

Muon Injection into FFAG Decay Ring

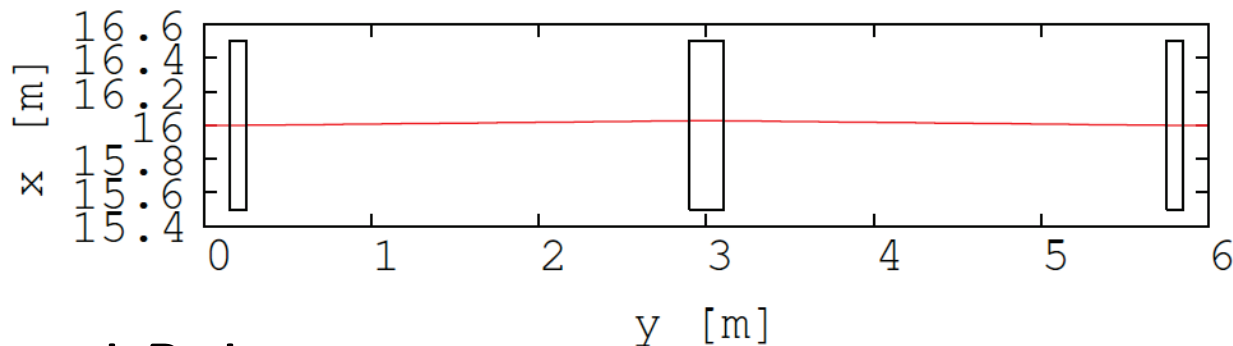
Update on progress

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VLENF meeting,
February 28, 2012

Assumptions and observations (2)

- The drift length in the straights are long (about 2.8 m) for the J-B. Lagrange/Y. Mori FFAG ring!
- They are ideal places to put kickers and septum.
- I try to design injection system assuming that the muon beam is formed in the decay channel (no D. Neuffer's trick used).

