A 20 GeV Coalescing Ring for a Muon Collider

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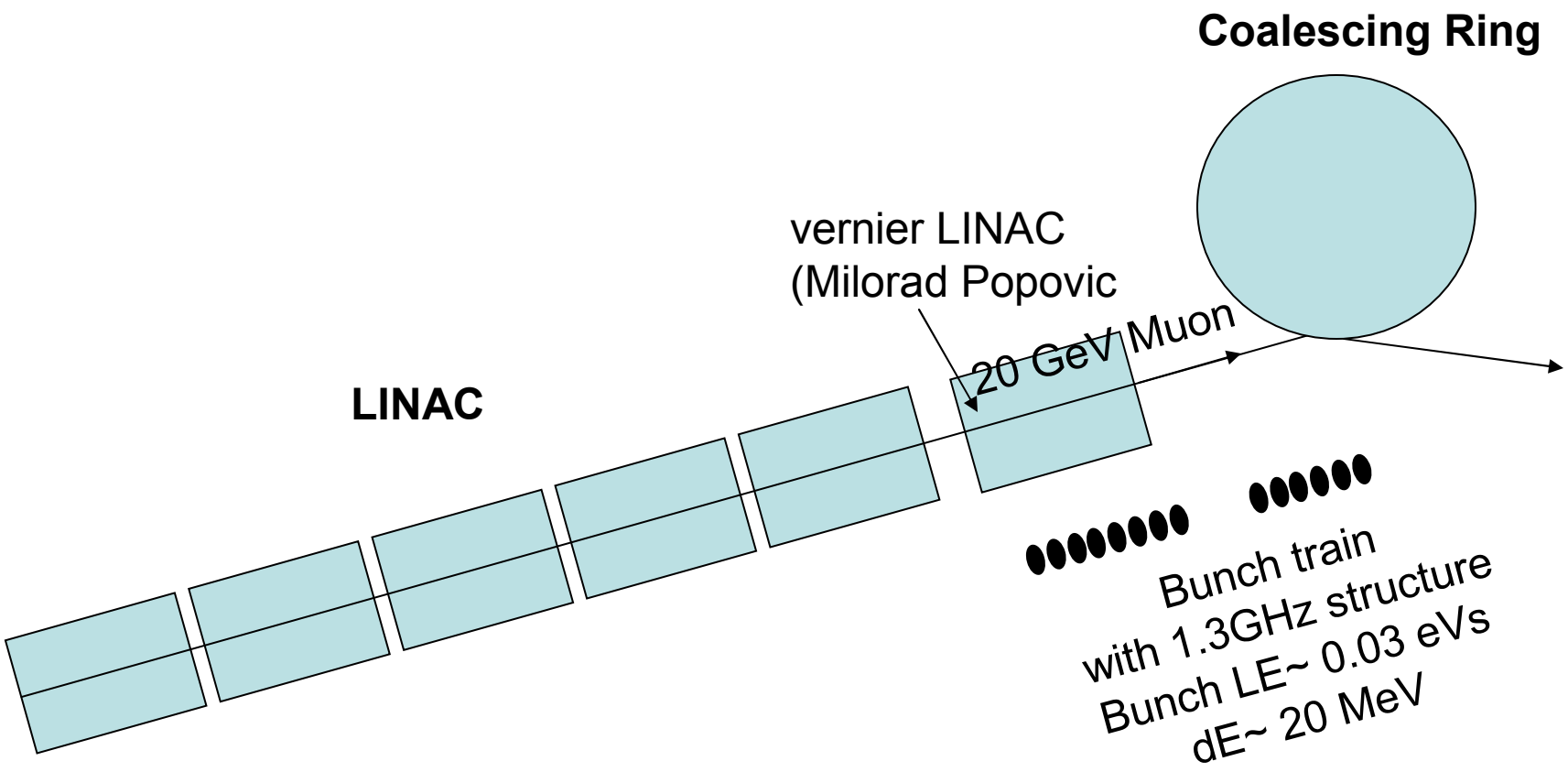
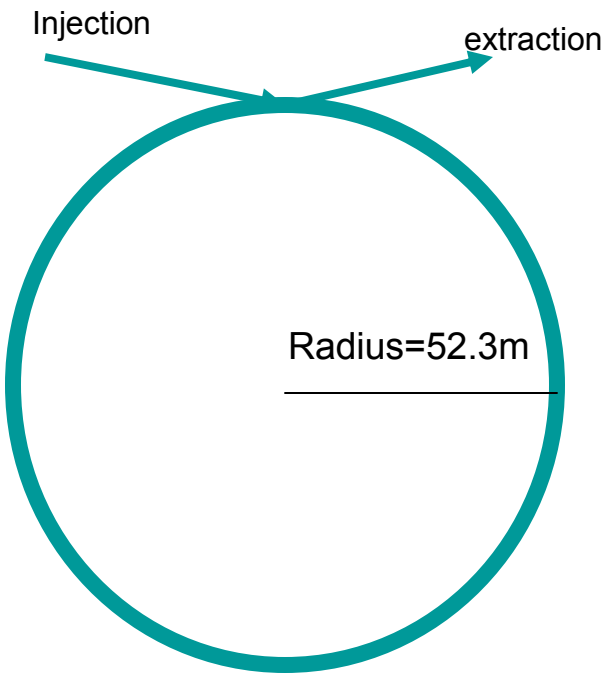
Schematic of the LINAC+Coalescing Ring



Muon Coalescing Ring.

