Beta-beam production chain

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Contents

production chain includes

- Target
- ECR
- Linac

Report from meeting of task 6, 9 and 10 at Orsay, 2nd May 06

Purpose:

- Communicate the requirements of the beta-beam
- Learn the status of the related EURISOL tasks

- Discussion with task 3 members

Ion intensities

Based on baseline scenario and top-down approach

- Achieve either a rate of $2.9*10^{18}$ anti-neutrinos or $1.1*10^{18}$ neutrinos per "physics year"

- LINAC to RCS
  - 10 Hz pulsed operation
  - during 2 s out of 6 or 3.6 s cycle
  - Rate: $1.9*10^{12}$ ^{6}He/pulse , $5.5*10^{11}$ ^{18}Ne/pulse

- Assumed efficiencies on the low-energy part →

Efficiency []	^{6}He	^{18}Ne
LINAC inj - RCS inj transfer	1	1
ECR ejection (charge state)	1	0.3
ECR accumulation	~0.9	~0.9
Target out - ECR injection	0.2	0.5
Target diffusion	0.4	0.4
Total efficiency	0.07	0.05

- Impact on production numbers →

Rate [s^{-1}]	^{6}He	^{18}Ne
LINAC injection	$1.9*10^{13}$	$0.5*10^{13}$
ECR out	$1.9*10^{13}$	$1.6*10^{13}$
ECR in	$2*10^{13}$	$2*10^{13}$

- Linac current (peak):
  - ^{6}He (charge state 2+): 12 mA peak
  - ^{18}Ne (charge state 6+): 11 mA peak

Beam parameters

At injection to the RCS

- 100 MeV/nucleon
- Charge state: $^{6}He^{2+}$, $^{18}Ne^{10+}$ (fully stripped)
- Physical transverse emittance
  - Injected:
    - h/v 1-1.5 π mm mrad (full)
  - Accumulated:
    - Physical h/v 13.7/7.4 π mm mrad (rms);
    - Simulated accumulation efficiency: 60-80%
- Longitudinal
  - Pulse length from linac: ≤50 μs (determined by ECR; RCS accumulation)

ECR ejection (traced from above requirements)

- 10 Hz repetition rate
- $\varepsilon_{transverse,\ full,\ physical}$ = 50 π mm mrad (also quoted at NuFact'02)
  - Allows a blow-up factor 2 to arrive at the RCS injection figures
- Bunch length: ≤50 μs

Outcome

- Production at target
  - Task 3 is optimistic to achieve rates for ^{6}He
  - ^{18}Ne seems to be impossible
    - Rely on alternative production scenarios for alternative ions (C. Rubbia et al.)

- ECR, task 6
  - Charge state efficiency under investigation
  - Short pulse duration achievable?
  - Mock-up test planned this summer, 70 GHz source
    V. Zorin et al. at Institute of Applied Physics, Nizhny Novgorod, Russia

- Linac
  - yet not studied
  - Limited resources within Task6
  - decision will be taken at upcoming CB meeting (June at PSI)
    - Recommendation to study independent linac
      - EURISOL post-accelerator to sophisticated
      - Beta-beam would occupy major part of beam time. Not acceptable for EURISOL physicists.

Conclusion:

- Current study within Task12 is independent of production scenarios
- This allows to identify and study technical challenges of a beta-beam facility independently.