Status of the ASTRID2 project

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ASTRID2

- ASTRID2 is the new synchrotron light source presently being built in Aarhus, Denmark
- Dec 2008: Received 37 MDKr (5 M€) to
  - Build a new SR light source
  - Convert ASTRID into a booster
  - Move existing beam lines
    - New 2 T Multi Pole Wiggler
- The project should be finished in 2013
ASTRID2 main parameters

- Electron energy: 580 MeV
- Emittance: 12 nm
- Beam Current: 200 mA
- Circumference: 45.7 m
- 6-fold symmetry
  - Lattice: DBA with 12 combined function dipole magnets
    - Integrated quadrupole gradient
- 4 straight sections for insertion devices
- Will use ASTRID as booster (full energy injection)
  - Allows top-up operation
ASTRID2 lattice

Betatron amplitude functions

Dispersion functions

Horizontal
Vertical
## ASTRID2 parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>580 MeV</td>
</tr>
<tr>
<td>Circumference</td>
<td>45.704 m</td>
</tr>
<tr>
<td>Current</td>
<td>200 mA</td>
</tr>
<tr>
<td>Straight sections</td>
<td>4x2.7 m</td>
</tr>
<tr>
<td>Betatron tunes</td>
<td>5.185, 2.14</td>
</tr>
<tr>
<td>Coupling factor</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Horizontal emittance</td>
<td>12 nm</td>
</tr>
<tr>
<td>Natural chromaticity</td>
<td>-6, -11</td>
</tr>
<tr>
<td>Dynamical aperture</td>
<td>25-30 mm</td>
</tr>
<tr>
<td>Energy loss/turn</td>
<td>6.2 keV</td>
</tr>
<tr>
<td>RF frequency</td>
<td>105 MHz</td>
</tr>
<tr>
<td>Harmonic number</td>
<td>16</td>
</tr>
<tr>
<td>RF voltage</td>
<td>50-150 kV</td>
</tr>
</tbody>
</table>

## Combined function dipoles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal (max.) dipole field</td>
<td>1.1975 (1.25) T</td>
</tr>
<tr>
<td>Bending radius</td>
<td>1.62 m</td>
</tr>
<tr>
<td>Nominal quadrupole field</td>
<td>-3.219 T/m</td>
</tr>
<tr>
<td>Nominal sextupole field</td>
<td>-8.0 T/m²</td>
</tr>
<tr>
<td><strong>Quadrupoles</strong></td>
<td></td>
</tr>
<tr>
<td>Magnetic length</td>
<td>0.132 m</td>
</tr>
<tr>
<td>Max. gradient</td>
<td>20 T/m</td>
</tr>
<tr>
<td>Magnetic length</td>
<td>0.170 m</td>
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<tr>
<td>Max. sextupole field</td>
<td>300 / 180 T/m²</td>
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<tr>
<td>Nominal sextupole field</td>
<td>249 / 161 T/m²</td>
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<tr>
<td>Dipole corrector angle</td>
<td>0 / 1.5 mrad</td>
</tr>
<tr>
<td><strong>Correctors</strong></td>
<td></td>
</tr>
<tr>
<td>Magnetic length</td>
<td>0.132 m</td>
</tr>
<tr>
<td>Corrector angle</td>
<td>3 mrad</td>
</tr>
</tbody>
</table>

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ESLS XVIII (25–26/11 2010), Status of the ASTRID2 project
ASTRID2 Layout
ASTRID2 girder and magnets

- One arc (1/6) of ASTRID2, showing the magnetic elements
ASTRID2 RF

- 105 MHz (like ASTRID)
- Main RF parameters
  - Synchrotron radiation power: \(~1.4\) kW
  - Synchrotron frequency: \(10\)–\(20\) kHz
  - Harmonic: \(16\)
  - RF voltage: \(50\)–\(150\) kV
  - Cavity power: \(0.8\)–\(7\) kW
  - 5–12 kW FM transmitter
    - Most likely a solid-state amplifier, but a tube-based amplifier is not ruled out
  - Cavity: collaboration with MAX–Lab
    - Presently in tendering
Each dipole chamber has
- one 150 l/s ion pump with integrated TSP
- All interconnecting tubes (Ø40mm) are NEG coated

Insertion straights
- ID chambers are NEG coated

Bake out: In-situ
- Dipole chambers: ~150°C
- Interconnecting tubes (NEG): ~200°C
- Heating: Thin (<0.5 mm) heating foil (like Soleil)
- Isolation: Thin (~1 mm) ceramic “paper”
  - To prevent excessive heat transfer to magnets
Most major components, except RF cavity, will be delivered 1st quarter 2011
- magnets on girders, fast magnets, magnet power supplies, vacuum equipment

Vacuum chamber is being finalized
- Design of dipole chambers almost ready
- Interconnection tubes: manufactured, ready for NEG coating

Timeline
- Spring/summer 2011: Installation
- Autumn/winter 2011: Commissioning
- 2012: First beam lines on ASTRID2
- 2013: All beam lines transferred to ASTRID2
ASTRID Operation

- No dedicated operation staff
  - I.e. the machine is operated by accelerator physicist (two until now) with the help of a beam line scientist (especially for helping with weekend injections)

- The control room is only manned during injections
  - One injection every weekday (~½h)
  - Typically one injection in the weekends
  - If beam is lost outside normal working hours the users can try to call an operator, but there is not an operator on call
  - We have an SMS service, which can alert the operator of machine failure

- Machine physics and repairs:
  - Each Monday morning
  - Once a month: ~3 days of machine physics and repairs
  - Twice a year: ~14 days of machine physics and repairs
  - On a need basics: Longer shutdowns
Expected ASTRID2 Operation

- No dedicated operation staff
  - Usually no one in the control room

- The machine should (hopefully) be fully automatic (Top-up)
  - Plan to implement an automatic beam steering system in the transfer beamline between ASTRID and ASTRID2
    - ASTRID will only be able to deliver a new pulse every 10–15 s
  - Expect some trimming of Microtron and injection into ASTRID on a daily basis