

ACCELERATOR ASPECTS

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Physics with a Multi-MW Proton Source

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Thanks

- I would like to thank the organizer and CERN for the well-organized workshop on the important physics to be done at MW proton accelerators, with potential of fundamental discoveries, also for the hospitality given to us.

Outline

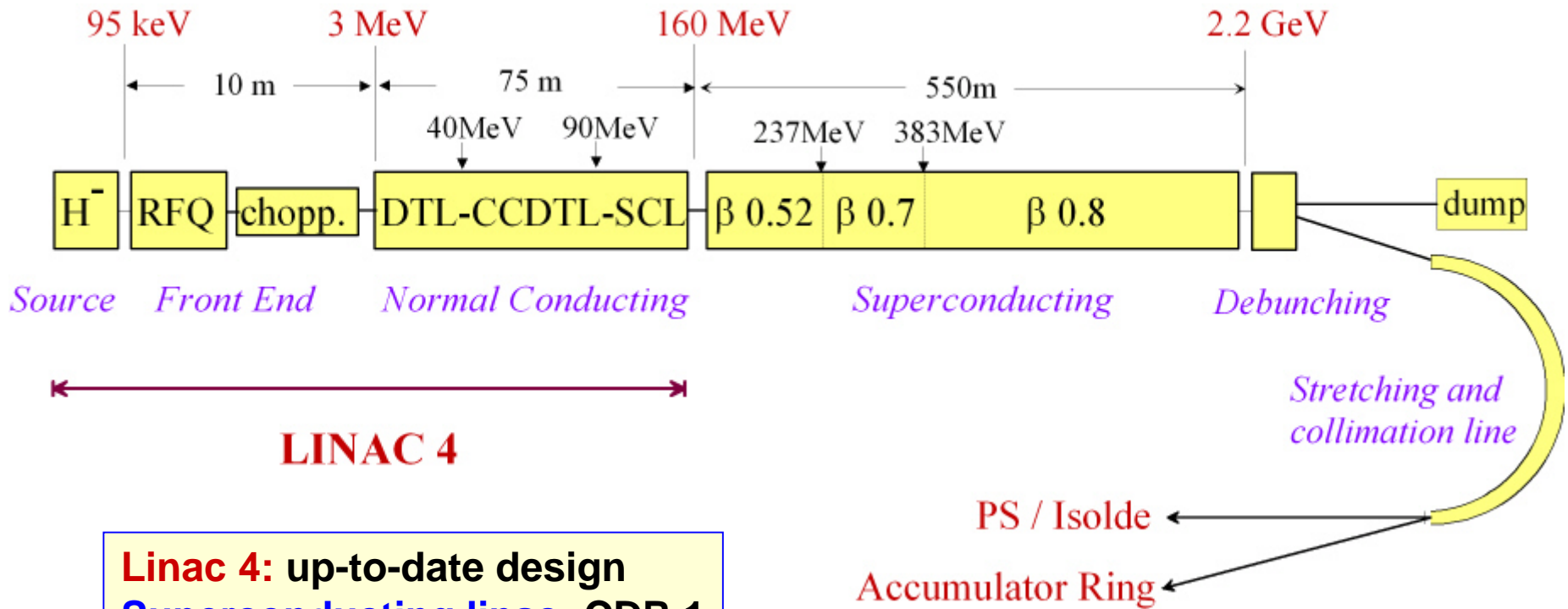
1. Summary of Talks on Accelerator Design
2. Design of the Proton Driver
3. Target/Horn and Neutrino Beam
4. Beam Losses and Shielding
5. RAMI
6. R&D and Upgrade Paths
7. Conclusions

