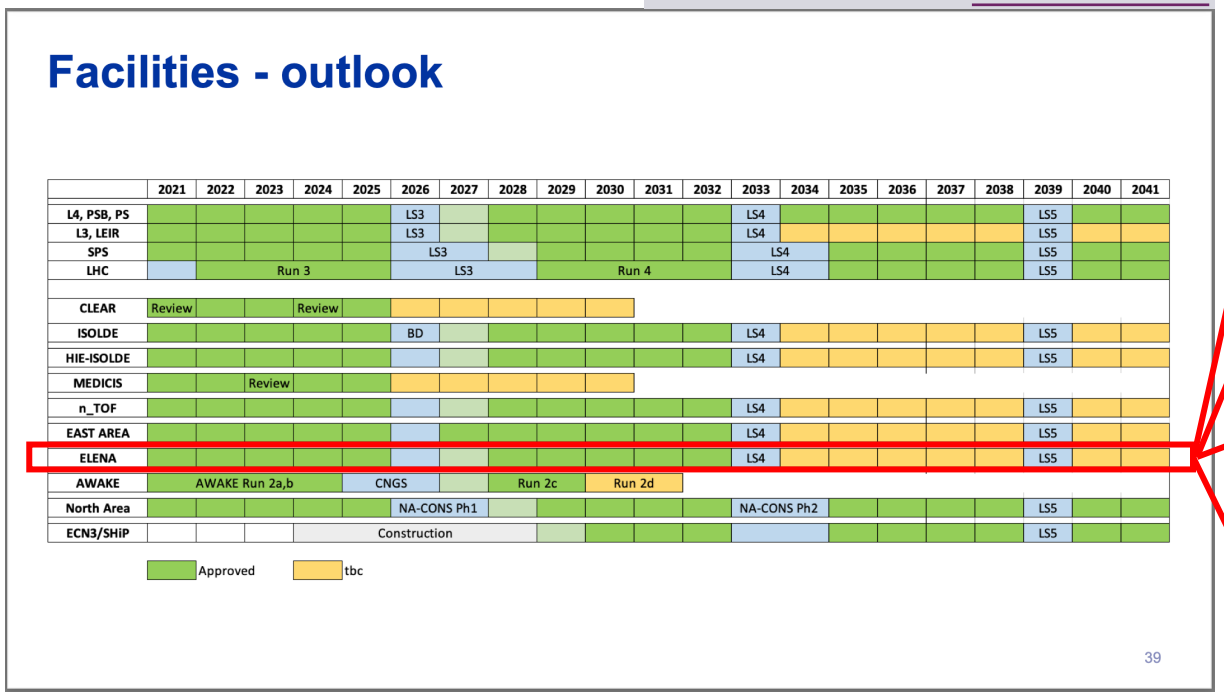
Possible future for AD/ELENA facility

Mike Lamont – June 2024



1. **The facility will <u>END in LS4</u>**
   - Let's discard this(?), assuming **community has enough to do** to justify the existence of AD/ELENA for the next 20 years…

2. **The facility continues <u>AS-IS till ~2042</u>**
   - CERN will need to **invest** in necessary **hardware renovations** (AD power converters, s-cooling, LHe…)

3. **The facility is <u>upgraded</u> in some ways, to run <u>at least till ~2042</u>**
   - **What do you need ?!**
   - **Requests must come "now"** to be studied and implemented in/by LS4

4. **There is the need for different / <u>new antimatter facility</u>**
   - Assuming this is **not known at this stage**

What we could expect (to be worked on…)

- **Proposals for “simple” experiments/modifications (discussed internally)**
  - E.g. **PAX@TELMAX** already “requested” (formal procedure for those kind of requests still to be set up)
  - **Change beam distribution** scheme (more/less bunches…)
- **Requests for “support” to be made to PBC @ CERN (as soon as possible)**
  - Study **the feasibility of having antideuteron** in AD/ELENA and/or a new facility ?
    - E.g. starting from a simulation/measurement of **antideuteron yield** measurement at **AD …**
  - Study the feasibility of **slow extraction from ELENA at 100 keV ?**
- **Experiment proposal over the next 20-years (to be submitted @SPSC 11-12 Feb 2025)**
  - It is assumed that several ideas already being drafted **by each single collaboration** (and new ones), assuming **AD/ELENA maintained AS IS**
  - This might include expressing **interest in antideuteron ?**
- **Requests for “minor” upgrades (to be “requested” @SPSC 11-12 Feb 2025)**
  - **Helium liquefier** on site (only possible after LS3) ?
  - **Slow extraction** from ELENA at **100 keV** (possibly during or just after LS3) ?
- **Requests for “major” upgrades (to be “requested” @SPSC 11-12 Feb 2025)**
  - **Higher flux pbar** production (x2 rep rate and/or x2 intensity) of H2bar production?
  - (Slow) extraction from AD and/or ELENA at **higher energy** ?
  - Study feasibility of **antideuteron deceleration** in AD/ELENA ?
- **Proposal requiring “new paradigm” (to be submitted @ESG by 31 Mar 2025)**
  - Proposal for **new facility** for **high intensity** and/or **high energy antiproton** and/or **antideuteron** studies ?
  - **White paper** proposed by the **ADUC** to **establish an overall program** (to be discussed at a user-organised workshop, as proposed by Stefan et al.)

