50 years
Space Research Institute
Russian Academy of Sciences

ИКИ
SPACE
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Lev Zelenyi
Afterword to Foreword

The interview with the director of
Space Research Institute
of the Russian Academy of Sciences
Academician Lev M. Zelenyi

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— Lev Matveevich, how did it all start, your interest in physics?

Well, I was in the seventh grade at the time when a new math teacher came to work in our school, she noticed me right away, even though, I was not particularly into math at the time. I liked geography then. One day, she came to see my parents and told them that I was a very gifted child and if I were to be left to my own devices — nothing good will come out of it. The thing was that we lived in the centre of Moscow near Palashov's market at the time and the atmosphere in the neighbourhood was quite hooliganistic (in a good sense of the word, if you will). I, by the fifth grade, escaping, somehow my parent's care, was spending more and more of my time in the streets. So, after her visit, my parents started to pay closer attention to my education. I began attending evening math classes for gifted school children at the Moscow State University, and unlike school studies, the math class was very interesting, indeed, so, soon I gave up all of my street endeavours altogether. After I finished the 8th grade I decided to apply to a specialist math school. There were several prestigious math schools in Moscow. One was in Izmailovo (the district at the far east of Moscow) — №444, another one in the centre near the "Moscow" department store, but I was mostly interested in **№7**, which was founded by Andrei Kolmogorov.

At school my nickname was 'Professor'

I took part in math olympiads, with only a moderate success — but I would usually get to the second round. The schools №2 and 7 sent me invitation letters, but I, for, some reasons, wanted to be invited also to the school №444 — finally I liked it best. When I came for my interview, they saw my report card and said that it was highly unlikely they would accept me here since I had a B-grade for behaviour and they worked with tube computers and I might get mischievous and smash their tubes. I asked them whether they would take me or not for sure since I already had another invitation letter from the school №7. They asked me to see it, then left me alone in the room, came back in 5 minutes, and said that I was accepted and on the first of September, 1963, I should be in the classes.

So, I started going to this school. I wanted to do more math, but we had a very good electrical engineering teacher, we were learning gas discharges with him. It's plasma, as well, but cold. I liked it, so much, I, gradually, began to be much more interested in physics.

The Head of the Learning Department, Semen Isaakovich Schwartzburd (the main ideologist of the school) kept telling me — "You must apply to the University, to Mechmat! You simply must!" and I would say — "No, I want to apply to Phyztech Institute," which was the most difficult place to be admitted to at that time.

When I finished school in 1966, the eleven-year school system was abandoned. Which meant a lot of young people finished school at the same time (the ten-year and the eleven-year programs). So, the competition was fierce at the Phyztech that year — 15 people fighting for one spot, but I got in.

Strangely enough, I didn't just do all the math tasks, but made it double — did 2 variants and got A++ on my math exam. Though, with physics, it was more difficult, after all, I had a mathematical brain. There was this task on the Mach Cone, easy if you know what it is — which I realized afterwards, but I couldn't, solve it (since physics were not taught well in our school).

Instead, I wrote this huge equation to minimize the time of, sound propagation from the plane to observer, which I could hardly finish.

The exam teacher was quite surprised when he saw my work and was going to give me an F. After I explained why I did it that way, he was astonished, that I was able to "re-invent" the Mach equation in order to have a solution. Everything I did was right, I just didn't have time to finalize the job. So, he gave me a B, I got all the score needed to be admitted.

So, the whole new life started, but I always kept in touch with my old school friends. We still see each other several times a year. My old math school was excellent and few of my schoolmates became famous mathematicians.

I liked it very much at Phyztech. The Institute was located in the town Dolgoprudny — quite far from Moscow — and it would take an hour and a half to get there, that's why many Moscovites were staying in dormitories right there. First, I was sharing a room with a senior student, he was in his 5th or 6th year and was considered a local celebrity, he already started writing his dissertation. His name was Vladimir Fortov. How is that for the irony of fate?

I stayed in that room several weeks in a row without going home even at weekends, very much to his surprise. I already made, some friends and we were studying a lot together. The freshman year was hard. It was not too bad for me because I had studied in a specialist math school before and I learnt plenty there.

After a while Fortov went to the student's committee and told them that the freshmen were extraordinary young men, extremely serious about their studies, so, they should be given a separate room to stay for all of them in order to create proper environment for their scientific work. That was not a usual practice, but Fortov was a very respected man and they decided to follow his advice. So, the four of us got the room.

Then our ways with Fortov parted. In the 80`s we met again and still working together at the Presidium of the Russian Academy of Sciences.

It was very interesting to study at Phyztech, though I didn't know yet what I was going to do in the future. Space, of course, fascinated me. I remember, there was a big article by Joseph Shklovsky in the "Technology for the Youth" magazine about how, by his calculations, the moons of Mars — Phobos and Deimos had to be hollow because of the way they were slowing down in space. So, if they were hollow, they must have been artificially made, by martians, no less. The notion captured my imagination.

— So, how did you happen to get into the Space Research Institute?

Well, fate, I suppose. It's interesting whether one feels anything, when some important events, which change one's life happen, or not. I was trying to remember what exactly was I doing and where was I on

the 15 of May, 1965. Did I feel anything special? That was the day the Space Research Institute or IKI was approved, by the Soviet Government, to be founded, and special secret decree was published.

There was something in the air for me, some, sort of a fate calling.

One day, in 1969, I was at Phyztech as usual, when I saw a notice on the notice board about applications for a new faculty/department called Space Physics. So, I went there. There was a man in a red tie sitting in the room, I remember him as if it happened just now. I came in out of curiosity. He said — "Sit and write me set of Maxwell equations," —, so, I did. He asked, some other questions and I answered them. Finally, he said — "Very well, you are accepted to our new faculty/department," as it turned out, I was one of the very few, who could write down without any mistakes all of four Maxwell's equations. I said — "No, thank you, I couldn't, possibly, accept it now, I am very happy with my own department." My base institute was the Research Institute for the Heat Processes, the very place where the famous "Katushas" were made, which was later called the Keldysh's Center. I was there with the department which was working on nuclear rocket engines. It seemed to be the top of all science to me. I didn't want to go anywhere else.

