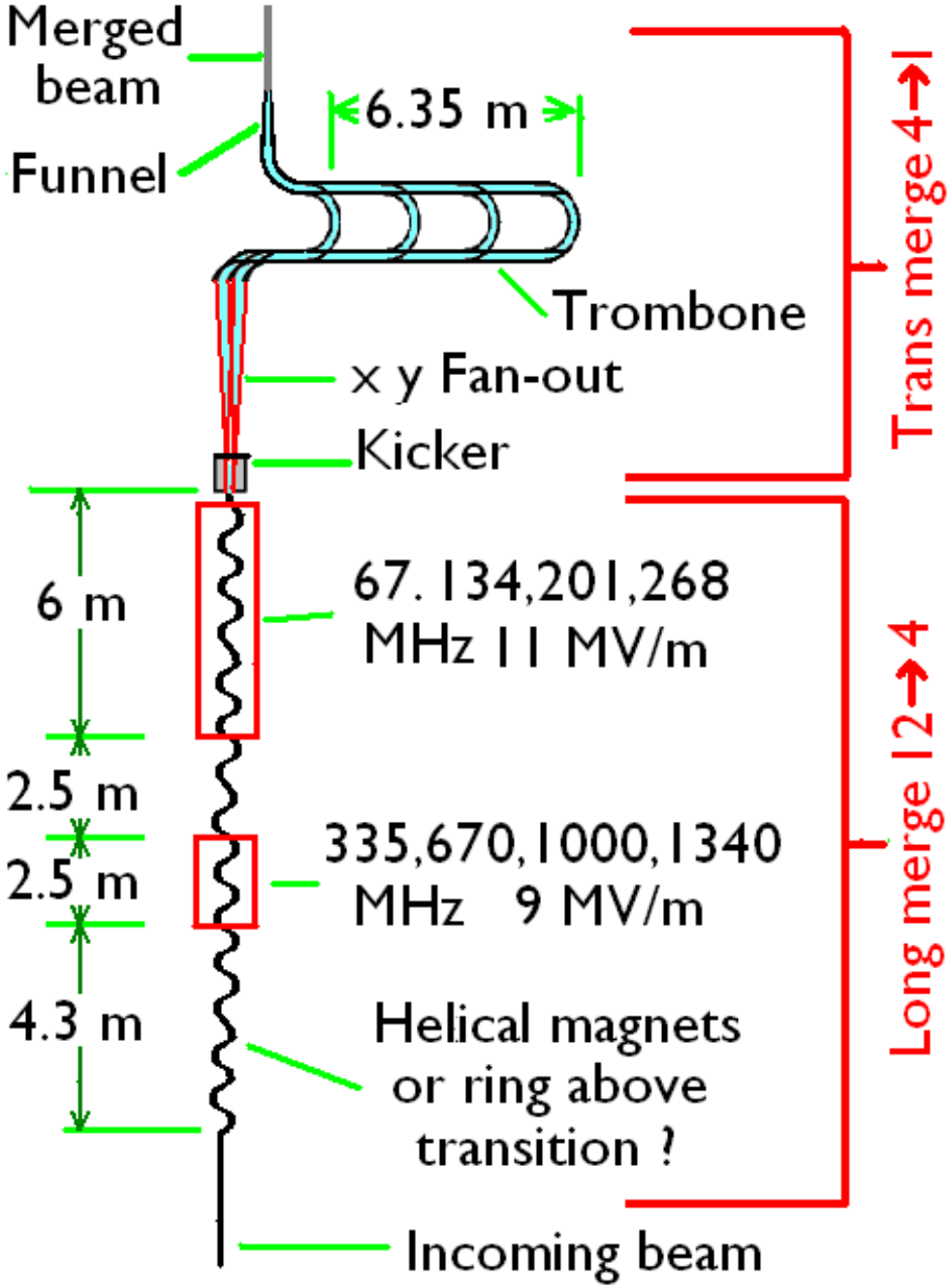
6D Merge

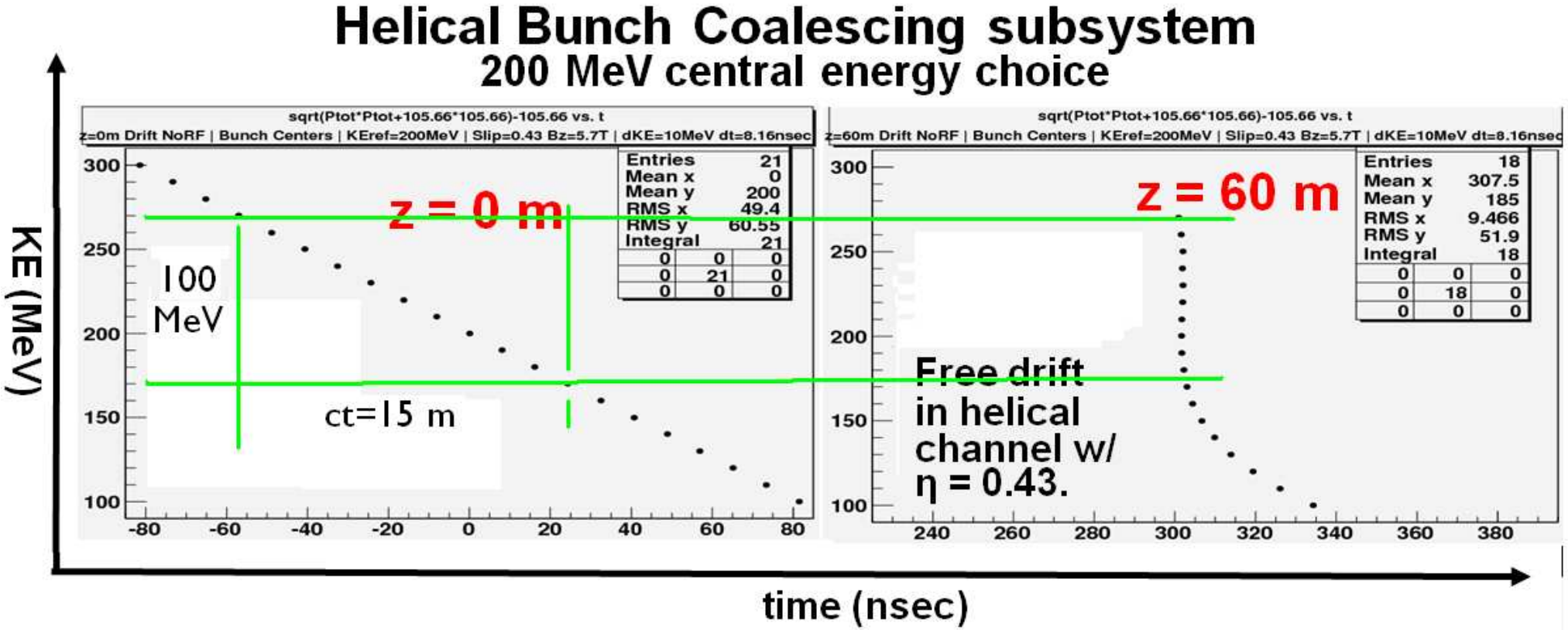
R. B. Palmer (BNL)

3/20/12


Merged beam
Funnel
6.35 m
Trombone
x y Fan-out
Kicker
Trans merge 4→1
6 m
67. 134,201,268 MHz 11 MV/m
2.5 m
2.5 m
335,670,1000,1340 MHz 9 MV/m
4.3 m
Helical magnets or ring above transition ?
Long merge 12→4
Incoming beam

longitudinal: use HCC lattice

From Neuffer 2D merge



Relative time shift (Δct) is linearly dependent on relative energy (ΔE) and drift (L)

$$\frac{\Delta ct}{L\ \Delta E} = \frac{15(m)}{100(MeV)\ 60(m)} = 0.025$$

Method

- We would like to use an inverse Neuffer phase rotation:
  1. Keep bunches contained by rf whose frequency changes as the bunches move in t
  2. Shift phases to accelerate one end and decelerate the other
  3. Let them drift together in time
- But we want to group only 3 at a time, pushing bunches forward or backward
- This cannot be done with continuous rf as in phase rotation
- So I:
  1. cook the crazy waveforms I need,
  2. Fourier analyze them, and
  3. use 4 rf harmonics to generate them
  4. use a saw tooth rf to line the bunches during the drift

