

# Accumulator/ Buncher with FFAG

for cw Proton Driver

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# Why is A/B needed?

- Muon/Neutrino/Neutron physics require a short pulsed(bunched) beam.

purpose	time structure	
	width	repetition
slow muon( $\mu$ -e conv.)	$\sim$ nsec	$\sim$ 100kHz
neutrino factory	$\sim$ nsec	$\sim$ 10Hz
muon collider	$\sim$ nsec	$\sim$ 10-100Hz
neutron	$\sim$ $\mu$ sec	$\sim$ 10Hz

- Beam accumulation and bunching/bunch-compressing are needed, if cw beam proton driver such as sc linac/cyclotron is used.

# ***Proton Driver for Muon Production***

- Require a short bunched beam.

- bunch width       $\sim < 3\text{nsec}$

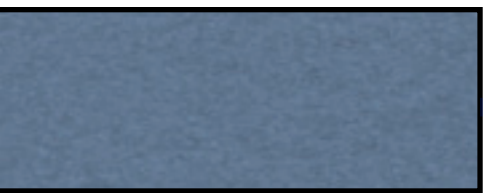
- repetition rate     $> 100\text{-}10\text{kHz}$

- Need an accumulator and a buncher if cw linac is used as an injector.

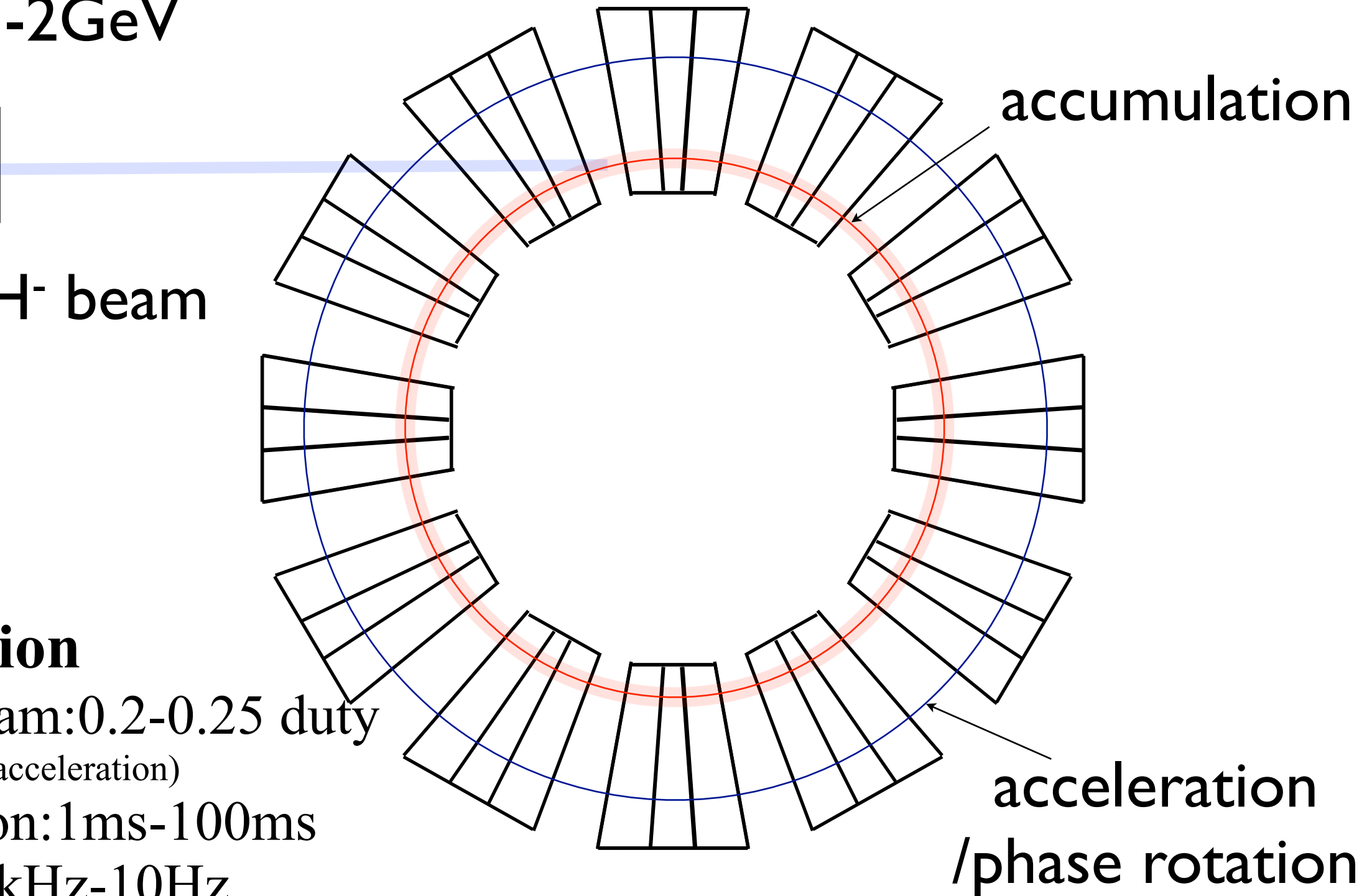
- FFAG has a possibility of being worked as accumulator/buncher, and accelerator as well.***

