



# A proposal for an experimental facility at CERN for research in hadron-therapy

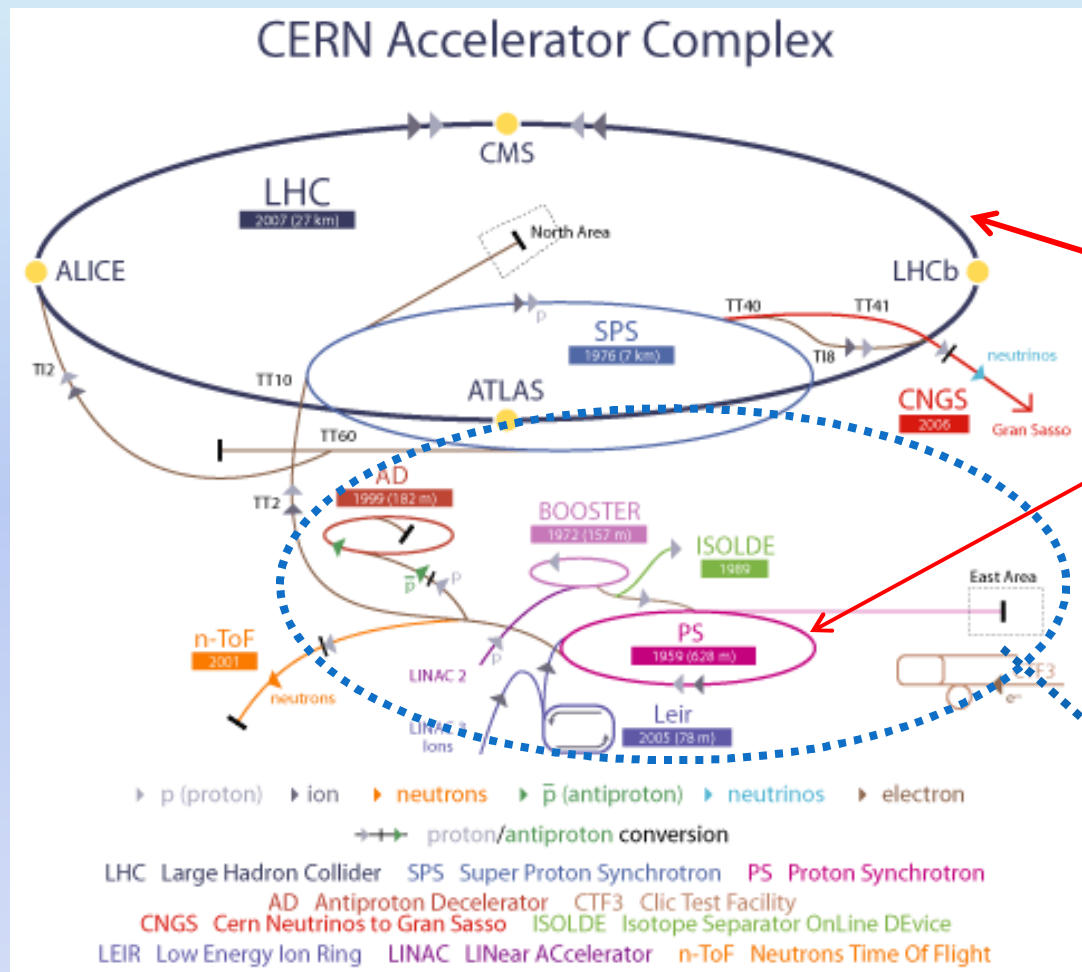
**U. Amaldi<sup>(1)</sup>, M. Dosanjh<sup>(2)</sup>, T. Eriksson<sup>(2)</sup>, S. Maury<sup>(2)</sup> and M. Silari<sup>(2)</sup>**

**<sup>(1)</sup> TERA Foundation, Novara, Italy**

**<sup>(2)</sup> CERN, Geneva, Switzerland**



# The CERN accelerator complex



**NOT TO SCALE!**

**LHC diameter = 8.5 km**

**PS diameter = 200 m**

We are looking at a facility located in the PS accelerator complex on the Meyrin site of CERN



