

AD Antiproton Decelerator CTF3 Clic Test Facility CNGS Cern Neutrinos to Gran Sasso ISOLDE Isotope Separator OnLine DEvice

LEIR Low Energy Ion Ring LINAC LINear Accelerator r-ToF Neutrons Time Of Flight



Proton beam production for LHC

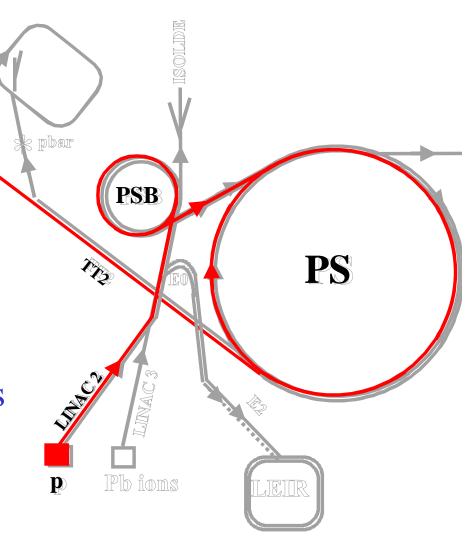
-Linac2 (50MeV)

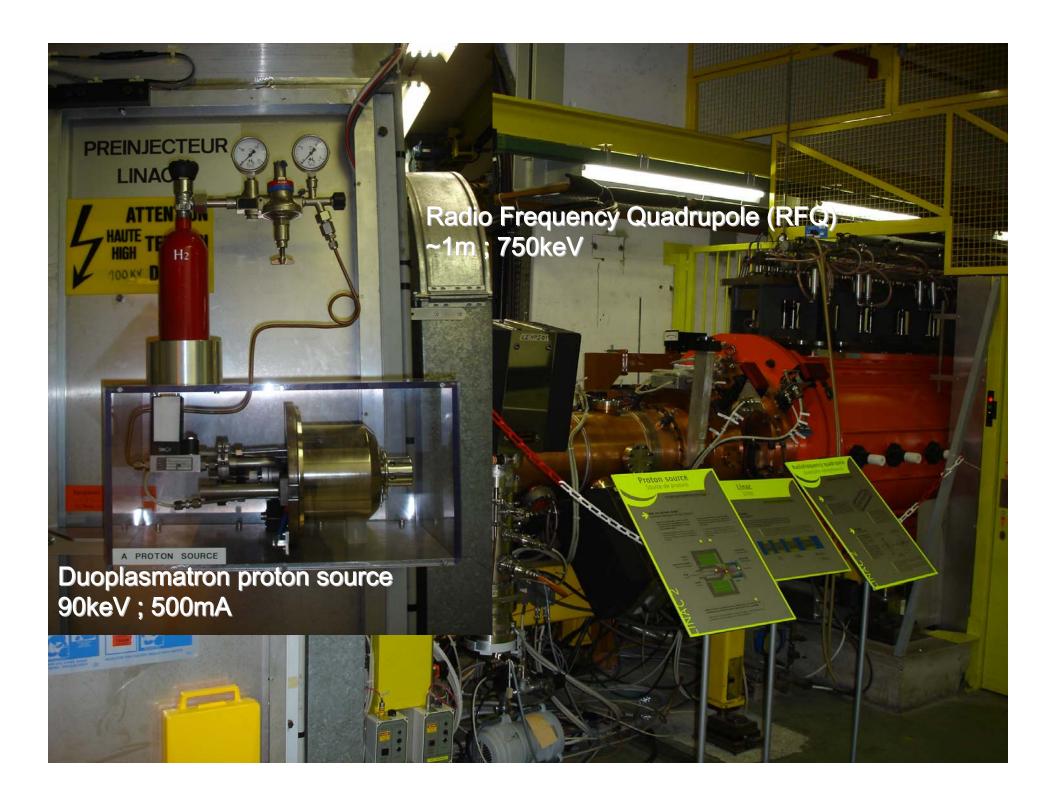
-PSB (1.4GeV) 4+2 bunches

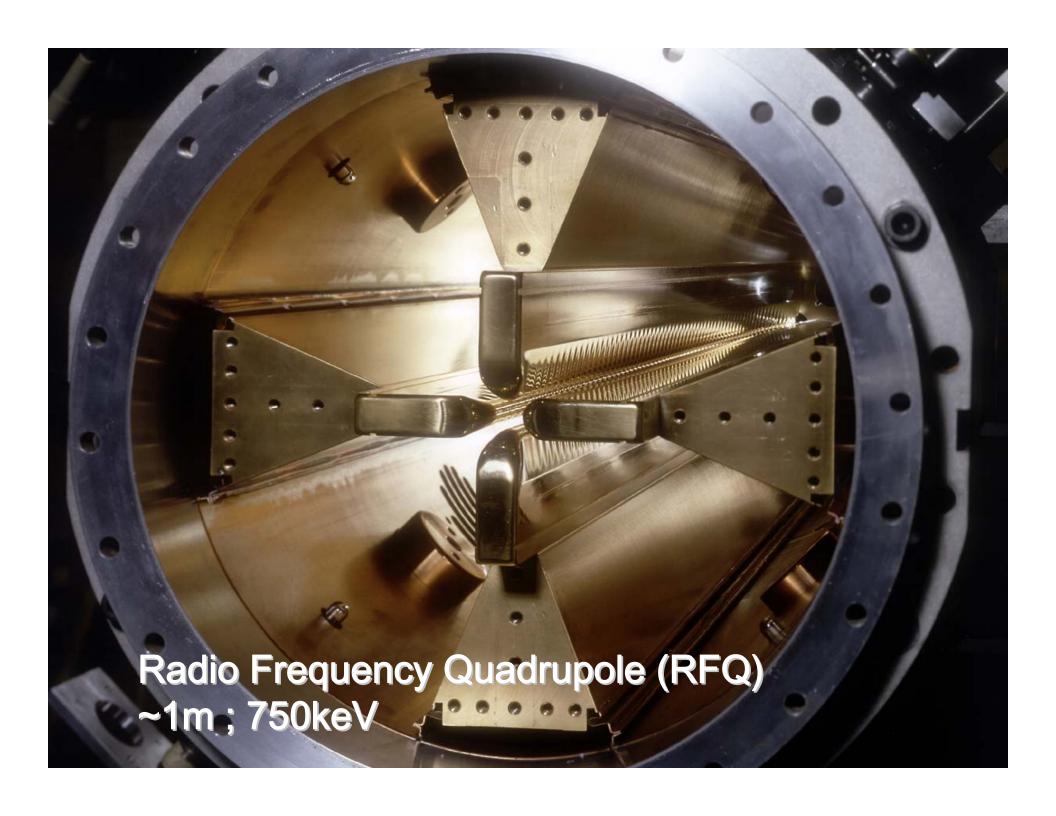
-PS (25GeV) 72 bunches

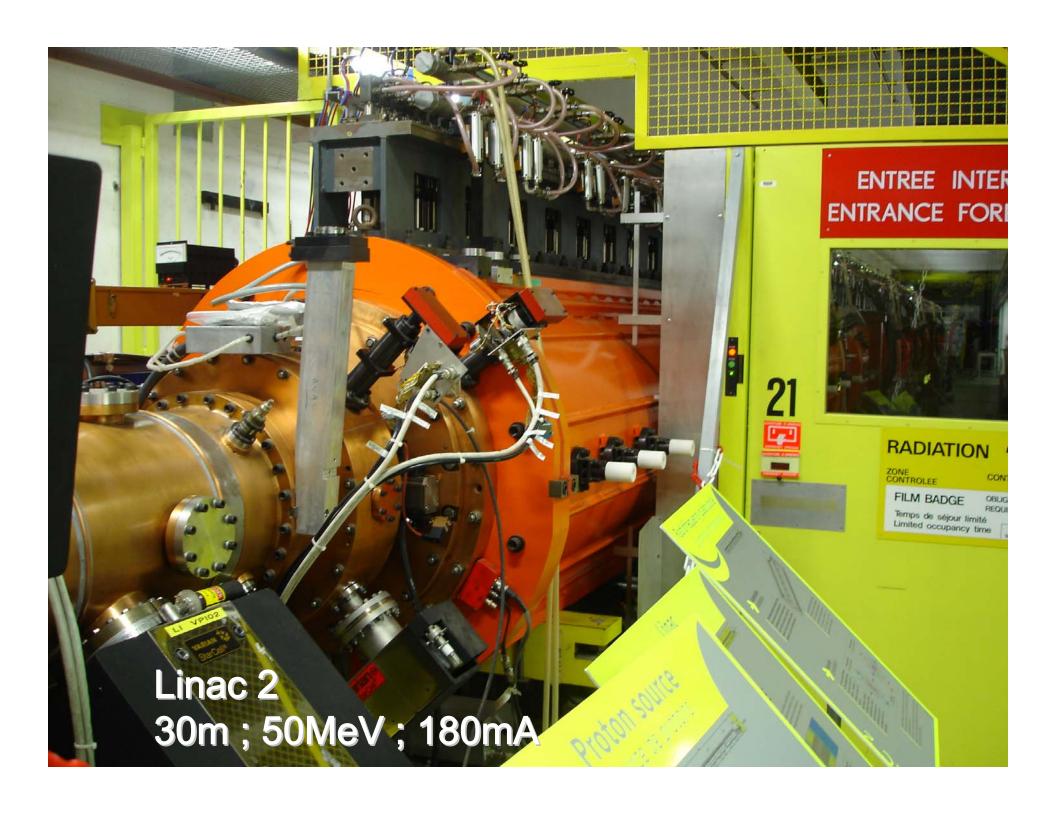
-SPS (450 GeV) 4 x 72 bunches

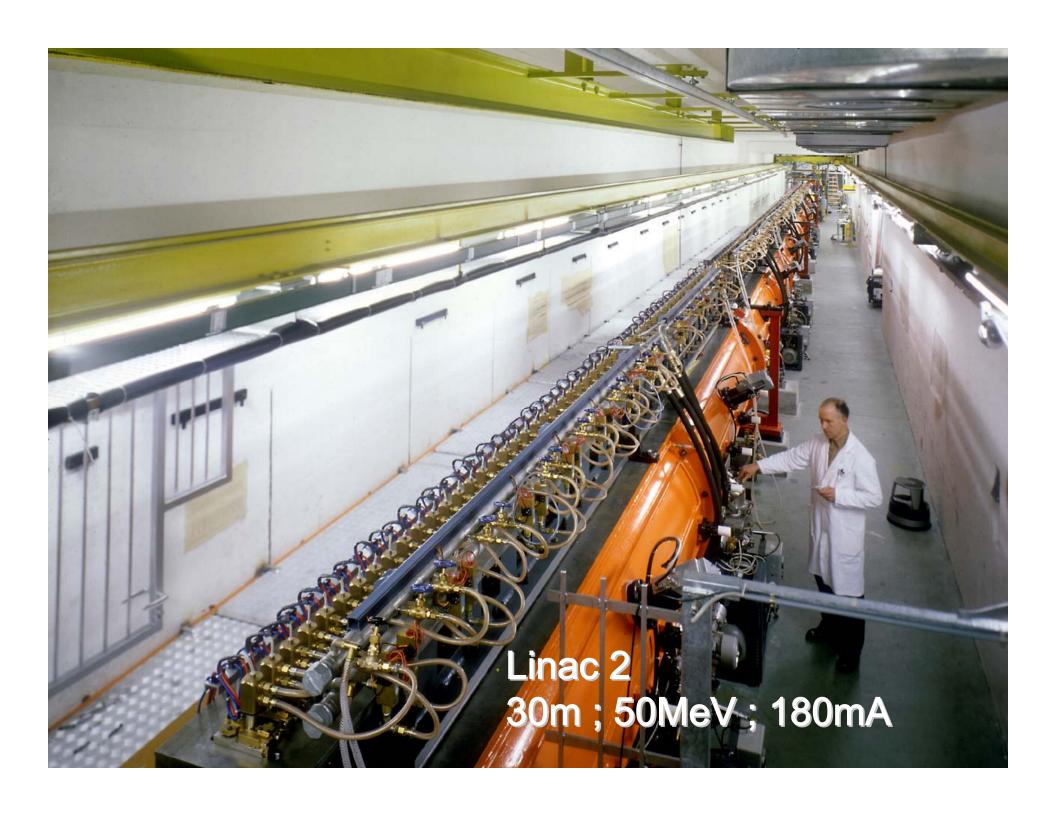
-LHC (7 TeV) 2 x 2808 bunches

