



Can we combine the High Energy μ^+ and μ^- Coalescing Rings into One ?

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<http://www.muonsinc.com/lemc2008/index.php?content=agenda>



Context

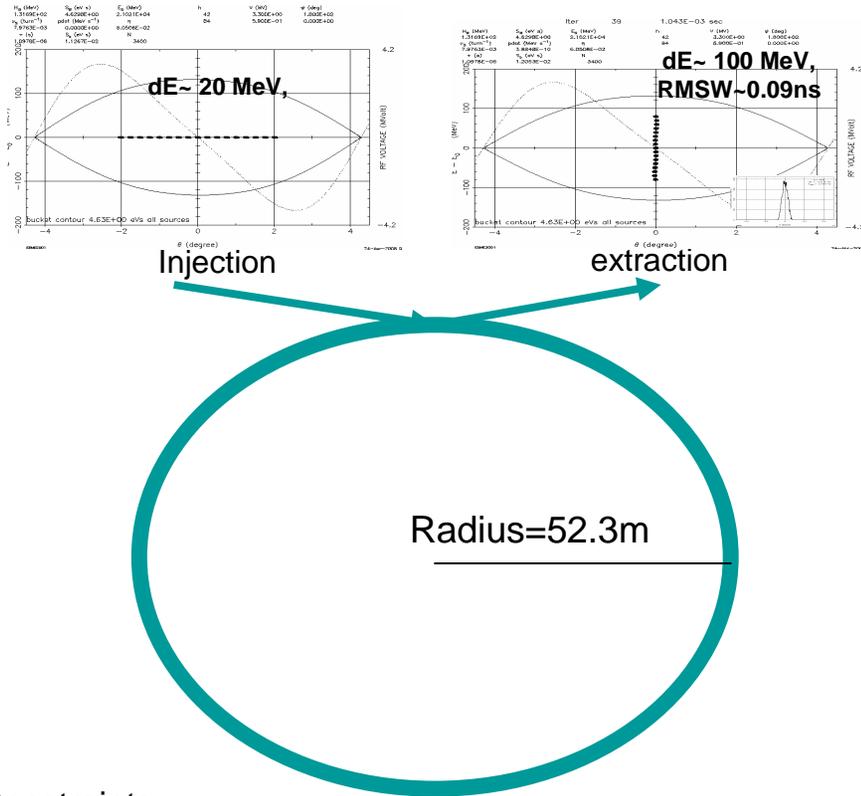
- Suppose that some day:
 - “Project-X”/proton driver based high intensity 8GeV proton beam exists;
 - High-intensity μ -beams are available with low emittances;
 - Which leads to the high energy μ^+ - μ^- collider
- Then,
 - In one specific scenario, each of ten equally spaced proton bunches produces a train of **sixteen equally spaced** μ^- bunches. However, to achieve high luminosity in a collider, it is highly desirable to combine the bunches.
- But,
 - Combining ought to be done after accelerating to high energy ~ 20 -30 GeV, where space charge is not a problem. At high energy, momentum-dependent path lengths work better than velocity differences for combining bunches.
- In LEMC'06 and NFMCC Meeting @ IIT, 2006
 - We have shown that μ^- bunches can be combined to enhance the luminosity by introducing bunch coalescing ring.

This led to →



Muon Coalescing Ring (LEMC'06)

The following parameters are assumed for the Coalescing Ring:



Injection beam : 1.3GHz bunch structure
 # of bunches/train = 17 with $dE \sim 20$ MeV,
 μ Intensity= $1E11$ /train

Ring Radius = 52.33m; Revolution period= $1.09\mu s$
 Energy of the $\mu = 20$ GeV ($\gamma = 189.4$)
 γ_T of the ring = 4

If we assume
 Ring-Radius/ ρ (i.e., fill factor) = 2, then B-Field = 2.54T
 (This field seems to be reasonable)

h for the coalescing cavity = 42, 84
 Number of trains/injection = less than 37
 (assuming ~ 100 ns for injection/extraction)
 RF voltage for the coalescing cavity = 3.3 MV ($h=42$)
 = 0.6 MV ($h=84$)

$f_{sy} \sim 7.27E3$ Hz
 $T_{sy}/4 = 34.4\mu s$
 Number of turns in the ring ~ 39

Constraints:

Muon mean-life = 2.2 μs (rest frame)