# A research facility for hadron-therapy



## **Aim:**

To provide an experimental facility for research in

- ✓ radiobiology
- ✓ monitoring of medical irradiations
- ✓ dosimetry

with light-ion beams to European institutions involved with hadron-therapy

## **Baseline:**

Minimum impact on CERN main activities

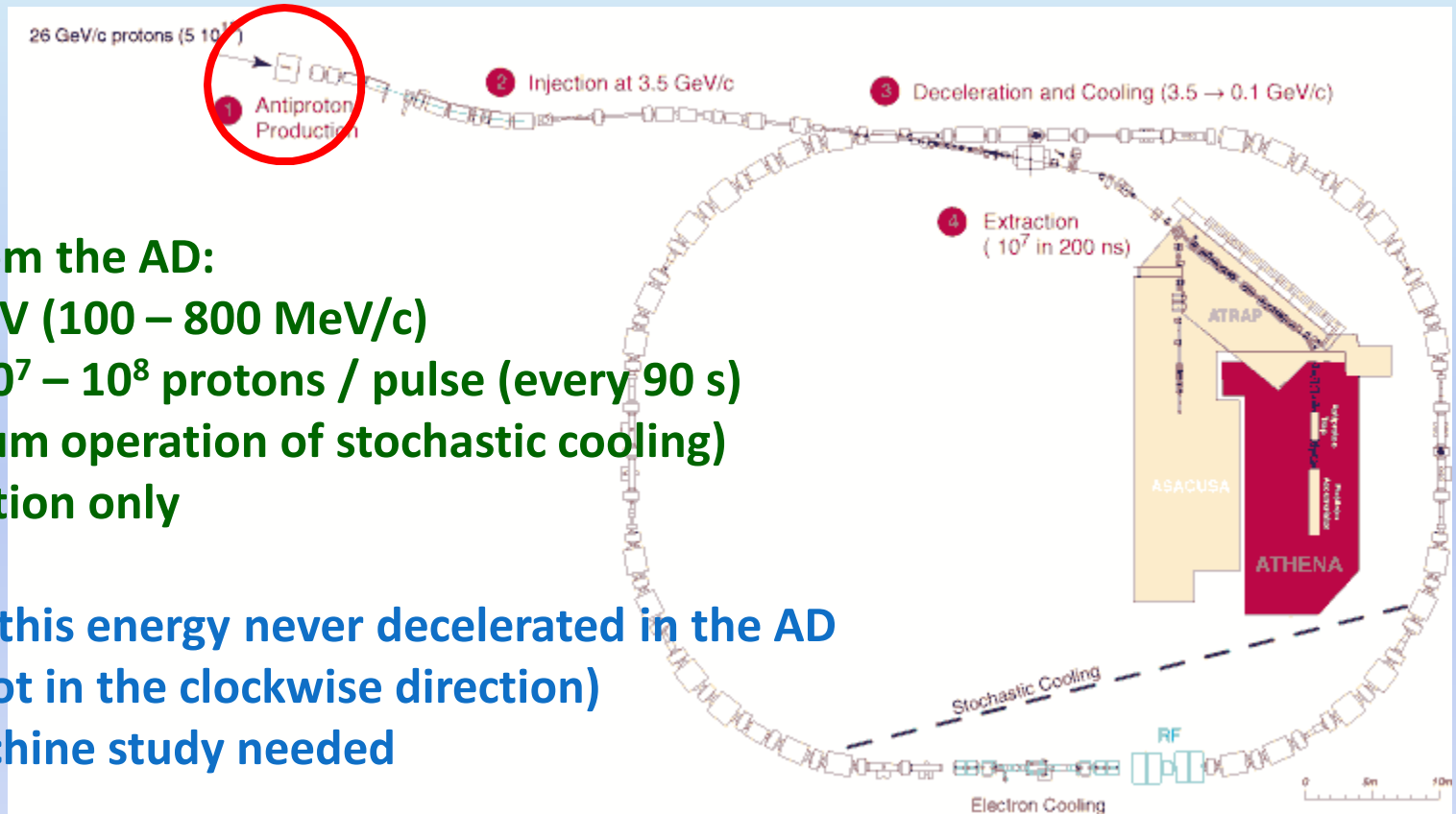
## **Options considered:**

Protons (rather than antiprotons) from the AD