Overview of “Independent” Upgrade Cases

- **Any of these (except TELMAX) will require well-defined physics experiment cases!**
- **The actual cost and feasibility of each option will be evaluated if/when requested**

External ”high energy” experimental hall?

TELMAX
Test Experimental Area

Higher pbar flux:
x2 on **rep rate**
x2 on pbar **intensity**

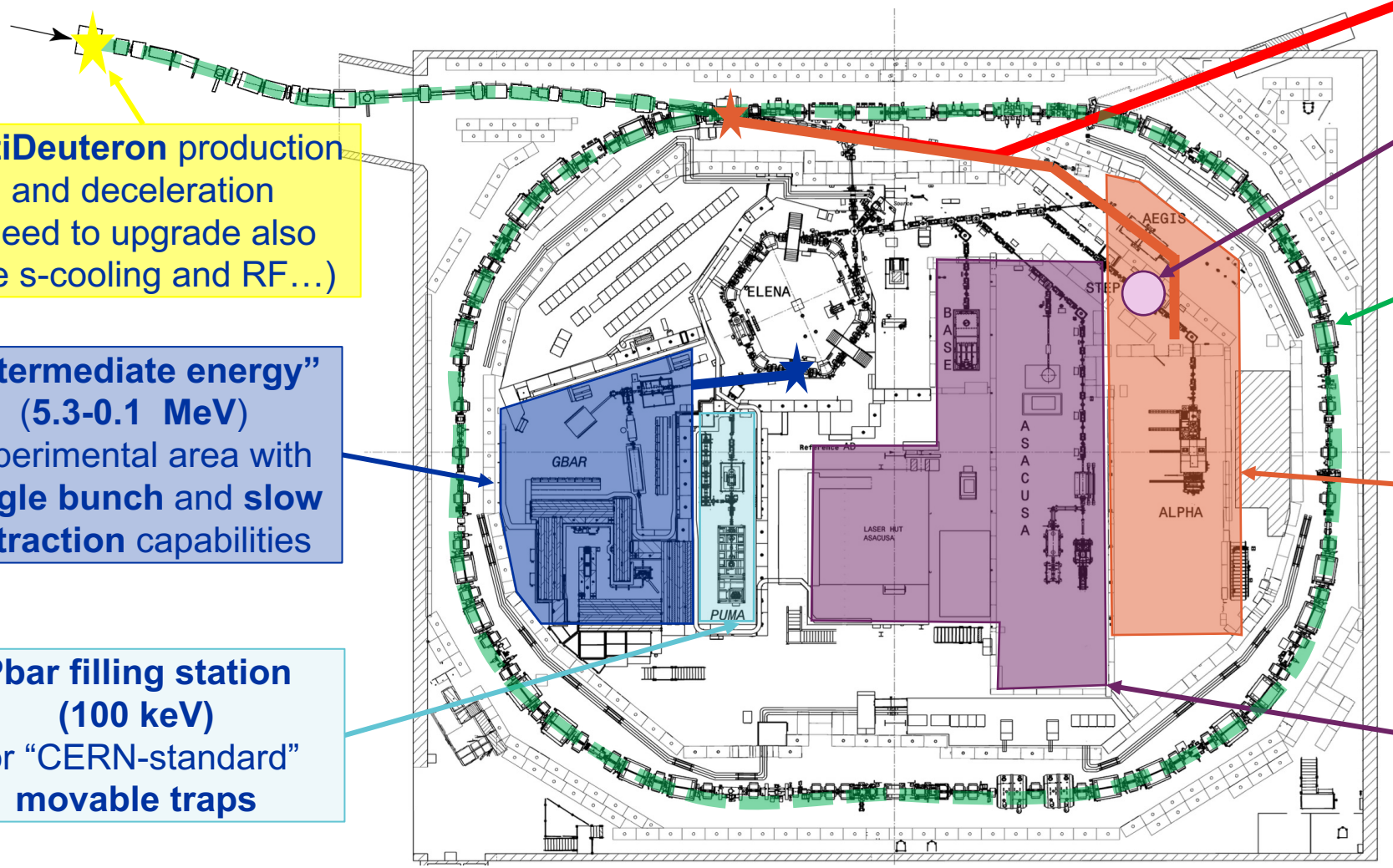
“High energy”
(**125-5.3 MeV**) Experimental area with **single bunch** and **slow extraction** capabilities

