Move Over, Einstein

By Adi Grasiel, *BeSheva* newspaper, July 21, 2016

Prof. Yaakov Friedman (Photo: Miriam Tzachi)

Over the past few years Prof. Yaakov Friedman and his team at the Jerusalem College of Technology – Lev Academic Center have been working tirelessly on revolutionary research, which is set to upgrade Einstein's Theory of Relativity. In an interview with *BeSheva*, Friedman discusses the unique experiments and international collaborations, recalls his childhood as a mathematical genius in a hostile communist environment, and reveals the unusual influence the Lubavitcher Rebbe had on his academic path

In his pictures from the experiments in the particle accelerator, Prof. Yaakov Friedman of the Jerusalem College of Technology – Lev Academic Center is seen wearing a white shirt, black kippah or a hat, with researchers with a distinctly non-Jewish look about them avidly following his every word. Even when meeting him in person, his soft tone and Chabadnik attire stand in contrast to his challenging one of the greatest physicists of all times, Albert Einstein. If Friedman's theory is correct, Einstein's Theory of Relativity will have to be altered. The consequences of the change may revolutionize a number of technological fields, including the computers and cellphones we use on a daily basis.

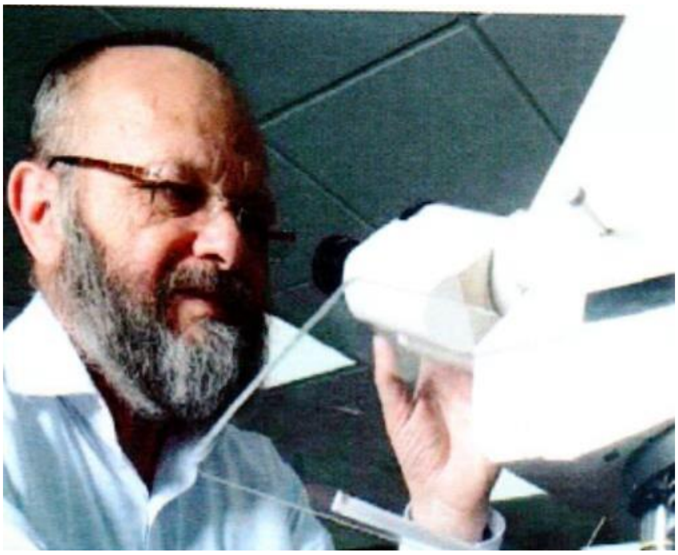
Obviously, it requires quite a bit of moxie to suggest corrections to the Theory of Relativity, but it seems that even as a child Friedman was not afraid to swim against the tide.

The Boy Was Bored in Math Class

Yaakov Friedman was born in Munkatch, Hungary, 68 years ago, when the region was under Soviet rule. His parents survived the Holocaust. However, it was a difficult time for the Jews who remained in the area. His father was one of the leaders of the group that revived Judaism in the area. They trained *shochtim* (butchers) in order to provide kosher meat. At the onset of the Doctors' Plot in 1953 (when Jewish doctors were accused of attempting to poison the leaders of the Soviet Union), the leaders of the community were imprisoned. Since his father had come to the town relatively late, the secret police had no file on him, so he was left on his own to head the community of about 2,000 people. The large synagogue in the town was shut down. The Russians permitted prayer in a synagogue at the edge of town, which was closed two years later. As a result, the Jewish community had to conduct clandestine services.

"I was lucky," Friedman recalls, "because the apartment next door had an improvised synagogue, and I could hear the praying through the wall."

The slaughterhouse the Jewish community used was actually a feather factory that provided stuffing for pillows. "The community bribed whomever necessary in order to ensure that they could continue to provide kosher meat," Friedman adds.



Friedman in the laboratory

Why did you choose mathematics?

