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# SOUNDS OF PEOPLE OF CERN

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**Collide Research Proposal  
by Dmytro Rizdvanetskyi**

This document consists of two parts.

The first part goes under the heading «**What**» and explains the main idea behind the proposed project.

The second part is named «**Why**» and assessing the general motivation behind the proposed research. While it briefly touches on the personal interest of the artist, it mostly focuses on exploring arguments that state why people at CERN might be interested in this research. To hear more about my motivation, please, watch this video available through the link.

# WHAT?

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## What are we made from?

When trying to grasp through a modern understanding of particle physics, a person not related to the subject might find himself in a disturbing situation. She might discover that what had been taught to her in school [is essentially a lie](#), as David Tong, a well-known professor of theoretical physics at [DAMTP in Cambridge](#), put it. What probably most of us have learned in

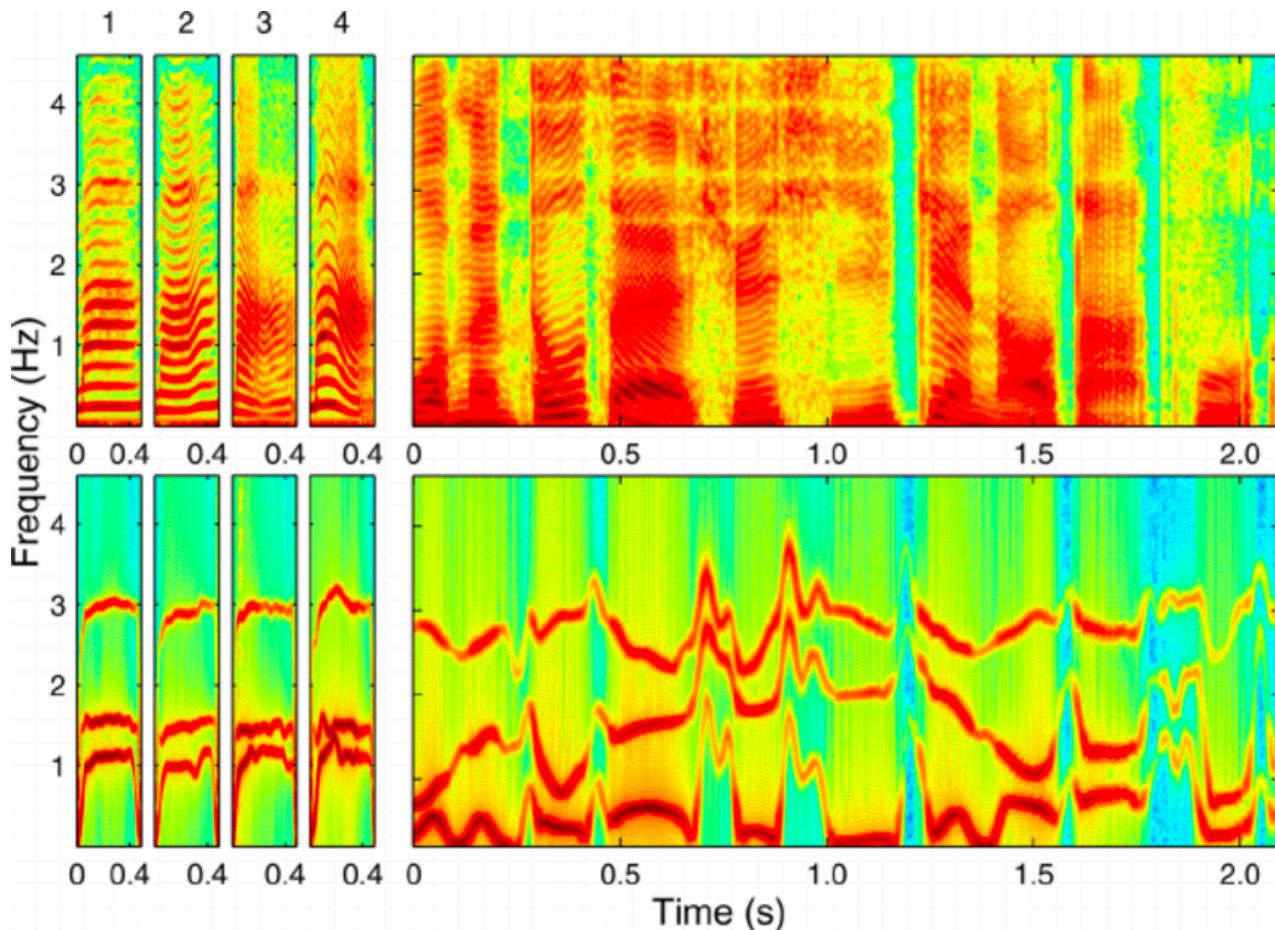
school and what is untrue is that all the matter consists of three fundamental particles: electron, the up quark, and the down quark. It is a «white lie» aimed to give students an easier version of reality sufficient to make a good approximation of how we understand reality without over