Leonid Lvovich Vanian, the man in the red tie, apparently, put me on the list of people he wanted to work with and gave the list to someone in Phyztech administration. This list happened to save me one day.

On April 14, 1969, my friend and I were wandering through the streets of spring Moscow till we reached the Mayakovsky's square. Suddenly, I remembered, that in the 60`s, on the day of Mayakovsky's death, the poets Yevtushenko and Voznesensky would hold poetic readings for the public there. I knew that since I was a child — I lived near and often went there to listen. And that was the very day, so, we decided to have a look at what was going on. These were different times now after the Czechoslovakian spring in 1968, the government started tightening the screws, so to speak, as a result poetic readings were banned. Well, we didn't know about that yet.

The atmosphere at the square was bizarre, people were running about, the police was trying to catch them, someone climbed the statue, while reading poetry, somebody else tried to pull him down... My friend Vladimir Parshev and I were just standing there as idlers, but, somehow attracted police`s attention and were arrested on the spot. We were

brought to a police station, interrogated, even though we didn't do anything illegal. They didn't know what to charge us with, so they wrote down our names and we were eventually let go.

I have forgotten all about this, but, as it became known later, there was an anti-Soviet group founded by famous dissident Valeria Novodvorskaya at Phyztech at the time. Some Phyztech students from this movement distributed the leaflets (the famous "Two Thousand Words") against invasion of Czechoslovakia. I hardly knew anybody from the movement, but my name was already red flagged from the previous encounter with the police. In my case they put two and two together. In the fall of 1969, a letter came, from the KGB, saying that a wide dissident's group existed within the walls of Phyztech and that they were seriously displeased with the deficiency of our ideological education. So, a lot of people were suspended, including us. The majority of our friends in Komsomol (young Communists) bureau, however, stood up for us and we were spared. But the political trust was lost. I was called into the dean's office and told that I should leave the secret institute I was assigned to and go to a new base, where, somebody would be very happy to see me. I was given a choice either going there or out. I didn't particularly want to change places, but I had no choice, so we went to the Space Research Institute (which had to be our new base, apparently). It became clear in 10 year's time just how lucky we were, me and Parshev. The students, who stayed with our "previous" line of research, eventually got into serious troubles because it became apparent that even though a nuclear engine could be created, but it would be impossible to test it at that point in time. The whole field of research was put to sleep for a while and only recently a new wave of interest for rocket nuclear propulsion has arisen.

When we first came to IKI, the main building was not there yet, there were, some little glasslike buildings on the site (usually such constructions in Moscow were used for barber's shops). There was no underground station nearby, we came on foot looking for the place and got lost. The second attempt was more successful since we were given precise directions.

Finally, the day came when I stepped for the first time over IKI threshold. The scientists such as Oleg Vaisberg, Leonid Vanian, Alexandr Ershkovich, and Vladas Leonas would give excellent lectures, I started to really love it here and then I found myself engrossed in space physics. I was

especially inspired by a recently discovered poetic and beautiful thing called “solar wind”. Well, in 1972, we became the second-generation of graduates from the space physics department. Half of the people working at the Institute today are the graduates of the same chair.

My new life started to unfold within these walls. My advisor Leonid Lvovich Vanian was the founder of the chair. He was warned of my complicated history when he took me in. One day he had a telephone call from the KGB, I suppose, while I was there with him, the call, apparently, was about me. I was still on their watch list, I guessed, but Vanian had nothing, but praise for me. He was very protective of me as well.

I graduated with the highest honours. I wrote quite a few articles before that. I liked it less and less, somehow, working at Vanian’s, I was becoming bored with electrodynamics since it was not the plasma physics, which is much more complicated including both electrodynamics and dynamics of charged particles.

I wanted to leave for Lebedev Physical Institute of the Academy (FIAN) or Sternberg Astronomical Institute (at the Moscow State University) where they had the space physics departments, but it didn’t worked out that way. It was not advisable to students to go where there

First symposium on, solar wind interaction with planets, 1975, Moscow

With Vladimir Sotnikov who works in the USA

was no chance of getting a permanent position afterwards. I stayed at IKI and graduated from Phyztech in 1972. In 1973 the "revolution" happened. A new director was appointed to head IKI — Roald Sagdeev. The quiet old times were over with, the whole new era of changes commenced. I was a member of the Young Scientists Committee, it was my responsibility to arrange lectures with distinguished scientists and I came to see Sagdeev (who didn't know me then) and asked him to give us a talk. He agreed. The topic of his lecture was "The Specifics of Space Research". We put out a small notice and expected 30 or 40 young people to come. We were dying to hear about new changes coming to IKI.

He entered the room, all of the people, who worked at the Institute gathered there and, some of them were, literally, hanging from the ceiling. He looked at everybody and said — "Well, even though I am glad to see all of you here, but you are supposed to be working now and the lecture was for the young scientists alone. If I could — I would fire you on the spot, I would, of course, take, some of you back, but trust me, many people, who are here now, wouldn't be here any longer."

Those were exciting times.

— Was there anybody who, actually, inspired you?