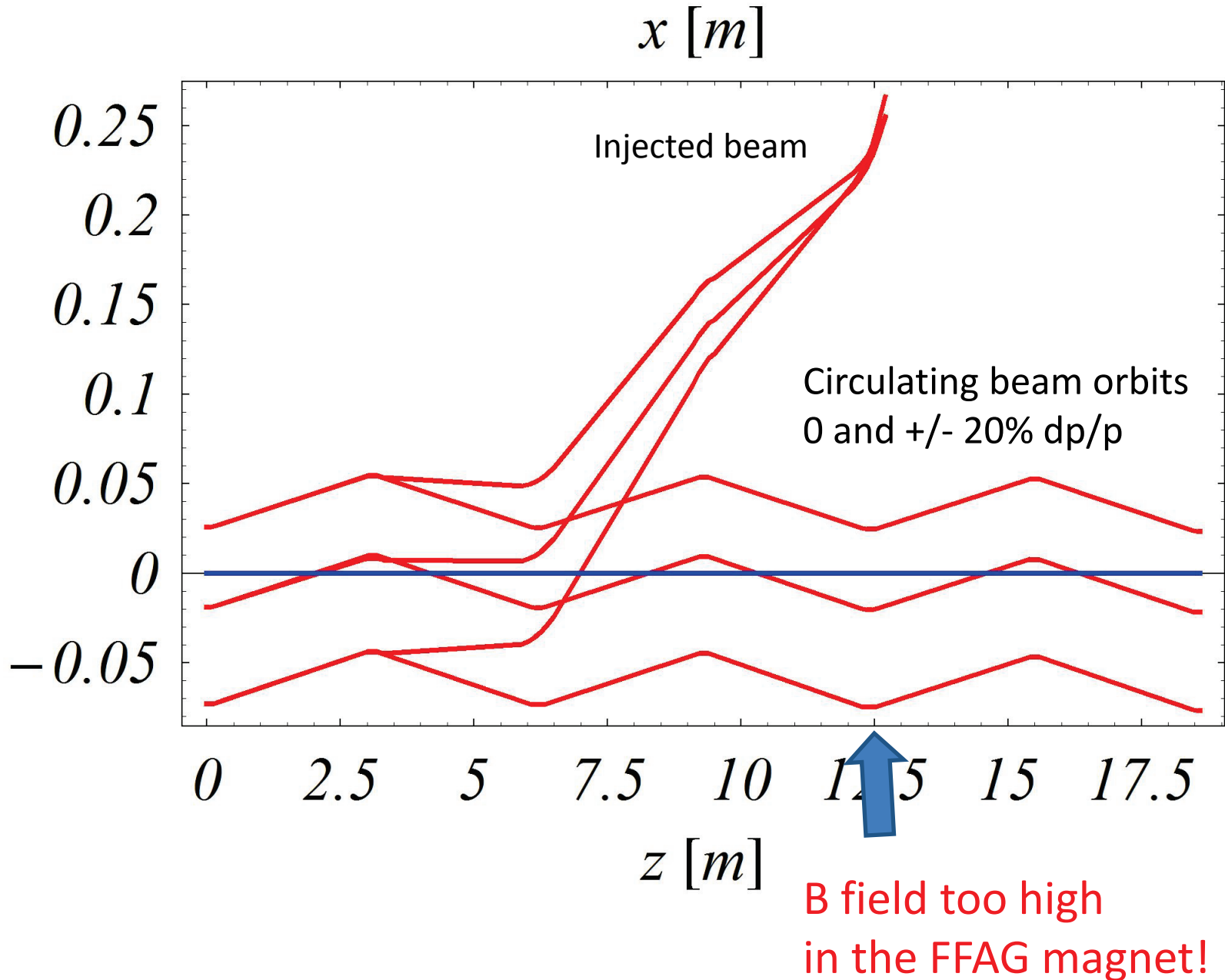


From J-B. Lagrange

Preliminary injection

- The long drifts are the natural place for septum and kickers.
- Kickers must be distributed (the more the weaker they are), **but the matching conditions can be more difficult.**
- Optics of the drift has been reproduced and zero chromaticity condition confirmed.
- Closed orbits have been calculated.
- The septum was assumed to be located downstream the D magnet.
- The needed orbit separation was estimated based on the acceptance plots in the paper on the FFAG Decay Ring (by J-B and Mori-san) and is about $12\text{cm}^2 + 1\text{cm} \sim 25\text{ cm}$.
- The additional separation to clear the magnet was assumed to be about **20 cm**.

Injection from the outside of the ring (version 1)

