TLEP ... Lattice Design & Beam Optics

starting point: version-top, 175 GeV

	TLEP Z	TLEP W	TLEP H	TLEP t
E_{beam} [GeV]	45	80	120	175
I_{total} [mA]	1180	124	24	5.4
#bunches/beam	4400	600	80	12
#e−/beam [10^{12}]	*1960*	*200*	*40.8*	*9.0*
horiz. emit. [nm]	30.8	9.4	9.4	10
vert. emit. [nm]	0.07	0.02	0.02	0.01
β^*_x [m]	*0.5*	*0.5*	*0.5*	*1*
β^*_y [mm]	*0.1*	*0.1*	*0.1*	*1*
σ^*_x [μm]	*124*	*78*	*68*	*100*
σ^*_y [μm]	*0.27*	*0.14*	*0.14*	*0.10*
L/IP[10^{32}cm^{-2}s^{-1}]	*5600*	*1600*	*480*	

TLEP ... Lattice Design

not the very first steps anymore (... V8.c)

Text-Book like approach

still 80 km, standard FoDo structure

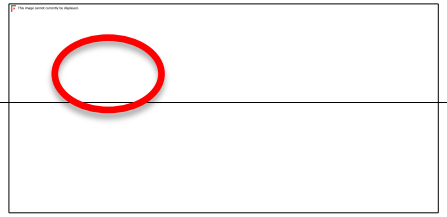
fill factor, robustness, easy to handle & modify

easy to understand & optimise analytically

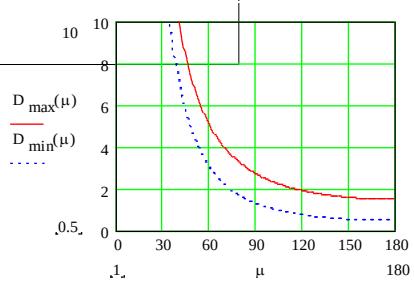
Choice of single cell: compared to V.3 ...V.6

cell length increased to L_{cell} = 50m

equilibrium emittance



scaling of dispersion in a FoDo



TLEP ... single cell

L_{cell}=50m

Dipole: N_{dipole} = 2784

L_{dipole} = 21.3 m

due to techn. reasons: 2 * 11 m

bending angle = 2.2 mrad

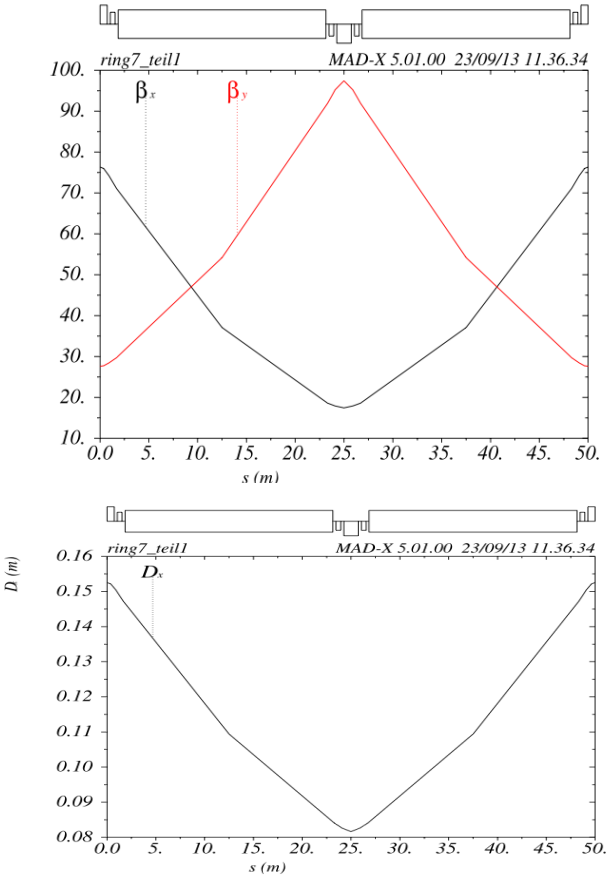
B_0 = 610 Γ

Quadrupole:

$L_{quadrupole}$ = 1.5 m

$k=3.55*10^{-2}\ m^{-2}$

$g=20.7\ T/m$



$\beta \approx 100m$, D_x= 15.3 cm

TLEP ... Lattice Design

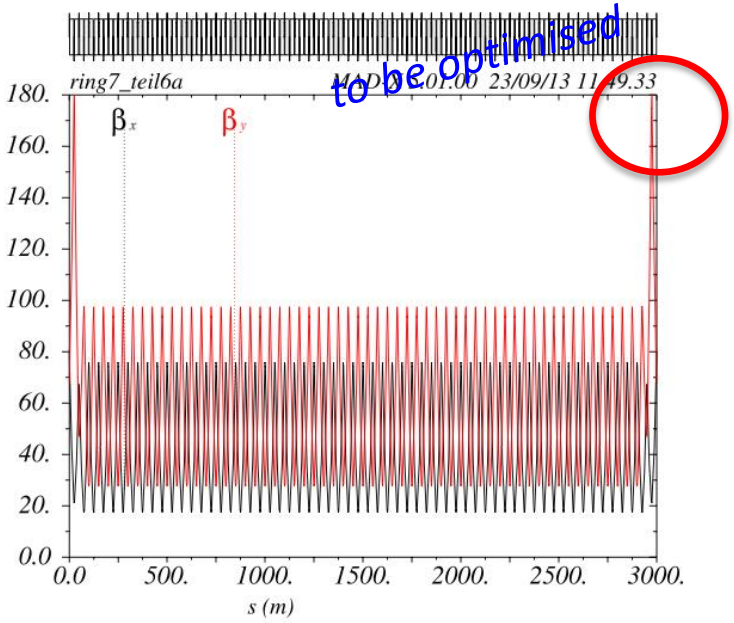
24 Arcs : 56 standard FoDo cells & 2 half bend cells at beginning and end

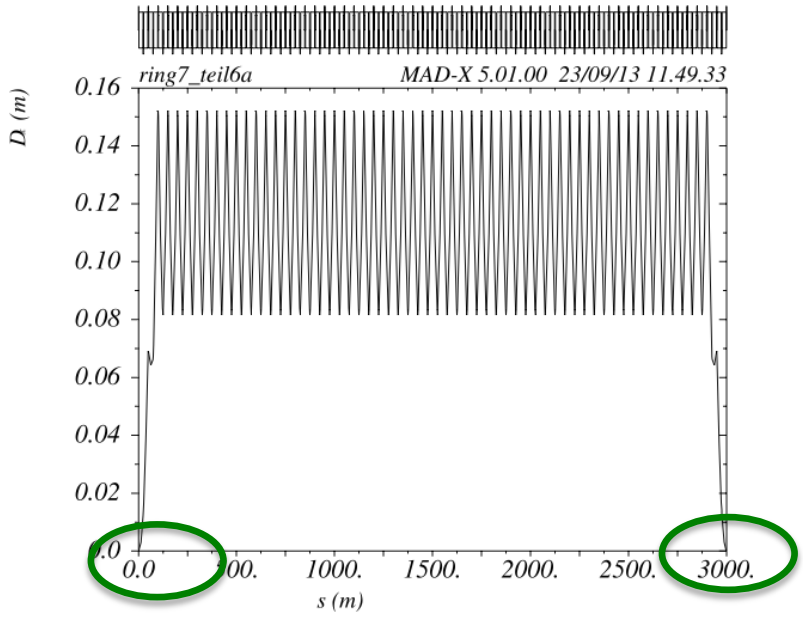
length of arc: 3.0km

each arc is embedded in dispersion free regions ...

arcs are connected by straight sections ... 12 long (mini β and RF)