longitudinal

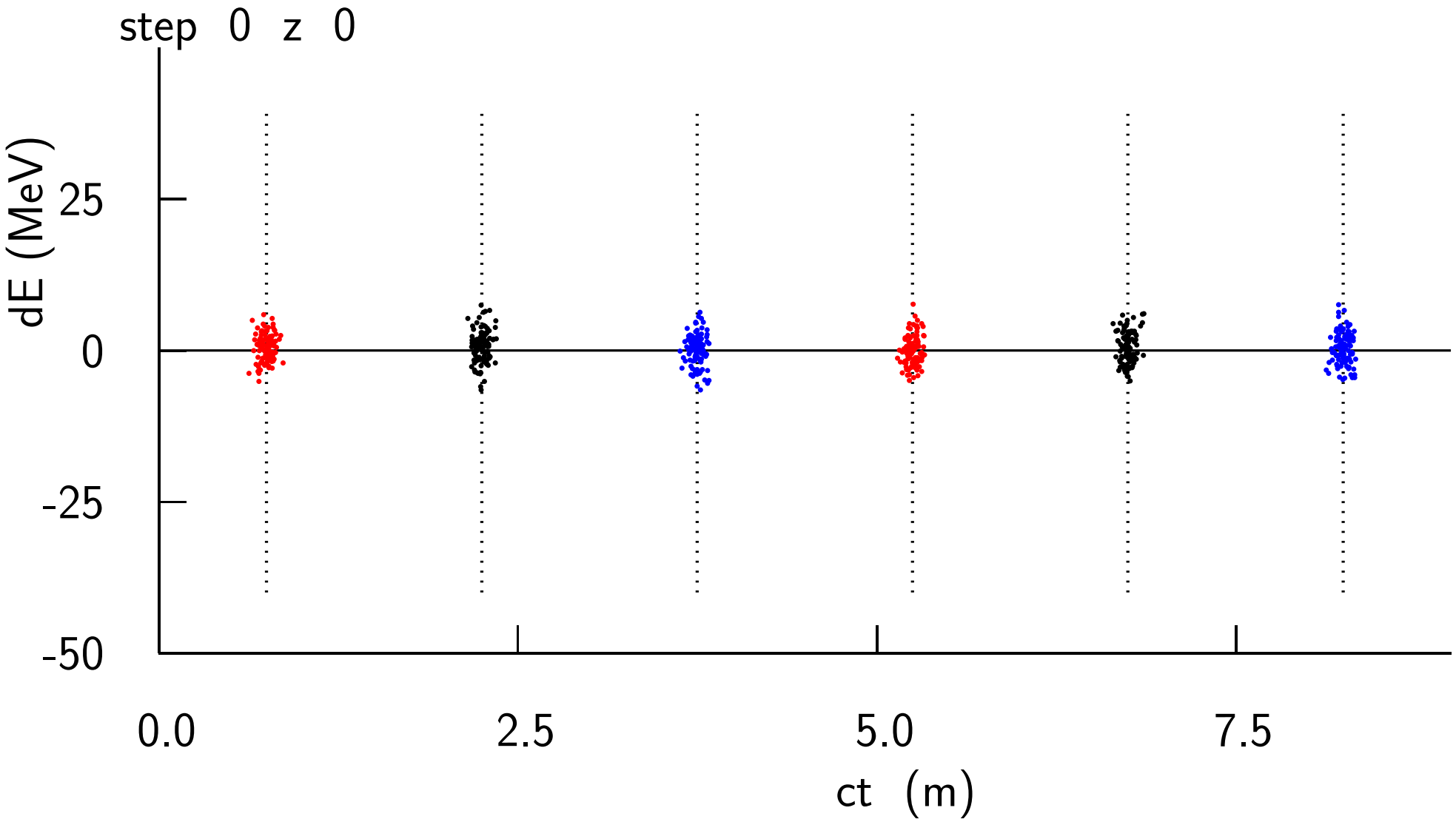


Fig. 1

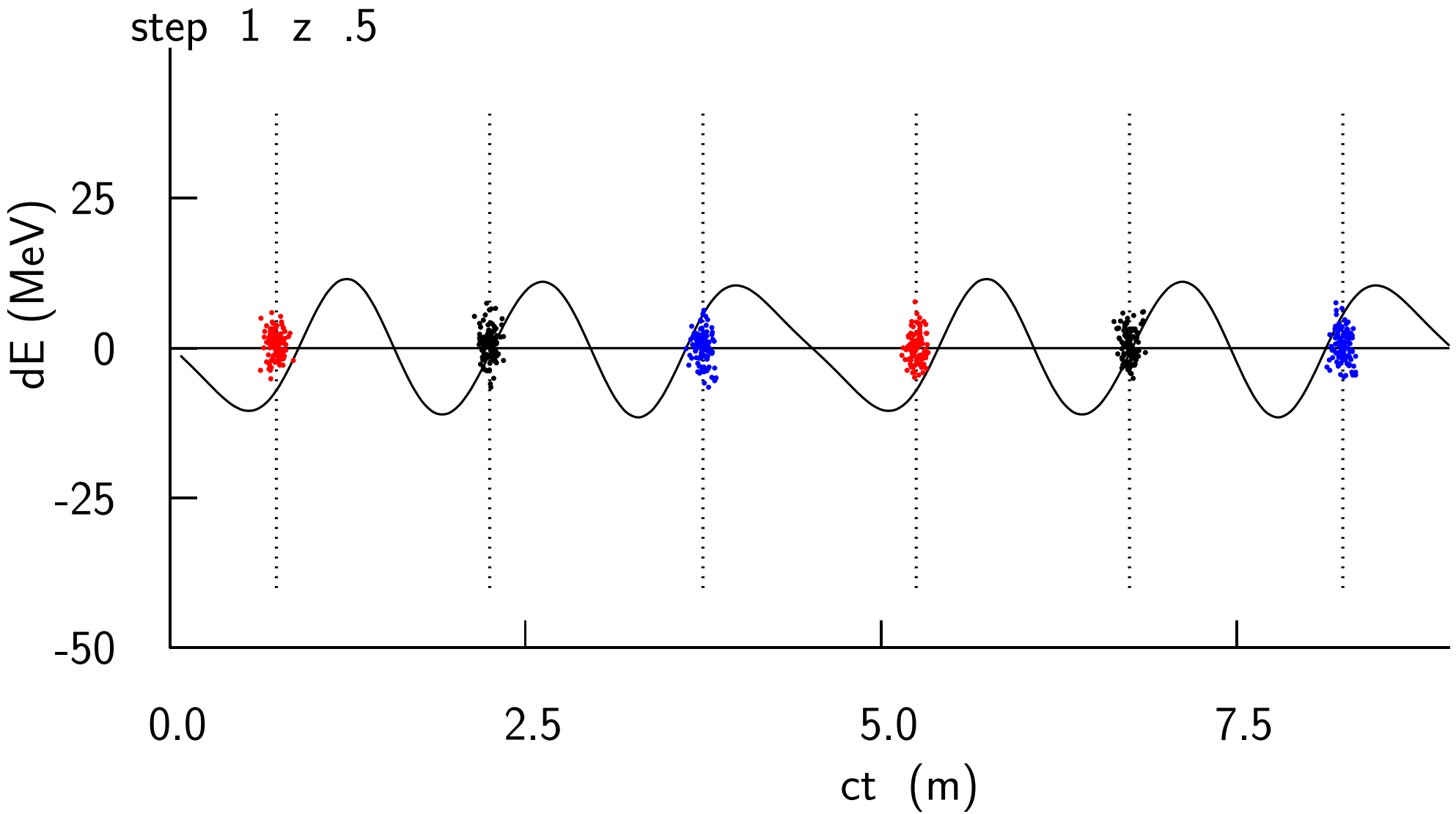


Fig. 2

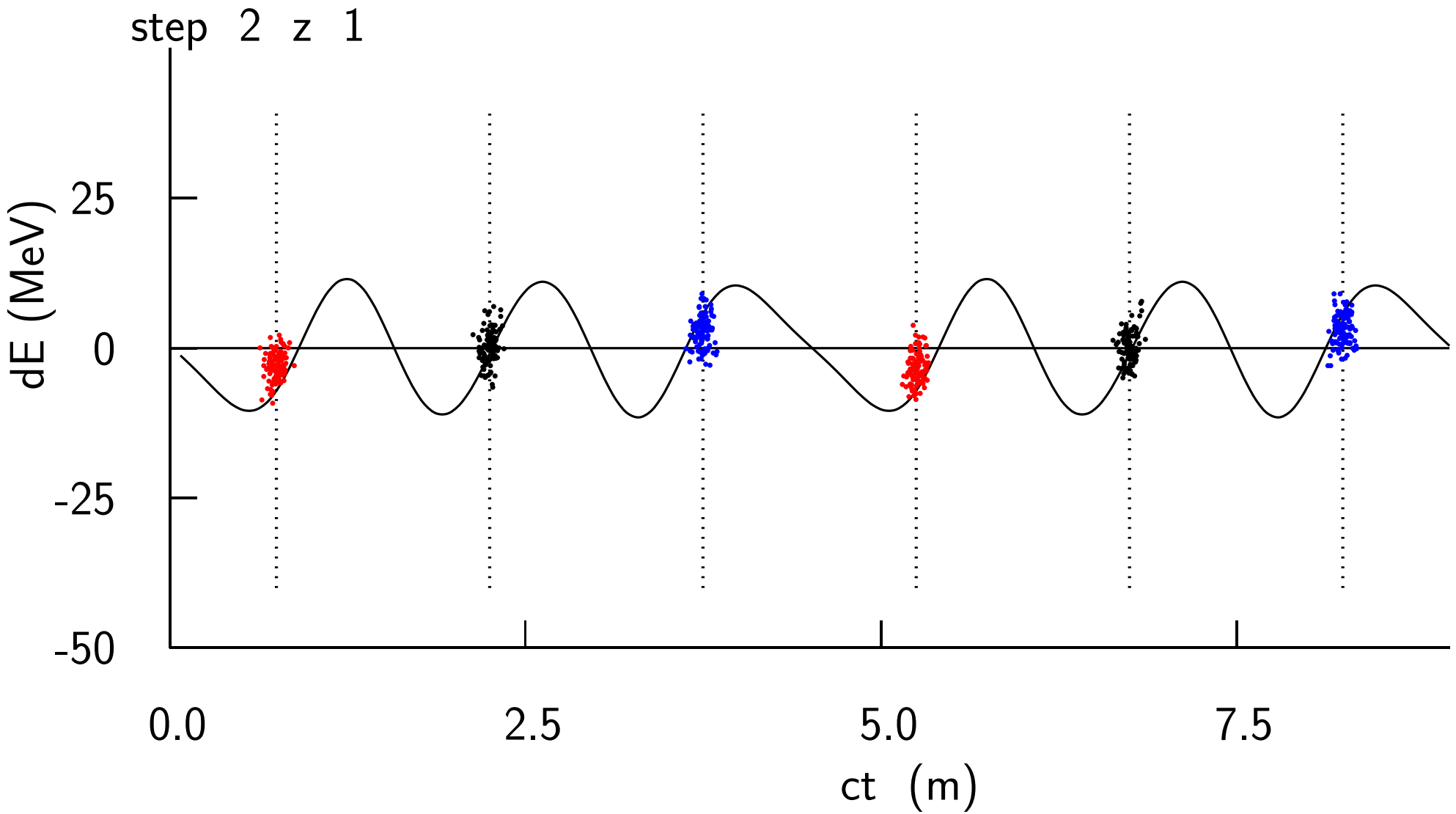


