STATUS OF THE HIGH BRILLIANCE SYNCHROTRON LIGHT SOURCE BESSY - II*

E. Jaeschke for the BESSY II Project Team†, BESSY, Rudower Chaussee 5, Geb. 15.1, D-12489 Berlin, Germany

Abstract

The High Brilliance Synchrotron Light Source BESSY II under construction at the WISTA Science and Technology Park at Berlin-Adlershof has by now passed major milestones with the completion of the injector complex. On April 3rd, 1997 a 50 MeV electron beam was stored on a stable orbit in the 10 Hz booster synchrotron. As all magnets and most of the other necessary hardware have successfully passed acceptance tests installation of the 240 m DBA storage ring in 16-fold symmetry has started. Stored beam is expected for the 2nd quarter of 1998. The paper describes the present status of the project.

1 INTRODUCTION

The High Brilliance Synchrotron radiation facility BESSY II [1] is a 3rd generation light source in the vacuum ultraviolet to soft X-ray range. Based on a very flexible 16 cell DBA lattice the 240 m circumference ring provides long dispersion free straight sections with alternating high and low horizontal beta functions for up to 14 insertion devices. The projected emittance at 1.7 GeV will be 5 nm rad. Various types of undulators, wigglers and superconducting wave length shifters (WLS) under construction or already finished will provide synchrotron radiation with brilliance values exceeding $3*10^{18}$ [photons/sec/(mm mrad)^2 /0.1%BW] for undulators. Performance is optimized for the spectral range from VUV to soft x-ray while harder radiation with excellent quality is available at the superconducting devices. So once fully operational BESSY II will be a very versatile and valuable tool equally well suited for fundamental research and industrial application. Commissioning of the light source will start July 1998 and regular user operation will be available from 1st of January 1999.

2 BUILDINGS

After two and a half years of civil engineering the buildings for BESSY II are basically finished. Figure 1 gives an aerial view of the facility as of April 1997.

Figure 1: Aerial view of the BESSY II Facility

The 120 m diameter hall houses the accelerators, the experimental area and "non-noisy" infrastructure installations on all together 12000 square meters. To control possible vibrations from cultural noise the experimental area and the storage ring tunnel share a heavily steel reenforced monolytic concrete plate of 60 cm thickness as foundation. Extreme care was taken in compressing the sand and gravel soil under the plate. The synchrotron tunnel as well as most of the technical equipment are situated on a separate plate to have an efficient decoupling. Vibration measurements done in the storage ring tunnel and the experimental hall with all infrastructure equipment (pumps, compressors, air conditioning, etc.) and the White circuits of the synchrotron running showed vibration amplitudes typically less than 100 nm in the frequency range of 1 to 60 Hz.

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† M. Abo-Bakr, W. Anders, B. Bauda, R. Bakker, J. Bahrdt, T. Becker, R. Bender, T. Bergl, N. Bergel, T. Birke, R. Brühl, K. Bürkmann, B. Dittmann, V. Dürr, H. Dreßler, J. Eigel, F. Falkenstern, D. Faulbaum, J. Feikes, W. Gericke, T. Görgen, M. V. Hartrott, K. Hennig, H.G. Hoberg, S. Horn, S. Khan, A. Knoch, J. Kolbe, D. Krämer, S. Küchler, B. Kuner, B. Kuske, P. Kuske, J. Kuszynski, T. Knuth, R. Lange, K. Ludwig, M. Loßmann, B. Martin, M. Martin, S. Mhaskar, T. Mayer, D. Müller, I. Müller, R. Müller, K. Ott, H. Prange, J. Rahn, F. Radecke, D. Richter, H. Rüdiger, L. Scanu, T. Schneegans, E. Schmitz, , G. Schindhelm, D. Schüler, K. Seliger, D. Simmering, U. Strönisch, L. Schulz, B. Thamm, S. Vogt, E. Weihreter, G. Wüstefeld.

3 COMMISSIONING OF THE SYNCHROTRON

The full energy 10 Hz rapid cycling booster synchrotron [2] of 96 m circumference has a FODO lattice in 16 fold symmetry. Figure 2 is a view onto the completed machine.

