

Dreaming in Geneva

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Abstract

A short journey through the history of science learns us that Geneva has always sparkled with scientific discussions and ideas concerning the origin of mass and gravitation. A Genevan physicist's dream evokes some dated insights ripe for rethinking.

Essay

That feeling seldom betrays. Today, you could carve history in stone. The old wise men were invited and chose seats a bit excentrated at the first rows down there on my left. The auditorium was packed to the gills, security people refused entrance to many bystanders. They were redirected to a room next door where they could attend the seminar on a screen. Cameras and microphones enough to record the talk. Even our colleagues “down under” could follow it by duplex. They concluded their opening day of our annual conference, gathering all the specialists in the field.

From my observation post nested far above, I could observe all these tense faces. The extra work of last weeks has exhausted many of us. Some were talking about the video that leaked out the conclusion yesterday, inadvertently. The atmosphere was sweaty. A little technical problem with the audio worried the audience, but was rapidly resolved. My neighbor colleague was very busy, he was live-blogging the event. Right from the start, the chairman, with his unmissable Einsteinian accent, announced the color: “*Toda-y is a special da-y!*” [1].

Followed our spokesman. I couldn't really concentrate on his talk. The detector was presented. My eyes passed from the speaker to the old wise men on the left, to the former directors, to my busy neighbor, to the slides and back again to the speaker. How could I thoroughly follow this seminar? To a layman, it would sound so boring, but I had no reason to be bored, and yet... (for the layman who feels confused when listening to physics talks, he may be comforted that this feeling is also shared by physicists[2]). I'd seen and discussed some of these things tens of times. The detector elements, electron calibration,

muons, tauons, W's, Z's, pileup jets, technical details, event selection... It seemed to last an eternity. And then, at a moment when even my neighbor Tommaso began to lose patience[3], a first hint was given for that bump in the spectrum. Everyone in the audience knew of that bump. We knew for a long time that there was a bump in that range. We had found something, but not quite enough evidence to shout victory yet. But, with more data, we would raise it out of the background, sure we would. It couldn't be otherwise, *the standard model longs for the Higgs particle in order to be a sound theory*[4]. Today, on that slide, it peaked even better, like a sugarloaf mountain. Meanwhile the speaker continued, presenting the ZZ decay channel, coming up to the point where, trying to moderate his enthusiasm and sweeping the laser pointer along the curve, he proclaimed: *"If we combine the ZZ and gamma gamma, this is what we get. They line up extremely well and in the region of 125 GeV, they combine to give us a combined significance of five standard deviations."* At my left, someone started to applaud timidly, followed by a short pause, but very rapidly the whole crew joined in. A historical moment. We surely pinned the Higgs boson! Or quite sure ... because looking closely ...

... I started dulling away, fading slowly into thoughts of colliding protons, decaying bosons and electron jets, quarks and other particles. Every now and then, my head tilted forward and, with a shock, reestablished into a serious-looking vertical position. But I couldn't resist, my eyelids invariably shifted before my pupils. Finally, I fell asleep and started dreaming.

I awoke at the edge of a little village. To the south, I could see the lake behind the slopes with regularly planted vineyards. In the distance, the Mont Blanc with surrounding mountains emerged from a misty scenery. To the right, the sun was half way on its western decline. It looked familiar, I landed somewhere between Geneva and Lausanne, but I expected other sensations. Nature seemed ... how would I say ... so natural ... no, better said, pristine. An olfactive wonder with sweet fragrances of fruits and flowers never perceived so well. The sky was profoundly blue. Normally, it was criss-crossed by aircraft contrails, but today, not a single one. And most surprisingly, I missed the noisy background of the motorway. All I could hear, were tweeting birds and a few dogs who barked in the larger village down on the right.