Fig. 3

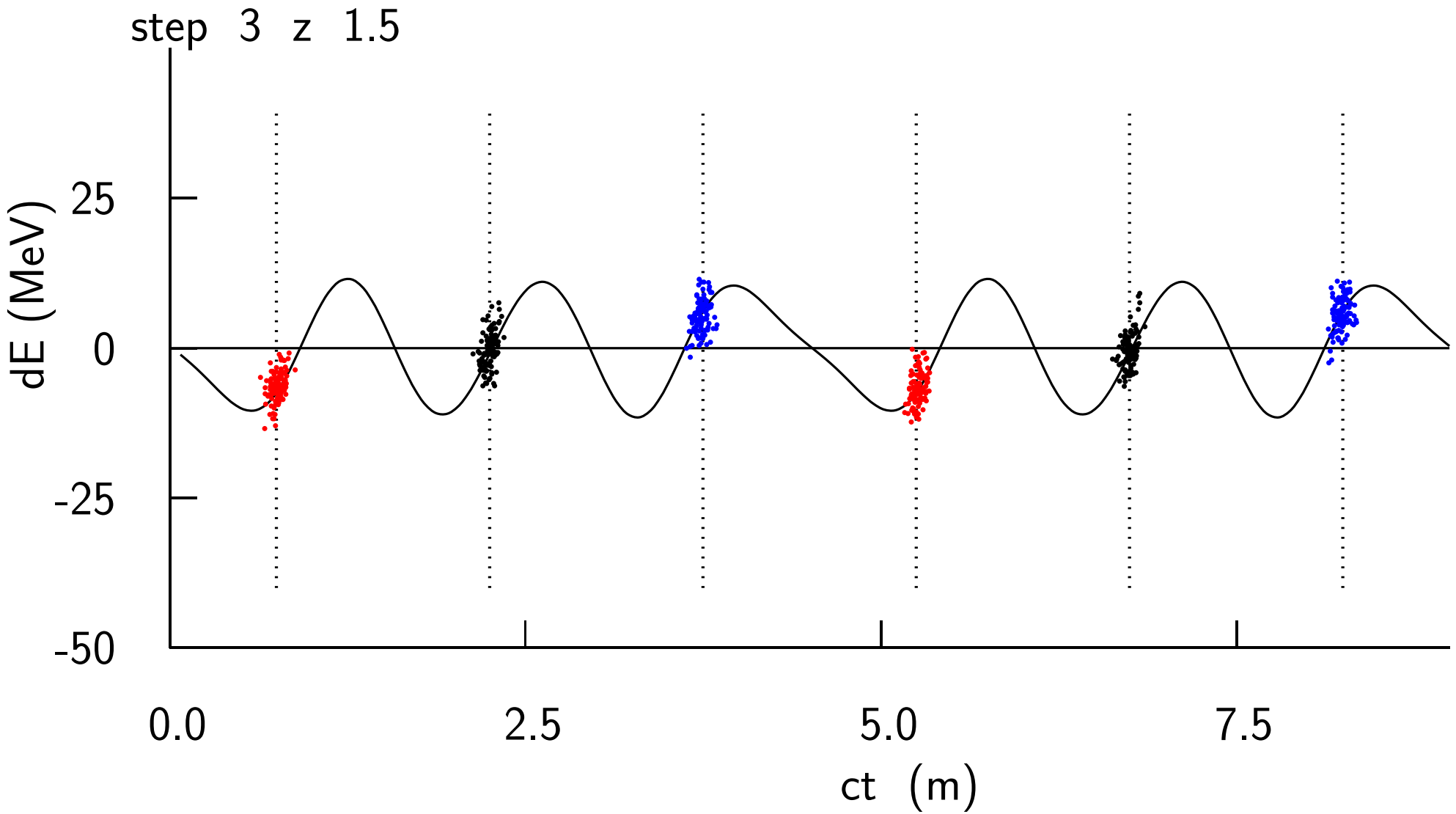


Fig. 4

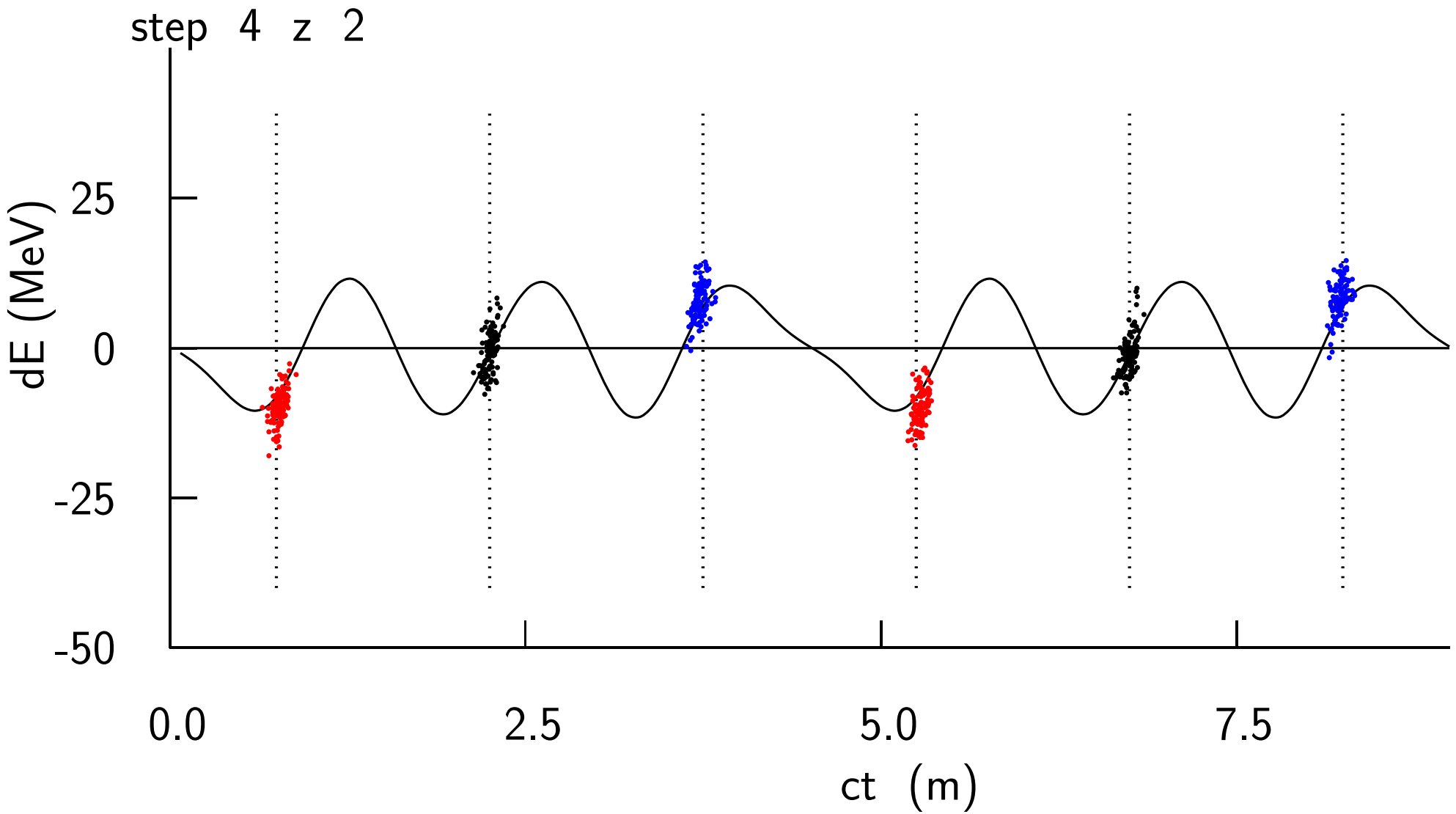


Fig. 5

