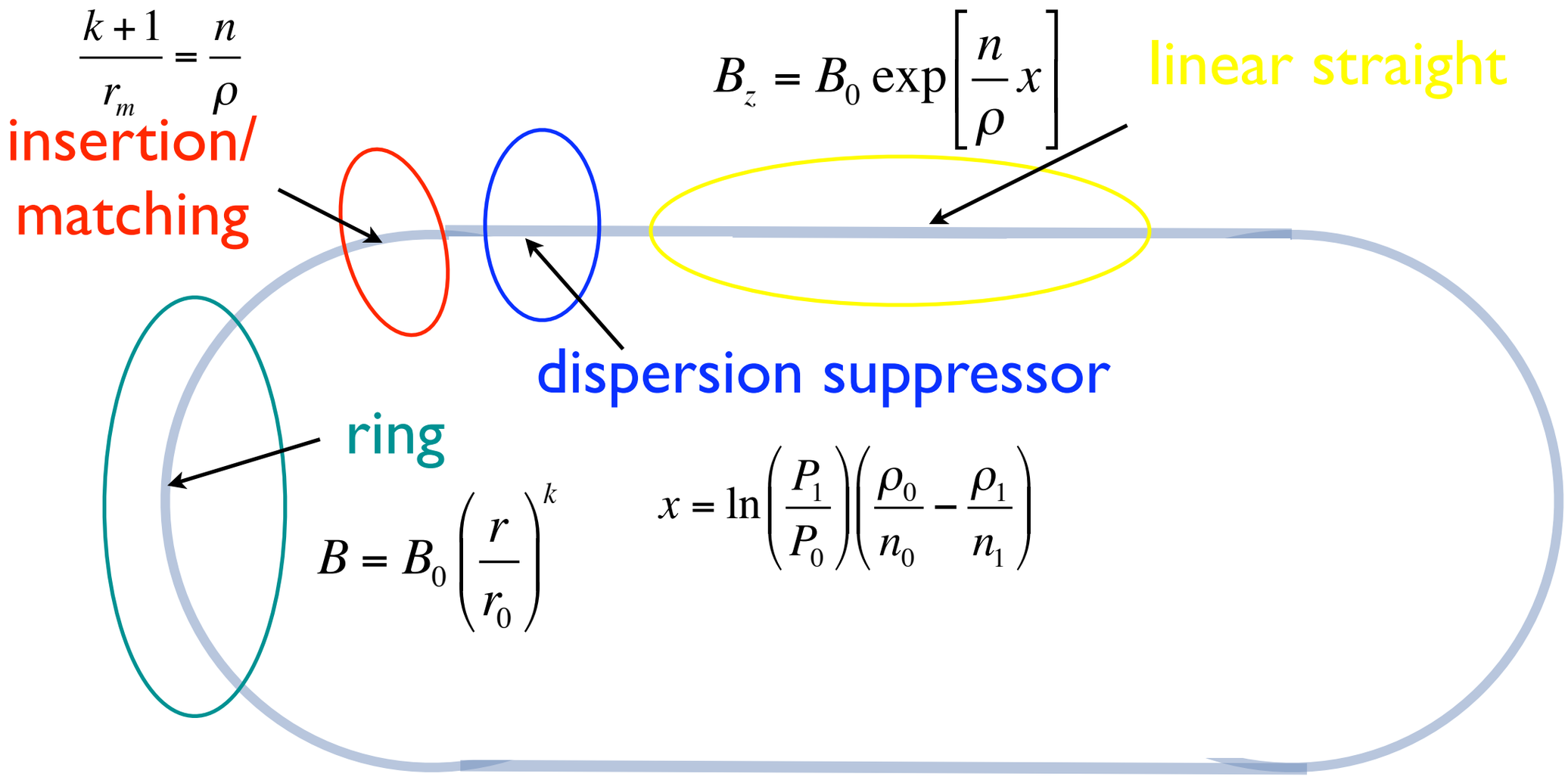
FFAG-Accumulator/ Accelerator/Bunch-rotator