Muon mean-life in lab = 418 μs

for 20 GeV beam

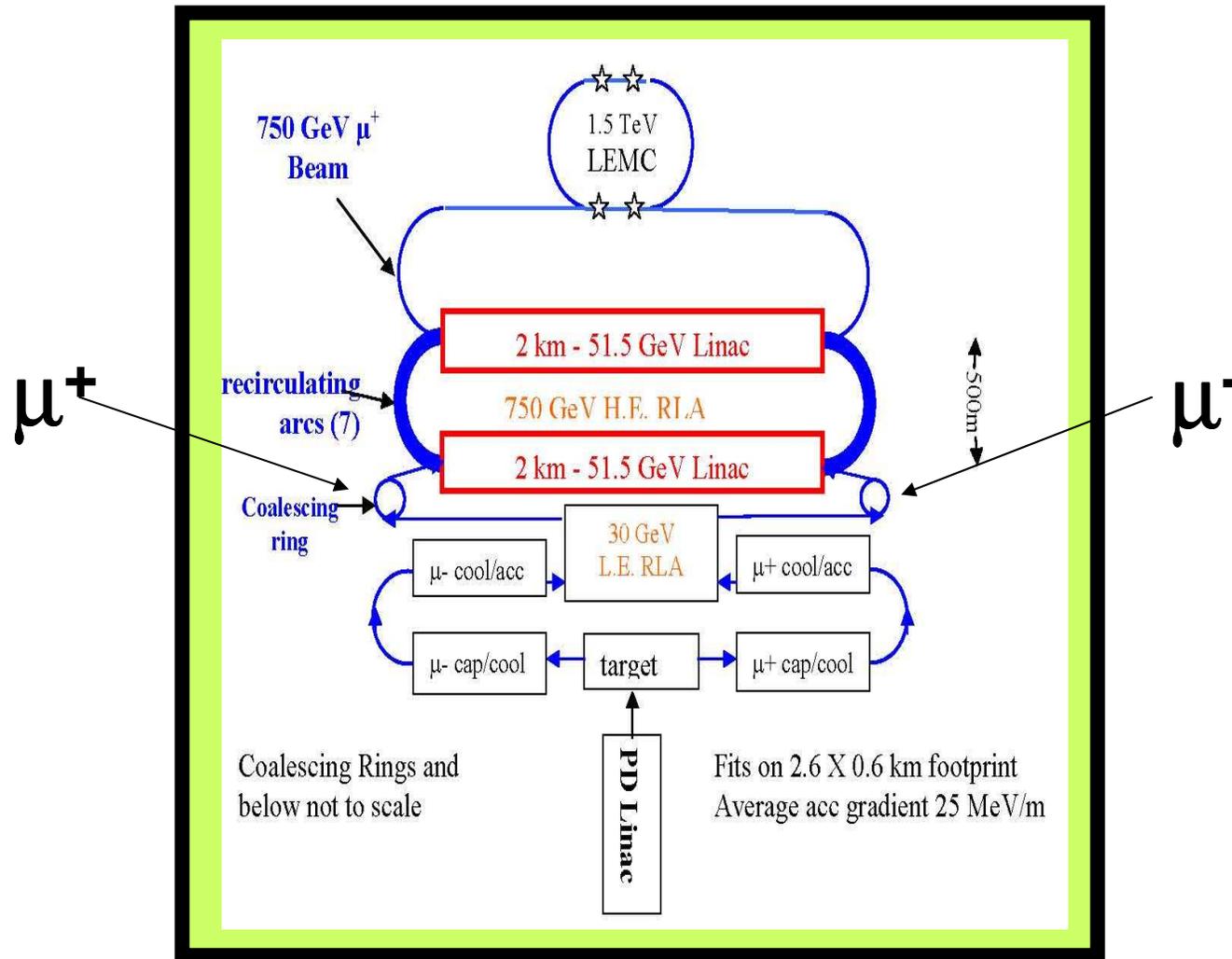
Time (90% survival) = 43.8 μs

Hence \rightarrow



Two coalescing Ring Scenario

