Transcript

Speaker 1

in physics we believe that everything around us can be made comprehensible. It's a job that can easily set you apart from other people. There is no restriction on thought.

Speaker 2

I think I have a quite pictorial view of physics. For me, particles are colourful. For me, an electron is red. I don't know why. Don't ask me why an electron is red. A photon, of course, is yellow because of light. A proton is brown. My perception of reality, you know, I go deep inside, so I eat my spaghetti, and I think of the quarks that are inside the spaghetti. That's true. You will say I'm crazy. I am a physicist, but I love music and been studying music. Music and physics are part of the same thing, human curiosity, human creativity, the wish of exploring or understanding how things work at the most fundamental level. And what really touches me in science, like in music, is this complexity built upon simplicity. In music you have very complex and rich symphonies, think about Beethoven, Mahler. But actually, they are built up on the combination of seven notes. And likewise, nature is beautiful and extremely complex, but actually the most fundamental level is made of just three particles.

Speaker 3

I always wanted to understand what are we made out of. I need to know how are things connected. How does one depend on the other? It is the most powerful, the most complex machine ever built by mankind to try to understand why we can exist at all.

Speaker 4

When I was young, I wanted to understand the logic of nature. The fundamental laws which allow us to exist.

Speaker 3

We need these laws for our existence.

Speaker 4

The trouble is that these laws can be used for peace.

Speaker 1

For war now I am become death the destroyer of worlds dr.

Speaker 5

Oppenheimer you and many like you who brought the bomb into being still seem to suffer may I say from a bad conscience.

Speaker 1

About it is that true sir I do think it has left a mark on many of those who are responsibly engaged. This is not the natural business of a scientist.

Speaker 3

After the first few minutes of elation, I realized what had happened to the world.

Speaker 1

The big thing I felt was to eliminate this.

Speaker 3

We have to explain to the governments that what we want to do is never to be associated with the use of these laws for war.

Speaker 2

Today, CERN is a truly global laboratory with a community of more than 17,000 people across more than 110 nationalities, an incredible melting pot of languages, cultures, traditions. But in a world where conflicts between countries, religions, and cultures sadly persist, this is a truly precious gift which cannot be taken for granted.

Speaker 1

We now have autocrats ruling the largest nations on Earth in ways we thought belonged to history.

Speaker 2

Russia launched a full-scale invasion of Ukraine by land, air, and CERN has announced that it will end cooperation with up to 500 scientists from Russian institutions.

Speaker 4

The last World War had been so terrible. I thought it would be unimaginable that a new war would start again. Humanity should have learned a lesson.

Speaker 1

Here at CERN, several thousand scientists coming from different social, political systems, having different religions.

Speaker 3

Having completely different mentalities, work together very peacefully and I might say so also very successfully. How many years ago was it that you stepped down as Director General?

Speaker 4

It's a long time ago in 1990.

Speaker 3

And you're still coming in.

Speaker 4

When I became 100 years old, some people asked me, what do you do to become so old? I said two things. Always stay active and always be curious. CERN Council decided that we have to stop almost all collaborations with Russia now. It's a pity. I think it was more or less the first time that in the 70s of CERN that politics determined essentially a council decision.

Speaker 1

So this week there was Council Week at CERN. So it means the representative of our member states got together for decisions and discussions The contracts with Belarus and with Russia already have been suspended. However, there is still this laboratory in Russia, which is a bit similar to what we have at CERN. And the collaboration with them dates back to 67. So it's a really longstanding partner. Here at CERN, we have Israelis working together with Palestinians, Indians with Pakistani. So science and fundamental science gives you a kind of basis where people, independent of their religion, independent of their political system where they grew up in, can collaborate and can communicate. And I think that's something important to keep. That was what CERN is for, science for peace.