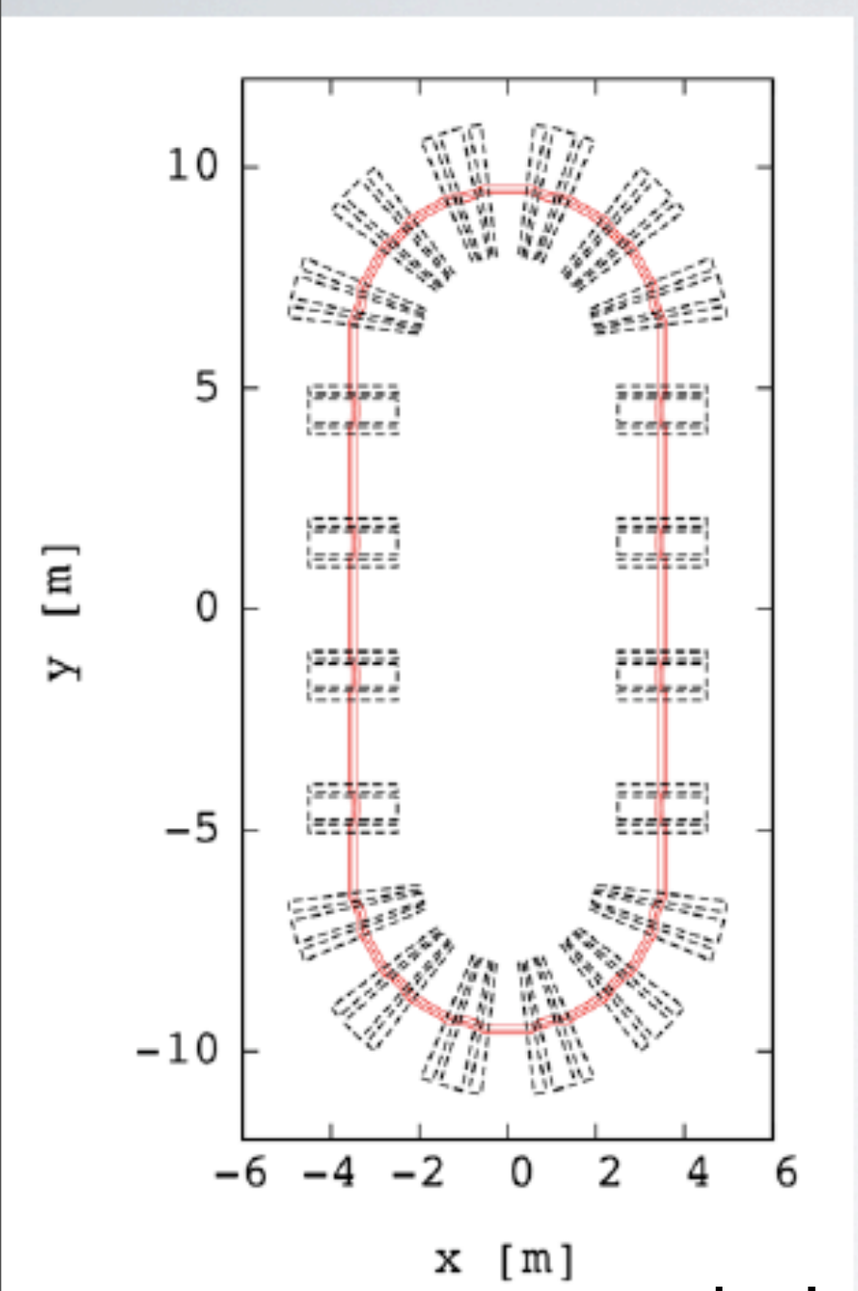
Yoshiharu Mori

Oct. 29, 2009 @ PRISM meeting

Advanced scaling FFAG



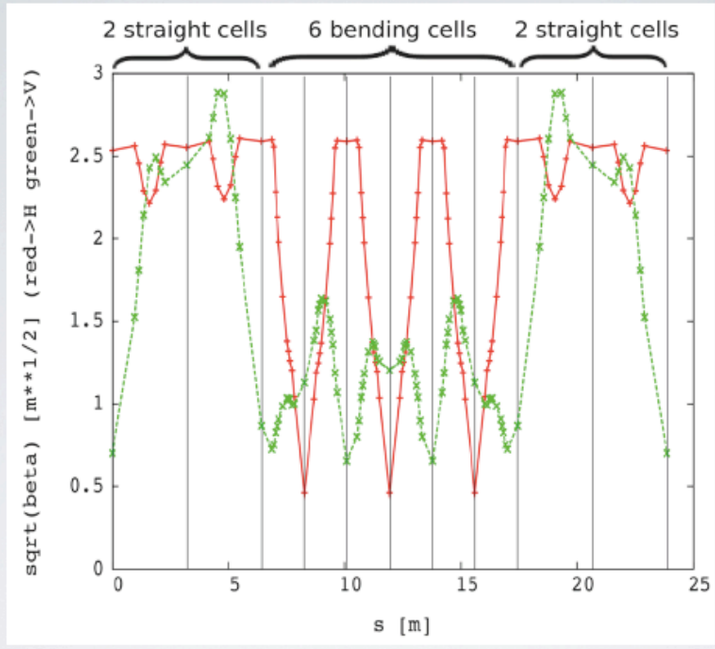
Muon phase rotation
PRISM ring with s.s.



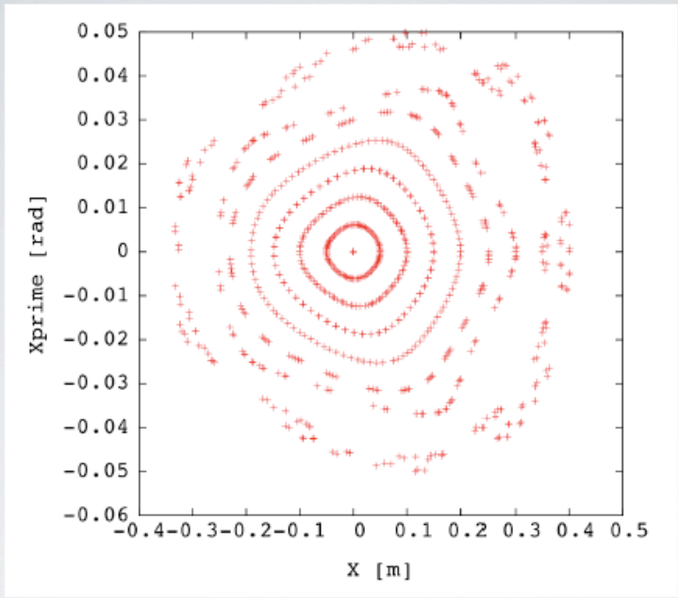
PRISM LATTICE

テキスト

Bending cell	
k	6.5
Average radius	3.5 m
Phase advances:	
horizontal μ_x	90 deg.
vertical μ_z	90 deg.
Dispersion	0.47 m
Straight cell	
n/ρ	$2.14\,m^{-1}$
Length	$3\,m$
Phase advances:	
horizontal μ_x	24 deg.
vertical μ_z	87 deg.



Betafunctions of bending and straight cells (half ring)
(red: horizontal, green: vertical)