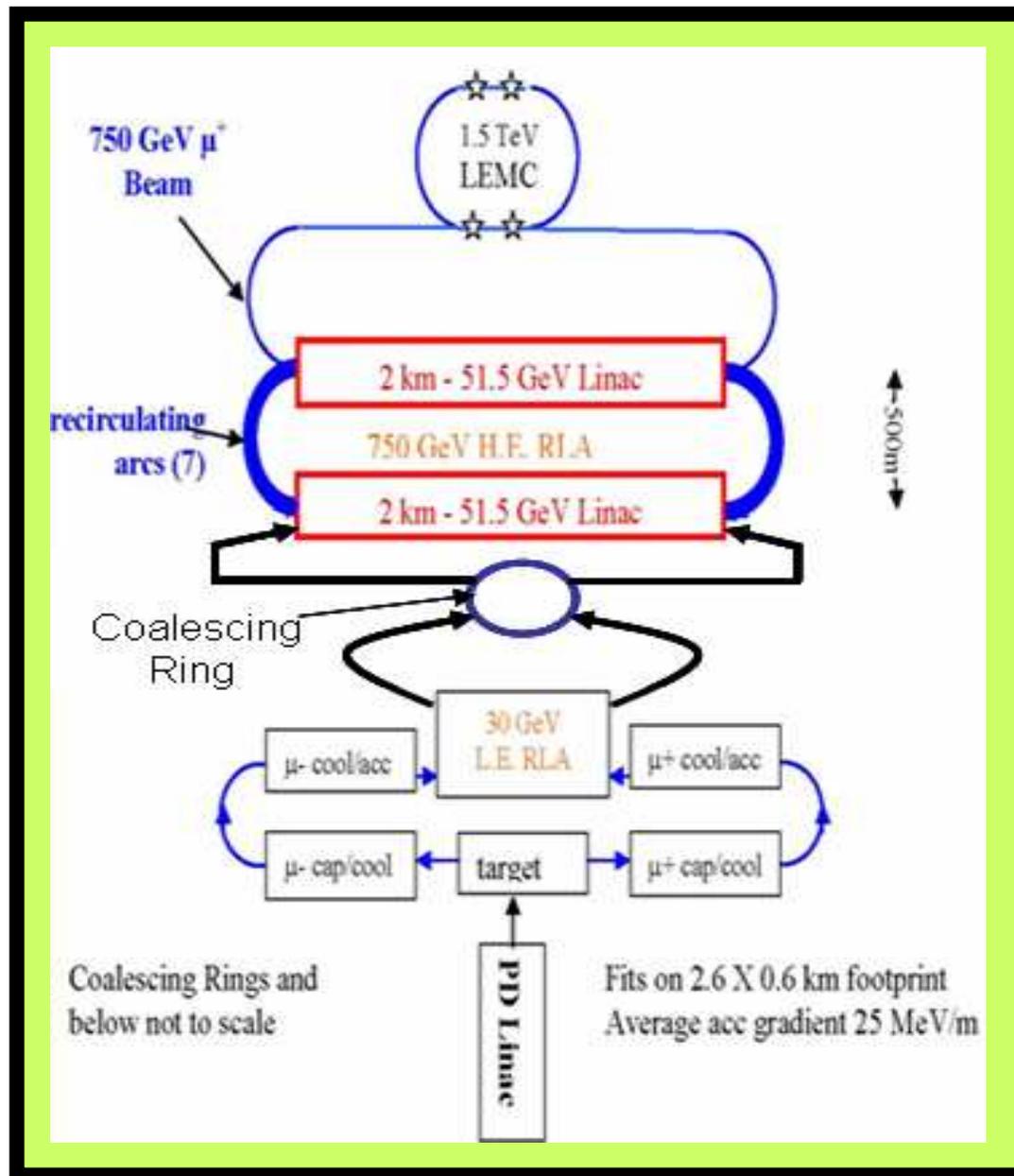
R. P. Johnson et. al, PAC2007(2007) p 2030



Can we combine the two High Energy Coalescing Rings into one?