"When I was very young, when we walked to the synagogue at the edge of town it was, of course, forbidden to speak *divrei Torah*, so my father would take advantage of the time to practice math problems with me. By the time I entered elementary school, I was bored during math class. The problem was that I was unfamiliar with Russian because we only spoke Yiddish at home. But we could not reveal that fact, so my parents said that I was incapable of speaking. And if a seven-year-old cannot speak, it is a bad sign. No one in school wanted to accept me. Until one of the teachers, an anti-Semite of all people, understood and offered to take me into her class in the Russian school," he recounts.

The math teacher was Jewish. When he saw that Friedman had an affinity for the subject, he gave him textbooks with math problems.

Friedman excelled in the field as a child and won several math competitions. He even won the Ukraine Mathematics Olympiad but because he was Jewish, he was barred from continuing to the next stage -- The All-Russian Mathematics Olympics. "They took the boy who came second," he says.

Upon completing his high school studies, Friedman was accepted, "through divine intervention," to Moscow University, which he says was considered one of the best academic institutions in the world. The Faculty of Mathematics and Mechanics was the only one that that practiced Jewish laws.

"Stalin wanted an atom bomb, and he realized that in order to do so, he had to take students according to their abilities and not by their party affiliations. There were only two such places in Moscow, one of which was the Mathematics Department of Moscow University," he explains.

Friedman began to study at the university one year before the Six Day War. Immediately following the war, the faculty was closed to Jewish students.

"In 1971, the year I graduated, 150 Jewish students graduated, all with honors," he says. “The problem was that they had nowhere to go because job placement at that time was assigned by government decree. When non-Jews graduated, all the government representatives would fight over them. But if they were Jews, no one wanted them."

But that discrimination actually worked in his favor.

"I found a factory in Munkatch, my hometown, which was willing to hire me. It was a factory that manufactured school laboratories. I didn’t actually have much to do there, so they let me do the calculations when the machines needed to be fixed. I asked, 'How do you do it now?' They replied, 'We fix them when they break.' I collected the data, and after several hours I created a plan for overall maintenance. The astounded manager said, 'Why so fast? This is work for a year.' That’s how it worked in Soviet Russia," he says.

That year Freidman's family, by then a family of six, began trying to escape.

"The fact that I studied in Moscow helped me because I knew how to speak their language. No one believed it would happen, but we received permission to leave. We had to organize everything within two weeks and leave. It was truly an unbelievable feat," he says.

While studying at university in Moscow, Friedman connected with a Chabad family and often had meals with them and prayed in their apartment.

"I had no private place in the dorms where I could pray. And, of course, there was no kosher food. So I would travel an hour each way every day to that family, pray and eat. Since then, I have had no trouble having only one meal a day," he says.

During his university studies, which were part of the Russian army's *Atuda* (combining academic studies and army service), he took an officers' training course during the summer vacation. It took place on a large base where they developed and trained the team's anti-missile divisions. The base also had groups from Arab countries, but there was no communication between the teams.

"The course was the most trying time in my life in regard to maintaining a Jewish lifestyle. No tefillin, siddur or kosher food," he says. "Once when I was I *davening Shemoneh Esrei* in the corner, an officer walked by and because I didn't stop to salute[1], I was punished and had to spend the day cleaning toilets."

However, other than that incident, the officers' relationship with Friedman was quite positive.

"I helped them plan the class scheduling, which was very complicated on that base up to that point. There were four officers in charge of assigning soldiers to various jobs. I created software for them – there were no personal computers at the time, only large ones – and the officers were pleased."

As a result, he received better treatment. In other words, as Friedman puts it, "I was punished less."

When his family arrived in Israel, Friedman went to visit a friend at a yeshiva in Kfar Chabad. He was 23 at the time, and his friend suggested that he study with a boy from Jerusalem who was only 17.

"I discovered that he was at a much higher spiritual level than I. Every question that I raised was met with a well-organized and convincing answer. For me as a scientist, that was extremely important. After less than an hour of studying together, I called my parents to tell them that I was staying at the yeshiva. I learned there for a year and filled in the gaps. It was one of the best years of my life," he recounts.