by Lagrange & Mori

Proton Driver for Muon Production

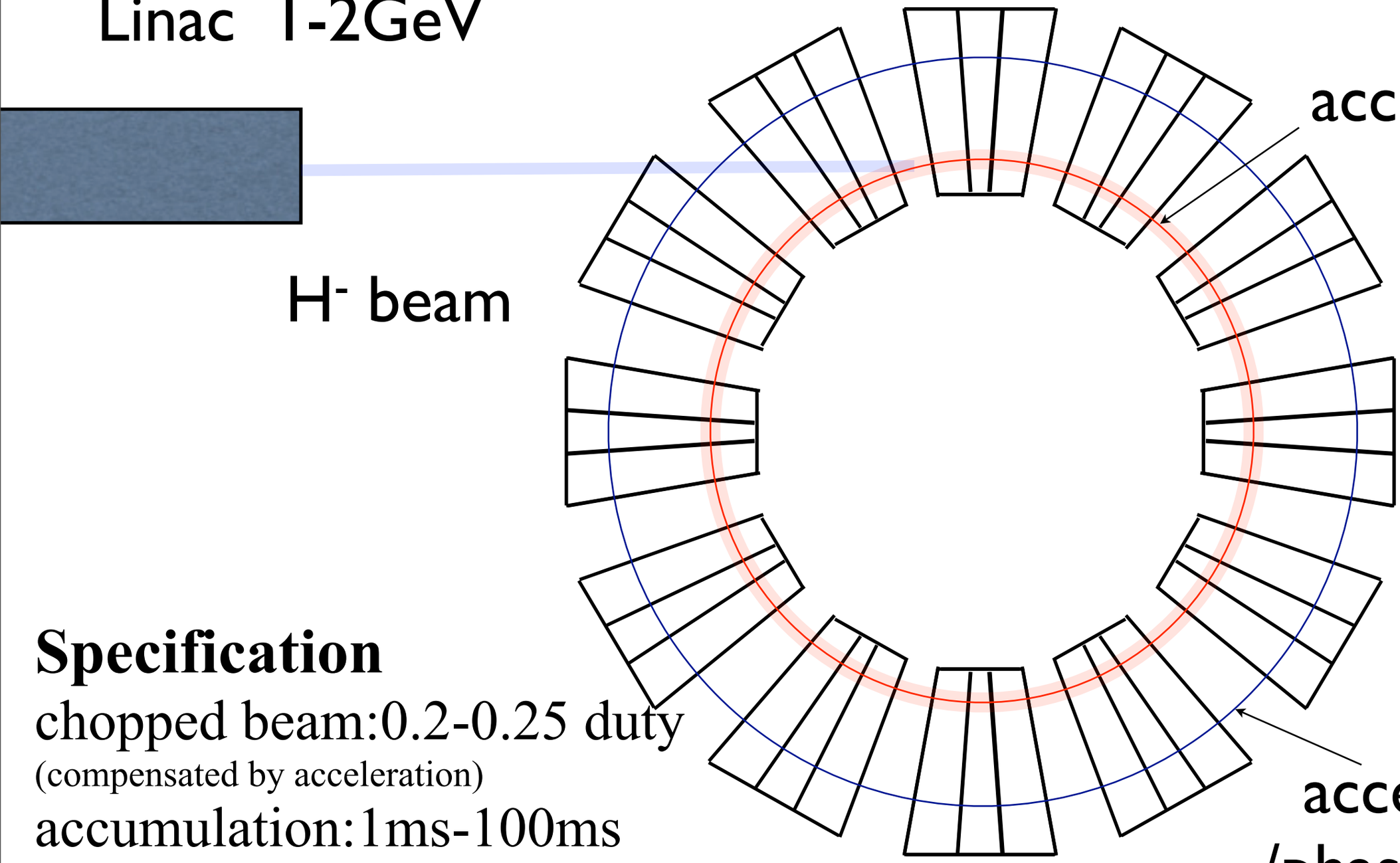
- Require a short bunched beam.
  - bunch width ~<3nsec
  - repetition rate >100-10kHz
  - Need an accumulator and a buncher if cw linac is used as an injector.

- ***FFAG has a possibility of being worked as accumulator/buncher, and accelerator as well.***

Concept of FFAG-Accumulator/Accelerator

Linac 1-2GeV

H^- beam



Specification

chopped beam:0.2-0.25 duty
(compensated by acceleration)
accumulation:1ms-100ms
repetition:1kHz-10Hz
acceleration:<100micro.s

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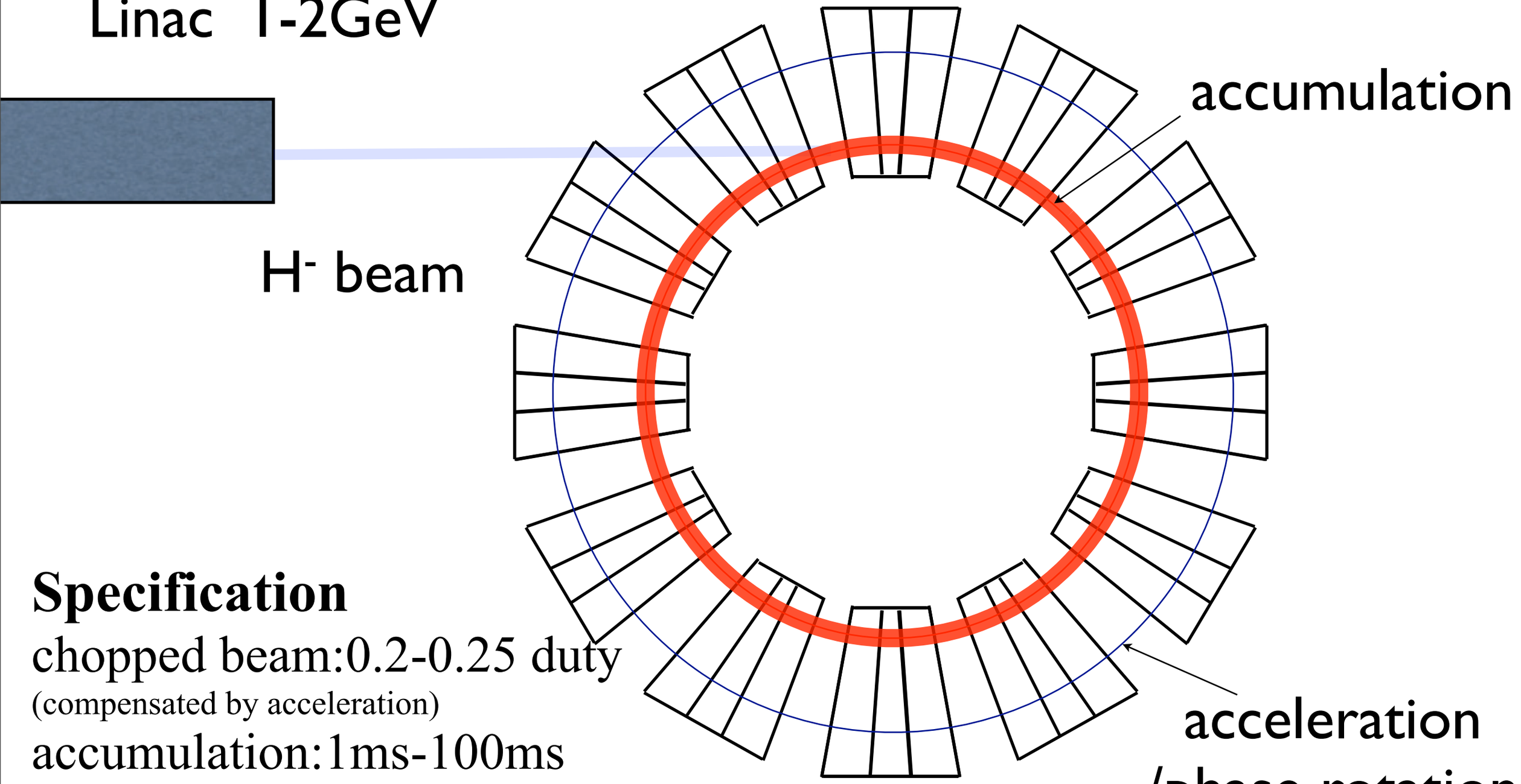