Speaker 6

I remember when I first came to CERN, I was here visiting because I was thinking about moving here and I wasn't sure. One of my mentors at the university arranged to see the Atlas detector and was the best thing anyone ever did for me because when you see it, it was like, it was love. You know, it's just this beautiful detector with the precision of it, the size of it, the amount of human effort and passion that went into building every single little part. I just wanted to be a part of that. I got to build this, help build this. There are, you know, thousands of people involved in this construction, and I really got to help with that, those teams putting it all together. There was a common goal that we all had, so it gave a special spirit to the whole thing. There was this chance to unlock something very deep about nature itself.

Speaker 1

2008, it was really the first time we switched on our camera atlas and took the first data. But the room was crowded at that time, so everybody who contributed was in that room. The preparation of this experiment took decades.

Speaker 7

We now believe that all the matter that we now see in the universe was made during the first fraction of a fraction of a fraction of a second of the age of the universe. In fact, it's something like 10 to the minus 35 seconds. That means a 1 with 34 zeros before it, an extremely small time. As their zero particle and all the other elementary particles have masses, they weigh something. Why is that? We believe that comes about from a particle called the Higgs boson. Peter Higgs proposed the existence of the Higgs boson in 1964. I would compare it to a Roman arch. So you've got this beautiful semicircular arch, and at the top there is a capstone. And if that capstone were not there, the arch would collapse. With my colleagues, we basically sat down and said, okay, we don't know what the mass of the Higgs boson might be, but for different masses, we could figure out the way in which it would show up in an experiment. Some experiments of that type were being done at CERN, but we really thought it was going to be heavier and could only be found at a higher energy accelerator.

Speaker 5

The protons are in the machine. We're ready at this end. We're now in the countdown.

Speaker 1

Next pulse.

Speaker 7

See what happens in the sort of experiments that are done here, well actually sort of underground, in some sense what's being done done down there is a sort of recreation of the first seconds of the Big Bang.

Speaker 2

You are about 100 meters underground at the absolute best experiment on Earth. The LHC pipe runs through the centre and protons come in from either direction. If we're lucky and if they hit really like a big strong head-on collision, We can create all sorts of cool stuff, potentially something we have never seen before. It's very nice here in control room because you can see in real time all these collision and particle, the shower coming out of it and sometimes, yeah, it's really overwhelming and actually it's also bothering me thinking about all the things that they will discover in the future and that maybe I will never know.

Speaker 4

Everybody's trying to write history in a way.

Speaker 5

That's our ambition. You know, the man of the caverns was writing pictures of cows on the walls, right? So that 3,000 years later, you walk in there, he says, My God, look at that. There's a human being there.

Speaker 8

Now, we are not trying painting ghosts on walls of caves. We're trying to do much more sophisticated things. When it's all done and over, what do you think we 20th century civilization have left beyond?

Speaker 4

I mean, my opinion is that we care and we respect us. And we respect us on the basis of the understanding we have.

Speaker 9

When I arrived here at CERN, you know, I was this student very much lacking in confidence, looking around at what's happening here. And I did not feel that I fit in here. I felt like an imposter. It was like another planet, first of all, because there were literally no Indians here at CERN. It was incredible. I can tell you that even the smell of coffee was alien to me. Coming from India, a woman working in the laboratory, you know, with Europeans and with Americans and all that, it was not easy. The confidence is today, the smiles are today, but I have had endless sleepless nights, years on end. This human endeavour is mind-boggling.

Speaker 1

When you were presented with the plans for the LHC, the engineering challenges absolutely enormous.

Speaker 5

Well, I wasn't presented with the plans, I made the plans. I came to CERN in 69. What is it, 55 years now? Practically. 55 of the 70. But this is home now, after all this time. I took over the project in '93, prepared it for approval, took until the end of 1994 to get approved.

Speaker 1

The project could provide answers to the nature of the universe. The machine, called the Large Hadron Collider, will aim to recreate the conditions at the time of the Big Bang.