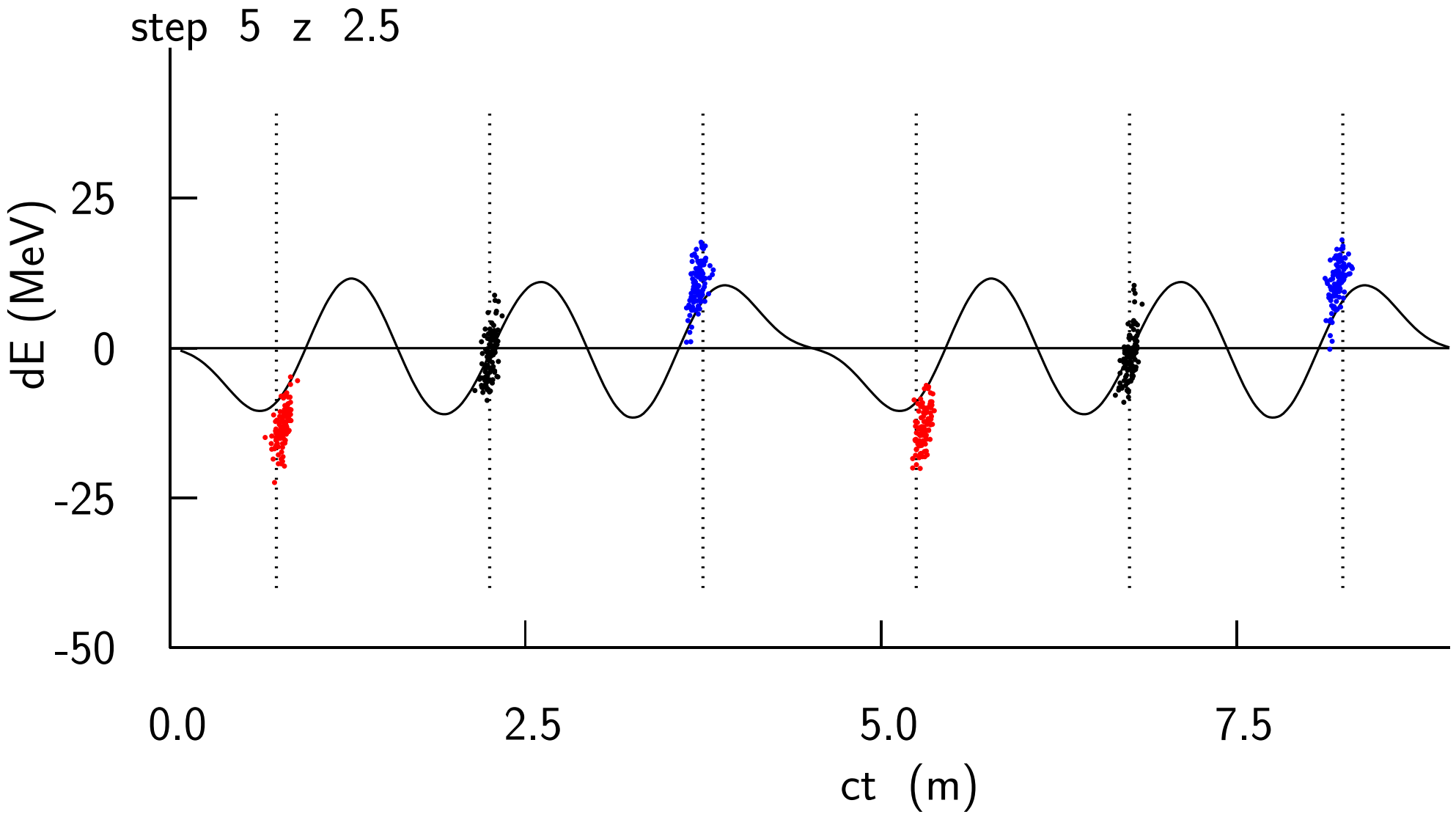


Fig. 6

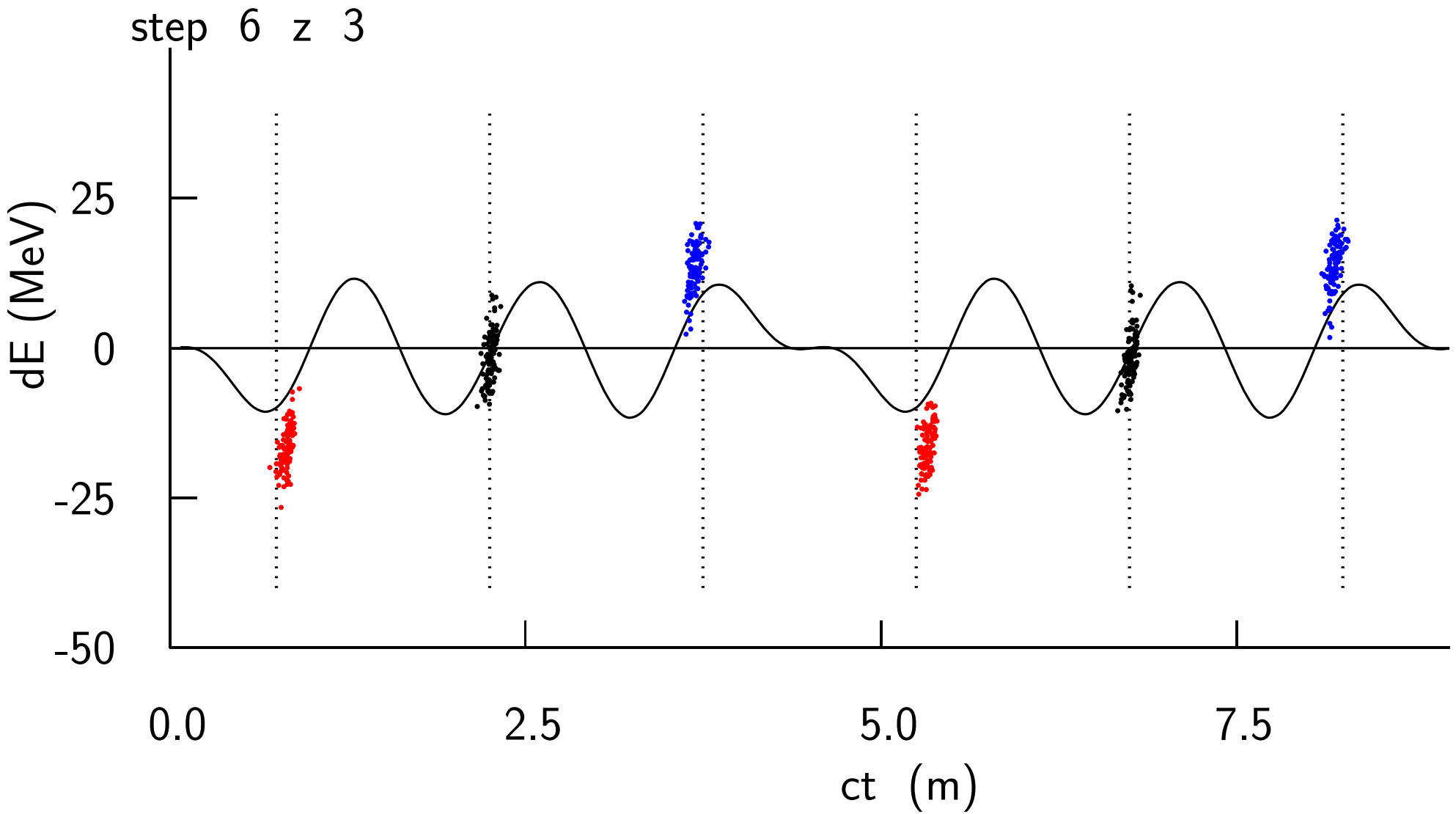


Fig. 7

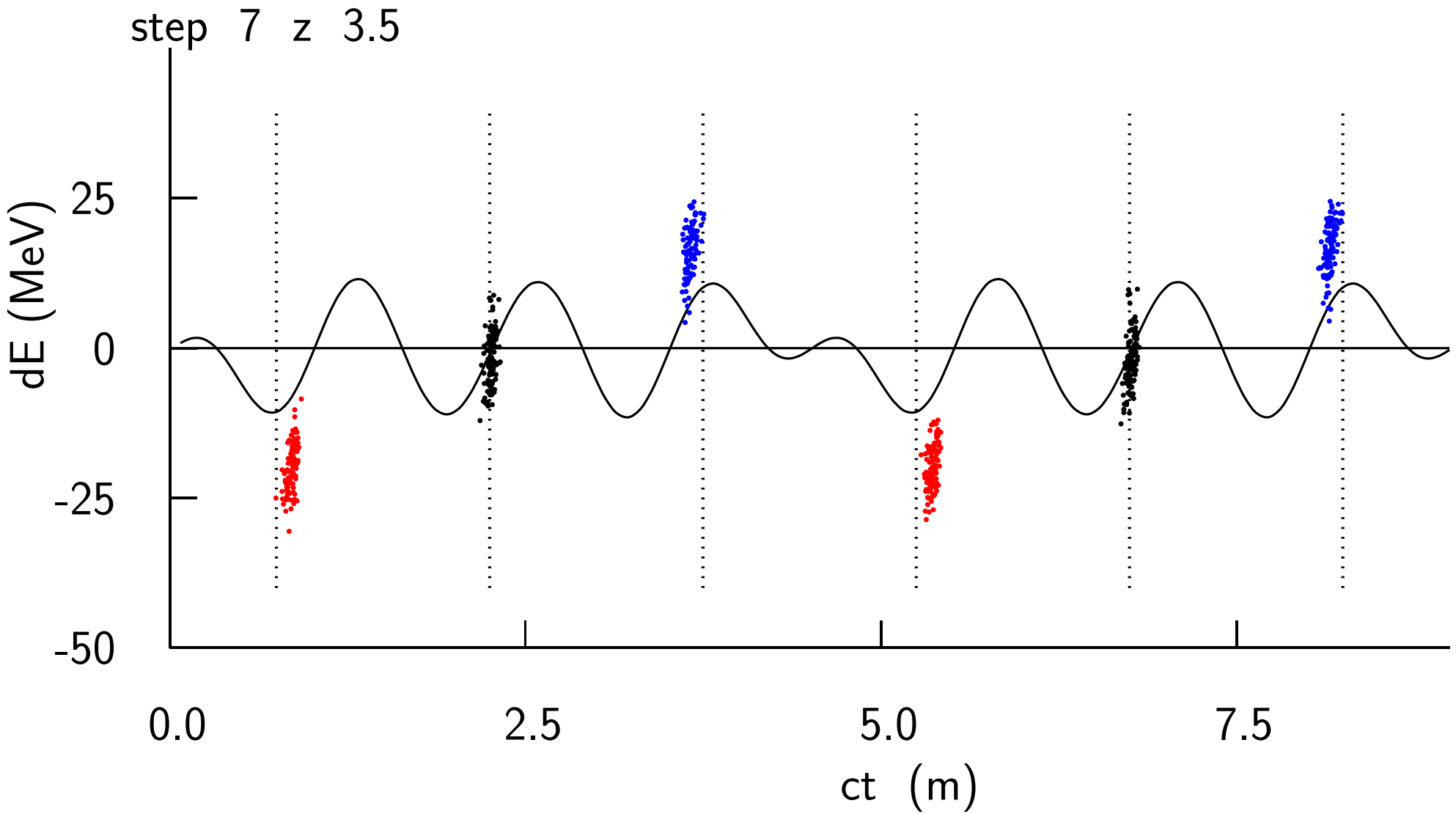


Fig. 8