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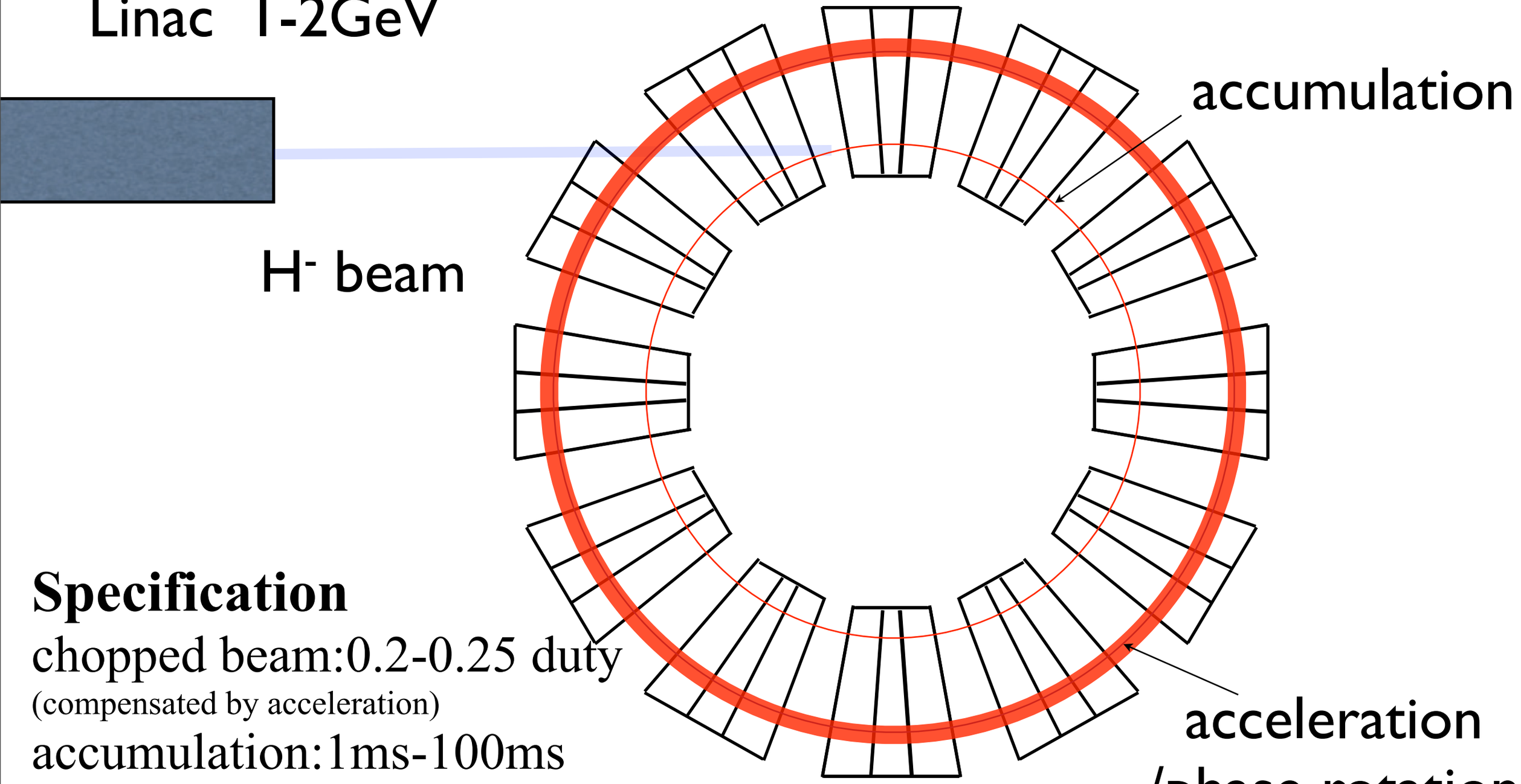

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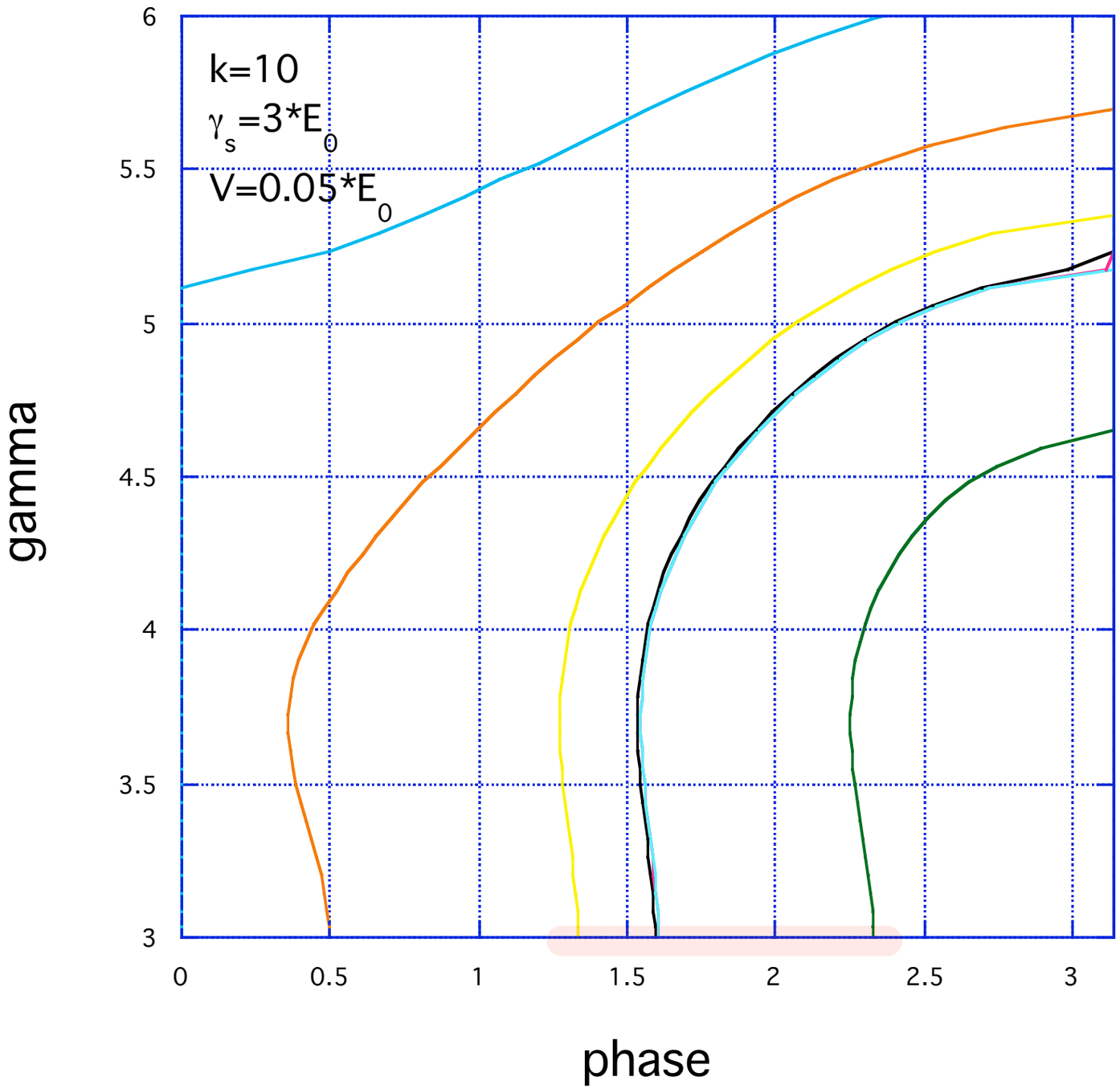
FFAG
accumulator/accelerator

