Linac Lattice Configuration

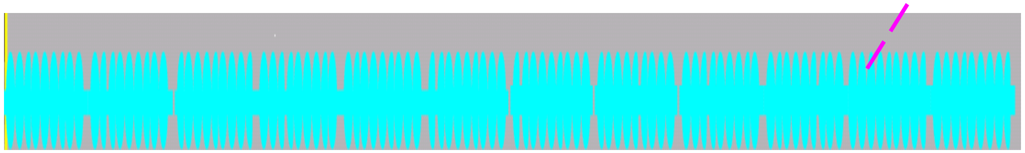
- Choice based on experience and multiple cross-checked calculations
  - TESLA TDR like lattice with continuously curved/segmented linac:
    - Most of Installation tolerances for cavity, Quad/BPM are achievable and was demonstrated at TTF cryomodules.
    - BPM resolution ~few µm routinely achieved.
    - One-to-one and DFS tuning algorithm was demonstrated, need more understanding of possible limitation.
    - XFEL as a benchmark ?

- Choice based on potential cost savings (need R&D)
  - Lattice with larger quad spacing:
    - High Energy part of the Linac is more robust (smaller emittance dilution). Larger quad spacing here is cost saving
    - Using beam position information from cavities for BBA will allow reduce number of BPMs.

MAIN LINAC CONFIGURATION

- Main Linac Design
  - ⇨ **TESLA TDR like** main Linac Lattice (280 quads) or regular **1 Quad / 2CM** Lattice (330 Quads)
  - ⇨: Linac Cryogenic system is divided into Cryomodules(CM), with **12 RF structures / CM**
  - ⇨ TTF like CM with 8 RF structures / CM is also fit both Lattice configurations
  - ⇨ Magnet Optics : FODO "constant beta" lattice, with β phase advance of **60^0** in each plane
  - ⇨ Each quad has a *Cavity style BPM* and a *Vertical Corrector* magnet; horizontally focusing quads also have a nearby *Horizontal Corrector* magnet.
- Main Linac Parameters
  - ⇨ ~**11.0 km** length (500 GeV c.m.)
  - ⇨ **9 Cell** structures at **1.3 GHz** and **12 structures** per cryostat; Total structures : **7920**
  - ⇨ Loaded Gradient : **30 MV/m** (Original: 28 MV/m; *TESLA TDR: 23.5 MV/m*)
  - ⇨ Injection energy = **5.0 GeV** & Initial Energy spread = **2.5 %**
  - ⇨ Extracted beam energy = **250 GeV** (500 GeV CM)
- Beam Conditions
  - ⇨ Bunch Charge: **2.0×10^{10} particles/bunch**
  - ⇨ Bunch length = **300 μm**
  - ⇨ Normalized injection emittance:
    - **$\gamma\varepsilon_Y$ = 20 nm-rad**

TESLA SC 9-Cell Cavity



12 "9-Cell Cavity" CryoModule

Main Linac Bending Options (site dependant solution):

- Straight line Linac, No bends.
- Continuously vertically curved Linac with bending magnets between CM, extra magnets, extra lengh
- Discrete vertical bends:
  1 bend / Linac for 500GeV c.m.; 2 bends per each Linac for 1 TeV.
  200m extra length per one bending Arc Optics

Installation tolerance (might be revised as a result of studying):

BPM Offset w.r.t. Cryostat	300 µm
Quad offset w.r.t. Cryostat	300 µm
Quad Rotation w.r.t. Cryostat	300 µrad
Structure Offset w.r.t. Cryostat	300 µm
Cryostat Offset w.r.t. Survey Line	200 µm
Structure Pitch w.r.t. Cryostat	300 µrad
Cryostat Pitch w.r.t. Survey Line	20 µrad
BPM Resolution	1.0 µm
BPM offset in launch region	~30 µm
Beam jitter	0.5 sigma

Beam based alignment methods:

- One-to-one correction as a first stage
- DFS; Ballistic alignment; Kubo or combination; second stage
- Tuning bumps: Linac entrance, exit,…

Bunch compressor (final choice depends DR parameters and bunch length 300 μm vs 150 μm):

- One or two stage bunch compressor (depending DR
- One stage ~ 500m
- Two stage more flexible choice, more tolerable to DR extraction tolerances, ~1000m

Quad and Cavity apertures

- Linac will presumably tolerate the increasing of the wakefield due to:
  - New shape HG cavities with smaller aperture ~30mm
  - New Quad design with smaller aperture ~35mm

Beam diagnostic sections:

- Linac entrance
- After Bunch compressor
- Linac exit
- Middle of the Linac: desirable, especially during linac comissioning.