# Concept of FFAG-Accumulator/Accelerator

Linac 1-2GeV



H<sup>-</sup> beam



## Specification

chopped beam: 0.2-0.25 duty

(compensated by acceleration)

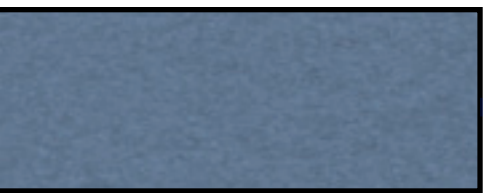
accumulation: 1ms-100ms

repetition: 1kHz-10Hz

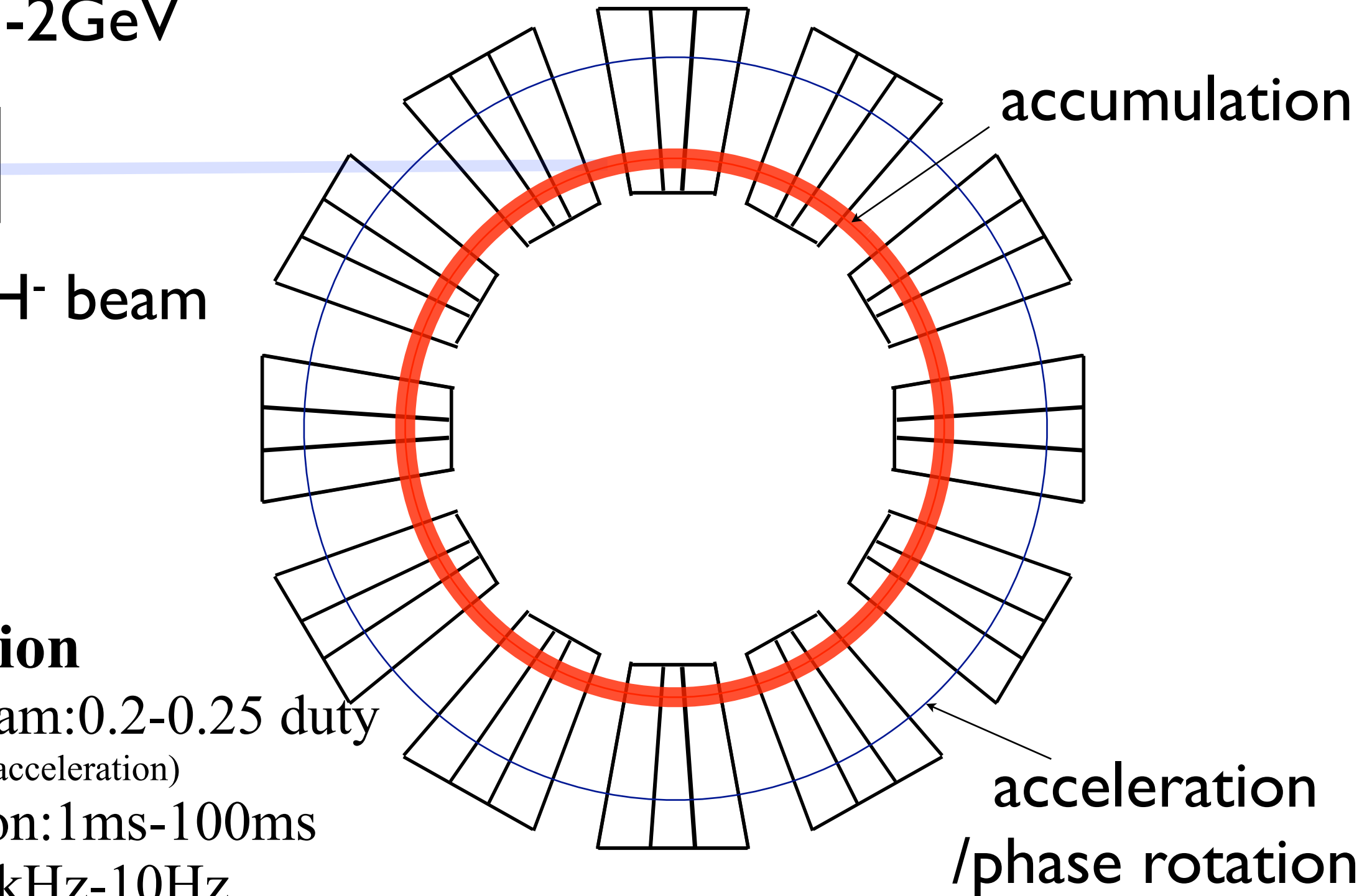
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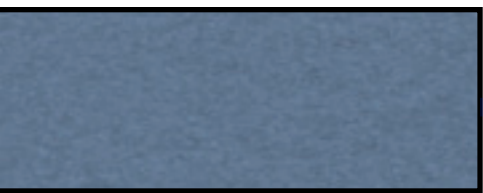
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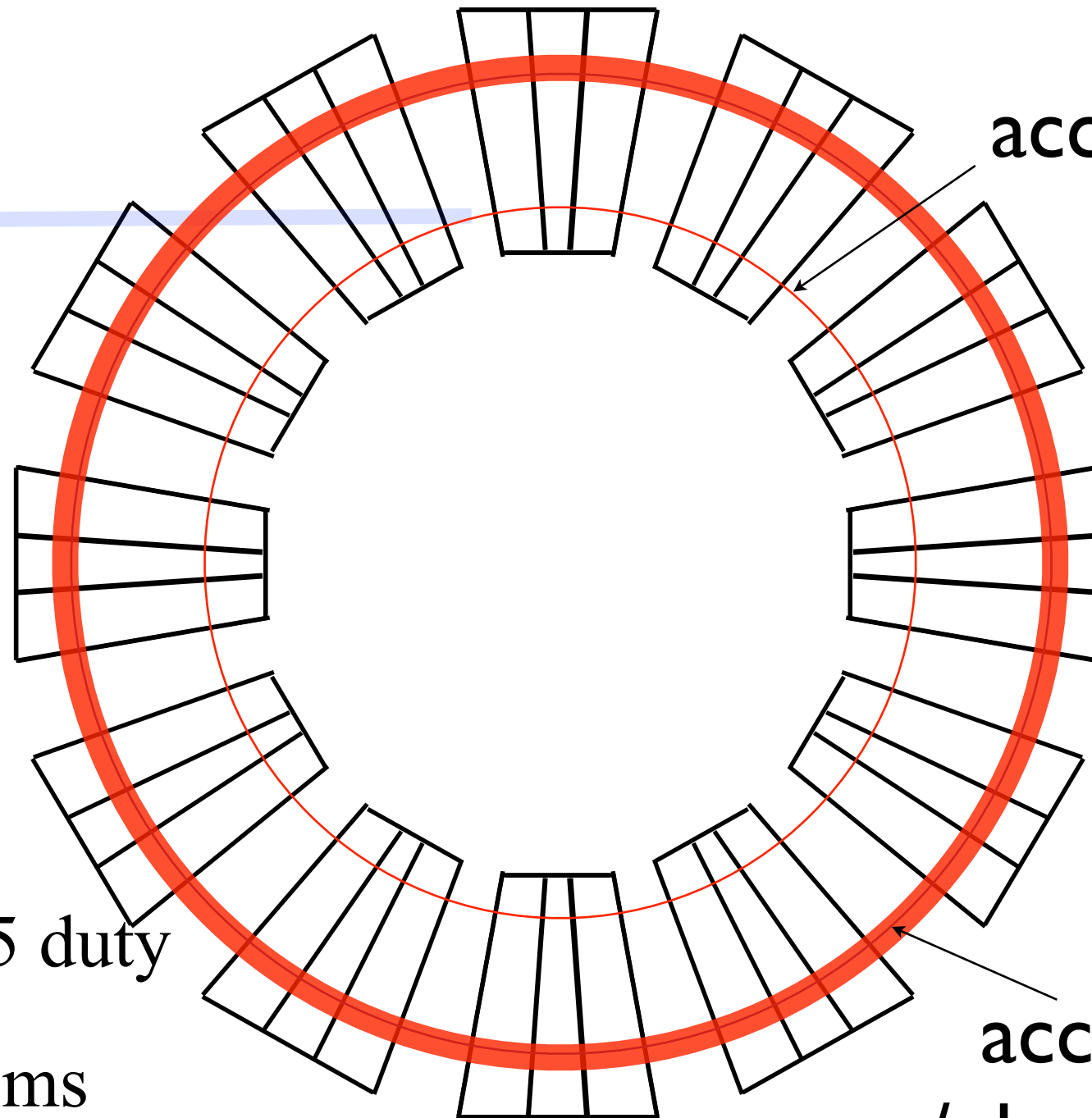
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H<sup>-</sup> beam



accumulation

acceleration  
/phase rotation

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# FFAG

## ***accumulator/accelerator***

### ● Single ring works as accumulator and accelerator (buncher/phase-rotator)

- Fixed field : large repetition rate  $> 1 \text{ kHz}$
- Large momentum acceptance : zero chromaticity
- Varying phase slip : from accumulation to acceleration (phase-rotation)

