SBF with 1 to 2 x10^{36} with SC Linacs and Energy Recovery

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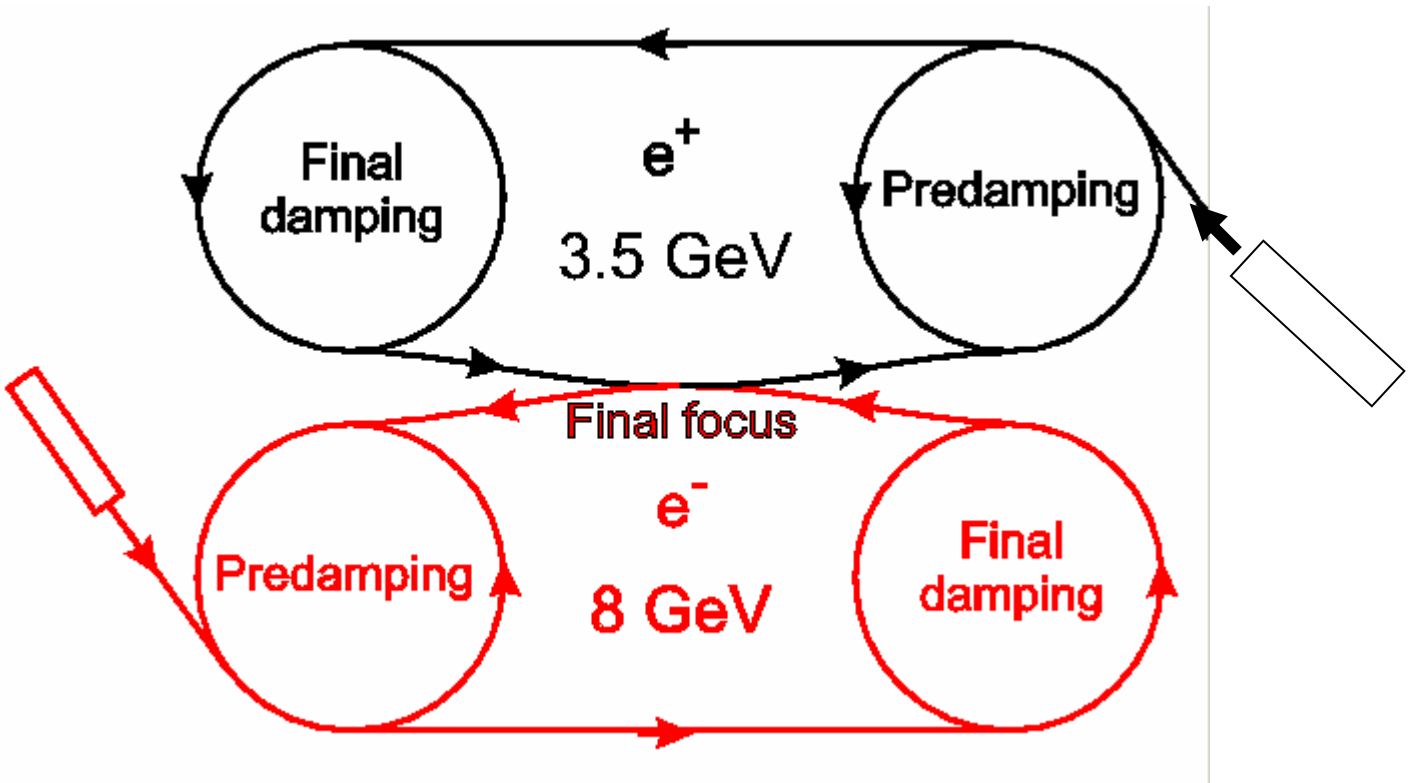
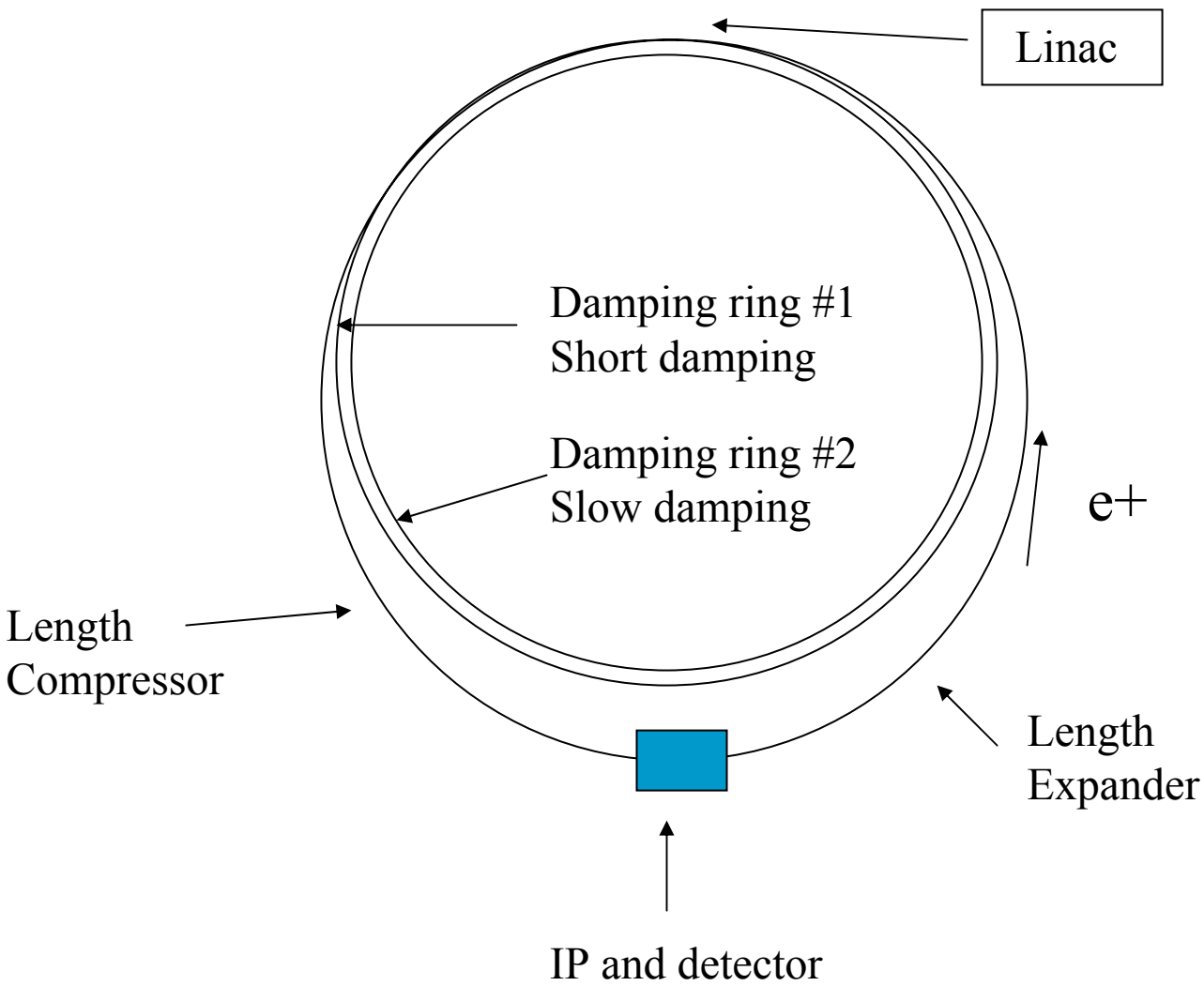
Reference Design of a SBF

