Available online at www.sciencedirect.com
SCIENCE DIRECT®
Nuclear Instruments and Methods in Physics Research A 543 (2005) 14–18
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH
Section A
www.elsevier.com/locate/nima

The status-2004 of the Kurchatov center of SR

V. Korchuganov[a,b,*], M. Blokhov[a], M. Kovalchuk[a,c], Yu. Krylov[a], V. Kvardakov[a], L. Moseiko[a], N. Moseiko[a], V. Novikov[a], S. Zheludeva[a,c], D. Odintsov[a], V. Rezvov[a], V. Ushkov[a], A. Valentinov[a], A. Vernov[a], L. Yudin[a], Yu. Yupinov[a]

[a]Kurchatov SR Center, RSC "Kurchatov Institute", 123182 Moscow, Russian Federation
[b]Budker Institute of Nuclear Physics SB RAS, Lavrentyev ave. 11, Novosibirsk 630090, Russian Federation
[c]Shubnikov Institute for Crystallography RAS, Moscow, Russian Federation

Available online 4 February 2005

Abstract

Kurchatov synchrotron radiation source (KCSR) was the first dedicated synchrotron radiation facility in Russia in 1999. The facility includes 450 MeV Siberia-1 and 2.5 GeV Siberia-2 storage rings. It is intended for experiments in the range of SR from VUV up to hard X-ray. Large progress was achieved in increasing stored current at Siberia-2 during the last year. The report describes the current work and the plans on the storage rings. It informs about achieved consumer parameters of an electron beam and status of SR stations.

PACS: 29.20.Dh; 29.27.Fh; 41.60.Ap; 41.85.Lc

Keywords: Storage rings; Electron; Lifetime; Synchrotron radiation; Wiggler magnets

1. Introduction

At present, the Kurchatov SR source operates close to the design parameters. Table 1 presents the main features of the acting optical structure of the storage rings Siberia-1 and Siberia-2 [1].

*Corresponding author. Budker Institute of Nuclear Physics SB RAS, Lavrentyev ave. 11, Novosibirsk 630090, Russian Federation. Tel.: +7 3832 39 42 38; fax: +7 3832 30 71 63.
E-mail addresses: korchuganov@ghost.inp.nsk.su, v.n.korchuganov@mail.ru (V. Korchuganov).

0168-9002/$ - see front matter © 2005 Published by Elsevier B.V.
doi:10.1016/j.nima.2005.01.022

2. Work with electron beam

Electron storage: As a rule, the work on Siberia-2 SR goes in the multibunch regime with a current of 100–120 mA by filling of $\frac{1}{2}$ to $\frac{1}{3}$ of the ring (25–37 bunches). The synchrotron oscillations collective modes appear after injection of the first four or five bunches. Nevertheless, we have realized that it is possible to store the electrons in all 75 bunches without specially made empty gap widely used to prevent ion trapping (see Fig. 1a).

Table 1
Main parameters of Siberia-1 and Siberia-2 rings

Parameter	Siberia-1	Siberia-2
Energy	0.45 GeV	2.5 GeV
Circumference	8.68 m	124.13 m
Optical structure	FODO	Modified DBA
Superperiods	1	6
Bet. tunes: v_x, v_y	0.793, 0.895	7.772, 6.692
Mom. compaction	1.64	0.0104
Damping x, y, s, ms	7.15, 7.15, 3.57	3.04, 3.17, 1.49
Hor. emittance	880 nm rad	78–98 nm rad
RF harmonic	1	75
Energy spread	0.00034	0.000953
Dipole field: B,	1.5 T	0.425, 1.7 T
ID space	—	2×3 m $(\eta = 0)$ 5×3.2 m $(\eta \neq 0)$
Bunch length: σ_s (without IDs)	30 cm	1.84 cm
Current	100–300 mA (single bunch)	100–150 mA (multibunch)
Lifetime (100 mA, coupling 1%)	1.5 (single bunch)	10–14 h (multibunch)

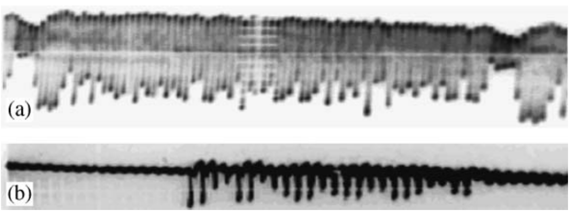

Fig. 1. (a) The typical picture of the filling at the injection. (b) The modulation due to collective mode instability losses during an energy ramping.

The energy ramping of the electrons with current in many bunches exceeding 150 mA is characterized by both big synchrotron motion in coherent modes and losses of the beam part. The losses depend on the number of bunches and modulate the particles numbers in bunches correspondingly with the synchrotron mode number (see Fig. 1b).

In single bunch mode, the storage is accompanied by the bunch lengthening and microwave instability leading to the increase in energy spread. Therefore, the enlargement of the bunch stopped the storage near 72 mA due to the losses of the particles as a consequence of the energy acceptance limitation. The maximum single bunch current that was accelerated up to 2.5 GeV was about 30–35 mA and also limited by the coherent synchrotron oscillations, which are strong when ramping the energy within 0.45–1 GeV.

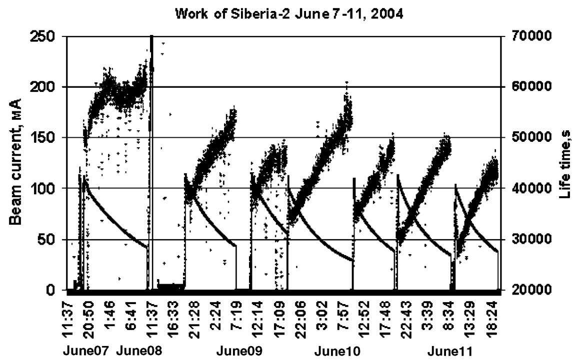

Fig. 2. Work of Siberia-2 in June 7–11, 2004.

During routine operation on SR experiments, the electron storage and acceleration regimes are reproduced in a stable way. Fig. 2 shows the dependence of the beam current and the lifetime versus the time at 2.5 GeV during the runs in June 07–11, 2004. Now the maximum currents achieved are 300 mA (450 MeV) for Siberia-1 in a single bunch mode, 270 mA (450 MeV) and 150 mA (2.5 GeV) for Siberia-2 in multibunch mode.

Vacuum: Last year, the vacuum system of Siberia-2 was opened twice. In May 27, 2003,