In my amazement, I saw and started to hear a carriage approaching, out of that village. Two minutes later, it had reached me, passed by and stopped right in front of the mansion at the entrance of the

village. The coachman was dressed in a 17th-18th century livery and a wigged gentleman got out of the carriage. They didn't notice me. Two men came out of the mansion to greet the traveler, apparently his father and a younger brother. They called him Nicolas. He just completed a harassing two weeks journey from London, with a three days stop in Paris. Nicolas had many events to relate, in French of course. My attention was caught by the fact that he was a good friend of Isaac Newton's. I moved closer and could even accompany them unnoticed in the mansion, eager to catch every detail of the discussion. Translated, it went something like this:

- ... my good friend Sir Newton formulated in his work on the Mathematical Principles of Natural Philosophy that the force that attracts two bodies is proportional to the masses of both and inversely proportional to the square of the distance that separates them. But he didn't give any explanation for that law. “*I feign no hypothesis*”, he told me. On the contrary, this was the question that interested me most and I have passed many hours and sleepless nights trying to find a mechanism. Finally, I worked out a simple idea that explains it all. Just imagine that space is homogenously filled with tiny particles that bounce on all matter. You can imagine them as the particles that compose light. But these particles do not specifically originate from light sources, but from all bodies in the universe, so they are present even in the dark. However, when two massive bodies are close to each other, they cast a shadow on each other. There is a depletion of bouncing particles in the shadow zone. And as ancient wisdom says, *nature abhors vacuum*, the bodies are attracted towards each other and I calculated that this attraction has exactly the same proportions to distance and quantity of matter as Sir Newton's law. I corresponded with Christiaan Huygens and visited him during my stopover in Paris. He totally agrees with me. I am presently writing a treatise which I will call “De la Cause de la Pesanteur”. It will shed light on the cause of all gravity. Imagine, this could be the final stage of science and will establish my fame forever.

I smiled in my dream and thought “the poor chap”. During my 8 years of physics studies, I've never ever heard about a Nicolas leaving a mark on science, let alone on gravitation, apart from Copernicus and my optics professor Gisin.

While I felt sorry for Nicolas that he put so much hope in a forgotten theory, my dream teleported me in

the center of Geneva, or so it seemed. I stood in front of a building that looked alike the Collège Calvin. To the left, I caught a glimpse of the Saint-Pierre Cathedral, with its copper green arrow flanked by two white rectangular towers. As I seemed to be invisible to others, I didn't refrain from entering the Calvin College and after strolling some time through gothic corridors, I found a small auditorium illuminated by the sun shining through stained glass windows. A smell of waxed wood filled the air and a big stove radiated heat into the room. A professor was writing polynomials and calculus formulas with chalk on the blackboard. People were wearing similar clothes as in Nicolas' village. Wigs were a little shorter. Just as the professor finished, a man in his twenties headed to the front and asked several questions about the professor's theory of gravitation. Moreover, the professor mentioned a scientist named Nicolas Fatio. I realized, they were discussing the theory of the gentleman I had seen earlier in that little village dominating the lake.

- ... but do you believe, Professor Cramer, that those ultramundane corpuscles are a kind of light particles that are able to penetrate any massive object? I am curious to know if Nicolas Fatio developed this question. Do you think I can meet him?
- But my dear Georges, sir Fatio is now a very old man, retired in England. I even doubt if he's still alive. Maybe you should inform at his nephew's who lives in a mansion at the entrance of Duillier, above Nyon. But I fear, you won't succeed in meeting sir Nicolas Fatio.
- You are right. That's a good idea. Anyway, maybe his nephew could give me other details about his life, answered Georges.

I vaguely asked myself if there was some relation between the familiar Higgs mechanism explaining inertial mass and these ultramundane corpuscles trying to explain gravitation. Curiously, those antique scientists already had far reaching questions with quite good answers, with respect to the experimental state of the art at that moment. Since then, we discovered that particles of light are emitted by any black body in the universe. Microwave photons and, to a greater extent radio waves, cosmic background radiation are composed of photons that penetrate nearly every body they encounter. And of course there are neutrinos...