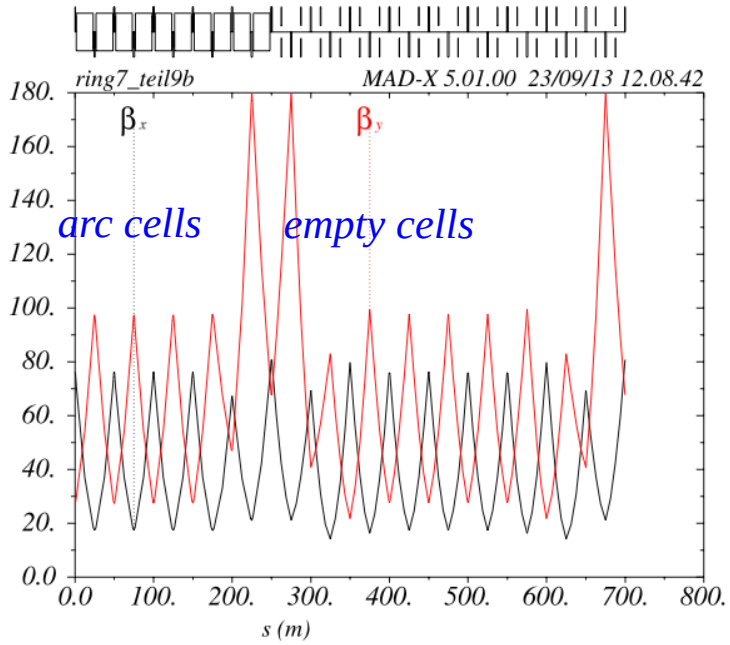
... 12 ultra shorties tbc

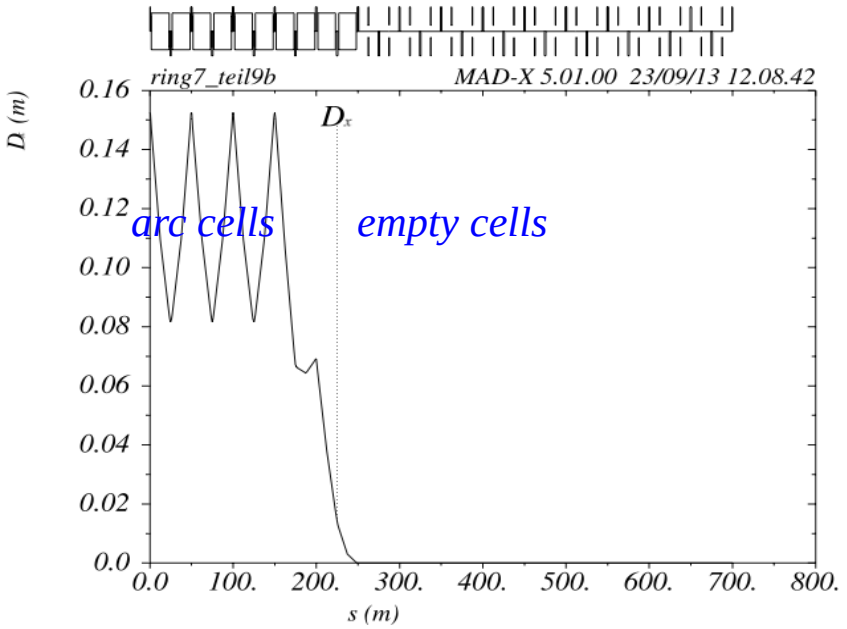




TLEP Straights

8 Straights : 9 empty (i.e. dispersion free) FoDo cells including matching sections
arc-straight, l = 450m

