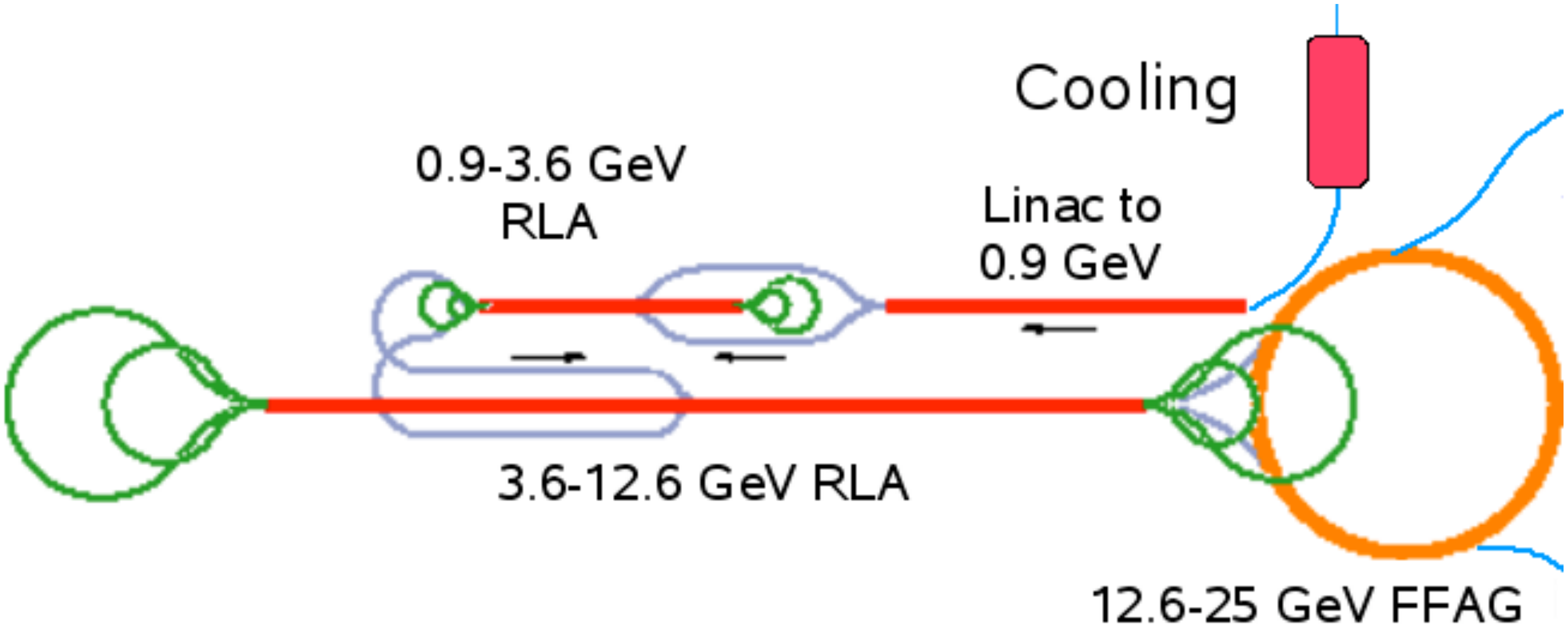
Fast acceleration



Linear Pre-accelerator (244 MeV to 900 MeV)

RLA I – 4.5 pass, **0.6 GeV/pass**, (0.9 GeV to 3.6 GeV)

RLA II – 4.5 pass, **2 GeV/pass** (3.6 GeV to 12.6 GeV)

Non scaling FFAG - 8 revolutions (12.6 GeV to 25 GeV)

SOLENOID	cSc0:cSc5	cSci1:cSci7	cScL0:cScL10
NUMBER	6	8	11
LENGTH	1	1	1
STRENGTH	1.4	1	0.83

CAVITY	A1:A6	I1:I8	L1:L11
NUMBER	6	8	11
LENGTH	0.744826	1.489652	1.489652
FREQUENCY	201249995.3	201249995.3	201249995.3

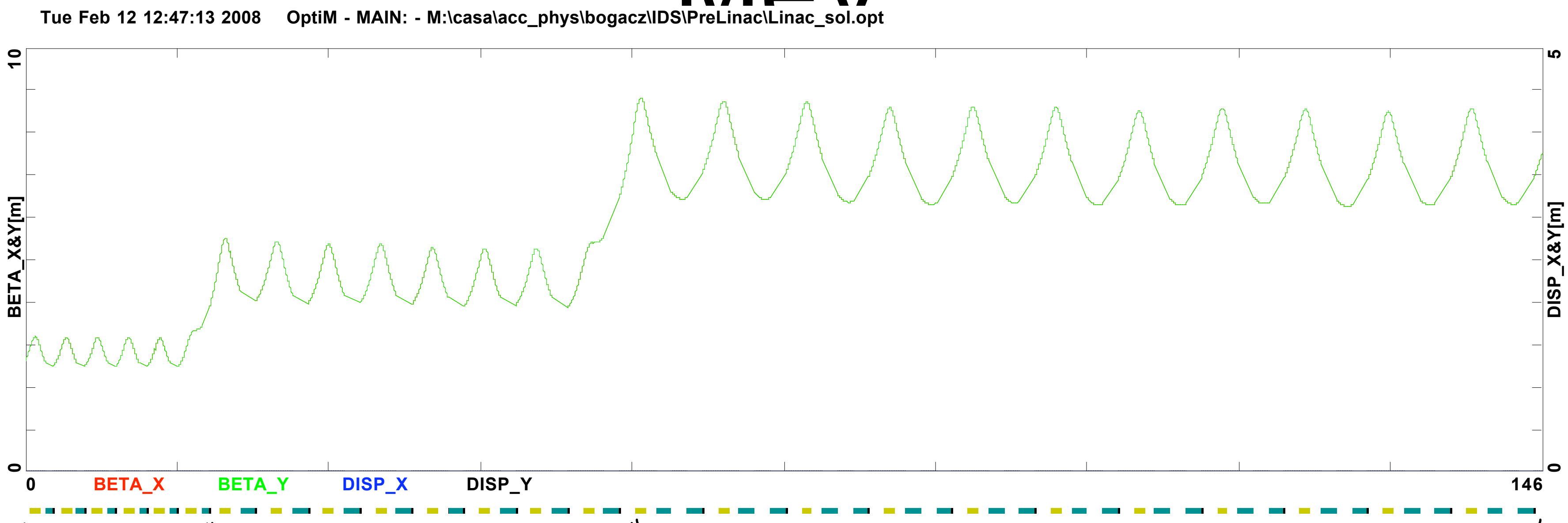
BEAM	MASS	CHARGE	ENERGY
MUON	0.105658	1	0.2440566

Solenoids

- Solenoids, in rotating frame:

  act as quadrupoles in both planes.
- The length of all solenoids are the same.
- The length of each cavity in the second and the third sets, twice as long as one in the first.