Carbon ions from the AD

Carbon (and other) ions from the AD, LEIR or the PS

# The Antiproton Decelerator (AD)



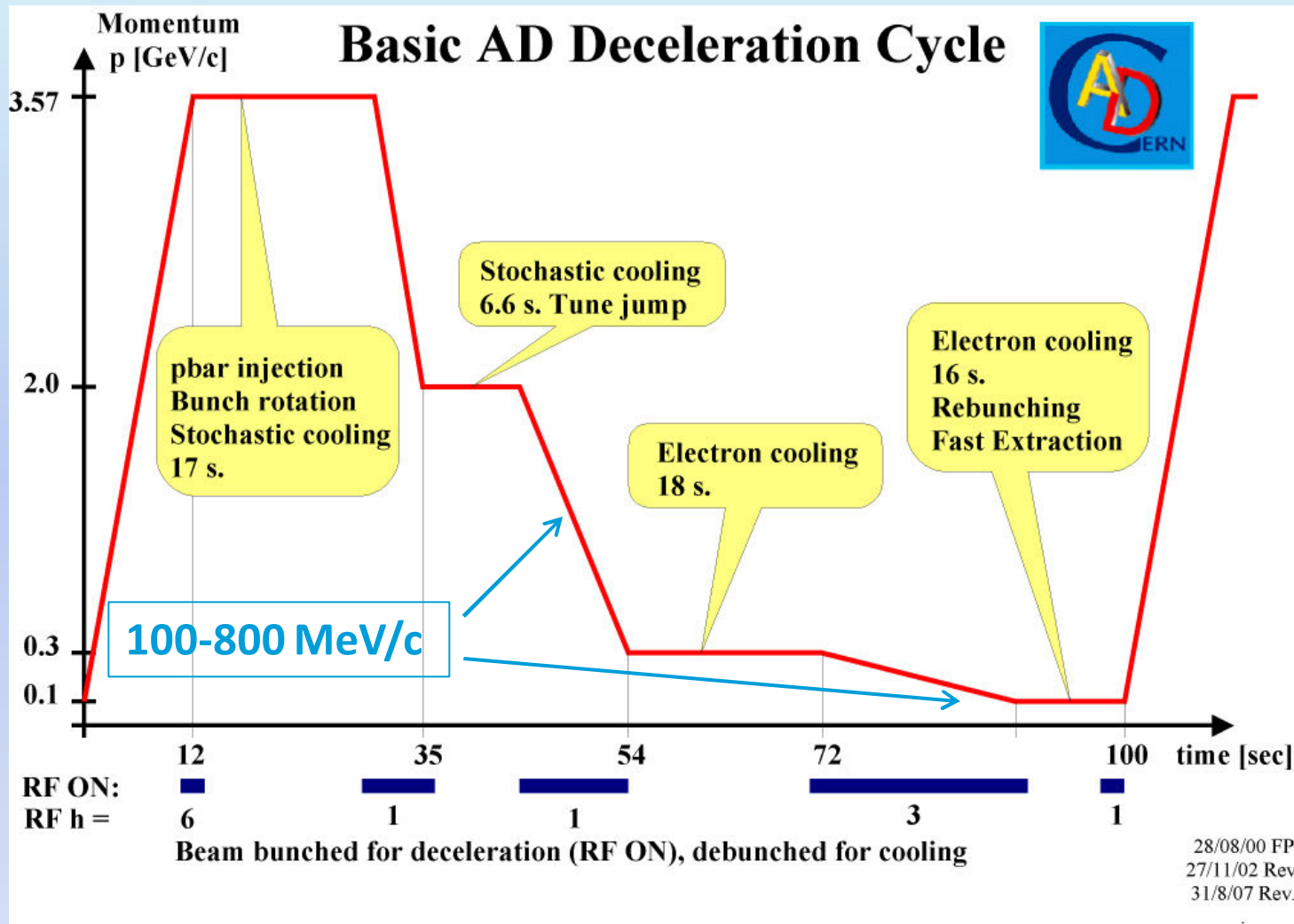
Protons from the AD:  
5 – 300 MeV (100 – 800 MeV/c)  
Intensity  $10^7$  –  $10^8$  protons / pulse (every 90 s)  
(for optimum operation of stochastic cooling)  
Fast extraction only

Protons of this energy never decelerated in the AD  
(at least, not in the clockwise direction)

