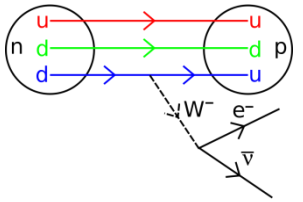
Beta-beams, recall



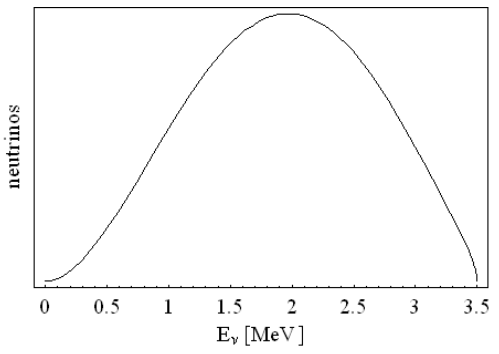
Aim: production of (anti-)neutrino beams from the beta decay of radio-active ions circulating in a storage ring

- Similar concept to the neutrino factory, but parent particle is a beta-active isotope instead of a muon.

Beta-decay at rest

- ν–spectrum well known from the electron spectrum
- Reaction energy Q typically of a few MeV

- Accelerate parent ion to relativistic γ_{max}
  - Boosted neutrino energy spectrum: $E_\nu \leq 2\gamma Q$
  - Forward focusing of neutrinos: $\theta \leq 1/\gamma$



E_0

Some scaling

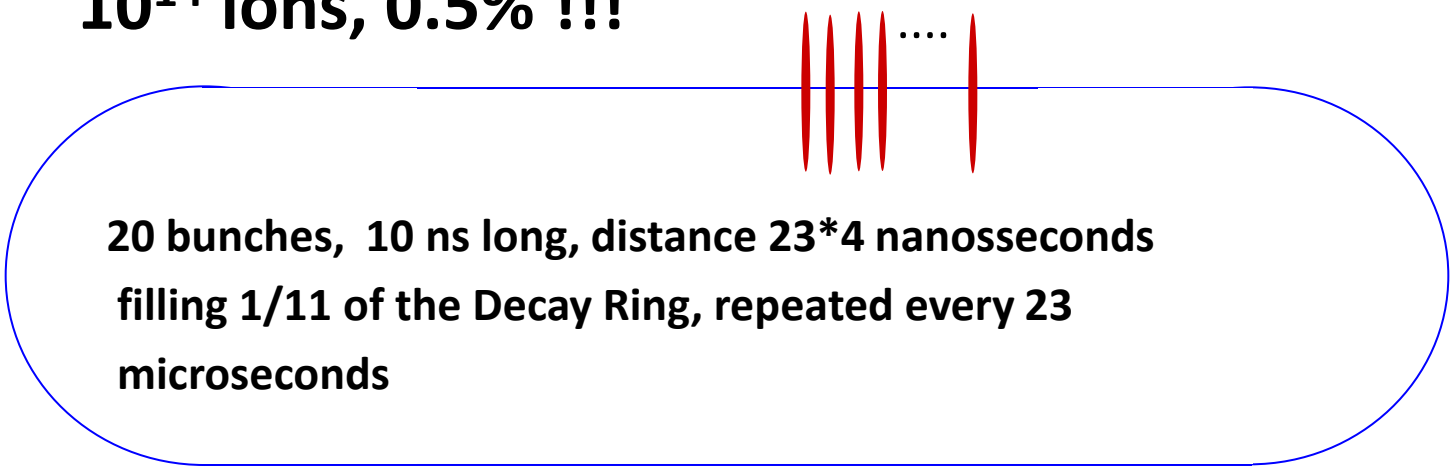
- Accelerators can accelerate ions up to Z/A × *the proton energy.*
- $L \sim E_\nu / \Delta m^2 \sim \gamma Q$, $Flux \sim L^{-2} \Rightarrow Flux \sim Q^{-2}$
- Cross section ~ $E_\nu \sim \gamma Q$
- Merit factor for an experiment at the atmospheric oscillation maximum: $M = \gamma / Q$
- Decay ring length scales ~ γ (ion lifetime)

Duty factor and Cavities for He/Ne

Duty factor: Signal/Noise

Noise suppression, atmospheric neutrinos

10^{14} ions, 0.5% !!!



20 bunches, 10 ns long, distance 23*4 nanosseconds filling 1/11 of the Decay Ring, repeated every 23 microseconds

We discard 50% of the ions in the decay ring to get small bunches

- Not conclusive yet - only first ideas - more work is needed!
- The heavy transient beam loading is unprecedented.
- Since there is no net energy transfer to the beam, the problem might be solved using a linear phase modulation in the absence of the beam, mimicking detuning - this could reduce gap transients.
- A high Q cavity (S.C.?) would be preferable.

High-Q dilemma:

Geometry: 5 times more flux needed

Detector + geometry: 10 times due to multiplicity in detector at higher energies

Sensitivity LAr for nufact (e-neutrinos) 6 times better tha WC at ~ 2 GeV

What about e-neutrino/mu-neutrino sensitiviuties

Accelerator part to be pushed, SPS can do for protons 7 10^{13} (Malika et al. CNGS), ~5 10^{13} would be fine for Li.

The rest of the complex? The LINAC? The PS?

Basic physics: For a certain accelerator complex the number of ions decaying in decay ring has a saturation point! We are below the saturation point.

Duty factor an obstacle to use all ions.

IDEAS?

Duty factor and Cavities for B/Li

5 10^{14} ions, 2? % !!!