**«The fundamental building blocks of nature are fluid-like substances which are spread throughout the entire universe and ripple in strange and interesting ways. We called them fields»**

DAVID TONG

comprehending our understanding and therefore reducing the risk of misinterpretation. Indeed the truth the way we know it now is much more complex and harder to explain. According to the current endeavors, the fundamental building blocks of nature are not particles but fields, fluid-like substances that ripple in strange and intriguing ways. It is something that hard to consume because we do think of matter and outsells as part of it as a combination of many particles and could hardly describe our physical bodies bubbles in the large blanket of fluids. However, there are some things that we are involved with daily that are not so tricky to imagine as ripples like sound waves. The propagation of the acoustic wave in a medium is viewed by broad convention as an oscillation of matter. Therefore, it is possible to use this well-known phenomenon to represent any object as a ripple in a field. That is precisely what this research proposal around. It is about trying to answer whether or not it possible to use sounds as a «visualization» tool for presenting human beings in a way

that closer to our modern views of fundamental blocks of nature but so hard to imagine because of how we understand ourselves as physical bodies. In this project, we will focus not on any human being but on a particular group of people who work at CERN.



Narrowband spectrograms of the natural speech materials (upper panels) and the sine-wave replicas of the same speech materials (lower panels). Source of image: <https://rb.gy/hq3kki>

## How do the people of CERN sound?

There is no secret that we all produce sounds. The most common sources of those are human speech and singing, but there are a lot more.

We are making noises while fulfilling our fundamental needs in the process of breathing, eating, and drinking. Many sounds are born through our collaboration with surrounding matter, sometimes as inadvertent effects of our doings (walking, typing keyboard, swimming in the lake) or as consequences of our interactions with tools or machinery (driving a car,

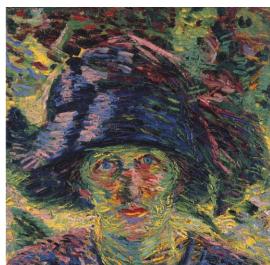
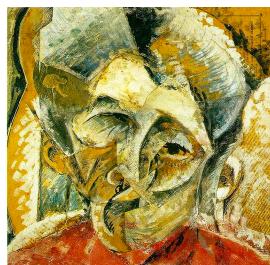
drilling a hole in the wall, printed on the paper). Sometimes we tend to organize noises in a particular way to induce intended feelings from a potential audience - the result of such an act is usually called music. If we listen meticulously enough, we can hear our heartbeats and our pulse and process happening in our stomach. Our bodies are full of even more unnoticed vibrations of all kinds like working of the sodium-potassium pump, transferring signals in our neural system, lymphocytes eating impostor cells.

There are limits to human hearing and a person's willingness to explore all possible noises that we can produce. It is also easy to lose focus in this maze of sounds that one can generate using a person as the principal source. Furthermore, while it is probably possible to capture vibrations of scientist bodies and convert those to sounds, it is not what we are interested in while trying to communicate the concept of fields as fundamental blocks of nature. So to make things both neat and straight to the point, we will focus on sounds that could be induced not from people's bodies but products of people of CERN works. These products might include something that emerges when individuals are fulfilling their duties at CERN (like character sounds of machine increasing its power). Also, properties of the environment that surround them when they work (acoustic characteristics of space), and something that generated as a cumulative consequence of their acts (structured and unstructured data that is possible to transform into sound). Let us call described products *artifacts*. The aim of collecting such *artifacts* is to provide materials for artistic expression, that could help to shape colors of potential outputs.

