Past, Present and Future of the X-ray Technique – a View from the 3rd International Conference on X-ray Technique

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Abstract. In this preface a brief history, modern aspects and future tendencies in development of the X-ray technique as seen from the 3rd International Conference on X-ray Technique that was held on 24–25 November 2016 in Saint Petersburg, Russia are described.

On 24–25 November 2016 in Saint Petersburg on the basis of Saint Petersburg State Electrotechnical University "LETI" n. a. V. I. Ulyanov (Lenin) was held the 3rd International Conference on X-ray Technique. The tradition to hold a similar conference in our country was laid in Soviet times. The last of them, the All-Union Conference on the Prospects of X-ray Tubes and Equipment was organized and held more than a quarter century ago – on 21–23 November 1999, at the initiative and under the leadership of the chief engineer of the Leningrad association of electronic industry "Svetlana" Borovsky Alexander Ivanovich and the chief of special design bureau of X-ray devices of "Svetlana" Shchukin Gennady Anatolievich. The most active part in the organization and work of the conference played members of the department of X-ray and electron beam instruments of Leningrad Electrotechnical Institute "LETI" (the former name of Saint Petersburg State Electrotechnical University "LETI"), represented by head of the department professor Ivanov Stanislav Alekseevich.

Choice of the special design bureau of X-ray devices as the site for the Conference at that time was not accidental. Total production of X-ray tubes of all types in the mid 80-ies of the 20th century amounted to tens of thousands of units per year. The company was the leading and almost the only manufacturer of X-ray tubes; had a unique experience and the most modern at that time vacuum equipment and technologies.

However, as a result of the collapse of the Soviet Union and the subsequent economic crisis, domestic industry of X-ray apparatuses production was largely destroyed and had long been in decline. Were broken once close scientific and technical relationships between developers, manufacturers and users of X-ray equipment, many of the technologies were lost and, most importantly, the experienced hardware manufacturers – the industry's elite – went out of business.

In recent years, in connection with the necessity of meeting the country's needs in X-ray equipment were revived some old and founded new enterprises of this industry. Practice shows that many of them compete successfully in certain areas of X-ray apparatuses production with leading international manufacturers. It is time to assess the state of affairs in this industry, in particular, the level of scientific and technological development, and also try to identify problem areas and possible sources.
for further development. In this regard, at the initiative of the leading lecturers of the department of electronic instruments and devices of Saint Petersburg State Electrotechnical University "LETI" was revived the Conference for researchers and producers of X-ray technique in our country.

Figure 1. Opening of the Conference.

The venue and the organizers of this post-Soviet Conference were determined not by chance: JSC "Svetlana-X-Ray" is still the largest developer and manufacturer of X-ray tubes not only in our country but in the world as well and Saint Petersburg State Electrotechnical University "LETI", in the face of the department of electronic instruments and devices – the current name of the department of X-ray and electron beam instruments, is the country's only higher educational institution training specialists directly in the development of X-ray tubes.

It is officially considered that the department of electronic instruments and devices was founded in October 1938. It was created on the initiative of professor Alexander Aleksandrovich Shaposhnikov – the founder of domestic scientific school on vacuum electronics. As head of the department was appointed Feofan Nikolaevich Kharadzha – a graduate of Leningrad Electrotechnical Institute "LETI", who have taken the long path from the engineer to the head of the laboratory of X-ray tubes in JSC "Svetlana". The first in our country X-ray technique department was founded in Leningrad Electrotechnical Institute "LETI", although the study in physics of X-ray radiation, design and technology of X-ray devices, as well as the development and application of methods of X-ray examination at that time was conducted in the leading universities of Leningrad – University, Polytechnic and Technological Institutes. They are now also held there, but the department of electronic instruments and devices is still the only one of its kind in Russia.

