Contents

- AD consolidation
- Planning
- Operation
- ELENA systems (not covered elsewhere)
A limited consolidation program was launched in 2009 in view of continued AD operation until 2016/17

Out of some 40 items needing attention, 1/3 was prioritized with a total budget of 2.3 MCHF

- E-cooler power supplies, HV equipment and controls interface – done
- Magnetic horn pulser and controls – done
- Ejection line bpm:s – in progress
- Ring/transfer line magnets – in progress
- Ring/transfer line power converters – in progress
- Vacuum system – in progress
- RF (C02/C10) – in progress
- Stochastic cooling – to be started
- Kickers – to be started
- Target area – to be started

With the ELENA approval a new consolidation program is being worked out assuming AD /ELENA will run at least 10 - 15 more years
AD consolidation

- For running until >2026:
  - Expand 2009 program =>
  - ~ 40 items such as:
    - **Target area**: water cooling, ventilation, interlocks, manipulation devices,
    - **Stochastic cooling**: parameter control, u-wave amplifiers/power supplies, controls, movement system, vacuum tank spares etc.
    - **Electron cooling**
    - **RF**
    - **Infrastructure**
    - etc.
  - Consolidation campaign started in 2010 for the experimental hall: safety, user facilities etc.

==⇒
Consolidation
AD Hall+
infrastructure

Infrastructure consolidation:
• Access control upgrade
• RP shields upgrade
• New gangways for circulation and evacuation improvement
• New control rooms for ALARA respect and racks/storage space increase
• Cranes upgrade for more efficient and safer handling
• Cryogens distribution audit
• Ventilation system audit
• Review needs for smoke/ODH detection
• Provide long term (bdg 133) and short term (new building) storage facilities
• New cafeteria/toilets/meeting room/parking
• New visit itineraries and procedures

= new access control (5)
ELENA planning

- Planning stretched in order to minimize impact on physics program
  1. Design, fabrication, installation of ELENA whilst using the existing ejection lines for physics @ 5.3 MeV => ~ 3 years
  2. Commissioning of ELENA in parallel with physics => ~ 6 months
  3. Installation and commissioning of new 100 keV ejection lines (physics stopped) => 0.5 to 1 year

=> Total duration 4 to 4.5 yrs
Initial planning

- Task 1: 2011-2012 shutdown, 101 days, start Mon 21/11/11
- Task 2: Setup for physics, 20 days, start Mon 09/04/12
- Task 3: AD physics run 2012, 141 days, start Mon 07/05/12
- Task 4: 1st long shutdown 2013/14, 350 days, start Mon 03/12/12
- Task 5: Setup for physics, 20 days, start Mon 23/06/14
- Task 6: AD physics run 2014, 90 days, start Tue 22/07/14
- Task 7: 2014-2015 shutdown, 50 days, start Mon 24/11/14
- Task 8: Machine startup, 25 days, start Mon 13/04/16
- Task 9: AD run 2015, 140 days, start Mon 18/05/16
- Task 10: ELENA TDR, 320 days, start Mon 03/10/11
- Task 11: Move kicker platform, 100 days, start Mon 11/03/13
- Task 12: Modification of 7000 line, 60 days, start Mon 02/06/13
- Task 13: Modification of AD hall, 195 days, start Mon 24/06/13
- Task 14: Design & procurement of ELENA, 776 days, start Mon 02/10/12
- Task 15: ELENA installation, 320 days, start Tue 01/10/10
- Task 16: ELENA commissioning, 171 days, start Mon 02/03/15
- Task 17: Install electrostatic beamline, 101 days, start Mon 23/11/15
- Task 18: ELENA & beamline commissioning, 66 days, start Mon 04/04/16
- Task 19: ELENA physics run 2016, 101 days, start Mon 04/07/16
# CERN/LHC run planning (provisional)

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</table>

=> Affects LHC injectors and AD!

T. Eriksson CERN BE/OP    28 September 2011
ELENA ring can be commissioned while 5.3meV physics program is running.

100keV transfer lines to be set-up once ELENA is running satisfactory.

Some reinforcement to the op-team is needed – request has been made.