Based on the information given to me by Chuck Ankenbrandt following parameters are derived for the Coalescing Ring



Constraints:
Muon mean-life = 2.2us (rest frame)
Muon half-life in lab = 288us
for 20 GeV beam
Time (90% survival) = 43.8us

Injection beam : 1.3GHz bunch structure
# of bunches/train = 17

Ring Radius = 52.33m; Revolution period= 1.09μs
Energy of the muon = 20 GeV (gamma = 189.4)
gamma_t of the ring = 4

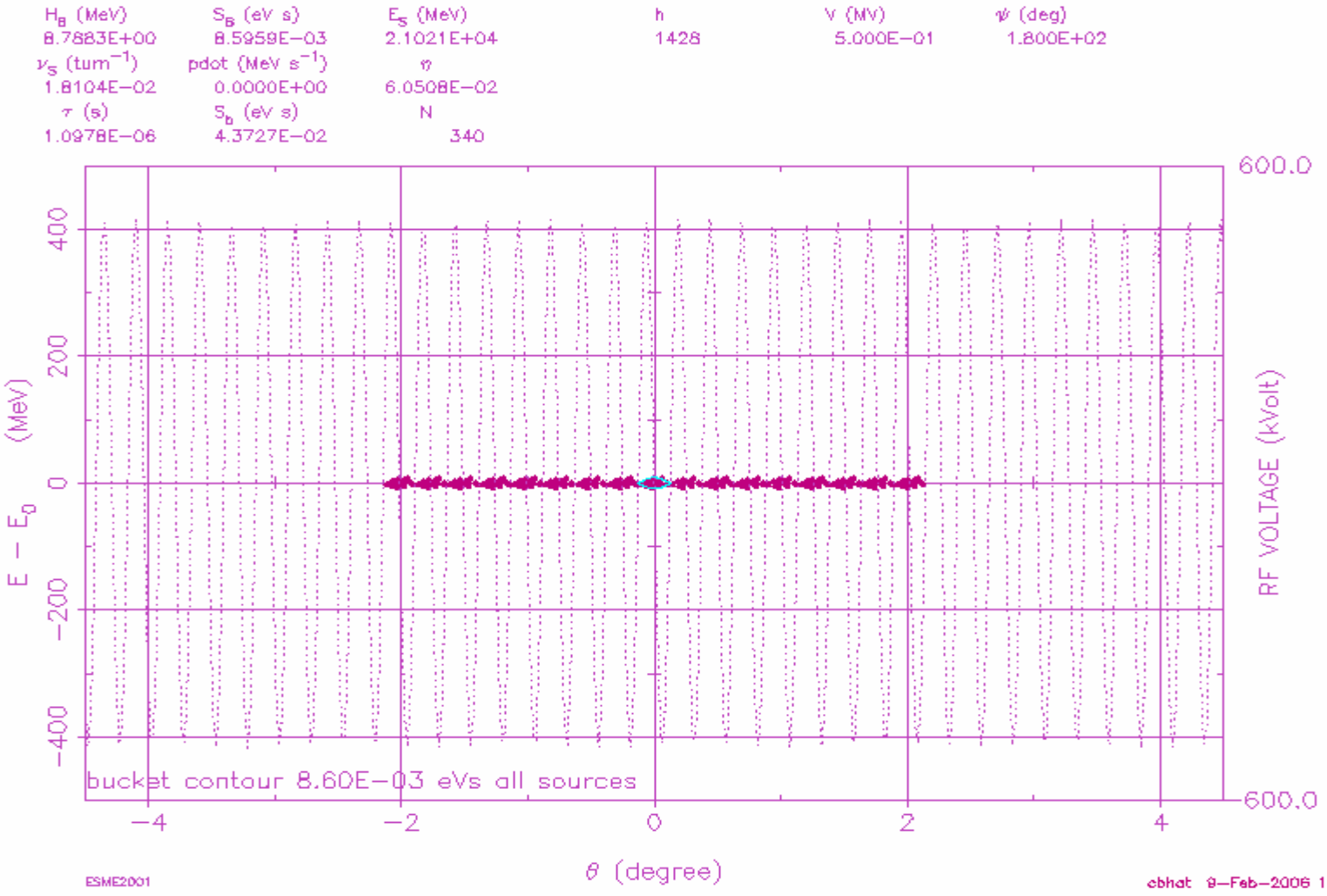
If we assume
Ring-Radius/rho (i.e., fill factor) = 2, then B-Field = 2.54T
(This field seems to be reasonable)

h for the coalescing cavity = 42, 84
Number of trains/injection = less than 37
(assuming ~100ns for injection/extraction)
RF voltage for the coalescing cavity = 1.9 MV (h=42)
= 0.38 MV (h=84)