Speaker 5

The tunnel was there already. We took it over from a previous machine. There is a pit where the big magnets can be lowered into the tunnel onto a transport vehicle, and then that gives us access to the LHC ring. This is really the biggest and most complex scientific project ever undertaken. The whole 27 kilometre circumference is aligned to better than a tenth of a millimetre.

Speaker 9

Very, very, very tiny movements will affect our data. The moon, for example, also affects the LHC. It's the kind of a breathing that goes on, like the tides, And we need to track everything. Think of gravity, that every time there is a movement of a piece of matter around the earth, that actually translates into a very, very, very tiny movement which can be reflected in the measurements at the scale at which we do the measurements, We are looking for a particle that has a lifetime of 10 to the minus 22 seconds. And within that, if there is a movement, you're lost.

Speaker 6

So the idea behind the collision is you're just getting a huge amount of energy into a single spot, and then you can produce something very massive. And so by studying these collisions, we understand this very microscopic world. And then that helps us understand how we evolved from a microscopic world to the macroscopic to galaxies, superclusters of galaxies. It's all intertwined. We can't understand that without understanding this.

Speaker 4

Hello, welcome. It's nice to welcome you here in my home. Please come in. Thank you so much. Do you still play the piano? Yes, a little bit, yes, a little bit. I like music besides physics very much. I am a very old man now. I have the advantage that I've seen now practically 100 years of European history. During the last war, I was a soldier. I was fighting against Russia and the British. In fact, I was, by chance, also adjacent when it was bombed. So I've seen it. Fortunately, I survived. So I know what real war means, where 10,000 people were killed in one night. All of that, of course, is nightmare. When war was ended, I was taken prisoner by the British troops near Hamburg. At that time, I imagine there was practically no radio. There were just a few local newspapers. There was no television, nothing. So I learned about the bombs, rather laid by chance.

Speaker 1

It is an atomic bomb. It is a harnessing of the basic power of the universe.

Speaker 4

I knew many of the people who were involved in the development of these bombs. In Germany, it was Heisenberg. And it was never quite clear whether the nuclear chain reaction would work. I knew Heisenberg quite well. He was surprised that the bomb had worked because he had calculated the detailed cross-section, and he made a mistake. It's very incredible, because I said, look, it can't have work. And they told him, yes, but it worked. So he sat down and found out, yes, he had made a mistake.

Speaker 1

A short time ago, an American airplane dropped one bomb on Hiroshima and destroyed its usefulness to the enemy. That bomb has more power than 20,000 tons of TNT. The force from which the sun draws its power has been loosed against those who brought war to the Far East. We have spent more than $2 billion on the greatest scientific gamble in history, and we have won. What has been done is the greatest achievement of organized science in history. I think when you play a meaningful part in bringing about the death of over 100,000 people and the injury of a comparable number, you naturally don't think of that as with ease. We had known the sin of pride. We had turned to effect, in what proved to be a major way, the course of man's history. The European policy of nuclear, the future of international, the Russian anatomy.

Speaker 3

It is an idea which is, to some extent, unimaginable today. Shortly after the Second World War, a handful of visionary scientists and a handful of visionary diplomats getting together from all the continents and saying, okay, we have to do something to get Europe out of the ruins. It took only a few years to create CERN. This is amazing. I cannot imagine something like this today.

Speaker 1

The Council of CERN is made-up of delegates from the 13 member states. The purpose of the European Organization for Nuclear Research is to further collaboration in scientific research of a purely fundamental nature.

Speaker 3

Looking at these people together, Oppenheimer, Heisenberg. who worked beforehand on different sides within the war, but they ignored the political difference and they were just concentrating on science.

Speaker 1

An atomic war would end this civilization and would end any science and so on. Mankind has to learn.

Speaker 3

To control itself because it now has within its power to destroy itself very cheaply. We brought the people together. We wrote a convention which clearly states peaceful application only. The organization to provide for collaboration among European states in nuclear research of a pure scientific and fundamental character.

