STATUS AND VERY FIRST COMMISSIONING OF THE ASTRID2 SYNCHROTRON LIGHT SOURCE

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Abstract

The new Danish light source, ASTRID2, to provide brilliant UV and soft x-rays, has recently been completed. The storage ring is designed for a 10-nm horizontal emittance at 580 MeV. First commissioning has begun to continue through 2012/13 with interleaved user operation of ASTRID, until all beamlines are fully operational on ASTRID2 towards the end of 2013.

INTRODUCTION

ASTRID2 [1] is the new synchrotron light source, presently being built in Aarhus, Denmark to replace the almost 20 year old light source ASTRID [2]. The new ring will deliver a more than ten-fold reduction in horizontal beam emittance as compared to that of ASTRID. In addition, 4 straight sections will be available for insertion devices as compared to the single unit on ASTRID. Converting ASTRID into a full-energy booster, ASTRID2 will be operated in top-up mode, as the expected Touschek lifetime will be short (5-10 hours).

Figure 1 gives an overview of the new transformed laboratory. The present 100-MeV pre-injector will be kept, injecting into the present ASTRID storage ring at the bottom of the figure.

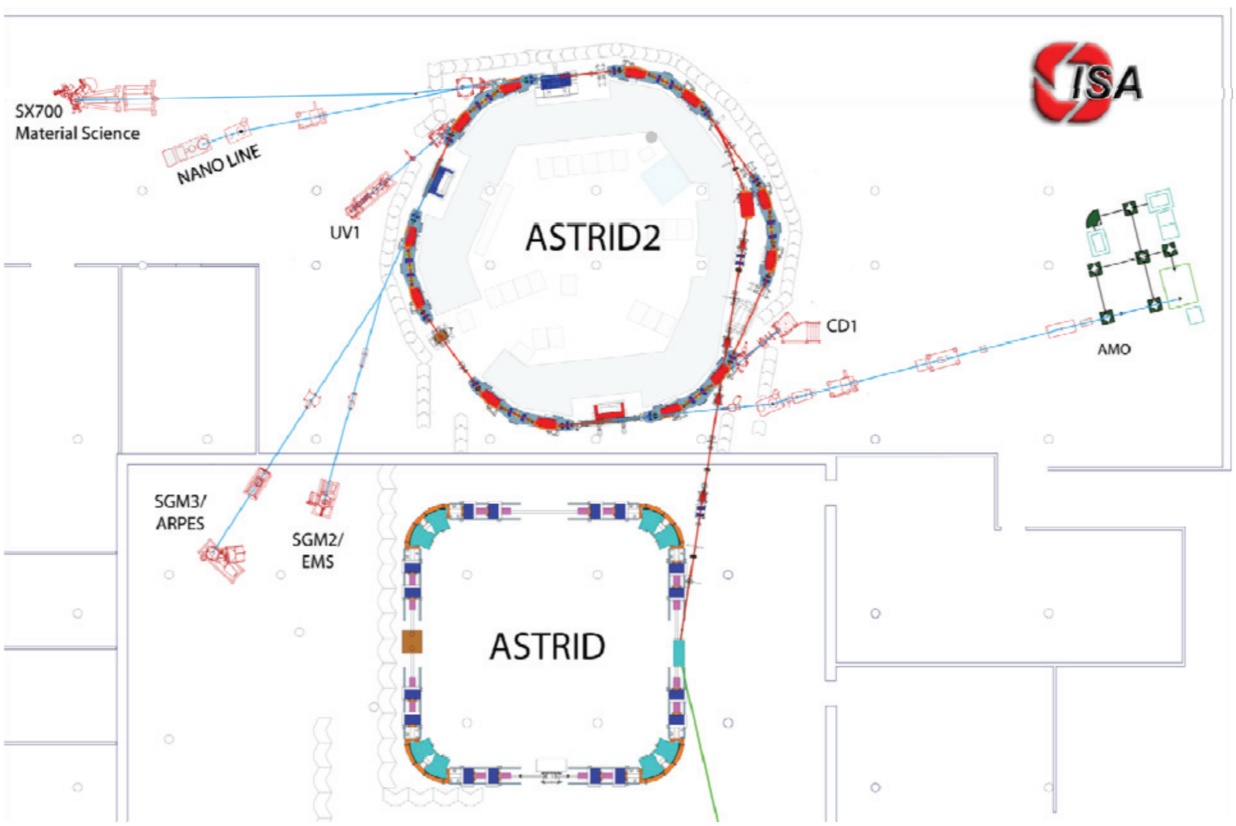

