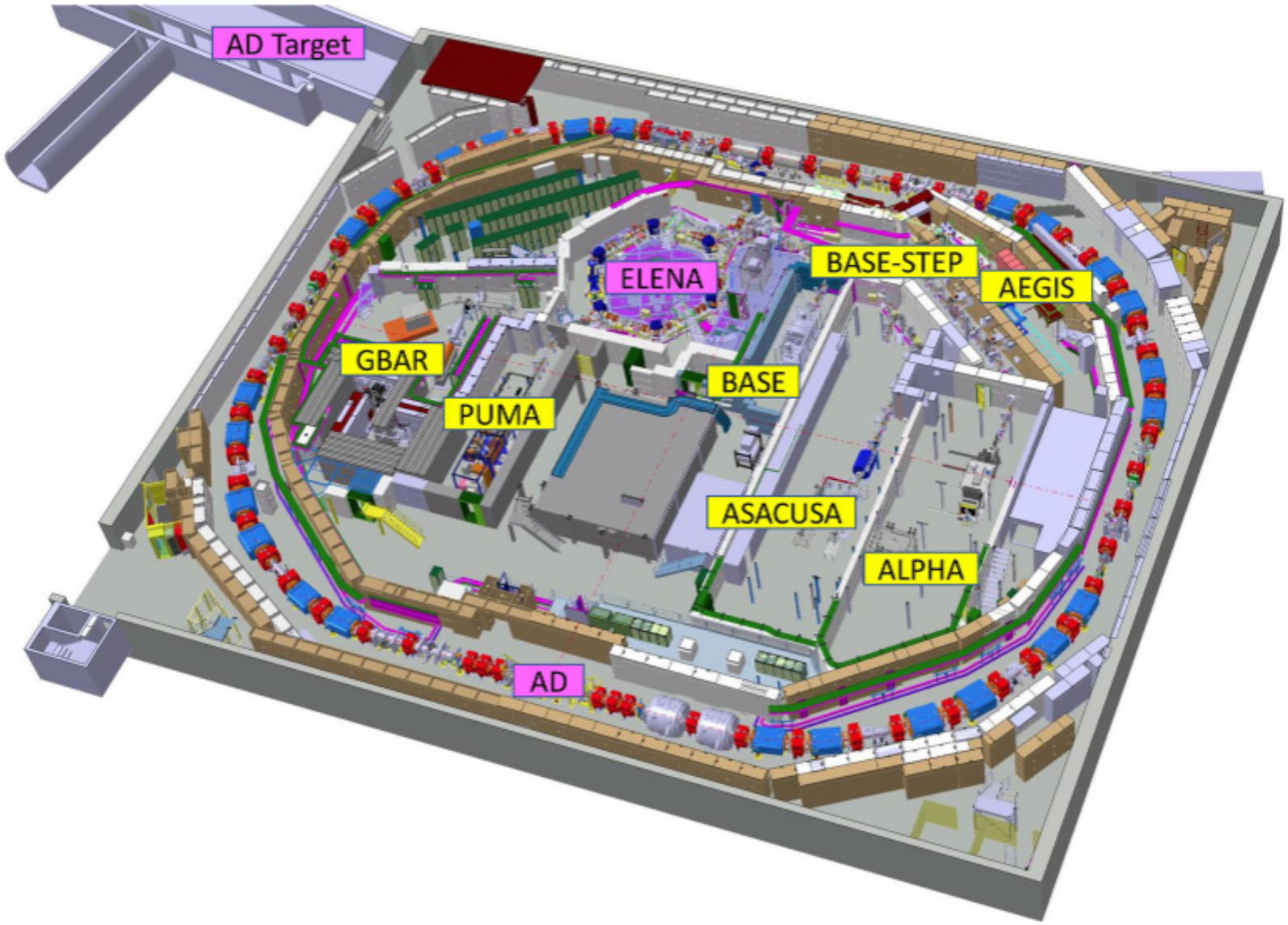
Antiproton complex performance upgrade strategy



- A full chain of decelerators:
  - a target area
  - 2 synchrotrons
  - 3 sets of transfer lines
  - 6 users collaboration (8 beam destinations)

Context

- Performance improvement requirement picked-up from users:
  - Reliability and stability
  - Higher repetition rate
  - More pbars in smaller emittance
  - Helium distribution
  - Less dependencies due to beam line and space sharing (vacuum, magnetic shielding)

