting. The ultimate character of both the technical assemblage and the human capital, i.e. scientists, technicians, programmers, etc., within the CERN facility is far away from a commonly shared picture of abstract science detached from reality and real life. On the contrary. The very exceptional assembly of technical and social setting opened up a space for quantum physics, and especially for the "God particle", to colonize imagination of people – to colonize the world of meanings. This I began to recognize mostly regarding the artifacts of cultural production. Particularly the way in which popular culture portrays various kinds of symbols using fictional means of expressions allowed me to see certain features in an exaggerated, and thus more palpable, form. I found one of the interesting examples in the movie *Angels & Demons* (Howard, Grazer and Calley 2009). Religion is here mixed up with quantum physics in the most explicit way: dialogues, trimmed of "needlessly" complex scientific explanations, combine the categories of faith, transcendence and mystery with conceptions of truth-searching, rational cognition and scientific objectivity; particular sequences confront the visuality of majestic Vatican cathedrals with the hypermodern equipage of CERN accelerator; honorable red and black uniforms of the servants of God sharply contrast with "value-neutral" scientific white coats, yet it is not uncommon that a white-coated CERN scientist wears a clerical collar at the same time. The fictional plot provides us with a bright insight into the manner in which the most heterogeneous, often even contradictory, symbols meet each other so as to create meaningful, coherent and comprehensible whole.

What might seem a bit paradoxical, then, is that there is not a big difference between narrative strategies of a fictional genre and a non-fictional (educational, documentary and similar) one. I used a short video made by the NSF (2009) as an example. Though the piece is clear about its primary message, the promotion of CERN research, we can see that particular narrating methods are very similar to those of fiction. There is a dramatic line along which the pictures of immense machines swiftly switch with compelling short utterances told by two quantum physicists and a persuasive voice of the narrator. Everything moves quickly and excitedly towards the "largest" and "fundamental" "triumph of human curiosity", towards "a key to our understanding of the universe". The matters of science here are authoritative, but also passionate and emotional, truth-searching, but also mysterious, challenging the universe to discover its "exotic mysteries", but also humbly admitting that "the Higgs is only the beginning". It seemed to me that the *scientific* on one side and the *obscure and mysterious* on the other side are not so different, independent, or even mutually exclusive. They are intertwined in very diverse and intricate ways: not denying each other, but rather existing in a certain kind of symbiosis.

Following my suspicion that the mysterious discourse regarding the "God particle" research is not purely a matter of the media or the lay audience, but that there is also a considerable contribution from the sphere of science, I had to become more familiar with the CERN scientists themselves. For this purpose I turned to sociologist Karin Knorr-Cetina (1999), who conducted a long-term anthropological research at CERN. One of her crucial findings is that in the framework of their everyday routine, while maintaining the "normal science" (Kuhn 1996[1962]), the scientists preserve and cultivate an *epistemic culture*, the way of categorization and knowledge acquisition *of its kind*. The special character of the CERN epistemic culture stems from what has already been indicated above: from the vast complexity of the scientists-and-machineries assemblage. The object of research has to be observed in a very indirect and counter-intuitive way. In order to maximize the amount of acquired useful information, scientists mobilize a broad spectrum of strategies in cooperation with their laboratory setting (colliders, detectors, computers, algorithms, data pools, etc.). The anthropological insight, then, brings us closer to the manners in which scientists cope with their tasks on day-to-day basis within this huge organizational structure. They talk about "phantasmic" (Knorr-Cetina 1999: 48) particles and "absolutely meaningless" numbers (Knorr-Cetina 1999: 56). Their work is long-term and goal-oriented (towards the discovery of one single boson, for example), but particular daily methods are continually modified and negotiated according to the ever changing knowledge of the whole environment. This fact is also involved in the meaning-making process: on one side there is expectation of a great discovery, the belief in a distant but amazing *telos* of the research and the abstract notion of truth-searching, on the other side there is daily confrontation with reluctant meaningless data, phantasmic particles and annoying signal noises. And, again, those two are not separable perspectives but they are deeply interdependent.

When I investigated further, this ambiguity within scientists' day-to-day framework led me to the discipline of phenomenology. According to Edmund Husserl (1970[1936]: 51), there is a discrepancy between "the intuitively given life-world" and assumptions we make on the basis of "geometrical and natural-scientific mathematization". This discrepancy was interestingly described regarding the debate between physicists Bohr and Heisenberg (Lurçat 2007); the case is that Bohr uses phenomenological argument of relating to every phenomenon as to a unique experience, while Heisenberg proposes that nature follows the mathematical scheme. The problem with quantum physics was that the anomalies which started to appear with new discoveries did not fit the scheme. The request for a coherent and holistic system fuelled the effort to look for correspondence between the observed reality and a theoretical model. Bohr, on the contrary, suggested that since we are concerned with a lived stream of experience, we cannot approach it as anomalous or ambiguous – the so-called "ambiguity" is an inherent quality of the reality and so it has to be dealt with as such. Anyway, because metaphysical foundations of quantum physics were generally accepted as "coherent" and "unambiguous", there persists a historically sedimented tendency to confront the theoretical model with the reality in order to ensure results "as objective as possible". This leads to the general concealment of what Latour (1999) calls the "circulating reference", the ever present reference of a scientific artifact (typically an article) to the conditions in the reality in which it was, step by step, fashioned. The concealment of this relation opens up a space for mysterious interpretations, arouses the imagination of both lay and professional audiences. It is not surprising, then, that a particular entity within a research project "begs for closure and interpretation" (Binder 2011: 109), that we are tempted to encapsulate it with meanings in order to make it somehow fitting our life-worlds. The notion of the "God particle" occupies a broad area of interpretation frameworks, a number of heterogeneous worlds in both physical and metaphysical sense. Historically, it is a part of a research tradition declared as rational, truth-searching, value-neutral, etc. At the same time it is an object of many years of passion, of the struggle for discovering the secrets of the universe.

It is a theoretical concept concerning distant and invisible phenomena but it is also embodied within the most complex and robust network of humans and devices. Generally speaking, it is a part of the story of modern progressive science, it is a great *telos* of our civilization. In particular interpretation schemes, it is a phantasmic particle oscillating on the very edge of meaninglessness.

The “God” part stands for what transcends us, what we have no other choice than to humbly obey. The “particle” part stands for what we struggle to learn, to embrace, and to dominate. Saying with Durkheim (1964[1915]), it is a *totemic center* representing our system of beliefs; at the same time being experienced with our earthly senses, and also representing the most abstract qualities of our civilization.

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