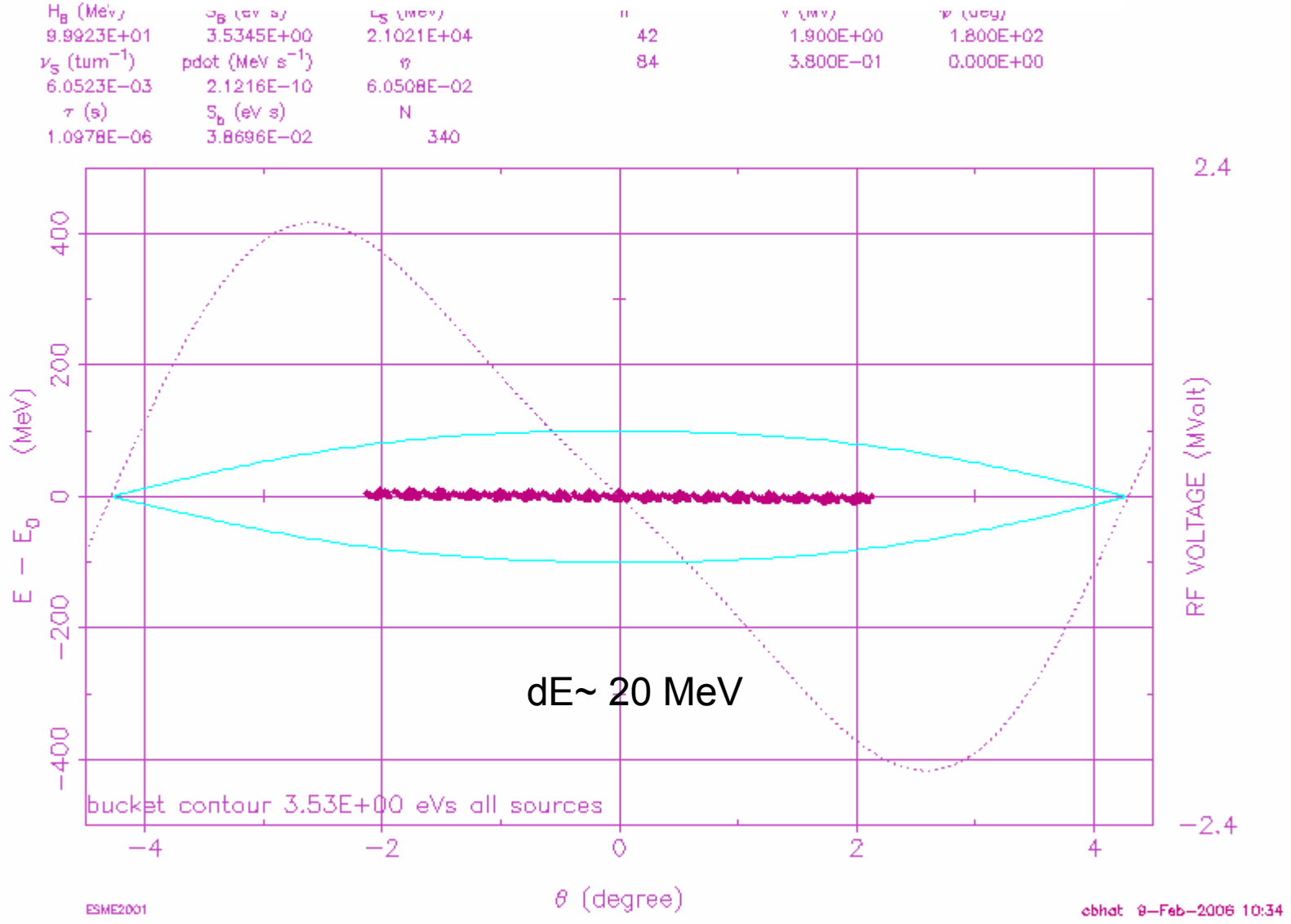
fsy ~ 5.75E3Hz
Tsy/4 = 43.5us
Number of turns in the ring ~40