Low energy
(**100 keV**)
experimental area for present and new (e.g. H2bar) experiments

AntiDeuteron production and deceleration (need to upgrade also the s-cooling and RF…)

“Intermediate energy”
(**5.3-0.1 MeV**)
experimental area with **single bunch** and **slow extraction** capabilities

Pbar filling station
(100 keV)
for “CERN-standard”
movable traps



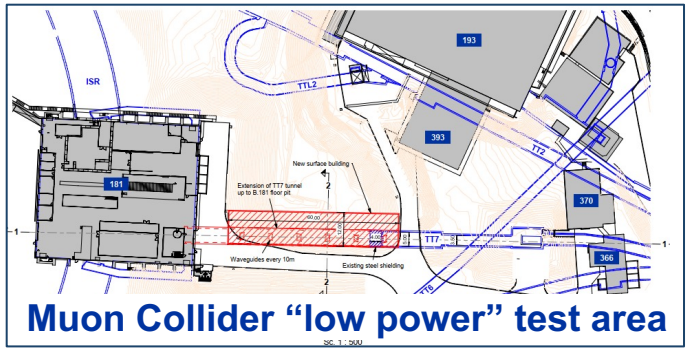
Appendix

Taking Action: Your Proposals are Awaited !

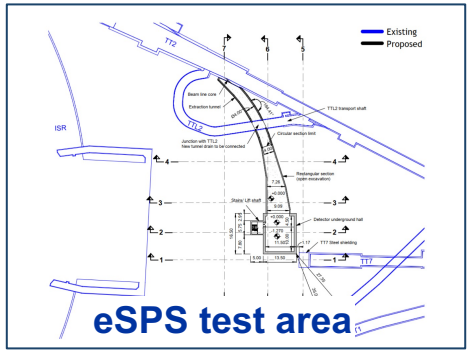
- **CERN SPSC – 11-12 February 2025 - link**
  - SPSC expecting **long-term (beyond LS3** and, **possibly, LS4) proposals** (call will be issued soon!)
- **European Strategy Update - 2026 - link**
  - Could be the place where to submit even **longer term** or **"new facilities"** (e.g. **antideuteron** at CERN, **high(er)-energy-related pbars physics**, …)
  - Written **inputs** expected **by 31 March 2025**
- **Note : major upgrades normally take place during Long Shutdowns :**
  - **LS3 (~2026-2028 for injectors)**
    - **Already too late** to propose **major upgrades** for AD/ELENA
    - **Maybe possible** to push for minor upgrades, e.g. **slow extraction from ELENA** at 100 keV **?**
  - **LS4 (~2033 for injectors)**
    - **Major consolidations** already expected (e.g. **power supplies**), **if facility approved** beyond LS4 …
    - "Last" chance for **major hardware upgrades of AD/ELENA**
      - (I suppose concrete requests, at least for studies, must be made by end of ~2025)

Bigger Exp. Area? e.g. 1000m^2 more?

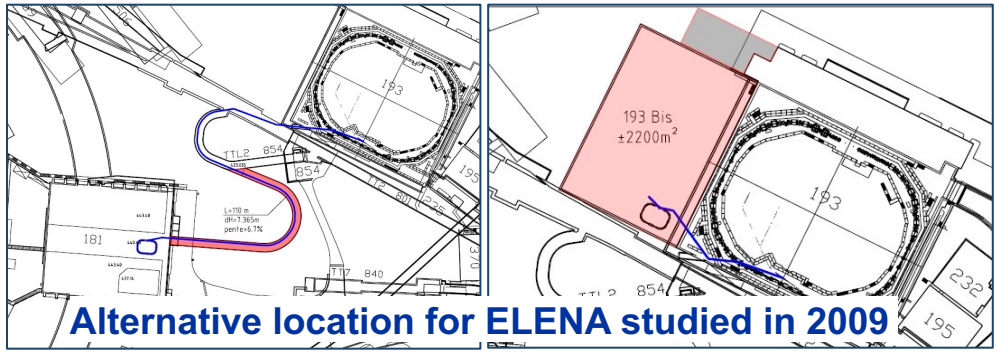
- **One must be looking outside of the AD hall, looking at other projects:**



