



Engineering Department



# **Possibility for irradiated beryllium at CERN**

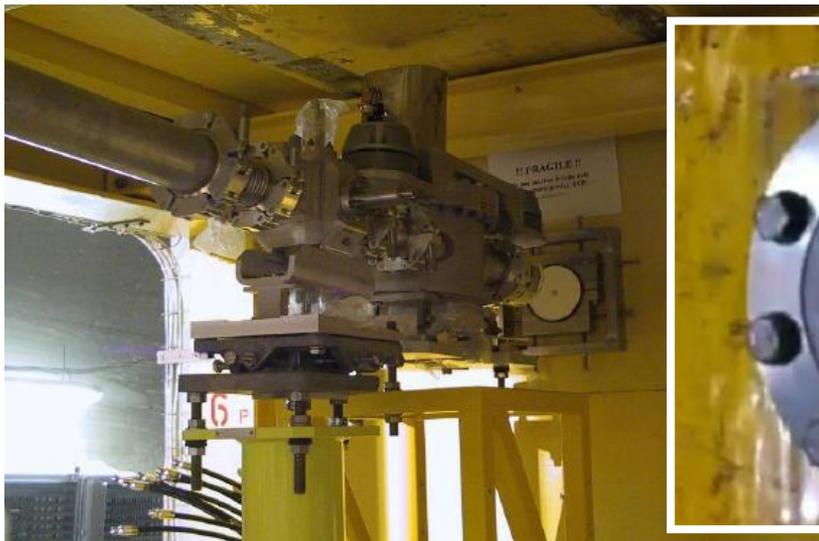
*RaDIATE meeting, 22<sup>nd</sup> July 2013*

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Sources, Target and Interactions Group)

- ▶ Two possibilities exist at CERN to obtain irradiated beryllium for testing:
  - ▶ beam windows, and in particular the last window of the CNGS primary beam line
    - ▶ 400 GeV/c p beam, pulse length 10.5  $\mu$ s (2x 50 ms), rep. rate 6 sec. (*fast extraction*)
  - ▶ SPS primary targets, used for secondary beam production for test beams and experiments (e.g. NA61, COMPASS, etc.)
    - ▶ 400 GeV/c p/ion beam, pulse length 4.8-9.6 s, rep. rate 14.4-39.6 s (*slow extraction*)