External help is also welcome!
ELENA systems (not covered elsewhere)

- Infrastructure
- Electron cooler
- Instrumentation
- B-train
- Controls
- Ejection lines
- H-/p source
<table>
<thead>
<tr>
<th>Item</th>
<th>Material (kCHF)</th>
<th>Manpower FSU or charged (kCHF)</th>
<th>CERN Manpower FTE (MY)</th>
<th>Needed manpower contribution FTE (MY)</th>
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<td>Magnets (ring+inj. line)</td>
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<td>RF + Schottky diagnostics</td>
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<td>B-trains</td>
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<td>H-source</td>
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<td>Experimental area: lines, vacuum, monitors</td>
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<td>6.3</td>
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<td>Mech. Design/Drawings</td>
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<td>Total (MCHF/MY)</td>
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<td>39.4</td>
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<td>Grand Total (MCHF/MY)</td>
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<td>71.9</td>
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</table>

2010 ELENA cost estimate

- Initial expectations: 50/50 CERN/external

1. Eriksson CERN BE/OP 28 September 2011
Infrastructure

- ELENA related:
- Electricity distribution
- Cooling/ventilation
- AD kicker PFN:s
- Equipment racks
- Storage AD equipment
- Storage/assembly for experiments
Cooler, solenoid compensators, orbit correctors and valves will occupy one complete straight section.

Cooling at 35 and 13.7 MeV/c MeV/c for efficient deceleration (compensation for adiabatic blowup) and to ensure that the phase-space characteristics of the extracted antiproton beam fit the requirements of the experiments.

Special attention must be paid to the design of the electron gun and the quality of the longitudinal magnetic field guiding the electrons from the gun to the collector => small transverse components \( \frac{B_\perp}{B_{\parallel}} < 10^{-4} \)

Partly based on existing designs (ext. collaboration?)
# The ELENA Electron Cooler

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
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<tr>
<td>Momentum (MeV/c)</td>
<td>35</td>
<td>13.7</td>
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<td>b</td>
<td>0.037</td>
<td>0.015</td>
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<tr>
<td>Electron energy (eV)</td>
<td>355</td>
<td>55</td>
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<td>Electron current (mA)</td>
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<td>Expected cooling time (mS)</td>
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<td>Bgun (G)</td>
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<td>Bcooling section (G)</td>
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<td>Cathode radius (mm)</td>
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<tr>
<td>Electron beam radius (mm)</td>
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</table>
The ELENA Electron Cooler

- Compact cooler for cooling at 35 MeV/c and 13.7 MeV/c
- Corresponding electron beam energies of 355 eV and 55 eV
- Conventional thermionic cathode ($n_e \approx 3 \times 10^{12} \text{ cm}^{-3}$)
- Effective cooling length $\sim 0.8$ m
- 100 G magnetic field in toroids and main solenoid to reduce perturbations to the ring
- Placed flat for ease of maintenance (vertical orbit distortion)
- Challenges:
  - Generation of a cold low energy electron beam ($T_\perp < 0.1 \text{ eV}, T_\parallel < 1 \text{ meV}$)
  - Electron beam energy stability
  - Reliable electron cooling diagnostics
  - Dynamic vacuum $10^{-12}$ torr
- External contribution possible: 1MY electronics technician ($0.5 \times 2$ yrs)

Cycle length = 10-15 s
Ring pickups

- 8 combined H+V units
- Based on existing AD design:
  - Diagonally cut electrodes (redesign?)
  - Existing head amplifier design
- Network analyzer used @ 100Hz BW, 30ms per p/u
- Theoretical resolution with 1E7 pbars: 0.1mm
- External contribution possible (~1MY):
  - PU/electronics/head amplifier design and tests
  - Manufacturing and tests
Profile measurements:
- Similar to existing AD system
- 4 motorized scrapers
- 2 scintillators/photo multipliers/HV supplies
- Electronics in rack outside machine enclosure

Tune measurements:
- Dedicated kicker and DSP-based BTF

Intensity/longitudinal Schottky:
- Covered in RF/Schottky
- BCT needed for calibration? (ext. contribution?)
Electron cooler related:

• Non-destructive H/V profile measurements:
  • Ionisation Profile Monitors (pressure bumps needed)
  • Mainly for startups/md:s
  • ~1mm resolution

• Recombination detector at exit of 1:st bending downstream of e-cooler (proton test beams)
2 systems needed: measured (mainly for commissioning) and synthetic
~Standard PS-complex design
Flux coil in bending magnet
Standardized CERN accelerator control system (FGC3, PLC, OASIS, timing DSC:s)

Existing rack space near ELENA

Cycle generation to be developed to present CERN standards (INCA, LSA)
  • AD cycle sw/hw will be upgraded at the same time
100 keV beamlines

- ~60m total length
- 4-layer shielding (fringe fields from AD and trap solenoids)
- electrostatic deflectors + lenses
- 28 u-wire profile monitors, Faraday cups, Cherenkov counters
- Vacuum ranging from $10^{-9}$ to $10^{-12}$
- External manpower contribution possible
  ~6FTE in total
Being considered….no descision yet
For setting-up independent of PS complex
Injection at 100keV, acceleration (low energy operation to be established first ?)
2 possible locations:
• In injection line (space?)
• In new ejection line for reverse injection (no cooling)
External contribution possible
Thanks for your attention!