

# Organizer of Antenna Science in Ukraine

Invited Paper

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**Abstract**— This paper is dedicated to the centenary of a founder of statistical antenna theory - Professor Yakov Shifrin who had been an organizer of the antenna science in the independent Ukraine since the early nineties until 2019. It outlines his life, education, participation in the World War II, scientific achievements, scientific-organizational and social activities, and human features.

**Keywords**—Yakov Shifrin, jubilee, centenary, antennas, statistical antenna theory

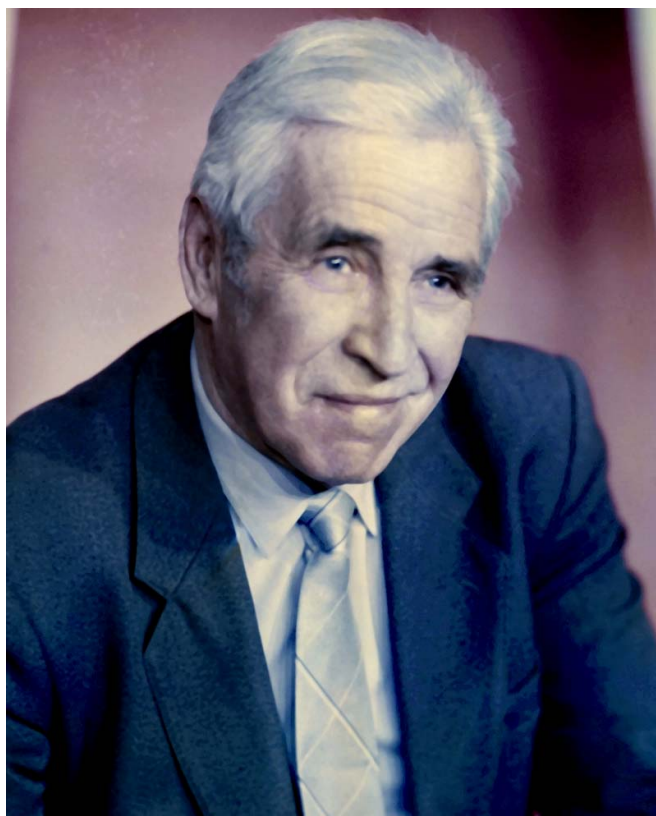


Fig. 1. Professor Yakov S. Shifrin

23 April 2020 was a date of the 100th of birthday of outstanding scientist, active participant of the World War II, and wonderful person Yakov Shifrin. He was born in a big family in small Belarusian town Mstislavl. His mother died in 1925, and in 1926, the Shifrins left Mstislavl for Leningrad. Yakov's father Solomon Shifrin studied only few years and, therefore, he had a dream to give his children a good education. In 1929, he was condemned as a nepman, and for many years, his four children were left to fend for themselves. Nevertheless, they got a secondary education and the higher one. Three of Solomon's sons – Friedrich, Kusiel, and Yakov – graduated from the Faculty of Physics of the Leningrad State University (LSU) and became outstanding scientists and teachers, whereas his daughter Fanya became a Doctor. Solomon Shifrin died in 1942 due to deprivations suffered in the siege of Leningrad.

Yakov graduated from the Leningrad 37<sup>th</sup> secondary school with a silver medal. He was proud of being a pupil of this school because in the pre-revolutionary times, it was the very prestigious Second St. Petersburg Gymnasium where sons of Aleksander Pushkin, and many outstanding persons studied. Teachers of the 37<sup>th</sup> school also were highly educated, and Yakov carried a grateful memory of them through all his life.

Among his pedagogues at the Faculty of Physics, there were scientists whose names are known, apparently, for everyone who received either an education in physics and mathematics or a technical higher education. First, there was Academician Vladimir I. Smirnov — an author of the famous 5-volume course on higher mathematics. Academician Vladimir Fock, who gave a quantum mechanics, was one of the most prominent Soviet physicists, which essentially contributed to a quantum mechanics, a gravitation theory, and a wave diffraction theory. There also were such brilliant pedagogues as Corresponding Members of the Academy of Sciences USSR Yakov I. Frenkel and Sergey E. Frisch, and Associate Professor V.I. Krylov who later became Academician of the Belarusian Academy of Sciences. Owing to them and other teachers, Yakov Shifrin received an extensive fundamental education in physics, having graduated from the LSU with honor.

He was planning to devote his life to theoretical physics. However, the WWII that began in the USSR on 22 June 1941 dramatically corrected his plans.