SC Linac - 201 MHz - 244 to 909 MeV



6 short cryos

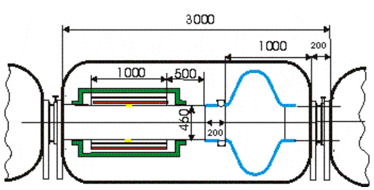
15 MV/m

8 medium cryos

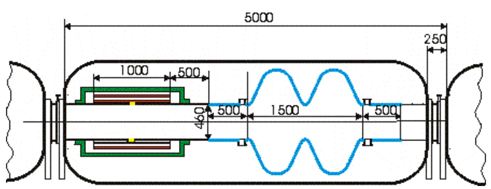
17 MV/m

11 long cryos

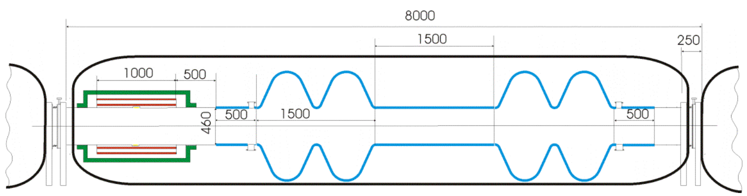
17 MV/m



1.4 Tesla solenoid

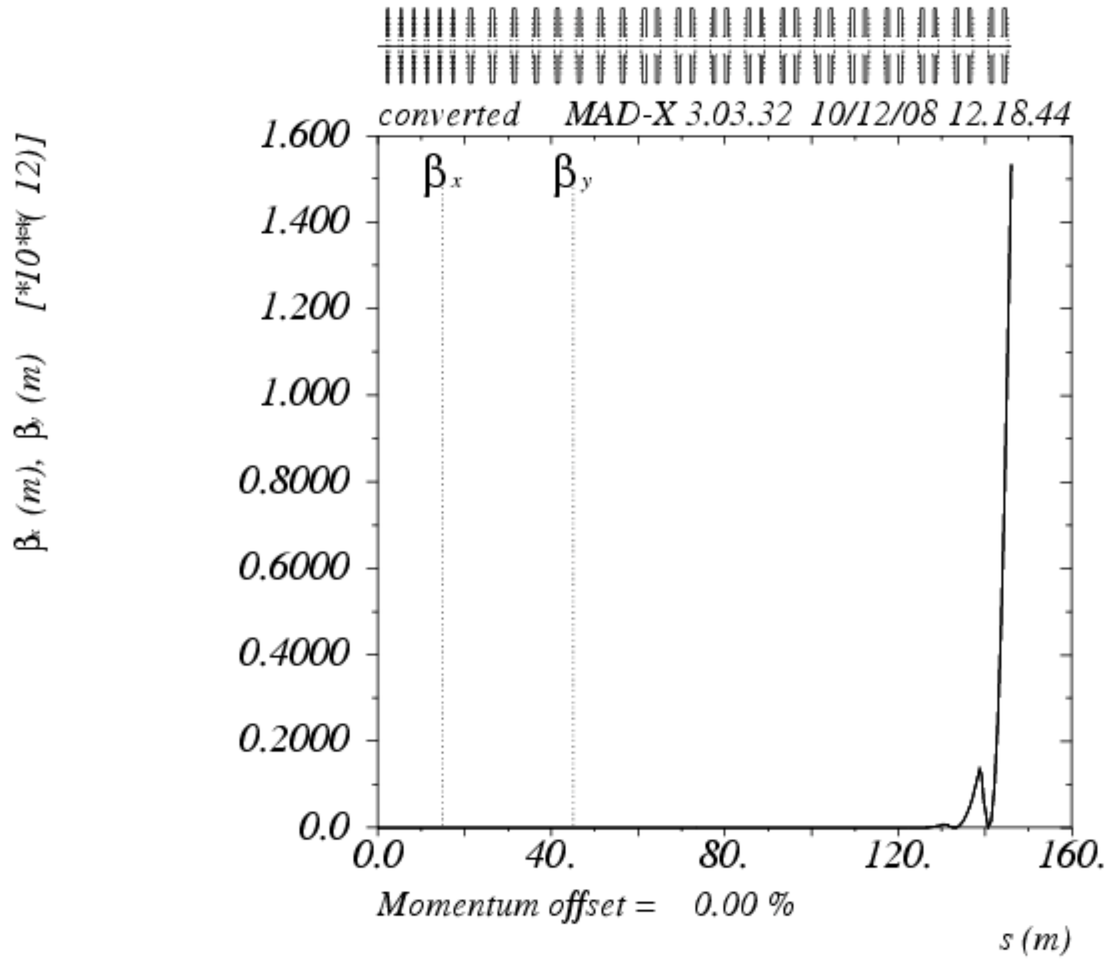


1 Tesla solenoid

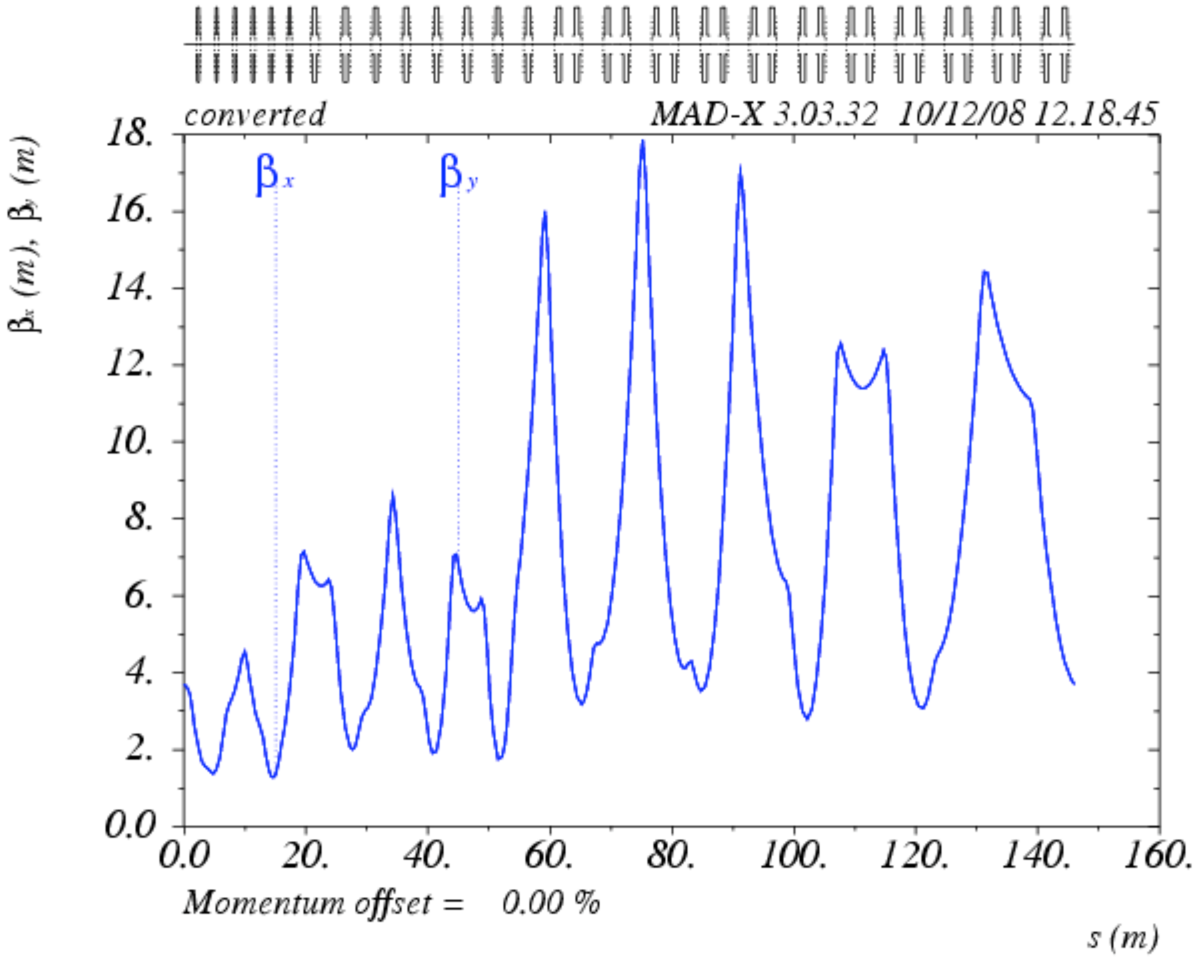


0.8 Tesla solenoid

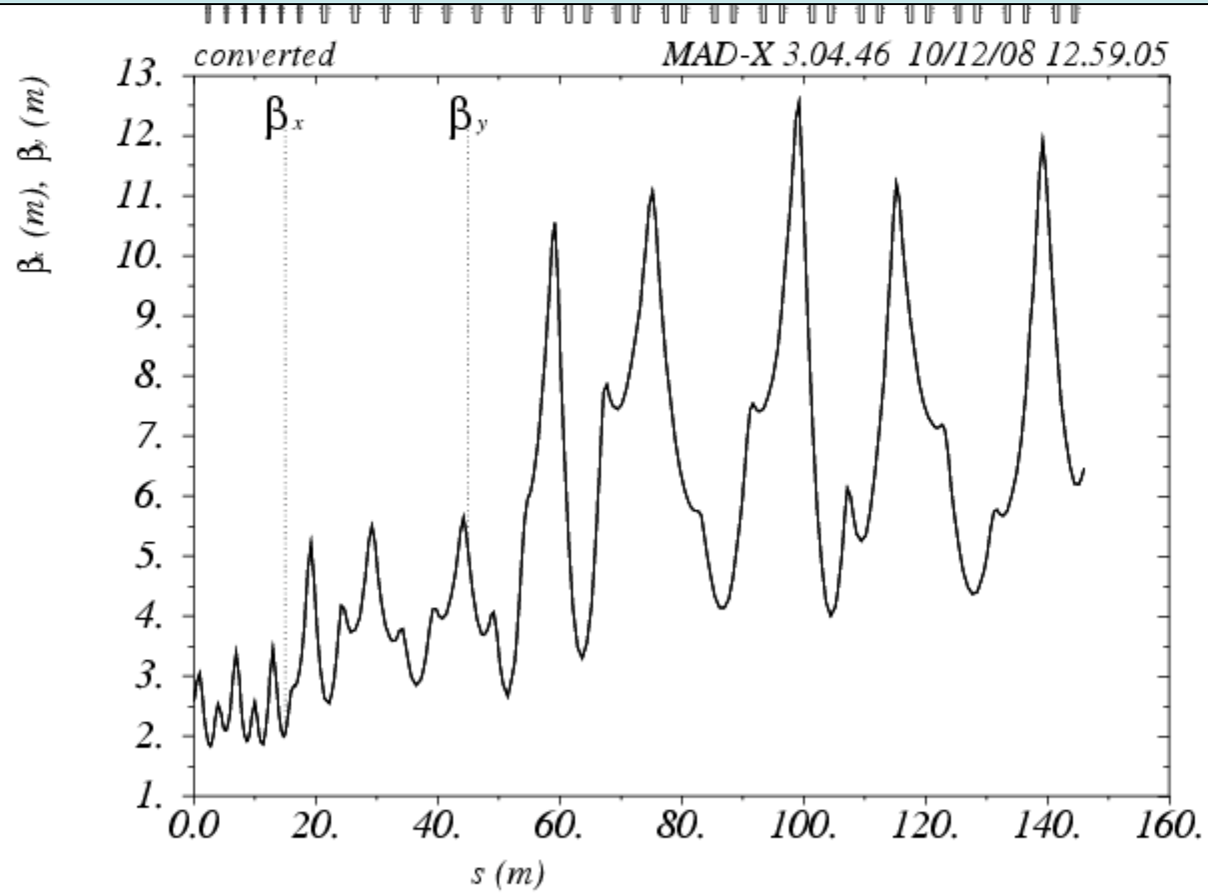
MADX, with Alex initial conditions



MADX without any initial values, matched solution



MADXP, with Alex initial condition.
No result without Initial condition!



Concern

- Difference of beta functions between Alex's code and MADX

Source of the inconsistency

- 1-Fringe field for solenoids,
  not included in MADX yet.
- 2- Mismatch in optics,
  linac focusing without a periodic boundary condition. Small mismatch at the beginning results in large beta beating.

soft-edge' solenoid model

- Zero aperture solenoid - ideal linear solenoid transfer matrix:

$$\mathbf{M}_{sol} = \begin{bmatrix} \frac{1+\cos(kL)}{2} & \frac{\sin(kL)}{k} & \frac{\sin(kL)}{2} & \frac{1-\cos(kL)}{k} \\ -\frac{k\sin(kL)}{4} & \frac{1+\cos(kL)}{2} & -k\frac{1-\cos(kL)}{4} & \frac{\sin(kL)}{2} \\ -\frac{\sin(kL)}{2} & -\frac{1-\cos(kL)}{k} & \frac{1+\cos(kL)}{2} & \frac{\sin(kL)}{k} \\ k\frac{1-\cos(kL)}{4} & -\frac{\sin(kL)}{2} & -\frac{k\sin(kL)}{4} & \frac{1+\cos(kL)}{2} \end{bmatrix} \qquad k = eB_0/pc$$

- Non-zero aperture - correction due to the finite length of the edge :

  - It decreases the solenoid total focusing – via the effective length of:

$$L = \frac{1}{B_0}\int_{-\infty}^{\infty} B_z(s)\, ds$$

  - It introduces axially symmetric edge focusing at each solenoid end:

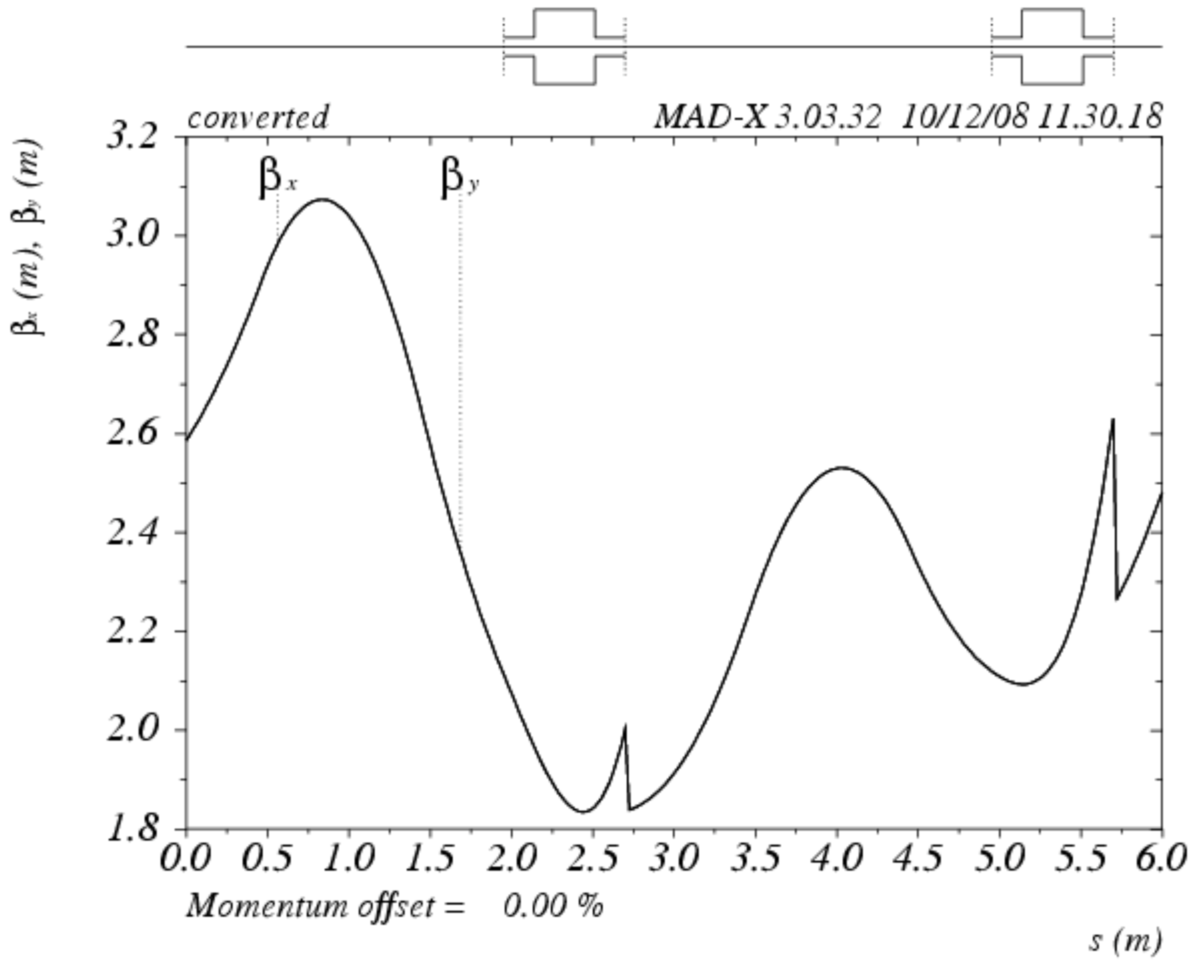
$$\Phi_{edge} = \frac{1}{2}\left(\int_{-\infty}^{\infty} B_z^2(s)\, ds - B_0^2\, L\right) = -\frac{k^2 a}{8} \qquad k = eB_0/pc$$

  - axially symmetric quadrupole

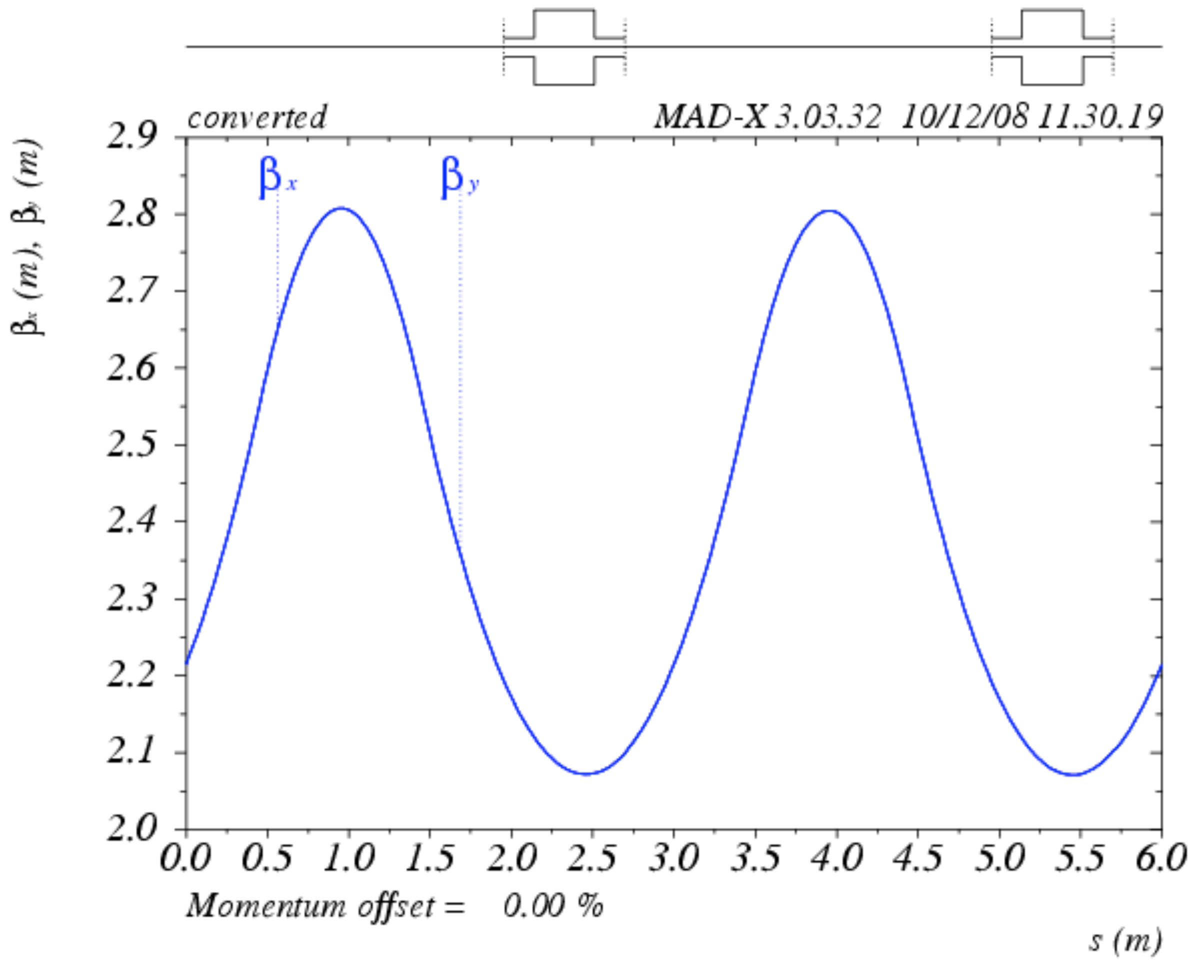
  - $$\mathbf{M}_{soft\ sol} = \mathbf{M}_{edge}\ \mathbf{M}_{sol}\ \mathbf{M}_{edge}$$