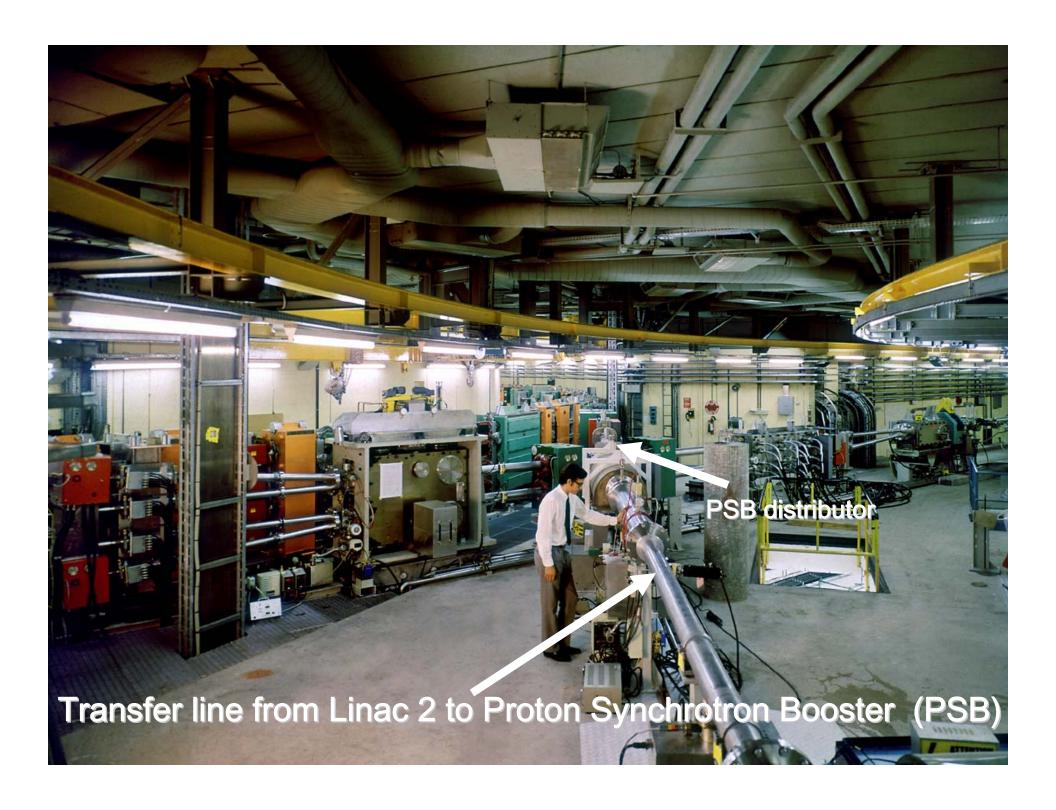




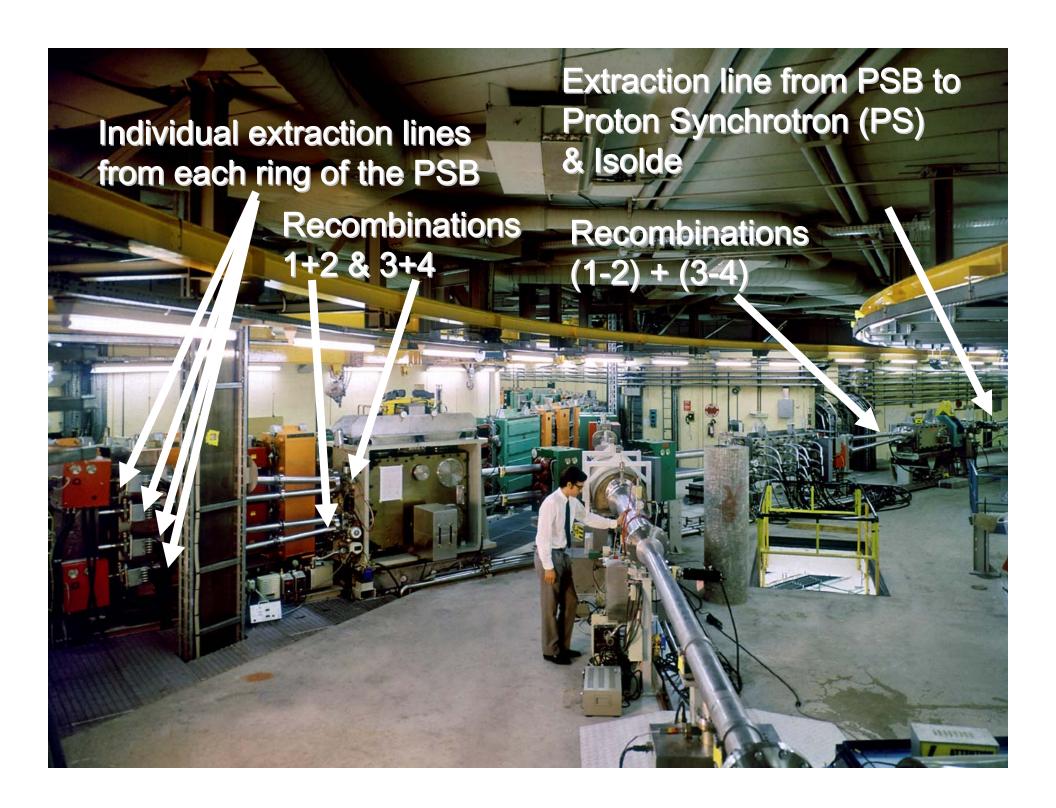


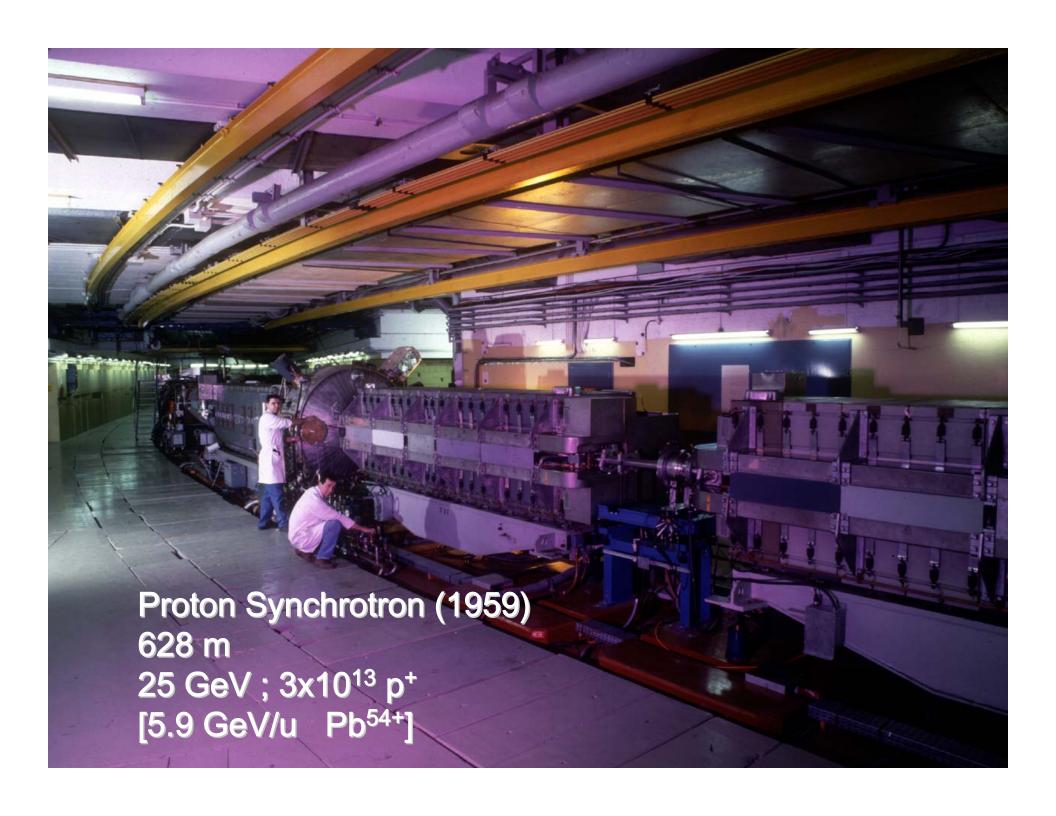


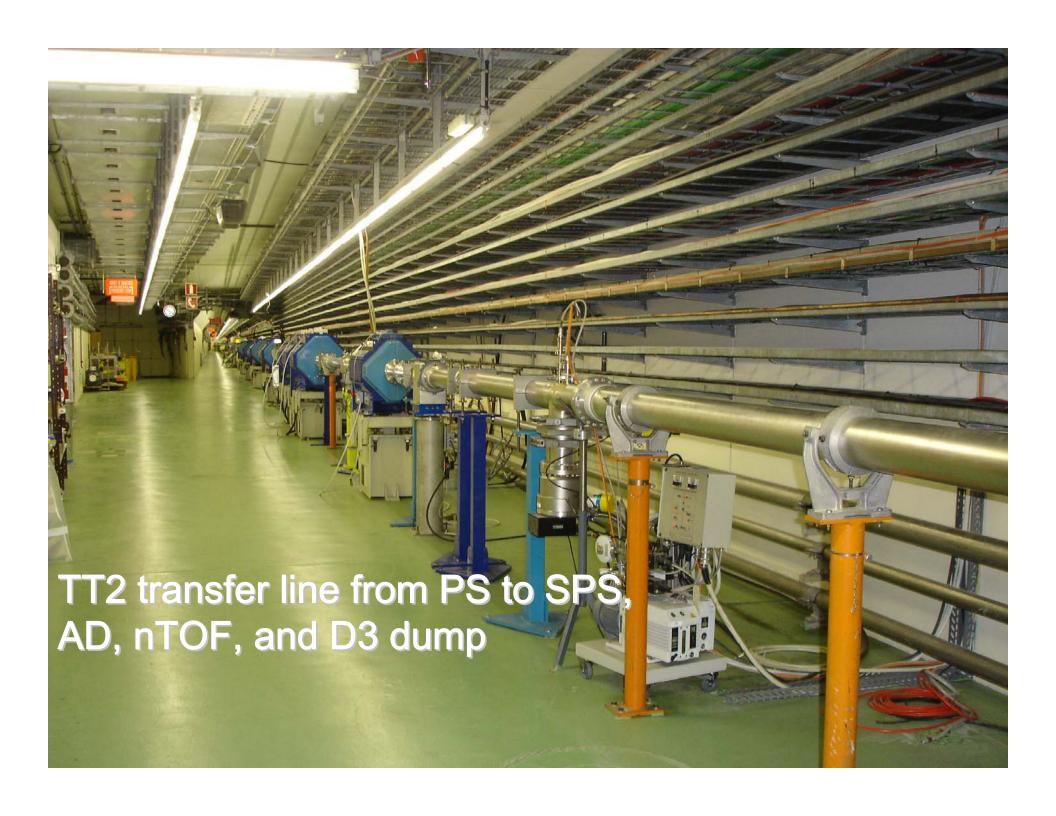


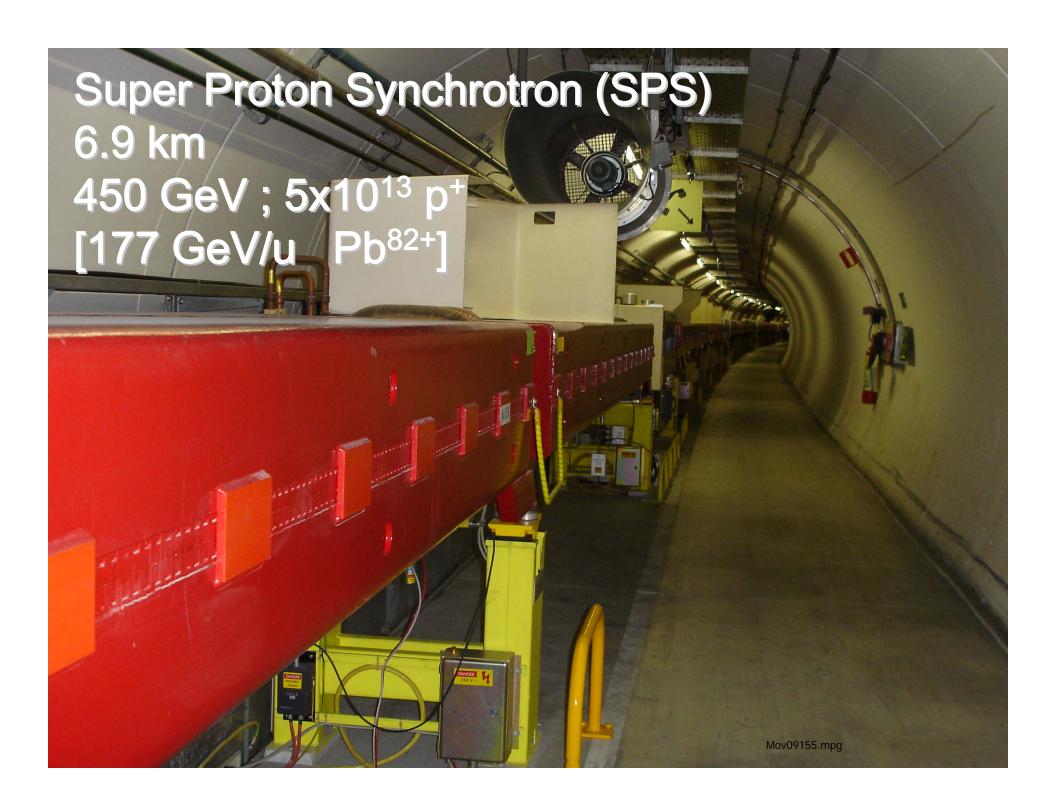










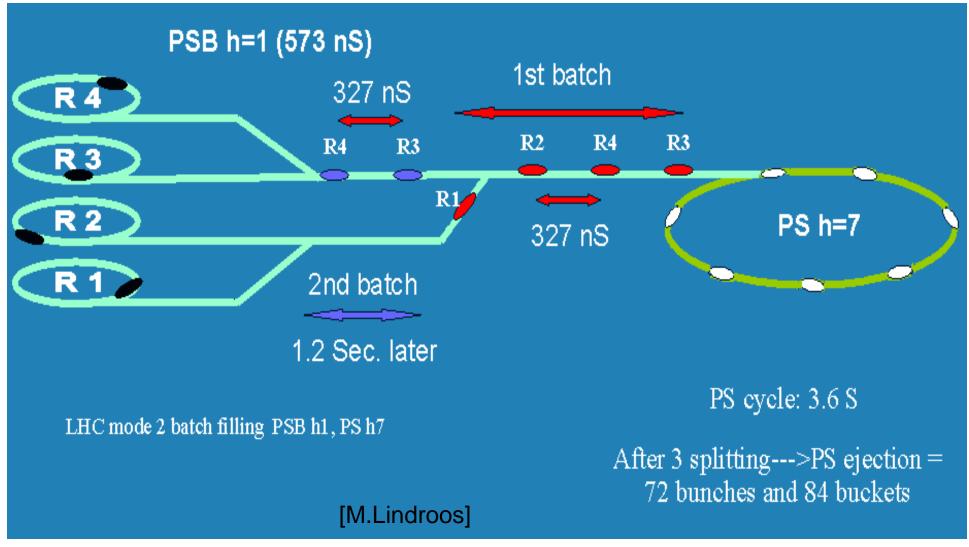








Double batch injection from PSB to PS