Of course, there was. With Sagdeev came his favourite pupil, a very young talent Albert Galeev, who already had a Ph.D. Doctorate to his name. Galeev was to become the head of the department where I was working at the time. It was obvious that some people didn't fit in with the profile of the Institute, the way Sagdeev saw it, and as a result the Vanian's lab (where I was working) was to go to the Institute of Oceanology. And I thought, I would have to leave with them too, but things went in a different direction. So, I was very much interested in plasma physics. I had learned all of Sagdeev's and Galeev's works by heart, I think. They had this fundamental monograph called "Reviews of Plasma Physics", volume 7, dedicated to the nonlinear plasma phenomena. I have tested and retested the theory several times and knew it better than Galeev himself, supposedly, since he wrote it a long time ago and probably had forgotten, some small details.

Galeev, as the future head of our department, was giving us a talk and I thought to myself, if I were to be let go anyway, I would at least, make, some show and have my say. So, I started asking cheeky questions — there were some little things left out here and there in his book, so I pointed them out to him. He didn't expect such an attitude, he, probably, thought that nobody had a clue here about anything in his book. To his surprise, here I was asking questions. I think, he liked my impertinence. So, he called me to his office and said — "Well, I can see, that you pretend to know plasma physics better than me. Here is a little "easy-peasy" task for you" — and he gave me not, so little or ever, so easy task, but I could find the solution quickly. It was the beginning of our collaboration and friendship.

Galeev is a great man, a genius on, so many levels. When I was first getting to know him, he demonstrated me such latitude of character as well as absence of complexes, some other mediocre scientist would probably show me the door or wouldn't let me near him. That was not the case with him, I think, he liked my challenging behaviour. Sometimes, he was up to some mischief, just like me. Later on, some people, who already knew me and another one of Galeev's pupils, Vladimir Krasnoselskih, but didn't know the fact that we both were his pupils, told Vladimir that he had a performance style like mine. Then I realized, that we, inadvertently, copied Galeev's style of presenting

things. His lectures were brilliant. He could draw very nice pictures to illustrate his point and make everything crystal clear. He was very inspiriational.

He would grasp everything in an instant I sometimes would come to him after a week of doing calculations and he would just take a quick glance and see the conclusion right away. He would say — "Ok, I see the solution, and what do you plan to do next?"

I had this huge moral dilemma in front of me at that time, because Vanian, who supported me all this time, wanted me to leave with him, unfortunately, I was not interested any longer in electrodynamics problems which his lab was engaged with. I chose to stay with IKI and plasma physics. I began working closely with Galeev, solved few interesting problems, and wrote my first thesis.

The title of my dissertation was very general "Plasma processes in the magnetosphere of the Earth" (sounded quite impertinent). Galeev and I wrote 20-30 scientific papers together, one of them is quite famous — we discovered that current sheets — the structures of the magnetic field in the magnetotail of the Earth — could become metastable. They can store energy and then explode. We proved

Russian-Bulgarian partnership, with the scientists from the Solar-Terrestrial Relation Lab, Rositsa Koleva and Iordanka Semkova

that property. That was the subject of my dissertation. Eventually, I started working on my own, I had a number of my own pupils now, too. They work all over the world, now.

Galeev asked me to join the project called INTERBALL which was addressing the research of many physical processes that I described in my dissertation. Before that, I was a mere theoretician and now I started taking part in preparatory experiments, though I didn't design any devices, but rather provided a logical basis for a course of actions.

In 1982 in Plovdiv, Bulgaria, I organized a conference with the same title as my dissertation. It was discussed in the course of the conference about what phenomena we should actually research, what tasks we can solve and goals to achieve and, so on, so forth. Later I organized several similar preparatory conferences in Suzdal as well. Project INTERBALL consisted of 4 probes, each one of them had over 10 different instruments on it. Every instrument had 10 engineers behind it. The INTERBALL development was seriously slowed down by the decay of Soviet Union. We started the talks about the project in the 80's and it finally was launched in 1995.

Russian-American workshop, Washinghton, 2002,
D. Papadopulos, G.M. Polischuk, R.Z. Sagdeev, A. V. Zakharov, L. M. Zelenyi

Plesetsk, INTERBALL launch. R.S. Kremnev, V.N. Paletskyi, L. M. Zelenyi, deputy director Maj.-Gen. G.M. Tamkovich

Sagdeev left our Institute by then and went to work in the USA, he gave the reighs to Galeev, and Galeev subsequently gave to me his responsibilities over Space Physics Department. It was already a new era — the era of democracy. Directors and heads of departments weren't appointed anymore, but elected. There was an election with a quite a tough competition for the director's position at the time. And yet again, the twist of the fate for me.

If Sagdeev had never left for America, things would have, probably, stayed the same for me. I would have led a quiet life of a theoretician who occasionally helps with experiments.

Now, everything went upside down — I made quite a huge leap in no time — from a senior research position I jumped to the head of the department, where I was managing over a hundred people and all of them were older than me. By that time, I already had my PhD and my Doctorate, worked on numerous experiments, so, the position was fairly easy for me to handle.

Prior to my becoming the head of the department, a lot of people were on the first name basis with me, after that they wanted to change things in order to show me their respect in my new position, so they

We have not learnt how to use chopsticks yet (in Japan).
A.A. Galeev, T. Mukai, R.A. Sunyaev, R.R. Nazirov, A. Nishida, L.M. Zelenyi

started using my patronymic, but I immediately put a stop to it since I thought everything should be the way it used to be. So, in 1989, I became the head of the biggest department of the Space Research Institute — the Space Plasma department.

Our famous humorist writer ZhvanetskyI once said — "The bad side of women's character comes from their beauty, while that of men's — from their talent."

In my Department № 54 I had a fair share of both and it was not easy in that respect — I hope, you won't get me wrong. American colleagues might remember the famous Club 54, which opened in 1950's in New York. There were many jokes about this coincidence.

The most important thing was that, this department № 54 was working hard on the international project called INTERBALL. The project was arranged by principle 2+2. Two tail probes on far, strongly elongated orbits (200 thou km) and another two probes in auroral region (20 thou km). Two probes were spacecraft of *Prognoz* series and two Czech sub-satellites belonged to *Magion* series.