## CNGS Be windows

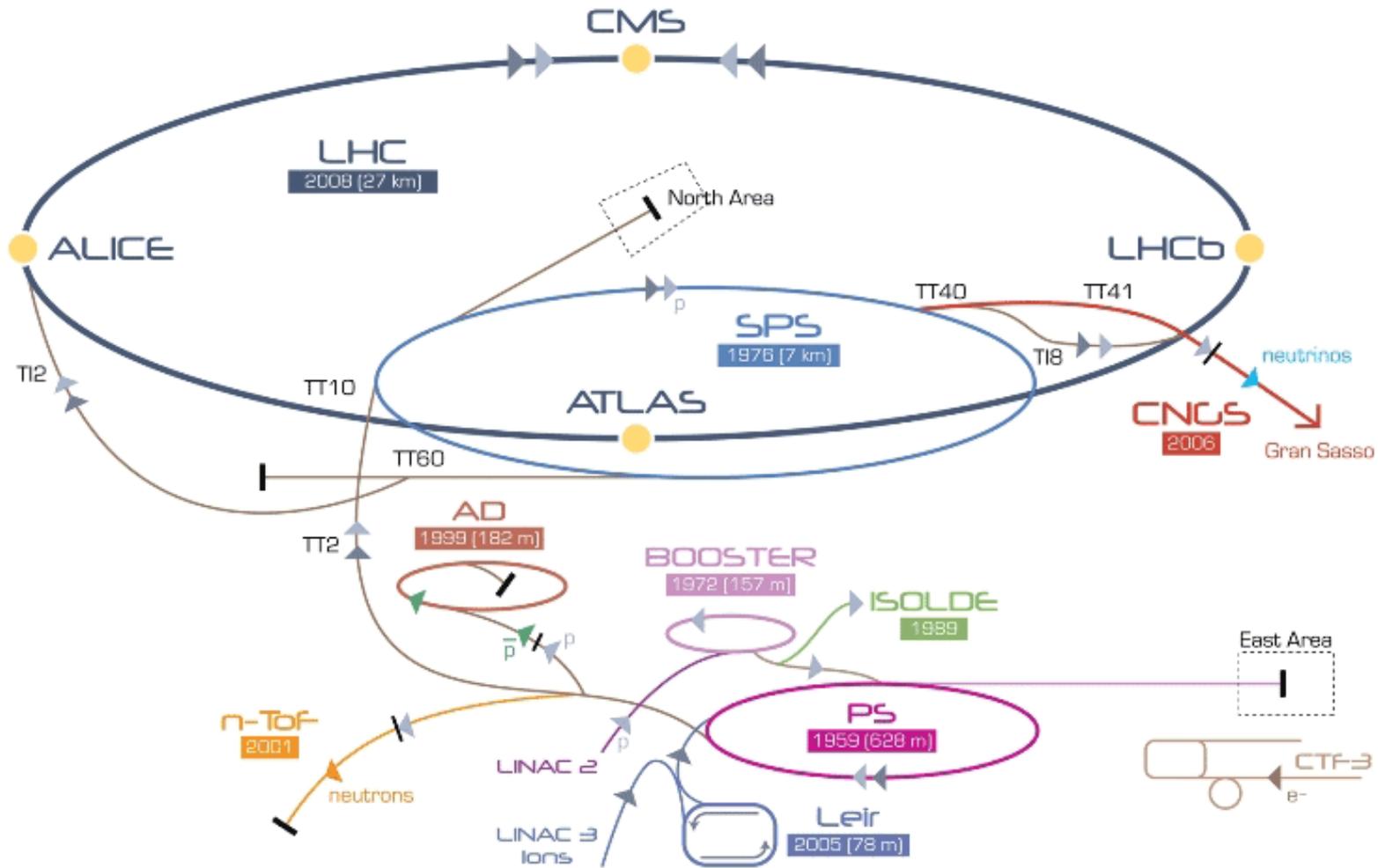
- ▶ 250  $\mu\text{m}$ , 70 mm  $\varnothing$  on 114 mm flange – PF-60 diffusion bonded
- ▶ Downstream end of the proton beam-line, just in front of the CNGS target shielding assembly
  - ▶ March 2011 before start-up (after  **$1.434 \cdot 10^{20}$  POT**)
  - ▶ April 2012 after  $\sim 2$  weeks of beam (after  **$4.9 \cdot 10^{19}$  POT**)
- ▶ 400 GeV/c beam spot at flange  $\sim 0.5$  mm  $1\sigma$



- ▶ At that time the vacuum group declared them as radioactive waste ( $>300 \mu\text{Sv/h} = 30 \text{ mrem/h}$ ) 
- ▶ Most of the residual dose comes from the inox flange and not from the Be itself
- ▶ The DPA range is in the order of **~1 DPA** in the central part
- ▶ The windows are presently in the temporary waste storage at CERN
  - ▶ Recuperation will be tempted at the **beginning of 2014**
  - ▶ Unfortunately RP service does not insure the integrity of the windows as they have been declared as waste 
- ▶ **If cut or decoupling possible, shipping should not be a problem**

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# CERN accelerator complex (2012)



# Secondary particle beams at CERN

- SPS – North Area**
- ▶ Secondary hadrons and electron beams
  - ▶ Ion beams
  - ▶ K and  $\mu$  beams
  - ▶ Attenuated primary proton beams

- CNGS**
- ▶ Long-baseline neutrino beam
  - ▶ CERN to LNGS (730 km)