The goal of science is to seek universal truth, and art helps us to reflect upon those findings. Art itself is also (from my point of view), the most complex and intelligent way of communication. In case we try to communicate the idea of the sound of the people of CERN, simple collection and processing of *artifacts* is not enough. Observation of things as they are is a brilliant philosophical concept that helps to unveil the secrets of nature. However, before 2400 people could begin to work in a united effort to smash particles inside LHC, something else had to happen. The place should have been built in the first place. And even before that, the compromise among representatives of many institutions should have

been made. This compromise can only be agreed upon if supported by a strong and persuasive narrative.

The narrative was listed as a very important thing by modern philosophers (Yuval Noah Harari), prosaists (Viktor Pelevin), bloggers (Tim Urban from <https://waitbutwhy.com/>). According to Harari, it is what defines our civilization, which makes enormously large collaborations, comparing to any other group of living species, even possible. It helps us to create and explore things unachievable the other way, and CERN is one of the most prominent examples of its power. Because of its level of influence, I choose narrative as a complementary form of artistic expression. By using it, I would like to inject meaning into finished work. While texts come to mind when we are thinking about any story, in terms of this research proposal, the focus shifted towards something else. Following a long musical tradition, we are going to narrate by organizing sounds extracting from artifacts in such a way that they represent various meanings and describe personalities which are serving as a source of collected noises.



Example of applying style of Boccioni portraits (left column) to graphical representation of sound wave (central column) to obtain stylised view (right column) of original image. Used here as metaphor of presenting person as soundwave (by converting one image to another)

To gather meta texts for narratives I plan to inject into collaboration with different people at CERN not only for collecting *artifacts* but also for asking diverse questions and discuss various issues. In these conversations, I'd like to touch on a plethora of topics about science in the area of expertise of my vis-a-vis, talk about their routines both related to work and not, their interests and passions, theirs views of themselves as scientific workers, citizens, and human beings. I expect to hear some thinking regarding what they think about themselves as ripples in the fields, how do they describe who they are, and what they do using sounds? What kind of noises represents their views and personalities in the best possible way? By asking those queries, I hope to receive enough meta texts to lead the organization of obtained sounds. The list of possible questions is in «Appendix A» to this document.

## More on *artefacts* and technology

The crucial component of this research is the interaction between scientist and artist. Diverse forms of *artifacts* may appear as a consequence of collaborative effort. The choice of artifacts is best to make in place based on feedback from people involving in the artistic process, including scientists and other specialists. Curators may guide towards possible options and help to connect with people who might have opinions and expertise valuable for research. Since the process of collecting *artifacts* is essential for the proposed project, it is worth mentioning possible forms of *artifacts* here for jury evaluation in terms of feasibility. Three groups of *artifacts* differentiated by source appeared previously in this document. Here I provide additional context.

### 1. First group of *artifacts*: Something that emerge when people fulfilling their duties at CERN

The kind of sounds that surround people of CERN daily could unveil interesting connections between their personalities and noises that occupy their attention. Is it possible to correlate particular stages of the scientific path (exploration, discovery, false discovery, solving puzzles, etc.) and acoustic feedbacks? What is heard when a person is taken by an insane flow of thinking process, when she finally makes a crucial discovery or when she experiences the frustration of inability to go

beyond a particular horizon or when results proofed to be false? Could we perhaps extract those sounds from one person's imagination? Or maybe we can use actual noises produced by machinery, people, materials, and particles as indicators of this or that concept performed or experienced by people at CERN?

## 2. Second group of **artifacts**: properties of environment that surround people of CERN when they work

*Artifacts* of this group are not sounds themselves but should be viewed more like filters or lens for noises emerging and coming through space. Acoustic properties of the entrance to the antimatter factory and cavern that surrounds ALICE would differ a lot. The idea behind filing this group is to capture these properties by extracting the sound properties of the target environment. Intriguing and ear-catching attributes of space are possible to infuse using the help of people working at CERN who can point out the most prominent areas available for artist reach.

### *How do we steal acoustic properties of space?*



There are insane ways to capture the acoustic properties of space. A method worse to be mentioned is **impulse-response convolution reverb**. The process of applying the method consists of recording raw material represented by the response of the space to audio impulse. The output is then processed through a piece of software responsible for applying characteristics of space and impulse emitted to space while recording to input sound. It does so by convolution of impulse response and input sound where frequency specters of both are multiplied in a way that accentuates shared frequencies and attenuates differences. As a result of this procedure, any input sound could be heard as it was played in an environment where impulse response was recorded without playing this sound in actual physical space! Depending on the task the original impulse signal could be emitted or left in place while applying convolution.