The project started coming to light in 1995, right in the middle of the Soviet Union collapse, it's hard to believe now. Now, I'd like to remember General Gennady Tamkovich, who was a deputy director

at the time, the real General by rank and by his character, who had numerous connections in the rocket industry. He was very pushy, there was nothing stopping him. That is why with his relentless efforts we were able to launch the first pair in 1995 and the second one in 1996. They were launched from the cosmodrome at Plesetsk. There was no accidents of any kind — everything went smoothly. Those were the best years of our lives. Oleg Vaisberg, our famous philatelist, arranged to be printed a very special edition of envelopes dedicated to the INTERBALL launch. I remember we went to the nearest village to stamp those envelopes together.

I'd like to tell you a funny story, which happened at the launch of the Auroral Probe in 1996 at Plesetsk. When we arrived to the cosmodrome, it was filled with Latin American top military man in bright uniforms with braids, epaulettes, and everything. They could hardly speak any English, but I managed, somehow to find out that our industrial partner — Lavochkin Association decided, without telling anybody, to make, some money for themselves and had undertaken the task of launching one more small probe for the Argentinian government for Earth observations. It would have been fine, but all the flags, which were all over the place, were not, exactly, Argentinian flags. I knew perfectly well

State commission on INTERBALL. Eupatoria, Crimea, 1996. With general G.M. Tamkovich

what the Argentinian flag looks like. I finally managed to learn from one of the colonels that it was not, as a matter of fact, the Argentinian flag or the probe, but the flags and the probe belonged to the province of Cordoba therefore, the flag, you see, was the flag of our the most important of all the provinces in Argentina. So, the parade of provincial, sovereignties (only too well known to Russians) was not just our sickness.

Both INTERBALL probe pairs went to their orbits successfully and worked there (by Russian standards) a long time perfectly well, for 5-6 years. The times were great, the whole Dept. №54 still remembers them fondly. We realized just how great it was only after the probes burned out in the atmosphere. Afterwards, we were never that lucky. A project just like an infant constantly demands attention and care. Many people played a huge role in the project, people like Georgy Zastenker, Slava Kovrazhkin, Mikhail Mogilevskyi, the late Lev Pesotsky (who left us far too, soon) and his team — Zhanna Dikareva and Tatiana Lesina. Our, very young then colleague Anatoly Petrukovich provided the project with necessary and constantly updated database of the key physical parameters of ongoing measurements.

We were decidedly lucky. The INTERBALL was launched in summer. In the fall of the same year, the project MARS-96 was about to be launched as well. I remember that day in November very well. I didn't go to the launch since I was not directly involved in the project, I went to the Mission Control Center, instead. I had a very bad feeling that morning. Somebody even asked me — "Why so glum at such an event?" MARS-96 was a huge apparatus filled with many complex devices and instruments, our industry doesn't make anything like that anymore.

Plesetsk. INTERBALL launch

INTERBALL team meeting, Sofia, 2002

I already mentioned it in the foreword to memoirs of Vasily Moroz. It became apparent at, some point that the spacecraft had never reached the proper orbit. At IKI, as usual, after a successful launch there was to be a huge banquet. There he was, Vasily Moroz standing there devastated — he already heard the bad news and I remember distinctly his words to Inna Afatkina (she was the caterer of the celebratory dinner) — "Kill the lights! The show's over!" It was a huge blow, he put, so much effort into that project. He died several years later.

I had the same ghastly feeling, some years later in 2011 when the project *Phobos-Sample-Return* met its fate. Yet again, it was a nasty dark day in the fall.

— The major change from the head of a department to the director's position in almost one go, how did it happen?

Galeev got sick, his memory was going fast to the point when it became clear that he might be incapable of managing the Institute. He did his best to make sure I was the one to be given the reigns of governing, so to speak. Galeev is not just a distinguished scientist, he also

is a great man. Even though he did not teach me anything specifically, I learnt a great deal from him over the years. So, it happens, I became his successor twice, first as the head of our department and then as the director of IKI. He, literally, took me by the hand and brought me to the board of the Academy of Sciences and told them that it was becoming increasingly difficult for him to work and he sees only me as his substitute at this point.

The minute he got sick, things, surrounding the matter of our Institute, started unfolding. All of a sudden, there were many academicians wishing and willing to head our Institute. Now, I ought to give a lot of credit to all my IKI colleagues in this case, they were all supporting my candidacy. Perhaps, the same principle applied in their mind as with an American saying "He might be a son of a bitch, but he is our, son of a bitch." Nobody wanted an outsider, so I was elected unanimously, in spite of the fact the Institute was not exactly the friendliest place in the world at the time. I had worked here for almost 30 years by that time and I must say all the people who ever worked at IKI have a special imprint on their mentality.

Galeev's times weren't the easiest. But not even once during his tenure people were not paid their salaries on time. The salaries were not particularly good, but at least they were paid out regularly, unlike the rest of the country. Miners, for instance, not being paid would take it out to the streets and start knocking their hardhats about a bridge near Russian White House. Galeev also proved to be a very wise politician one day, when the infamous *coup de tau*t happened in August of 1991, he, actually, raised the banner of resistance. I was working in the States at that time and missed all the historical events. Nobody knew what to expect. One thing was apparent later — he chose the right way to go, because of that decision, IKI never had any problems with the new Russian government. Of course, now we all know too well how we were deceived with their beautiful speeches about freedom, democracy, and equality.