### ● Accumulator

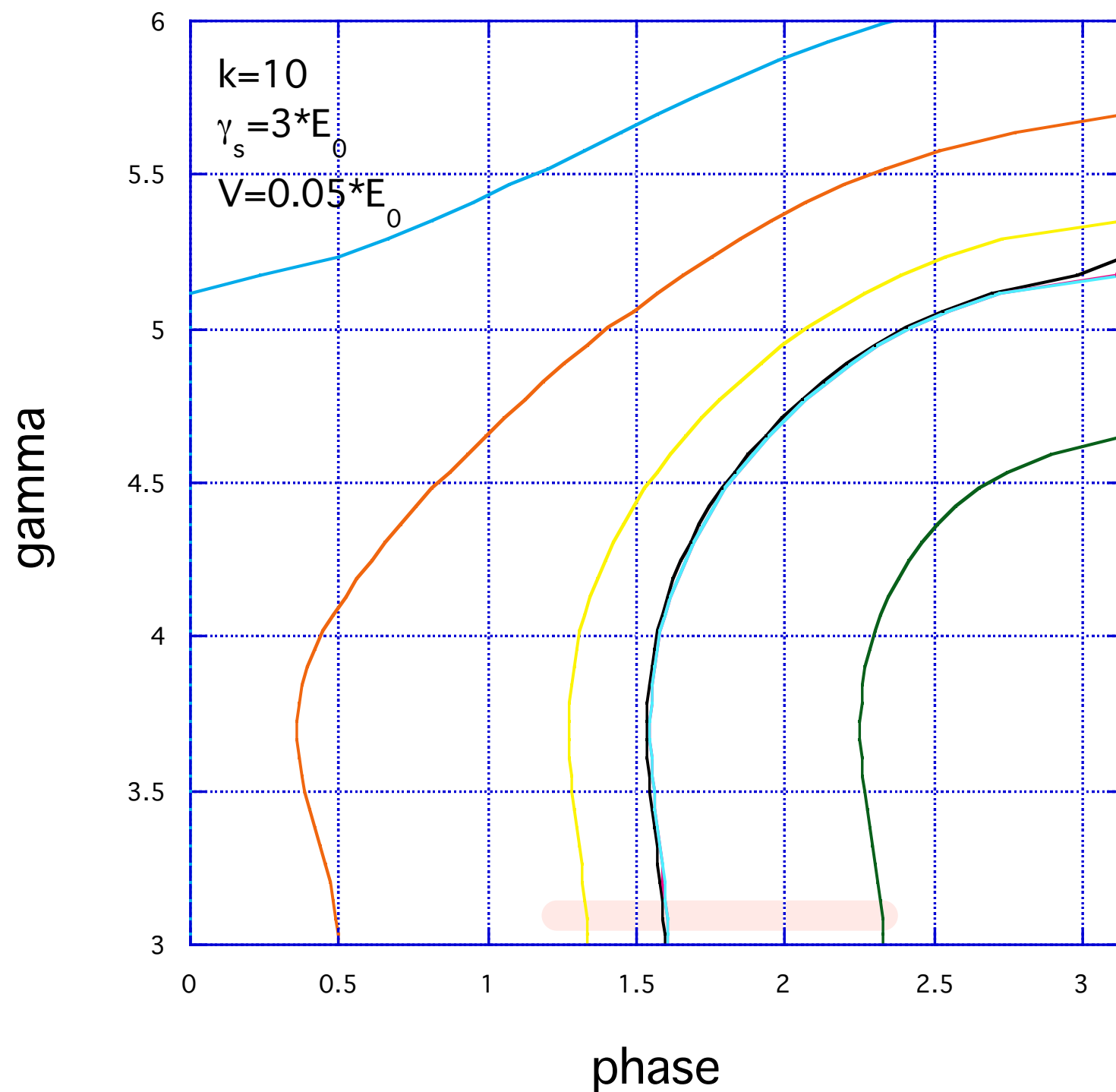
- Need small slippage factor.  $\eta = \frac{1}{\gamma^2} - \frac{1}{k+1} < 0.01$
- Keeping bunch length constant during charge-exchange multi-turn injection. Bunch length increase  $< 10\%$  for 10,000 turns

