Nuclear Instruments and Methods in Physics Research A282 (1989) 422–423
North-Holland, Amsterdam

Section II. FELs and undulators

ELECTROMAGNETIC UNDULATORS FOR THE VEPP-3 OPTICAL KLYSTRON

N.G. GAVRILOV, L.G. ISAYEVA, G.N. KULIPANOV, V.N. LITVINENKO, S.F. MIKHAILOV, V.M. POPIK, I.G. SILVESTROV, A.S. SOKOLOV, E.M. TRAKHTENBERG, N.A. VINOKUROV and P.D. VOBLY

Institute of Nuclear Physics, 630090 Novosibirsk, USSR

Two types of electromagnetic undulators are described. The first one has 33.5 periods with a length of 10 cm and a magnetic field amplitude of 5.3 kG. The other, developed for future FEL experiments, has 39.5 periods with 7 cm length and a magnetic field amplitude of 55 kG.

In a new magnetic system, an optical klystron installed on the dedicated straight section (bypass) of the VEPP-3 storage ring, two electromagnetic undulators have been used. The cross sections of the undulator are schematically shown in fig. 1 and its parameters are given in tabel 1.

The field in the undulator is excited by 8 periodically bent copper buses with holes for water cooling. The buses are commuted on the ends of the undulator.

Each undulator has 68 poles; those on both ends are wound by one turn and they have half the magnetic potential. The undulators are installed on the bypass one after another and are bilaterally symmetric about the centre of the section between them. This automatically provides absence of distortion of the storage ring equilibrium orbit. Correction coils are put on both end poles and on three pairs of internal poles of each undulator; however, magnetic measurements and operations with electron beam showed that those were not necessary.

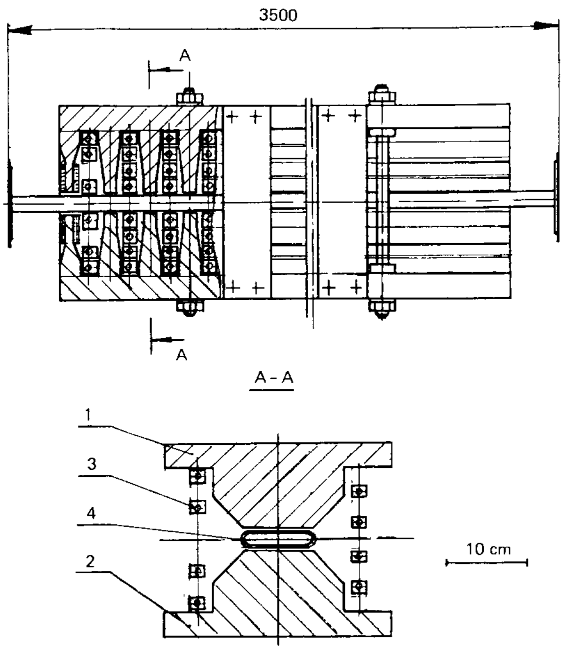

Fig. 1. Cross sections of the undulator.

Fig. 2 shows the measured visible part (fundamental harmonic) of the spontaneous-radiation spectrum at zero angle from one undulator with 350 MeV energy; the field in the undulator is 3.4 kG. The spectrum shape agrees with the calculated one.

The undulators are connected in series and they are fed by a conventional 2 kA, 100 kW power supply. The maximum field obtained in them, shown in table 1, is limited not by the saturation in the poles but by the current of the power supply.

Making use of the above-described undulators, the lasing of coherent radiation was obtained at wavelengths from 0.69 to 0.24 μm. To increase the gain per pass in the ultraviolet, the undulators are scheduled to be replaced by new ones. Their parameters are given in

Table 1
Undulator parameters

Undulator length [m]	3.4
Number of periods	33.5
Period [cm]	10
Magnetic gap [cm]	2.2
Maximum magnetic field along the axis [kG]	5.3
Pole transverse width [cm]	9
Number of separate buses	8
Cross section of a bus [mm^2]	18 × 18
Current consumption [kA]	2.2
Power consumption [kW]	60

0168-9002/89/$03.50

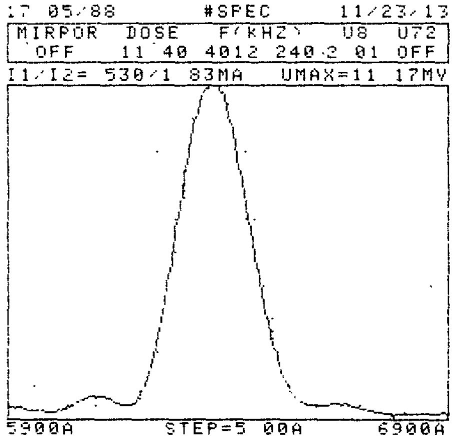

Fig. 2. Spontaneous radiation spectrum from the undulator.

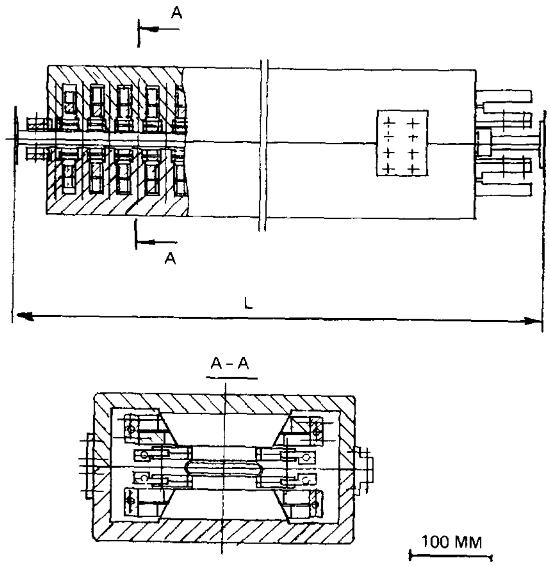

Fig. 3. Cross sections of the new undulator; $L = 2.8$ m.

Table 2
Parameters of the new undulators

Undulator length [m]	2.8
Number of periods	39.5
Period [cm]	7
Magnetic gap [cm]	2
Maximum magnetic field along the axis [kG]	5.5
Pole transverse width [cm]	8
Number of separate buses	8
Current consumption [kA]	3
Power consumption [kW]	90

table 2 and their cross sections are shown in fig. 3. The period was successfully decreased by means of optimally shaped buses milled of a copper sheet and by increased power supply (undulators will be operated off two separate power supplies).

References

[1] N.A. Vinokurov and A.N. Skrinsky, Preprint 77-59 of the Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences (Novosibirsk, 1977).
[2] N.A. Vinokurov, Nucl. Instr. and Meth. A246 (1986) 105.