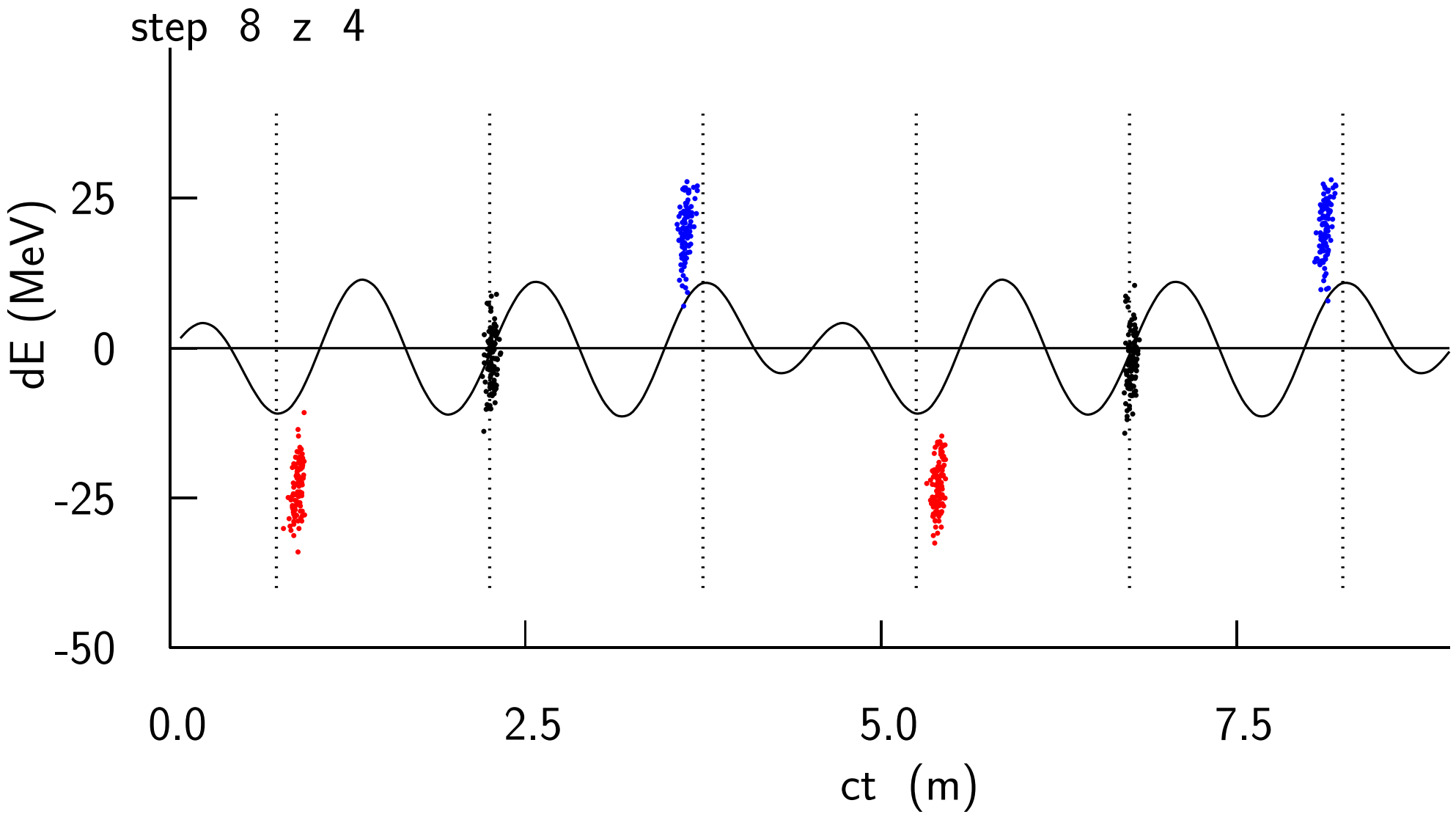


Fig. 9

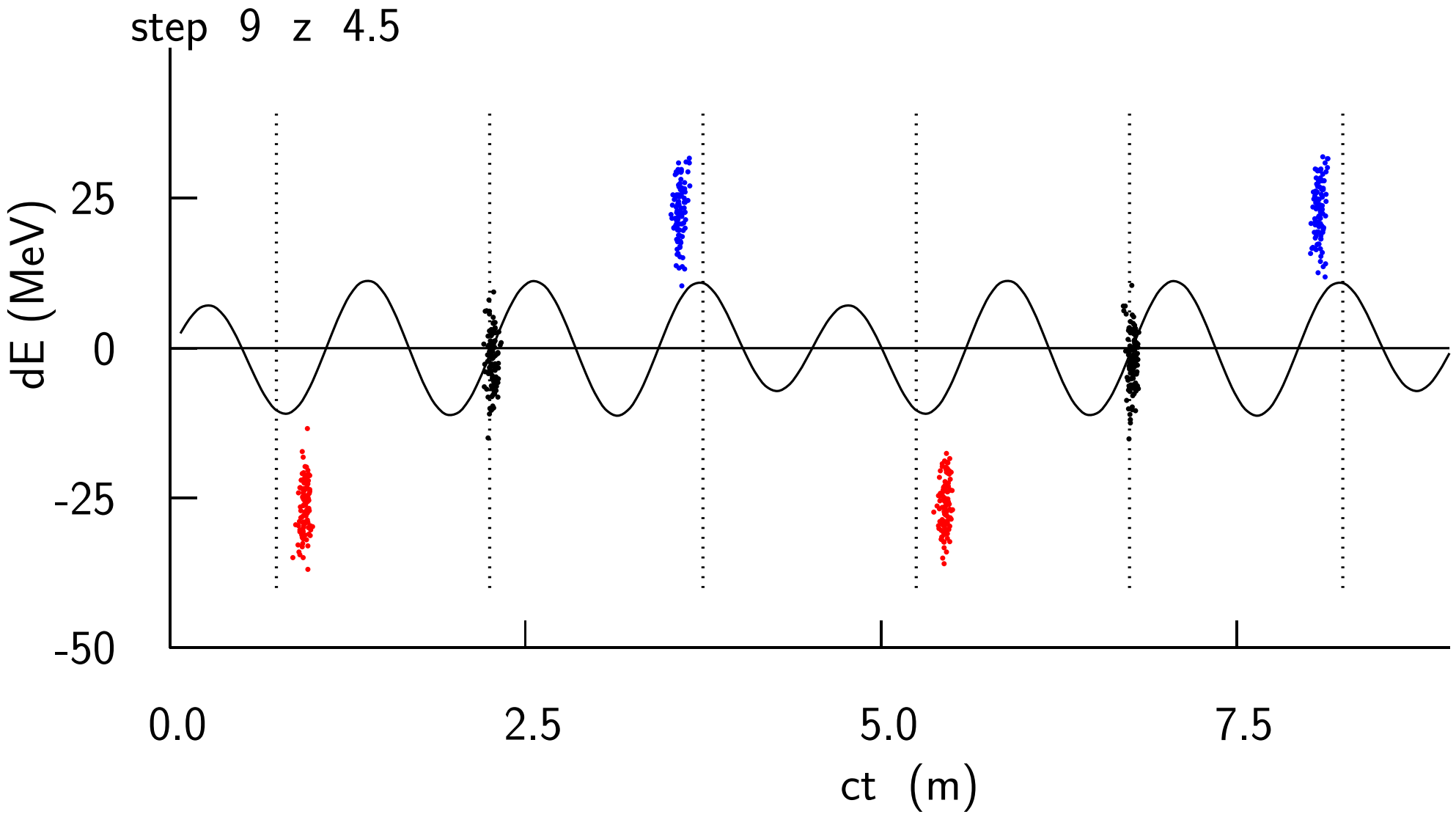


Fig. 10

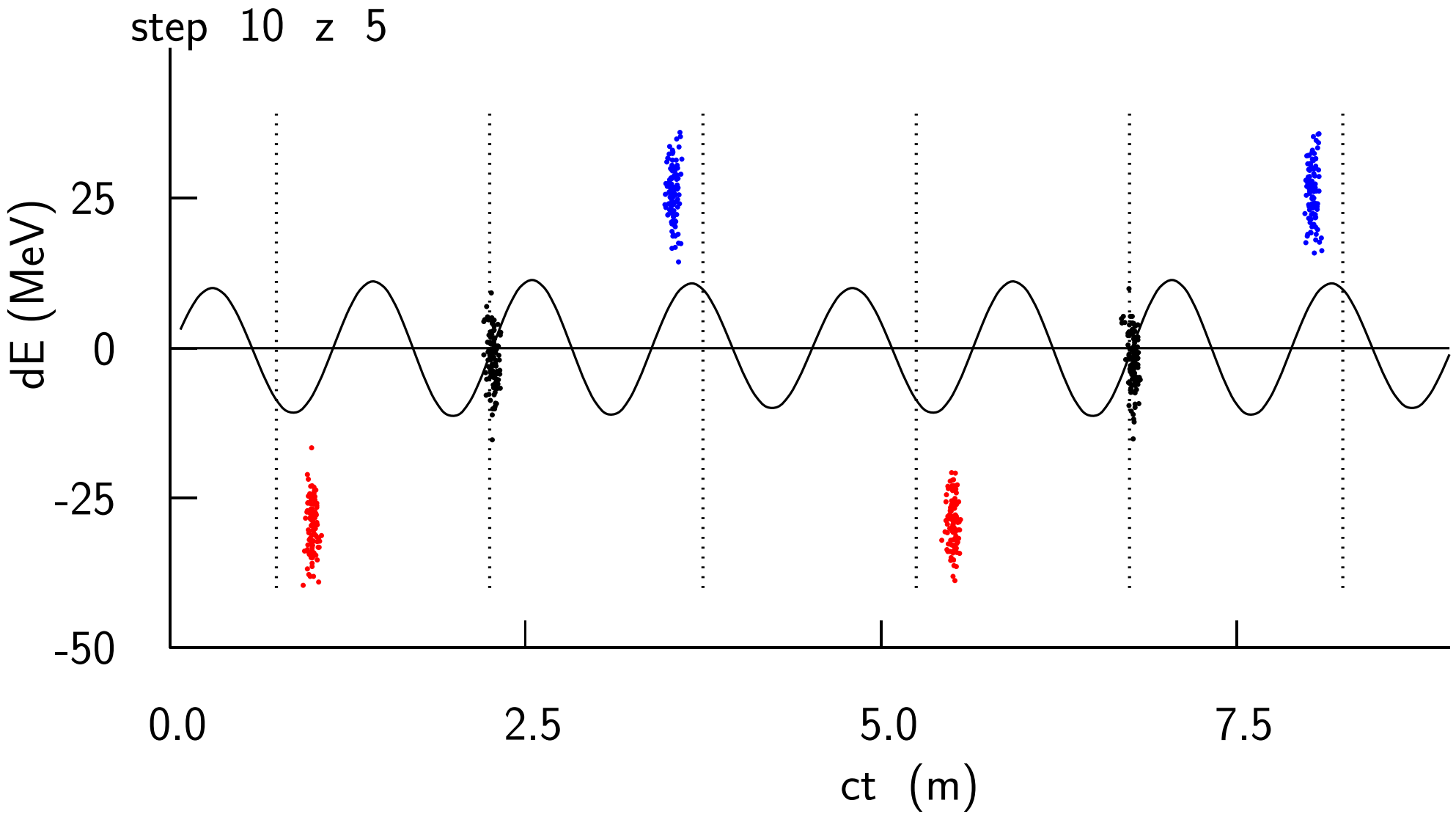


