*Quantum Electronics* **47** (12) 1075–1076 (2017) 

***PERSONALIA***

https://doi.org/10.1070/QEL16587

# In memory of Nikolai Gennad'evich Basov

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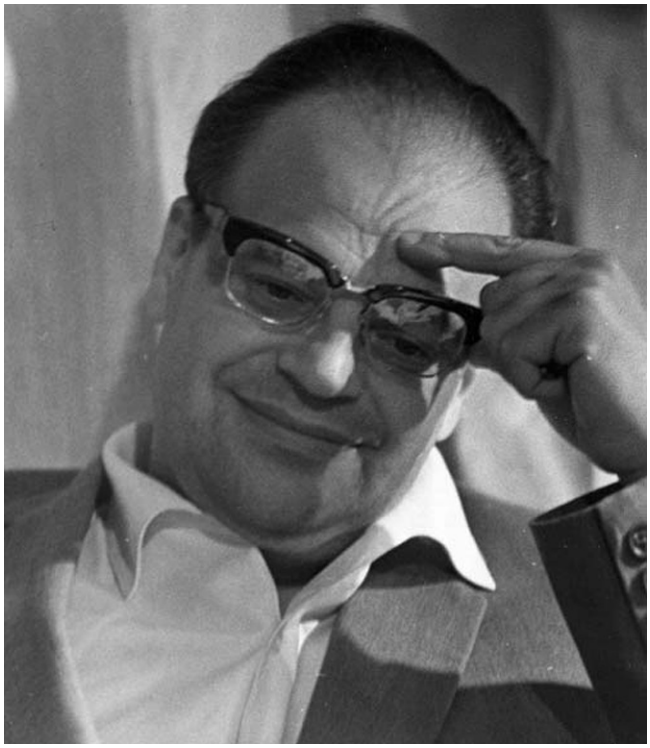
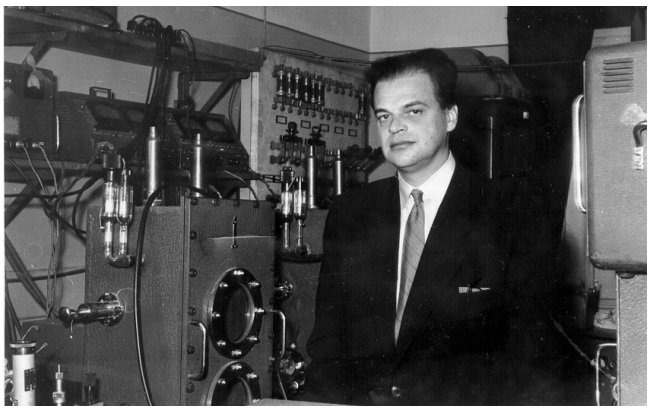
Nikolai Gennad'evich Basov, one of the originators of quantum electronics (1964 Nobel Prize in Physics 'for fundamental work in the field of quantum electronics, which has led to the construction of oscillators and amplifiers based on the maser– laser principle', shared with A.M. Prokhorov and Ch.H. Townes), would be 95 years old on 14 December 2017.

Basov created and headed a world-renowned school of thought. Moreover, he himself actively worked with high energy until the last day of his life.

The possibility of utilising induced emission from quantum systems for creating microwave oscillators was first envisaged by Basov in his report at a conference on the magnetic moments of nuclei that was held in 1953 at the P.N. Lebedev Physical Institute (LPI), USSR Academy of Sciences, and was headed by D.V. Skobel'tsyn, director of the institute. The report was stored for many years in archives and was published in the collected volume 'Zapiski arkhivariusa' (Archivist's Notes), issued at LPI in 1997. It seems likely that Basov was the first to address this issue.





In those years, Basov worked in the field of the radio frequency spectroscopy of molecules at the Laboratory of Vibrations, LPI, headed by A.M. Prokhorov.

Interestingly enough, impetus to the use of induced emission instead of absorption was provided by the necessity of improving the resolving power of a radio frequency spectroscope for probing the fine and hyperfine structures in spectra of molecules at radio frequencies. These objectives were also pursued in the first journal publications by Basov and Prokhorov [*J. Eksp. Teor. Fiz*., **27**, 431 (1954)] and by the Townes group [*Phys. Rev*., **93**, 282 (1954)].

What scientific issues were addressed by Basov in those early years? These were of course problems related to the coherence of radiation. Namely, how can an ensemble of excited molecules emit highly monochromatic light despite the finite lifetime of the excited state? An answer to this question was found later: it is important to maintain the excited state using external stimuli (the process was dubbed 'pumping'). And a molecular oscillator – maser – will emit a highly monochromatic wave.

It became clear by 1958 that the same principles could be applied to the optical range: one can make electromagnetic generators operating at short wavelengths, including the visible range. This was of course an immense qualitative leap in quantum electronics, not only scientific, but also psychological, because it made it possible to directly see what was radiation emitted by a quantum oscillator.

Laser physics became the subject of Basov's constant passion. As early as about 57 years ago, just after the advent of lasers, he predicted a very nearly new technological revolution due to this discovery. It was then regarded by many as an over-exaggeration, but time showed that he was right. It is

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Received 27 November 2017
*Kvantovaya Elektronika* **47** (12) 1075–1076 (2017)
Translated by O.M. Tsarev

Now he is here forever. The photo was taken on 24 November 2017, when the monument to N.G. Basov at the National Nuclear Research University 'MEPhI' was unveiled.

today that lasers rapidly penetrate into modern technologies: from the use in subcutaneous and ophthalmic operations to the construction of transcontinental communication links and internet, from precision measurements to compact discs, laser printers and materials processing in the engineering industry.

Basically, the key features of Basov as a scientist were an inquisitive mind and creativity in solving problems. His mind constantly generated riddle questions, and the answers to them engendered new ideas and opened up new research directions or new ways of resolving problems.

It was in this way that he put forward ideas of creating frequency–time standards; ideas of employing semiconductors, which were implemented in highly efficient diode lasers; ideas of using lasers for heating plasmas to high temperatures, with application to so-called laser fusion; ideas of developing high-power chemical, photodissociation lasers pumped by the light from the shock wave generated by explosive detonation; and ideas of making electron beam pumped $CO_2$ lasers, excimer lasers, and many others.

At the Moscow Engineering Physics Institute (changed to the National Nuclear Research University 'MEPhI'), where he learned in the early post-war years and which he loved, he founded a 'Higher School for Physicists', and later his name was given to it. Today, students from many regions of Russia learn in this school. I always paid attention to how Basov felt about his institute. It was a son's attitude towards his father, which persisted until the last days of Basov's life.

Basov was the founder of the Kvantovaya elektronika (Quantum Electronics) journal and its editor-in-chief for 30 years. He headed the Priroda (Nature) and Kratkie soobshcheniya po fizike (Brief Communications on Physics) journals.

Certainly, it is impossible to list all he left for us, his pupils and followers, as a heritage of his very active and fruitful scientific career. He was a really unique person and scientist, and his scientific results belong to eternity.

Basov's death on 1 July 2001 was a great shock for Russian physics and the Russian Academy of Sciences and a great grief to his pupils and colleagues. Years have passed since, but his memory does not fade: it will live on in our hearts as long as we live.