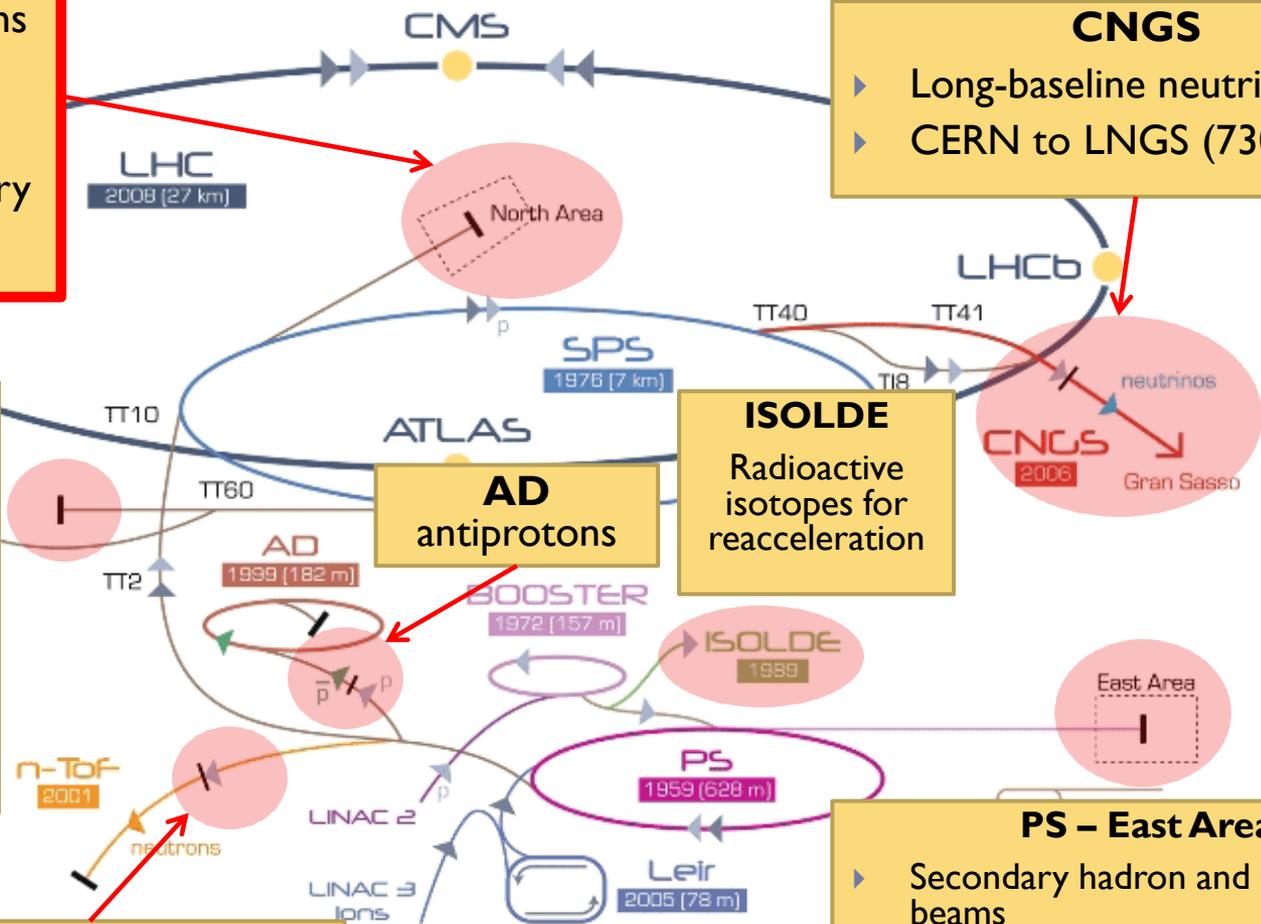
- SPS – West Area**
- ▶ Secondary hadrons and electron beams
  - ▶ Ion beams
  - ▶ Wide and narrow band nu-beams
  - ▶ Hyperon beams
  - ▶ Attenuated primary proton beams
  - ▶ Decommissioned in 2004
  - ▶ From 2012 HiRadMat

