The ASTRID2 SR light source and its use of Libera Electrons

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Content

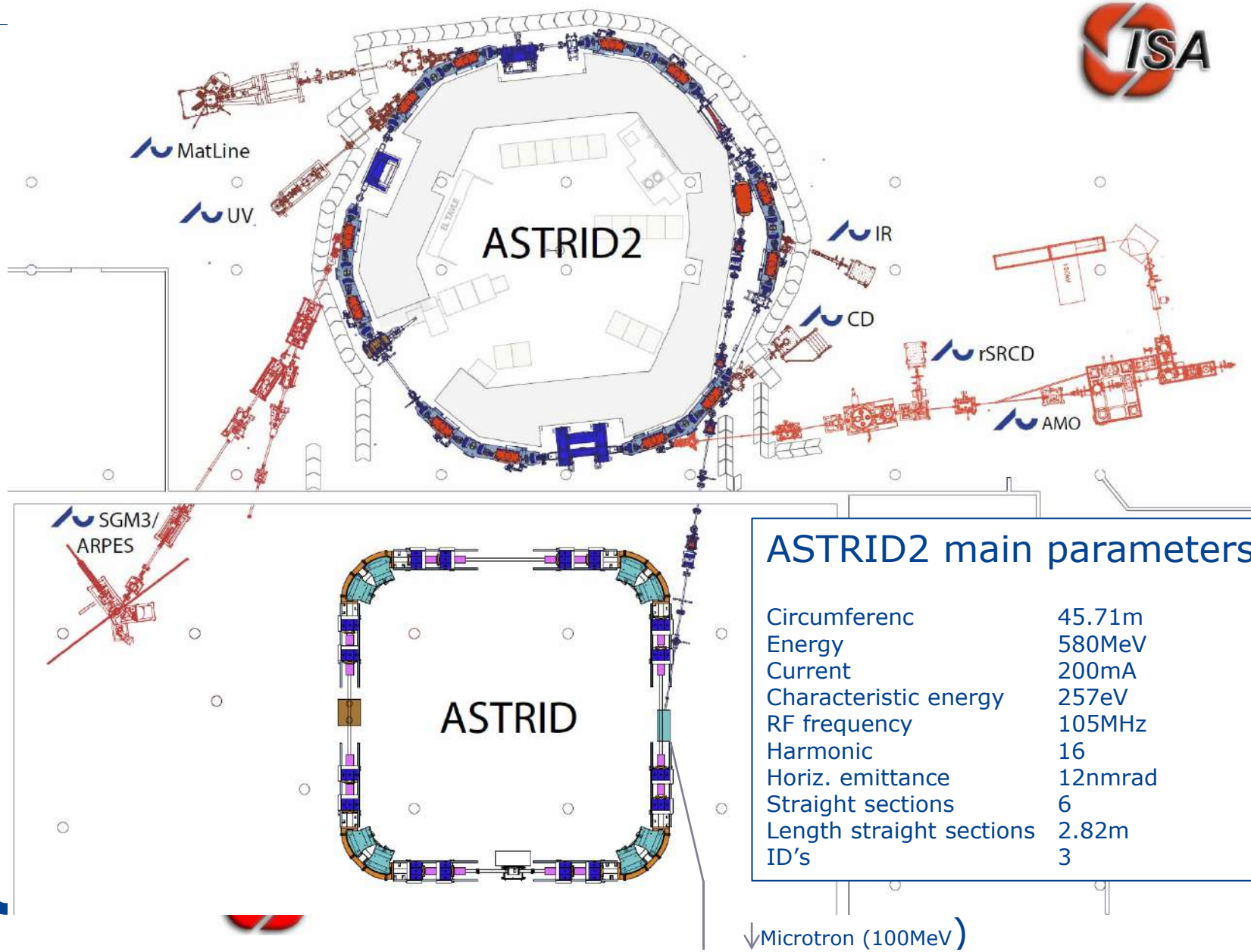
- The ASTRID2 ring
- Why did we chose Libera Electron BPM system
- How do we use the Libera Electrons
- Further use of the Libera Electrons

ASTRID2

- ASTRID2 is the new synchrotron light source in Aarhus, Denmark, replacing ASTRID
- 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
  - Using ASTRID as booster (full energy injection)
    - Allows top-up operation