Another crazy method is to transduce objects presented in a space to speakers by resonating them with harmonic frequencies and recreate digital music instruments copies of those objects by arranging obtained samples to a particular tuning system.

Both of the mentioned methods are widely explained in the interned from many perspectives. If you want to have a good example of the application of these methods in the artistic process I would highly recommend searching for «[The Beautiful Tones of Gigantic Sewer Pipes](#)» on the YouTube channel of astonishing musician Benn Jordan known as «The Flashbulb».

### 3. Third group of *artifacts*: something that generated as a cumulative consequence of peoples of CERN acts

When human colossus focuses on concentrated effort to solve mysteries of the universe, and computer technology is of wide use, a lot of data not only produced but processed and stored as a consequence. This data can be structured (stored in relation database), semi-structured (usually document-based storages), or unstructured data (data that is not presented in any particular order and found in texts, videos, and images). There are practically limitless possibilities of using this data for *artifact* production. Well, structured data could be converted to distributions, properties of which they might be used as control parameters for sound design. The simulations of particle collisions are possible to code based on this data to extend that allows creating [MAX/MSP](#) patches to create melodies of harmonic progressions that resemble the behavior of particles after the collision. We are able to apply various APIs to process texts, images, videos, and convert them into successions of noises and FX.

It is well understood that the actual selection of *artifacts* will highly depend on many factors, including time limitation and availability of source. During the active research faze priority will be to focus on gathering relevant raw data for future selection, whether recorded sounds or various datasets, code, images, texts, and videos. While it is tempting to focus on technology right away, there is a risk of missing real value based on exploration. To eliminate this risk collection of *artifacts* is planned as a background process using automation tools whenever it serves artistic purposes, and if not suggested otherwise by scientific partners. It will allow maximizing artist availability to communicate with members of the CERN community.

## Expected Output

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**«That is no guarantee of success - that is the beauty of science»**

SEAN CARROLL  
AUTHOR OF «SOMETHING DEEPLY HIDDEN»

So far, I expect that the final result of this research will transform into a product that reflects on the idea of metaphorical representation of people of CERN as separate personalities and/or groups as

sound waves. It is what has the potential to show that we, people, could be perceived as ripples in fluid-like substances. The big question of research though whether or not such artistic approximation could be both appealing to the scientific community and broader audience and coherent enough to be associated with an underlined concept? There are challenges dictated by aspects of acoustics perception that vary depending on heritage, culture, and age. That is why the main proposed art form constructed from sounds might be needed to be complemented by the described metatexts and, maybe, visualizations. More than that, the outlined product is better to organize for allowing personalized experiences while keeping core elements indistinguishable for most.

Similar to the fact that no single person could understand everything that is going on in CERN it is impossibly hard for the artist alone to decide on the form of delivery that would be appreciated and valued. Diligent analysis of opinions and reflections is what is best before such a decision. There is no problem for an artist to propose a concept of the final product. There is a strong desire in me to do so, but I value the opportunity to stay open to diverse ideas and be prepared to adjust whatever initial point of thought regarding the final piece of art I have now. The research phase would be considered successful if the aforementioned question will be asked with precision and clarity. I believe that the mere attempt to answer it will bring enough material for the next step.

Last but not least. During the preparation of this proposal, I discovered that team of artists (Haroon Mirza and Jack Jeffs accompanied by GAIKA, resident of beloved WARP records) already did some work around sounds during their collide residence. They raised the following question: «How