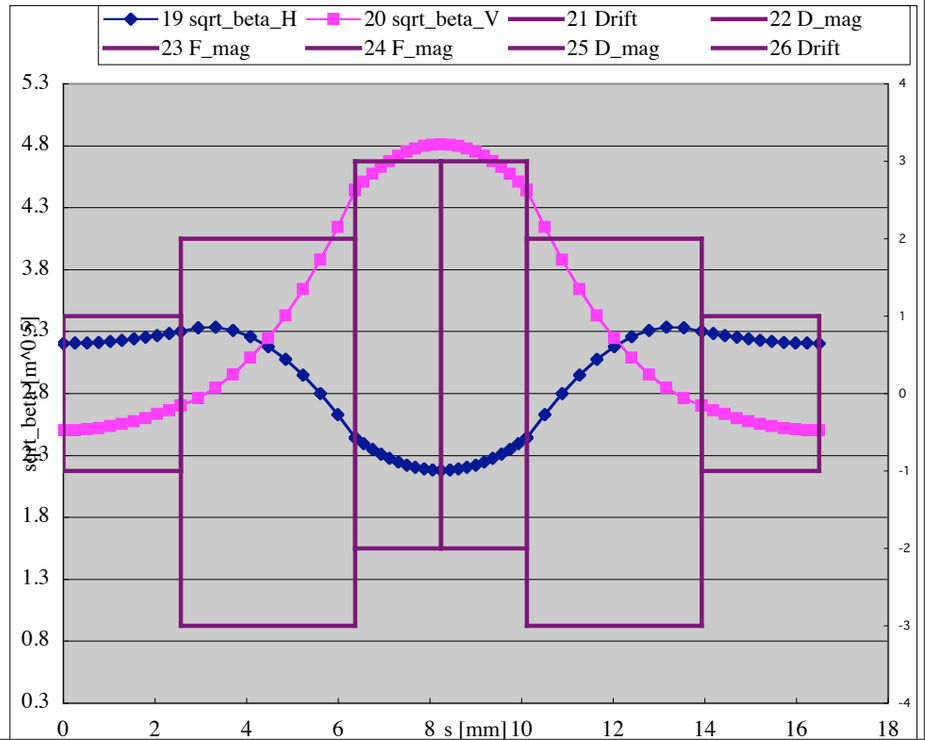
- Single ring works as accumulator and accelerator (buncher/phase-rotator)
  - Fixed field : large repetition rate >1kHz
  - Large momentum acceptance : zero chromaticity
  - Varying phase slip : from accumulation to acceleration(phase-rotation)
- Accumulator
  - Need small slippage factor. $\eta = \frac{1}{\gamma^2} - \frac{1}{k+1} < 0.01$
  - Keeping bunch length constant during charge-exchange multi-turn injection. Bunch length increase < 10% for 10,000turns
- Accelerator(phase-rotation)
  - Need large momentum acceptance. $\frac{\Delta p}{p} \geq 0.1$
  - Require large slippage factor for phase rotation. $\eta \geq 0.1$
  - Accelerate the beam rapidly keeping RF frequency constant.

FFAG longitudinal gymnastics



FFAG-ABA ring

energy range	2 - 4GeV
lattice	FDF-scaling
field index	10
number of cells	12
radius	20m
Bmax	3.4T
F/D ratio	1.98
beam excursion	1.2m
RF voltage	45MV(h=1)



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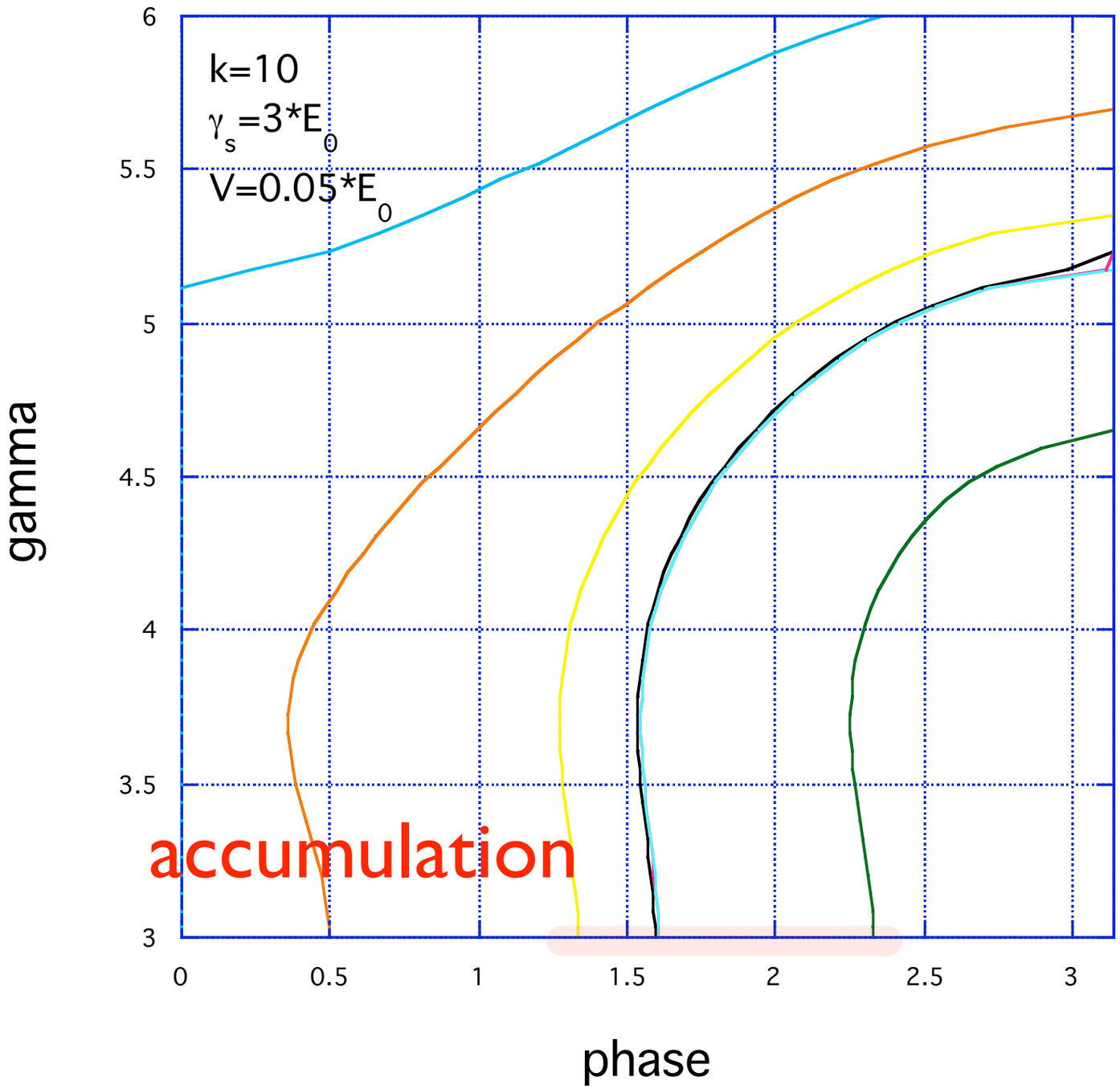

