

# On Low Energy Operation, 1/2 collision rate option

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K. Kubo

# Low energy ( $E_{cm} < 500$ GeV) operation (Scheme of $e^+$ production)

Positron production by low energy  $e^-$  beam

- Require long undulator, or
- Reduced luminosity (depends on beam energy)

1/2 collision rate option

- Change  $e^-$  beam energy by every other pulse
  - High energy  $e^-$  beam for  $e^+$  production
  - Low energy  $e^-$  beam for collision

Checked whether the 2nd scheme is possible from beam dynamics in main linac.

- Linac will be tuned for low energy.
- Can high energy beam go through the linac? etc.

Undulator line has not been checked yet.

# Main Linac Simulation

Low energy beam:

Full acceleration in the first half part of linac and no acceleration in the second half. (Final beam energy 125 GeV)

(exact zero voltage is not possible, but probably, low voltage operation is.)

High energy beam:

Full acceleration (Final beam energy 250 GeV)

Assume RF setting can be changed pulse by pulse. But not magnet setting.

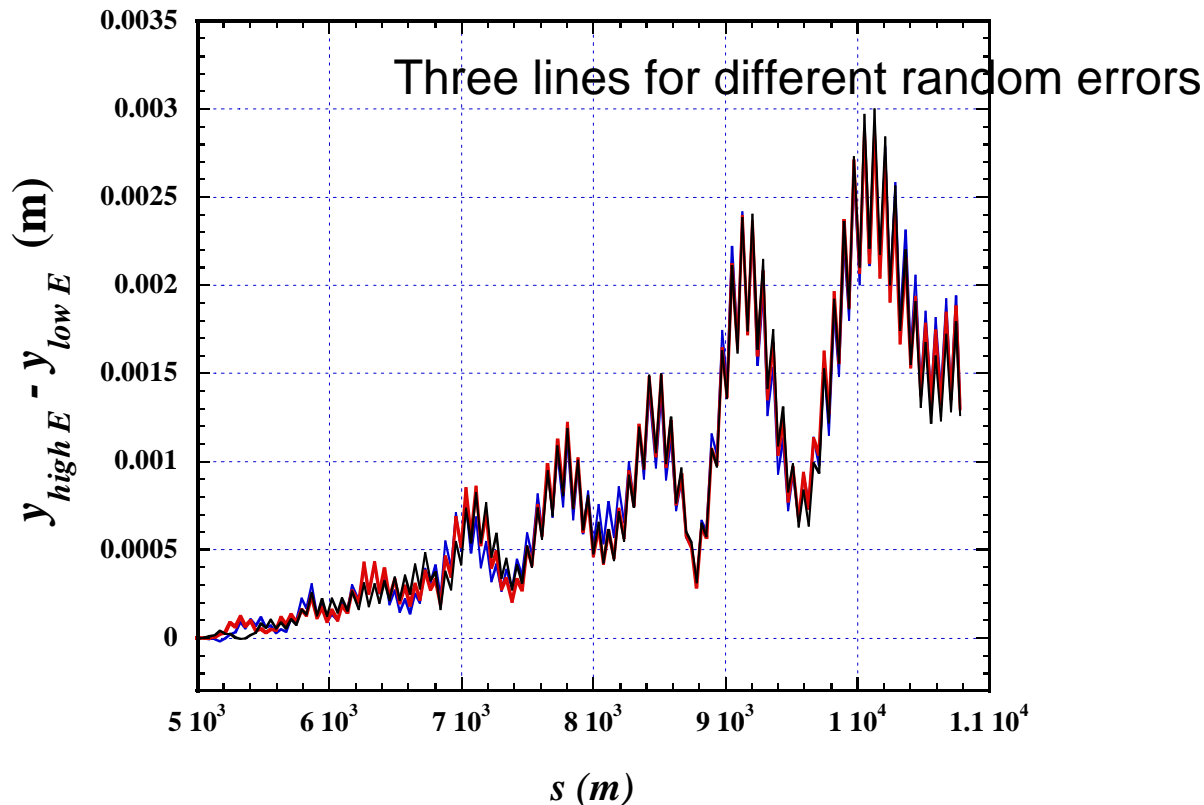
Simulation:

- Set “standard” alignment errors.
- Perform DFS correction for low energy beam
- Track high energy beam for the same alignment and magnet setting.
  - Change Only RF setting of the second half of the linac.