Muon Collider "low power" test area

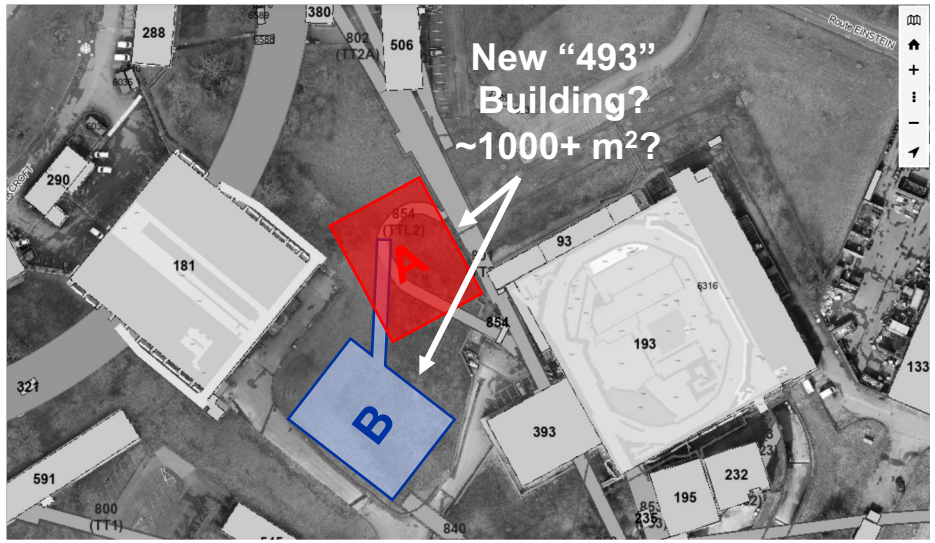


eSPS test area



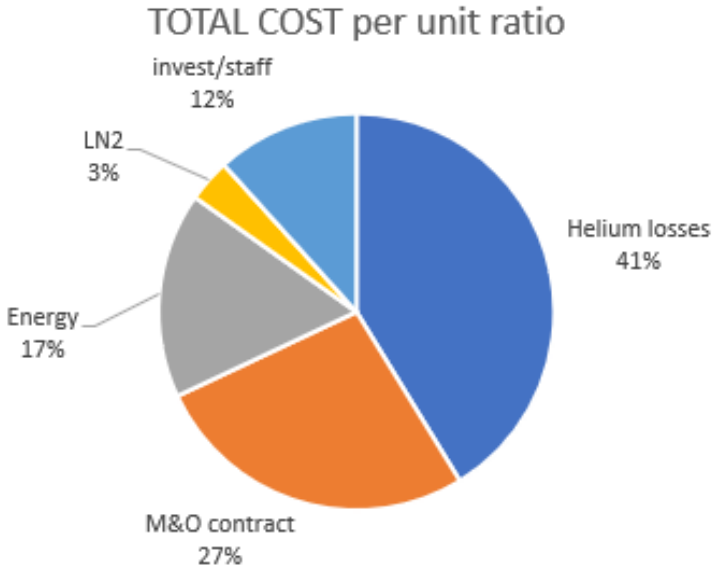
Alternative location for ELENA studied in 2009

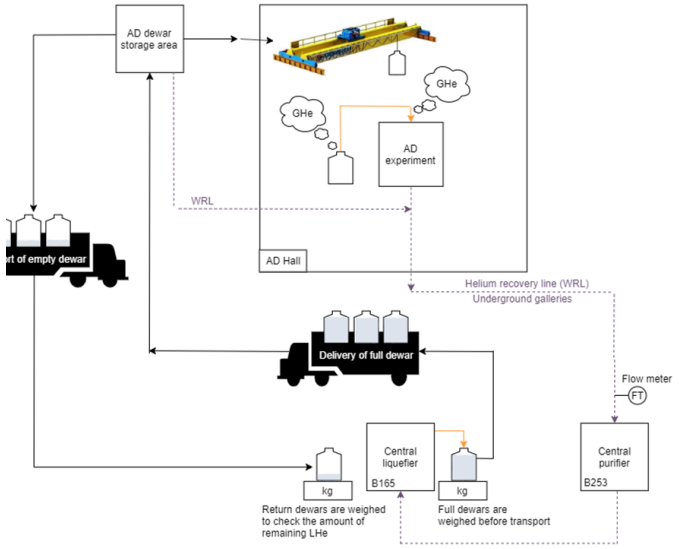
- **TTL2** is empty and **not useful**, today.
  - What about **new building** (493?) with semi-underground experimental area for "high energy" experiments?
  - It could take **protons** from PS, **pbars** (up to 3.5 GeV/c?) from AD, e$^-$ from **eSPS**?, used as **Muon Collider** "low power" test area? (e.g. A, B, …)…