$$\mathbf{M}_{edge} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -\Phi_{edge} & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & -\Phi_{edge} & 1 \end{bmatrix}$$

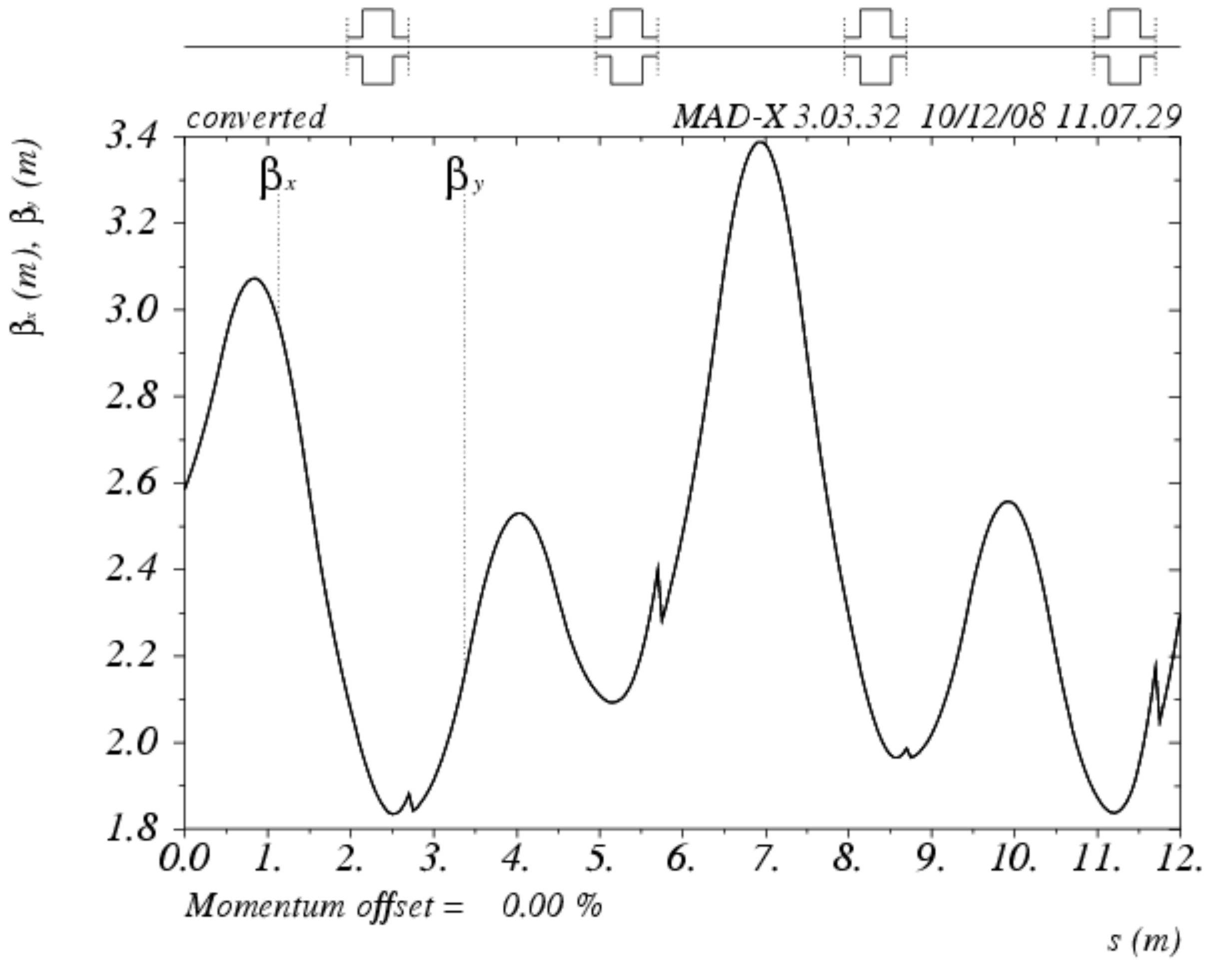
The first two solenoids, with the Alex initial conditions