1st Scenario

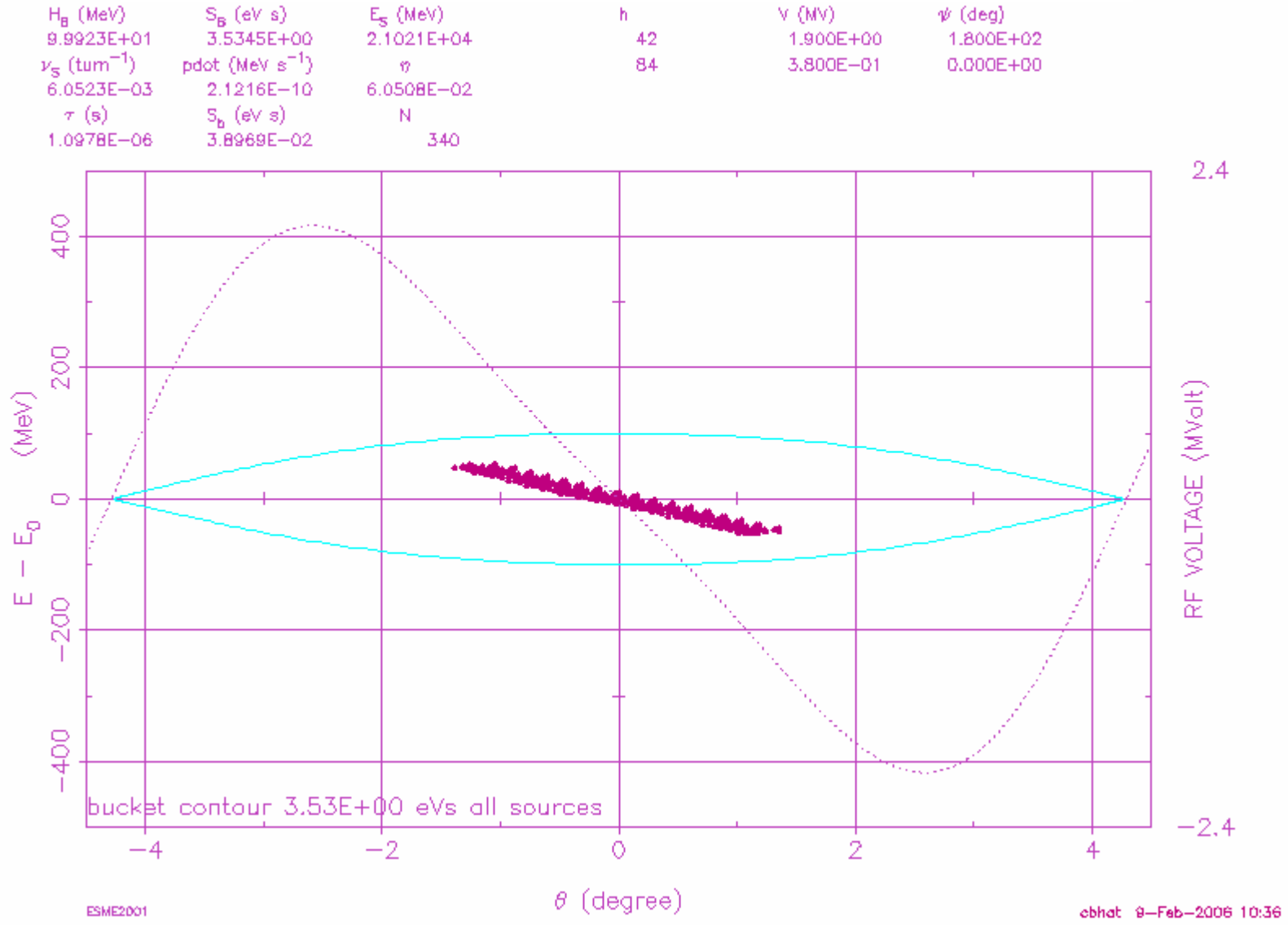
Muon Bunch train from the LINAC



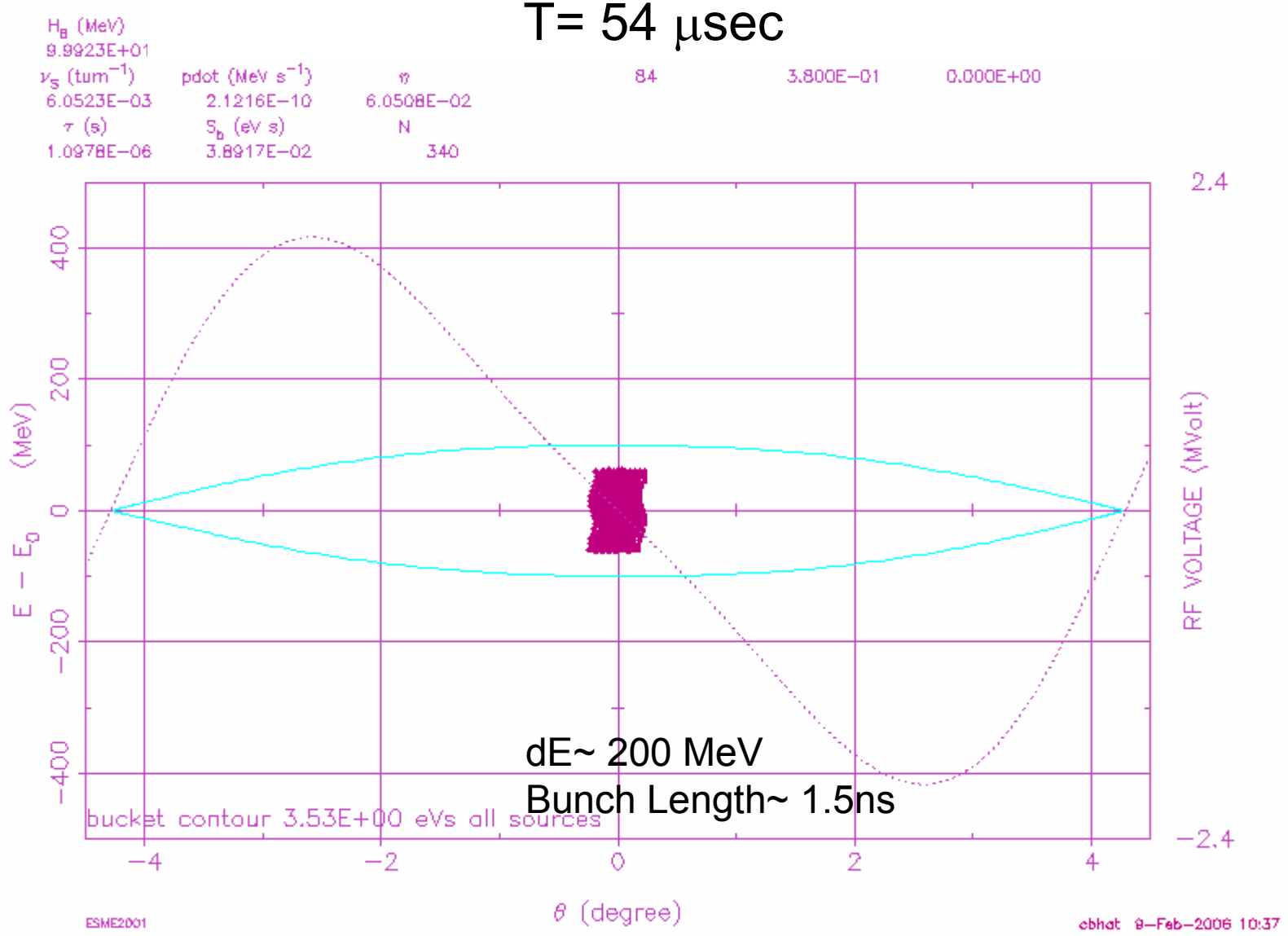
Muon Bunch train in the coalescing bucket
T=0 sec



Muon Bunch train in the coalescing bucket
T= 31.6 μsec



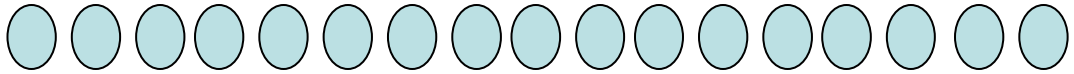
Muon Bunch train in the coalescing bucket
T= 54 μsec