Figure 1: The transformed laboratory with the present storage ring ASTRID at the bottom, and the new light source ASTRID2 at the top. The existing beamlines on ASTRID will be upgraded and transferred to ASTRID2 together with new beamlines, which are named in the figure.

After first demonstration of the extracted 580 MeV beam from ASTRID in 2011, first commissioning of ASTRID2 is has started in May 2012, to continue through 2013. The commissioning of ASTRID2 will be interleaved with normal user operation of ASTRID through 2013. In this period, the beamlines on ASTRID will be upgraded and adapted to operation on ASTRID2 and consecutively installed on ASTRID2. One new beamline is also being built, and funding for an additional beamline has been applied for. Although there will be less user beam time in 2012 and 2013 as compared to previous

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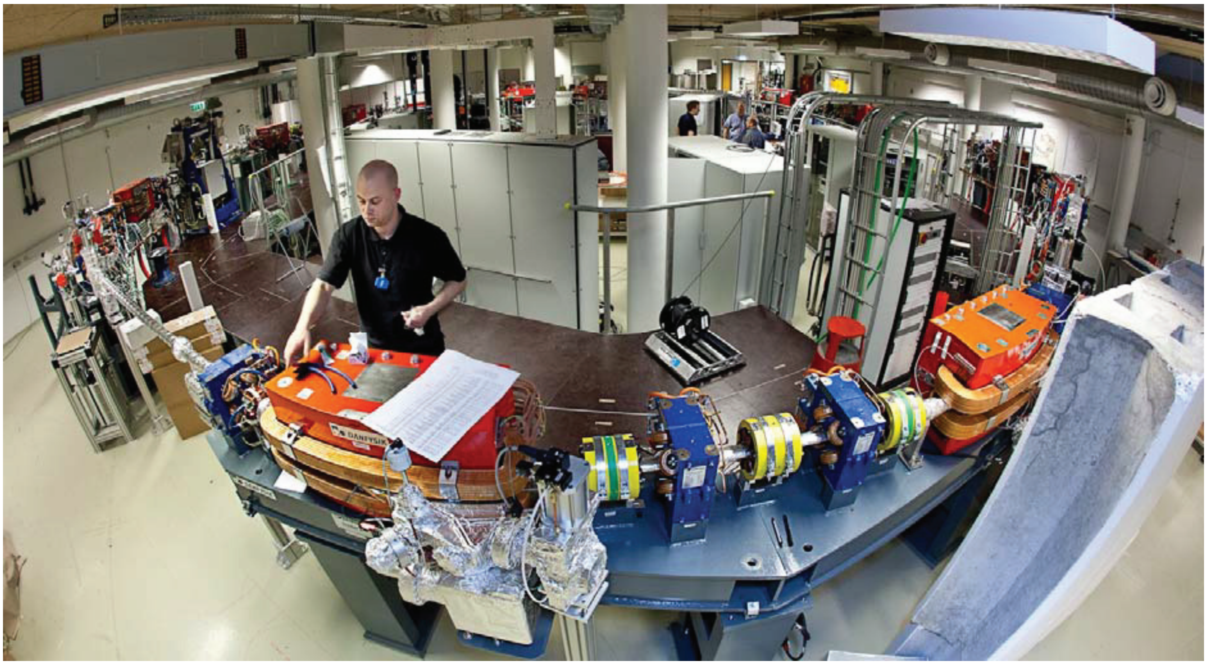

Figure 2: Close-up of the ASTRID2 ring with one of the six girders in the foreground showing the 2 red combined function dipole magnets, the blue quadrupole and the yellow sextupole magnets. The multi-pole wiggler is noticeable in the background. Power supplies etc. are seen in the centre of the ring.

years, there will be no long dark period during the construction of the ASTRID2 project, which will benefit the user community.

