RCS-PD
NUFACT05

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Outline

Proton Drivers based on Rapid Cycling Synchrotrons

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Outline

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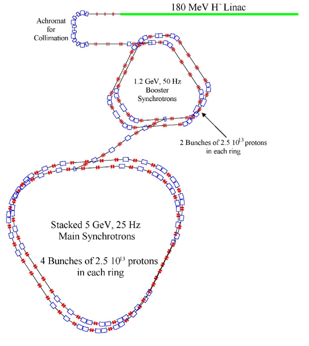
Proton Driver Designs: Synchrotron-Based

General issues to be addressed

- Realisation of $\sim$4 MW of beam power at appropriate repetition rate at pion target
- Accumulation of beam
  - Balance between linac current and number of injection turns
  - H^- foil stripping, foil heating and lifetime, phase space painting
- Trapping and acceleration
  - beam instabilities (electron cloud)
  - space charge problems
- Nanosecond bunch compression

5 GeV, 50 Hz, 4 MW RCS design

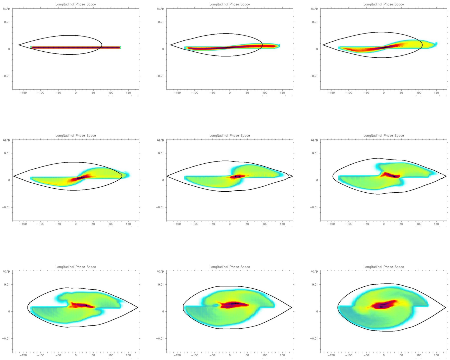
5 GeV, 50 Hz



- Booster rings for proton accumulation and initial acceleration
- Main rings for remaining acceleration and bunch compression
- Pairs of rings reduce space charge
- Doubling radius, halving frequency leads to acceptable $\frac{\mathrm{d}B}{\mathrm{d}t}$ and RF voltages
- Repetition rate restored by extracting on alternate half cycles.
- Compression at 5 GeV relies on $\gamma \to \gamma_t-$ and adddditional 0.5 MV of RF at $h = 24$.

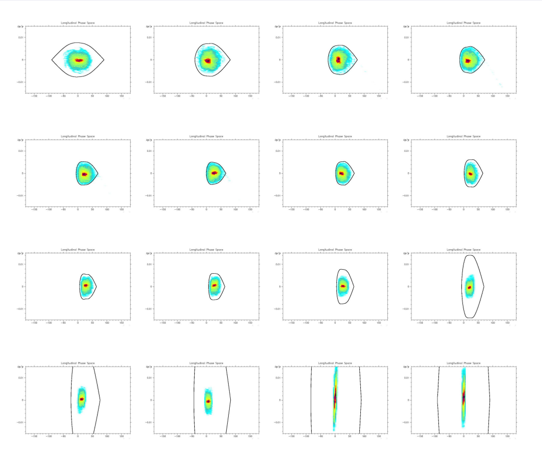
Beam Accumulation

- About 70 mA of H^- needed from ion source
- Achieved at RAL (see Jürgen Pozimski's talk)
- Beam chopper (70%) - mature, EU-funded, programmes at CERN and RAL

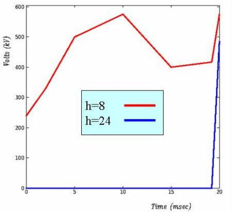


Synchrotron models use phase space (dispersion) painting, RF voltage modulation and RF steering to achieve very low loss ring injection.

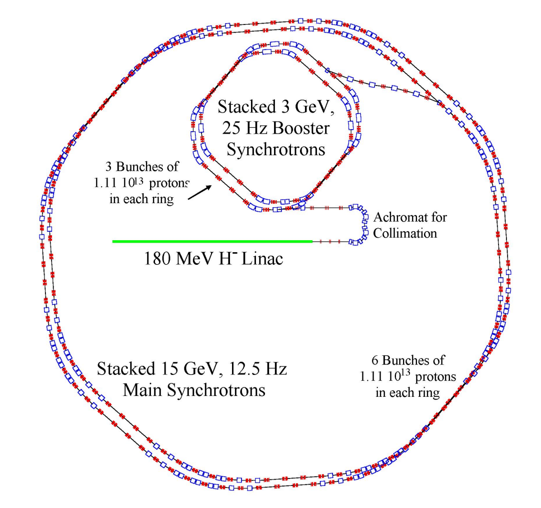
Bunch Compression at 5 GeV



Final compression enhanced by addition by $h = 24$ voltage and achieved by converging on isochronous conditions.

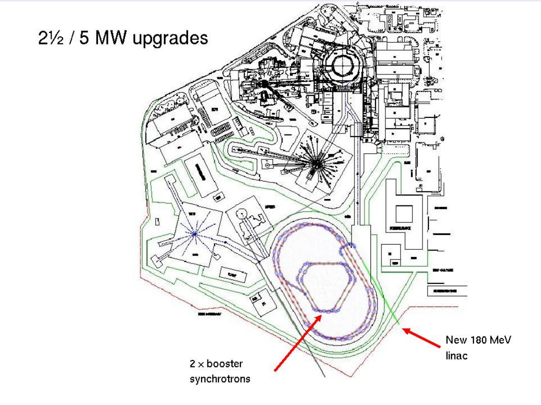


15 GeV, 25 Hz, 4 MW RCS Driver



Same general principles and similar procedure for injection painting. Normal bunch rotation achieves ns compression.

ISIS upgraded to a 4 MW Proton Driver



Progressive development 0.5 MW to 1 MW to 2.5 MW to 5 MW, with phases for bunch compression and target testing, resulting in a combined neutron/neutrino facility

Comment

- The target is arguably the most difficult part of the whole NF facility (*c.f.* ESS experience).
- The proton driver needs to take account of target limitations (shock, heating) in its choice of energy and the length and structure of the bunch train.
- The driver energy and target geometry determine the pion/muon distribution and affect the design of the capture channel.
- The need is to maximise the number of muons entering the accelerating system.
- Particularly close collaboration is therefore needed between driver, target and muon front-end working groups to produce the optimum operable system overall. This will inevitably mean a compromise between all regions of study.