FLASH II.
Preliminary design of the extraction beam line.

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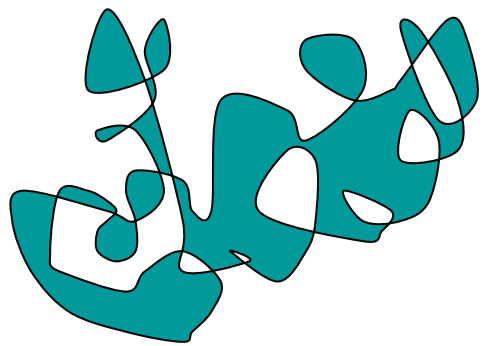


The challenges are:

- A fast distribution of the beam within one rf pulse (kicker-septum extraction scheme).
- A compact design to allow as much space as possible for the undulators.
- The principle possibility to add another beam line at a later stage (FLASH III).
- All beam lines of the FLASH facility will be operated simultaneously.

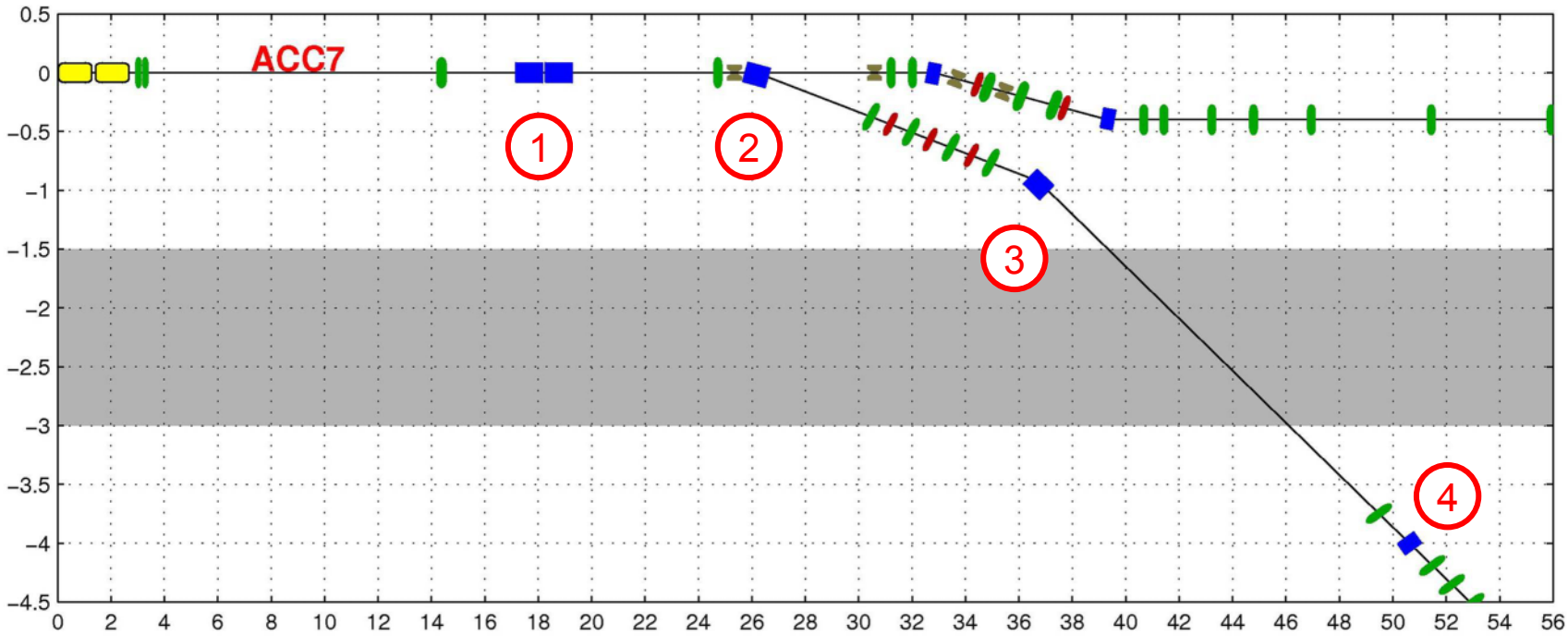
This means that the extraction line optics should not require special initial betatron functions and thus a change of quadrupole settings upstream of the extraction point.

- Beam transport while preserving the beam quality required for lasing.
- Geometry constraints and etc…..