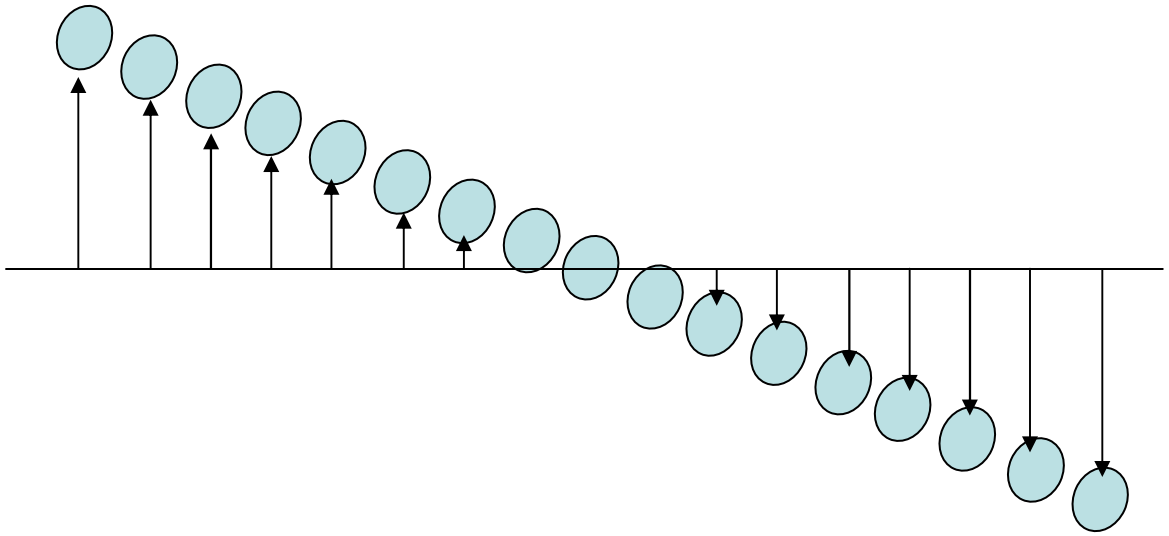
2nd Scenario

- A vernier-linac to give a tilt in the Longitudinal Phase-space

Bunch train before the special purpose pre-linac

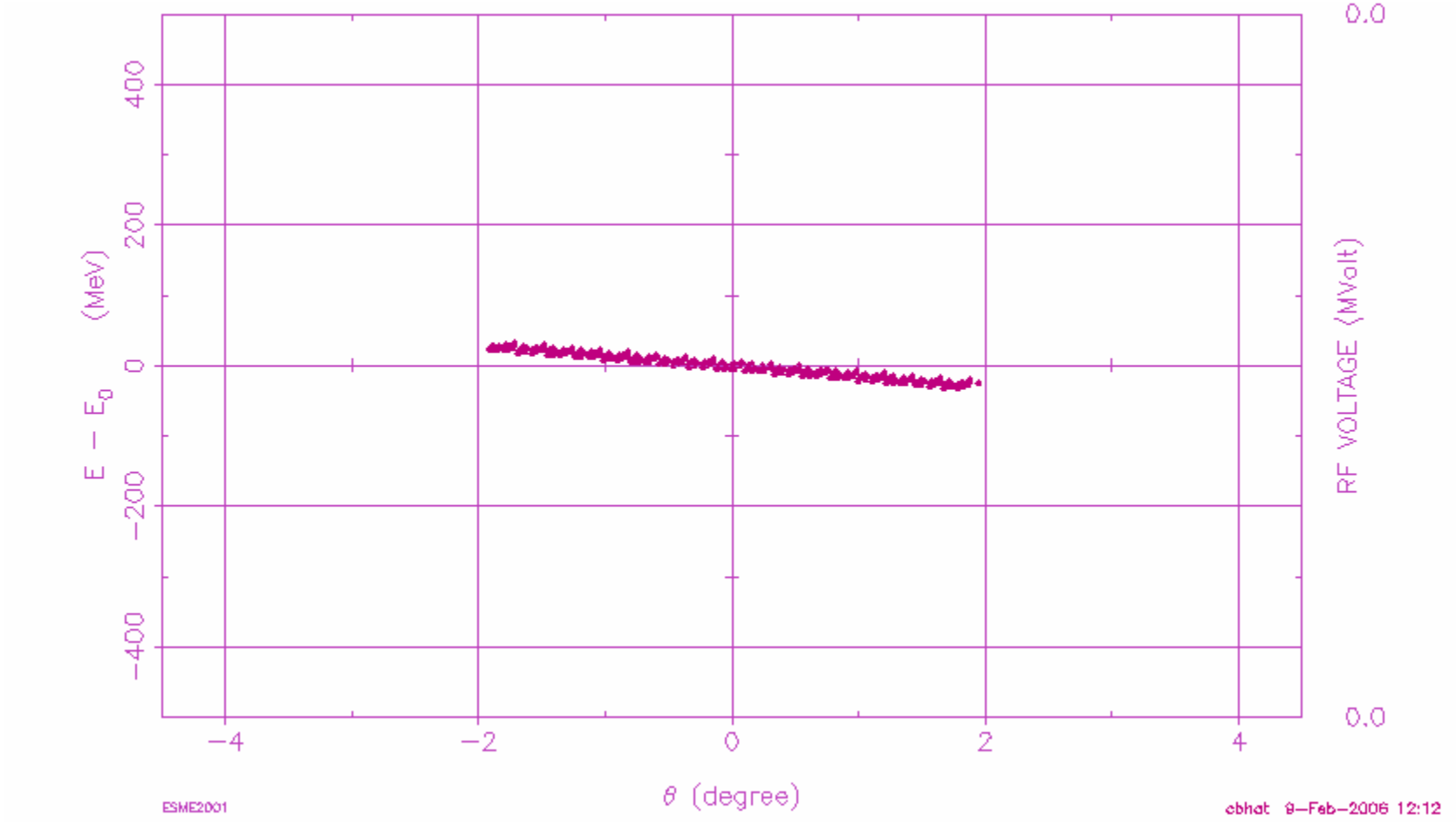