OVERALL STATUS

After the design and procurement of the many components for ASTRID2 in 2009 and 2010, most deliveries took place in 2011 followed by installations. Major installation and preparation milestones include:

- April 2011: Infrastructure of the underground hall including water and power finished
- April-August 2011: Main magnet girders delivered
- September 2011: Beam extracted from ASTRID
- October 2011-April 2012: installation of all vacuum systems including in-situ baking.
- January 2012-April 2012: Cabling for magnets, diagnostics, heating elements etc.
- Beginning of May 2012: Installation of concrete shielding
- Beginning of May 2012: Delivery of RF cavity
- June 2012: Installation of last BPM blocks, replacing the presently installed dummies.

STATUS OF SUBSYSTEMS

RF systems

Two new electron-beam welded 105 MHz cavities have been ordered together with a larger number of units for the MAX IV project in Lund from RI in Germany. One cavity was delivered shortly before IAPC'12 to be used on ASTRID2. The second cavity is planned for ASTRID as a spare for the present aging Cu-plated iron cavity. The cavities, fig. 3 and 4, are capacitively loaded cavities with one stub at one end. Tuning is performed by mechanical deformation of one endplate. Due to late delivery, the cavity will not be installed for the first commissioning run in May.

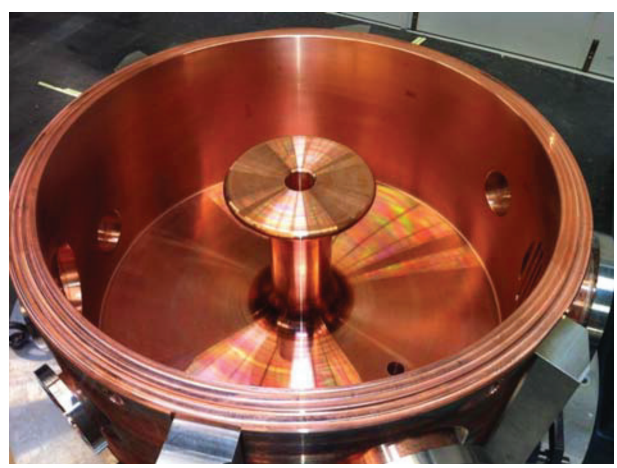

Figure 3: Inside of the 105 MHz ASTRID2 cavity before final weld of the endplate.

A 3-rd harmonic passive Landau cavity has also been ordered to increase the lifetime of the ASTRID2 beam.

Beam acceleration will be provided by a 8 kW solid-state amplifier, which has been delivered several months ago.

A new digitally controlled low level RF system has successfully been in operation on ASTRID since more than a year, and a second system will be used for ASTRID2.