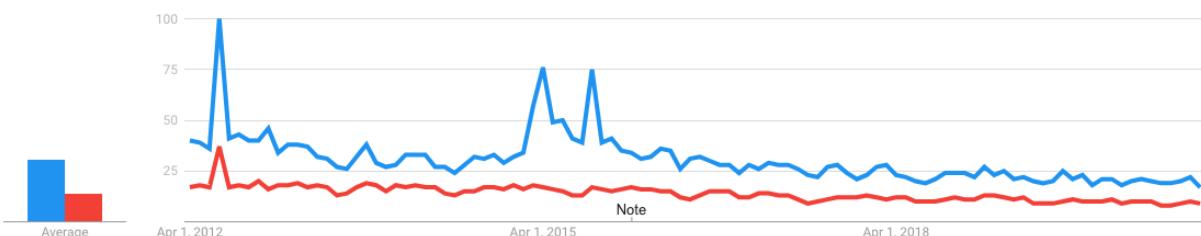
*would a civilization several thousand years from now interpret the remains of the Large Hadron Collider at CERN with its underground complex machinery?». A musical album «The Wave Epoch» will be released in January 2021. I want to be specific that the proposed challenge is very different from this one. While hrm199 had focused on ephemera, the task of this research is, among other things, to find something perpetual and ongoing. The lifespan of the underlying fabric of nature is so big compared to human life that it is eternal to us in many ways. And since we are constructed from the same material, it means that even if the Earth suddenly evaporates with all living things on it, we will be present because information about our existence wouldn't be lost but rather transformed to cosmic energy. It is possible to view proposed research as an act of return to romanticism, in some way. However, because romanticism is outdated and cannot be truly recreated in its first form, something different might appear when this research end.*

# WHY?

## The challenge

Helga Timko pointed out while asking one of the questions during online translation Info Day Collide 2020: «Now we are looking to find trace or signatures of beyond standard model in the collisions and along with this physics research is also an accelerating physics problem which is looking at what the possible accelerators and machines that we are going to build in the future in order to facilitate that kind of research at even higher energy». In January 2019th «CERN had released a design report for the Future Circular Collider, which would be four times as big as the LHC. The design for the FCC would be some 100 kilometers (62 miles) long and, when operating at full capacity, collide particles at ten times the energy of the LHC» writes MIT Technology Review. The costs of construction were estimated at 24 billion euros, and if the contract is signed FCC will be ready for smashing particles by 2040.

During his lecture at the Royal Institution «Beyond the Higgs: What's Next for the LHC?» in October 2017 Harry Cliff delivered an essential message. He said that while many important things had been done in physics since the Higgs boson discovery in 2012th, none of them went beyond the standard model. And as far as I know and also based on what we heard from Helga during Info Day, the situation did not change since.



Google trends on topics «Large Hadron Collider» (blue) and «Particle physics» for the last eight years. First peak indicated Higgs boson discovery. Second one is related to LHC relaunch in 2015 after planned sundown.

From my experience as a Data Scientist, I know how hard it might be to find yourself stuck in a place unable to break through an invisible wall. What a frustrating experience it is and how quickly it could devalue all previous work, raise bad feelings about oneself, and unbalance her life. Physicists know that particles described by the standard model cannot be all there is — they do not account for the dark matter and dark energy that, according to the current state of knowledge, is contributing to the most mass in the universe. And again, what an agony to know something like that and yet, won't be able to proceed using the most advanced technology currently available and having the most talented people in a team.

Perhaps we had hit the limits of what we can obtain from LHC? If so, it is easy to understand why the scientific community proposed to build an even bigger machine. What happens when two particles colliding at LHC follows the famous Einstein equation  $E = mc^2$ . Physicists are creating mass from energy, so the more amount of energy we have in the system, the more amount of mass is resulting out of a collision. We have already discovered particles with very short lifetimes, and those with the shortest lifespans are also the heaviest. Therefore, exotic particles might be observed in collisions with a higher sum of energy, or maybe some evidence of extra dimensions can be found.

The possibility to go beyond current technical limitations is thrilling, but this is a problem with FCC that even if it eventually has been built, the particle physicist community should wait another 20 years before getting their minds to it. And this is what bothers me a lot.

## In what ways this research can help?

Scientists are perceived by society in many ways. Sometimes we see them as evil geniuses, and more often simply as weirdos. For a fraction of us, scientists are like superheroes. If we could ask all humanity to create a portrait of the average scientist, it is most likely will be far from the actual truth. And even if there are indeed some traits that differ scientific thinker from another person, the ground truth that scientists are in most ways are

just people. People that need to be challenged to live a fascinating life but also people that need to be supported, cheered up during hard times and reminded of their beauty and importance.

By doing this research I want to explore people of CERN to show that there is more to the work that they have been doing for the last decade. The research topic is reflecting on the most advantageous knowledge about fundamental blocks of nature, and it is worth being reminded that this achievement happened thanks to people. What is also important is that while attempting to describe their work as a continuation of themselves in form of sound waves, people of CERN may unveil something new about their scientific journey and see things from a different angle. And not only scientists but all who contributed to the common goal should be invited to dialogue if last possible. So this is the first goal of this research proposal. It is to show people of CERN both their work and themselves from an intriguing angle, and thus to improve their perception about themselves.