During the first days of the war, Yakov Shifrin, who was a chairperson of the Physics Faculty Trade Union, actively participated in formation of the Leningrad Army of the People's Militia and joined its ranks. In August, he was seconded to study to the S. M. Budenny Military Red Banner Academy of Communications (MRBAC). His military internship took place in summer and autumn 1943, when he participated in battles for liberation of Ukraine on the 3-d Ukrainian front. In 1944, having graduated with honor from the Radio Faculty of MRBAC and from a brief course on radar, he was appointed a commander of one of new batteries of gun pointing stations.



Fig. 2. Battery of gun pointing station. Yakov Shifrin sits in the middle

This battery commanded by Yakov Shifrin met the end of the WWII in Timișoara, Romania. After the war, in 1946, Shifrin was appointed the first teacher on radar to the Sevastopol School of Anti-aircraft Artillery, located in Zhitomir. He lived there with his wife Lydia, elder daughter Valentina and mother-in-law.

Yakov wanted to do science most of all. Therefore, in 1948-1951, he was among the first seven adjuncts (postgraduate students) with the Artillery Radio Technical Academy (ARTA) in Kharkov. In the ARTA (renamed later as Military Engineering Radio Technical Academy – MERTA), he was an only adjunct who studied under supervision of Aleksander I. Akhiezer being one of the first and closest disciples of Academician Lev D. Landau. Shifrin's thesis for a candidate of science degree (equivalent to a Ph.D. degree) was devoted to traveling-wave devices. He defended the thesis in 1952, but his degree was confirmed only in three years. Yakov Solomonovich considered that this three year delay was due to the Soviet government anti-Semitism.



Fig. 3. Yakov Shifrin in 1954

In 1957, Yakov Shifrin was appointed a head of a chair of antenna-feeder devices and radio wave propagation (AFD&RWP) where the investigations under a governmental program had been carried out aimed at studying the long-distance tropospheric propagation (LDTP) of radio waves. At this chair, he became a leader of this study. One of accompanying results of his active scientific activity in the field of LDTP was his membership in the Radio Wave



Fig. 4. The AFD&RWP chair in the 60-s at ARTA

Propagation Council of the Academy of Sciences USSR. He had been there a deputy chairperson of the Troposphere section for a long time.

In those years, Yakov Shifrin met first-order scientists in the field of antennas and propagation. They were L. D. Bakhrakh who became his closest friend forever, A. A. Pistolokors who was a recognized leader of the soviet antenna science, G. G. Boubnov, and others.

In the sixties, when a project of unique radio telescope RATAN-600 was under development, Yakov Shifrin was the government expert whose opinion how the atmosphere would affect the characteristics of this huge radio telescope was decisive. Opponents of this development argued that the impact of the atmosphere would significantly reduce the RATAN-600 efficiency [1]. The results of Shifrin's calculations appeared to be favorable for the authors of this project, and the RATAN-600 was built.

The most important part of the LDTP investigations was in studying the characteristics of a receive antenna operating in the LDTP field. Shifrin saw that in all cases, the field distribution in the antenna aperture appeared to be random, and it was impossible to study the antenna characteristics using an ordinary antenna theory, even with some amendments. It became clear for him that the characteristics should be studied with methods of both the probability theory and the random functions theory. He decided, therefore, to build grounds of a new theory – a theory of antennas with random sources [1]. He titled it Statistical Antenna Theory (SAT). First, Yakov Shifrin published its grounds in the book "Field statistics of a linear antenna". His ideology given in this book "opened the eyes" of developers of multi-element phased array antennas (PAA) and allowed them developing antennas of new class.

The SAT was Shifrin's thesis for a DrSci degree. A. A. Pistolokors agreed to be his opponent. Yakov Solomonovich wrote later that he learned much from him. After the successful defense of the thesis, Yakov Shifrin wrote the book "Issues of statistical antenna theory", which was published in 1970. Unexpectedly for the author, American publisher Peter Beckmann immediately translated and published the book in the USA as "Statistical Antenna Theory" (Golem Press, 1971). The theory was recognized worldwide as a cornerstone of general antenna theory and practice [2], because it was acutely relevant due to the development of large antennas for radio technical systems designed to detect space objects.