Note that design presented was made for the case of the 'spike-like' compression scheme as presently used for FLASH (may be simple reduction of bending radii by usage of longer dipoles will already help to deal with CSR effect on projected emittance ?).

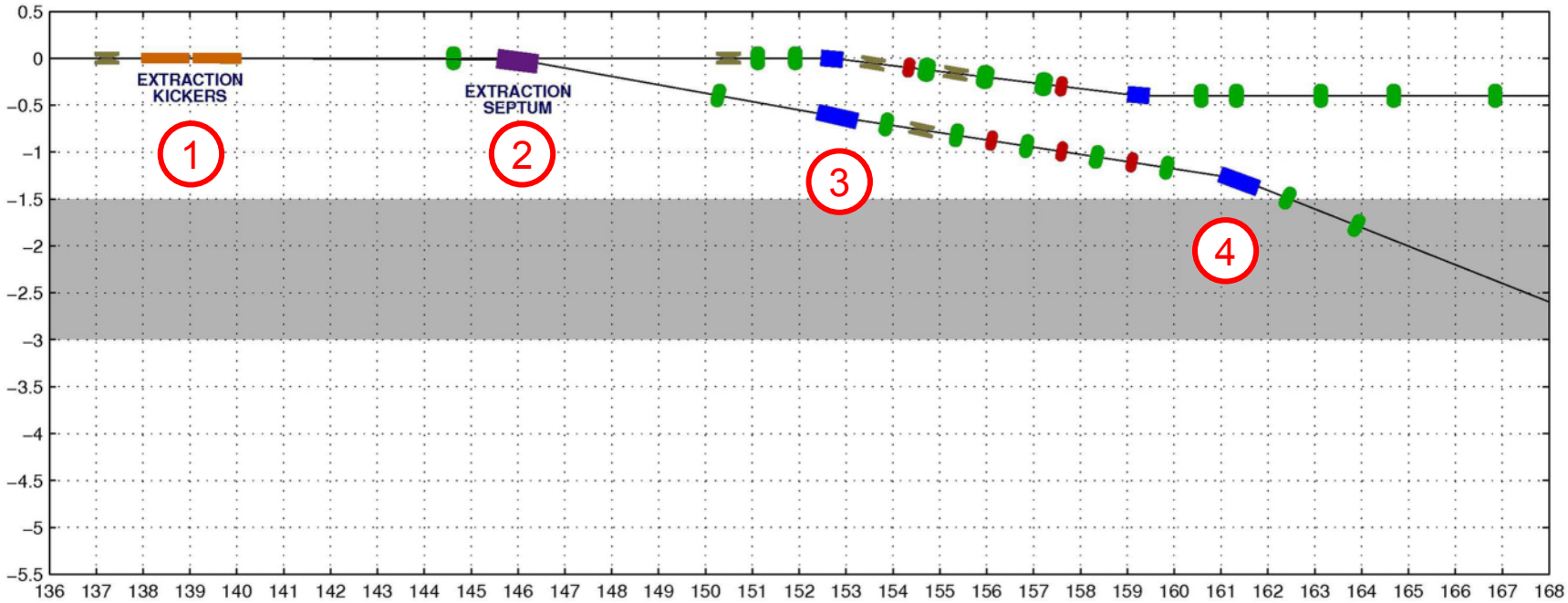
Also, it is assumed that kickers and septum all deflect beam horizontally (i.e. we use current sheet septum as originally was used for design of the XFEL beam separation area). Do we have to make new design using Lambertson type septum ?

Layout of the extraction area for the FLASH II beam line (Emax = 1.3 GeV, Version 1, October 2007)