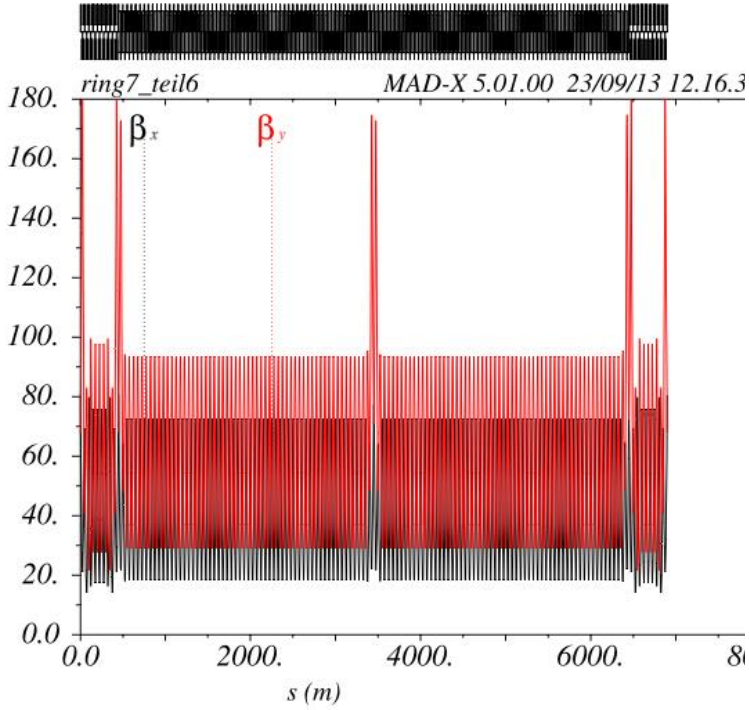


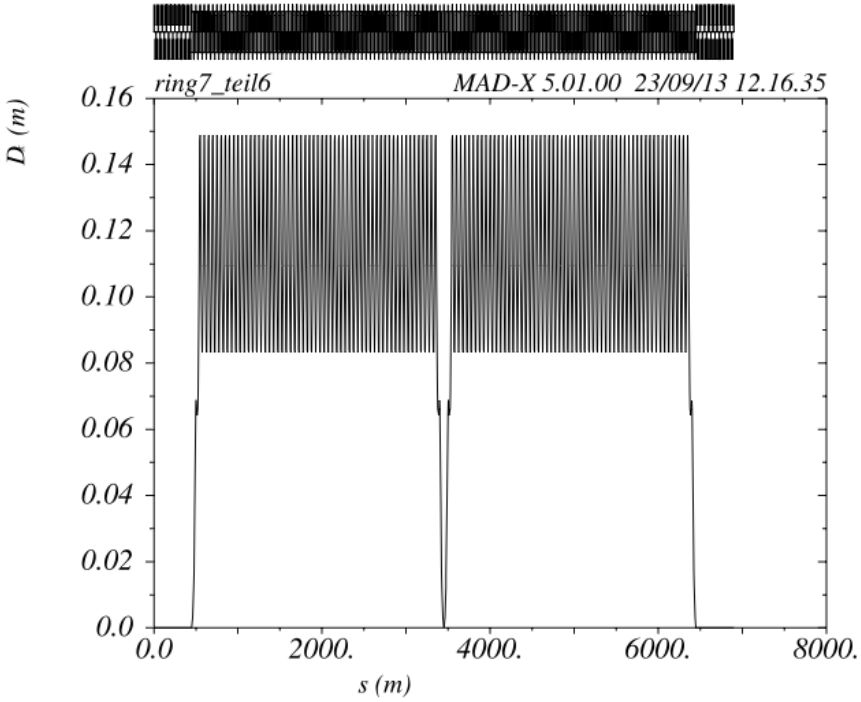


to be optimised: β_y at matching section,
needs an additional quadrupole lens → already built in but not used yet.
and / or optimisation of the lens positions