Muon Bunches after pre-linac

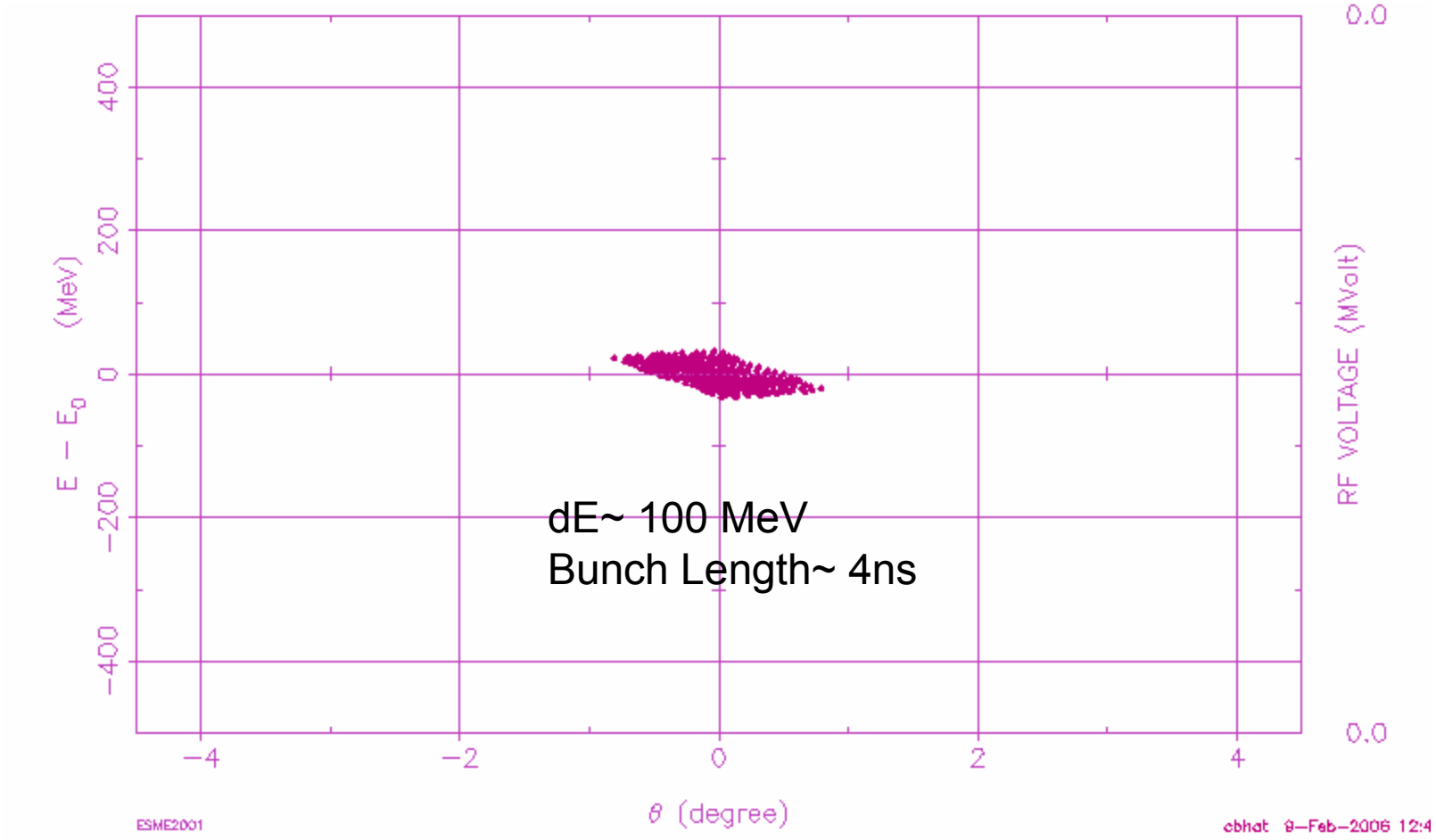


- And next inject the beam into the **Coalescing Ring**

Muon Bunch train in the Coalescing Ring
T=0 sec