- A reminder that AD has inherited its hardware from another machine (and century)
  - The machine has been designed and is operated to fit the hardware
  - Maybe it is time to review all opportunities to adapt the hardware
    => Mini workshop on AD consolidation and improvement to be organised

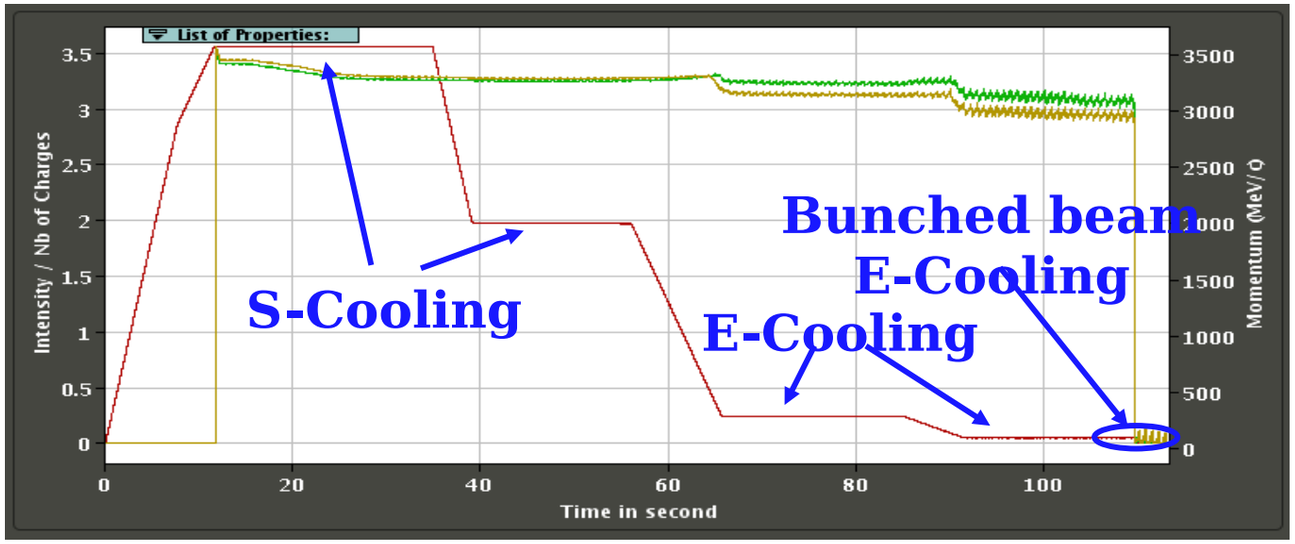
Strategy

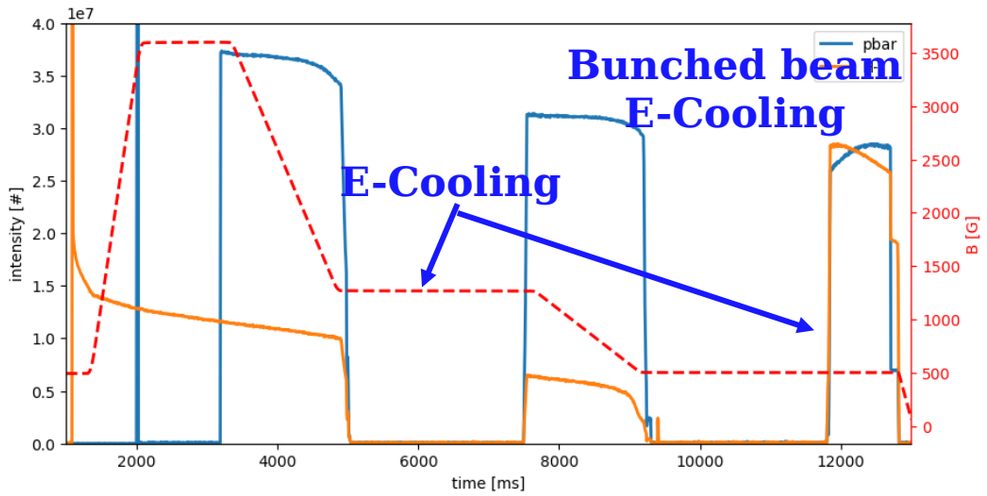
- Maintain the performances:
  - Restaure operation of the faulty equipment: e.g. BCCCA, BHZTRIM
  - Ensure long term lifetime of equipment: e.g. SEM

- Improve reliability/availability
  - AD CONS:
    - DI consolidation magnet and power supply:
    - AD ring mains
    - E-cooler
    - Stochastic cooling