Note linac is curved following the earth.

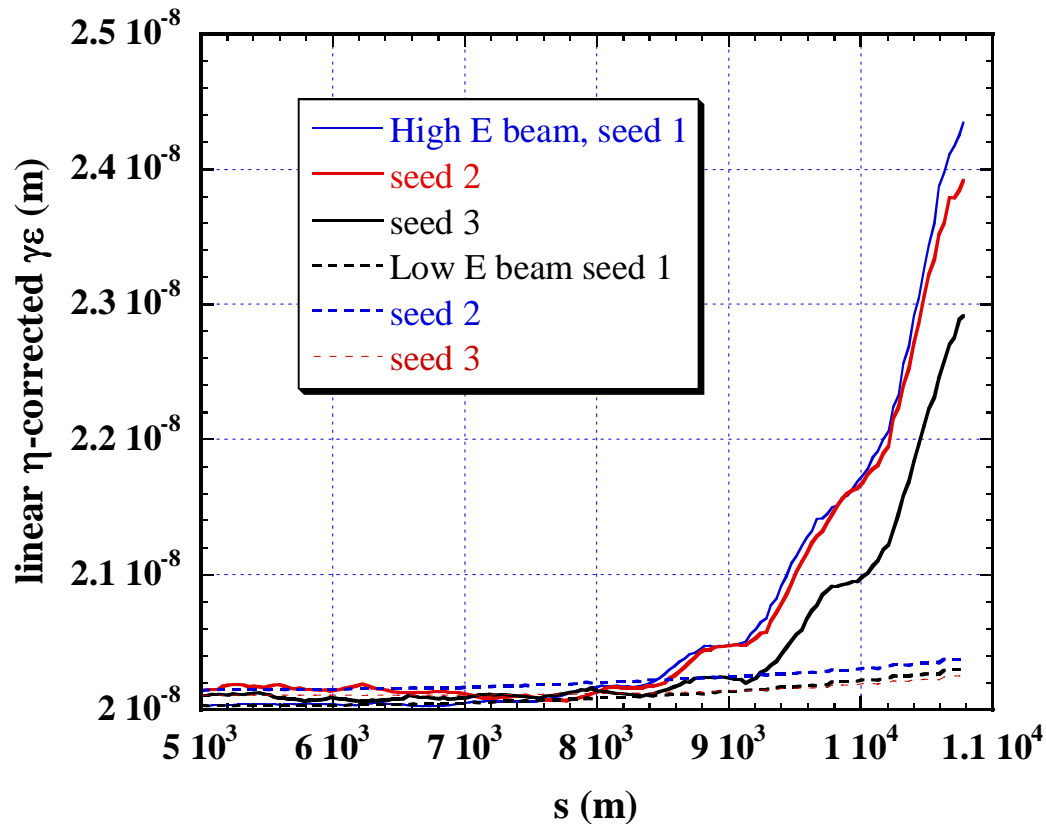
Only three linacs (random seeds) were simulated this time.

# Vertical orbit difference between high and low energy beam



Orbit change by 2 mm at the linac end.  
No important dependence on misalignment.

# Vertical emittance of high and low energy beam in linacs tuned with low energy beam



Emittance growth looks acceptable.

# Consideration for 1/2 collision rate option

- High energy beam in linacs tuned with low energy beam
  - Orbit will be different from low energy beam by about 2 mm at the linac end.
    - This is due to curvature of the linac.
  - Emittance growth will not be significant.
- **No problem in the main linac.** (2 mm is within aperture.)

But

- Probably, undulator section cannot accept 2 mm orbit change.
  - **Need switching magnets to correct the change.**
- Orbit of high energy beam in undulator must be good and emittance of low energy beam must be preserved.
  - **Bypass beam line of the undulator section will be desirable (may be necessary)** for low energy (colliding) beam.
    - Should be checked.