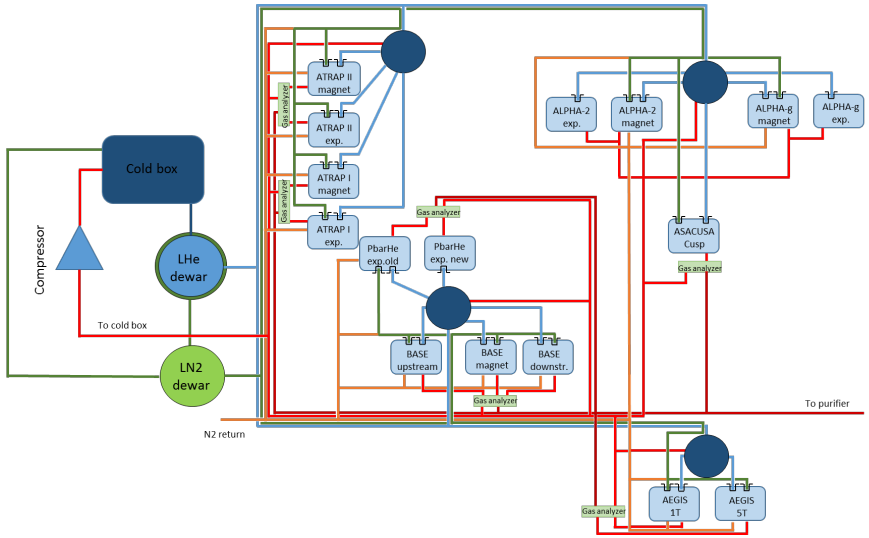


Users Helium Consumption

- **CERN cost in 2022: ~2 MCHF for ~700x500L dewars of LHe**
  - "Constantly" at 20 dewars/week delivery (CERN max capacity: 25 Dewars/week)
  - ~3140 m3/year of gHe (roughly 88 kCHF), mainly needed for pressurize Dewars for lHe transfer
- **Alternative cooling methods**, e.g. cryocoolers, **will require long/costly RD program**
- **Closed circuit system with local liquefier:**
  - **Addresses distribution** and **safety concerns,** offering a **more eco-friendly** solution!
  - **Cost 8.3 MCHF** + 8.5 FTE (only possible **after LS3**), **savings 0.6 MCHF/year!**



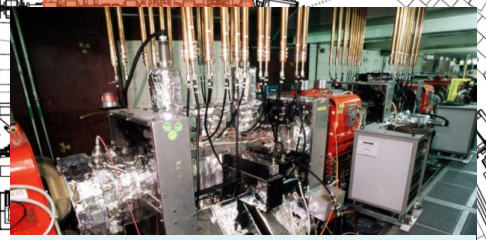




Hardware: Most Critical/Aged Items

Injection line magnets with high risk of breakdown and no spare

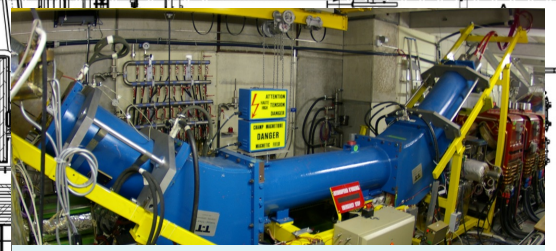
Outdated Power Converters



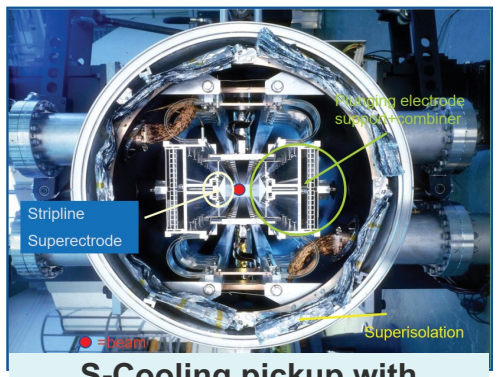
Critical reliability and spare availability for s-cooling kickers and power amplifiers

