The Beta-Beam Task in the EURISOL Design Study

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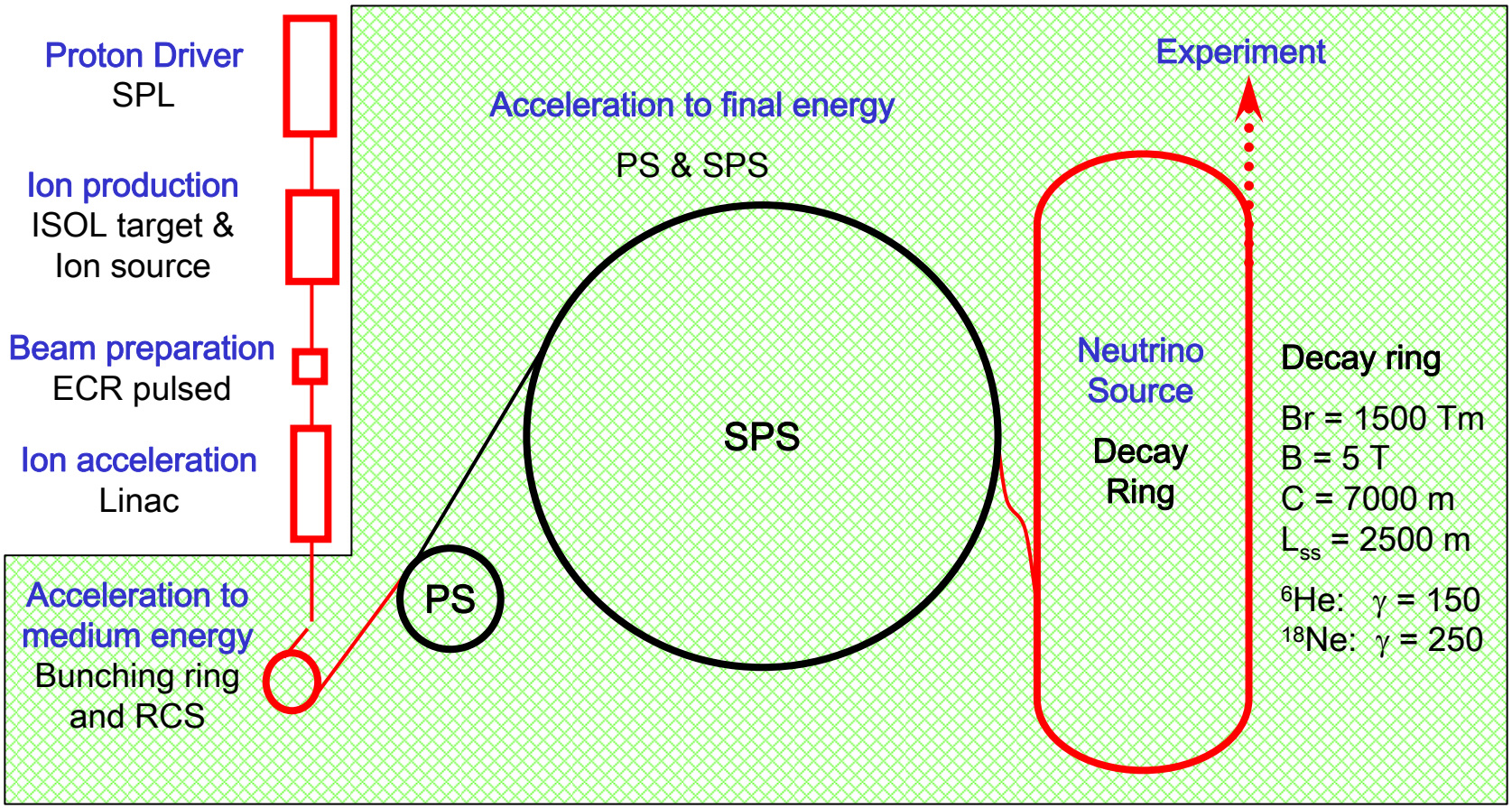
Task: Beta Beam Aspects

Starts at exit of heavy ion LINAC (~100 MeV/u) to Decay Ring (~100 GeV/u).



The Beta-Beam Task: Boundary Conditions

- Beta Beam task starts at exit of the EURISOL post accelerator.
- Comprises the design of the complete accelerator chain up to the decay ring.

Assumed starting conditions – incoming ion beam:

Fully stripped beam (6He or 18Ne) with several 10 μs pulse length.
Beam energy of around 100 MeV/u.
Repetition rate around 15 Hz during ~1 second
No beam during following 8 seconds (total cycling time 8 - 10 s).

What are we aiming at in the Decay Ring:

Very few, very intense bunches, as short as possible (4 bunches,<10 ns)
Stacking of the “fresh” ions with the already circulating bunches.