TLEP Octant

Straight – Arc – Arc - Straight





TLEP Mini-Betas

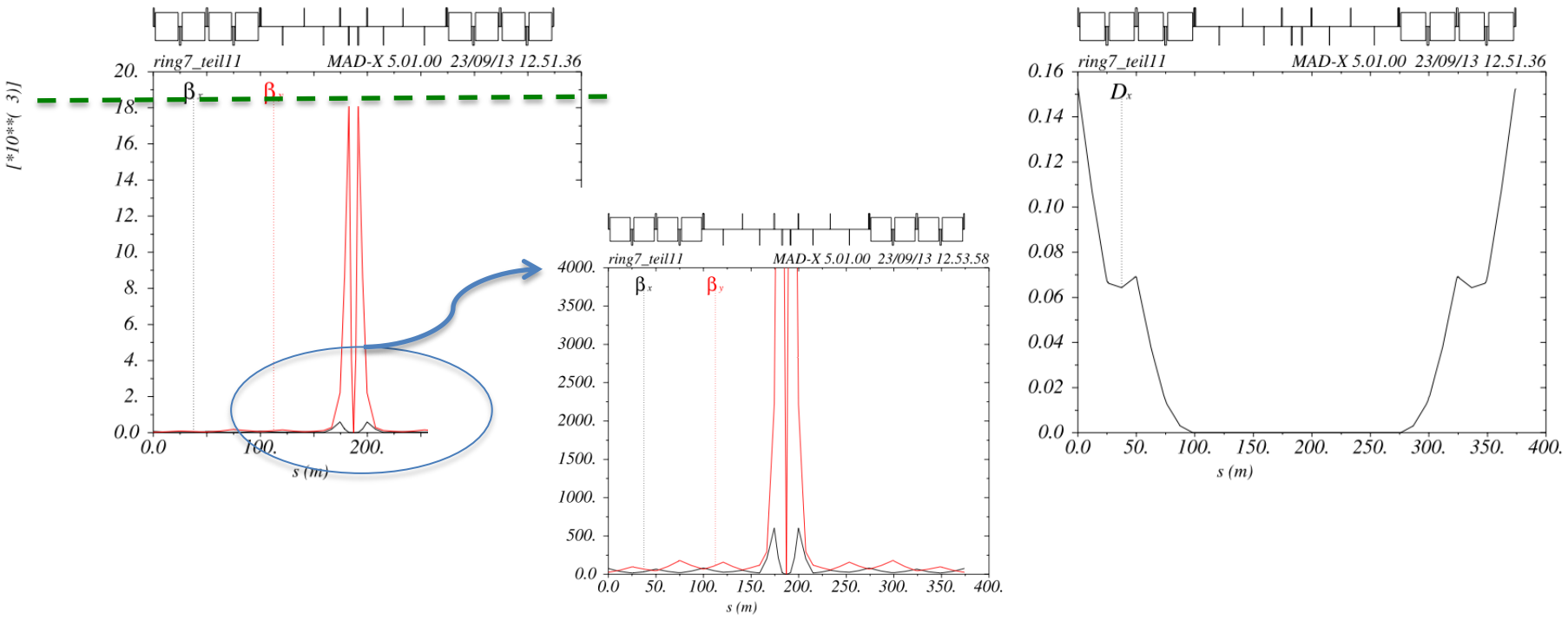
4 Mini-beta-Insertions : based on empty (i.e. dispersion free) FoDo cells

L*=4m

β^*_x =1m, β^*_y =1mm

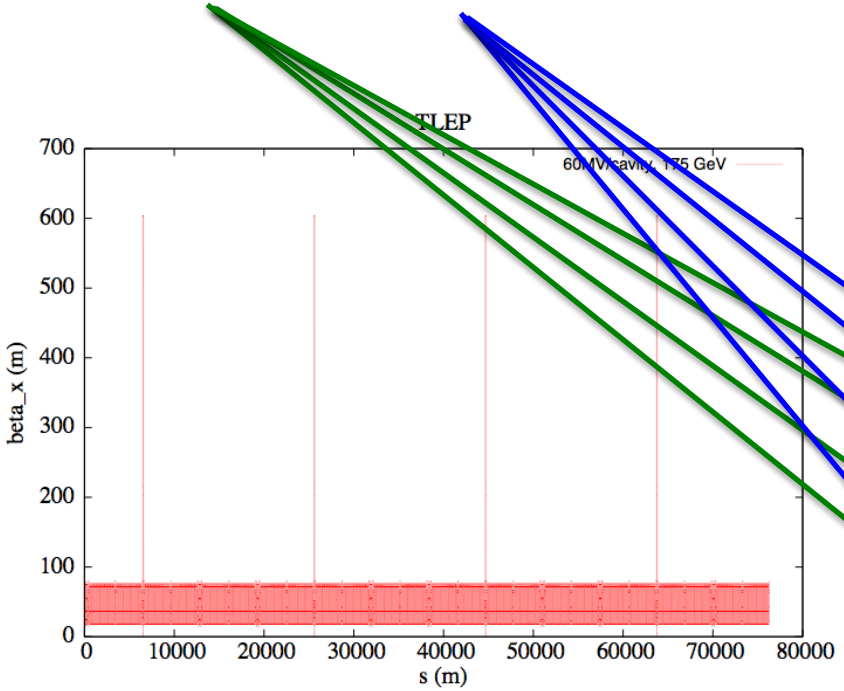
standard doublet structure & matching section