Speaker 4

When we work, we don't think of making military applications. The responsibilities of the scientists is that the new technologies are used in the proper way. Every technology can be used for the good of humanity or against humanity. I mean, typewriter can be used for war or can be used for peaceful poetry.

Speaker 8

I grew up in an industrial part of the United States in western Pennsylvania where everybody's grandfather and father worked in the steel mills. And they told us when we were kids that if we didn't study hard, we'd end up in the factory like they were. And I totally failed, you can see. We have Metallica, Muse, Roger Waters, Jack White, Pixies. The bar is pretty high. It's not just for any rock stars. There'll be more, I hope. The science fiction question is, do we have enough antimatter to be dangerous or to power a starship? And the answer is, even though this is the best and only machine to create this antihydrogen atom, we kind of suck. It's never going to be a danger to anybody. It would take longer than the age of the universe to accumulate just one gram of antimatter. But that one gram of antimatter could put a space shuttle into orbit, right? That's a cataclysmic amount of antimatter to lose all at once. We simply... I wouldn't want to be anywhere near that, let's put it that way.

Speaker 2

CERN in the early 90s, I found an extremely exciting atmosphere. Those were the years we were developing the Large Hadron Collider. ATLAS is the biggest experiment ever built in particle physics. We are all pushed by the same spirit and by the same awareness of being very close to discover something big.

Speaker 7

In addition to the fundamental science, which might have interesting applications, there are the technologies which you develop in order to make the research possible. And the World Wide Web is one example of that. This is a technology which was developed in order for scientists to be able to collaborate around the world, and of course it's completely revolutionized the way that humans interact.

Speaker 1

So what's the web? It used to be difficult to explain what the web would be like. Now it's difficult to explain why it was difficult. But back in the 1980s at CERN, it was an exciting place to be. Lots and lots of information systems on different computers, on different networks, all incompatible. So the idea was that one should be able to communicate by sharing information. How many of you have actually never experienced the World Wide Web? I see one hand, two, three, four, five, six, seven.

Speaker 5

No, come on.

Speaker 1

What was it that made the web click as the universal hypertext on a computer network? It is the URL, and that is Tim's fundamental contribution. We sat under the big tree in the CERN cafeteria

one evening with a beer. And then I said, we need a catchy title for it. And suddenly Tim said, what about World Wide Web? I said, yeah, that's great.

Speaker 7

It's a bit long.

Speaker 4

I like its name, the World Wide Web, which was unpronounceable to French people. That's why most French people didn't like it.

Speaker 1

I don't think we've even seen the tip of the iceberg. I think the potential of what the Internet is going to do to society, both good and bad, is unimaginable. I think we're actually on the cusp of something exhilarating and terrifying.

Speaker 5

It's just a tool, though, isn't it? No, it's not. No.

Speaker 1

It's an alien life form. What do you think? I mean, when you... Is there life on mine? Yes, it's just landed here.

Speaker 2

You never spend your nights with me. You don't go out with other girls either. You only love your collider.

Speaker 9

You never spend your nights with me. You don't go out with other girls either.

Speaker 4

You only love your collider. Tim Berners-Lee and our group of friends were part of a theatre group. We used web pages for the clubs and for work.

Speaker 9

And I mean, I did think it was a brilliant thing.

Speaker 4

When this Cernet picture got published, it ended up being the first picture of a band, of an artist, of something social on the web, which was not mere physics.

Speaker 7

I think that we realised fairly early on that the World Wide Web was not something that it could manage.

Speaker 1

The most ambitious attempt ever to recreate conditions at the beginning of the universe is launched this morning in Switzerland. Catastrophic claims Professor Otter Roessler, who went to court to stop the experiment, warning the Earth could be eaten inside out.

Speaker 3

How many months or years it takes to eat the whole Earth cannot be predicted at the moment.