Fig. 11

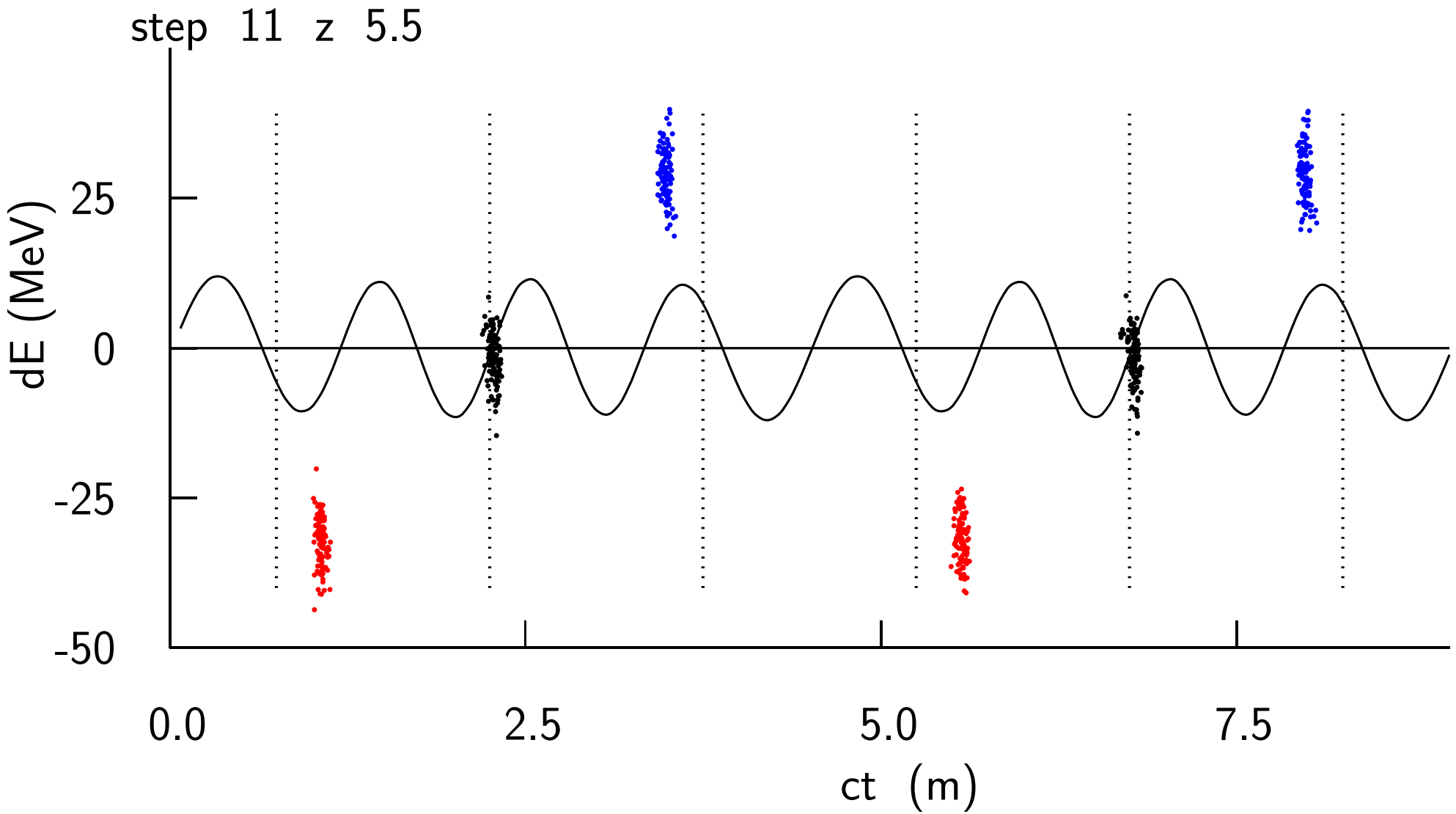


Fig. 12

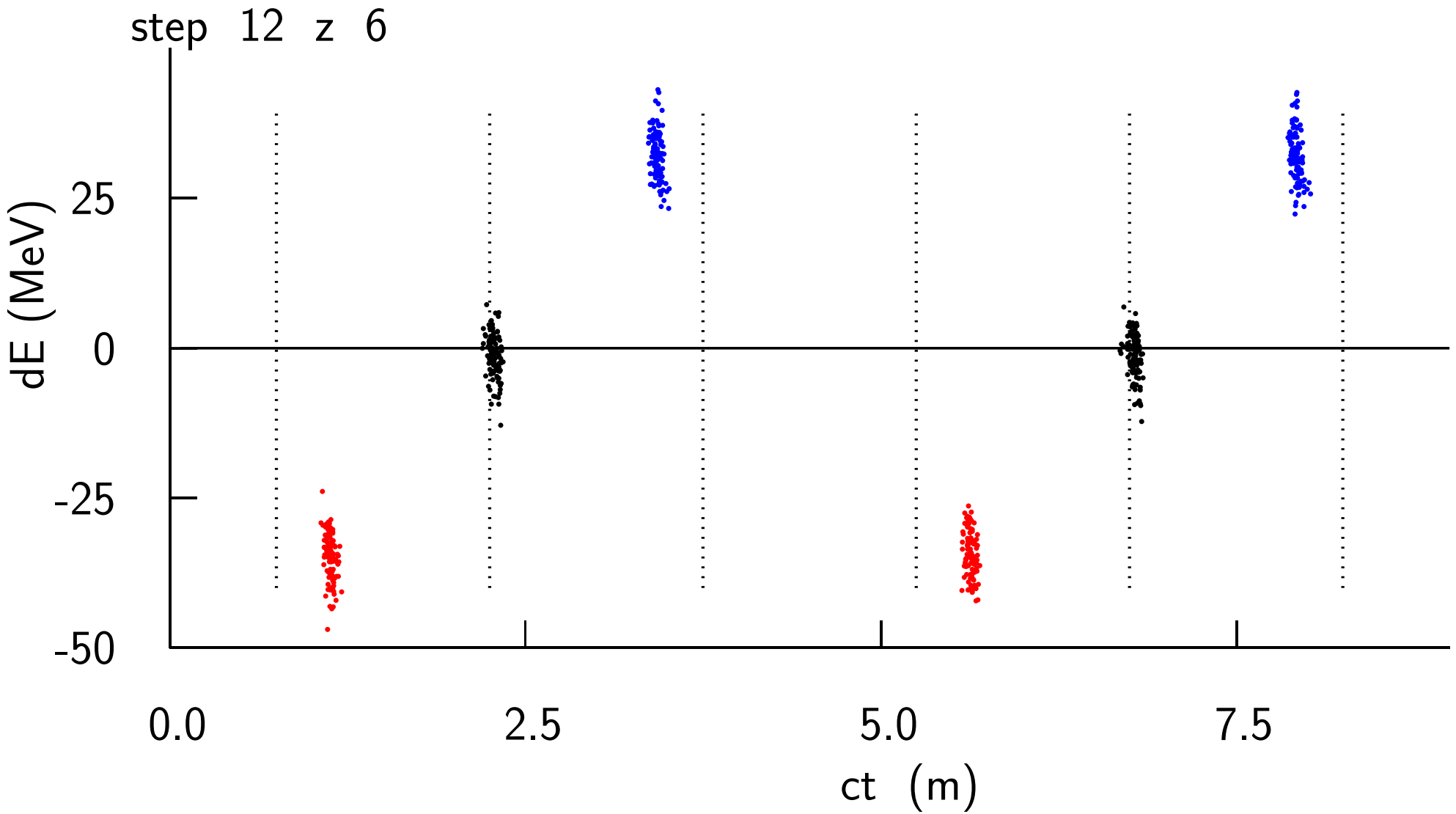


Fig. 13

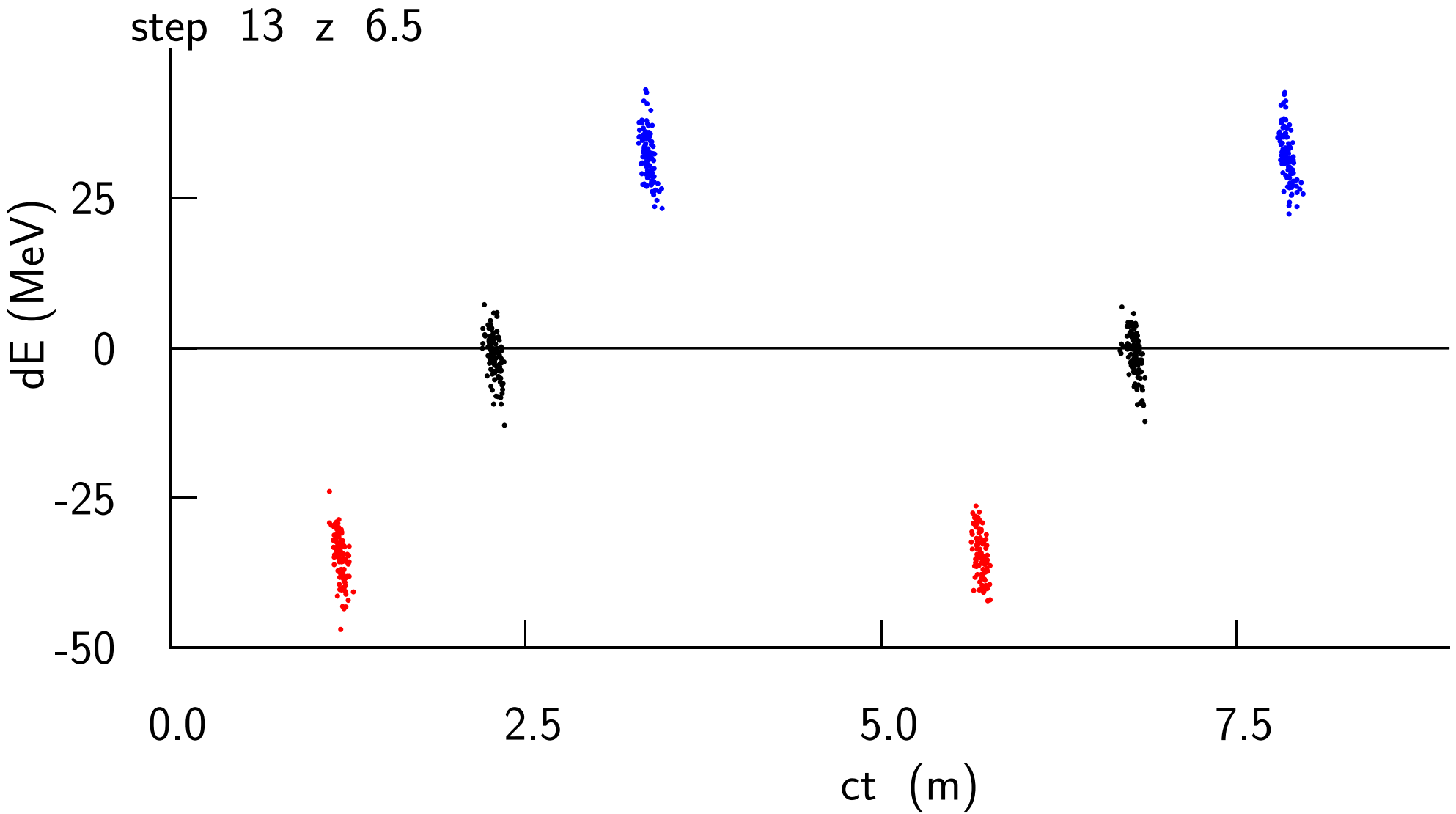


