

Intermediate Report on Summer Research At ALPHA

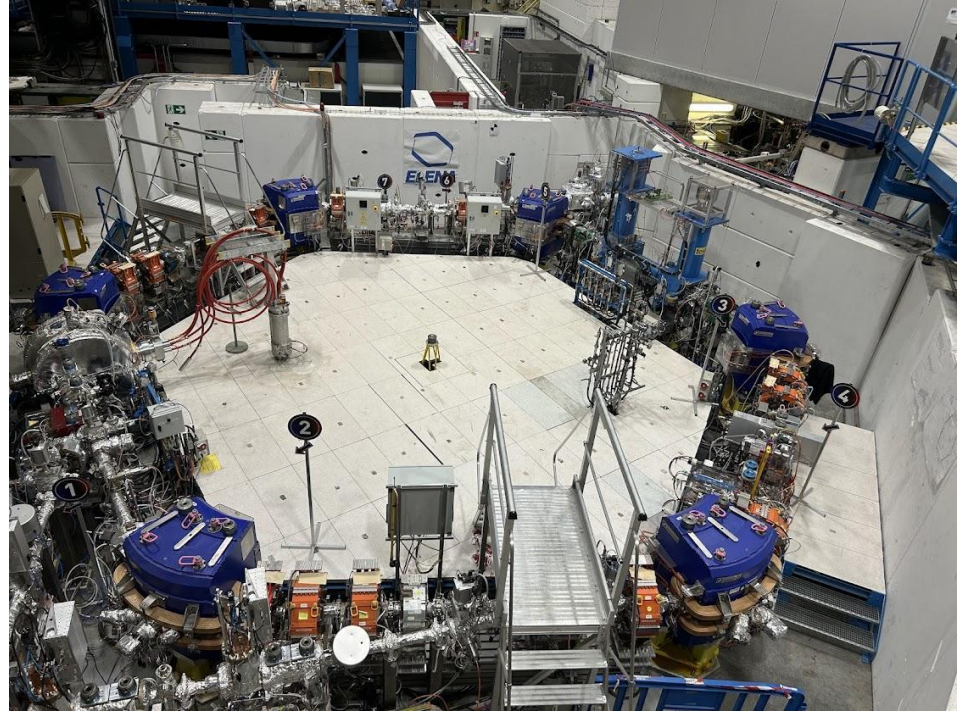
CERN Project

- Working on ALPHA this summer
 - Observing properties of anti-hydrogen
 - Working on hardware with Ina Carli
- Progress
 - Scintillators connected and logic done
 - Attended two shifts and learned about data taking at ALPHA-2