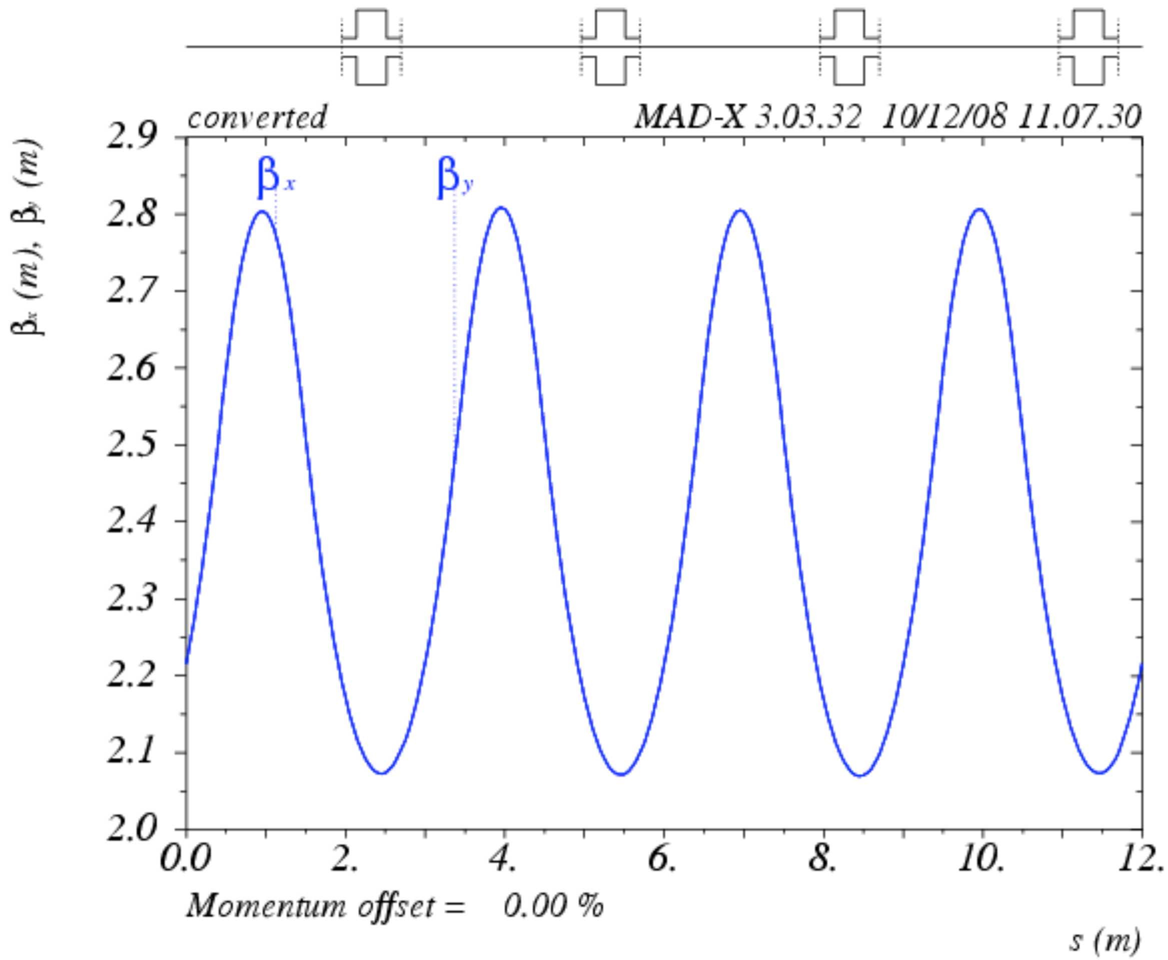
The first two solenoids, without characterising the initial conditions



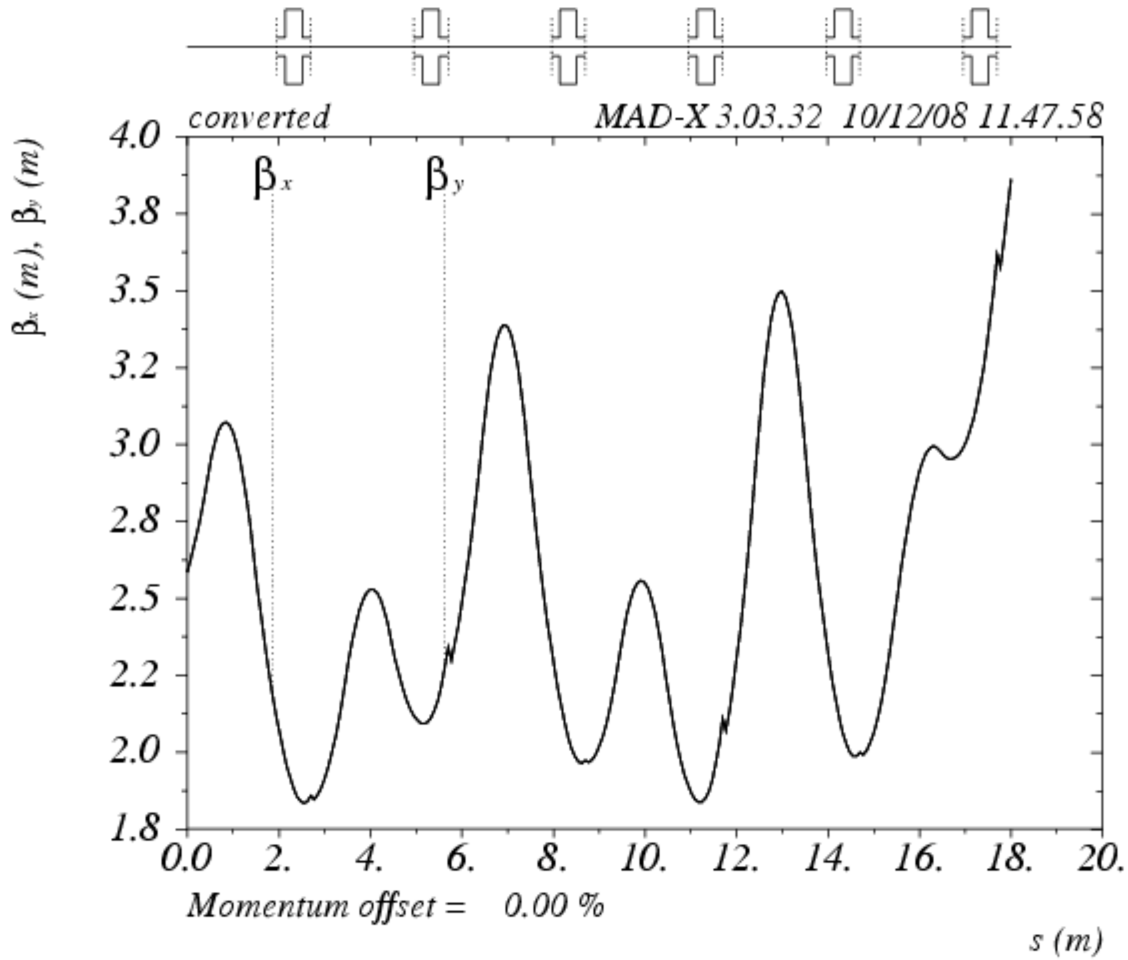
The first 4 solenoids, with Alex initial conditions