ASTRID2 Layout

The ASTRID 2 facility

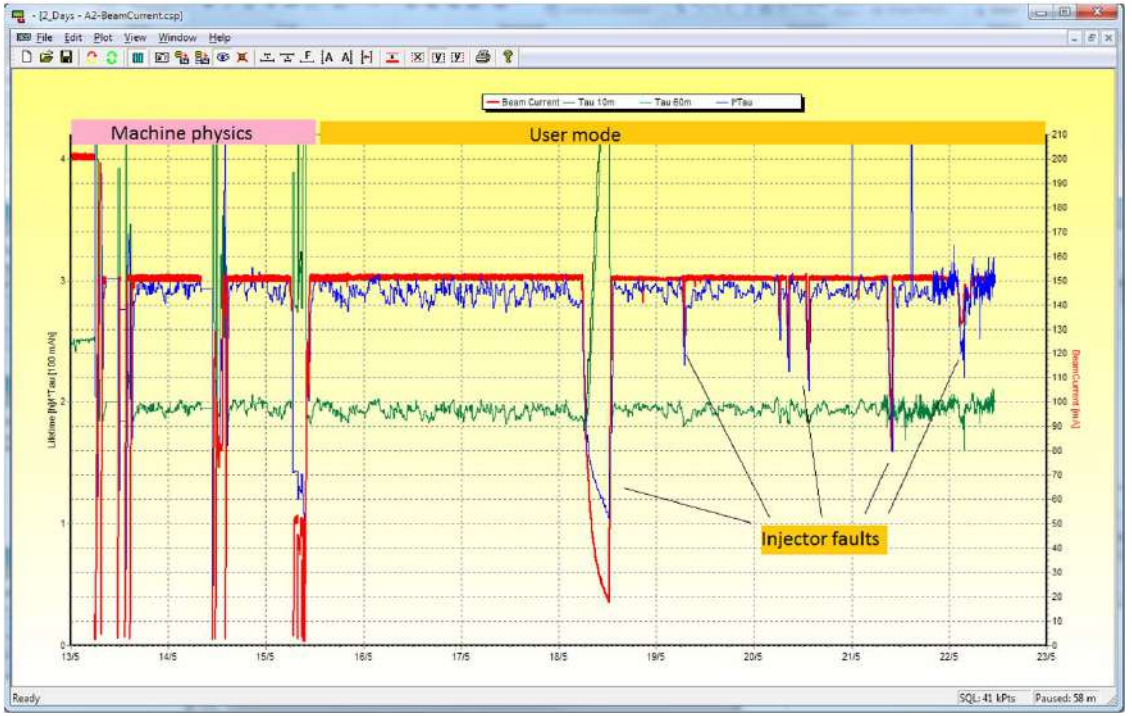


ASTRID2 main parameters

Circumferenc	45.71m
Energy	580MeV
Current	200mA
Characteristic energy	257eV
RF frequency	105MHz
Harmonic	16
Horiz. emittance	12nmrad
Straight sections	6
Length straight sections	2.82m
ID's	3

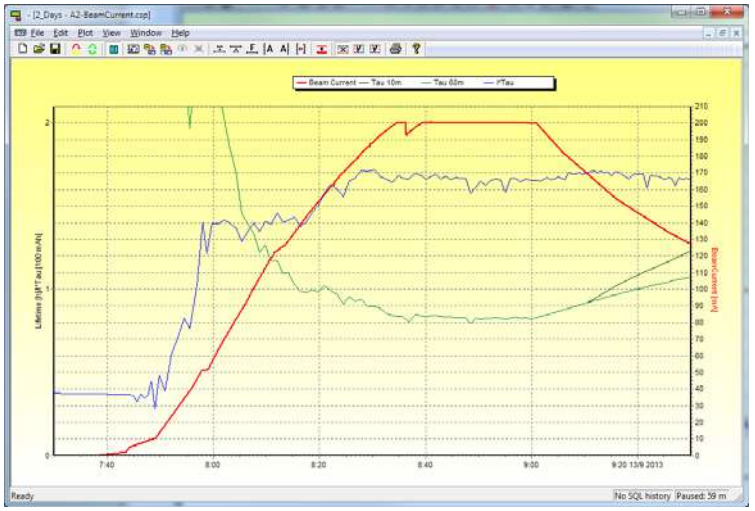
ASTRID2 Status

- 150 mA continuous TopUp for users
  - Initially had a problem with the injection bumpers, which limited continuous TopUp operation to 80 mA
- 4 beam lines in operation
- 1 being commissioned
- 2 being build