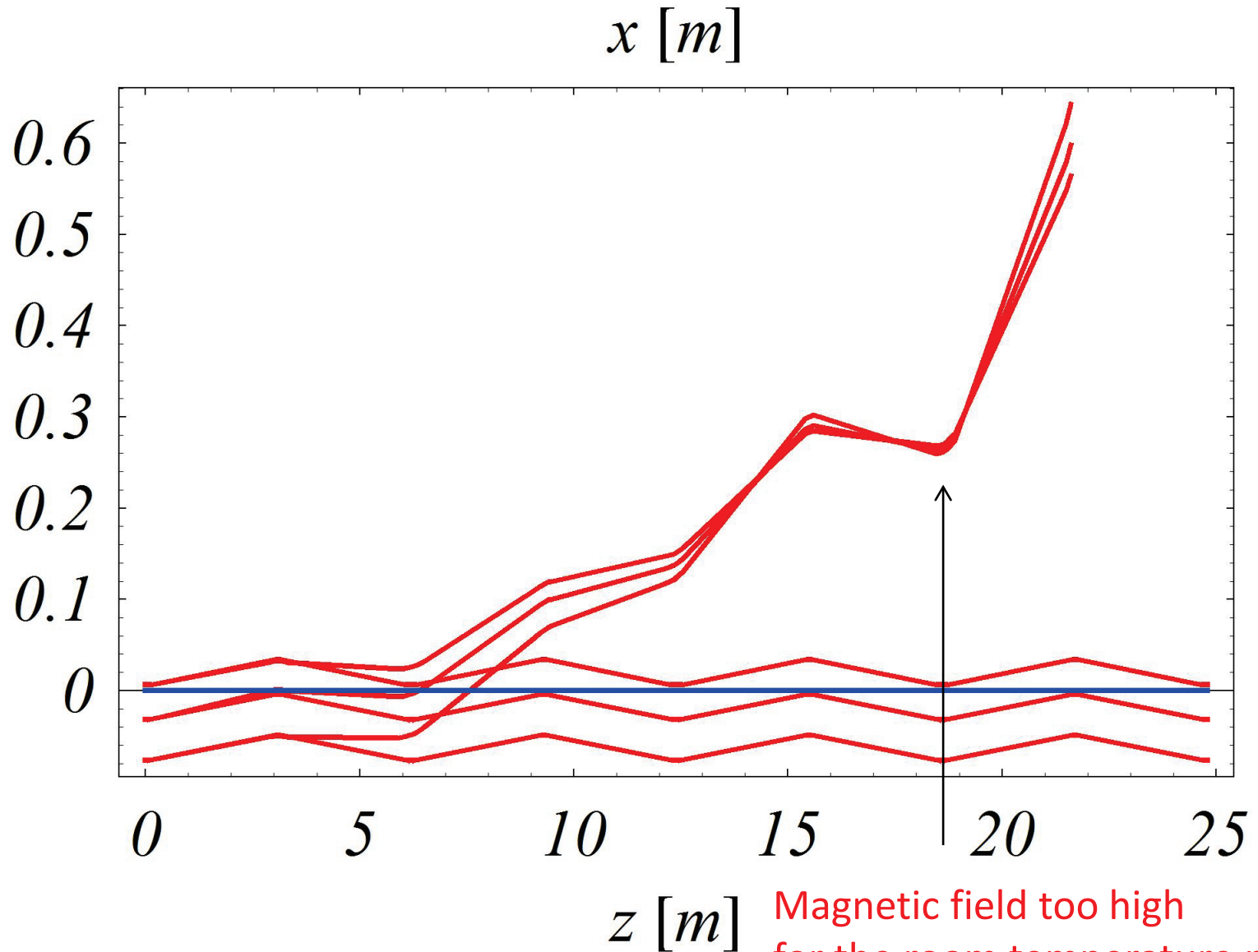


Preliminary injection – parameters for injection from the outside of ring (version 1)

- Number of kickers 3
- Kicker B field 0.05 T
- Kicker length 2.6 m
- Kicker aperture 60x30 cm
- Septum B field 0.6 T
- Septum length 2.6 m in length and
- Septum aperture 30x30 cm

Injection from the outside of ring (version 2)

(Orbits for $\pm 16\%$, effect of 2 kickers and septum included)

