STATUS OF THE 2.5 GeV LIGHT SOURCE ANKA

G. Buth, S. Doyle, D. Einfeld, A. Gies, J. Goettert, M. Hagelstein, A. Hagestedt, S. Hermle, F. Holstein, E. Huttel, H. Knoch, A. Kruessel, M. Lange, Y.-L. Mathis, W. Mexner, H. O. Moser, E. Pellegrin, E. Rathjen, U. Ristau, R. Rossmanith, J. Schaper, H. Schieler, R. Simon, G. Spannagel, R. Steininger, S. Voigt, R. Walther; Forschungszentrum Karlsruhe (FZK), ANKA Project Group, Germany
F. Perez, M. Pont, Forschungszentrum Karlsruhe (FZK), ANKA Project Group (on leave of absence from LSB-IFAE, Barcelona, Spain)
M. Plesko, J. Stefan Inst., Ljubjana, Slovenia

Abstract

ANKA is a 2.5 GeV synchrotron light source under construction in Karlsruhe [1]. ANKA has a novel mission and provides preferably service with synchrotron radiation for customers and, in addition, dedicates a significant fraction of its beam time to basic research work. ANKA will offer full service in X-ray lithography, mainly for micro- and nanofabrication, and in analyzing and investigating non-destructively various properties of samples. The light source is scheduled to become operable in the year 2000. During the first operational period only the light from the bending magnets (1.5 T) will be used, later four long straight sections and one short straight section can be equipped with insertion devices. The main components are described in detail in various papers in these proceedings [2]. At the moment the prototypes of the vacuum chamber and the magnets are tested. The power supplies are ordered. The complete injector (53 MeV microtron and 500 MeV booster) is built by industry.

1 INTRODUCTION

The main parameters of ANKA are summarized in table 1. One of several possible optic for one quarter of the ring is shown in fig. 1. The machine can be operated with zero dispersion in the long straight sections (horizontal emittance about 70 nm) and a dispersion of 0.5 m in the long straight sections (horizontal emittance about 40 nm).During the first operation period the machine will operate without insertion devices.

Table 1: Parameter list of ANKA

Energy [GeV]	2.5
Current [mA]	400
Circumference [m]	110.4
Q_x/Q_y	7.1/3.15
Horizontal emittance [nmrad]	41 - 73
Momentum compaction factor	8.1×10^{-3}
Injection energy [GeV]	0.5
Natural energy spread	9.1×10^{-4}
Natural chromaticities	-17.3/-7.7
Number of bending magnets	16

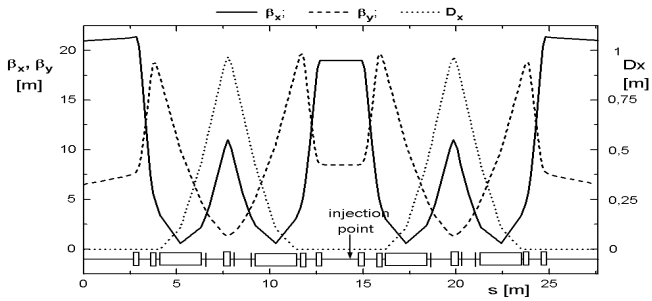


Figure 1: Optics with zero dispersion in the long straight section. The optics is shown for one quadrant

2 BUILDING

The actual status of the building (as of June 1998) and an artist's view of the completed building are shown in fig. 2 and fig. 3.

The building will be completed in September 1998 and the installation of water, electricity, cooling etc. will be finished January 1999. The building is a steel construction of rectangular shape with no offices and laboratories. Surrounding buildings used at the moment for different purposes will be used later as office and laboratory buildings.

Figure 2: Status of the building as of June 98

Fig. 3: Artist's view of the complete building

3 INJECTOR

The injector consists of a 53 MeV racetrack microtron and a 500 MeV booster synchrotron. The whole injector complex is built by industry. Commissioning of the microtron will begin September 1998 at Danfysik in Denmark. The microtron will be shipped in January 1999 to Karlsruhe. The commissioning of the whole complex will start March 1999 [2].

4 MAGNET PRODUCTION

Prototyping of the magnets has already started. The prototype for the bending magnets will be delivered in a few weeks. Fig 4 shows the magnet with the girder.