Fig. 5. Radio telescope RATAN-600



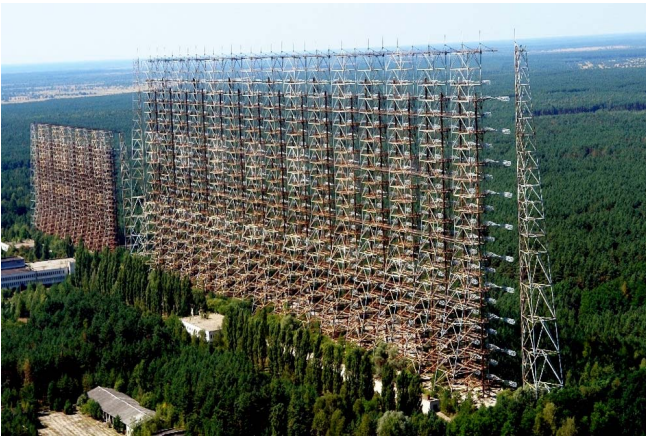


Fig. 6. The 800m×150m PAA designed using SAT

Since that time, Yakov Shifrin is known as “the father of statistical antenna theory”. At the AFD&RWP chair, he managed the work so that in five years all the pedagogues there defended their theses for a candidate of science degree. Then, defenses of theses for a DrSci degree under Shifrin’s supervision started as well. Yakov Shifrin devoted the lion’s share of his time to training his disciples.

Since 1970, Shifrin’s work was aimed at the further development of the SAT grounds, removal of limitations used for the theory grounds, expansion of the scope of using the SAT. Unlike the stage of the theory formation, at which he worked alone, in the late 1960s, when he was Head of the chair, he involved a number of the chair members and postgraduate students in the SAT elaboration. The investigations were carried out on a number of the SAT issues: developing grounds of a statistical antenna synthesis, studying statistics of antenna radomes and covers, building a statistical antenna measurements theory, studying statistics of large sectionalized traveling-wave antennas, etc. Some of those studies were carried out in cooperation with members of Moscow Research Institutes. The additional important result of all this work was in defenses of theses for a candidate of science degree, and later for a DrSci degree on SAT. Since the mid-1970s, yearly, one doctoral and three to five candidate dissertations were completed.

The important direction of Yakov Shifrin’s activities on SAT after 1970 was the explanation and popularization of the SAT concepts and results, as well as all kinds of support for scientists from organizations of the USSR in their investigations on SAT. He had given a series of lectures at schools for young specialists and at meetings for Heads of chairs from electromagnetic higher schools of the USSR. He helped different scientists publishing their works on SAT. In particular, Shifrin noticeably helped a group of antenna specialists from the Minsk Higher Anti-Aircraft-Rocket School in preparing six theses for a candidate of sciences degree on reliability theory being close to SAT. He essentially helped Lyubov M. Lobkova writing the monograph and thesis for a DrSci degree, who was a researcher of the Leningrad Institute of Communications, and later became Doctor of Technical Sciences, Professor, and Head of chair with the Sevastopol National Technical University.

Such a work continued after Colonel Professor Shifrin retired from the Armed Forces in 1980, and unexpectedly for him (despite the prior agreement) was forced to leave MERTA.



Fig. 7. The AFD&RWP chair at MERTA

Beside of scientists of the aforementioned higher schools, Yakov Shifrin rendered the help to researchers of many other higher schools of Kharkov, Kazan, Taganrog, Dnepropetrovsk, Sevastopol, Odessa, etc.

Yakov Solomonovich also supported a team of researchers from the Povolzhsky State University of Telecommunications and Informatics (Samara, Russia) headed by DrSci, Professor Oleg N. Maslov. This team developed the new direction “Random antenna theory”, considering it as one of the SAT directions [1].

At a new place of work, the Kharkiv Institute of Radio Electronics (KhIRE, now Kharkiv National University of Radio Electronics, KhNURE), at the beginning, Prof. Shifrin worked as Professor of the chair of radio measurements and became an unofficial leader in electromagnetics. Owing to his advices, for the very short time, mass defenses of theses, which failed before him, started to be successful not only for a candidate of science degree at this chair, but also for a DrSci degree at the Radiotechnical Faculty as a whole, what seemed something unreal before he came here.

Later he created a new chair of theoretical electromagnetics and antennas (TEA) and became its Head. At KhIRE, Yakov Solomonovich involved researchers of the chair in his studies on SAT.

Simultaneously, he got insight into the investigations carried out at the chair before him. This resulted in the development of a sufficiently general theory of antennas with lumped nonlinear elements (jointly with A. I. Luchaninov).

After some reorganizations at KhNURE in 1996, Yakov Solomonovich used to be a chief researcher until 2019.