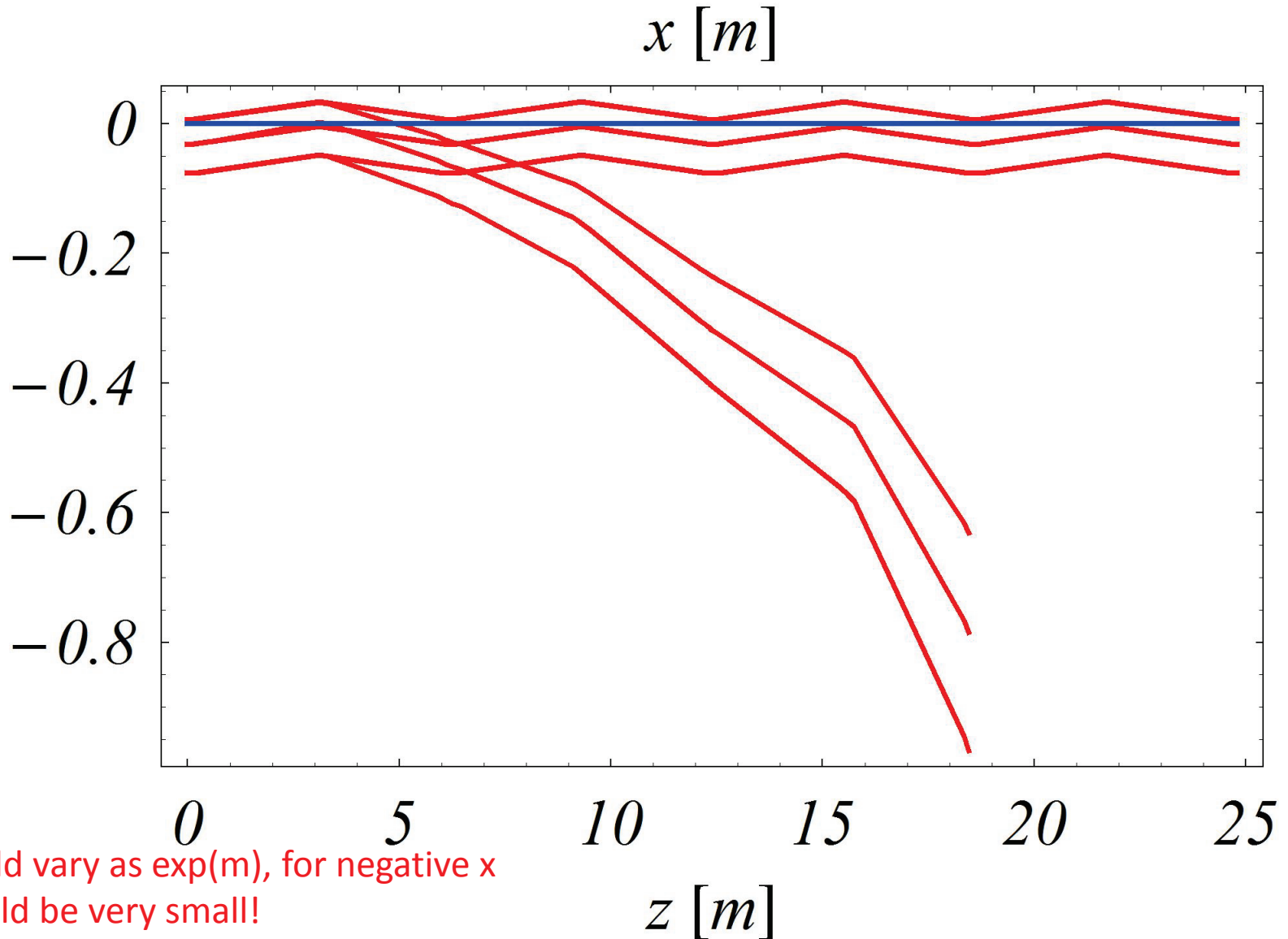


Magnetic field too high
for the room temperature magnets!

Preliminary for injection from the outside of ring (version 2)

- Number of kickers 2
- Kicker B field 0.038 T
- Kicker length 2.6 m
- Kicker aperture 40x30 cm and 30x30 cm
- Septum B field 0.33 T
- Septum length 2.6 m in length and
- Septum aperture 30x30 cm

New injection scheme from the inside of the ring (Orbits for +/-16%, effect of 2 kickers and septum included)



B field vary as $\exp(m)$, for negative x
should be very small!

This option seems more feasible!

Parameters for injection from the inside of the ring

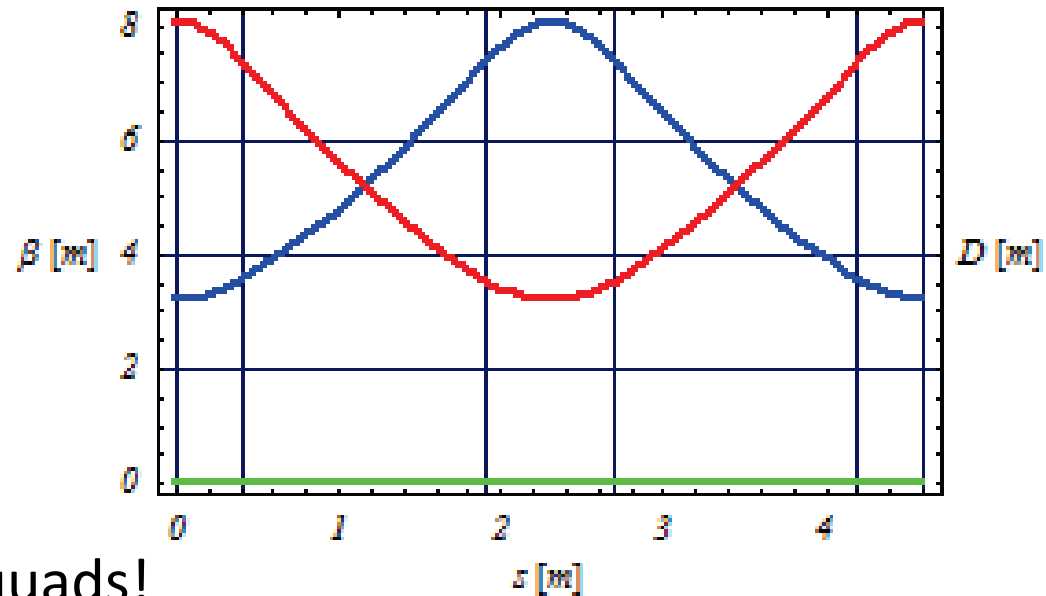
- Number of kickers 2
- Kicker B field 0.06 T
- Kicker length 2.6 m
- Kicker aperture 40x30 cm and 50x30 cm
- Septum B field 0.33 T
- Septum length 2.6 m in length and
- Septum aperture 60x30 cm