Talks in Accelerator Session

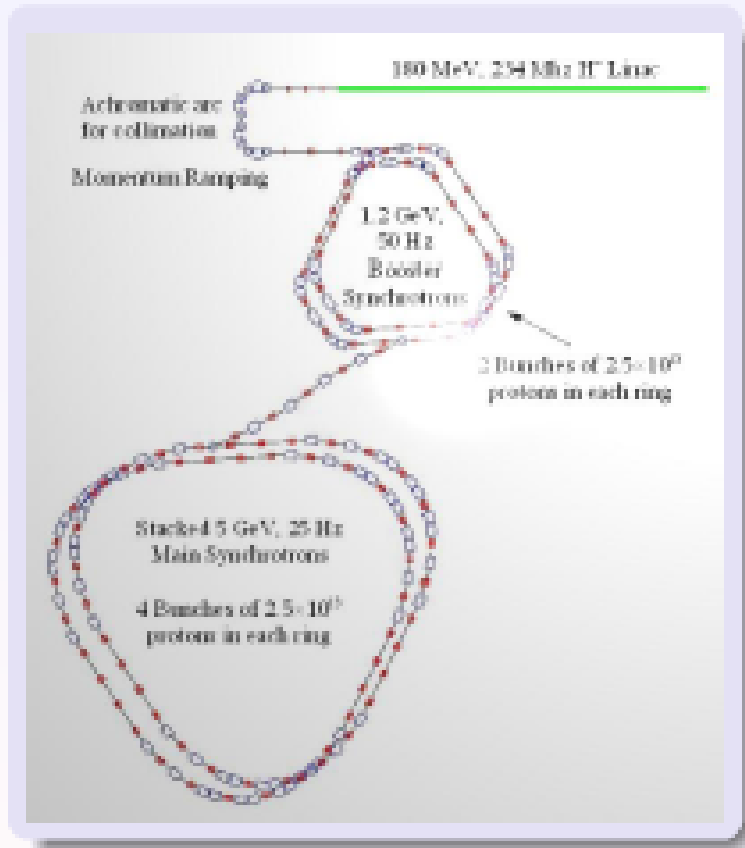
1. R. Garoby, SPL at CERN
2. C. Prior, RSC Options
3. H. Haseroth, Target/Horn & NuFact
4. M. Apollonio, HARP
5. A. Mueller, Nuclear Phys/EURISOL
6. M. Lindroos, Beta-Beam

SPL block diagram (CDR 1)

Design of the Proton Driver



RAL 5 GeV, 50 Hz, 4 MW Driver



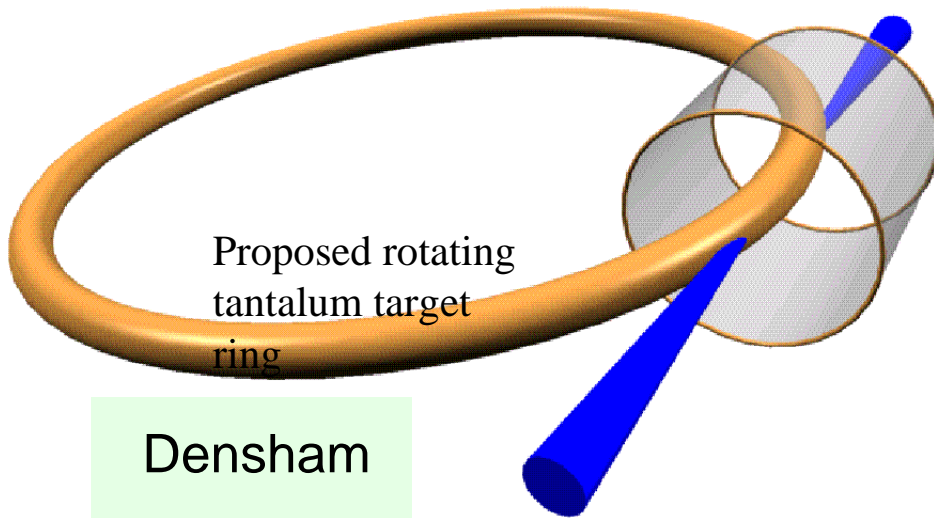
- "Proof of Principle Study"
- Based on double rings of radii in ratio 1:2, frequencies 2:1
- Beam prepared for injection in linac and achromatic arc
- Charge exchange injection via Al_2O_3 foil in booster rings: loss at 10^{-4} level mainly from scattering in foil
- Acceleration in main synchrotrons with ns bunch compression achieved with combination of RF harmonics