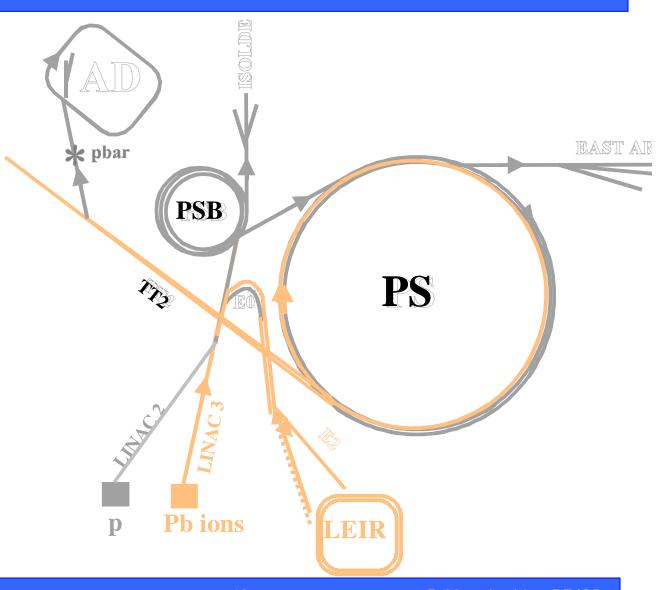




Ion beam production for LHC



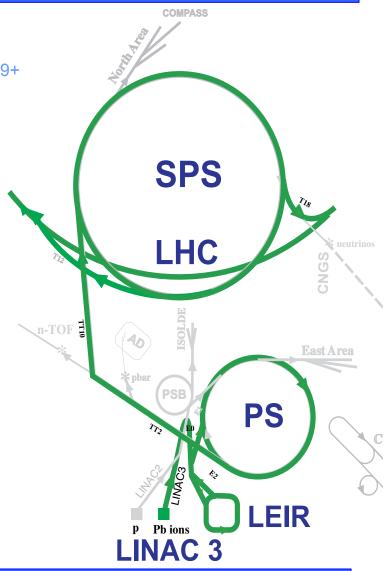
- LEIR
- -PS
- SPS
- LHC





Lead ion injector chain

- ECR ion source (2005)
 - Provide highest possible intensity of Pb²⁹⁺
- RFQ + Linac 3
 - Adapt to LEIR injection energy