Outdated (and not very "green") cooling and ventilation systems

AD magnets consolidation being finalised



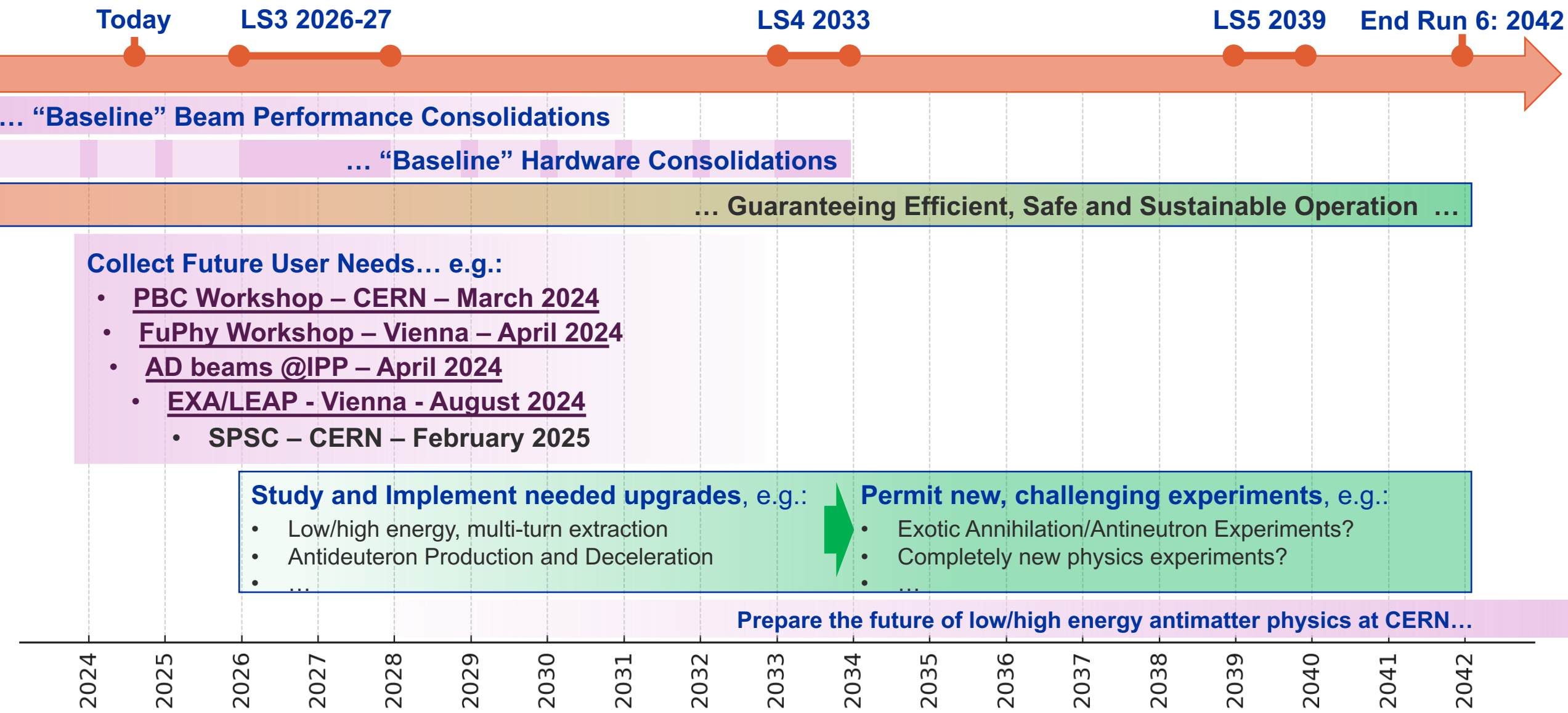
Outdated e-cooler design, critical in spare parts



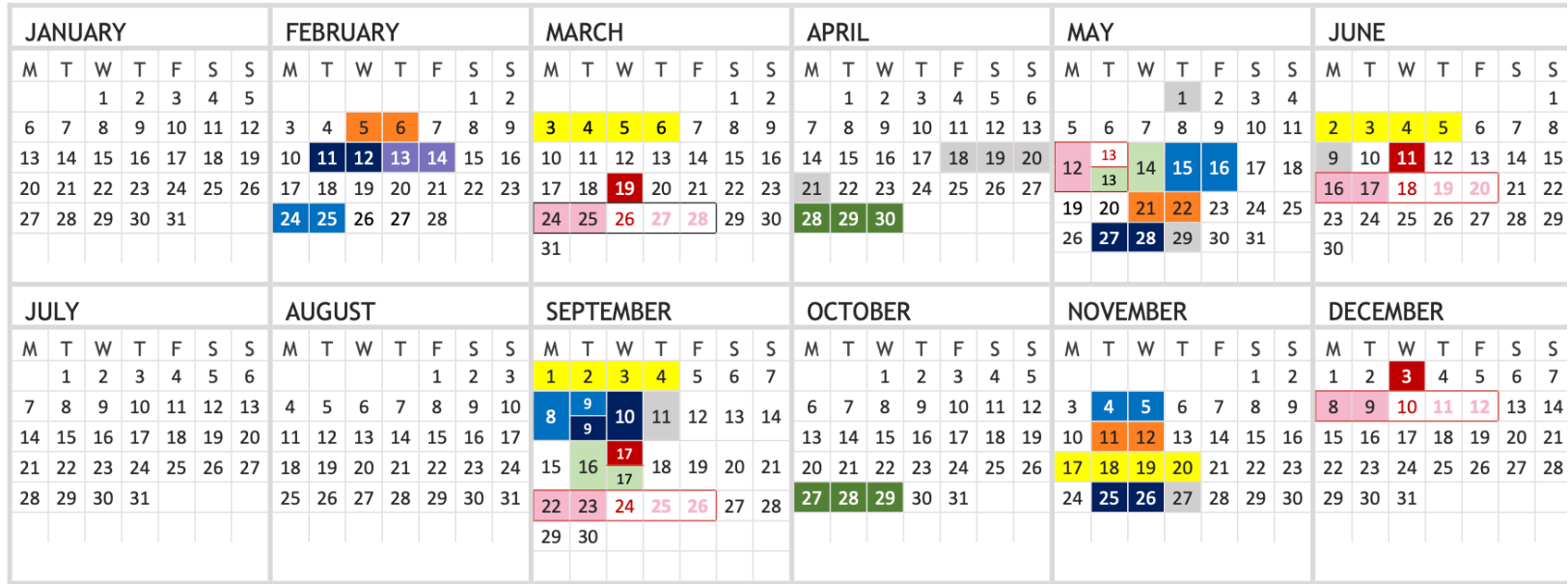
S-Cooling pickup with no spares, limited know-how