Targetry

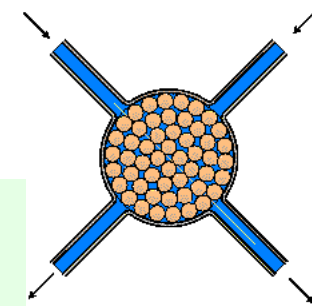
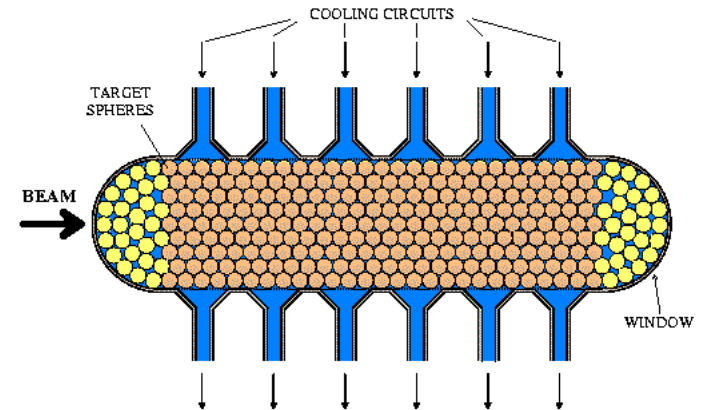
Many difficulties: enormous power density \Rightarrow lifetime problems
neutron capture

Replace target between bunches:

Liquid mercury jet or rotating solid target



Stationary target:



Sievers

Comments on Accelerator Design

- The choice between SPL and RCS has to be decided on the basis of physics goal, but from technical point of view, the SPL is a convincing alternative with great potential to better satisfy most of the needs presented in this workshop.
- The choice of bulk Nb cavity can provide higher gradient, hence higher energy, or shorter physical length.
- There are existence proof of high power linac; such as: LAMPF and SNS to assure the feasibility of SPL.

Accelerator design,--- continued

- The current SPL design is capable of realizing its goal and is flexible enough for many future programs.
- The realization of linac4 is a very valuable first step that can also benefit LHC and proton physics at CERN in general.
- The challenge of the SPL is in its careful confirmation of emittance growth, beam loss, radiation shielding, reliability, and cost reduction.

Target / Horn and Neutrino Beam

- As has been shown that 1 MW target/horn system is feasible; however, the 4 MW one needs active R&D for realization.
- Current international collaborations include,
 1. Material testing at BNL
 2. Proposed Hg jet testing at CERN
- The target/horn system is integrally connected to the proton driver and physics requirements, hence, close communication among those groups are essential.

Beam Losses and Shielding

- Develop realistic analysis of beam losses, collimation, and shielding requirements.
- Remote handling should be provided to reduce human exposure and equipment damage.

RAMI

- For a MW facility, the provisions for reliability, availability, and maintainability has to be designed in in the beginning.
- The radiation shielding, spares, and the maintenance and repair procedure are part of the design thinking

R&D and Upgrade Paths

- The suggested R&D items include, ion source, chopper, SRF cavity, target/horn which should be supported with vigor to meet the schedule requirement.
- Anticipate possible different operation modes and upgrade paths now to minimize cost and interference later.

Summary and Conclusions

- The choice of an SPL for the CERN proton driver is realistic and competitive which has no show-stoppers in its current design.
- The emittance preservation in the SPL needs further analysis with correction provisions.
- Realistic target/horn has to be developed.
- CERN should play important role, if not the leading role, in the international collaboration of R&D efforts and encourage participation from its staff, as long as CERN's core mission is not compromised.

Conclusions,--- continued

- Current conceived applications are too varied for an effective project. Intensive discussion among accelerator experts and physicists has to take place to identify realistic phase-I experiments to select proper accelerator configuration (SCL vs RCS), intensity, energy, pulse length, and target/horn design for optimal secondary beam spectrum. Then, other applications and further upgrades can be contemplated.