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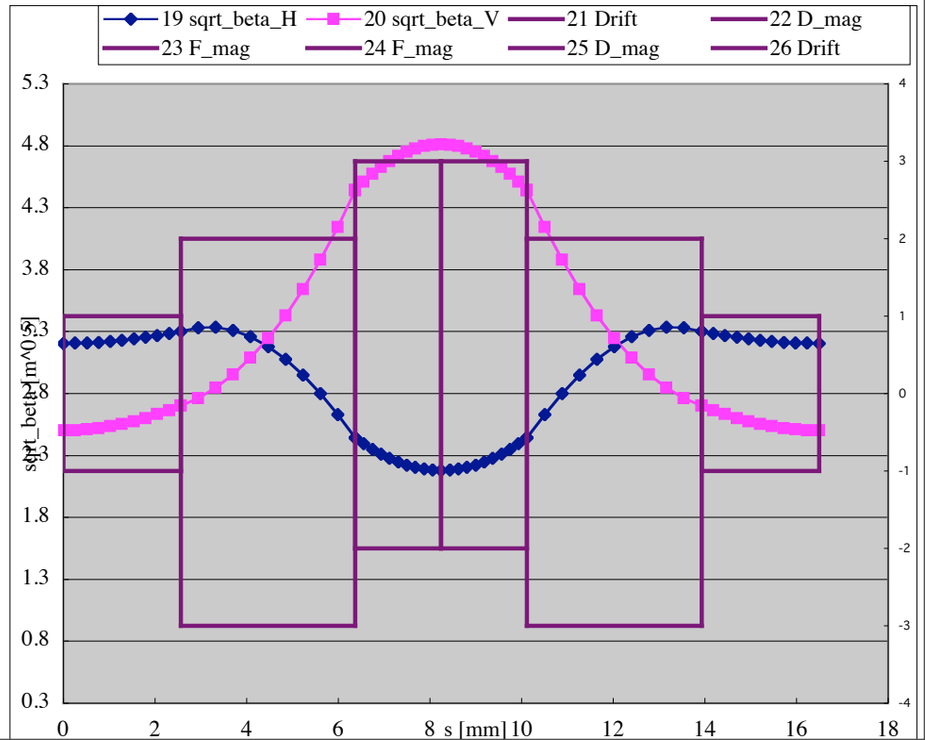

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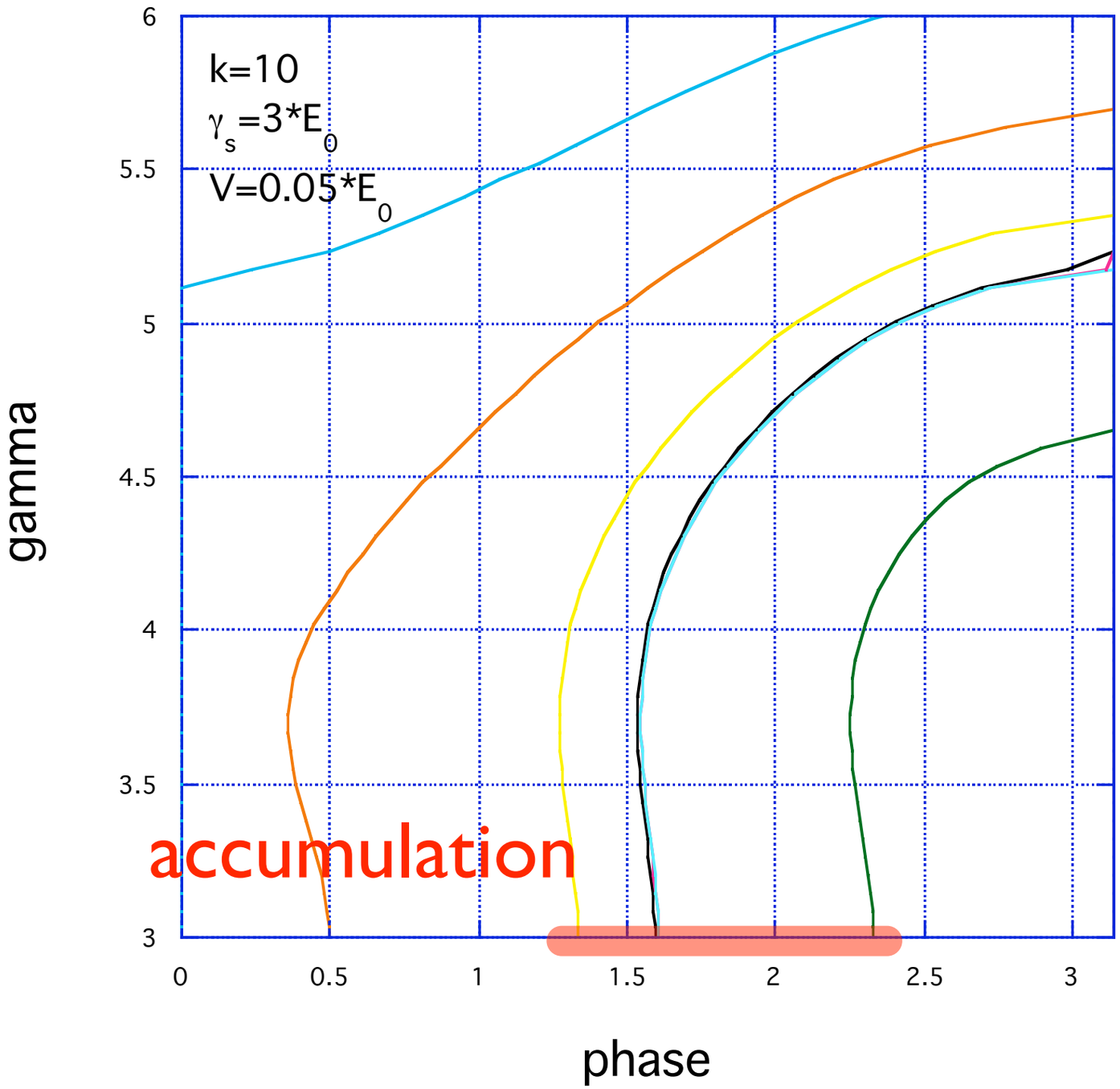