One Coalescing Scenario



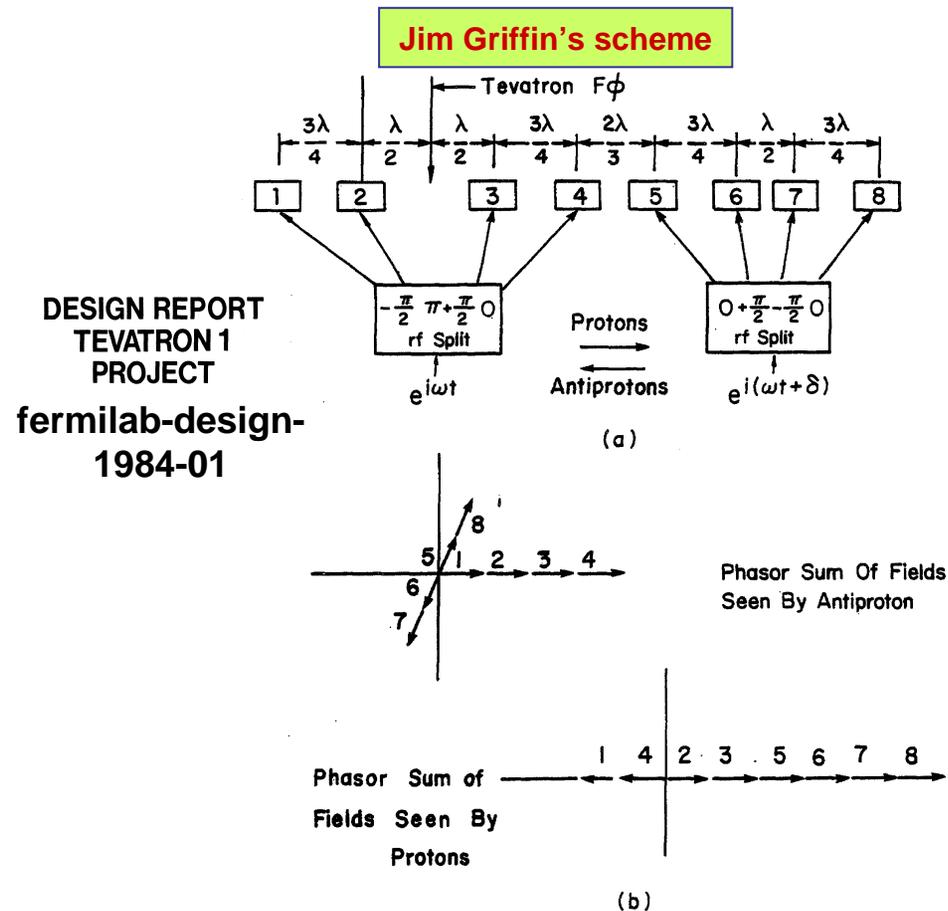
**Answer is
“Yes We Can!”**

- Barack Obama



protons and antiprotons Bunches in the Collider

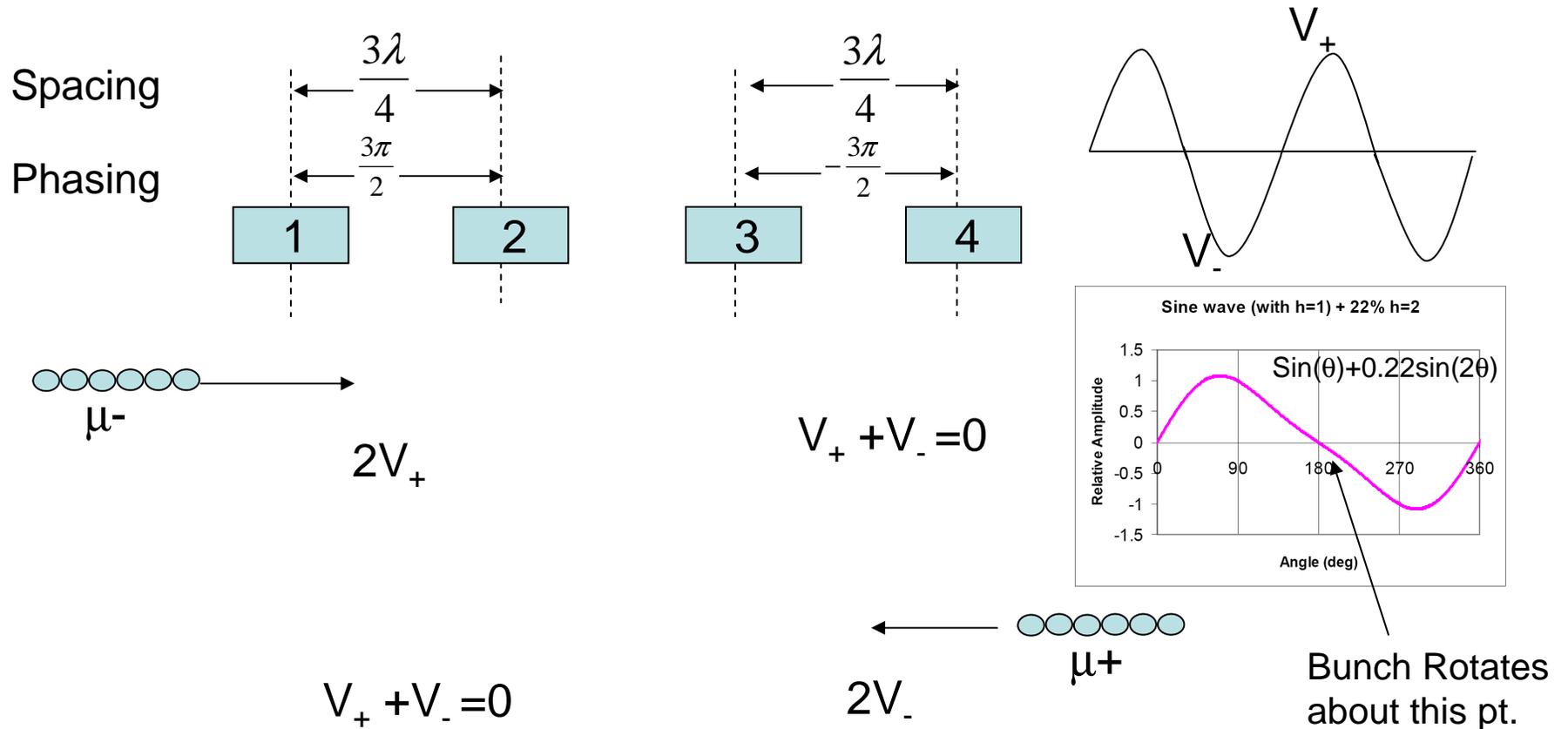
- In the Tevatron the proton and antiproton bunches are accelerated in the same ring simultaneously and made them collide.