Fig. 14

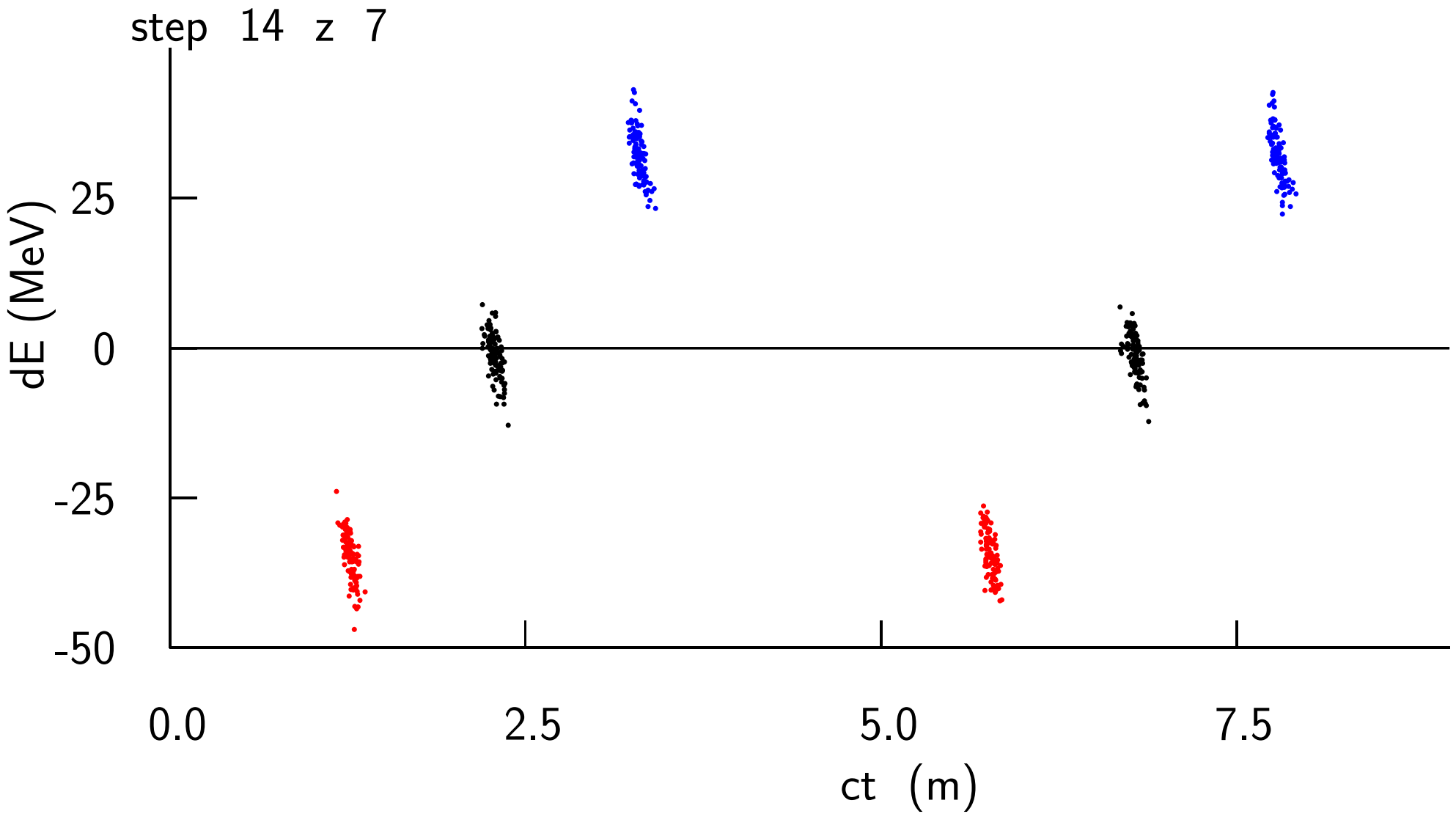


Fig. 15

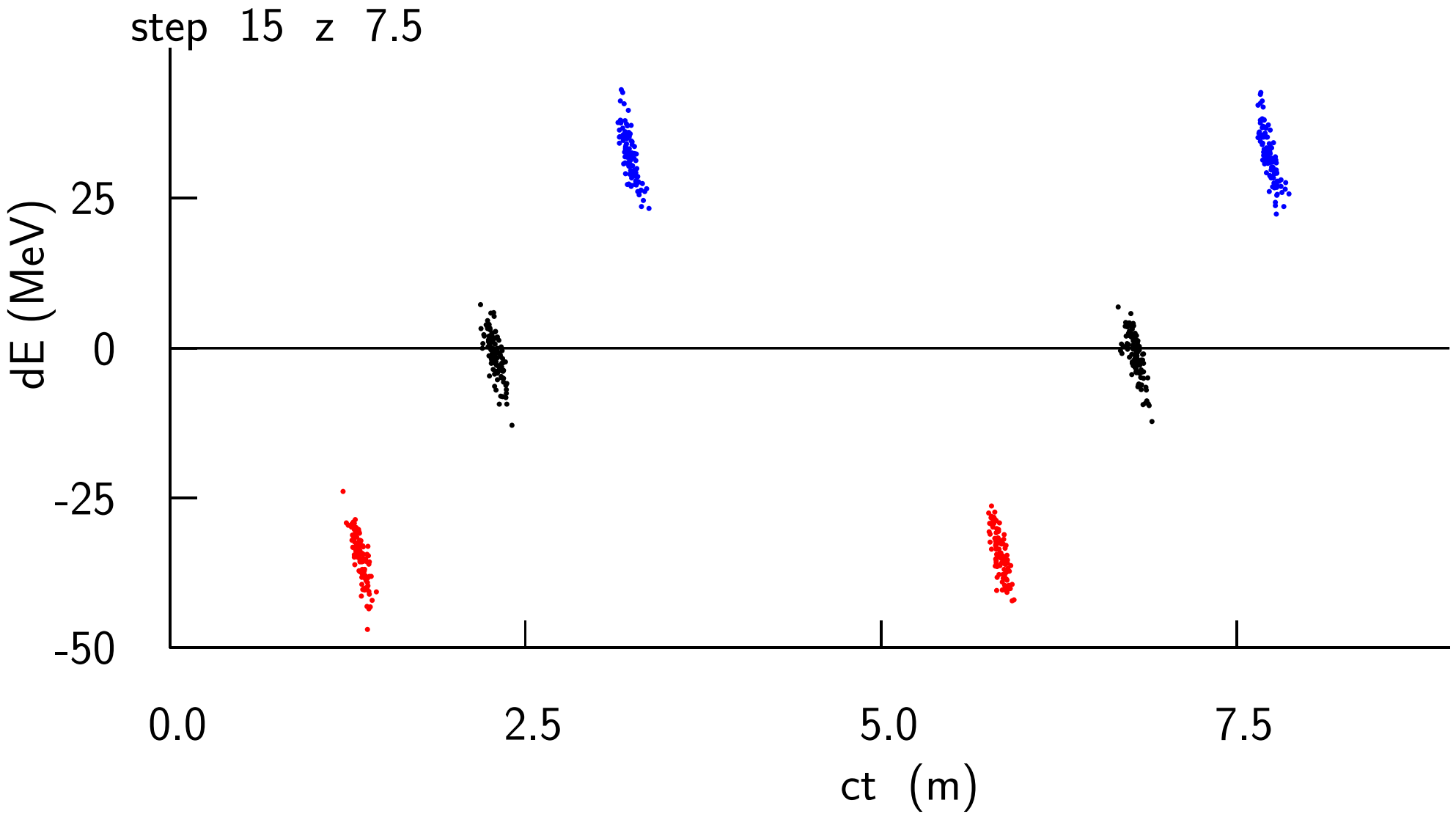


Fig. 16