Friedman wanted to continue at the yeshiva. Like any good Chabadnik, he wrote to the Lubavitcher Rebbe and was sure that the Rebbe would approve his decision. But the Rebbe's response was surprising: "Continue with academia, get a doctorate and combine it with Torah learning," he advised.

Friedman moved to Bnei Brak, where he studied and taught half a day at Tel Aviv University and spent the other half learning in a kollel.

---

[1] According to halacha, one is forbidden to interrupt this prayer under any non-life-threatening circumstances.

"The university was not an easy place for someone from the yeshiva with a kippah and tzizit," Friedman says. "There were no religious people at all, and when I walked through the hallways, I received remarks such as 'What are you doing here?' and 'You must have gotten here by accident.'"

While Friedman was studying for his doctorate, the Yom Kippur War broke out. He was conscripted, completed a rushed basic training and was sent to Syria with his division. He spent the winter in Khadr (which was recently usurped by ISIS). His technological abilities were put to good use there when he helped calculate the routes for the mortars and cannons, in an age before such processes were computerized. In exchange, the commanders made sure that he was given permission to go home every Shabbat, despite the stoppage on leaving.

Friedman completed his doctorate in 1979, specializing in Theoretical Mathematics: the Geometry of Infinite Dimensional Spaces. He completed his doctorate in collaboration with a boy from a kibbutz who was doing his doctorate at Hebrew University on the same subject. "We received rare approval to work together," Friedman recounts. "Later on, it turned out that the problem we were trying to tackle was actually considered to be unsolvable."

After a year, the young researchers managed to solve it, having to devise new concepts and tools to do so. The accomplishment earned each of them prestigious post-doctorate positions. The boy went to Texas University, and Friedman went to California State University in Los Angeles. Quite a few of the faculty members were Jewish, says Friedman, but none of them were religious.

The early 1980s was a rough time for academia. In Israel and abroad, available jobs were reduced, and there were no new openings. However, the hi-tech field began to flourish. In addition to his university work, Friedman served as a consultant for start-up investors. He was later involved in establishing several start-ups himself, one of which was sold to IBM. A big investor offered him a job at his company with a salary that was three times what he was making as an academic. The investor was willing to donate a hefty sum to Chabad institutions and asked Friedman to consult with the Lubavitcher Rebbe. The Rebbe said no: "Stay in science."

For eight years, Friedman worked at University of California. Then he received offers from the Jerusalem College of Technology – Lev Academic Center, as well as from several other universities in the United States.

"I asked the Rebbe, and he answered: 'Come to Jerusalem permanently!'" Friedman says.

Ever since, that is where Friedman has remained. He started off as a lecturer at JCT, and then continued to advance as a faculty head, deputy rector, rector and vice president for research. He later received an explanation from the Rebbe for his response.

"The Rebbe said that he was against telling people to make a change that eradicated part of their lives. We need to take advantage of all that we have done and learned in order to worship G-d. So if divine providence directed me toward studying mathematics, then I must use it. The Rebbe also explained that working with science and its development was an important part of preparing the world for *geula* [redemption]. So we will see the world come together not only on a spiritual level but also on the physical level. That changed the way I view academic activity. It later encouraged me to change my focus. Math is only a tool for other sciences; but if you want to understand the world, you must learn physics," he says.

Some 25 years ago, Friedman began to try to make a connection between math and natural sciences. "Until that point, they only taught theoretical science, in a way that disconnected it from other sciences. I made changes in the curriculum in the field," he says.

"When I teach a course in mathematics," he explains, "instead of beginning with theory or writing mathematical proofs, I open with a practical problem. I present its constraints and arrive at the equation from there. I do that in order to create a connection between reality and math. It is only after that stage that I explain how to solve it and how to use the solution to understand better the problem. That way, the students learn how to approach problems in the real world."