Another task that requires accomplishment is related to gathering enough materials for achieving a better connection between Scientists and Society. And here I mean making improvements to the CERN image. Many mysteries of the universe were indeed solved by particle physicists over the last decades. However, this is not what is always appreciated, and if new collider billions in costs needed to build it should receive sponsorship from powerful institutions that represent public interests. We live in extraordinary times where, among other things, conspiracy theories are flourishing in many people's minds. Some of those people are farmers, other computer engineers, and some of them are politics, sometimes possessing great power. CERN does a great job by educating people, giving lectures, informing mass media and public, and many more things. Yet, it is hard to overdo things in this direction.

Should only a group of new media representatives with just enough subscribers launch a fresh conspiracy idea and watch - 5G towers are easily mind-converted into Coronavirus spreading devices, the real damage is done to property (many of them were burned) and suddenly WHO and

institutions cannot be trusted. So when scientists are declaring about raising problems related to Global Warming, it is not so hard for the President of one of the most powerful countries to end its membership in the PARE agreement because he has the full support of a significant fraction of his people. Overthrow spreading of 5G, on the other hand, is much heavier, because opposite business interests are involved. It is a bad thing because it means that something valuable for all humanity in a long perspective could be easily deprioritized if it is not intended to provide financial benefits to a particular group of people in the first place.

The Earth sucking miniature black hole, vacuum bubble, strangelets - all these very improbable things could do real damage to prospects of entire field particle physics by making the task of gaining financial support harder. That is why this research builds on individual inputs. I expect to gain new forms of evidence that people at CERN are very interested in the common good and that none of them are intended to run experiments when they even slightly unsure that the results of those experiments would do existential harm. I want my work to pronounce something like that to a potential observer: «Look, these are people of Cern, and they build from a fundamental, fluid-like substances called fields, just like you and everything you see, touch and smell. We transformed those people into sounds that we are presenting now to you to experience. Please, listen to the continuation of their personalities, representing their thoughts, feelings, and acts. Take a chance to share their passion, their curiosity, their love and struggle and became one step closer to the edge of the universe itself».

# APPENDIX A

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## List of potential questions for interview / discussion

The first group of questions:

- Imagine that your task is to describe a person as evidence of the fact that fundamental blocks of nature are not particles but fields. How would you do it? If you are going to use arts what kind of art form would do the task the best and why?
- Would it possible and plausible to use the concept of a sound wave to describe human likeliness to something that emerges from fields? If so, how is it possible, and what kind of material could be used for such purposes?
- Despite your first impression of human representativeness in form of the organized flow of noises, if it would be your task, how would you do it? And how would you perform such an act if you need to describe yourself as a scientist/software engineer/technician and person?
- How does your job sound? What are the character noises that surround you while fulfilling your duties? What is getting your attention when you are: taken by your work, during procrastination hours, at the edge of discovery, and after reaching exhaustion? Could you locate a particular place when you feel inspired or strange?
- How do the phenomena that you are working with sound? Could it be heard by the human ear or by using some tool, or could it be only imagined? If it can't be heard what is the reason behind our inability - is it the character of phenomena itself? Is it due to our technological limitations? If you could only imagine those sounds, how can we reproduce them?

- How does it sound to be creative, frustrated, to feel the importance of your work and amount of contribution, to be overdone, to experience a rush, to pride, to love, to have doubts?
- If a song describing your professional journey would exist, how will it sound? What will be associated with tension and release? How long will it last? Will it be boring most of the time with occasional peaks of unpredictable twists, or might it be that it will develop from one small voice to something of unimaginable complexity?

The second group of questions:

- What are you currently working on? How do you describe your work to a child, experienced scientist? What are the spread misconceptions about the topic of your work, and what are the arguments to break them?
- Where the scientific process begins, how long does it last, where it leads
- How does it feel to make a discovery, and what is it like to make no one after investing a lot?
- What helps to keep interested, and what annoys modern scientists?
- What sacrifices are made to achieve desirable results in science?
- How does the popularity or unpopularity of research topics affect scientist's willingness to continue their work?
- What is the personal motivation for being a scientist?
- What does it mean to be a scientist and make discoveries? Why is it significant?
- How does it feel to be part of a larger scientific community?
- How does it feel to be part of human society?