Speaker 4

This might be my last broadcast, because tomorrow may be the end of the Earth.

Speaker 5

You get these things moving around at the speed of light, then bam.

Speaker 2

That story was very beneficial for us because it attracted a lot of interest and attention by the public, the media, which was not there before.

Speaker 5

Normally we would not publish a switch-on day, but we never did that before. We were forced into it effectively, so we had to pick a day and then go flat out to make it. We're actually inside the control room for what is genuinely the biggest experiment ever undertaken by mankind. Nobody was more surprised than me when I came in at six o'clock in the morning and saw these huge satellite dishes and big lorries full of mobile studios and God knows what, they were under enormous pressure. We would normally not accept that.

Speaker 6

Don't forget that it made Google. The Google logo was the LHC that day.

Speaker 5

I didn't really know how much in the spot I was. I was doing a running commentary on what we were doing step to step. Let's get started, everybody. Now comes the day of reckoning. Little did I know that my wife was watching it at home. There are innumerable things that could go wrong. This has never been done before.

Speaker 6

I did not sleep that night before because I kept thinking, I had this list in my brain. Did we check that? Did we check this? What about the voltage? Everything that could have gone wrong, I was sure it was going to go wrong.

Speaker 5

Everybody is staring at a series of screens above us and the tension you could cut with a laser beam. OK, the next cycle, we will inject the beam into the LEC. Now we go into new territory. Okay, let's go. Five, four, three, two, one, zero. Nothing.

Speaker 6

Wait! Wow, last night I was like waking up constantly like, Did we say that right? What about? Oh my gosh! Physics has that kind of garage feel to it. It's not production. You know, it involves a lot

of tweaks. It involves a lot of hacking. I mean, we're hackers in the end. We fix things, they don't work. We tweak them, we don't work, they tweak them. Fundamental research is a lot of getting it wrong until you get it right. But fortunately, we got it right on the first try. Never happens.

Speaker 2

That was a really big emotion when you see the thing on which you have been working for years together with thousands of colleagues from all over the world become real. And they said, Wow, here we are. We managed. We did it.

Speaker 5

It may have looked easy to you, but I can assure you it was only made to look easy because of the quality of the equipment, the quality of the software and above all the quality of the people who have built this machine and will operate it in the future. I got a call, so I went straight over to the control room and all the screens were red. Red is a bad color.

Speaker 6

What we thought it was at the time was that they had lost the helium and that it would take us two months to recover. I mean, at that point, we were just like days from data and ah, we've got to lose two more months because of the helium. I think it only settled later that we were talking about a year. It took a long time to recover emotionally from it.

Speaker 5

It took about 50 magnets in one sector that we had to replace. Fortunately, we had all the spares. It was just picking ourselves up, rolling up our sleeves yet again, and getting on with the job.

Speaker 7

Clearly, I was frustrated, but that was 24 years after first thinking about the physics that you could do with the LHC. So if it was going to take another year or two, no, that's okay.

Speaker 10

So I am a Palestinian from Hebron, West Bank. Part of this job is it's international. We work physics and for physics, and we have to collaborate with all people, regardless of their background. Hello, friends. I don't care what you believe. Our goal is to understand the building blocks of matter, the fundamental interactions in nature. I am a Muslim, and I believe the God Almighty, and I believe there is a beginning of the universe. And my goal is not to contradict God, but to discover the laws of God, the laws that govern nature. So my belief, my physics works, or side by side, there is no contradiction. Is my belief consistent with my receive? Up to now, yes. There is no contradiction.

Speaker 2

There are so many unanswered questions. If we really do want to understand why the universe is the way it is, we need to understand what the pieces are that make it up and how those pieces fit together. the pieces that we know about, is that all of them or are there more pieces? When they were building a part of this, they needed some really, really high purity brass, which was expensive and difficult to get hold of. But some of the Russian colleagues realized that they had loads of World War II shell casings made out of exactly the right quality brass necessary. And so

over a million World War II shell casings were collected, melted down, and turned into our calorimeter right in here.