So, Galeev's time was not the easiest. Unfortunately, we lost a lot, especially in his last years as the director, when he was really sick, but we, somehow managed to keep the Institute afloat. With Sagdeev IKI evolved into the leading institute in the field. Next ten years after him, we desperately tried to keep the status and succeeded in the end. From 1990 to 2000 we didn't have any big project to work on, except for the INTERBALL and GRANAT, which was an astrophysical project. We

With my friend, eminent Japanese scientist Hiroshl Matsumoto, president of Kyoto University

were barely functioning, there was almost no work, there was this feeling of uselessness in the air, it was the time of full blown crisis. With Yeltsin in power, the years were nowhere years for science in general.

By the middle of 2000, the situation began to improve considerably, we had now on our hands a new project *Phobos-Sample-Return*. We just loved working on it.

These days, there is, so much work to go around, unfortunately, we are experiencing now the lack of science and engineering workforce to get it done. The Lunar program, the Martian program, some astrophysical research plus few, solar and magnetosphere projects. Some people might complain about working too much without breaks, but those who remember only too well the hard times, prefer now to then for sure. Personally, I think, being idle is never good.

— So, IKI once again is in front of the whole planet?

Well, development, as dialectics teaches us, happens by leaps. The process is not necessarily linear. Sometimes you just have to go back — we have time for that. In recent years, for instance, the new group

of departments emerged, led by Evgeny Lupian, they tackle problems like the Earth observations, environmental health of woods, rivers, and agricultural fields' research, problems of oceans' pollution and, some effects of global warming.

The 90`s were troublesome years, the life was quite drab then. Next, after the INTERBALL project, was the 4-probe project called CLUSTER which was developed by the European Space Agency. We didn't have any of our instruments or devices on the probes, but Slava Kovrazhkin and I were invited to take part as co-researchers. The CLUSTER was launched in 1996, they used for the first time the *Ariane-5* rocket launcher and it crashed. Unlike the INTERBALL (coincidentally launched at the same time), they planned to have four probes working together at a close distance. And all of that unique equipment just crushed and dived into the swamps of the French Guiana. The pictures of the disaster were quite heartbreaking. People in them were trying to salvage bits and pieces of the equipment covered in dirt on the crash site.

The same year we had a similar disaster with our MARS-96 mission (the 4th stage ignition failed to take place and the whole thing broke up in the Earth atmosphere). Unlike us, the European Space Agency made

With my friend Gurbax Lakhina, director of Mumbai institute of Geomagnetism

a huge effort and in just 4 years they replaced all four spacecraft and successfully launched them. The second time around, they didn't use the *Ariane*, instead, in 2-stage program they, using the *Soyuz* rocket carrier with the *Fregat* booster, launched their satellites in pairs into their planned orbits. All four spacecraft are still working perfectly well. In recent years, many of my articles on the subject of space physics were based on that extraordinary fine project. Thanks to our European colleagues, who generously shared their results with us, we, despite the lack of our own experiments, were able to test our theoretical models, using the measurements received from the CLUSTER satellites. Of course, it's much better to get our own results from our own satellites in space. Multiple satellite launch idea was first implemented in the INTERBALL project and now is still developing strongly. Subsequently, in March 2015, NASA specialists launched their four spacecraft mission called *Magnetospheric Multiscale* (MMS). I hope to participate in their theoretical group. As we can see, more and more complex systems are being launched now and the measurements techniques are advancing as well.

We have one more project in mind called ROI, which is "swarm" in Russian. It consists of four small satellites working in a close range (10 times smaller than CLUSTER satellites) in order to explore physical

In Sheremetyevo bar – before the trip to IACG meeting in Florida.
Rashid Sunyaev, Lev Zelenyi, Albert Galeev, Ravil Nazirov

Bern, Einstein Museum. Russian delegation to IACG:
Victor Oraevsky, Albert Galeev, Lev Zelenyi, Rashid Sunyaev

processes not only on the scale of ion dynamics, but on the scale of electron motion as well. Unlike the MMS project, the project ROI exists, so far, only on paper.

Today we have more plans than the concrete results. A big chunk of different projects, in the category of the fundamental space research, is the part of the Federal Space Program now being discussed by the Government. A lot of difficulties are related to the financial crisis. We have a Lunar Program, for the years 2016-2025, which includes landers, rovers, orbiters, and there is also a complicated mission of cryogenic delivery of lunar soil from polar regions. There is a Mars program which is a joint venture with the European Space Agency. There is an experiment, waiting for its turn for many years, — the project SPEKTR-ROENTGEN-GAMMA, which was delayed for 12 years and now its launch is stretching to the year 2017.

There are another two, I would say, the most fascinating projects of all, though, not put into motion yet. One is the study of Jupiter's moon Europa, where under the thick layer of ice an ocean of salty water was discovered. We tried to tackle the task many times already, first, we thought to put a lander on the icy surface of Europa but the high levels of

A. Nishida, distinguished Japanese Professor, being awarded with the medal of Gagarin

radiation trapped by Jupiter's magnetic field represents very difficult problem, so we decided to fly to Ganymede instead, the next situated further away from the Jupiter moon. The recent discovery of plumes — jets of hot material — would probably again cause our plans to be corrected in the future.

Another project — new mission to Venus, we started to discuss it with NASA last year, but under the circumstances all the talks were suspended. Recently, we received the good news from NASA that they are ready to proceed with analysis of the possible structure of the joint Venusian mission.

In the field of space plasma we are planning one more project called RESONANCE, expanding the INTERBALL ideas — i.e. multi-probe plasma measurements. RESONANCE is also a multi-satellite system, which is going to work much closer to the Earth and explore the regions of the near-Earth space where the hot plasma meets the cold one. It's a work in progress not without difficulties, as well. At first, we wanted to build two large

With two most famous space physicists Eugene Parker and Ian Axford

The great friendship between Skobeltsyn Institute of Nuclear Physics (MSU) and IKI, M. Panasyuk and L. Zelenyi, meeting in Beijing

satellites, but the industry suggested four small ones instead. Later on, we found out that the platform for them is not ready yet. So, at the moment, the project is in a limbo.