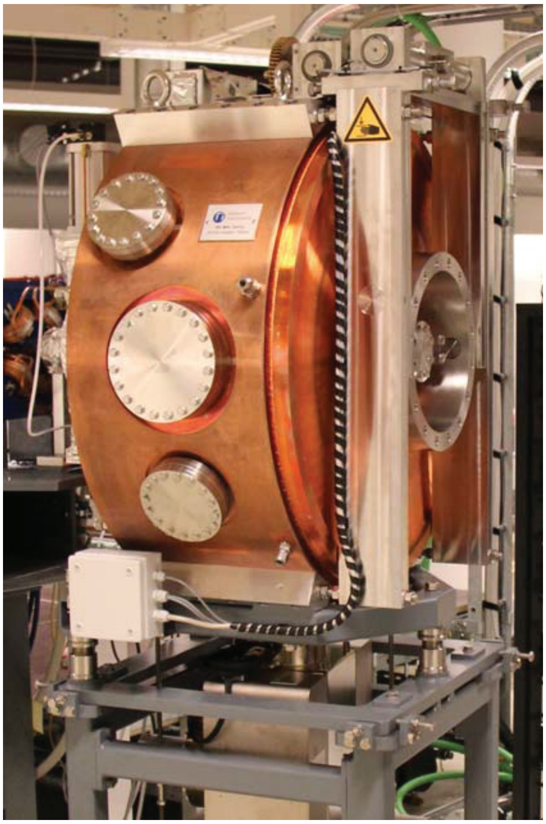

Figure 4: The 105 MHz ASTRID2 cavity mounted on its support stand. The mechanical tuning mechanism pulling on the right end-plate can be observed together with the gear on top.

Vacuum and bake-out system

Early in the design of the ASTRID2 vacuum system, it was decided to use an in-situ bakeable stainless-steel vacuum system. Aluminium is only used for the extruded insertion device chambers.

Most heating elements are flexible print foils. Around the dipole chambers these are glued together with a second flexible print used as pole-face windings for vertical tune adjustments. Thin ceramic-"paper" insulates the heating elements from the magnets.

NEG coating is used extensively in all straight vacuum tubes, and only at the ends of the straight sections and in the somewhat complicated dipoles chambers are discrete ion pumps used. A high pumping speed from this distributed pumping system is expected to lead to favourable gas scattering lifetimes.

Resulting pressures below 10^{-10} mBar has been obtained after activating the NEG coatings.

The synchrotron radiation power from ASTRID is relatively modest, just above 1 kW. Hence, relatively simple absorbers cooled from the outside with copper blocks are used at the exit of the main dipole vacuum chambers and at the outlet of the Multi-Pole-Wiggler chamber.

Table 1: ASTRID2 specifications

Quantity	Value
Energy	580 MeV
Betatron tunes	5.185; 2.14
Horizontal emittance	~10 nm
Natural chromaticity	-6; -11
Current	200 mA
RF frequency	105 MHz
Circumference	45.7 m
Dynamical aperture	25-30 mm
Beam power	1.1 kW

ASTRID extraction and transfer to ASTRID2

100 MeV electrons from the 100-MeV racetrack microtron are today injected into ASTRID using a relatively thick (11 mm) 11° DC septum and a diametrically oppositely placed half sine-wave kicker. The DC septum was from the start of ASTRID designed to extract low intensity 580 MeV Touschek scattered electrons at 9°. For booster operation, a fast (risetime < 50 ns) kicker (1.75 mrad) has been installed in ASTRID ¼ betatron wavelength before the septum. After being kicked twice by the kicker (to relax the angle), the septum magnet extracts the beam into the extraction beamline. Injection into ASTRID2 is made with three 3.5 mrad bumper magnets and a pulsed 15° septum magnet.

Last news is observation of the 1.2×6 mm^2 beam on a fluorescent screen after the ASTRID2 septum, see fig. 5.

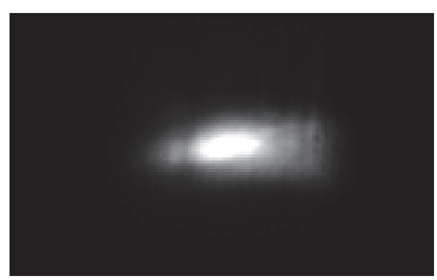

Figure 5: Beam observed after the ASTRID2 injection septum magnet.

ACKNOWLEDGMENT

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REFERENCES

[1] J.S. Nielsen, N. Hertel and S.P. Møller, IPAC'11, San Sebastian, 2011, THPC003, p. 2909.
[2] J.S. Nielsen and S.P. Møller, EPAC'98, Stockholm, 1998, WEP05F, p. 406.

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