Obituary

Evgenia Andreevna Zabolotskaya, 1935–2020

Evgenia (Zhenia) Andreevna Zabolotskaya, born and raised in Moscow, passed away in Santa Fe, NM, on June 2, 2020. The impact of her work over her lifetime made the name Zabolotskaya iconic in the field of nonlinear acoustics.

Zhenia completed her undergraduate and graduate studies in the prestigious Faculty of Physics at Moscow State University (MSU). Her graduate research in the 1960s was conducted under R. V. Khokhlov, who was then transforming MSU into a leading international research center for both nonlinear optics and nonlinear acoustics. Zhenia was among the first of Khokhlov's graduate students who worked in nonlinear acoustics.

From the very beginning Zhenia's work was groundbreaking. As a graduate student she published an article (Zabolotskaya and Soluyan, 1967) that contains not only the first effective medium theory for nonlinear propagation of sound in bubbly liquid but also an alternative to the Rayleigh-Plesset equation for the nonlinear dynamics of gas bubbles based on their volume rather than their radius.

Prior to graduating from MSU in 1968, Zhenia started working at the Acoustics Institute in Moscow. In 1969, she published one of the most famous equations in nonlinear acoustics to appear in the second half of the twentieth century, the Khokhlov-Zabolotskaya (KZ) equation for nonlinear sound beams. The KZ equation became known as the KZK equation after V. P. Kuznetsov included the term for energy dissipation.

It cannot be overstated how much the KZK equation has impacted the science and practical applications of nonlinear acoustics. It was used originally to describe nonlinear effects in sonar (1970s and 1980s), particularly parametric arrays. In the 1980s, Zhenia extended it to include sound beams in isotropic solids and crystals. For the past few decades, the KZK equation has been used to model therapeutic ultrasound and nonlinear diagnostic ultrasound.

In 1985, then at the General Physics Institute in Moscow, Zhenia was awarded the USSR State Prize for her many contributions to nonlinear acoustics. Today, this award is bestowed in the Kremlin by the president of Russia.

Zhenia and her husband, Yurii (Yura) Anatolevich Ilinskii, a famous physicist himself, moved to the United States in 1991 to work at the University of Texas at Austin (UT). There, Zhenia published, in 1992, a theoretical model for nonlinear Rayleigh waves, a type of interface wave in solids. This initiated a new direction of research that continued at UT for over a decade.

From 1997 to 2000, Zhenia and Yura worked at MacroSonix Corporation in Richmond, VA, where they developed theoretical models for nonlinear sound fields in resonators. They returned to UT in 2000 to model nonlinear effects in thermoacoustic engines, and in 2003, the UT Applied Research Laboratories hired them to initiate a research program in biomedical acoustics. This brought Zhenia full circle to the subject of her graduate work, the nonlinear interaction of sound with bubbles but in connection with shock-wave lithotripsy.

Zhenia retired from UT in 2015 but continued working in nonlinear acoustics, mainly on acoustic radiation force. In 2017, she became the first woman to be awarded the Acoustical Society of America Silver Medal in Physical Acoustics.

Zhenia was preceded in death by Yura, who died in 2019. They are survived by their two daughters, Katya in Santa Fe, NM, and Ksenia in Moscow, Russia, and by seven grandchildren.

Selected Publications by Evgenia A. Zabolotskaya

Bakhvalov, N. S., Zhileikin, Y. M., and Zabolotskaya, E. A. (1987). *Nonlinear Theory of Sound Beams*. American Institute of Physics, Melville, NY.

Zabolotskaya, E. A. (1992). Nonlinear propagation of plane and circular Rayleigh waves in isotropic solids. *The Journal of the Acoustical Society of America* 91, 2569-2575.

Zabolotskaya, E. A., and Khokhlov, R. V. (1969). Quasi-plane waves in the nonlinear acoustics of confined beams. *Soviet Physics-Acoustics* 15, 35-40.

Zabolotskaya, E. A., and Soluyan, S. I. (1967). A possible approach to the amplification of sound waves. *Soviet Physics-Acoustics* 13, 254-256.

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