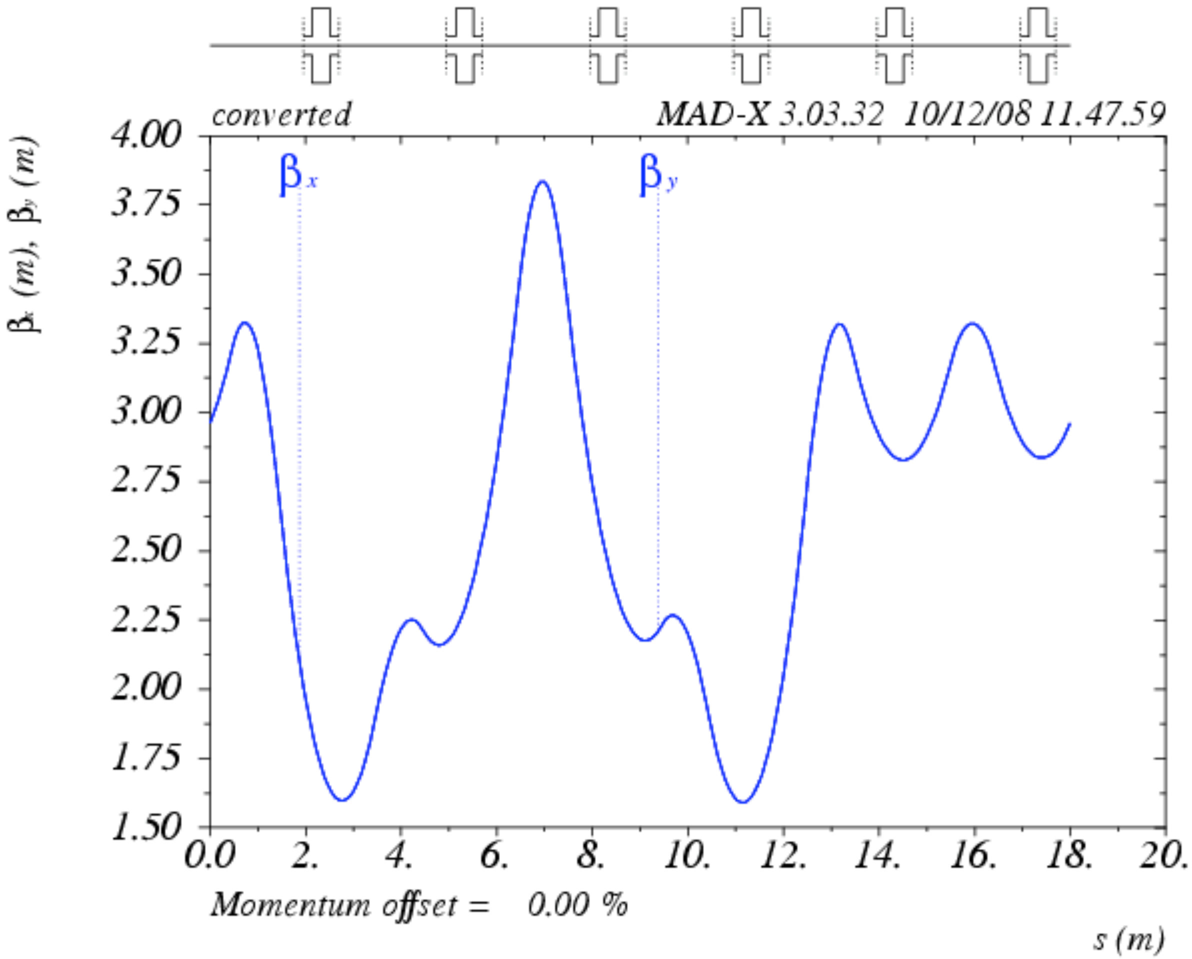
The first 4 solenoids, without characterizing any initial conditions



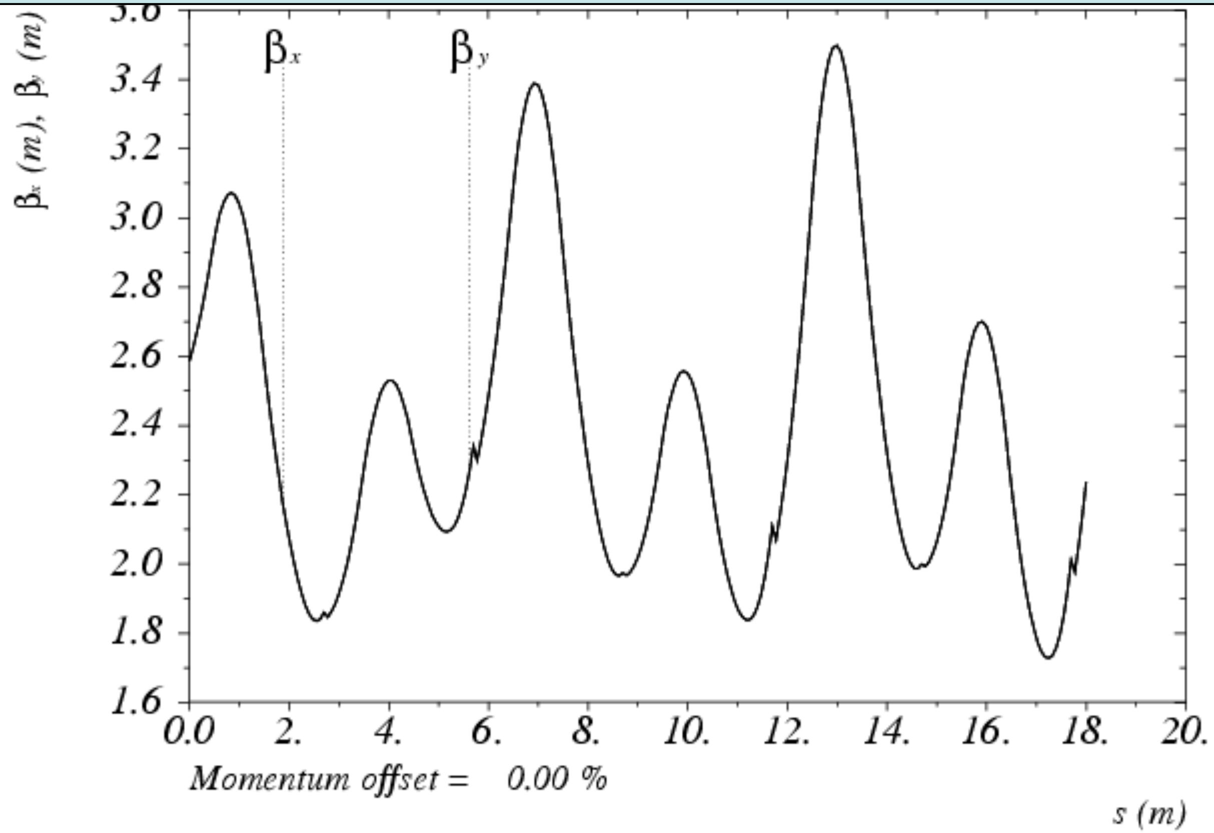
The first 6 solenoids, with the Alex initial conditions. The strength of the 6th solenoids a bit smaller