ASTRID2

- Some highlights
  - Dec. 2008: Money awarded
  - Nov. 2012: First stored beam
  - May 2013: First light in a beam line
  - 11-12/9 2013: First experiments performed with the AU-UV beam line
    - UV absorption and Circular Dichroism
  - Friday 13/9 2013: Accumulated 200 mA
    - TopUp for ~20 min
  - May 2014: General user operation
    - 80 mA Topup
  - May 2015: 150 mA Topup

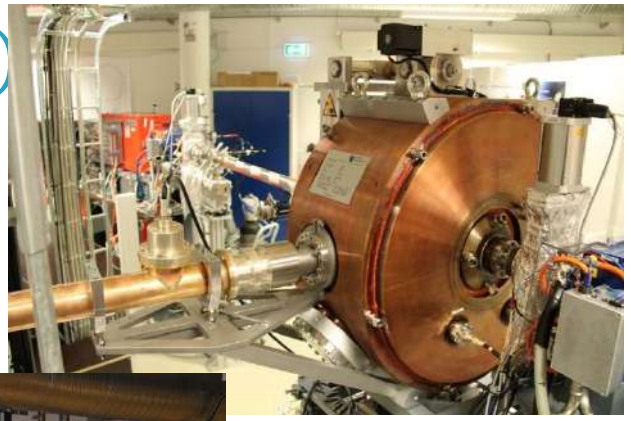


ASTRID2 RF

- 105 MHz (like ASTRID)
- Main RF parameters
  - Harmonic: 16
  - RF voltage: 50–150 kV
  - Synchrotron frequency: 10–20 kHz
  - Synchrotron radiation power: ~1.4 kW
  - Cavity power: 0.5–7 kW
- 8 kW solid state amplifier from Tomco Technologies (Australia)
  - Has been running exceptional well, except for two humidity sensor boards which failed in a way so an internal 5V supply was overloaded, preventing operation

ASTRID2 Cavity

- Basically the same as MAX IV cavities
  - Built by RI (RF design by MaxLab)
- Conditioned to ~150 kV (~2 kW)
  - No real problems seen
  - Outgassing at the highest powers



- 315 MHz Landau cavity (also from RI and based on MaxLab design).
  - Installed in March 2015
  - Have improved lifetime and beam noise

ASTRID2 Operation

- Only two operators (accelerator physicist)
- Control room is empty most of the time
- Try to automate as much as possible
  - Topup runs automatic
  - Topup is disabled if an error occurs
    - Automatic reset of known errors
      - E.g. phase error (230 V brown out) of booster dipole magnet supply

Why Libera (Electron)

- Only analog BPM electronics in budget
  - Very small budget (~5 M€) for ASTRID2 construction
- Reasons which persuaded us:
  - First turn diagnostics
    - Quickly determine cause of injection problems
  - Turn-by-turn measurements
  - 10 kHz output
    - Possibilities to see noise in orbit
    - Did not (and do not) expect to have Fast Orbit Feedback