A considerable role was played by Alexander Stepanovich Popov – the creator of the radio and the first elected director of Leningrad Electrotechnical Institute "LETI". As it is well known, X-ray radiation was discovered by professor of the Würzburg University (Germany) Wilhelm Conrad Roentgen on 8 November 1895. Less than in two months, in January 1896 A S Popov with the assistance of the Mine Officers' Training Course (Kronstadt) worker produces the first in Russia X-ray
tube according to the scheme of the Englishman Crookes. And in early February he already demonstrates the experimental production of X-ray images of different objects placed in a cardboard box on the meeting of the Russian physicochemical society in Saint Petersburg University. Alexander Stepanovich was a skilled glass-blower and, for example, made his wife colored perfume bottles. Of course, he could make, as it is said in technology, a vacuum-tight glass container of X-ray tube. It is obvious that research in the field of X-ray technique did not end in his untimely demise, but was successfully continued.

The appointment in 1938 of F N Kharadzha as a head of X-ray technique department, who was a production worker with extensive experience was no less symbolic, and meant at that time a close connection of the educational and research process with the needs of the relevant sector of industry. Satisfaction of the needs of industrial enterprises on the basis of a deep scientific study of the task became a solid basis in the formation and subsequent development of the department and its future.

In this regard, it should be called another name – August Augustovich Potsar, also a graduate of Leningrad Electrotechnical Institute "LETI". He came to the X-ray technique department having extensive practical experience in the measurement laboratory of the "Svetlana" plant. Together with F N Kharadzha he conducted one of the first scientific and technical research on the development of gasotrons. Their result was formulated principles for the design and technology of high-voltage vacuum devices on the basis of the partitioned glass shell. To this day in the nomenclature of products of JSC "Svetlana-X-Ray" is listed the 2 MeV partitioned X-ray tube for industrial inspection. Not by chance as the head of the organized in 1946 at the faculty of electronic technique of Leningrad Electrotechnical Institute "LETI" department of industrial electronics (since 1952, the department of gas discharge devices) was appointed A A Potsar. Subsequently, the fate repeatedly brought together and separated these two departments. Last and final their unification under the name "X-ray and electron beam devices" occurred in 1980. In 1992 the department received its present name – "electronic instruments and devices".

Figure 2. On the sidelines of the Conference.
In confirmation that a close relationship, established from that time, between the department of electronic instruments and devices and domestic electronic industry is not broken, you can name a few names from a very extensive list of executives, and that as the lecturers work with students: Alimov O A (general director of scientific and research enterprise "Electron"), Brytov I A (deputy of the general director of scientific and production enterprise "Burevestnik"), Vetrov N Z (general director of JSC "SED-X-Ray"), Vildgrube G S (general director of scientific and production enterprise "Electron"), Klevtsov V A (deputy of the general director of "Svetlana"), Kulikov N A (general director of JSC "Svetlana-X-Ray"), Komyak A I (general director of scientific and production enterprise "Burevestnik"), Lesish Y K (chief engineer of the Leningrad association of electronic industry "Svetlana"), Stepanov R M (chief engineer of the scientific and production association "Electron"), Tataurshikov S S (chief engineer of the scientific and production association "Electron"), Schukin G A (general director of the Leningrad association of electronic industry "Svetlana").

In 2016, at the 3rd International Conference on X-ray Technique presentations were made by more than 20 specialists of enterprises, actively engaged in research in the field of creation and application of X-ray equipment. Traditionally of special interest were reports of the leading members of the JSC "Svetlana-X-Ray", dedicated to the development of X-ray tubes and betatron cameras of new generation. They are designed for projection radiography, industrial radiography and medical diagnostics and therapy. All the designs were put into mass production and are used in most modern domestic X-ray machines and digital radiography systems. Of particular note is the X-ray tube with a photoelectron multiplication of the anode current, which has no analogues in the world.

For the first time, were so widely presented materials of the younger generation of researchers and students of the department of electronic instruments and devices on the results of research in the field of application of X-ray radiation for medical purposes, including the development of methods for X-ray image acquisition, processing of the obtained images, estimation of radiation dose, etc. Almost every report of graduate students and young scientists of Saint Petersburg State Electrotechnical University "LETI" caused a lively debate, which contributed to an objective assessment of the results.

In summing up the Conference results, it was emphasized that it is very important for the development of domestic production of X-ray tubes, including the preparation of highly qualified specialists. In general, it creates the preconditions for the promotion of Russian industry of X-ray apparatuses production into a leading position in the world.