— Where do you see the Institute in the future? Which way is it going to go?

Good question, which I appreciate — *Quo vadis*? Over past 50 years, the Institute went through different phases of life. IKI was set up as the leading scientific organization, where the best minds of the country gathered in order to carry out experiments in space. The idea belonged to the theoretician of national cosmonautics (as he was called in press, while his real name was kept in secrecy) and at the same time the President of the Academy of Sciences Mstislav Keldysh and was very much supported by the First Secretary of the Communist Party Nikita Khrushev. So, two partner centres were founded — Space Research Institute for the purpose of robotic exploration of space and from space and, a year prior to that — the Institute for Biomedical Problems to work on complex and completely new medical problems related to manned cosmonautics.

Versailles substorm meeting.
Lev Zelenyi, Frank Chen, Tony Lui, Jorg Buechner, Vitenis Vasiliunas

With Roald Sagdeev, the director of IKI in 1973-1989

At the beginning, the Institute was not really ready to accomplish its difficult mission. All the different people, who came to work here, brought their old ways and traditions with them. It was very counterproductive, all different ways of thinking created conflicts, so the "melting pot" was not exactly happening. When I came here as a student in 1969, I was astonished by how divided the place was, every group played their own political games, and there was this constant fighting — everybody against everybody else.

I, personally, only heard the echo from all the commotion. I completely engrossed myself in my work at the Vanian's lab, doing my calculations. I wrote a few, not so bad at least for a student, articles by the time I graduated. The title of my first article was "About the frequency dispersion of the transverse conductivity of the ionospheric plasma".

Then, in 1973, Roald Sagdeev came here as a new director and the situation changed dramatically. He weathered the storm and the Institute turned into the leader in the field of space research. It was not just a leading Institute, but the center of international activity, for instance, the meetings in the course of the famous APOLLO-SOYUZ project were held right here, even though the project itself had not much to do with the Institute's line. During the Cold War in the name

Academician Jumber Lominadze, 40th anniversary of IKI, gifts from sunny and friendly Georgia

of secrecy all engineers from Korolev's design bureau "Energia" were "hired" and introduced themselves as the actual staff of the Institute. All the following projects such as GRANAT, INTERBALL, where 18 countries participated, as well as VEGA, a great project, Sagdeev's favourite, confirmed our status as the ultimate leader.

In the 90's — the country was in decline, so was the science in general. There were fewer new projects, our major concern was just to fulfil the obligations we made in the Soviet past. Even that proved to be quite difficult, as with the MARS-96 failure. The leading role of the Institute was fading away. A few new centres appeared, thinking themselves experts in the field of space device engineering, and set up their own testing facilities to test one or two instruments for their, sole project. Financially, it was counterproductive, the testing quality was questionable and as a consequence, there were many failures.

By the end of the 90`s, Galeev was already fighting with his malady for his health, he didn't have enough energy to compete with his "toothy" colleagues or protect the Institute's interest in general.

It seems, in the next decade, the institute won back the leading status, specifically, in the field of planetary research, solar-terrestrial physics, and partially astrophysics. I am very pleased with all that,

With Ludmila Kozak, Professor of Kyiv University and collaborator in studies of plasma turbulence

Ekaterina Philippova, Lev Zelenyi, Olga Zakutnyaya

particularly, because we worked together as a team without any serious fights or conflicts, which usually weaken the spirit of the staff, although, of course, there were not so many angels amongst us.

Today, our Institute is preparing a huge package of interesting space projects, financed by the Federal Space Agency (Roscosmos). The means provided are quite substantial compared with the 90's financing. The financial sequestration, which came in 2015, considerably complicated our life, but the whole situation with the funding of our fundamental scientific research was handled by Roscosmos with good care. Many thanks to the new head of the Roscosmos Igor Komarov. I am confident, we will be able to carry out all of our plans. In recent years, we complain mostly about the lack of the qualified workforce rather than the lack of financing.

I see the future of the Institute as the interdisciplinary centre for space research, in some way an analogue of the Jet Propulsion Lab in Pasadena, the USA, which has a very powerful testing and instrument making facility. This is the vector of development we should stay on.

We, with the help of my young and energetic deputy Ilya Chulkov, want to convert our control and testing station into a centre for collective use. We want to supply the centre with the best possible universal equipment without doing double work in each case for every separate project from different institutes. Hopefully, tools, devices, and instruments made and tested in this new collective centre will be highly reliable and suitable for ours as well as for international space missions. We can't afford the luxury of doing twice the same things, since there are not so many new experiments in Russia these days.

Fortunately for us, things, in the space sphere, seem to be getting in order. There is going to be the united corporation "Roscosmos", incidentally, I was always in favour of the formation of such a structure in space industry, based on a successful example of corporation "Rosatom", handling nuclear energy in Russia.

The debates about the new federal space program for the period of 2016-2025 are almost over.

My task for the time being is to make sure that the fundamental space research will keep its deserved place. I would use all my efforts to stand up for it. However, other institutes are as important as the Space Research Institute. When the sequestration is in progress everybody understands that there are things, like the fundamental research, which could be easily cut off. What difference does it really make, if a probe is sent to Mars in 10 years instead of 5 years? Not to fret, you can explore two black holes instead of ten. This might be somebody's way of thinking, which is very dangerous not just for science, but for the development of the country.

Now, we are fighting for our field not to suffer much loss under the circumstances, but I must admit "Roscosmos" is doing its part in order to help us to succeed.

With Sergey Mironov – chair of the State Duma near the mockup of Phobos spacecraft. IKI, 2007

International Space Science Institute is very important part of my scientific life since 1996. Member of the board since 2003

I am glad to see that a lot of young people came to work here and the average age of the scientific staff is lowering. In science the early stage of scientific career is very important and often their best results scientists produce before forty. I was the youngest director in our Physical Division of the Academy and also became later the youngest academician for a moment.