Suddenly, I was lifted up in the sky, riding a photon, in the direction of the Mont-Blanc. From my relativity courses, I knew that someone travelling with a photon wouldn't experience any passage of

time. Outch, this has always confused me! Why are we still dealing with reference frames and such classical stuff which only confuses current day physics? There's no big difference between a photon and a massive particle, say an electron. I even wonder sometimes if the electron is not just a transformed photon, an excited photon that has reached enough energy to activate a higher oscillation mode... well, of course, but a photon and an electron behave differently. The photon is the electromagnetic force carrier, while the electron is the force subject. But this point of view is unfair for the photon. If a photon mediates a force between two electrons, then wouldn't it be equally correct to say that the electron mediates a force between two photons. Anyway, do we really need to talk about "forces". With hindsight, a force seems such an outdated concept. It can more conveniently be seen as a consequence of one to one quantum interactions.

Seen this way, recoil "forces" are repellent, for example an electron sending a photon towards another electron recoils due to the impact. While shadowing forces are attractive. Let's think about it this way: an electron repels an electron, due to the recoil mediated by the photon "force carrier". And how about the interaction between an electron and a positron? ... no, that effect is experimentally unmeasurable... then what about the interaction between an electron and a proton? The proton casts its shadow over the electron: there is an attractive shadowing force. Well, could be... But what then happens between two protons? A proton casts a shadow, so it must necessarily attract another proton. That's not what I was taught in my electromagnetics course, alike electric charges repel... But wait! Recently, I read a paper about two positive charges that attracted each other[5]. And by the way, are we experimentally sure that a proton repels a proton through an electrostatic force? I once read a sentence by J. J. Thomson in Maxwell's principles: "*The difficulties which would have to be overcome to make several of the preceding (electrostatic) experiments conclusive are so great as to be almost insurmountable.*"[6] So even Thomson, the greatest expert in electrostatic forces of his time, didn't find experimental behavior totally conclusive. This reminded me also about some electrostatic experiments with resinous rods and catfur, experiments of my younger classes. The demonstration never went exactly as expected, to which the physics teacher always argued that air was too dampy or other taradiddles. I noticed that electroscope experiments always started with negative charges. Not once have I found an experiment that started with repelling positive charges. Why that? Shouldn't those experiments be totally symmetric with respect to charge? In the same idea, it is clear that in semiconductors the absence of a negative charge, a "hole", acts the same as if it were a positive charge. So, if a hole acts the same as a

positive charge, what's the reality behind positive charges?

Meanwhile, I was still riding that photon from Geneva to the Mont-Blanc, I could clearly experience the passage of time. The photon was spinning like the hands of a clock, counting its cycles: 1, 2, 3 ... 99, 100, 101, ... Invariably, I could also feel a pleasant oscillatory motion from the environment, whose period matched exactly the cycles of the clock... Both motions, spin and oscillation were assisting each other. *“Assuming that the particle has an internal vibration which allows to assimilate it to a small clock, ... the clock was traveling with the wave in such a way that its internal vibration remained constantly in phase with the wave's : this is the phase matching postulate”*[7]. I was clearly experiencing the passage of time as I wobbled on the wave. I quit counting at 1000. During those thousand counts, I had moved forward for less than a millimeter.

I got lost a long time on the snowy slopes of the Mont-Blanc, being cast back and forth between snowflakes. Curiously, after a long while, I was riding my photon back towards Geneva and landed precisely in the same old wax-smelling auditorium of the Calvin Collège. But now, electric bulbs were giving light to the auditorium and the heat was radiated by several creamy-white radiators which hang against the walls under the windows. Three older people, professors it seemed, were complaining about the newly taught relativity theory and the invasion of mathematics in physics.

The tallest, with white hair and whiskers, was arguing that gravitation could well be caused due to short wavelength electromagnetic radiation. In the conversation, I learned that his name was Thomas Tommasina and his two interlocutors were Ernest Naville and Théodore Flaurnoy, not really what I would call experts in physics, but very skilled in rhetorics[8]. So they were feeding their conversation with erudite claims. I learned that Poincaré had developed a radiative gravitation theory and Tommasina had worked it further out, building also on Georges-Louis Le Sage's theory which needed only some adjustments to be totally satisfactory, he told. And I realized that I knew Le Sage, having caught a glimpse of his discussion with Professor Cramer, back in the 18th century.