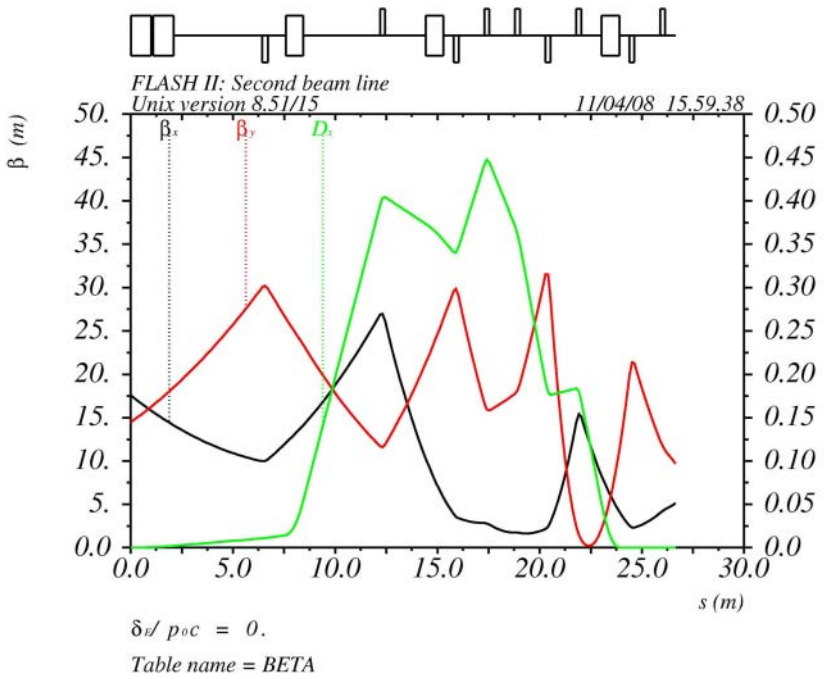
1. Two kickers. Each 1 *m* long with maximal field 0.005 *T*. This gives ~2 *mrad* beam deflection and ~13 *mm* beam offset from the linac axis at the septum entrance.
2. Septum. 0.85 *m* long with maximal field 0.445 *T*. This gives 5° beam deflection.
3. First dipole magnet. 0.85 *m* long with maximal field 0.67 *T*. This gives 7.5° beam deflection.
4. Second dipole magnet. Very weak (deflection angle of about -0.2°) and is used for dispersion matching.

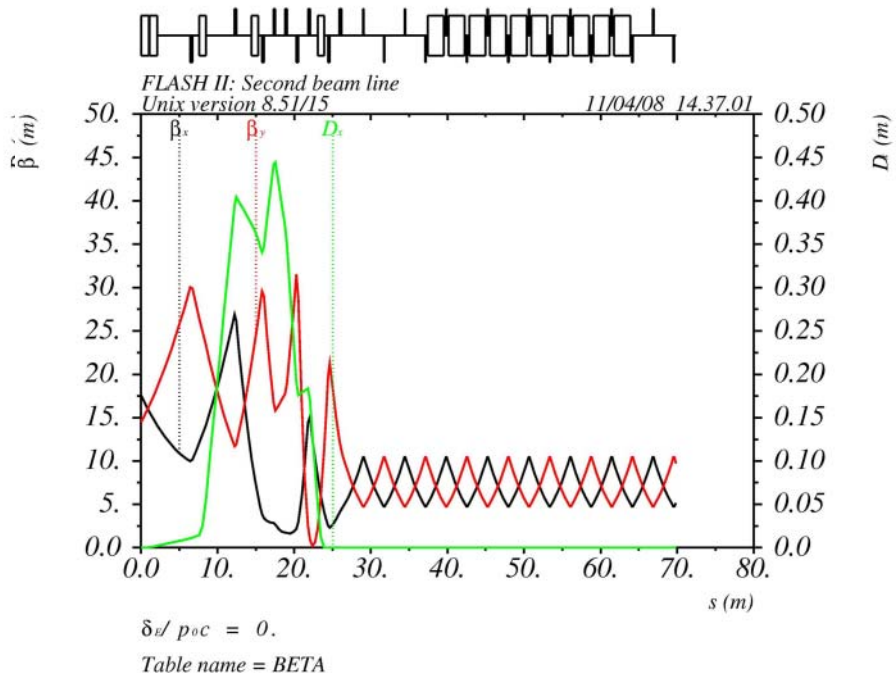
Layout of the extraction area for the FLASH II beam line (Emax = 1.4 GeV, Version 2, March 2008)



1. Two kickers. Each 1 *m* long with maximal field 0.005 *T*. This gives ~2 *mrad* beam deflection and ~13 *mm* beam offset from the linac axis at the septum entrance.
2. Septum: 0.85 *m* long, +5° beam deflection, 0.48 T for 1.4 GeV.
3. First dipole magnet: 0.85 m long, -0.7° beam deflection, 0.07 T for 1.4 GeV (weak).
4. Second dipole magnet: 0.85 m long, +6.8° beam deflection, 0.65 T for 1.4 GeV.

