XFEL Diagnostic Sections BC1 & BC2
- Revised Layout -

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New Design Criteria as a result of XFEL Bunch Compressor Review Meeting (18/12/2006):

1. Too complex, too long (K Floettmann, W Decking, …)
2. Budget (R Brinkmann): 1 TDS per diagnostic section
3. LSC (M Dohlus): Significant contribution from warm sections – keep them short
4. Girder/module length: ca. 6m (N Mildner, T Wohlenberg)
   Common girder/module concept
Current Fluctuations (rms) for a laser heater, $R_{56}$ of 0.85 mm in Collimator and 5 kA electron beam

**Old Layout**
- Total Irms: 269 A
- Diagnostic Sections: 269 - 79 = 190 A (70%)
- Diagnostic Section Inj: 110 - 79 = 31 A (16%)
- Diagnostic Section BC1: 213 - 110 = 103 A (55%)
- Diagnostic Section BC2: 269 - 213 = 56 A (29%)

**New layout** (-34% in BC1, -7% in BC2)
- Total Irms: 221 A (-18%)
- Diagnostic Sections: 221 - 79 = 142 A (-25%)
- Diagnostic Section Inj: 110 - 79 = 31 A (-0%)
- Diagnostic Section BC1: 178 - 110 = 68 A (-34%)
- Diagnostic Section BC2: 221 - 178 = 43 A (-23%)

Matchcad code by Martin Dohlus
Diagnostic Section BC1: old Engineering Layout

Lattice can be divided into modules:

- 10 modules: 3.8 m (3.8 meters)
- 5 modules: 7.6 m (7.6 meters)

Alignment laser

2.5m

Booster Linac

FODO lattice

RES

T2

SR
Diagnostic Section BC1: New Layout 2007

Total length: 29.5m (44.5m)
Quads (QC): 15 (22)

New!

5 modules!
+ 1 upstream BC
Optics Layout Diagnostic Section 1
Slice emittance measurements (optic 1)

Resolution in x and y: long. Profile: 15 fs, slice emittance: 37 fs

Matching into Linac

3 FODO cells
45° / 45°

67 deg
113 deg

Old!
Slice emittance measurements (optic 1)

Resolution only in x: long. Profile: 11 fs, slice emittance: 13 fs

Win32 version 8.51/15

1.5 FODO cells

30° / 76°
Optics Layout Diagnostic Section 1
Projected emittance/ commissioning (optic 2)

6 FODO cells:
All phase advances between 22.5 and 90 deg can be matched!
Optics Layout Diagnostic Section 1
Projected emittance/ commissioning (optic 2)

New!

ALL

Win32 version 8.51/15
18/01/07 21.57.14

3 FODO cells:
45 deg phase advance

(Similar to DBC2-Section in FLASH)
Diagnostic Section BC2: New Layout 2007

Total length: 60.1m (64.0m)
Quads (QD): 18 (19)

10 modules
+ 1 upstream BC

ORS laser

FODO lattice

Main Linac

Modulator

Dispersive Section

Radiator

3.6m

2.0m

3.7m

TDS-x

VK1

VK2

2.5m

New!
Optics Layout Diagnostic Section 2
Slice emittance measurements 76 deg (optic 1)

Resolution only in x: long. Profile: 11 fs, slice emittance: 12 fs
Optics Layout Diagnostic Section 2
Slice emittance measurements 76 deg (optic 1)

New!

Resolution only in x: long. Profile: 11 fs, slice emittance: 13 fs
Optics Layout Diagnostic Section 2
Projected emittance/ commissioning (optic 2)

New!

3 FODO cells: 45 deg phase advance

Matching into Linac
Conclusions

Conclusions (1):

Diagnostics Sections BC1 and BC2 have been optimised for compactness and simplicity. The length has been reduced:
BC1: +1.0 m in BC and -15 m in diag section = -14 m
BC2: +1.0 m in BC and -3.9 m in diag section = -2.9 m
LSC reduced by 18%

Both sections have similar generic layout, i.e. similar operation modes, controls, analysis tools, ...

Asymmetric FODO lattice is optimised for slice emittance measurement in y-plane. Different optics need to be loaded for projected emittance measurement.

Number of quads in revised Diagnostic Section layout
BC1 was 22 now 15 (magnet list B. Krause 27 QCs)
BC2 was 19 now 18 (magnet list B. Krause 17 QDs)
Conclusions (2):

Layout of the Diagnostic Sections can be arranged in 5.7 m long girders/modules.
Components can be pre-aligned and tested.
This saves time during installation and commissioning.
BC1: 5 + 1 girders/modules
BC2: 10 + 1 girders/modules

Meeting on the engineering layout of the girders:
Wednesday 18/4/07 13:00h, Bldg. 55a – Room 110