- Improve performance:
  - Increasing repetition rate:
    - Reduce machine(s) cycle length
    - Optimize PS supercycle structure
  - Increasing delivered intensity:

One exemple: Improving repetition rate





- Average repetition rate in 2022 around 120 s, AD cycle is 110 s long, ELENA cycle is 14 s
  - Optimize PS supercycle already discussed (see D. Gamba and D. Cotte's talks)
  - Reduce the machines cycle length: can we dream on a 60s AD cycle?
- Reducing ramp rate already done in 2022:
  - change of harmonics to profit of the new finemet cavity
- Reducing the plateaus length = optimizing cooling**s**:
  - Improving stochastic cooling, especially at 2 GeV
    - Need a tunable system to work at 2 different energies
  - New e-cooler design
  - Improve bunch beam cooling performance:
    - Improved live instruementation

Machine Infrastructure Improvement

- FTA line:
  - Instrumentation: BPM and BLM in the line, (see R. Ramjiawan's presentation)
- Target/horn: (see T. Giles' presentation)
  - Investigation on new designs to be added in AD-CONS?
- DI line covered by AD-CONS
  - Rescope of SY-EPC project to be considered to cover new magnets design (see A. Newborough's presentation)
  - More optimal and energy efficiency powering
    - Modification of timings to pulse only at injection instead of every 2.4s
  - Re-add/study collimation technique for improved radiation level in experimental areas
  - Better instrumentation
- AD Mains consolidation as « upgrade » or intelligent consolidation:
  - Problems with BHZ trim, QUAD
  - Need more flexible control, especially to better use the "pause" functionality
  - Extension of the AD-CONS scope => to be adressed in a dedicated miniWorkshop
- AD hall space management:
  - BASE-STEP will aim for offsite analysis to extend their high-precision measurement program
    - Open the door to new experiments of this kind and new way of AD use

Wish list for improvement unblocking

- New E-cooler project detailed at the last IEFC meeting, covered by AD-CONS
  - Additionally: new magnets in e-cooling section to ease exploration of new optics/better cooling
- Stochastic cooling consolidation: it is a critical and very old element, it should work!
  - Spare or new kickers/pickups to be built/redesigned
  - Upgrade of control system, amplifiers optical notch filter …
    - RF team need more support/ressources: ideas to recover hardware/expertise from other facilities
      - Can we set-up a collaboration with Julich?
- AD/ELENA ring instrumentation:
  - Live instrumentation: BPM, BCCCA, Schottky
    - Improve reliability of the system is the key parameter for efficient setting-up and a pre-requisite for any optimization tools
  - Need to have AD IPM fully back operational
  - Can we dream of a BCCCA and an IPM in ELENA?
- ELENA transfer line instrumentation
  - Problem of cross calibration of the different sytems to be followed-up
  - There is a free experimental line (LNE03), could we use it for test of instrumentation, foils, degrader….

Cohabitation between users

- Helium consumption and delivery :
  - Discussions on-going to find alternative to the fix line distribution
  - Need important efforts from the experiments
- Vacuum:
  - Some issues at the end of the year with the rush for beam time
  - Agreed interlocked level to be enforced
- Magnetic shielding of the experimental magnets:
  - Would allow to make users independent of the status of each others
  - Could we review the decision taken at the beginning of the project?
- RP shielding in AEGIS area, a long standing issue:
  - Triggered at AD injection
  - Will be improved during the YETS after removing of the old DE0/DEM line
  - Better modelling of the injection line could allow to reduce the radiation at the source

- Beam sharing:
  - Do we need new delivery scheme: 5 bunches or 1 bunch to only one user for dedicated time?
  - More flexibility on the beam requests handling to really use the 4 bunches?

Key points

- AD-CONS plans well defined for but one to one consolidation may not be the optimum choice as most of AD hardware was not designed for AD!
  => Mini workshop on AD consolidation and improvement to be organised

- Wish list for Christmas:
  - New mains for AD with a moder controls system
  - A valid model for the pbars production and transport in DI line
    => formalize collaboration between different groups involved
  - A consolidated stochastic cooling system
  - A new e-cooler
  - More live instrumentation in the ring (BCCCA + IPM), reliable intensity measurements all along the pbars complex
    => formalize the responsabilities between the different groups involved
  - Consolidate operational equipement: e.g Btrain, Hminus source
  - Set-up test stand for low energy beam instrumention in the LNE03 line
  - Performant He distribution system and optimized users consumption to not limit the physics programs