What did we get

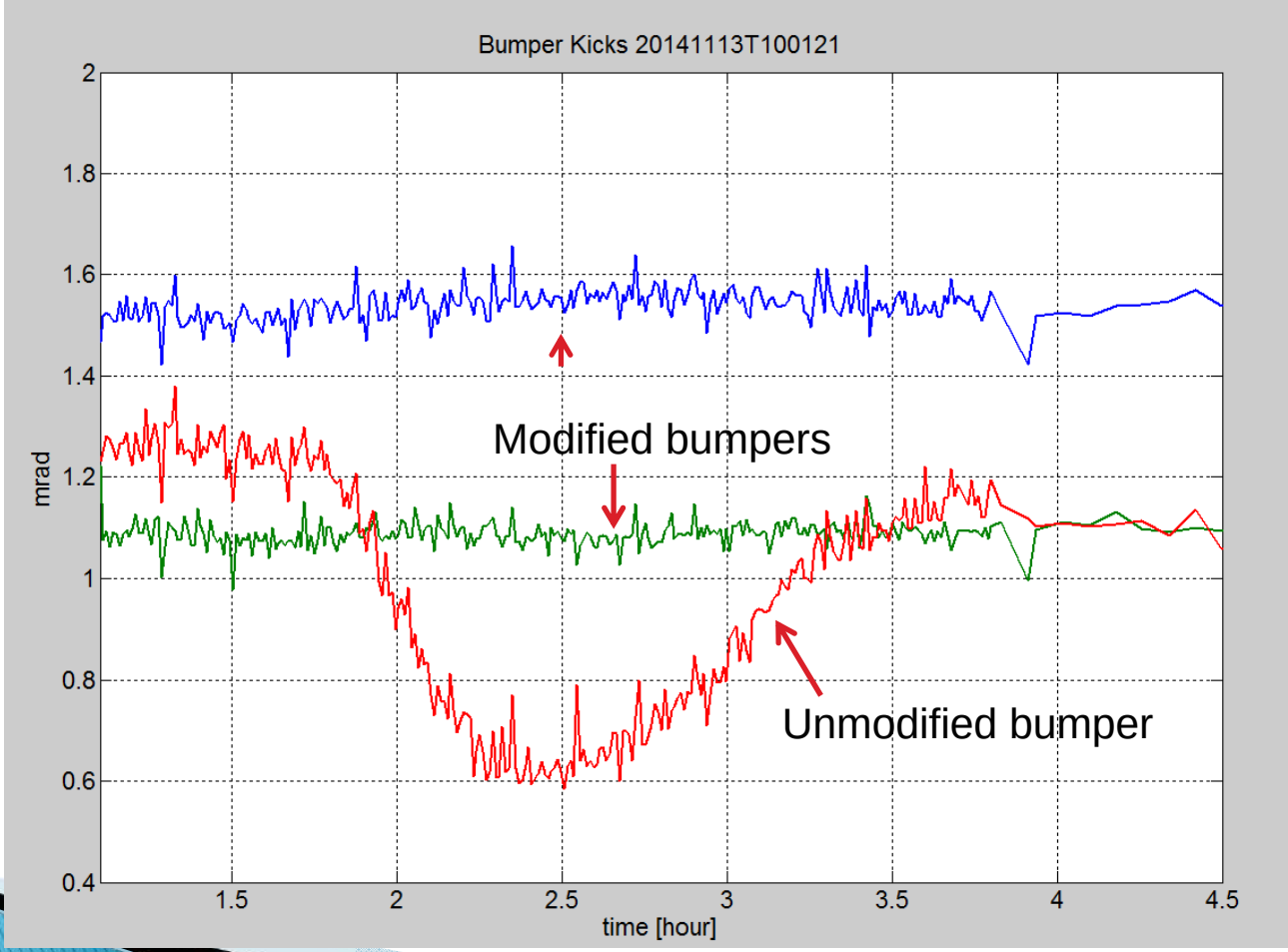
- 24 Libera Electrons:
  - Regular BPM's for 10 Hz orbit correction
    - 6 sectors each with 4 BPM's
- 2 spare Libera Electrons
- 2 spare Libera Brilliance
  - Used for
    - The two diagnostics BPMs in ASTRID2
    - ASTRID BPMs
- 3 Clock distributors
- Molex cables for FA grouping
  - 3 stacks interconnected by fibers

What are we using

- Regular 10 Hz orbit correction
  - BPM noise: ~0.25 μm
- TBT
  - Injection bump
    - Measurement of bump angles (important in understanding our bumper problems
  - Tune measurement (auxiliary measurement)
- FA (10 kHz)
  - (Test) measurements of beam position noise (noise frequencies)

Bumper kick angles

- Using TBT from the 24 regular BPM's we have measured bumper kick angles



Further use in the future

- FA (10 kHz)
  - Further measurements of beam position noise (noise frequencies and noise source determination)
- First turn measurements
  - Diagnose injection problems
- TBT
  - Improve tune measurement
- Booster (ASTRID) stability measurements

Conclusion

- We are very happy with the choice we made
- We certainly find the system very useful
- We will continue to expand the use of the Libera BPM system