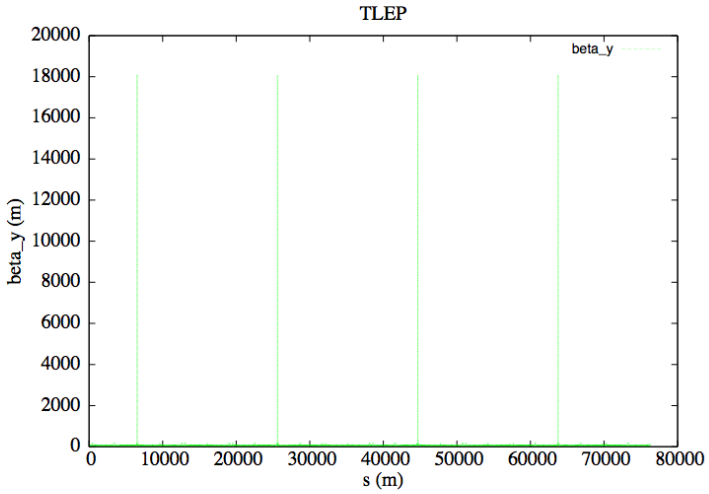
$\beta_{m,ax}$ =18 km

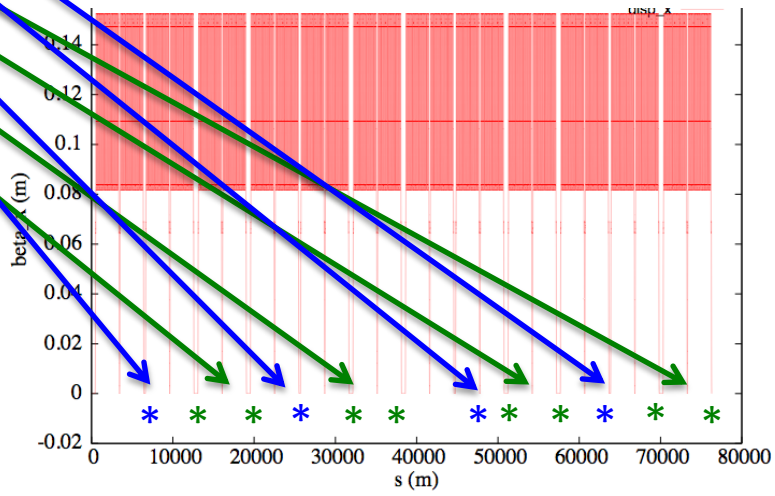


TLEP The Ring

L_{ring} = 76.3km
4 min- betas,
24 disp free straights, 12 long straights
8 for rf equipment, 4 for mini-betas