Speaker 3

CERN was one of the holes in the Iron Curtain during the Cold War, because all the people from the other side of the Iron Curtain could come to CERN, and vice versa.

Speaker 4

Is the only organization which had in its foundation the double rule to promote science and improve the relations between countries.

Speaker 1

The moment is at hand.

Speaker 7

President Reagan now is at a lakeside mansion about 8 miles north of Geneva, and it is there that the president will meet this morning with Mikhail Gorbachev of the Soviet Union. The first meeting between the leaders of the two most.

Speaker 1

Powerful forces in the history of civilization in more than six years now.

Speaker 4

When I was Director General of CERD, I got a call from the head of the American delegation to prepare the discussion. We said, Look, we need a place which is respected by both sides, where we can freely and informally discuss the problems. So I invited small groups from both the Russians and the Americans to dinner at CERD. And after their first dose, I left them alone. I said goodbye.

Speaker 1

I called for a fresh start, and we made that start. I can't claim that we had a meeting of the minds on such fundamentals as ideology or national purpose. But we understand each other better, and that's a key to peace.

Speaker 4

I think if, in the end, Gorbachev could sign his first disarmament agreement, it must, I believe, with the help of the physicists.

Speaker 3

The Large Hadron Collider is a machine for the world because it's the only machine of that type. It brings the world forward and it can only work because the whole world is involved. We could not immediately start with the highest possible energy for which the LHC was designed, so we decided to go up very slowly, but we reached the highest energy ever with an accelerator on Earth.

Speaker 1

It's a bit like an explorer, because I see something which nobody else had seen before. It's brilliant. 40 million pictures per second of these collisions, roughly 150 million channels, and it's a three-dimensional picture. Of course, then we were in a rush to find the Higgs particle. I mean, that was what we wanted to see.

Speaker 3

What's left to fill the gap between theory and experiment, that's the Higgs boson contribution.

Speaker 6

For particle physicists discovering the Higgs boson, this would be like landing on the moon. It's not just a particle. It's not just a thing that gets produced. It is a clue to one of the most fundamental concepts of our lives and worlds, which is how do we get mass? It was sort of bam, bam, bam. We were working along, we were doing everything, calibrating the detector, and then suddenly there was something there. I mean, and we thought, okay, God, is this the Higgs? You know, could this be it? You know, of course, there was this excitement that we knew, but it happened so fast.

Speaker 1

You check and recheck, and then you see suddenly this peak or this number of pictures indicating something interesting growing.

Speaker 2

People were working days and nights looking at the data. There was something special going on.

Speaker 3

We decided, okay, we will have a seminar. But we didn't know yet, is it a discovery or is it close to a discovery? Today, we had two presentations from the two experiments, Atlas and CMS, on their update on a search for a certain particle. We have a magic limit in particle physics. When we cross this threshold of evidence, then we can call it a discovery. We needed to cross this threshold in both experiments. because the cost check is absolutely vital.

Speaker 2

There were many, many people who had made the history of CERN, previous Director General. Peter Riggs was there, Francois Anglaire.

Speaker 6

The day of the announcement was really kind of not only was the world learning about it, but also half the community was learning about the other half.

Speaker 2

This distribution extremely clean, except one big spike here in this region here. So, zooming in this region. We.

Speaker 3

Have observed a new particle consistent with a Higgs boson. As a layman, I would now say, I think we have it. Do you agree? Maybe one more round of applause to all the guys supported the whole project for more than 25 years here. All them, okay.

Speaker 5

Let me just take a step back and look at what we achieved. It was huge.

Speaker 3

The elementary particles wouldn't have a mass. They would fly through the universe with the speed of light. No chance to form composite matter. No chance to form us. No chance to form the Earth. And now we found the explanation. We found it. A great moment.