- ISOLDE**
- Radioactive isotopes for reacceleration

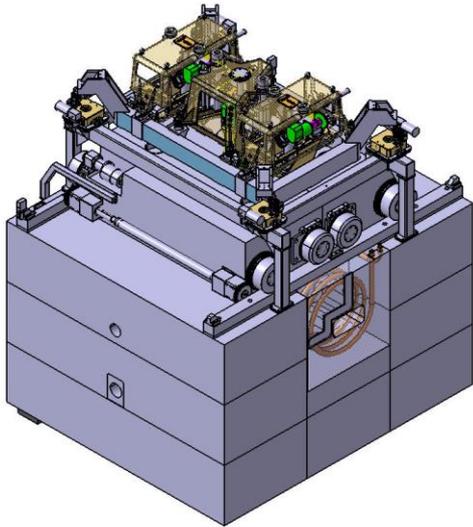
- AD antiprotons**

- PS – East Area**
- ▶ Secondary hadron and electron beams
  - ▶ Attenuated primary proton beam

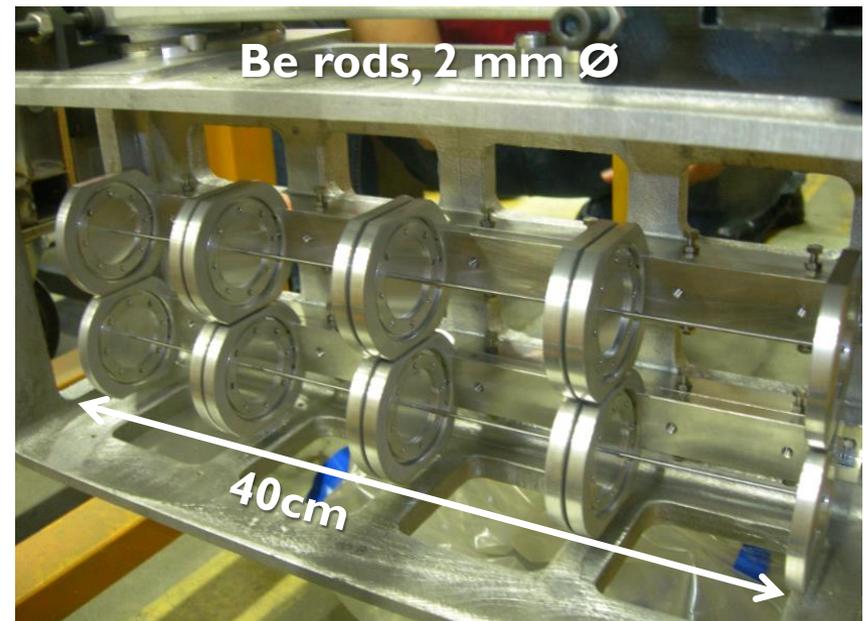
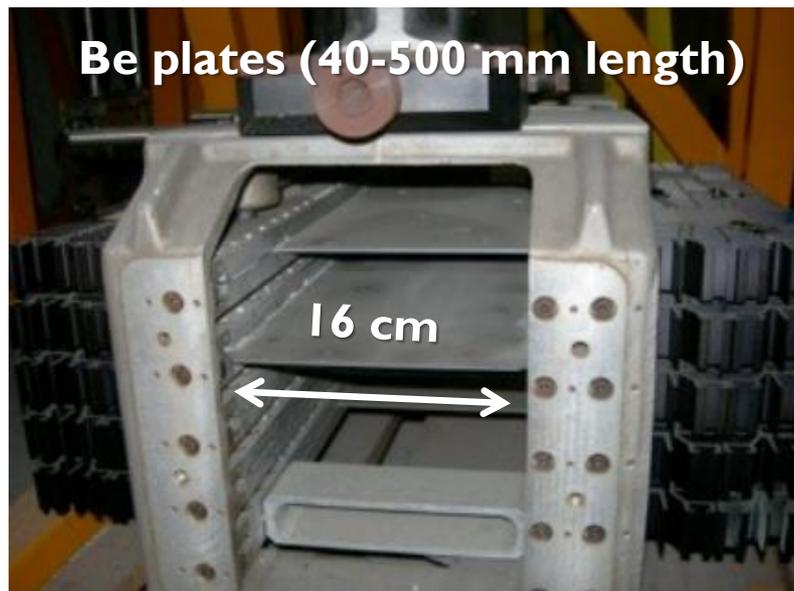
- n\_TOF**
- ▶ Spallation neutrons for TOF measurement