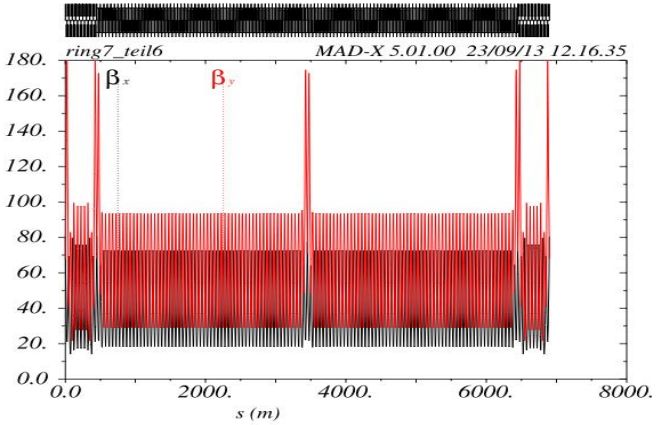






TLEP ... Lattice Design V8.c

The Ring: a kind of three times LEP

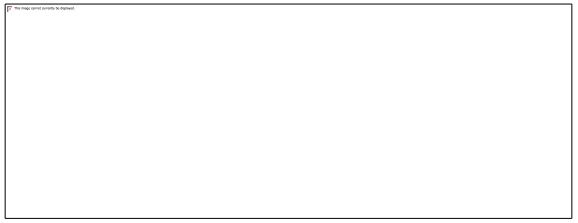


Main Parameters:

momentum compaction

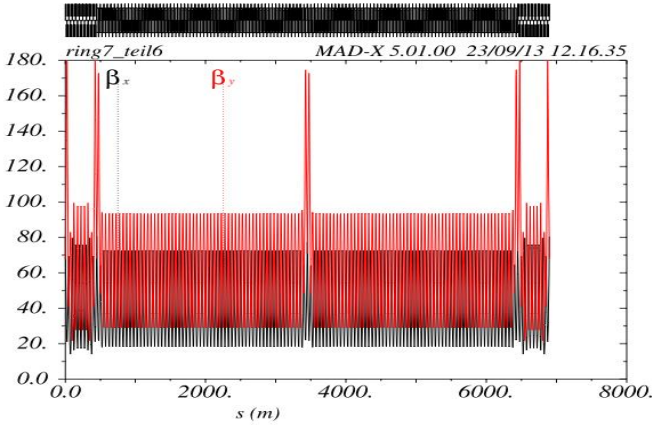
MADX: $\alpha_{cp} = 8.6 * 10^{-6}$

energy loss per turn:



MADX: $\Delta U_0 = 8.64$ GeV

TLEP ... V 8.c



Main Parameters:

Damping & Beam Emittance

Global parameters for electrons, radiate = T:

C	76296.4	m	f0	0.003929313283	MHz
T0	254.4973963	musecs	alfa	-6.710369321e-07	
eta	-6.710454585e-07		gamma(tr)	1220.750156	
Bcurrent	5.665908018e-05	A/bunch	Kbunch	1	
Npart	9e+10	/bunch	Energy	175	GeV
gamma	342466.4839		U0	8643.658514	[MeV/turn]