The tone of professor Tommasina seemed to me highly pretentious but alas, why not? From all these discussions I caught in my dream, I learned that countless explanations of gravitation popped up in the history of science. I realized that the Higgs field mechanism was not so different from all these

theories. The difference is that we nowadays have more and better experimental data.. Anyway, there are surely some parts of truth hidden in the rejected ideas of the past.

Thinking about the history of science, ether, force carriers, etc, I was transported to a charming little castle in a beautiful park on the banks of the Lake, the Museum of the History of Science. A 60 year old professor was talking with a student in front of a pendulum.

- ... some 15 years ago, I myself have built a very short Foucault pendulum to investigate its oscillations. I've isolated it as much as possible from the environment and collected data about the direction of the plane of oscillation, sometimes over a period more than a month.
- Tell me more about it, Professor Allais[9].
- The pendulum hinge point rested on a ball which gave it maximal freedom of motion, I called it a paraconical pendulum. Do you know that the physics of Foucault pendula has never been treated completely. I discovered that the experimental data of my pendulum showed deviations, with periodicities different from the sidereal day. Moreover, I had the surprise to discover anomalous behavior during a solar eclipse in 1954. That effect was confirmed during another eclipse in 1959. I wrote an essay on this effect and it rewarded me a prize for the yearly essay contest of the Gravity Research Foundation. Unhappily, I could not continue to fund those investigations. But, come on, we're late. My lecture at the Institut Universitaire de Hautes Etudes Internationales starts in 10 minutes...

And I saw Professor Allais and his student leaving the museum, shrinking as they walked through the Parc de la Perle towards the Institute. I was floating in the air, the wind carried me in the direction of the CERN and I landed on my seat in the main auditorium. Strangely, all listeners were wearing suit and tie. The atmosphere looked a lot more formal than back ago for the Higgs announcement. I was still dreaming. A board with old wise men was sitting in front of the audience and, in perfect French, the chairman announced Hendrik Casimir. I grasped for a folder on the seat next to me. It said : “25 Juin 1979, 25^{ème} anniversaire du CERN”. On the program, I found the line “Big science and technological progress”, speaker Hendrik Casimir, director of Philips Lab, Eindhoven[10]. The spectacles wearing professor began his talk, with a typical Dutch accent, rolling the R's.

Of course, I knew of the Casimir-Polder force, which is an attractive force between two objects. Like

Le Sage's push gravitation, Casimir force is caused by a depletion of quantum electromagnetic modes between two objects. The attractive force is inversely proportional to the fourth power of the distance when both objects are plates. Between a plate and a sphere, the force follows an inverse cube law. When both objects are spheres, it is an inverse square proportionality, like gravitation. Therefore, it seems rewarding to try to unify gravitation with the Casimir force[11].

Back to professor Casimir who spoke: *“I'm profoundly impressed. And sometimes slightly depressed because I wistfully remember the days of my youth when electricity was still taught with pith-balls suspended on silk threads and vulcanized rods wrapped with cat skin.”* I smiled and thought about all those failed demonstrations in electrostatics... Suddenly, the speaker lost his mike, attracted to earth by the force of gravitation. He remarked: *“even in CERN, the suspension of these things leaves something to be desired”*. And in my dream, I fell asleep, dreaming of guitar riffs that were slowly overpowering professor Casimir. It appeared as if Nicolas Fatio floating in zodiacal dust, no, ... Isaac Newton was singing [12]:

If I'm dreaming

It don't matter, I can feel that fresh air

Let me out, let me out

Let me out of here [13]

At that very moment, my colleague Tommaso, poked me, saying: “Boy, it's finished, if you don't want to miss the drink, you should hurry ...” My head and neck were aching, I had to awake from a two-tier dream, first back to professor Casimir and second back to the Higgs announcement. I felt sick and had trouble to stand up. While following the stream of people heading towards the party room, I promised myself to investigate the ideas evoked in my dream. Surely, history has a lesson to teach us.

References

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