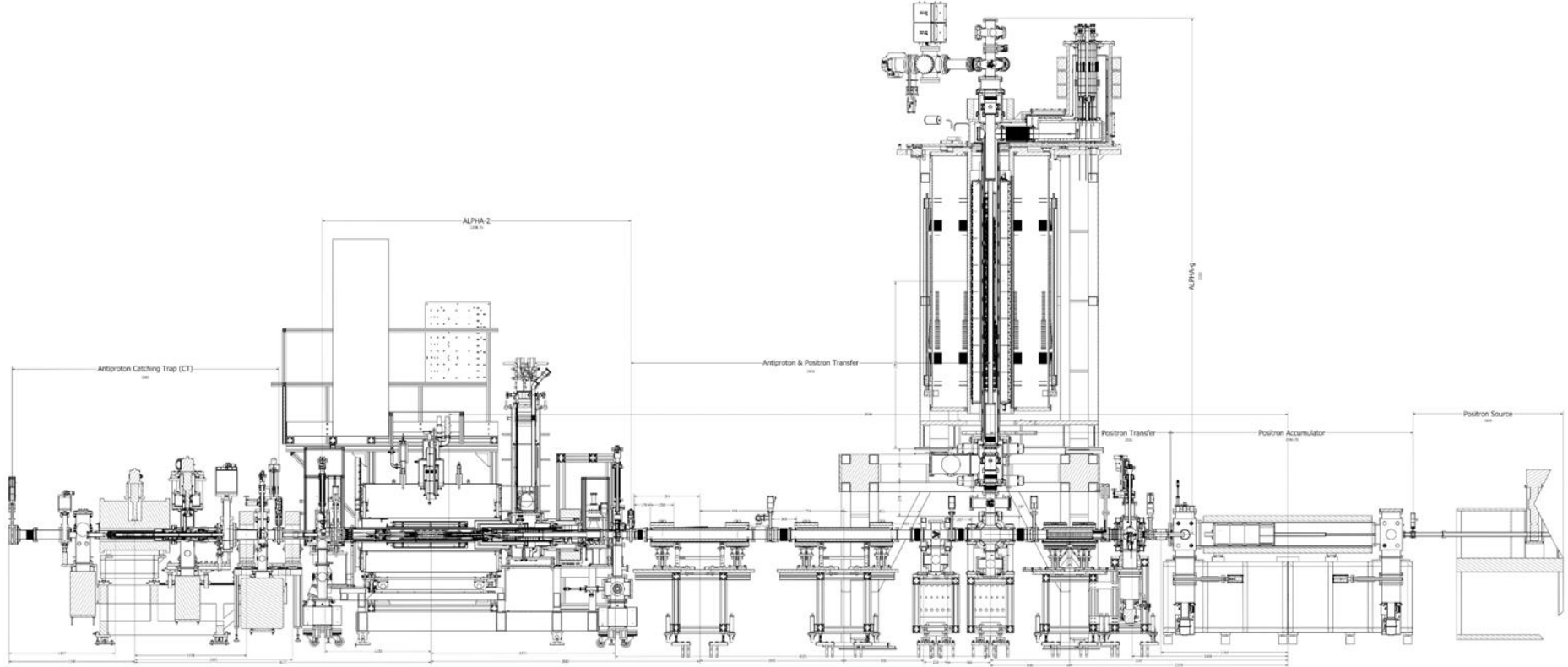
Production of antihydrogen: AD Hall and ELENA

- Antiproton Decelerator (AD) → slows down anti-protons from the Proton Synchrotron
- The Extra Low ENergy Antiproton ring (ELENA) slows down anti-protons even more
- The anti-protons are then injected into experiments in the AD Hall, including ALPHA



Production of antihydrogen: ALPHA

- Anti-protons are mixed with positrons from a radioactive source (Na-22) and stored using magnetic fields in Penning traps
- The anti-proton and positrons plasma is cooled by combining it with cold electron plasma for the anti-protons and nitrogen gas for positrons
- The plasmas are mixed together to form anti-hydrogen!
- They are further cooled with laser cooling (Doppler cooling)
- Anti-hydrogen used in two experiments at ALPHA: ALPHA-2 and ALPHA-g
- Produces around 150 antihydrogen atoms per mixing



Alpha-g

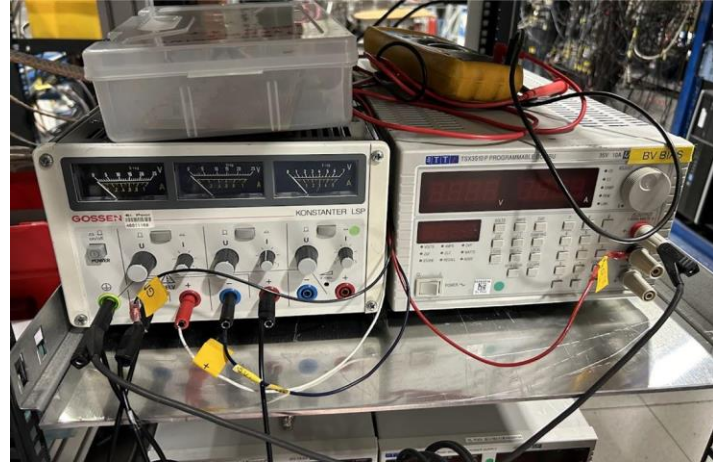
- Goal: measuring the g acceleration of antihydrogen atoms
- Antihydrogen released from magnetic wells and annihilate on the walls
 - The measurement of g is based on where the antihydrogen annihilates, taking into account the thermal energy of the atoms
- Annihilations are detected by scintillators placed around Alpha-g

