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PERSONALIA

In memory of Erast Borisovich Gliner

PACS numbers: **01.60.+q**

On November 16, 2021, Erast Borisovich Gliner passed away in San Francisco at the age of 98. He was a scientist who obtained outstanding results in the theory of general relativity and in cosmology working mostly at A.F. Ioffe Institute for Physics and Technology (Ioffe Institute) from 1963 to 1980.

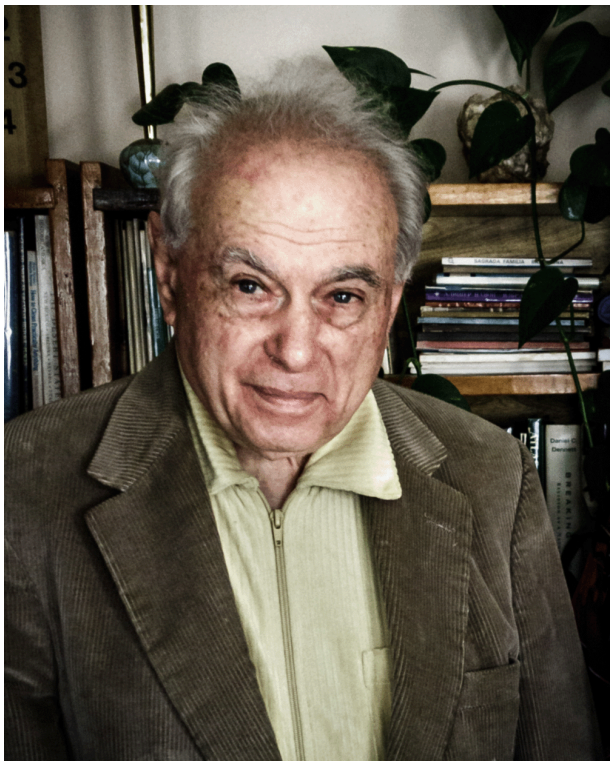
Erast Gliner was born on January 26, 1923 in Kiev; his life was hard. In 1926 the family moved to Leningrad. At the beginning of the war, after graduating from his 1st year of Chemistry Faculty at Leningrad State University (LSU), he was mobilized to build fortifications near Leningrad. He was shell-shocked, spent the entire winter of 1941–1942 in Leningrad, and was evacuated to Saratov suffering from extreme dystrophy.

In April 1942 he volunteered for the front, where he was wounded several times. After the most serious wound in November 1943, he lost his right arm and spent several months in hospitals. Then he was released from the army, and he returned to Leningrad in the summer of 1944. He was readmitted to the university, but in the spring of 1945, he was arrested on false denunciation and sentenced to 10 years (fully rehabilitated in 1955).

While serving his sentence in a construction bureau (KB1), where anti-aircraft missiles were designed, he proposed a radical improvement in the guidance system. A freelance mathematician who worked in KB1 advised him to study theoretical physics with L.D. Landau after his release, and promised to talk with Landau about him.

In 1956, Gliner managed to meet with L.D. Landau. As a result, Landau agreed, as an exception, to cooperate with Gliner during one year without passing the theoretical minimum. However, the offer was unrealistic to accept. After the prison, Erast Gliner managed to find a job only in the Leningrad branch of the former KB1. At the same time, he studied at Physics Faculty of LSU and worked on a textbook on mathematical physics. The textbook "Partial Differential Equations of Mathematical Physics" (co-authored with N.S. Koshlyakov and M.M. Smirnov) was published in 1962 and was a great success. Erast Gliner was admitted to the Ioffe Institute after graduating from LSU in 1963 on the initiative of B.P. Konstantinov, director of the Ioffe Institute.

Only after getting this job at the age of 40, Erast Gliner was able to seriously engage in science. He chose the most difficult field — the general theory of relativity, his dream for many years. By 1970, he had already obtained truly fundamental results. Of these, two should be emphasized. Firstly, it is the interpretation of Einstein's cosmological constant as a manifestation of a new physical state of the very early Universe. The result was published in Journal of Experimental and Theoretical physics (in Russian: *Zh. Eksp. Teor. Fiz.* **49** 542 (1965); English translation: *JETP* **22** 378 (1966)); the medium was described using de Sitter space (uniformly filled with 'heavy vacuum' with a constant energy density ε and negative pressure $p = -\varepsilon$). Secondly, it is the assumption that the transition of the very early Universe to the Friedman expansion stage was accompanied by a strong increase in size ('rapid expansion') of the Universe (*Dokl. Acad. Sci. USSR*, in Russian: *Dokl. Aksd. Nauk* **192** 771 (1970); in English: *Sov. Phys. Dokl.* **15** 559 (1970)). These results formed the basis of Erast Gliner's dissertation. Getting scientific degree in Russia is a two-step process. The first step is to become Candidate of Sciences (equivalent of PhD) and the second step is to become Doctor of Sciences (equivalent of Habilitation in some countries). The first step took place in 1972. Initially, it was suggested that the thesis was so good that it deserved to be treated as Doctoral (by skipping the first step). However, it did not happen because the idea was



Erast Borisovich Gliner
(26.01.1923–16.11.2021)

E. Gliner in Tolmachevo, more than 101 km from Leningrad (1954)

E. Gliner (1958)

supported by A.D. Sakharov, who was then in political disfavor.