### ● 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.

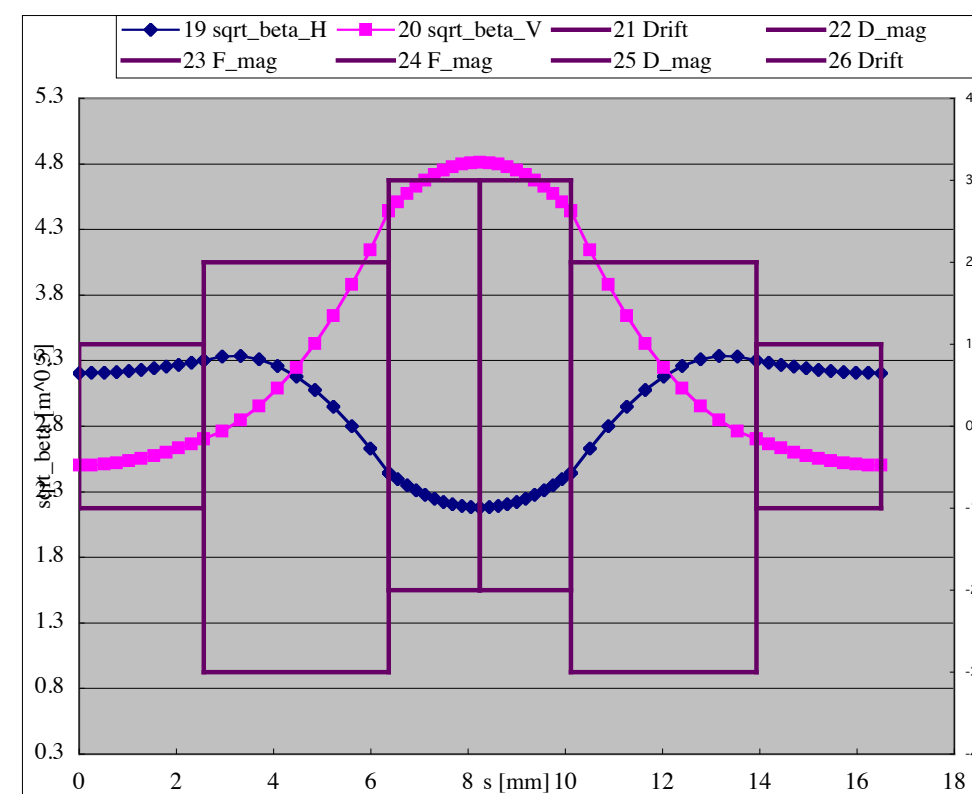
# FFAG-ABA

## -Accmulator/Buncher/Accelerator- longitudinal gymnastics



### FFAG-ABA ring

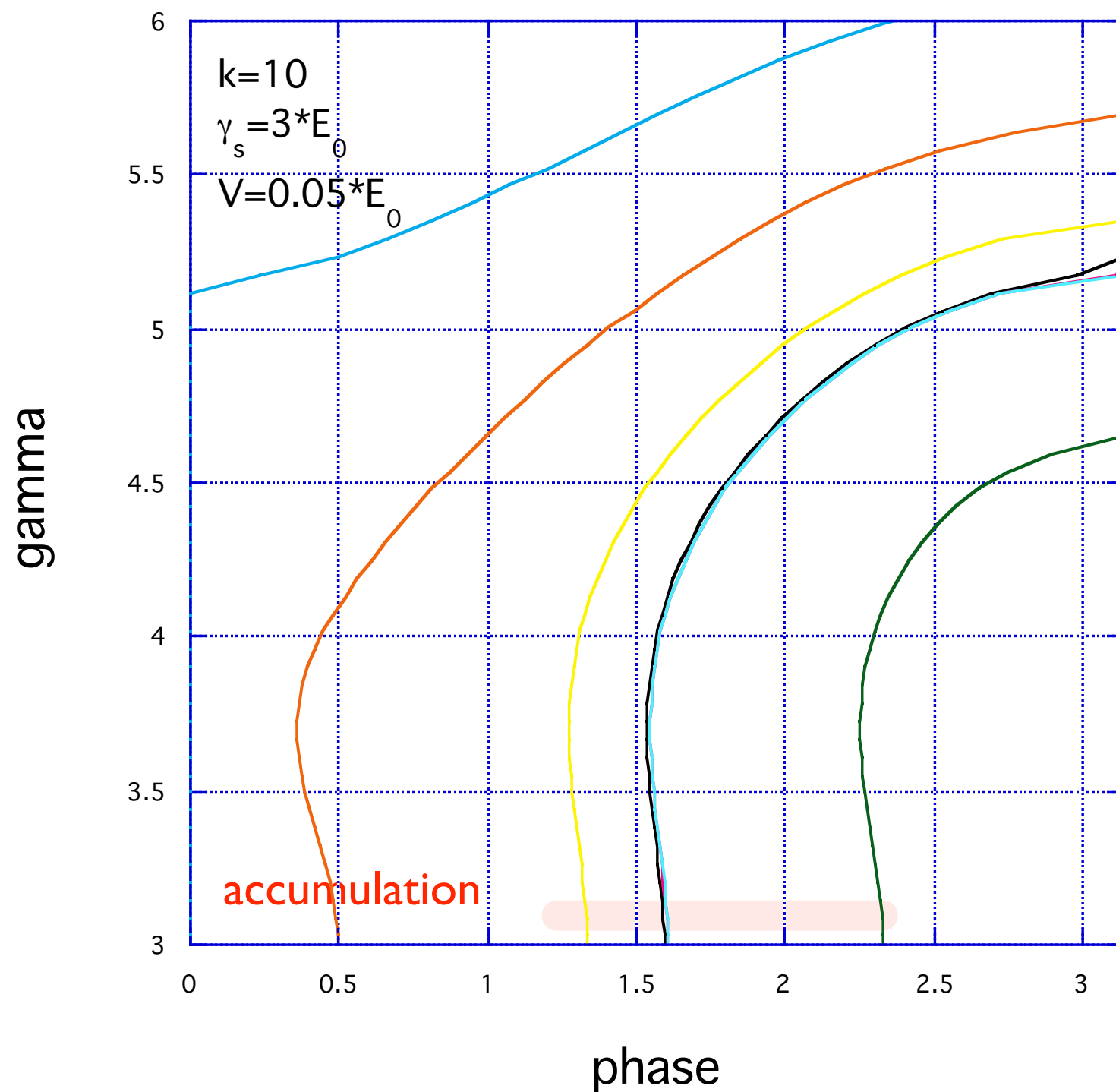
energy range	2 - 4GeV
lattice	FDF-scaling
field index	10
number of cells	12
radius	20m
Bmax	3.4T
F/D ratio	1.98
beam excursion	1.2m
RF voltage	45MV(h=1)