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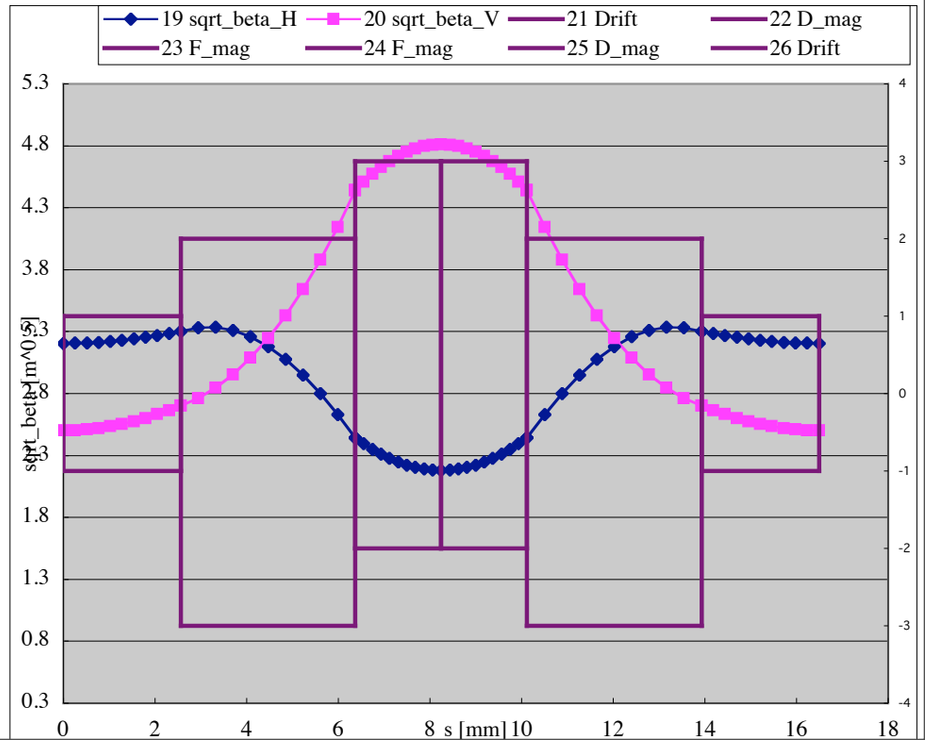

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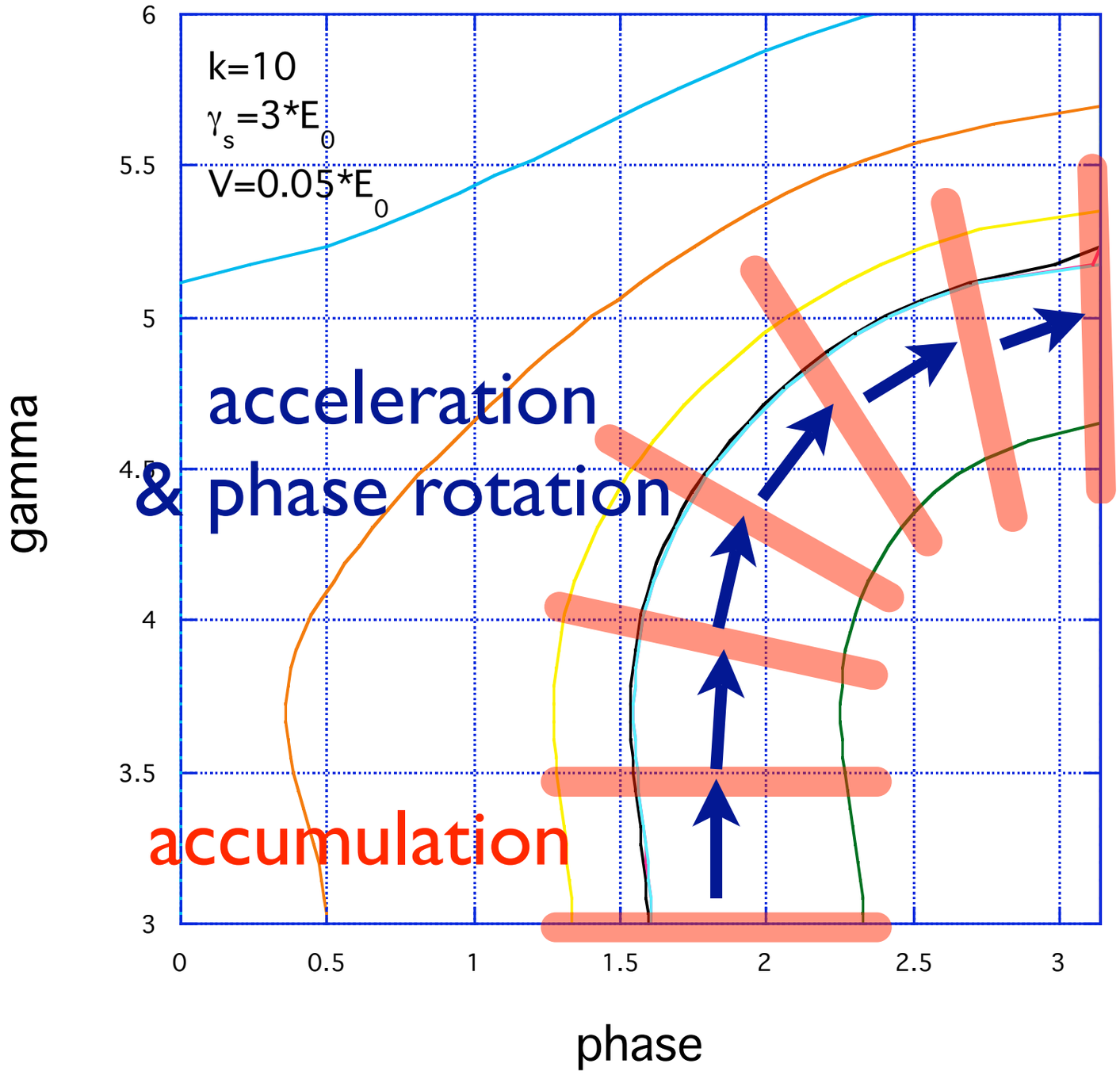

