Creating Gaps in the eRHIC Linac

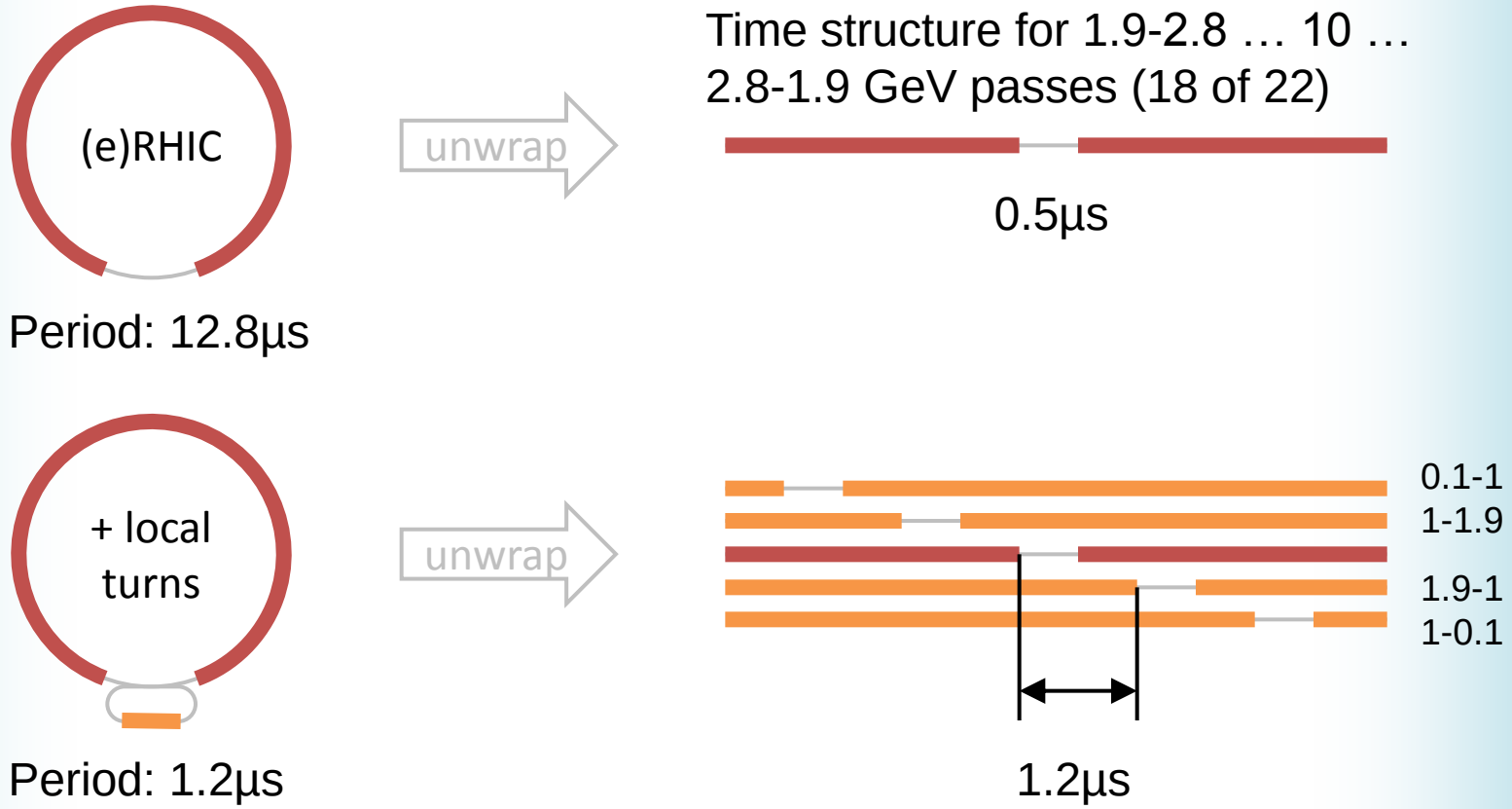
Useful numbers

- RHIC revolution time: 12.8μs (78.2kHz, 3.8km)
- h=120 period: 107ns (9.38MHz, 31.9m)
  - As I understand it, this is the frequency of both:
    - RHIC proton bunches
    - eRHIC electron bunch trains
- eRHIC RF frequency: 2.42ns (413MHz, 72.6cm)
  - This is 44 times the h=120 frequency
  - Minimum spacing of eRHIC electron bunches
    - Except for decelerating bunches that are 180deg off

Problem with Local Turns

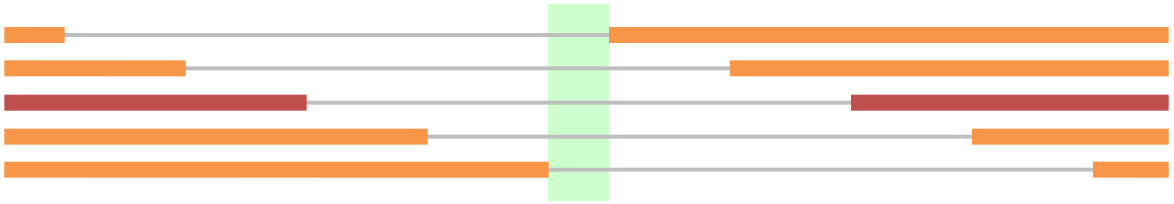
- There is a need for ~0.5μs of clear time in linac
  - Exact value still to be determined
  - Useful for:
    - Clearing trapped ions
    - Inserting a diagnostic single bunch with space around it
- A gap could be inserted, isochronous with the RHIC proton abort gap, in the 2.8-10GeV FFAG
- Two local turns have shorter period of ~1.2μs
  - Cause “echoes” of the ring train structure in linac

Time Structure Diagram



- So there is no gap because of delayed trains

Producing Gap by Brute Force



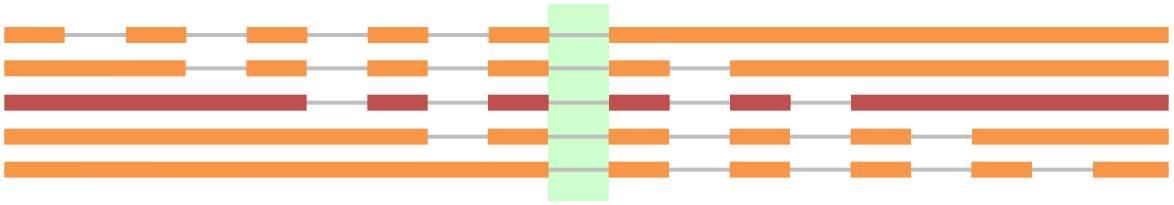
0.5μs gap

Time structure for main FFAG

0.5 + 2*2*1.2 = 5.3μs without beam required

- 12.8 – 5.3 = only 7.5μs remains with beam
- 7.5/12.8 = only 58.6% of original luminosity

Improvement using Multiple Gaps



0.5μs gap

Time structure for main FFAG

5*0.5 = 2.5μs without beam required

- 12.8 – 2.5 = 10.3μs remains with beam
- 10.3/12.8 = 80.5% of original luminosity

Lumi vs. Required Gap Length

- Bulk figures only, not looking at trains

Linac Gap (ns)	Brute force	Five gaps	← With gap in RHIC abort gap	
100	61.7%	96.1%	64.2%	96.7%
200	60.9%	92.2%	63.4%	93.5%
300	60.2%	88.3%	62.6%	90.2%
400	59.4%	84.4%	61.8%	87.0%
500	58.6%	80.5%	61.0%	83.7%