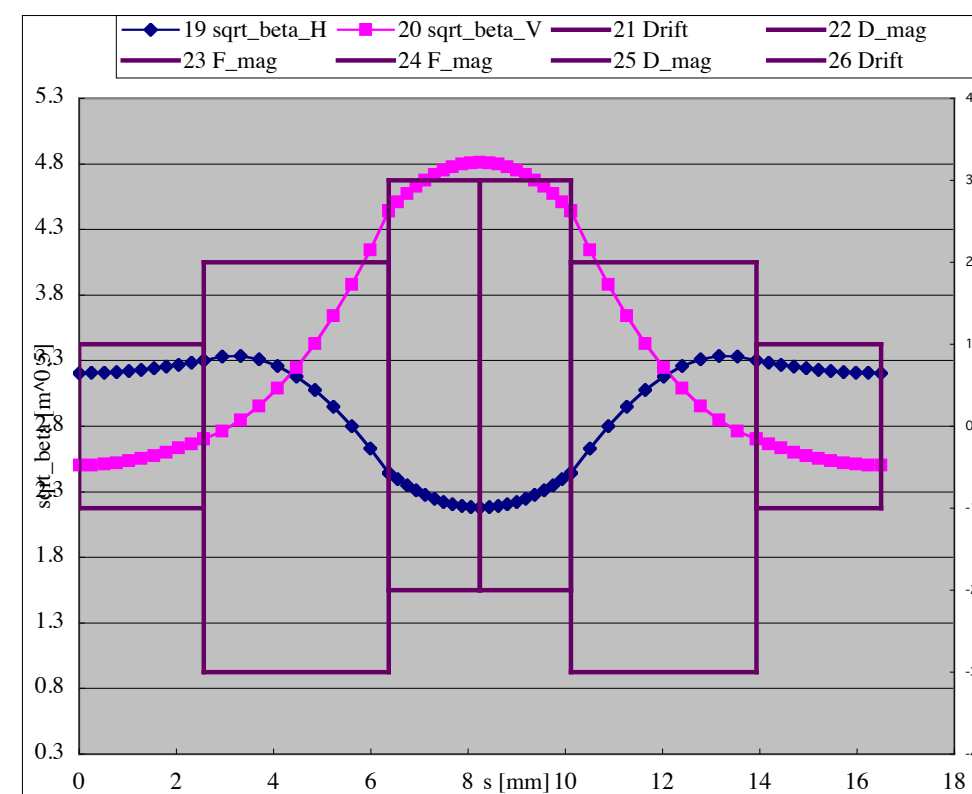
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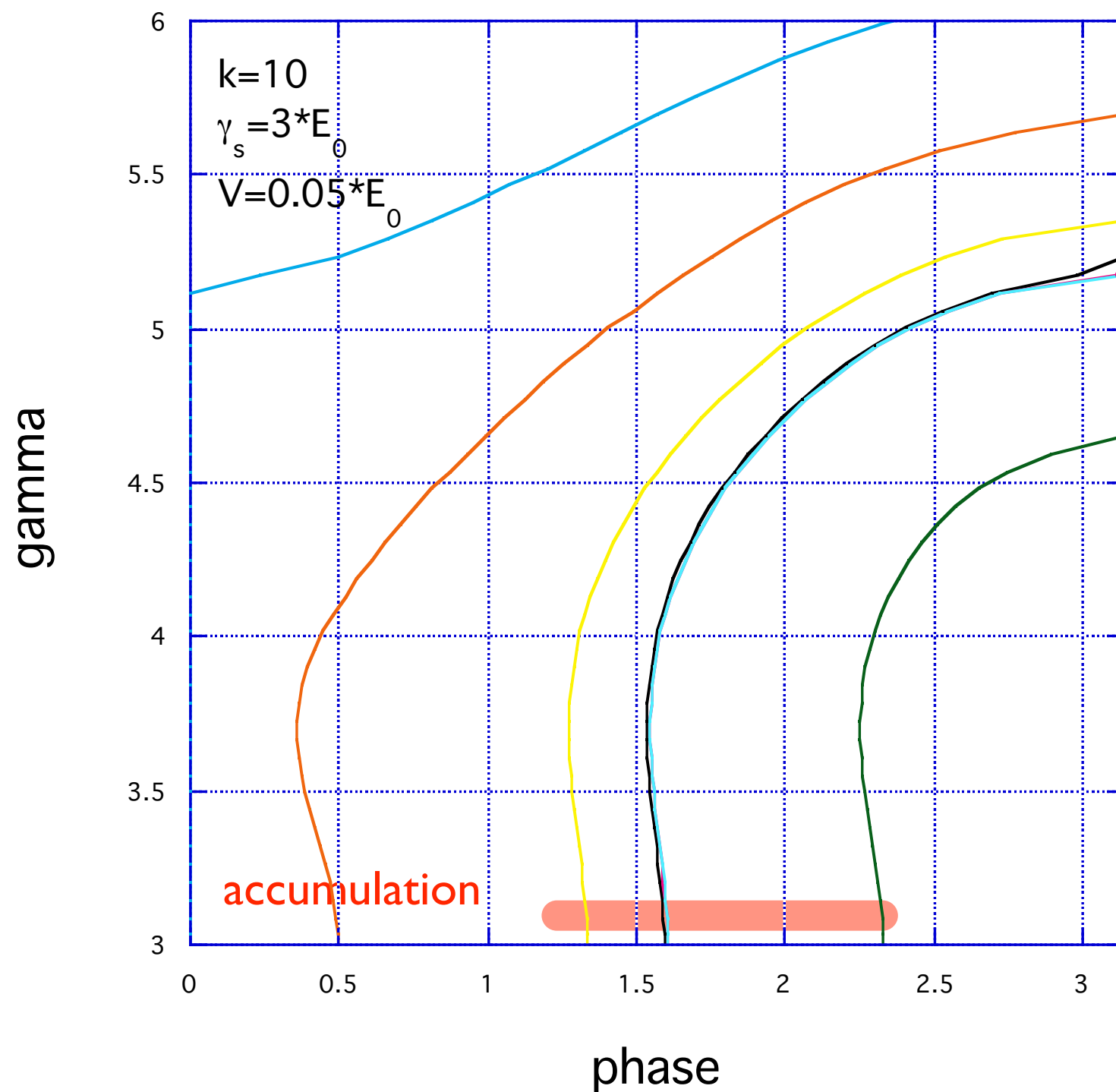