Scintillators

- Plastic (polyvinyltoluene) scintillators with Silicon Photomultipliers (SiPMs)
 - Charged particle enters scintillator, excites electrons in the atoms. They then fall back to the ground state and release a photon
 - Photon is reflected within the scintillator and then arrives at one of the SiPMs, which amplifies the signal
- 4 rectangular scintillators are positioned around Alpha-g, more will be installed later
 - They are used for counting occurrences of annihilations

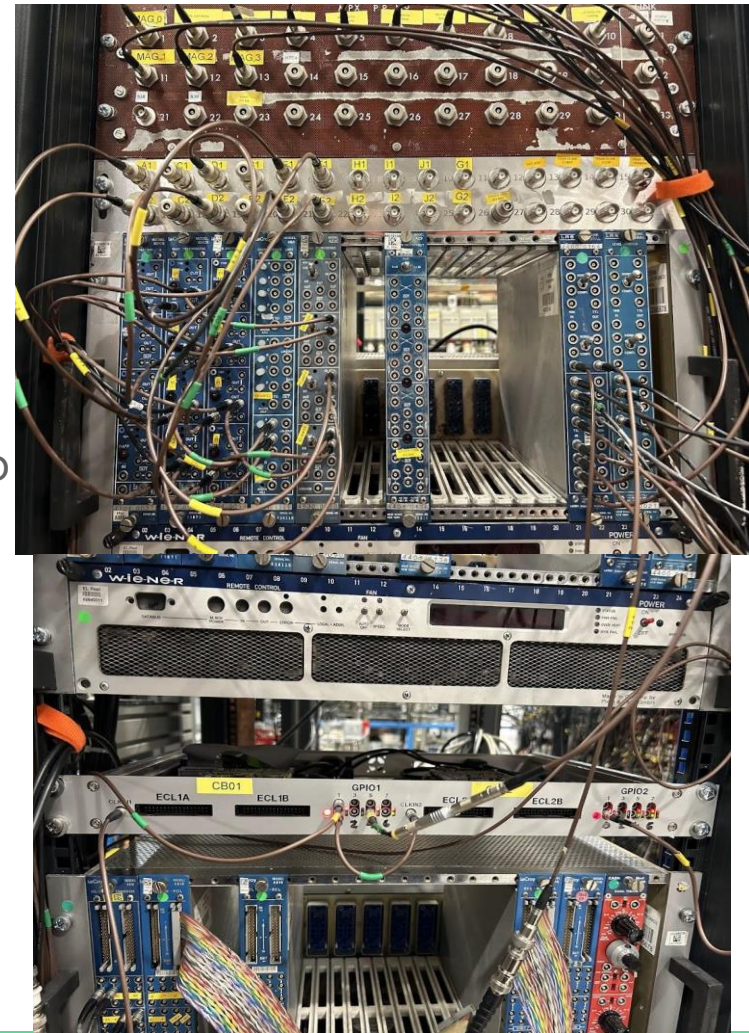
What has been done

- Four scintillators connected to modules
 - Two channels + power cables
- Set up power supply
- Connected cables to monitor the start and stop processes of various parts of ALPHA for time coordination