Professor Shifrin fundamentally contributed to science in four directions: the statistical antenna theory, the long-distance tropospheric propagation, the theory of antennas with nonlinear elements, and, jointly with U. Liepin, the phaseless diagnostics of phased array antennas.

Yakov Shifrin was a pedagogue on radiophysics, electromagnetics (antennas and propagation), and radar for over 60 years and established an influential school on antennas and propagation theory in the Soviet Union and later in Ukraine. He was an adviser for more than 20 Doctors of Science and in excess of 50 Candidates of Science. He was an author or coauthor of 16 monographs and 300 plus journal and conference papers [2]. Many generations of radio-



Fig. 8. The TEA chair at KhNURE

engineers in Ukraine, Russia and Belarus have studied by his excellent textbook “Antennas”.

Professor Shifrin was a brilliant speaker able to convey complex things to listeners in a clear and plain language. Since 1991 to 2006, he had been an invited speaker at major international conferences on antenna and microwave theory and techniques and had given lectures and talks on statistical antenna theory and antennas with nonlinear elements in 17 countries around the world, including Japan, Poland, France, the USA, Germany, the Netherlands, China, etc. [2]. He met prominent scientists from those countries, and some of them became his friends for many years.

After the Soviet Union collapsed in 1991, Yakov Shifrin decided to consolidate the antenna&microwave community in Ukraine. With this aim, he became an organizer of antenna science in this country in the early nineties, i.e. in the most difficult time for Ukrainian scientists. He founded the National Antenna Association of Ukraine and had been its unchangeable president for 26 years. In order to integrate the Ukrainian antenna and microwave community into the international one, he took active part in creation of the East Ukraine Joint Chapter IEEE in 1995 and created the Kharkiv Joint Chapter IEEE in 2000. He was a founder, Chair, and, later, Honorary Chair of the biennial International Conference on Antenna Theory and Techniques (ICATT) held in Ukraine since 1995.



Fig. 9. Organizing and Program Committees of ICATT'99

These conferences became successors of analogous conferences held under leadership of A. A. Pistolkors in the USSR. As a distinct of them, Shifrin's ICATTs are

international conferences and their proceedings have been published in English and distributed around the world.

In addition, Professor Shifrin initiated the international conferences on Ultrawideband and Ultrashort Impulse Signals (UWBUSIS) having been held in Ukraine under leadership of Professor N. N. Kolchigin since 2002 [3].

In 1998, Yakov S. Shifrin was elected IEEE Fellow with citation “For fundamental contribution to antenna theory and technology”. In 2008, he became IEEE Life Fellow. He was a Presidium member and Honorary Academician of the Academy of Sciences of Applied Radio Electronics and Honored Worker of Science and Technology of Ukraine.

One of classrooms of the Kharkiv Military University (KMU), which was a successor of MERTA, was named after Yakov Solomonovich Shifrin. Today, when KMU became the Ivan Kozhedub Kharkiv National University of Air Forces and was located in another building, there is Shifrin's classroom too.



Fig. 10. Yakov Shifrin in the Shifrin's classroom

Yakov Shifrin was elected Honorary Professor of the Kharkiv National University of Radio Electronics, the Taganrog Technology University, the Sevastopol National Technical University, the Kazan National Research Technical University named after A.N. Tupolev, and the Ivan Kozhedub Kharkiv National University of Air Forces, and also Honorary Doctor of the V.N. Karasin Kharkiv National University.

For his scientific activities, Yakov Solomonovich was granted very prestigious professional awards:

- The A. S. Popov Prize of the Academy of Sciences of the USSR (1983) “For works in the field of statistical antenna theory that fundamentally contributed to antenna theory and techniques”. This prize was granted once every three years for the best work in the field of radioelectronics.

- The medal of the European Microwave Association (EuMA) “EuMA Outstanding Carrier Award 2014”. None of scientists from the former USSR was awarded this medal before him. In order to receive the medal, 94-year old Professor Shifrin made a flight to Rome where EuMA President Prof. Dr. Wolfgang Heinrich handed this award to him at the plenary session of the European Microwave Week 2014.

- The Pioneer Award of the Aerospace and Electronics Systems Society of IEEE. Yakov Shifrin was selected to receive this prestigious Award for 2015 for his pioneering contributions and accomplishments that had stood the test of time: “For founding contributions to modern radio physics and Statistical Antenna Theory (SAT)” [4].