 - strip to Pb⁵⁴⁺
- LEIR (2005)
 - Accumulate and cool Linac 3 beam
 - Prepare bunch structure for PS
- PS (2006)
 - Define LHC bunch structure
 - Strip to Pb82+
- SPS (2007)
 - Define filling scheme





The 3 roles of LEIR

- Accumulate enough ions for LHC bunches
- 3 plane stacking

Keep their H, V and // emittances small

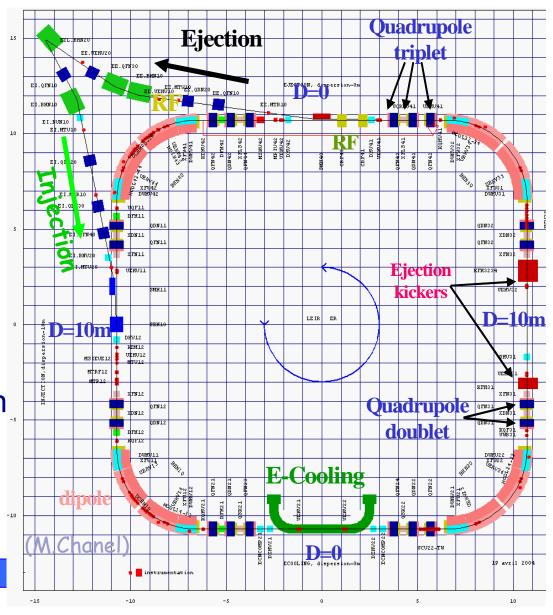
- **►** Cooling
- Bring Linac3 ion beam to PS injection energy Acceleration





LEIR layout

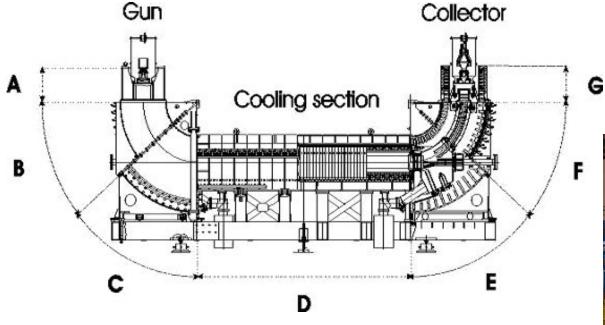
- Square shaped "circular machine"
- Circumference = 78.54m= PS/8 = SPS/88
- Operated below transition γ_t≈2.87
- 4x90° bending magnets
- 2 SS's with Q doublets, 2 SS's with Q triplets,
- Common injection/ejection line
- Electron cooling





Electron Cooling

- Principle: an electron beam with <u>same velocity</u> as the ion beam is merged with it over a fraction of the circumference (~3%)
- In the moving frame, collisions between electrons and ions correspond to the mixture of a hot ion gas with a cool electron gas
- The heat exchange leads to cooling, i.e. emittance reduction, in all 3 planes (H,V, //) of the ion beam





(G.Tranquille)