Coalescing μ^+ and μ^- in a Single Ring

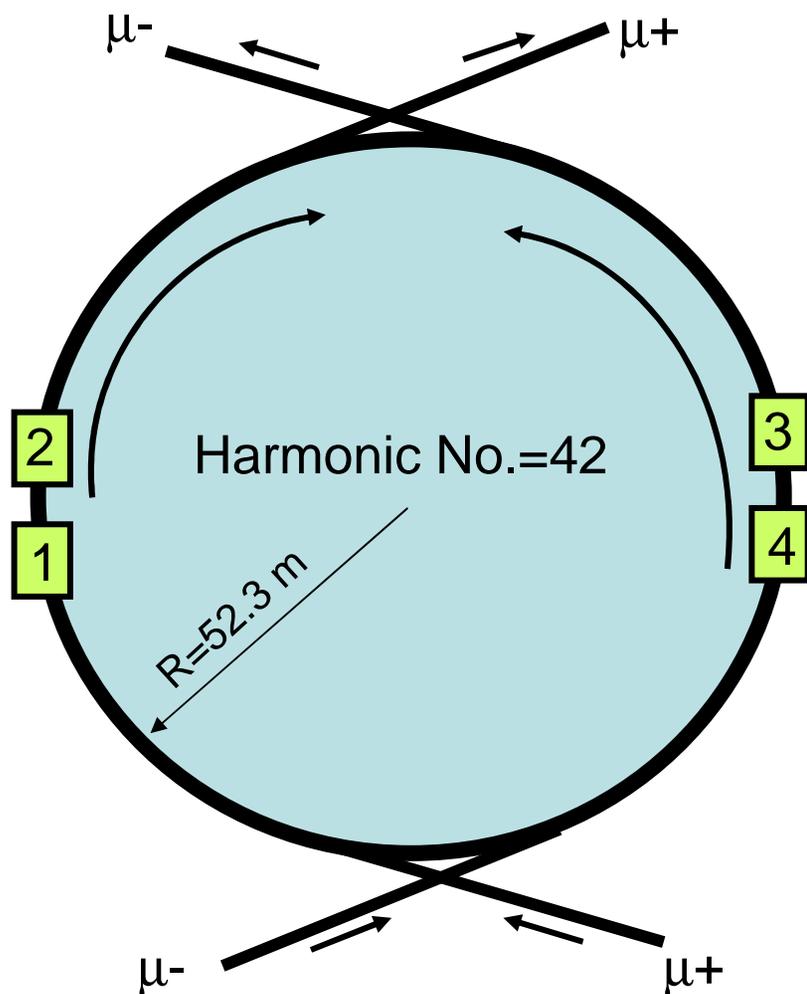
Spacing and Phasing the rf systems for μ^+ and μ^- coalescing





Coalescing Ring – version 1

Schematic of the Ring, RF and Injection/Extraction



of bunch trains= 10 each

Issues:

1. Beam loss due to bunch crossing
This may not be a problem
2. Beam-beam interactions
3. others



Summary and conclusions

- Yes, we can replace two coalescing rings by one. The rf cavities have to be properly spaced and phased
 - ← One less ring; Saving several M\$
- Details of the rings lattice, injection and extraction lines have to be worked out

Thanks to

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2. C. Ankenbrandt
3. D. Neuffer
4. J. Griffin