Fig. 11. EuMA Outstanding Career Award

Being a large-scale person and scientist, he had friends who were mostly outstanding scientists as well. Among his close friends of his generation, beside of Lev Bakhrakh, there were A. A. Pistol Kors, Yakov N. Feld, Efim G. Zelkin, Aleksander I. Akhiezer, Yakov D. Shirman, Savely Ye. Falkovich, Aleksander S. Serdakov, Valentin A. Grabina, and Abram L. Gutman. All they passed away earlier than Yakov Solomonovich.

In order to commemorate the most outstanding scientists of his friends, he published articles and conference papers to their jubilees. The ICATT'11 participants may recall the paper by Y. S. Shifrin and V. F. Kravchenko "Antenna Science Atlantes" dedicated to jubilees of A. A. Pistol Kors, L. D. Bakhrakh, and E. G. Zelkin. Besides, Yakov Shifrin published the articles "To Y. N. Feld's centenary", and, jointly with Valery Tyrnov, "Two anniversaries" about brothers Akhiezer.

Being already over 80 years old, he wrote and published his memoirs in the excellent book "How We Lived" he dedicated to his parents. Yakov Shifrin was thankful during all his life to his school and University teachers, and wrote this book in memory of them too.

Later, he wrote two books about life and works of his brother Kusiel Shifrin who was an outstanding scientist in the field of atmosphere and ocean optics. In the early nineties, 74 year old Kusiel left Saint Petersburg for the United States in order to work with the Oregon University.

Yakov Shifrin dedicated one of the books, "Kusiel Solomonovich Shifrin. Scientist, Teacher and Person", to brother's 90-year jubilee, and the book "Kusiel Solomonovich Shifrin. Autobiography, Scientific Heritage, Letters" to the 100<sup>th</sup> birthday of his brother. It was not only the work at the desk for Yakov, but also an extensive correspondence and repeated trips to St. Petersburg to search and select materials for the books. Besides, Yakov Solomonovich did all his best for a special session, dedicated to the Kusiel Shifrin centenary, to be organized at the XIV all-Russian conference "Applied technologies of hydro acoustics and hydro physics" (HA-2018), held in Saint Petersburg in 2018. Indeed, this session took place with several presentations dedicated to K. S. Shifrin. Being 98 year old, Yakov Solomonovich could not take part in it. The organizers and participants of HA-2018 informed him that everything was held at a high level, and they sent to him the conference proceedings.

Yakov Solomonovich prepared for printing, edited and published a very truthful book by his distant relative Boris Bartkov (Isenberg) "33 Months in the Enemy Rear", what was impossible to do in the USSR.

At the age of 93, Yakov Solomonovich completed his next memoir book, "On the Slope of Years", in which he described

the current life after the first book, and at the age of 96 published its second, supplemented edition.

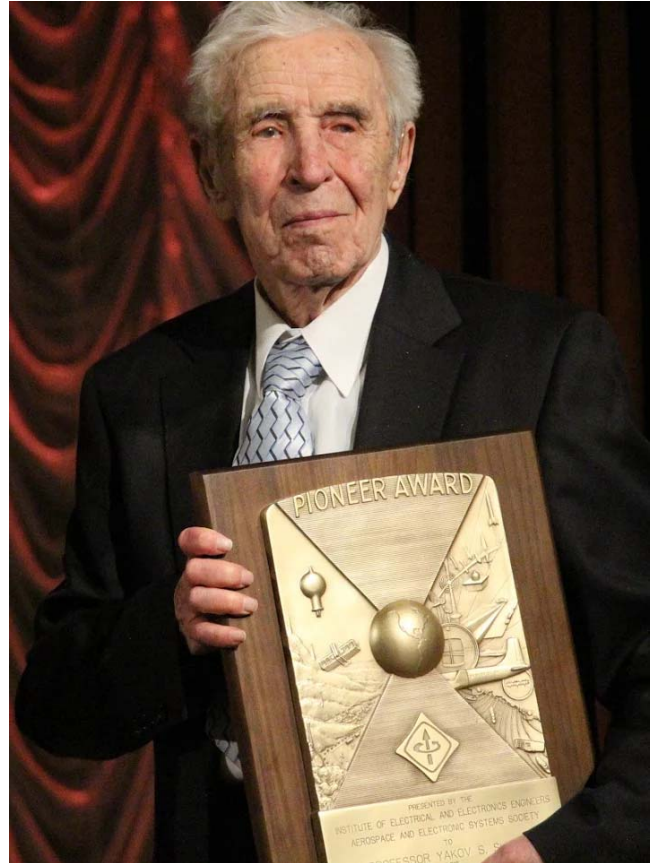


Fig. 12. Professor Shifrin with the IEEE, AESS Pioneer Award



Fig. 13. Brothers Kusiel Shifrin and Yakov Shifrin

When writing his memoirs, he hoped that they would be of interest for his two daughters, four grandchildren, the following generations (there are four his great-grandchildren today), and for his other relatives, colleagues and friends. The first book of the memoirs, "How We Lived", was published in 2004, but we have been receiving requests for it so far.

