V. S. Panasyuk. *New types of synchrotrons as dedicated generators of synchrotron and x-ray radiation.* The wide application of synchrotron radiation for various purposes began at electron storage rings originally constructed for research in high-energy particle physics. In such research the long lifetime of the electron beam is of principal importance, which complicates the construction of storage rings. Dedicated sources of synchrotron radiation are basically similar in construction to classical storage rings with the difference that the energy of the accelerated electron beam is significantly lower than that achieved in the prototypes.

It should be noted, however, that in some cases it is unnecessary to employ synchrotron radiation continuously. This is especially true when the peak power of pulsed synchrotron radiation markedly exceeds the power of continuous radiation. It is shown in Ref. 1 that for a given spectral range of wavelengths it is advantageous to increase the power of the radiation by increasing the strength of the guiding magnetic field and simultaneously decreasing the orbit radius of the beam. Limitations on field strength produced by electromagnets with ferromagnetic cores may be removed by employing electromagnets used for generating ultra-high magnetic fields.[2] If currently achievable magnetic fields of several hundred kilogauss are used for guiding the beam, the optimal electron orbit radius for radiation in the visible and soft x-ray spectral ranges shrinks to several centimeters. This significantly simplifies the technical construction of a cyclic accelerator because high magnetic fields are achieved in small volumes.

Given the small dimensions of the high-field magnetic system it is advantageous to employ the simplest injection of particles and to accelerate them at the beginning of the cycle, similarly to a cyclotron with soft focussing of the beam. Synchronicity between the angular frequency of the particles and the fixed frequency of the ultra-high-frequency accelerating field right up to a fixed-radius orbit is automatically maintained by the rising slope of the pulse of a strong magnetic field.[3,4] For construction reasons the ultra-high-frequency voltage is best generated in a cylindrical resonator (the H_{111} mode), possibly in the electromagnetic cavity itself. An example of such technology is the "Troll" synchrotron,[5] which has the beam orbit radius of 1.7 cm, intensity of 10^{10} electrons in the accelerating cycle and a final energy of 50 MeV.

For purposes of optical radiometry[6] pulsed synchrotron radiation of microsecond duration is appropriate. Technological application may require pulses of tens of milliseconds. Obviously a long-lived circulating beam in the range of strong magnetic fields supplements the application regions of dedicated sources examined above. However, the generation of strong continuous magnetic guiding fields is currently possible mainly through the use of superconducting solenoids, in which case the achievable field strength is significantly lower than if ordinary high (ultra-high) magnetic field electromagnets are used. Among the types of accelerators and electron storage rings examined, synchrotron radiation of a long-lived beam falls in the vacuum ultraviolet wavelength range. In these machines the particle acceleration technique discussed above is combined with the motion of an electron beam in a magnetic guiding field, where the guiding field is a superposition of a time-varying and a constant high magnetic fields.[7,8]

The idea of maintaining synchronicity between the angular frequency of charged particles and the fixed frequency of the high-frequency accelerating field as the particles are accelerated from thermal to relativistic velocities in a pulsed magnetic guide field also proved to be fruitful in cyclic accelerators with an electromagnet containing continuous poles and a ferromagnetic core. A flat accelerating structure, much like cyclotron dees (TEM wave), is positioned between the poles. The pulsed operation of the electromagnet necessary for the described acceleration technique, requires either a laminated iron core or a ferrite core, in which cases the accelerating pulse frequency may reach hundreds of kilohertz resulting in a higher average power of the electron beam or x-ray bremsstrahlung. Of course particle energy in this very simple synchrotron is a few MeV. It is also certainly possible to produce a long-lived electron beam in a large magnetic system with unlaminated core and dee accelerating structure using methods presented in.[7,8] In such a case the principles cited in Ref. 1 are probably invalid; the device becomes equivalent to a classical dedicated electron storage ring, but with continuous poles of the guide field electromagnet and an internal particle source. In some circumstances, such as when the guide field electromagnet of a cyclotron or the like is "vacant," an application may be found for synchrotron radiation—such an arrangement appears sensible.

In conclusion let us note that in the course of developing high-frequency autogenerators for inducing the accelerating voltage in cyclic accelerators a new type of capacitive coupling between the accelerating resonator and the generator tubes was constructed. Using these autogenerators linear charged particle accelerators were developed—some are already in use as portable x-ray machines.[9,10]

The contents of this report have been published in the major journals, in reports at national and international conference, and in lists of inventors' certificates—more than 90 titles in all. The following reference list illustrates the main topics of this report.

[1)]The first theoretical description of μ-catalysis was presented by Ya. B. Zel'dovich[8] already in 1954. This theory adequately describes the d–μ–p-fusion reaction.

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