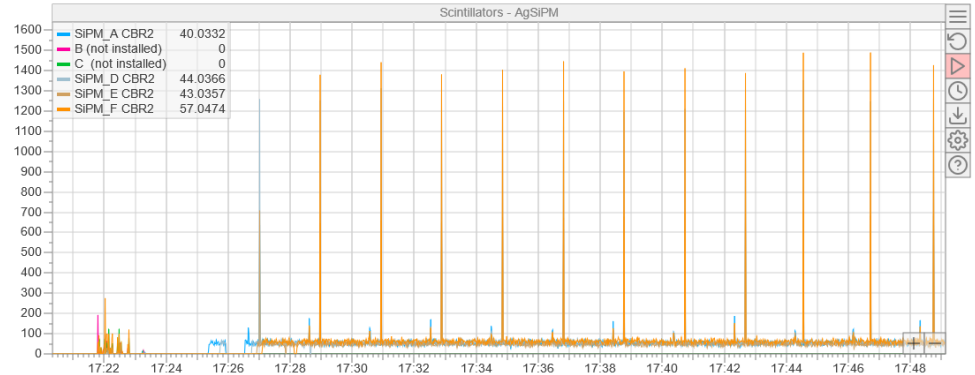
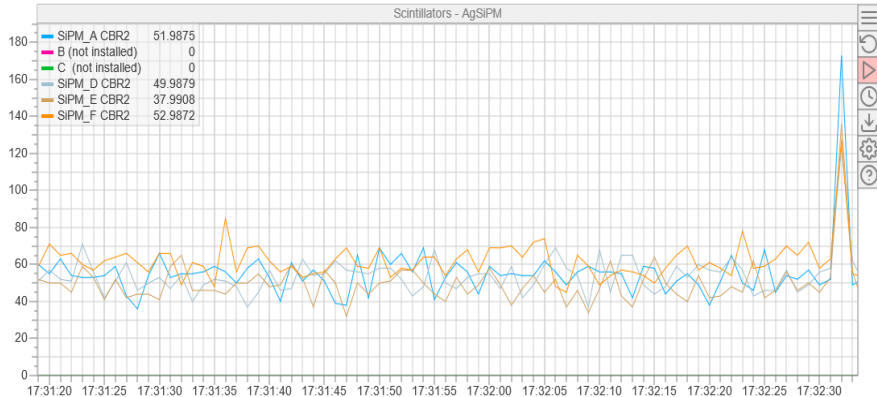
What has been done

- Logic
 - Pulse has to be at least 100 mV to be significant
 - Has to appear in both channels to be significant (coincidence)
- All pulses that are not noise are transmitted to another module and counted
- The data from the counter is transmitted to a master computer and compiled with other data in the experiment
 - Master computer also sets the time for the experiment



Results

- Scintillators properly wired
 - Detects cosmic rays (50 Hz)
 - Detects muons from antiproton injection from ELENA
 - Detects antiproton delivery



In Progress

- Finish last bit of wiring
- Compare current data of background signals with data from the last run (in 2022)

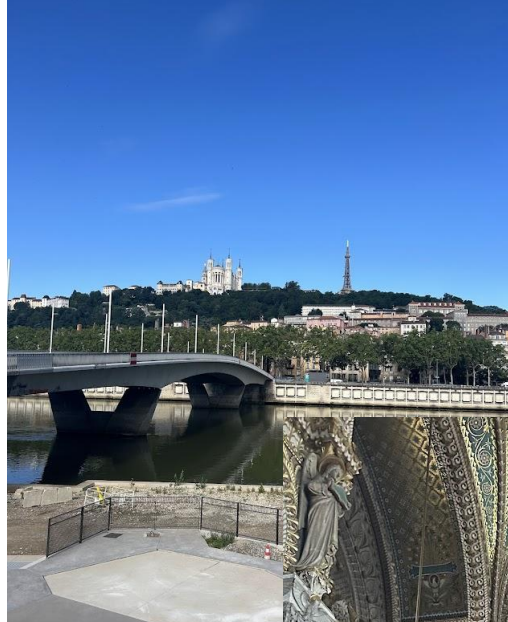
Culture

Geneva + Chamonix



Culture

Lyon



Culture

Rome