➡ machine study needed

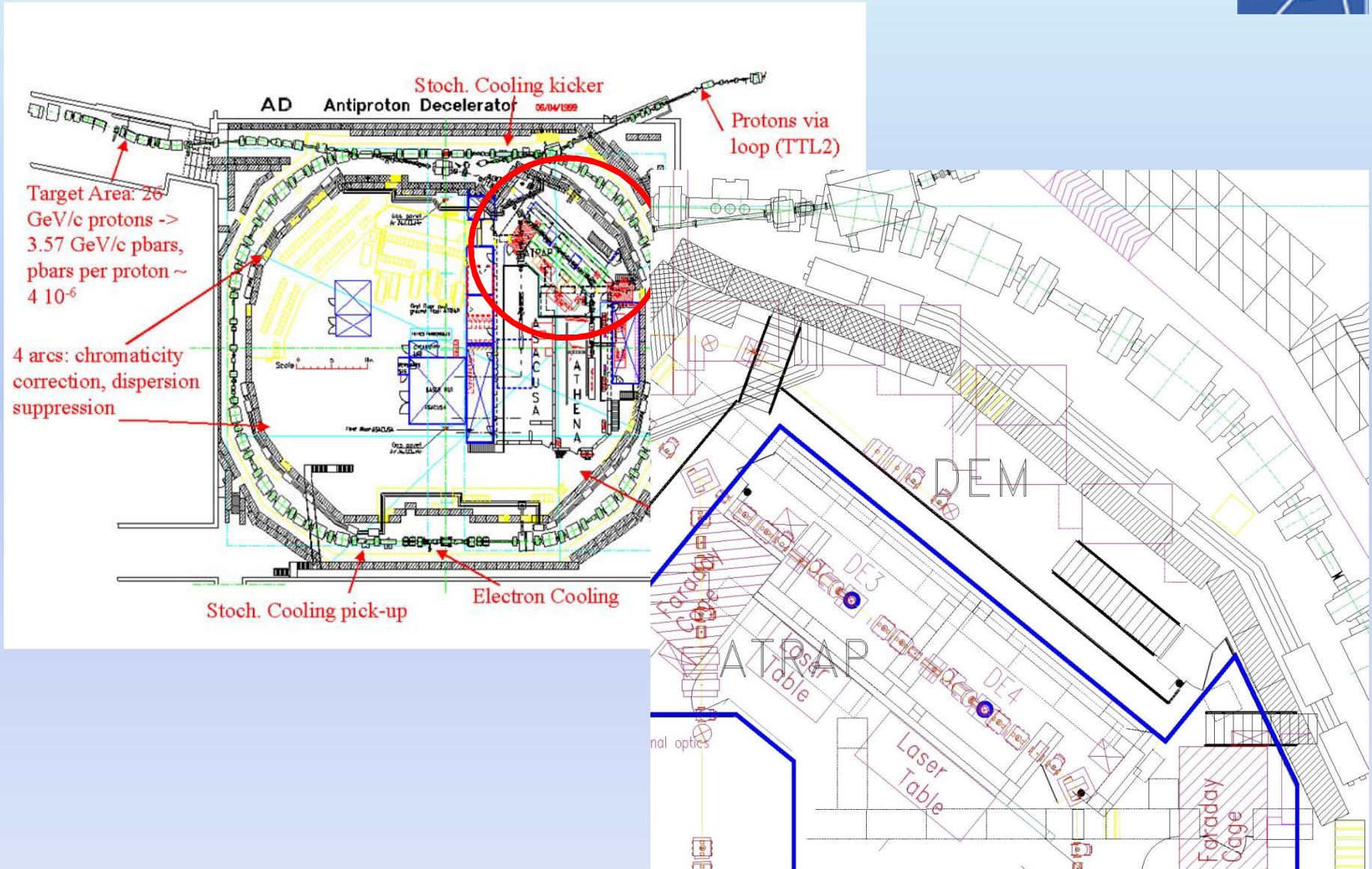
- Remove **antiproton production target**
- Change magnet polarity in the PS-AD injection line downstream, in the AD ring and in the extraction line from the AD → **easy**