A good example of the success of this approach is one of Friedman's students who chose to specialize in brain sciences. "I taught him how to analyze data that comes from brain research data. He wanted to see if depression could be identified by mapping brain activity, and we managed to find that connection. Today, that student is a leader in the field at MIT, and several patents on the subject have since been filed," Friedman says.

Later, as a natural progression for someone so interested in the practical world, Friedman shifted his focus to physics.

"Everyone said it was academic suicide," Friedman recounts. "In mathematics, if a certain theory seems feasible and logicaly correct, it is considered accurate. It is not uncommon for some mathematic model to hold for dozens of years, finance dozens or hundreds of researchers, earn them doctorates and professorships, and then someone comes along and disproves it. But physics is tested in real life. It is perceived in an entirely different way."

How did you learn physics?

"Most of it I learned on my own, and some through teaching. For example, Quantum Theory, which deals with the world of small particles within the atom. The mathematical model used in this area differs from that of regular physics. I decided to teach a course in Quantum Theory at JCT, and that forced me to know it well," he says.

Over the past several years, Freidman has been dealing with a problem that he defines as central to the unification of the universe. In physics, he explains, there are two areas: the regular world, the realm of the usual laws of physics; and the quantum region, the world of small particles, which behave differently.

"Scientists built a description of this behavior that differs significantly from the description of normal physics. But that does not make sense. It is, after all, the same world," says Friedman. "At a certain point, I decided to try to connect the two. It is a common belief that the difference between the areas is due to size. But that is not very convincing, since the classic laws of physics [Newton's laws] are applicable to vast stars in the same way as they are to grains of sand. So, supposedly, the size is not responsible for the change in rules. My proposition is that the main factor is acceleration, meaning the change in velocity. Immense forces operate in small particles and, when following the famous equation of force equals mass times acceleration, the small particles reach tremendous accelerations. However, the Special Theory of Relativity only describes the effects on high speeds on the laws of physic. Einstein said that as you approach the speed of light, the regular laws of physics change: Time slows down, and the body expands. In practice, however, you it is hard to achieve such velocities. Particle accelerators are almost the only place where such speeds can be reached. Whereas, the General Theory of Relativity deals with gravity and acceleration generated by it and shows that gravity can warp space," he says.

"My idea is to develop a model that also addresses the effect of any type of acceleration on the laws of physics. It may contradict one of Einstein's hypotheses ['the clock hypothesis,' which claims that time is only affected by speed], but that hypothesis is disputed among physicists in any case," he says.

"In order to test my hypothesis, I needed a particle accelerator. Not the kind that creates collisions, such as the famous accelerator at CERN [the European Organization for Nuclear Research], but the kind that creates powerful radiation with qualities that enable high precision measuring. Such accelerators are called synchrotrons," he says.

"The world has several influential synchrotrons. The best synchrotron is in Hamburg DESY, and the European Union's synchrotron ESRF is located in Grenoble, France. Along with my colleagues Prof. Israel Felner and Prof. Israel Novik from Hebrew University, as well as a German team, I sent a request to the German accelerator, and it was approved. The results were that acceleration was indeed the catalyst for changes, but they were more complicated than we expected. To date, we still do not have a full explanation for those findings," he says.

Friedman, along with the team from the previous experiment, decided to conduct the experiment a bit differently. This time, in the accelerator in France.

"For this experiment, with the help of a team of scientists from the nuclear center in the Negev and Ben-Gurion University, we developed and constructed a unique centrifuge," he says.

The experiment yielded better results, and still the effects of acceleration were far greater than what Friedman's model predicted.

"I brought some of my students with me. They quickly integrated and proved themselves. Everyone there was convinced that they were doctoral students. They had no idea that they were undergraduates. If they had known that they were undergraduate students, they might not have let them in," he says.

The results of the experiment were published in leading European journals.