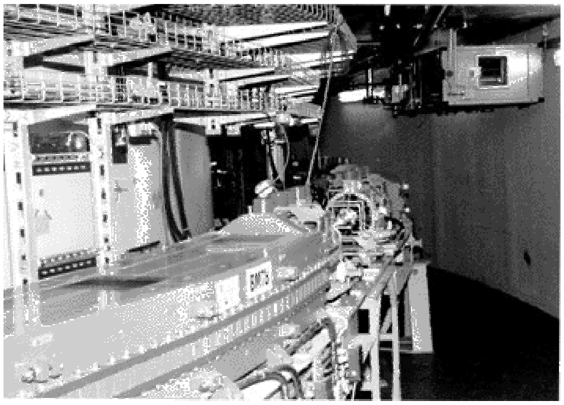

Figure 2: The completed BESSY II synchrotron.

The magnet system [3] manufactured at the Budker Institute of Nuclear Physics, Novosibirsk was installed in mid 1996 just after the tunnel had been handed over by the construction company. After completion of the vacuum system in late October and the installation of power supplies, rf-system, kickers and septa, a first beam from the 50 MeV race track microtron could be injected on April 3rd . Immediately after injection tests had started a signal of a stably stored electron beam could be detected from a strip line monitor with no orbit corrections applied at all. (See Fig. 3)

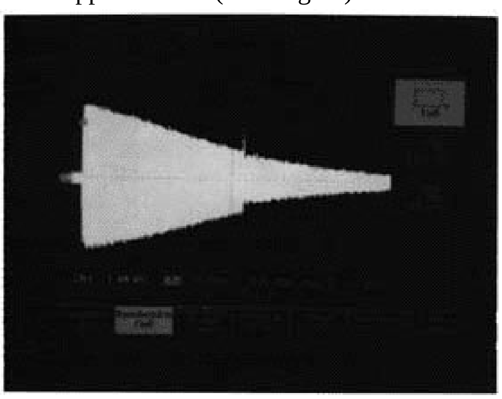

Figure 3: Strip line signal of the first stored 50 MeV electron beam in the synchrotron on April 3rd 1997. Two injections 100 ms apart are visible

The oscilloscope picture shows that electrons are circulating for 100 ms before stopped when the next bunch is injected from the race track microtron. After applying orbit correction beam life time is now approximately 4 minutes corresponding to a vacuum pressure of P = 8 10^{-8} HPa. Energy ramping as the next milestone up to the final value of 1.9 GeV is under preparation.

4 STATUS OF THE STORAGE RING

Parallel to the commisssioning of the booster synchrotron work on the storage ring is progressing well aiming for a first stored beam mid of 1998. The first of the 16 achromats has been assembled already. (See figure 4)

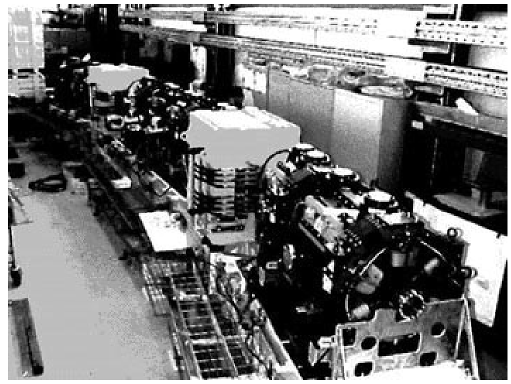

Figure 4: The first assembled achromat with multipole lenses preadjusted on 3 girders and the two dipole magnets inbetween located on individual stands.

4.1 Storage Ring Magnets

For all magnets of the storage ring (144 quadrupoles, 112 sextupoles and 32 dipoles) magnetic measurements have been done in house as for example mapping of the dipole fields and determination of the multipole coefficients for the quadrupoles and sextupoles. The data were used for sorting of magnets [4] in order to minimize the integrated field errors. While the closed orbit amplitudes can be reduced to 0.5 mm rms by proper positioning of the dipoles, (see figure 5) , the ß-beat is decreased from 60% to about 1% by sorting the quadrupoles. Sextupole field errors turned out to be insignificant to reduction of dynamic aperture thus these magnets are positioned without sorting.