# The AD deceleration cycle

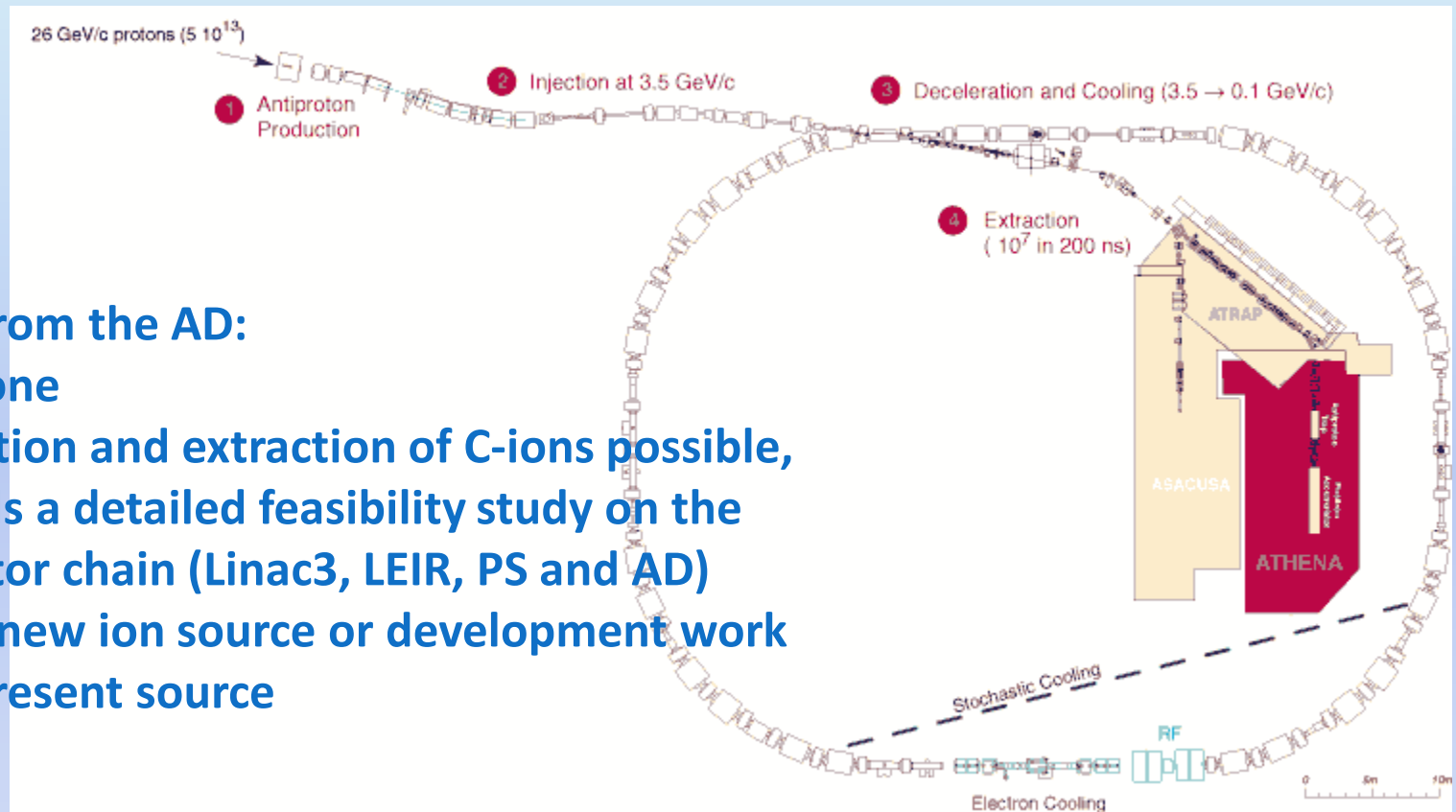


Extraction of protons from the PS at momentum lower than 3.5 GeV/c can possibly be studied