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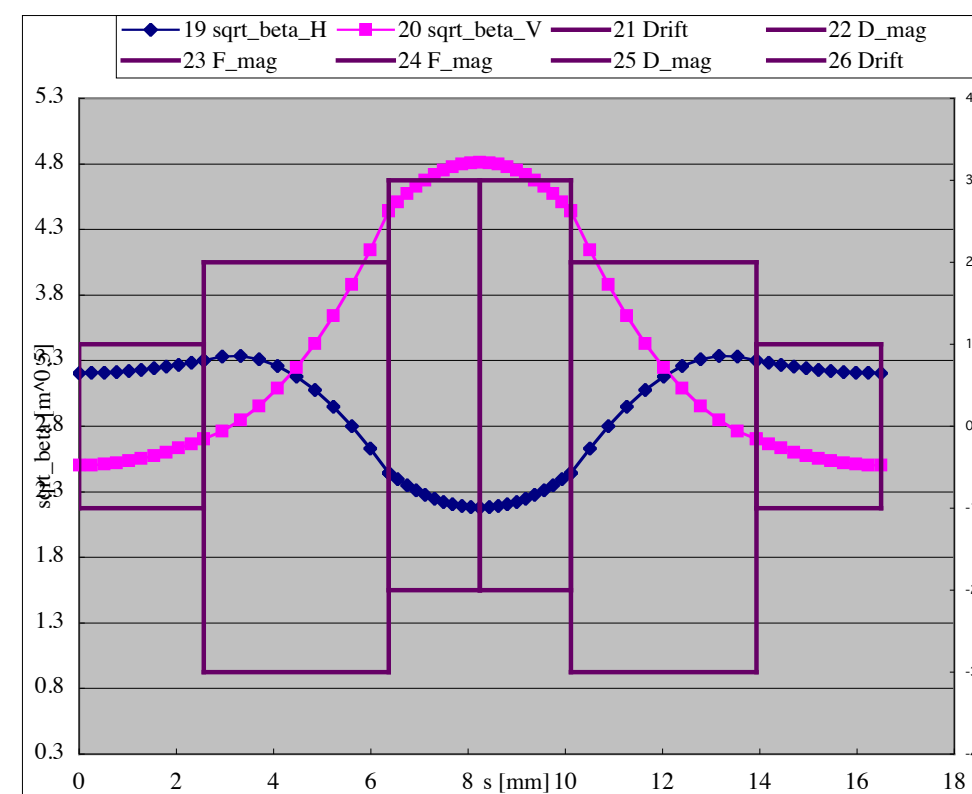