When Yakov Shifrin's disciple Mark B. Petrushansky wrote the book "From the Maccabees tribe" (300 pages), Yakov Solomonovich reviewed it and sent additional materials for its second edition. Editors used his review as a preface for this extended (910 pages) edition of the book. (Yakov Solomonovich was looking forward to see this book, but unfortunately, neither its author Mark Petrushansky nor its reviewer Yakov Shifrin saw it.)

Yakov Solomonovich wrote a preface to the book "Life and fate of Josef Rappoport" by Leonid P. Leonidov. J. Rappoport was a famous geneticist, who revealed himself not only as an outstanding scientist and as a legendary participant of the WWII, but also as one of the most courageous people after the war. He was not afraid to oppose false scientist Trofim Lysenko, despite the fact that Stalin strongly supported Lysenko. As punishment for this, the authorities forbade Professor J. Rappoport to work by his profession and only ten years later they allowed him to return to his work. Yakov Shifrin wrote in the preface: "It is difficult to find a person who, by the totality of his military and scientific merits, by his rare courage and exceptional integrity in any life situations, could be put on a par with Josef Rappoport".

To some extent, we can apply these words to Yakov Shifrin himself. He was a unique person not only in science but also in life. Everything was of his concern, and when seeing injustice, he fought against it.

He fights and makes progress in improving the medical care of participants of the Patriotic War. He writes to the Kharkiv authorities about the need to properly bury the Soviet army soldiers who died in the war in Kharkiv.

He wrote about the need to provide the full support for disabled war participants.

He succeeded when demanding a phone number to be returned to the clinic of the Kharkiv Military Hospital.

He made many efforts to restore a commemorative plaque to legendary submariner Israel Fisanovich. The Fisanovich Street appeared in Kharkiv owing to Shifrin too.

For many years, Yakov Shifrin sought the Akhiezer Brothers street to appear in Kharkiv in order to commemorate these outstanding scientists, Naum Akhiezer (in the field of mathematics) and Aleksander Akhiezer (in the field of physics).

And he succeeded in this: there is such a street in Kharkiv now, but it is called a bit differently – the Akhiezers street.

Y. Shifrin took active part in the long struggle for the monument, installed at a site of the Mstislavl Holocaust taking

place in autumn 1941, to contain an inscription with the number and nationality of people killed at this place, and he had a success in this. Moreover, he demanded to organize a meeting dedicated to the 70<sup>th</sup> year of the Mstislavl Holocaust, when opening the monument with the new inscription, and this meeting took place.

For participation in combat operations, Yakov Shifrin was awarded two Red Star orders, the Patriotic War Order, the Combat Merit Medal and other medals.

In the independent Ukraine, he was awarded the III class order of Bohdan Khmelnytsky and the V class order of Yaroslav the Wise.

Yakov Shifrin believed that his titles and awards supported him in the fight for right and fair.

The scientific, pedagogical and social activities of Professor Shifrin were highly appreciated in the city where he lived for 73 years, and he was granted the honorary citizenship in the city of Kharkiv, Ukraine.

We would like to emphasize human features of Yakov Shifrin – his amazing diligence and activity, remembrance of his roots, a care and support of his large family, the desire for justice and the desire to help people in need, excellent skills in Russian language, encyclopedic knowledge of history, literature and art, and the excellent memory that amazed everyone. On one hand, he was a very demanding person, and, on the other hand, he was a person of impeccable decency, honesty, and magnetic charm that attracted people to him until his last days.

Yakov Solomonovich passed away on August 6, 2019, only several months before his 100<sup>th</sup> birthday.

A few films were made about him. One of them made by the KhNURE TV is "Five Lives of Yakov Solomonovich Shifrin" and one can watch it here:

<https://www.youtube.com/watch?v=CgLrQmDN3uM>

By this paper, we would like to pay tribute of deep respect, admiration and appreciation to outstanding Scientist, unforgettable Teacher, and wonderful Person YAKOV SHIFRIN.

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