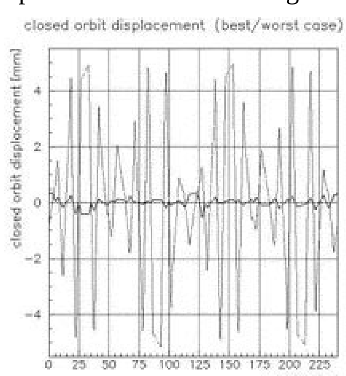

Figure 5: Closed orbit distortion for best/worst sorting

4.2 Vacuum System

The vacuum chambers for the storage ring manufactured from DIN 4429 steel with explosion bonded copper liners as radiation absorbers are already available in sufficient numbers for installation. Figure 6 shows a special outlet chamber following dipole-1 in an achromat.

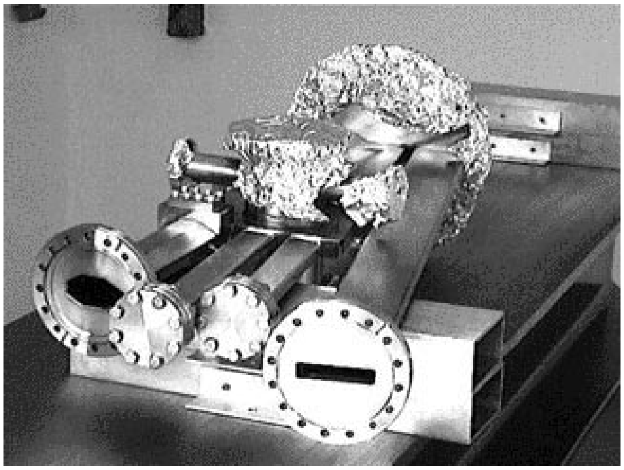

Figure 6: Dipole-1 outlet chamber

4.3 RF-System

The BESSY II rf-system consists of 4 DORIS type 500 MHz single cell resonators fed by individual 75kW clystron transmitters. All transmitters are in house and are presently commissioned.

4.4 Control System

The control system [5] based on the EPICS standard has proven its power by successfully running in all parts of the accelerator complex commissioned up to now. Figure 7 shows the control panel for the microtron injector.

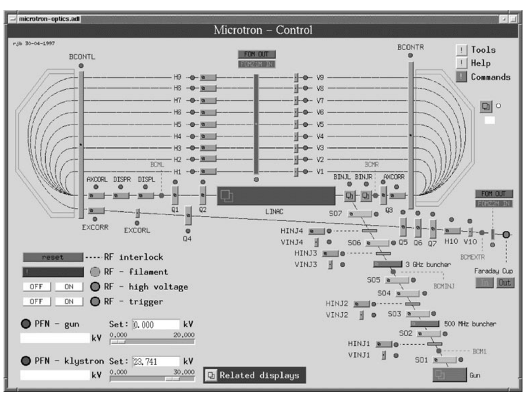

Figure 7: EPICS control panel of the race track microtron

4.5 Insertion Devices

Offering 14 straight sections BESSY II is optimized for insertion devices (IDs) . So various IDs are under construction at Berlin-Adlershof. U180, an electromagnetic device covering the spectral range from 25 to 1900 eV is on the test bench, while the hybrid undulator U49 (see Figure 8) has just been completed. It will deliver radiation with a brilliance of $3x10^{18}$ [photons/sec/(mm mrad)^2/0.1%BW] at about 300 eV.

A 6T WLS presently operating at BESSY I for LIGA applications will cover the range 6 to 50 keV.

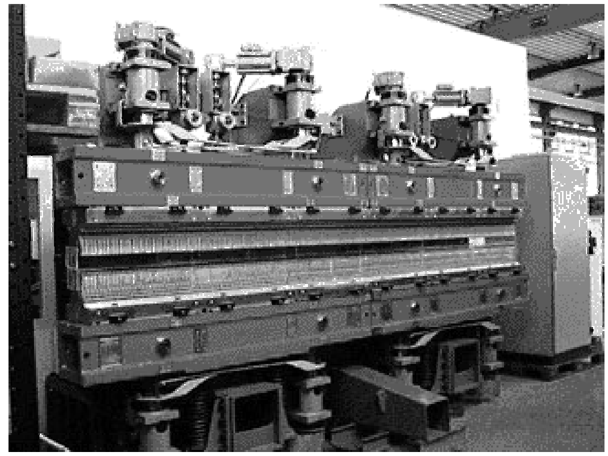

Figure 8: Undulater U49 ready for installation [6]

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