Outdated LLRF and HLRF for C10 cavities

Overall Long-Term Timeline Proposal



SCIENTIFIC COMMITTEES 2025



Experiment Committees

- RB — Research Board (CERN DG) (attended by Chairs of INTC, LHCC, SPSC)
- DRDC — DRDC Committee (T. Bergauer)
- INTC — ISOLDE and n_TOF Committee (M. Pfutzner)
- LHCC — LHC Committee (F. Simon)
- SPSC — SPS and PS Committee (J. Nash)
- REC — Recognized Experiments Committee (CERN Director for Research) (attended by Chairs of INTC, SPSC)

Resources

- RRB — LHC Resources Review Boards (CERN Director for Research)
- SG — LHC Resources Scrutiny Group (A. Frey)
- P2UG — ATLAS P2UG Meetings (S. Nahn)
- P2UG — CMS P2UG Meetings (M. Demarteau)

Council Meetings

- SPC — Scientific Policy Committee (attended by Chairs of INTC, LHCC, SPSC)
- FC — Finance Committee
- CC — Council meetings
- CERN Official Holidays (Thanksgiving 27 November 2025)

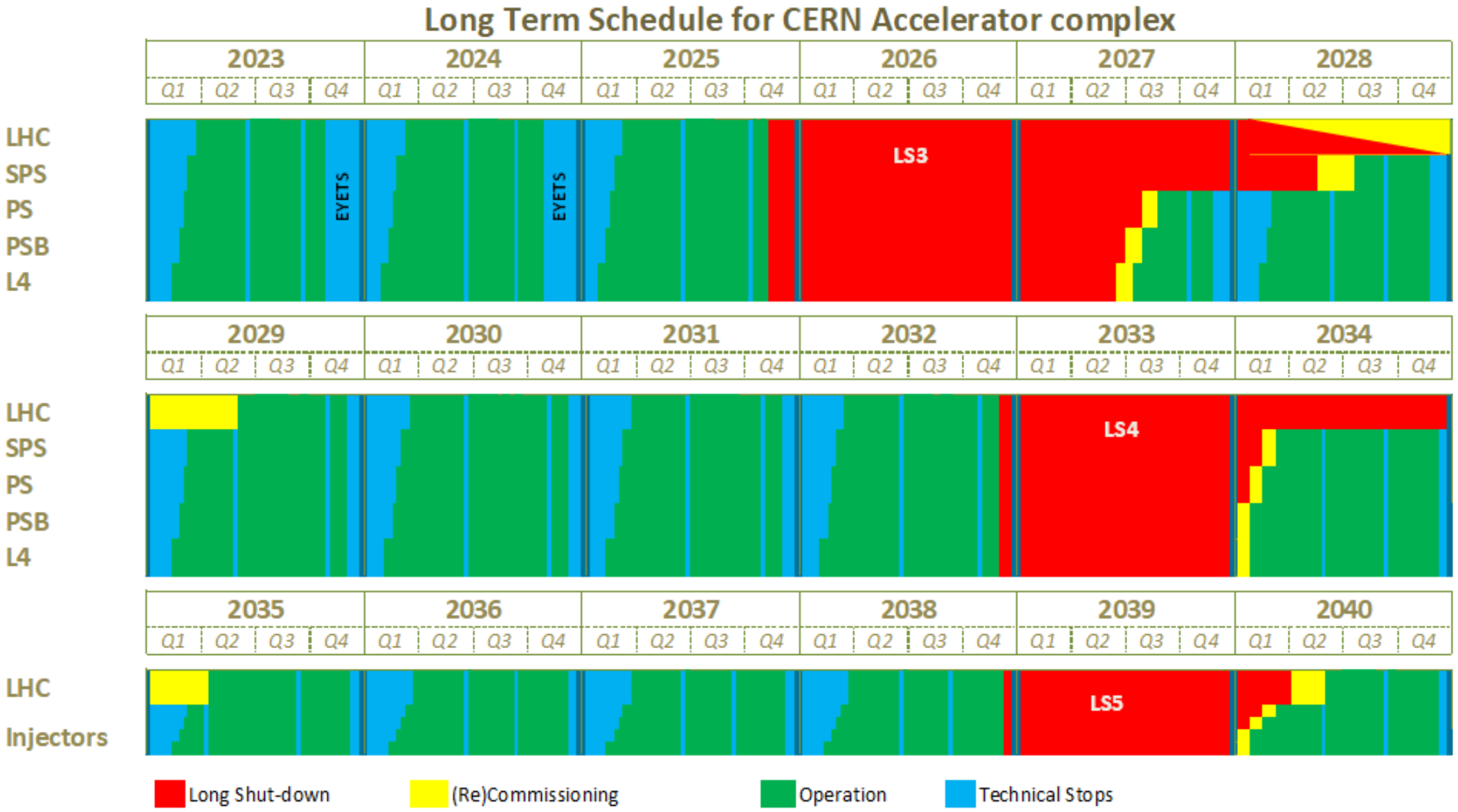
EP-AGS-SCS | 23 May 2024

From official web page

Timeline for the update of the European Strategy for Particle Physics

Proposed timeline for the European Strategy Update process

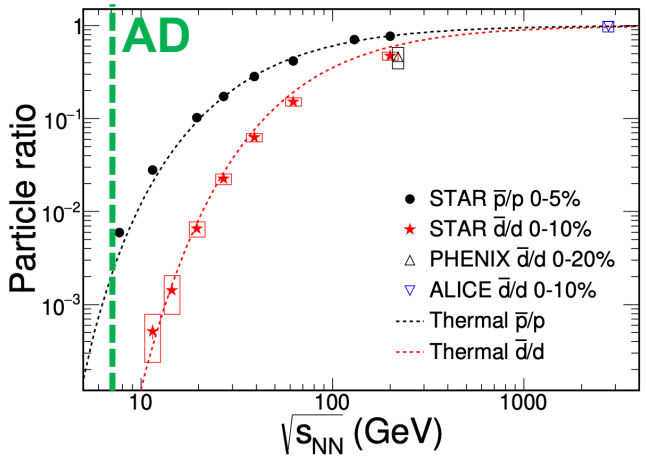