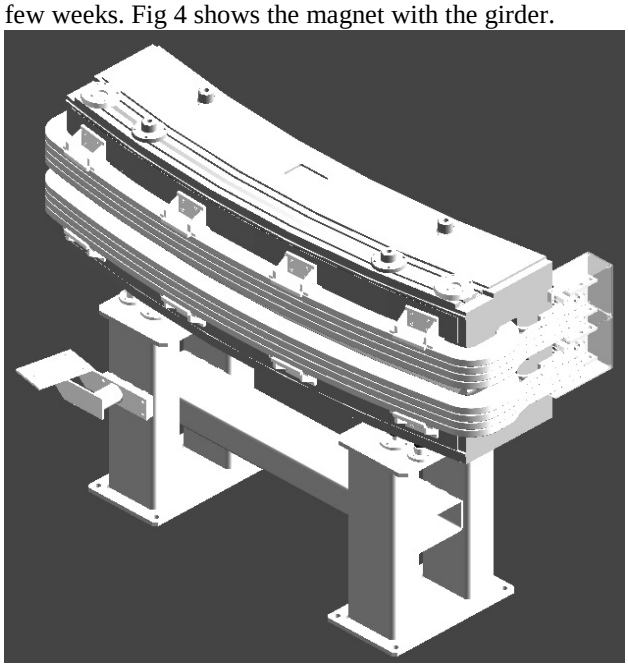
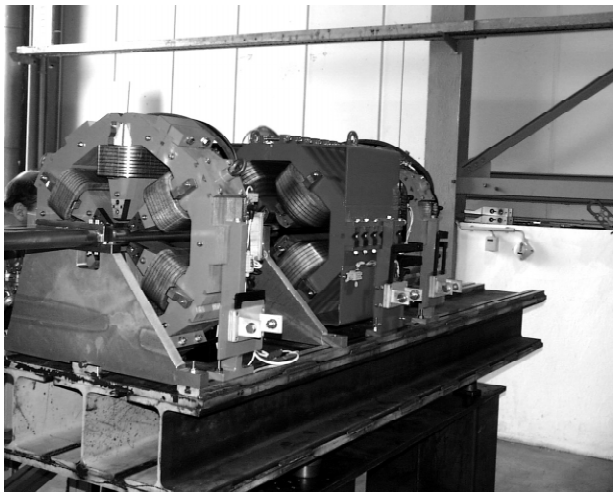


Figure 4: View on the bending magnet and the girder

The prototype of the quadrupole and the sextupole are tested and accepted. Series production will begin July 1998. Fig. 5 shows a part of a section with quadrupoles and sextupoles together with the vacuum chambers and girders. With all the prototypes it was posible to build up 1/16 of the storage ring [2].



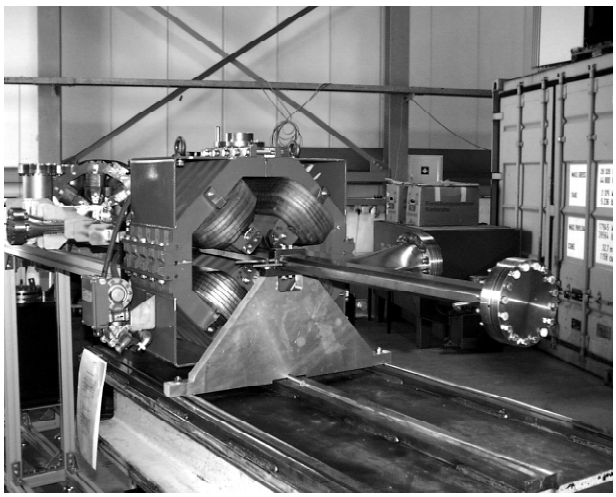


Figure 5: Prototypes of the quadrupole and the sextupole together with the dipole vacuum chamber. The straight section is equipped with a button beam position monitor.

5 VACUUM

The prototype of the first dipole vacuum chamber is shown in fig. 6 and is now under test. The series production of all chambers will start in July 98.

Figure 6: Prototype of the first dipole vacuum chamber

6 RF SYSTEM

The first ANKA 500 MHz RF cavity under test by ELETTRA is shown in fig. 7. Four cavities will allow to store a beam of 400 mA. The klystrons and the wave-guides are ordered and will be delivered spring 1999 [2].