What are the applications of your theory?

"If we understand the effect of acceleration, we will be able to understand the particle world, as well as the world of astrophysics, since a large number of astrophysical phenomena relate to high acceleration. For instance, neutron stars, which are particularly heavy stars, or black holes. Since today there is a vast amount of information from shuttles and telescopes, one can say that it is a natural, completely sterile lab that G-d created for us. With my theory, I managed, along with Prof. Menachem Steiner from the Jerusalem College of Technology, to solve a 150-year-old problem related to Mercury's orbit. It is the only planet that does not clearly adhere to Newton's laws, and its orbit around the sun has a precession of 43 arc-seconds over 100 years which cannot be explained by classical physics. That was the first piece of evidence that Newton's laws are not absolute. Einstein solved this with the General Theory of Relativity 100 years ago and said that it was the greatest achievement of his life. With my theory on the effect of acceleration one space and time, I also managed to reach the right answer using a quick and direct method, without warping space like Einstein did.

"My project also has great potential in the hi-tech field, as the technology constantly increases the frequencies. An example of this is with computers. In such frequencies, acceleration has a significant effect. Without understanding what the effect is, we will never be able to advance to higher frequencies. On the other hand, the devices and components are getting smaller and smaller. Today, the conversation revolves around nanotechnology, and we cannot reach quantum-atomic levels, since we do not fully understand the rules at those levels."

Despite the success of the experiments to date, Friedman needs more investments and more researchers.

"It isn't something that you can raise funds for from investors. It must be funded by the government," he says. "This is an opportunity to reach the forefront of international research, which can push us forward. I am certain that the industry in Israel can translate our results to attain greater achievements and reap the benefits."

The Jerusalem College of Technology: "The Religious Community Has What to Contribute to Scientific Breakthroughs"

For over 40 years, the Jerusalem College of Technology (JCT) - Lev Academic Center offers academic studies to religious studies in the fields of science, technology, computers and management. Today, there are 4,500 students, men and women, in separate campuses for women (Tal and Lustig Campuses) and men (Lev Campus) for undergraduate and graduate degrees, supplementary years and pre-academic programs. The areas of study are engineering, computer science, accounting and information systems, business administration, bio-informatics and nursing. JCT has over 8,000 graduates, with a 93% employment rate, some of which are placed in key positions in the market and industry.

JCT has a staff of over 500 lecturers, including professors and scientists operating in highly advanced laboratories. The Jerusalem College of Technology is at the forefront of scientific development and conducts scientific research in various fields in 11 research centers. These include The Center for Nano-Optic Adaptive Research; The Center for Medical Optic Research; The Center for Immune System Disorders; The Optic Center for Photovoltaic Solar Energy; The Center for Mathematic Models for Physical Processes and their Applications and more. In addition, JCT has a Research Authority, which aims to encourage academic and applied research for developing multi-disciplinary projects, with the goal of advancing the level of research and commercializing the acquired and developing knowledge of the academy center. JCT also conducts joint research projects with leading companies in industry and the labor market.

President of JCT, Prof. Chaim Sukenik, says: "The nation of Israel was blessed with a human resource of sharp minds, which earn international recognition and are in high demand by leading companies around the world. Israeli researchers, such as Prof. Friedman, are breaking ground with a variety of technologies and developments, which were considered to be unattainable only several years ago.

"It is important that a scientist possess curiosity as well as the need to thoroughly examine things, even if it means that they must swim against the stream and challenge the common way of thought in their field. Prof. Friedman was gifted with such a quality, and his personal story summarizes the story of the Jewish people, who must fight for its freedom and independence while reaching breakthroughs and leading in innovation.

"In order to continue to be one of the leading countries in the world, Israel must invest in the grown and development of new generations of scientists so that they will have the tools and abilities to push ahead, and we, at the Jerusalem College of Technology, believe that the religious community has what to offer in this area to Israel and the entire world.