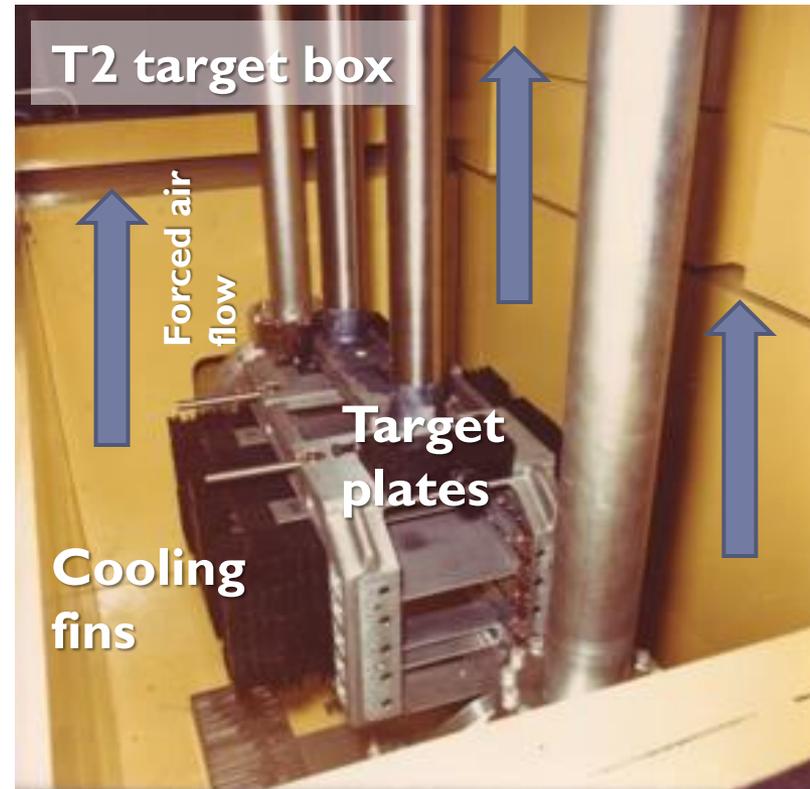
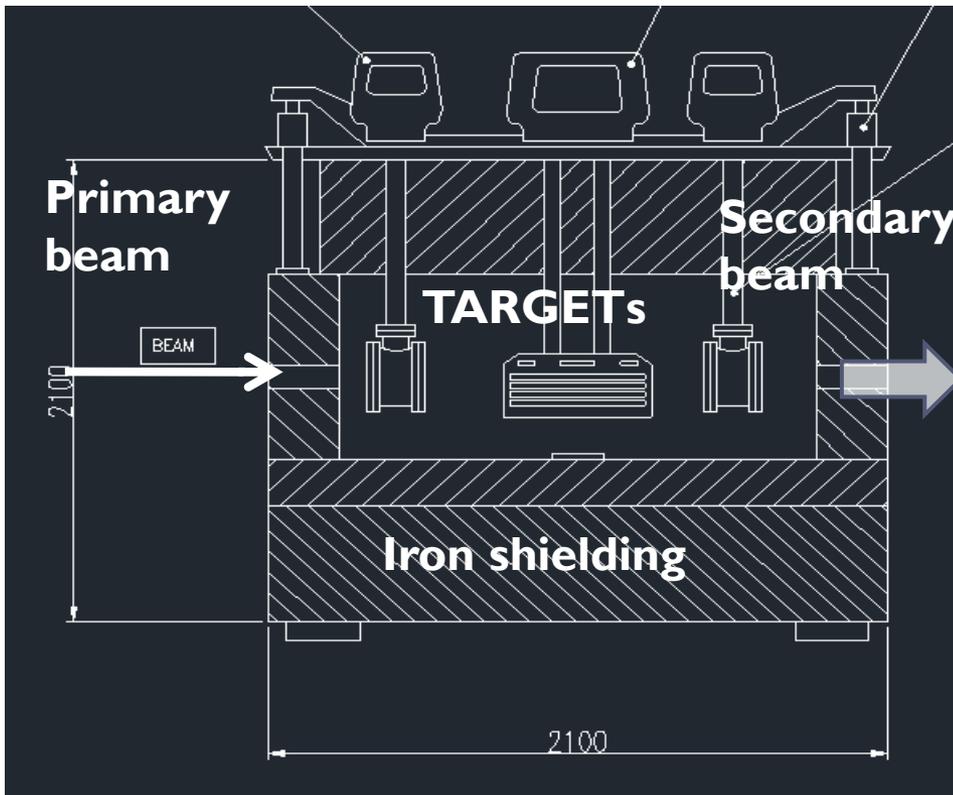
# North Area primary targets