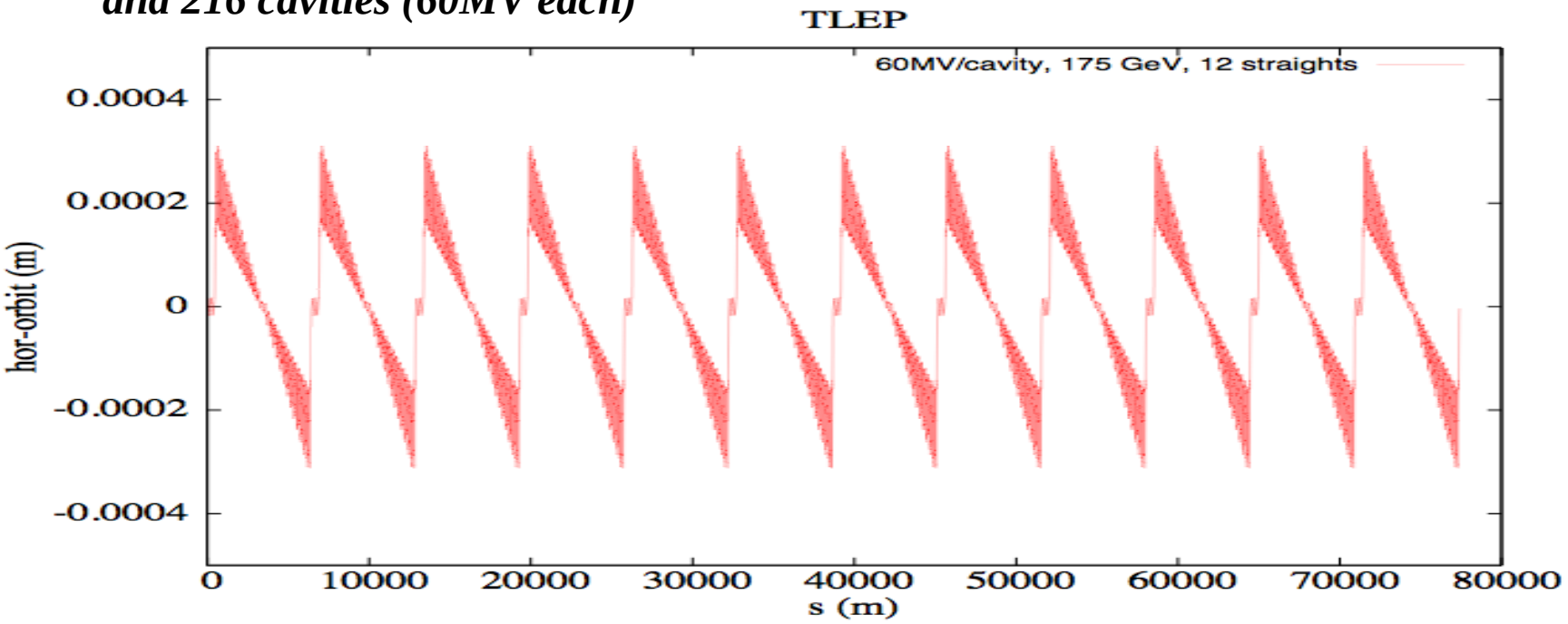
Damping partition numbers	0.99975674	0.99999623	2.00024083
Damping constants [1/s]	0.97015174E+02	0.97038413E+02	0.19410093E+03
Damping times [s]	0.10307666E-01	0.10305197E-01	0.51519589E-02
Emittances [pi micro m]	0.15912457E-02	0.27441207E-28	0.42790221E+00

Synchrotron Radiation Power

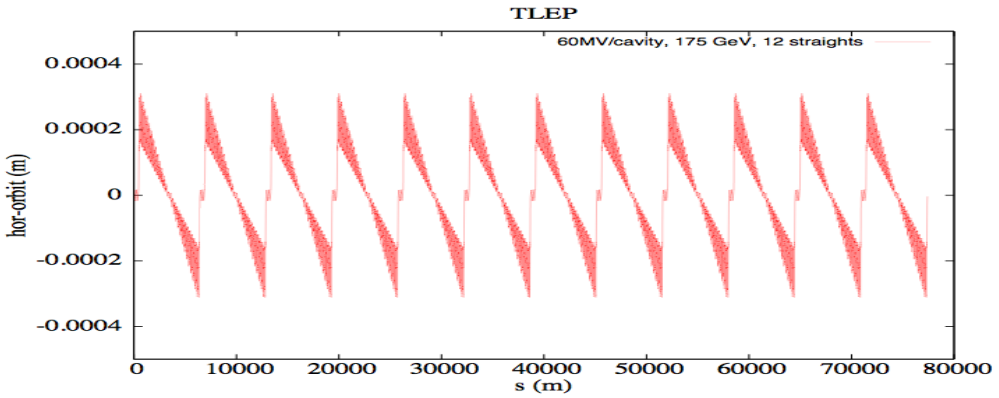
$N_p = 9*10^{12}$
$\Delta U_0 = 8.64\ MeV$
$T_0 = 263\ \mu s$

... and Saw-Tooth effect

rf distributed over 12 straights
and 216 cavities (60MV each)



Next steps:



* *Optics fine tuning*

* *Do we really need D_x= 15 cm or should we relax ??*

* *Establish complete versions for different Mini Beta Options*

* *Optimise RF distribution*
  how many straights do we really need ???

* *80 km / 100 km ??? tbd*

* *start with the Ph.D. topics:*
  what about the momentum acceptance ???