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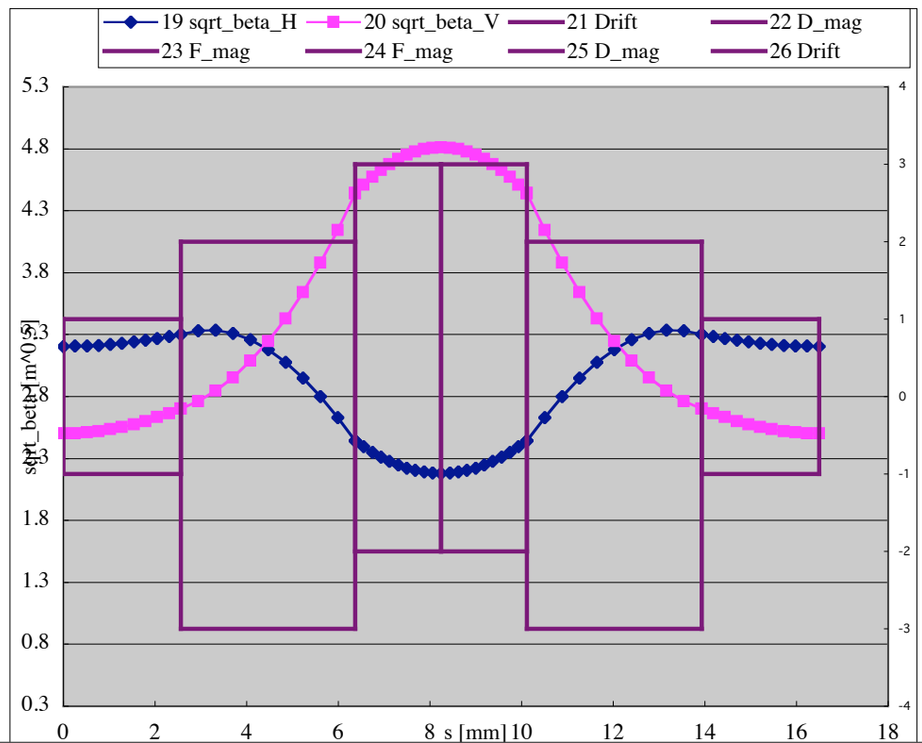

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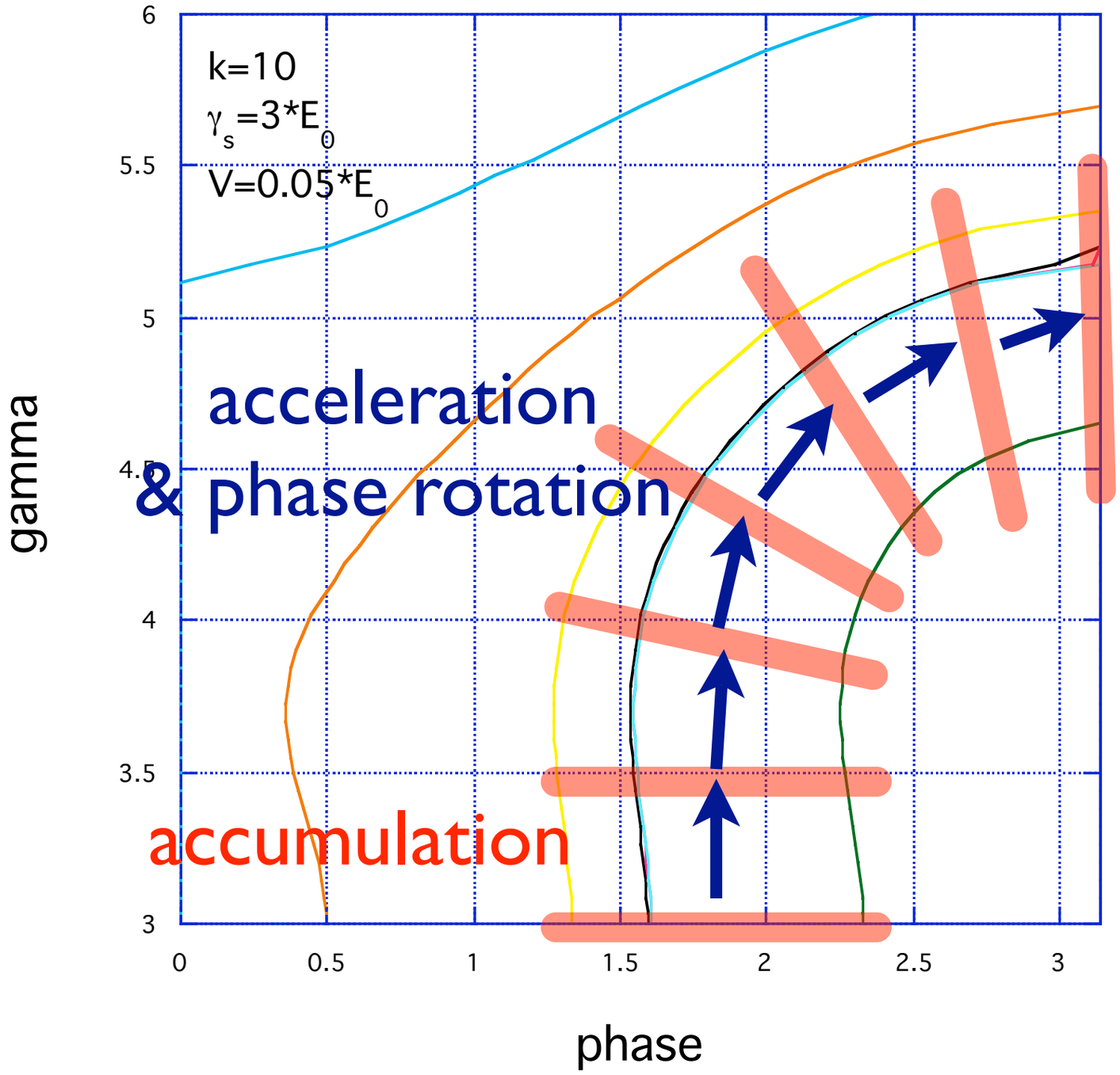

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