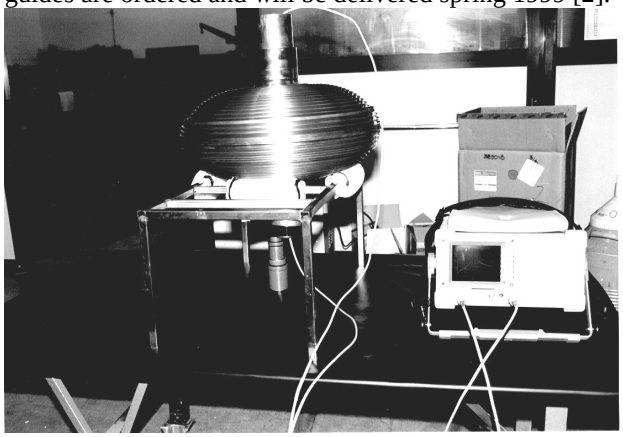


Fig. 7: Test of a 500 MHz cavity for ANKA at ELETTRA

7 POWER SUPPLIES

The power supplies for the magnets and the klystrons are ordered and will be delivered to ANKA spring 1999. The prototype of the steerer power supply is under test.

8 THE CONTROL SYSTEM FOR THE ACCELERATOR

The control system of the accelerator will be based on PC's and a LonWorks field bus. The PC's will communicate via CORBA with Windows NT (TM) hosts in the control room. At the moment activities are concentrating on building the low level control cards for power supplies, vacuum elements and RF components. A first test of the (rudimentary) control system is foreseen in September 1998 during the commissioning of the microtron [2].

9 TIMING AND INSTRUMENTATION

Timing system and instrumentation are at the moment under consideration. The timing system will be based on commercially available delay generators. Two sets of delay generators are foreseen: one set is controlling the injection trigger chain into the synchrotron (triggering the gun, the microtron klystron and the injection kickers), the second one is controlling the ejection from the synchrotron and is triggered by a revolution clock of the storage ring. With this system a gap in the filling can be produced in order to reduce ion effects on the stored beam. In the first stage the injection of single bunches and the storage of single bunches is not foreseen.

The beam position monitors in the booster synchrotron and the storage ring are standard button monitors with a digital readout. Q-values both in the microtron and the storage ring are measured by spectrum analysers in the standard way. Both the microtron and the storage ring will have an optical monitor. For the storage ring the profile monitor will be integrated in one of the beam-lines.

10 BEAMLINES

In the first phase, ANKA will be equipped with three beam lines for various aspects of X-ray deep lithography, six beam lines covering the most important X-ray analytical methods, one XUV beam line devoted to spectromicroscopy, and an infrared beam line with a useful spectral range from the near to the far infrared. In addition, one X-ray beam line to characterize thin metal and alloy films will be built by the Max-Planck society.

The services offered by the ANKA beam lines are intended to help industry to improve their processes, products and quality management thereby enhancing their competitivity.

Table 2 The beam lines and their main parameters

	Spectral range	Power or Photon flux
X-ray lithography I	1-4 keV	6 W
X-ray lithography II	3-8 keV	40 W
X-ray lithography III	4-30 keV	100 W
Spectromicroscopy	0.09-1.4 keV	$>2\cdot10^{10}$ ph./s
IR-spectroscopy	$4\text{-}10^4$ cm^{-1}	$>1\cdot10^{13}$ ph./s
Fluorescence analysis	1-30 keV	$3\cdot 10^{13}$ ph./s
SAXS	4-20 keV	$1\cdot 10^{12}$ ph./s
Protein crystallography	5-20 keV	$1\cdot 10^{12}$ ph./s
Roentgenography	6-20 keV	$1\cdot 10^{12}$ ph./s
Diffraction	5-30 keV	$2\cdot 10^{11}$ ph./s
Absorption	2.4-30 keV	$2\cdot 10^{11}$ ph./s
Grazing incidence diffraction	6-20 keV	$1\cdot10^{11}$ ph./s

11 SUMMARY

Summarizing these statements the time schedule will be as follows:

September 1998: Begin of commissioning of the Microtron in Denmark
October 1998 : Building for ANKA is completed
January 1999 : Microtron arrives in Karlsruhe
March 1999 : Begin commissioning of the injector
October 1999 : Begin commissioning of the storage ring
January 2000 : First stored beam in the storage ring
August 2000 : Start of first experiments with synchrotron radiation

REFERENCES

[1] H. O. Moser et al. Proposal (unpublished): Forschungszentrum Karlsruhe, 2. Auflage 1995
[2] See also the papers on injection, RF system, magnets, impedances and control system in these proceedings