Beta-Beam work packages

The present base line scenario features a three stage accelerator chain:

- One or more low energy machines for bunching of the (long) beam and fast acceleration to higher energies to increase lifetime.
-The existing PS and SPS machines for further acceleration to the required top energies.
- A high energy Decay Ring to accumulate the ions and to act as neutrino source.

This suggests to define the sub-tasks in the way the accelerator chain is structured:

WP 1: Design of the low energy ring(s).

WP 2: Ion acceleration scenarios in PS/SPS and required upgrades of the existing machines including new designs to eventually replace PS and/or SPS.

WP 3: Design of the high energy Decay Ring.

Beta-Beam Steering group

Major Activities

- Review and confirmation of the beta beam base line design as starting point.
- Close contacts to the neutrino physics community to guide the accelerator complex design according to requirements and evolution of the physics case.
- Ensure the link to other related EURISOL tasks to clearly define the needs, expectations and “hand over” points.
- Act as “parameter” and steering group for the other beta beam sub tasks.

Goal

- Steering and follow up of the Beta Beam accelerator complex design.

Time aspects / manpower estimate

- During the complete duration of the design study (48 months).
- One members from each of the participating institutes, Task leader and Work package leaders.

WP 1: Design of low energy ring(s)

Major Activities

- Optics design with beam dynamic simulations for low energy ring(s).
- First technical designs demonstrating the feasibility of critical hardware.

Specific Aspects

- Accumulation of relatively long linac beam (multi turn injection, etc.)
- Aspects related to fast acceleration (RCS?) magnets, power converters, RF, etc.
- Machine protection and collimation issues.

Goal

- Conceptual design of low energy ring(s) demonstrating basic feasibility.
- Identification of critical hardware issues to be addressed in further studies (FP 7).
- First order cost estimate.

Time aspects / manpower estimate

- Starts after three months with total duration of 36 months (led by M. Lindroos).
- Participants: CERN, IN2P3, Univ. Stockholm, TRIUMF (Ca)
- Manpower requirement: 10 man-years (theoretical design ~6 and technical ~4)

WP 2: Acceleration in PS and SPS Upgrades and new Designs

Major Activities

- Beam dynamic simulations for ion acceleration in PS/SPS.
- Estimation of effect of large beam losses (PS) and possible solutions.
- First technical designs demonstrating the feasibility of critical hardware.
- Optics design and beam dynamic simulations for new machines.

Specific Aspects

- High intensity ion operation in PS/SPS (space charge issues, etc., cf. LHC ions)
- Machine protection and collimation issues (existing machines).

Goal

- Proof the feasibility of Beta Beam acceleration in PS and SPS.
- First technical design of required upgrades and critical components.
- Conceptual design of medium/high energy machine(s) to replace PS and/or SPS.
- Identification of critical hardware issues to be addressed in further studies (FP 7).
- First order cost estimate.

Time aspects / manpower estimate

- Starts after three months with total duration of 36 months (led by S. Hancock).
- Participants: CCLRC RAL, CERN, GSI, FNAL (USA).
- Manpower requirement: 12 man-years (theoretical design ~8 and technical ~4)

WP 3: Design of Decay Ring

EURISOL

Major Activities

- Optics design with beam dynamic simulations for the ion Decay Ring.
- First technical designs demonstrating the feasibility of critical hardware.

Specific Aspects

- Highest intensity ion operation (space charge issues, etc.)
- Injection, accumulation and stacking of ions at high energy.
- Machine protection and collimation issues.
- Superconducting magnets in high radiation environment

Goal

- Conceptual design of the ion Decay Ring.
- Identification of critical hardware issues to be addressed in further studies (FP 7).
- First order cost estimate.

Time aspects / manpower estimate

- Starts after three months with total duration of 36 months (led by J. Payet).
- Participants: CEA-Saclay, CERN.
- Manpower requirement: 12 man-years (theoretical design ~7 and technical ~5).

Work Organization, Meetings

- First 18 month to produce optics designs for all machines. Analyze different options (e.g. FFAG vs. RCS, etc.)
- Afterwards linking of all machine designs and converging towards an optimized accelerator complex (18-24 months). Freeze all parameters.
- 24-36 improve optics design, work on more technical design aspects of critical elements (rf, collimators, etc…)
- 36-42 review of overall design, check for consistency, corrections.
- 42-48 produce final report.

- 2-3 meetings/year of all persons involved in Beta-beam task.
- 2-3 meetings/year of steering committee.
- Few smaller working meetings as needed.

Planning 2005

- Task group meetings in April/May and November/December.
- Complete review of base line scenario (MB, ML, SH) for April/May.
- WP1: Comparison RCS vs. FFAG and choice of preferred solution for Nov/Dec.
- WP2:
  - Résumé on ion acceleration in PS/SPS – identification of bottlenecks.
  - Definition of main parameters for eventual PS replacement (Nov/Dec).
- WP3: Decay ring optics design – comparison of options, choice of preferred solution.