Decay Channel Considerations

- Symmetric FODO type
- Cell length 4.6 m
- Quad length 0.8 m
- Quad gradient 5.35 T/m
- Distance between quads 1.5 m
- B field at the poles 1.34 T
- Half aperture 0.25 m -> Large quads!
- Central momentum 2864 MeV/c
- Momentum acceptance $\pm 42\%$

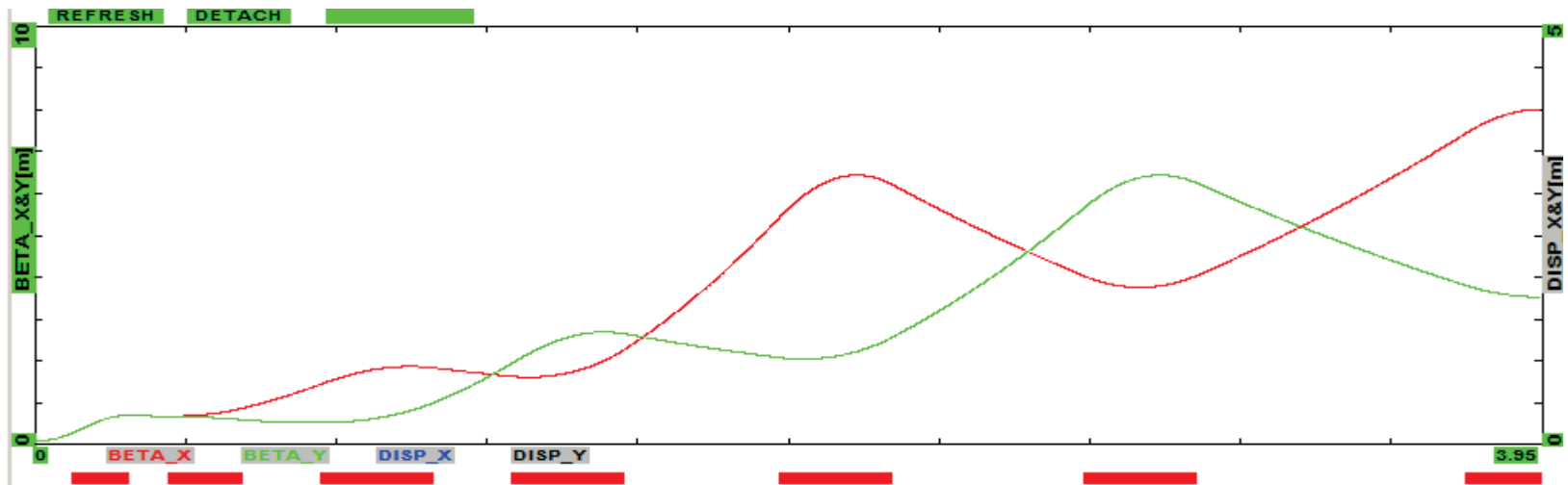
(for all pions contributing to the muons wanted -2 GeV/c $\pm 16\%$,
this means both forward and backward decays)

- Physical acceptance 7.7 Pi.mm.rad
- Phase advance per cell 53.6 degrees
- Channel length minimum 16 cells -73.6 m (could be longer)
- This includes 32 quads



Coupling with the target

- Details of the matching section between the target and the decay channel still to be worked out!
- Optimisation should include the question at which momentum to set the reference matching condition.
- We can use similar design to the one worked by David and Milorad as a starting point.



From D. Neuffer

Summary and future plans

- Single turn 2 GeV/c muon injection into FFAG Decay is possible, but rather easier from the inside of the ring.
- We need to work out, how to pass the ring (a vertical separation or passing first through a long drift in the straight and redirecting).
- Using more than 2 kickers results in the optics being mismatched (visible nonlinear dispersion) -> 2 kickers selected as a solution -> 0.06 T!
- The decay channel has been designed based on the FODO channel for both forward and backward decays.

- Matching from the target to the decay channel needs to be defined.
- Performance will be simulated in G4Beamline.
- Final matching to the ring needs to be defined.
- The pion decay into the FFAG-type ring should also be studied. This is almost certainly possible! -> Next task...