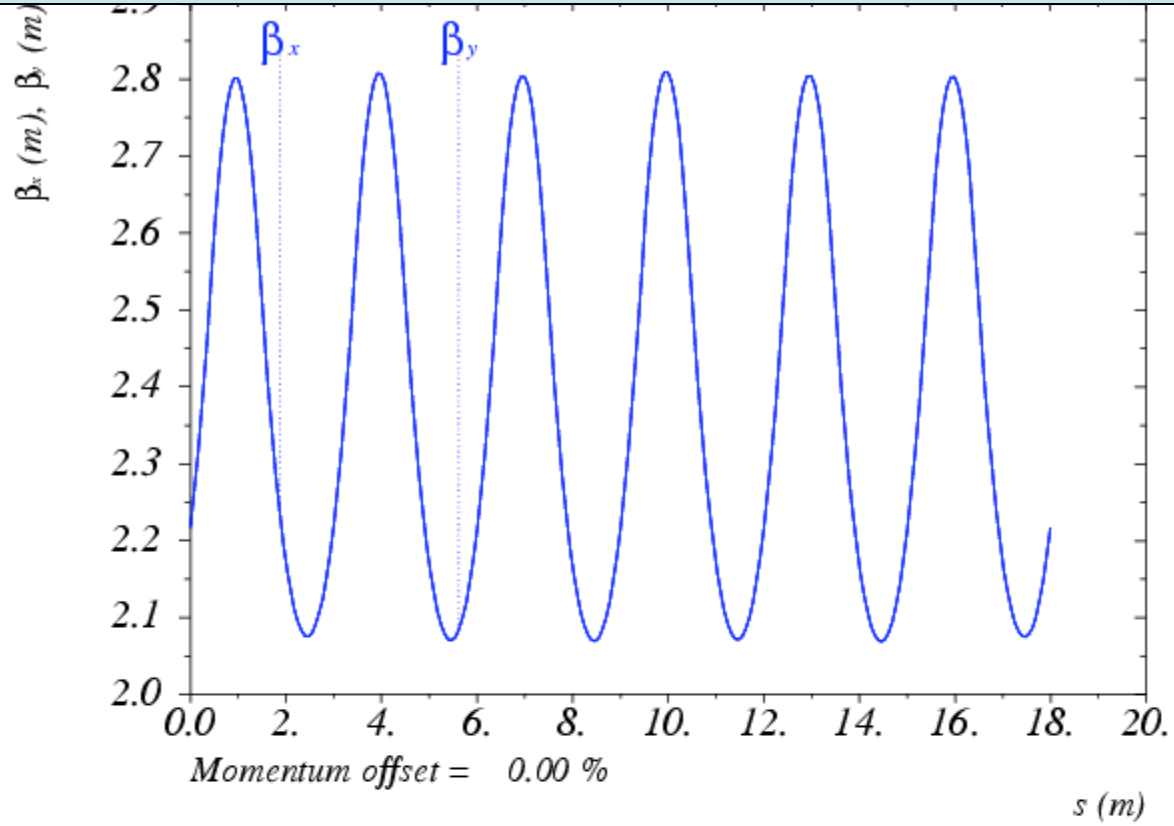
The first 6 solenoids without characterising any initial condition. The strength of the 6th solenoids a bit smaller

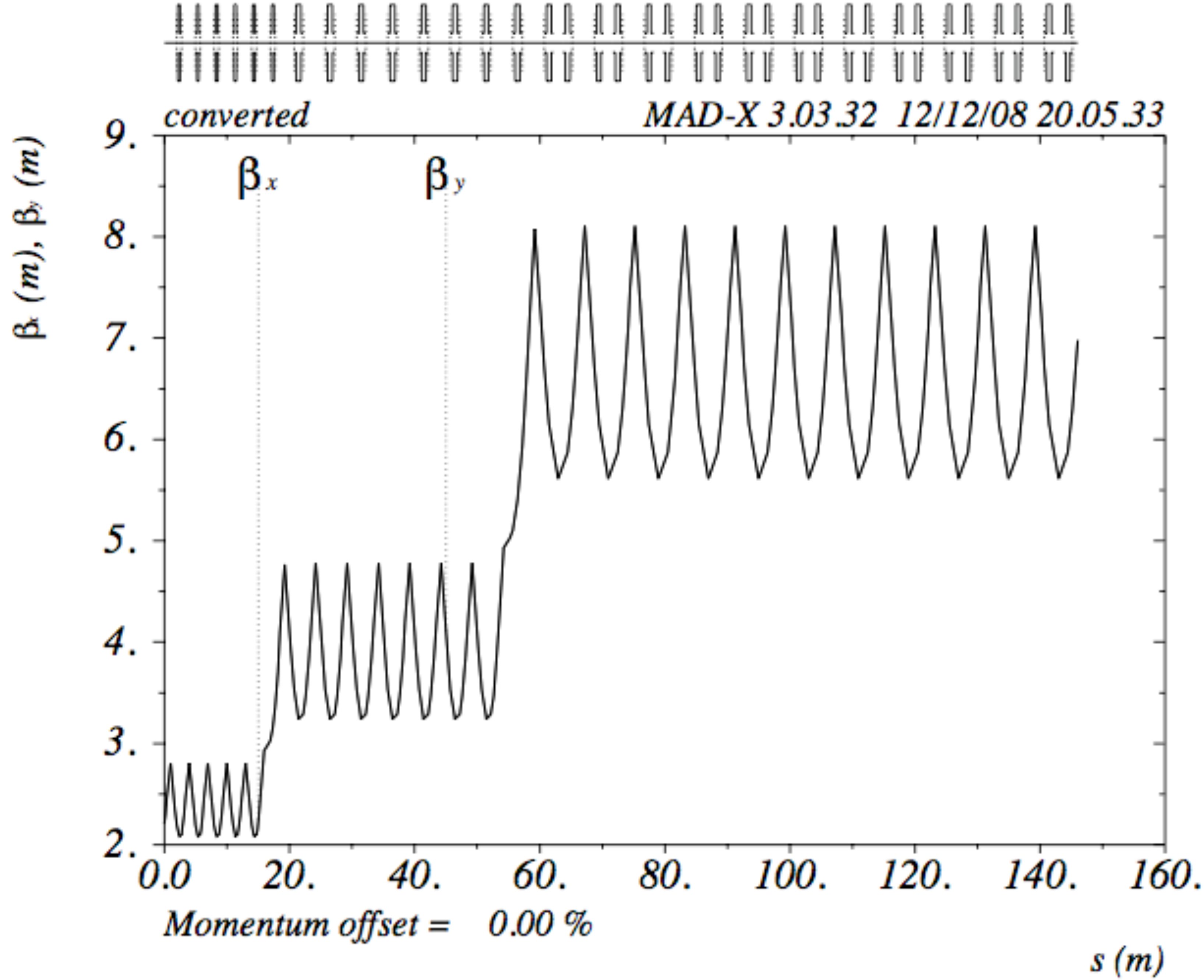


The first 6 solenoids, with the Alex initial conditions.
The strength of the 6th solenoid like the last solenoids.
with appropriate sign



The first 6 solenoids, without initial conditions.
The strength the 6th solenoids like the previous ones
. With appropriate sign.




converted
MAD-X 3.03.32 12/12/08 20.05.33
β_x (m), β_y (m)
β_x
β_y
9.
8.
7.
6.
5.
4.
3.
2.
0.0
20.
40.
60.
80.
100.
120.
140.
160.
Momentum offset = 0.00 %
s (m)

Outlook

- Contacting CERN people.
- Contacting INFN People.
- Using aperture for each solenoid.
- Using thin solenoids before and after each original solenoid.
- Matching procedure