# The AD experimental areas



# Carbon ions from the AD

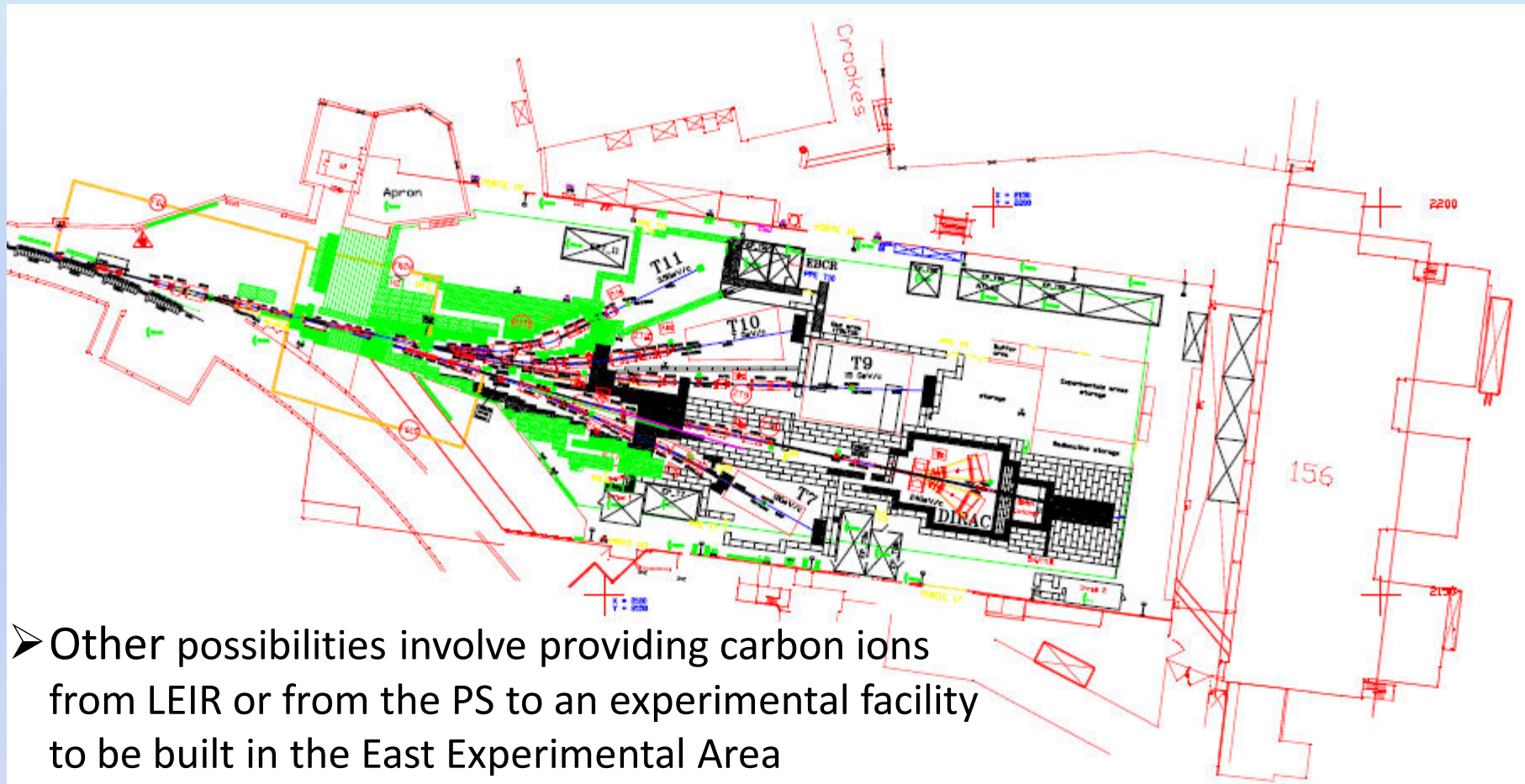


## $^{12}\text{C}^{6+}$ ions from the AD:

- Never done
- Acceleration and extraction of C-ions possible, but needs a detailed feasibility study on the accelerator chain (Linac3, LEIR, PS and AD)
- Needs a new ion source or development work on the present source



# The PS experimental areas (East Hall)



- Other possibilities involve providing carbon ions from LEIR or from the PS to an experimental facility to be built in the East Experimental Area
- Low-energy C-ions can be provided by LEIR, but a study (and money!) needed for higher energies

# A three-stage scenario?



- Phase 1** (3-years), provide 100 – 300 MeV protons from the AD, offering beam time for the experiments in the range one to two months per year
- Phase 2** In parallel, carry out a detailed feasibility study for providing 100 – 400 MeV/u  $^{12}\text{C}^{6+}$  beams from either the AD, LEIR or PS, from the fourth year onwards
- Phase 3** Assess the feasibility to set-up a dedicated experimental facility served by the AD – *once the antiproton program has been terminated* – to provide various light ion beams (alpha particles to carbon or oxygen) from a few MeV/u to about 400 MeV/u.

Studies are currently ongoing at CERN for the production (for the LHC) of other ions such as Ar and Xe, in case in the future these may be of interest for medical purposes



**We hope that this proposal can be of interest to the international scientific community**

**We ask interested groups to inform one of the authors of their intentions and their needs, so that a written document can be submitted to the CERN management**