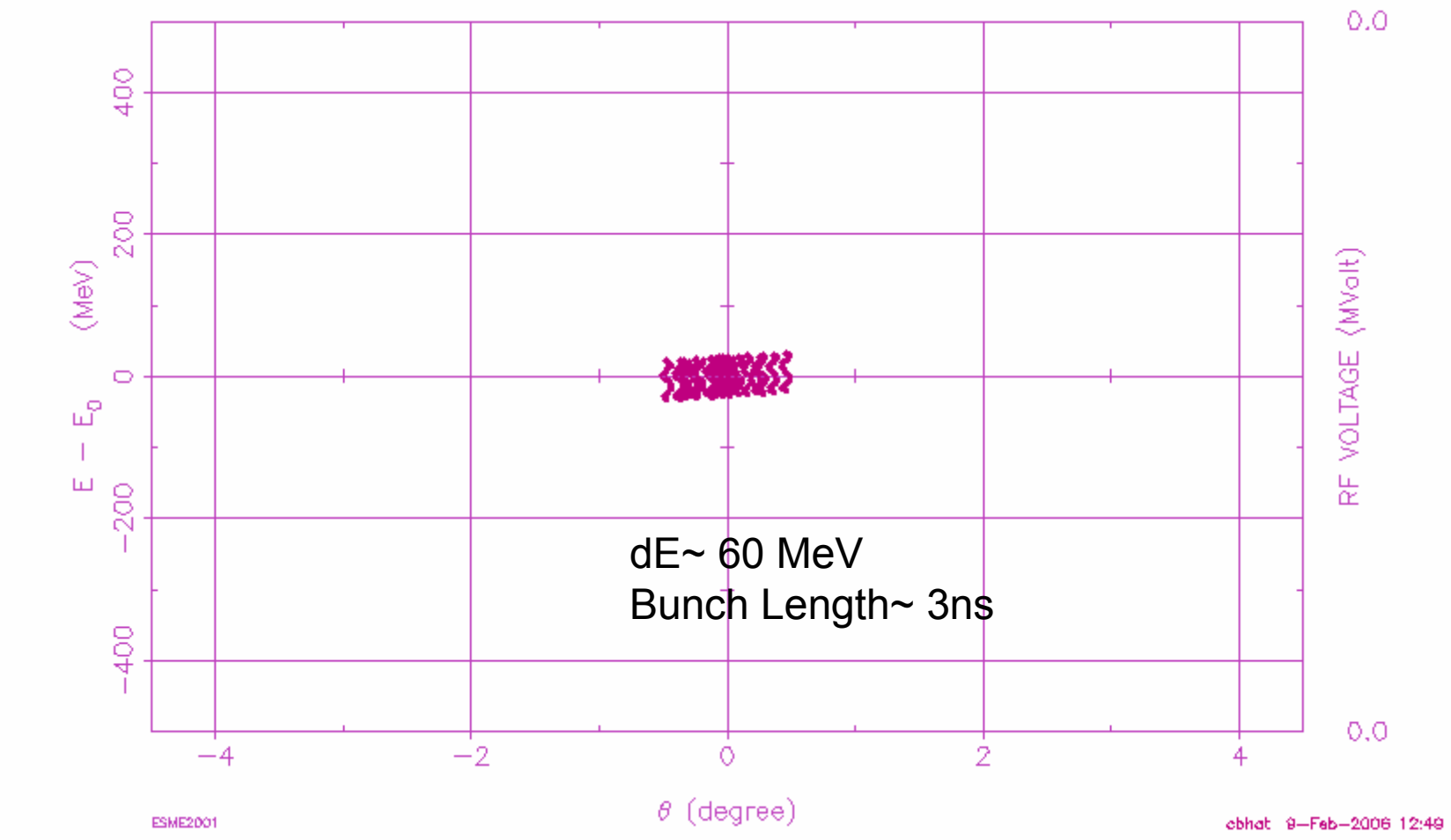


Muon Bunch train in the Coalescing Ring
T=46 μsec



dE~ 100 MeV
Bunch Length~ 4ns

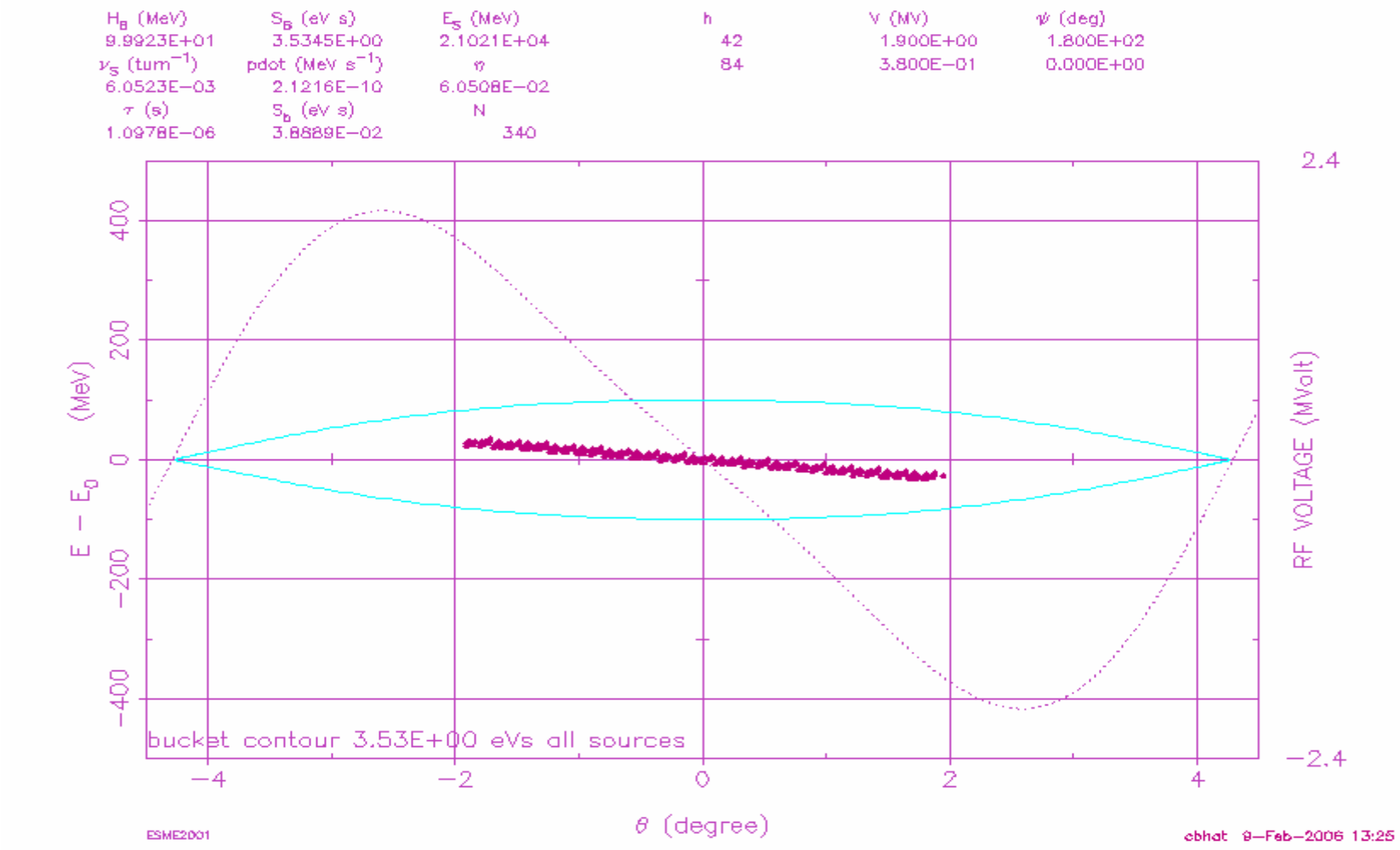
Muon Bunch train in the Coalescing Ring
T=71 μsec