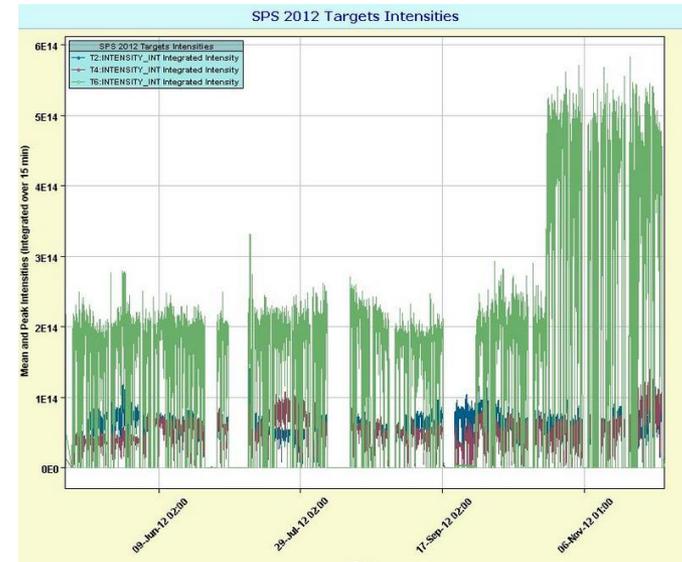
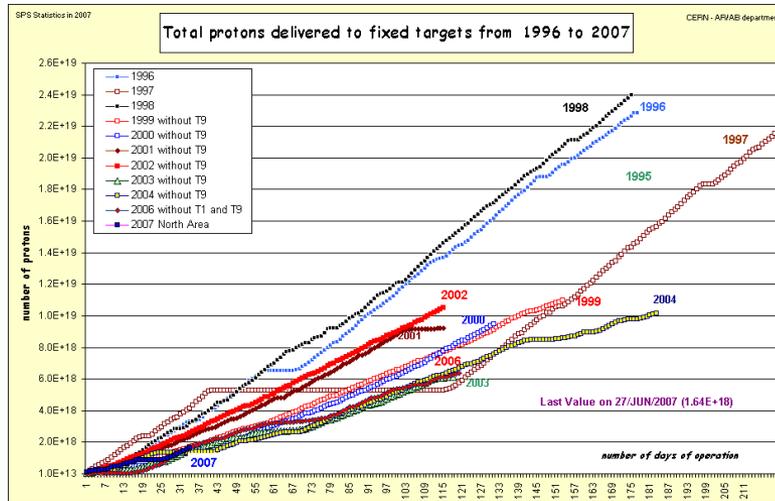


- ▶ 4 beryllium primary targets, secondary particle beams for exp.
- ▶ 1.6 MJ/spill, ~300 kW over the spill, ~100 kW in the SC
- ▶ Will all be consolidated/rebuilt by the end of 2014
  - ▶ Be removed from target boxes during summer 2014



# T2/T4 schematics





- ▶ Difficult to estimate the exact POT on each of the Be heads (sharing between targets, “history”, beam impact point)
- ▶ Estimates goes in the order of few  $10^{20}$  POT on the most exposed Be target
- ▶ Beam size  $\sim 0.5$  mm  $1\sigma \rightarrow$  again  **$\sim$ few DPA max**

- ▶ Dismantling will start before summer 2014 in order to profit for the longest possible cooling down
- ▶ Dose rate of the assembly in the order of **~10 mSv/h** (1 rem/h) at 20 cm, mostly due to the structural cast iron
- ▶ When the assembly will be removed we could evaluate whether we could disassemble the plate remotely by means of robots
  - ▶ Dose rates of Be plates will be orders of magnitude less
- ▶ **If decoupling possible, shipping should not be a problem**



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