From official web page

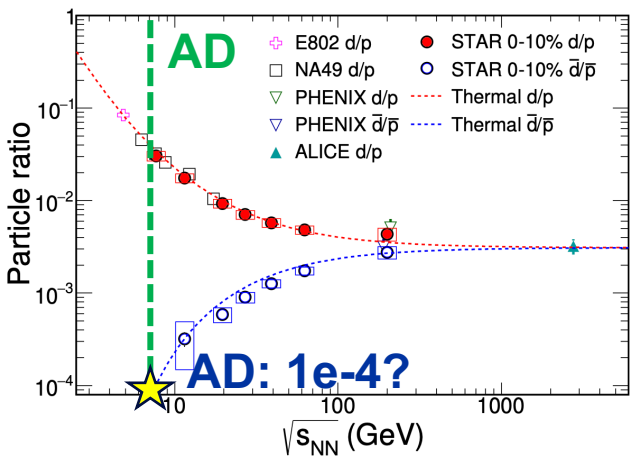

Long Term Schedule for CERN Accelerator complex
2023
2024
2025
2026
2027
2028
Q1 Q2 Q3 Q4
LHC
SPS
PS
PSB
L4
EYETS
EYETS
LS3
2029
2030
2031
2032
2033
2034
LS4
2035
2036
2037
2038
2039
2040
LHC
Injectors
LS5
Long Shut-down
(Re)Commissioning
Operation
Technical Stops

What about Antideuteron?

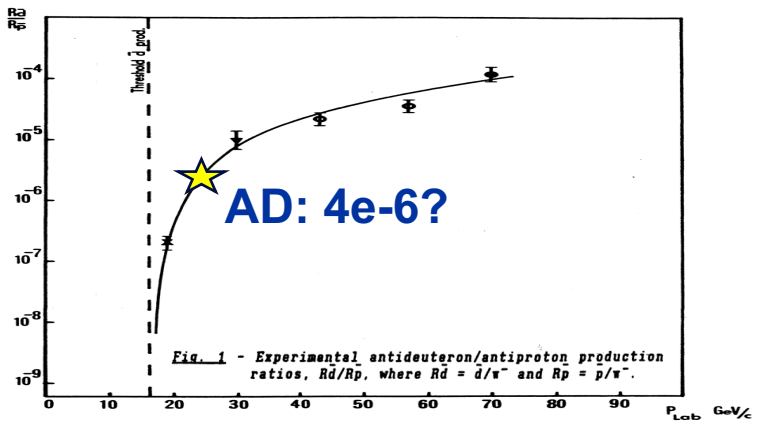
- **Maybe possible to have ~10 to ~1000 antideuteron at AD injection already today ?!**

J. Adam et al. – PhysRevC.99.064905





C.D. Johnson et al. – CERN-PS-88-05-AR



- So far, **not possible/being able to detect antideuteron in AD …**
  - Informally exploring the feasibility of a **single-particle Resonant Schottky detector in AD …**
- Still, assuming they could be decelerated/trapped, **would those numbers be interesting?**
  - **Note**: even if dbar found, **s-cooling** and **RF systems will require key modifications to allow deceleration!**

- **A new target and/or full facility might be required:**
  - A question that would **need to be addressed to relevant strategic bodies beyond AD/ELENA …**