Optical functions

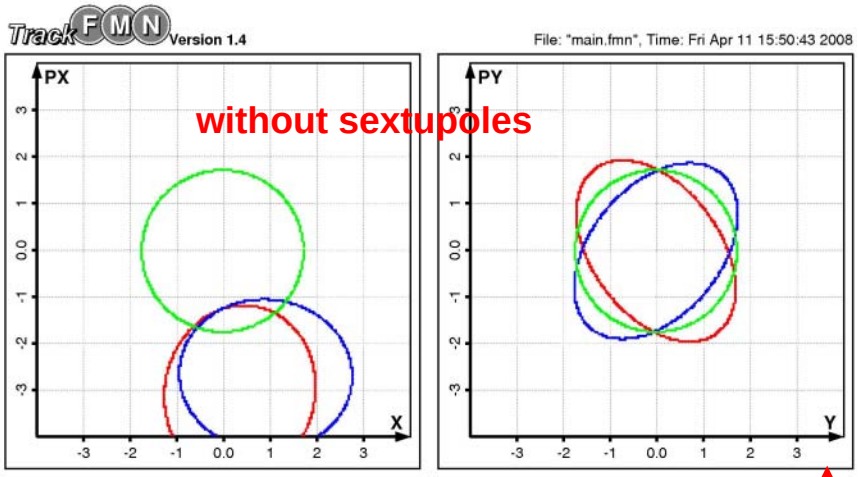


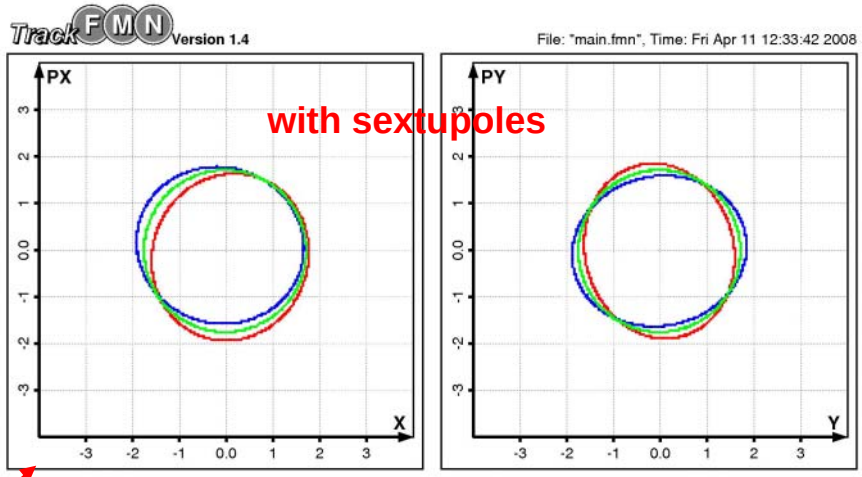


Extraction optics does not require special initial betatron functions and changing of quadrupole settings upstream of the extraction septum.

R56 of the shown system is equal to zero and there is a possibility for its tuning in some range organizing "dispersion bump" through the central dipole.

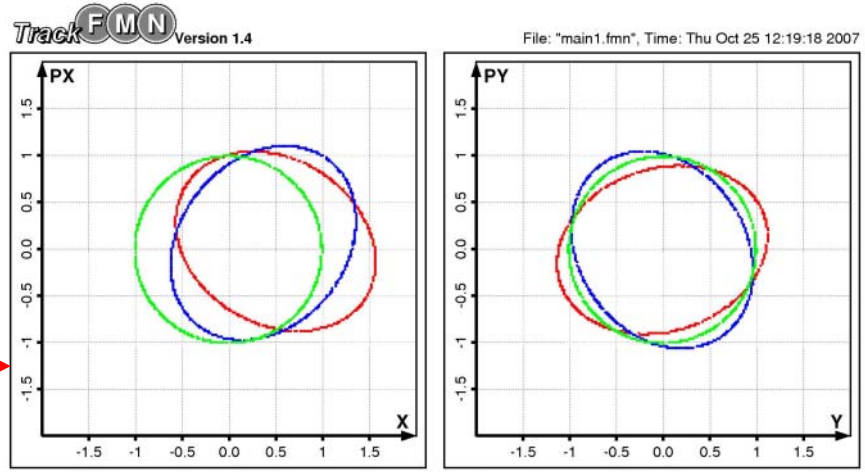
Chromatic properties of the beam transport





Phase space portraits of monochromatic 3σ ellipses (matched at the entrance) after tracking through the extraction arc. The relative energy deviations are equal to -1.5%, 0% and + 1.5% (red, green and blue ellipses, respectively).

For comparison: tracking through the existing collimator dogleg.



Conceptual layout of extraction into the third beam line