- 

Overview schematic (One beam)



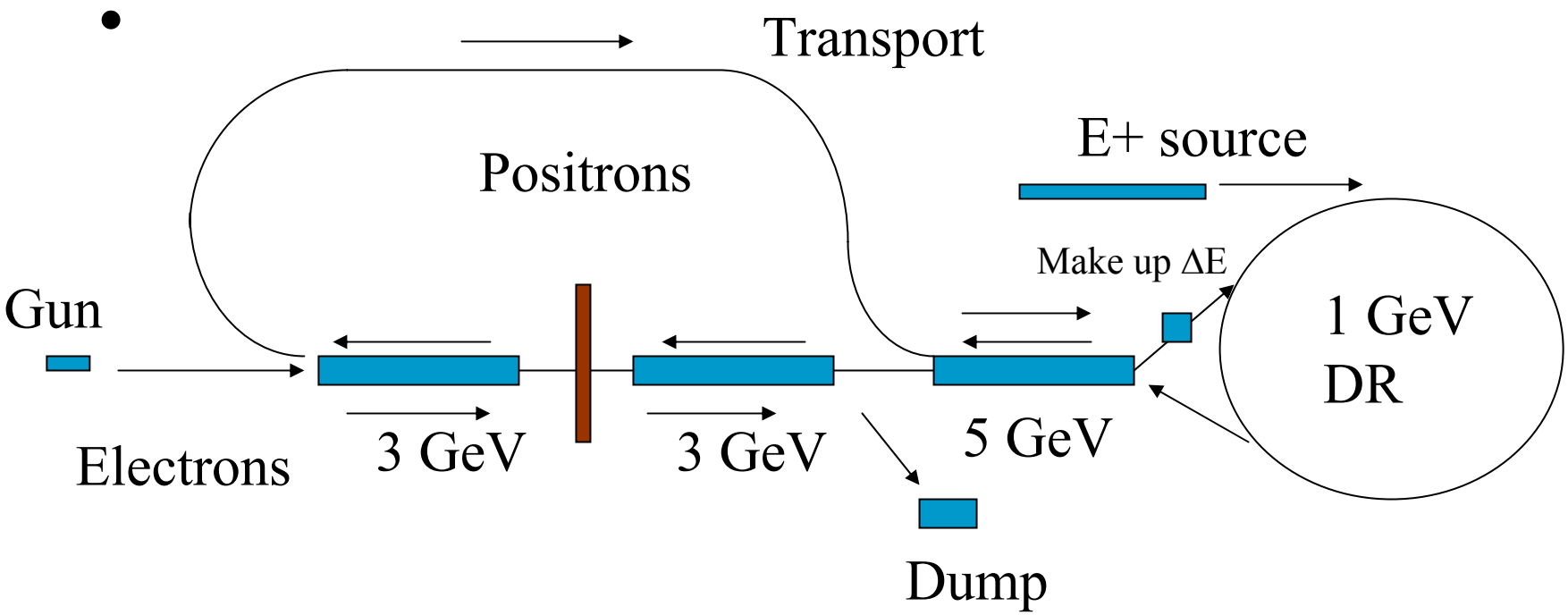
Reference geometry

- 4x7GeV
- 10000 bunches at 10^{11} = 10A
- 476 MHz at 0.63 m spacing
- Two damping rings per ring at full energy
  - 3000 m damping ring at 3.7 msec damping
  - 3000 m damping ring at 4.6 msec damping time
- 120 Hz collisions for 8.3 msec cycle time
- Assume two damping times between collisions →sum 8.3 msec
- 4GeV: 20 MeV/turn, Pwall =400 MW
- 7 GeV: 35 MeV per turn, Pwall=700 MW
- Total power = 1100 MW

How to reduce the power

- Use SC linacs to recover energy
- Use lower energy damping rings to reduce synchrotron radiation
- No electron damping ring
- Make electrons fresh every cycle
  - Damping time means time to radiate all energy
  - Why not make a fresh beam if storage time is greater than 1 damping time

New SBF Layout with SC Linacs



New Proposed Design

- 3 x 9 GeV
- 10000 bunches at 10^{11} = 10A
- Damping ring R = 476 MHz at 0.63 m spacing
- SC linac for 3 GeV e- with low emittance photo-gun
- SC linac frequency = 1400 MHz
- Accelerate 1 GeV positrons to 9 GeV
- Damping ring for 1 GeV positrons with wigglers
  - 3000 m damping ring at 3.7 msec damping
  - 3000 m damping ring at 4.6 msec damping time
- 120 Hz collisions for 8.3 msec cycle time
- Assume two damping times between collisions →sum 8.3 msec
- Recycle energy for both beams in SC linac structures
- 1GeV ring: 5 MeV/turn, Pwall =100 MW
- Accelerate 10^{11} particles to 3 GeV (e-) and also 8 GeV (e-)
- Without energy recovery, beam generation power = 211 MW
- Assume energy recovery is 95% efficient, needed power = 11 MW
- Cyrogenic power (1W/MeV) = 11 kW ???
- Total power = 111 MW

Conclusions

- Recovery SC linacs can save a factor of ten in power.
- Better not to make the electron ring