After defending his PhD, Erast Gliner continued to work intensively and obtained a number of important results. In particular, he elaborated his PhD results with I.G. Dymnikova (*Sov. Astron. Lett.* **1** 93 (1975); reprinted as Addendum in *Phys. Usp.* **45** 213 (2002)) and proposed a model of Friedman cosmology with an initial stage of de Sitter vacuum, which avoids singularity. Also, together with I.G. Dymnikova, he proposed a covariant description of energy in general relativity, based on introducing a generalized energy-momentum tensor of rank 4 (that was done in Ioffe Institute, i.e. before 1980, but published later in *Phys. Rev. D* **28** 1278 (1983)). In 1977 – 1978, Erast Gliner tried to organize a gravitational wave experiment with a broadband antenna at Ioffe Institute. The experiment did not take place, but a new type of monochromatic gravitational-wave detector was proposed (with I.G. Mitrofanov, *Zh. Eksp. Teor. Fiz.* **76** 1873 (1979); *Sov. Phys. JETP* **49** 949 (1979)). However generally, after he was unjustly denied defending his thesis as Doctoral, the career of the already middle-aged Erast Gliner at home was unpromising.

In 1980 he emigrated to the United States, where he tried to continue working in the field of general relativity. Throughout his creative life, he developed many profound ideas, some of which were published, and some were only expressed or mentioned in preprints. Particular attention was paid to 'heavy vacuum,' the elimination of singularities in the solutions of equations of general relativity (nonsingular black holes, non-singular initial and final stages of the Universe evolution), to a possible existence of clouds of 'heavy vacuum' and a new concept of quantum gravity (in particular, the problem of quantum nonlocality). In addition, until 1995, Erast Gliner managed to find a job in the USA on the physics of the Sun and the solar corona; he became the author and co-author of more than a dozen publications on this topic. He was also engaged in educational and human rights activities; two of his articles in defense of A.D. Sakharov were published in *Nature* (**318** 513 (1985) and **320** 480 (1986)). He was not careful in advertising his works, believing that any decent work would be noticed by specialists. In conversations with colleagues, he often expressed original ideas, but refused to co-author subsequent publications.

In the late 1970s and early 1980s A.A. Starobinskii (in Russian: *Pisma Zh. Eksp. Teor. Fiz.* **30** 719 (1979); English translation: *JETP Lett.* **30** 682 (1979)) and American scientist Alan Guth (*Phys. Rev. D* **23** 347 (1981)) proposed a new ('inflationary') version of the cosmology of the early Universe. They also used the metric close to the de Sitter one to describe the evolution of the early Universe and assumed an extremely strong expansion ('inflation') of the Universe before the transition to the Friedman expansion stage. This scenario used the theoretical models similar to those put forward by Erast Gliner in the late 1960s, but the scenarios were significantly different (by initial conditions, expansion dynamics, interpretation of the de Sitter solution and other factors). Both scenarios predict the occurrence of the same observable Friedman stage of the Universe expansion; there are no direct observational tests that would distinguish 'inflation' from 'rapid expansion' yet.

Very quickly inflationary cosmology became extremely popular. Many inflationary scenarios have been constructed that are not fully confirmed in modern observations. Apparently, this circumstance led to almost complete oblivion of the fact that it was Erast Gliner who had put forward the ideas that were used in modern models of the

Erast Gliner at home in San-Francisco (2014)

early Universe. Vitaly L. Ginzburg, who supported the work of Erast Gliner since 1971, tried to correct the situation. As editor-in-chief of *Physics Uspekhi* (*Uspekhi Fizicheskikh Nauk — UFN*), he invited Erast Gliner to write an article on comparative analysis of the 'inflation' and 'rapid expansion' theories. The article "Inflationary universe and the vacuum-like state of physical medium" was published in 2002 (*UFN* **172** 221 (2002); *Phys. Usp.* **45** 213–220 (2002)).

It was followed by the paper by A.D. Chernin (*UFN* **178** 267 (2008); *Phys. Usp.* **51** 253 (2008)) and the monograph by A.S. Silbergleit and A.D. Chernin (*Interacting Dark Energy and the Expansion of the Universe*, Springer, 2017), where Gliner's ideas of 'heavy vacuum' were further explained, but the situation remained the same.

Meanwhile, it is now becoming clear that E.B. Gliner was more far-sighted than many who did not accept his ideas on 'heavy' vacuum. Actually, he anticipated the existence of dark energy. For its observational discovery S. Perlmutter, B. Schmidt and A. Rice were awarded with Nobel prize in Physics in 2011. There is growing evidence that dark energy has the pressure $p = -\varepsilon$ predicted by Gliner in 1965.

Erast Gliner was a very gentle, ironic, insightful man and an extraordinarily talented scientist. He had a unique gift of explaining the most difficult things, especially delicate problems of general relativity. His second love in science was chemistry, which was forbidden to him because of amputation of his arm after the heavy wound in 1943. He was extremely poetic and developed his own ('non-Marxist') theory of the perception of beauty, for which he was arrested in 1945. Despite his gentleness, he was rock-solid in matters of principle, which multiplied his troubles. He was very much loved by the Ioffe Institute staff, and he was conflict-free in communicating with colleagues. In 2003, a conference was organized at Ioffe Institute in honor of his 80th birthday. He arrived and met with many scientists, his good friends. There were many discussions and friendly conversations. His talk was the most interesting and impressive.

It would be fair to preserve the memory of this man and his contribution to science. V.L. Ginzburg wrote in the introduction to the Gliner's paper (*Phys. Usp.* **45** 213 (2002)), that "... we are deeply indebted to E.B. Gliner." It is hard to imagine how much he would have done in science if fate had been a little more favorable to him...

E.A. Bogomolov, A.M. Bykov, A.M. Cherepashchuk, A.G. Doroshkevich, A.V. Ivanchik, A.D. Kaminker, A.A. Kaplyanskii, G.G. Pavlov, K.A. Postnov, N.N. Rosanov, V.A. Rubakov, Yu.A. Shibanov, A.S. Silbergleit, V.S. Yuferev, D.G. Yakovlev