Speaker 7

I have to say I was pretty emotional. I'm not quite sure whether I had tears in my eyes. Peter Higgs certainly did. So this was 48 years after they had proposed their theory.

Speaker 3

Well, I would like to add my congratulations to everybody involved in this tremendous achievement. For me, it's really an incredible thing that has happened in my lifetime.

Speaker 1

Just at the moment where you say, okay, that was worth all my work, this moment, this day, and basically you then stop working after that seminar, we just celebrated. It was a day full of champagne and beer. Perfect.

Speaker 5

I think the one good thing that I had going for me when I started this was that I was naive. and never realized the mountain that we had to climb to actually succeed.

Speaker 7

You look at the experimental teams that discovered the Higgs boson. They include Russians and Americans. They include Chinese and Europeans. They include Indians and Pakistanis. They include Israelis and Palestinians. This is an endeavor which I think really unifies the human race.

Speaker 2

The situation is complex today. The war in Ukraine does have an impact. Last year, the CERN Council decided to terminate the collaboration with some Russian institutes.

Speaker 7

So there is one institute based in Russia that we're still working with. Now the Sun Council must decide whether it wants to keep that long-standing collaboration going or whether it wants to cut all ties.

Speaker 10

Sanctioning Russia and Belarus, yeah, that contradicts the foundation. So CERM was established after the Second World War on the Ash of Europe in 1954. And the 1950s, 60s, 70s, at the height of the Cold War, World War, Americans, Germans, West Europe, Russians, Soviets worked together. So what changed? Why don't you keep that?

Speaker 2

You cannot generalize to all the people. You cannot generalize to all Russian or Ukrainian the decision of few people in the governments, maybe. I know these people, they are against war, and they are paying for something that is not their fault.

Speaker 1

So I'm really curious now to see whether Fabiola somehow has sent something. There is something. I'll wait.

Speaker 3

An important item on the room council, has the council decided not to terminate the agreement?

Speaker 1

That's good. I'm very happy to read that CERN remains in its tradition.

Speaker 3

Very good.

Speaker 2

If the council had not taken that decision and had decided to terminate the agreement, that would have been the end of any relation with the Russian Federation. This is really the nerve center. This is where everything happens. You know, how can we make sure, you know, that we continue being the number one lab? So it's projecting CERNs, you know, in decades away from today. This is why we're doing this feasibility study. You know, should we have a super, super duper large accelerator? It's going to be three times the size of the current LHC.

Speaker 1

What is dark matter? That's the question I'm looking for. We know it's there and it must be there in an enormous amount, about four times more of this than the visible mass of the universe. We're in the control room of my experiment on the space station. The highest energy particle come from cosmos. To know the original problem, you have to go above the Earth's atmosphere.

Speaker 3

Thank you very much for the great ride and safe delivery of AMS to the station. Your support and fantastic work has taken us one step closer to realizing the science potential of AMS. We have some very, very important resource that correspond to dark matter collision.

Speaker 4

So we have learned from this experiment cosmic rays behave in a way nobody dreamed of.

Speaker 3

That's why it's so interesting.

Speaker 2

It's the mystery of life and we have to accept that there are things that are much bigger, much more complex than our brain and our imagination can capture.

Speaker 4

We are made of subnuclear universe. We are pieces of the subnuclear universe. Believe it or not, it is the real origin of existence.

Speaker 2

Do you sometimes want to wake up to the singularity we once were? For every atom belonging to me as good belongs to you. When Earth was sky and animal was energy and rock was liquid and stars were space and space was not.

Speaker 4

Only a tiny dot brimming with is, is, is. All.

Speaker 1

Everything.

Speaker 4

Home.

Speaker 7

How the careers and reputations of scientists in the race to build the first super bomb were seared in the process. Back 60 years next on BBC4 with a rare archived documentary, Too Near the Sun.