As it happens, with me came the team of young deputy directors — Mikhail Pavlinskyi, Evgeny Lupian, Oleg Korablev, Ilya Chulkov, the only one from earlier times was Ravil Nazirov. The team has worked together successfully for almost 12 years. Though, they are not exactly young scientists anymore, rather middle age ones, but they are still full of powder and pepper. Now we have two new correspondent members of the Academy, who were elected before the distressing reform of the RAS began — Anatoly Petrukovich and Evgeny Churazov. However, after 3-year moratorium the new elections are coming and I am pretty sure, we have many deserving candidates to be nominated and elected to the Academy. Though, this title doesn't hold the same significance, compared with 5-6 years ago.

Famous director of ISSI of that time Roger Bonnet in the centre

— How do you perceive your position here and your time here? Did the Institute become your second home?

Yes, it did. I had worked for many years in the room №436 and after that in Galeev's former room №414 on the fourth floor. When he became our director, I moved into his office, but not right away, eventually, I made it my home especially when I put in some bookcases filled with my books. If you want to get to know a person, you should take a look at his home. I moved to the director's office on the second floor not long ago and in my former office I had worked for 15 years. I spend a lot of my time at work, much less at home. Meanwhile, I am, certainly, not the only one here who works all hours. Come and take a look — weekends are almost as busy as working days. It reminds me of my favourite book "Monday starts on Saturday" by Strugazky brothers.

Young scientists today (who can come to work any time they like) wouldn't have a clue that in the past we were not allowed here after hours or weekends, let alone holidays. There was a very strict schedule in place and if one wanted to work evenings or weekends — one'd have to apply for a permit every single time with a very good reason at that.

At, some point, I, with the help of other work enthusiasts, decided to fight the system, somehow or at least, try to make it easier getting permits. So, I, being a vice president of the young scientists committee (Sasha Lipatov was the president, then) made a speech at the meeting of the Communist party bureau on the subject of liberalization of the rules of entering the Institute. Unfortunately, it was rather a bad choice of words, the word "liberalization" was not in their vocabulary then. Nobody supported my proposal. Nevertheless, later on, I was able to convince the person responsible for making that decision to do it in our favour. We are talking about a local legend here. He was the Head of the Regime Department, V.D. Makarenko, the man of very firm views and strong opinions, who used to be a police inspector, at that. So, no arguments would, normally, work with him. He'd say — "Rules are rules, they are there for good reasons, no further discussions." So, one day, I tricked him, I said "You know, you, actually, break the moral code of a builder of communism yourself, which is "The sabbath was made for man, and not man for the sabbath"." The biblical reference made such an unexpected impression on him — left him speechless, so he just signed the proposal paper. The moral code was a huge thing back

Russian-American-French partnership, the meeting in LA, CA, 1993, from left to right: J.L Rauch, M. Ashour-Abdalla, B. Savenkov, L. Zelenyi, V. Sotnikov, J.M. Bosqued

then, they were simply drilling it into our heads, and Makarenko was very much aware of that. The times were getting freer, in two years, they would simply put a little star on your badge to indicate that you are, in fact, allowed come to work any time you please.

I never considered doing my job as a chore, that's just the way it is for me. As I mentioned before, I went through many "bifurcation" points in my life. Before Sagdeev met his future wife Susan Eisenhower and left for the United States, I couldn't even imagine that anything might change at all. The Perestroika was just taking off, but everything around me looked so familiar as if the time stood still and the feeling was that there always going to be, someone like Chernenko at power.

At the time, I was not allowed to go on business trips anywhere else, but the Warsaw Treaty countries (even that was quite an achievement). I was spending most of my time for work, the little time left for my personal life, so, in fact, I didn't feel the pressure of everyday life just like one doesn't feel the atmospheric pressure. All of a sudden, everything started to change rapidly.

When I was about to defend my doctoral thesis in 1987, I thought, I would, jokingly, call it to go with the times, "Perestroika and Acceleration". Of course, I didn't mean economics, but reconnection

Meeting with Goddard Space Flight center scientists:
Lev Zelenyi, Sandro Taktakishvili, Masha Kuznetsova, Anna Chulaki

UCLA Space Simulation Group

of magnetic field and acceleration of charged particles. Sagdeev, then, was a very young director and everybody hoped he would continue to be one for, at least, another 30 years, which was customary back then.

When Roald Sagdeev got married and Galeev was elected the director, I became his successor in Space Plasma Department. So, everything is related and as physicists say the world is permeated by long-range correlations. The trajectory of my life yet again went through another bifurcation point.

The problem was when they finally opened the door, I found myself very much in demand. Of course, I was invited to work in many countries before that, but, as I said, I was not exactly allowed to go. Now, the door was wide open, unfortunately, I was not free as a bird, simply a senior scientist. The department demanded a lot of my time and attention. Nevertheless, for many years integrally, I worked in California, at UCLA. It became my third home, I would go there for the whole summer and at Christmas time, using my long professor vacations. Frankly, Galeev was not particularly happy about that, he thought, I was spending far too much time abroad. If it were not for Galeev or my departmental responsibilities, I would have left for good permanently.

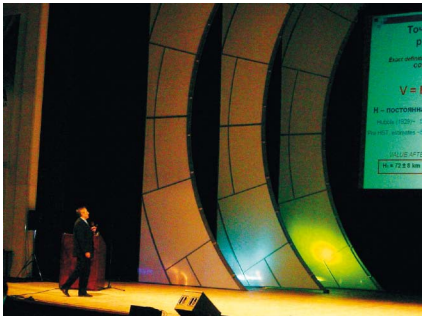
In the 80`s, I began working with Jorg Buechner, a graduate from the Department of Physics of the Moscow State University, who was then already on the staff at the Institute of Astrophysics in Potsdam. We wrote together, I think, over a dozen articles which are often quoted even these days as well as then. We became good friends.