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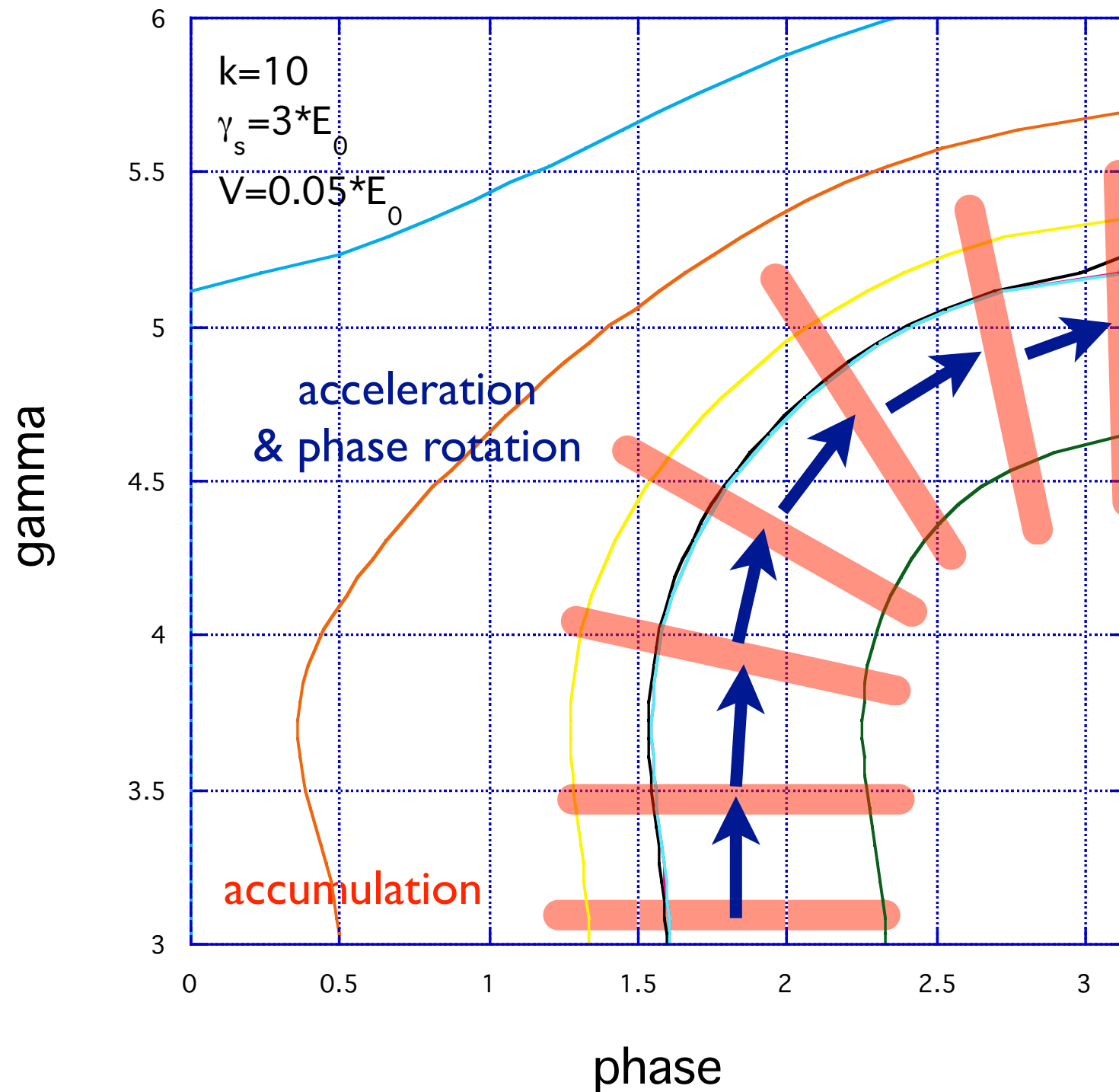
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