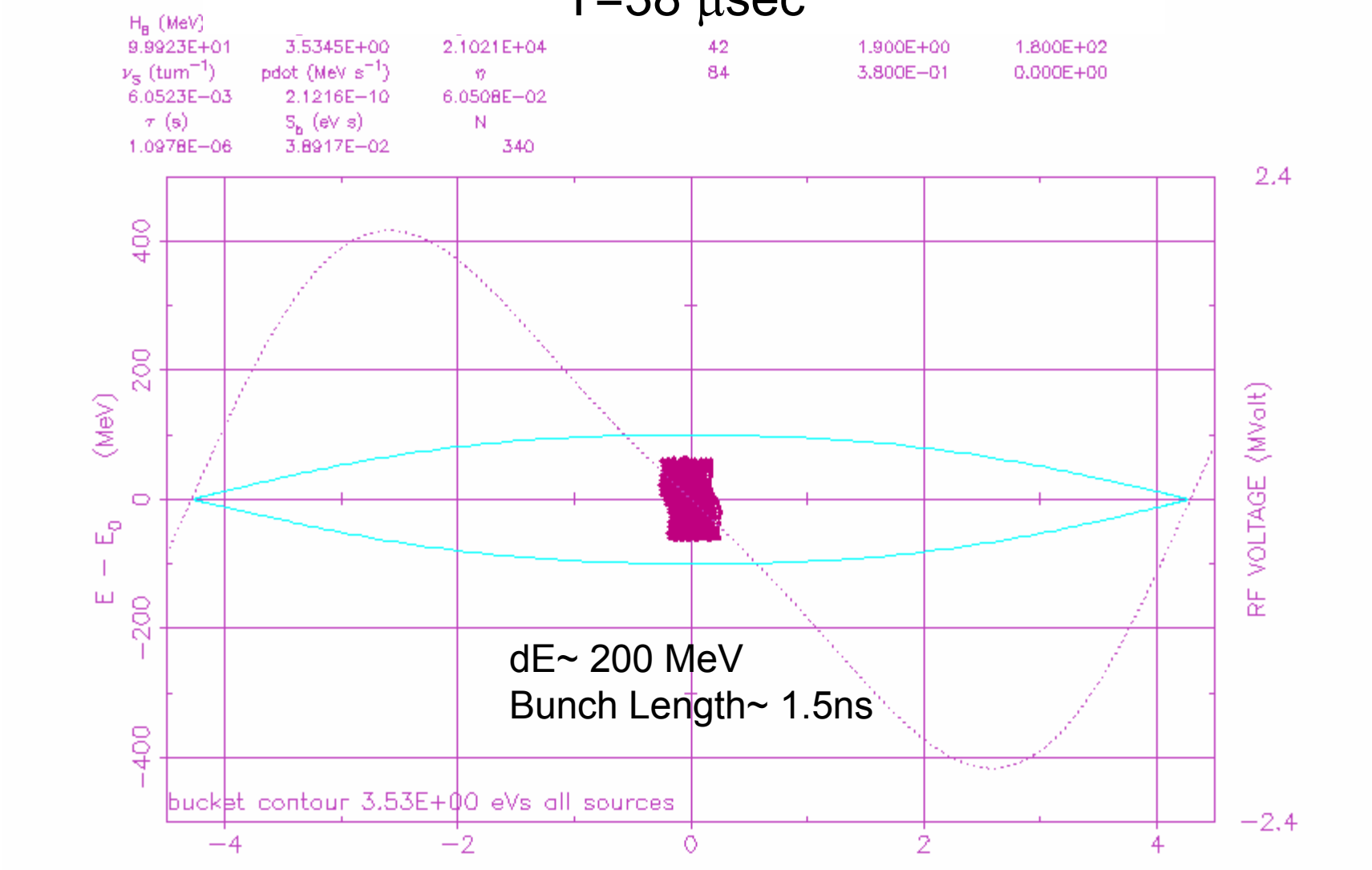
dE~ 60 MeV
Bunch Length~ 3ns

3rd Scenario

Muon Bunch train in the Coalescing Ring
T=0 sec



Muon Bunch train in the Coalescing Ring
T=38 μsec



Summary

- We have done a preliminary design of a 20 GeV ring for muon collider
- Discussed three scenario for 20 GeV muon beam rf manipulations for upto 37 groups of 17 bunches of 1.3GHz
  - Scenario1: the muon bunch injection and coalescing (no vernier cavities before injection to the 20 GeV ring)← takes about 54 μs
  - Scenario2: the muon bunch injection after giving an energy offsets to the leading and trailing bunches and no coalescing rf cavities ← takes about 46-54 μs
  - Scenario3: the muon bunch injection after giving an energy offsets to the leading and trailing bunches and with coalescing rf cavities ← takes about 38 μs