At the beginning, we thought, we were dealing with a simple task about charged particle motion in the Earth magnetotail, gradually, we realized, we "struck gold". As a result, we developed a new theory of particle motion in a weak magnetic fields as an alternative to the existing classical theory, we determined the reasons for chaotic motion of particles. The discovery was extremely important for a number of different problems.

I often visited Potsdam and loved the city, unfortunately, there was this ugly zigzaglike line of concrete wall dividing Potsdam and the West Berlin. The infamous Berlin Wall. By the end of 1989, they started taking down the dreaded thing. I remember, in the spring of 1990 I filled a suitcase with bits and pieces of the Berlin wall and delivered it to Moscow (being forced to pay for the overweight luggage by remaining East German marks).

That year Jorg and I started our collaboration with Professor Maha Ashour-Abdalla, the head of space simulation group at UCLA.

By then, in Germany and the USSR, we were finally free to go abroad to work, subsequently, we started spending several months at a time at UCLA, California. We were allowed to use their computing power to verify our theoretical models of regular and chaotic particle dynamics. We, actually, discovered a new phenomena — structurizing of



Anniversary of Sputnik Launch. Speech in the Big Academy Hall

Meeting at the Russian parliament. Chair of the Federation Council Valentina Matvienko on the left

accelerated plasma flows. Those structures, we would call "beamlets", were later studied in great details by Elena Grigorenko, who used data obtained both from the INTERBALL and the European mission CLUSTER.

My work in LA went on for many years. At different times, some of my colleagues from our Institute such as Tatiana Burinskaya, Masha Kuznetsova, Maxim Dolgonosov came with me and worked there too.

I think, we together, professor Ashour-Abdalla, her team, and Jorg managed to do plenty of useful things — we, as a matter of fact, created a whole new original field — large scale kinetics — the study of global macroscopic effects formed by microscopic kinetic processes.

Soon after the beginning of my directorship, by 2005, I didn't have enough time anymore for my long summer trips to UCLA. I have not been to California for a long time and I miss LA (that's how they call Los Angeles over there). LA is the scene of many Hollywood action movies and when I sometimes watch them − between shooting and car race scenes I keep looking for the places I have been to and the streets I wandered.

My next "bifurcation" point came in 2002, when it became noticeable, that Galeev's health was getting progressively worse and he asked me to substitute him. I had a feeling that, something was going on. One day, YurI Galperin, Georgy Zastenker, and Vasily Moroz (a group of the most respected Institute people) advised me that I must become the director, in spite of the fact that it will, probably, stand in the way of my scientific work. I had no choice, but except my next quantum leap. Prior to that, I was responsible for a hundred people, now it was

With Georgy Polischuk, former head of Lavochkin Association

Space Science Days at IKI

a thousand. My department was my niche where I did what I knew well. In these new circumstances, I was forced to deal with many new things, astrophysics, planets, and Earth observations. For many years, I didn't feel myself a director, I didn't even want to move into the director's office (where Galeev used to work).

In 2013, the chain of "bifurcations" carried on — and the next thing was the election of a new president of the RAS. Vladimir Fortov became the new president of the RAS winning with the biggest number of votes casted for him. I had met him before, many years ago, if you remember, in my first year at Phyztech (though, I doubt that he remembered me, a freshman). I was delighted to join his team as his vice president in the field of physics and space.

When I was newly elected director, some people criticized me for the old way of thinking in terms — these are my people, those are not. It was not easy to free myself from this previous mentality. Soon enough, I got used to the notion that everybody is my people now since I am responsible for them. Something similar happened the second time around. The Institute is still my home, but I couldn't possibly favour it amongst other institutes. Nobody would understand if I did, and as the first President of our Academy Lavrenty Blumentrost would say in his German Russian — "Good this is not."

At the beginning of 2013, we were celebrating Sagdeev's 80th birthday at the Institute. Vladimir Fortov was among the guests. We took him aside and told him that all of us — physicists, chemists, natural science people — wanted him to run for the president of the RAS position. He had his doubts, but we were quite determined to persuade him. I think, there were a lot of people, who supported him besides us. So, luckily for us, Fortov decided to go for it. He was elected in the very first round. As I mentioned, he invited me to work in his team, but the happiness didn't last long — one single month. On the 30th of June, 2013, the Government adopted the new law which was about dissolving the whole of the RAS. Simultaneously, all of our extensive plans and projects with Roscosmos were ruined.

So, we started another chapter of life and when asked if I regret that my life took yet another unexpected turn, I'd say — "Yes, I do very much", but one can't change fate, can one?

A lot of troubles were put in Fortov's and our team's way — we had to survive the reforms and minimize their potentially devastating effect.

Next two years, we spent in tedious fighting, not necessarily knowing, what we we were fighting with and why, but it was obvious enough who we fought. All that fighting was a huge waste of time for me and thousands of my colleagues.

So, quoting Gen. Lebed, who is very famous in Russia, — "It is really hard to swim in hydrochloric acid with your legs tied." This is precisely how we feel at the moment. We find our comfort in Lermontov's poem.

But there is Court of God you, evil manifold! — the terrible court: it waits, it's not reached by a ring of gold.

We have to stay optimistic, as history teaches us — everybody get what they deserve in the end.

I am sure, those, who would be here for our Institute's 60th anniversary and the 300th anniversary of the RAS, will see powerful, effective, and very much in demand Russian Academy of Sciences in the centre of intellectual life of our country.

Let's live a long and happy life to see it one day.

Congratulations, my dear colleagues and all the friends of our beloved Institute!

Questions by Svetlana Vinogradova

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