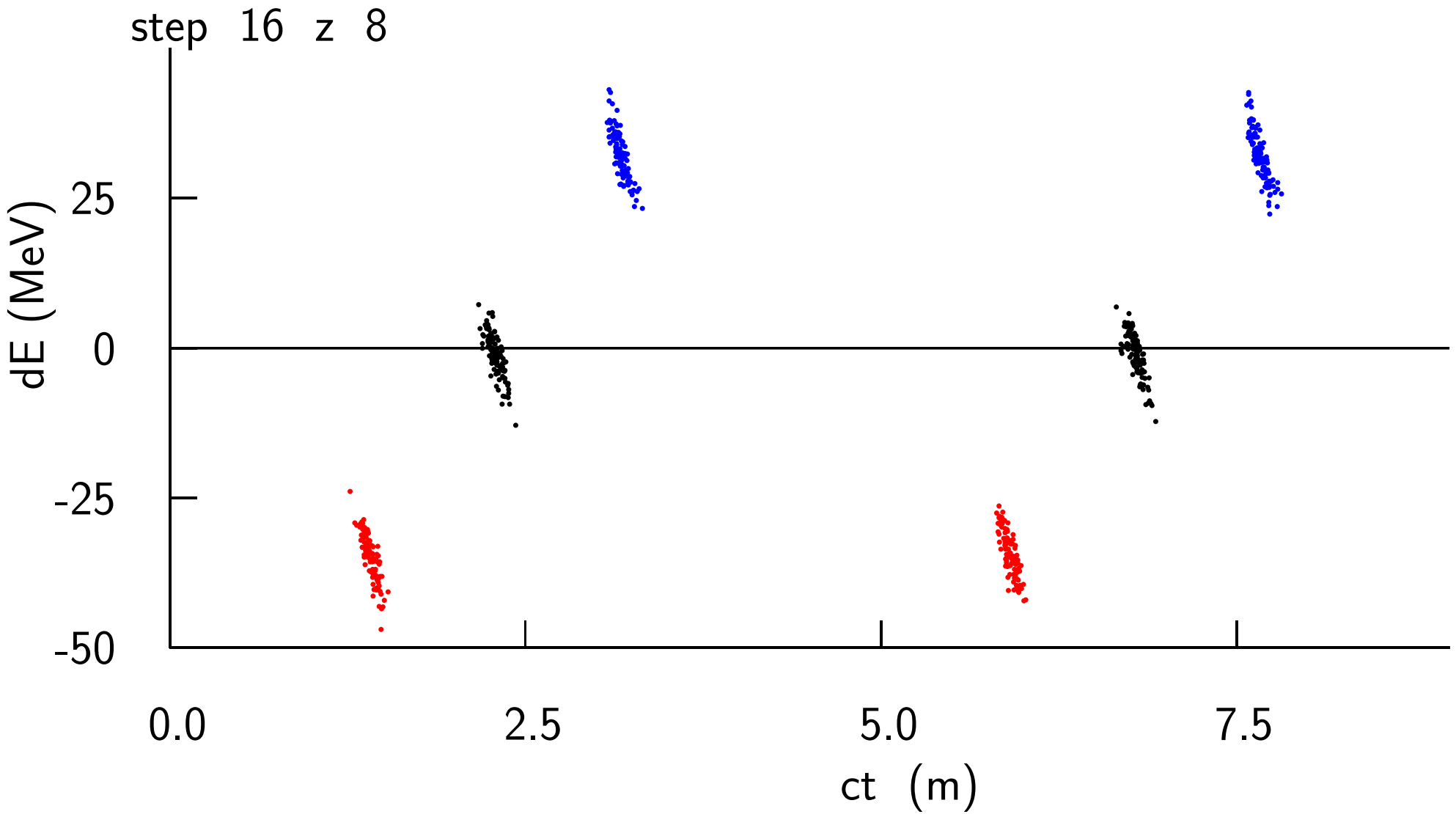


Fig. 17

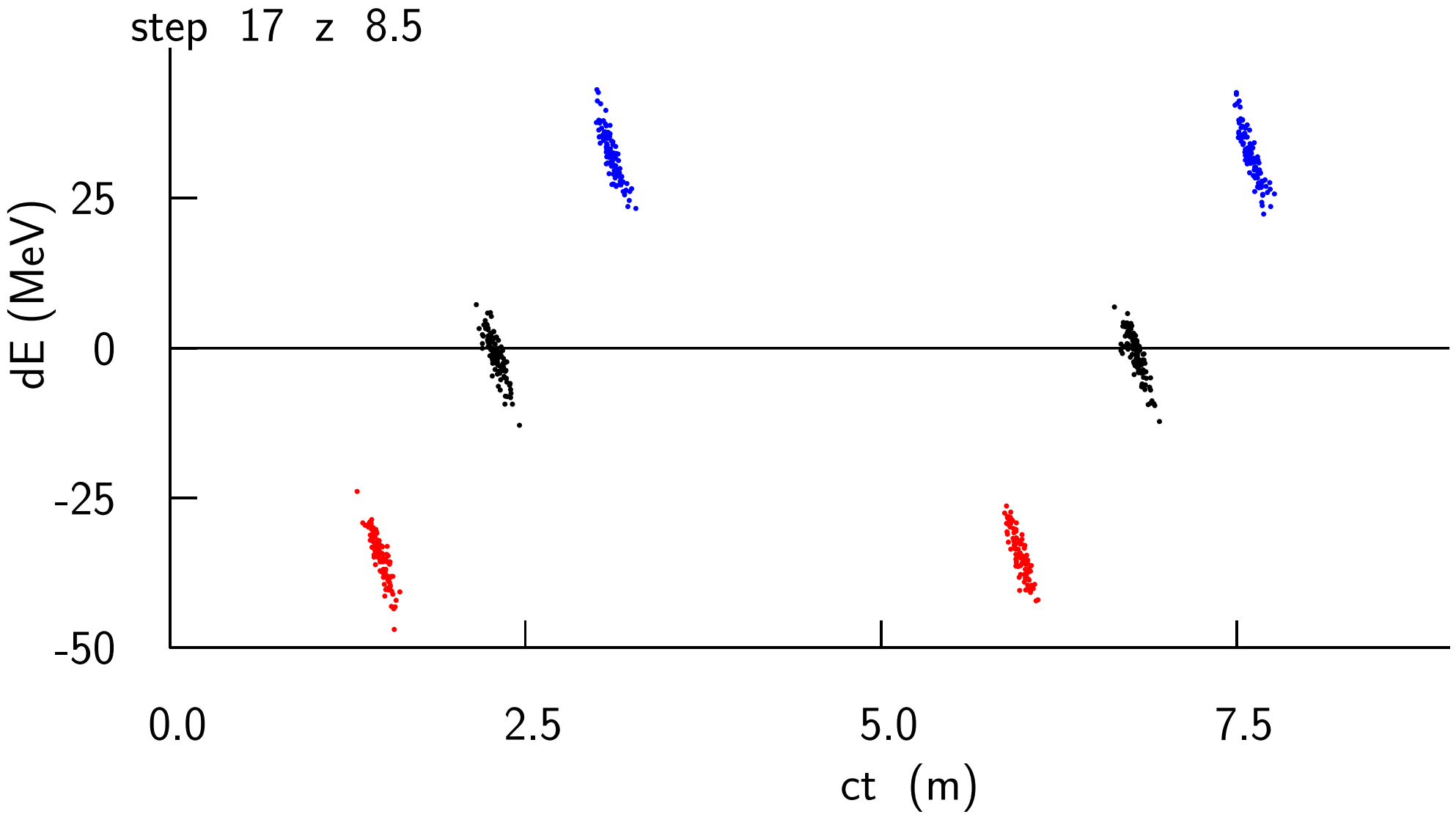


Fig. 18

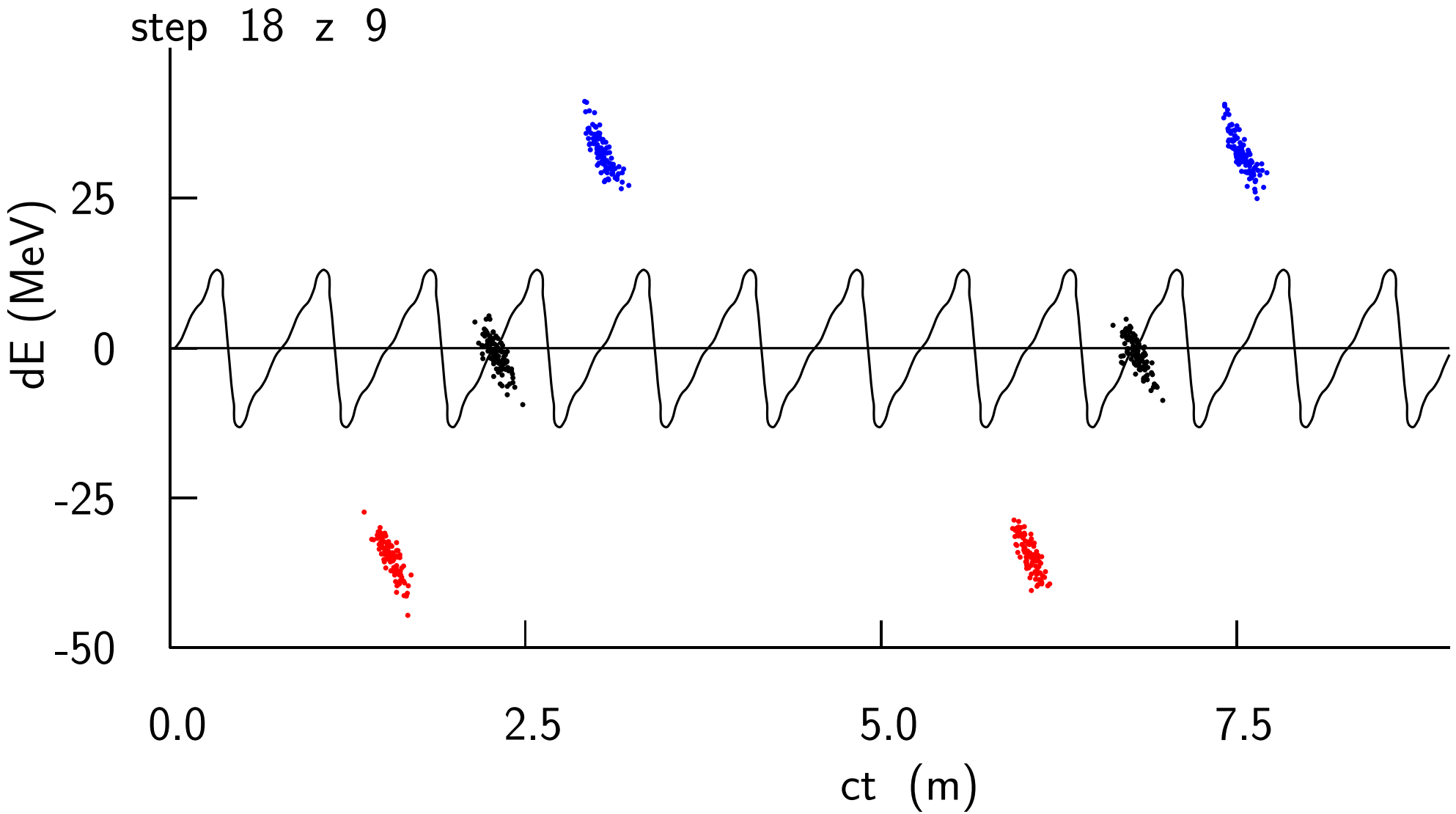


Fig. 19

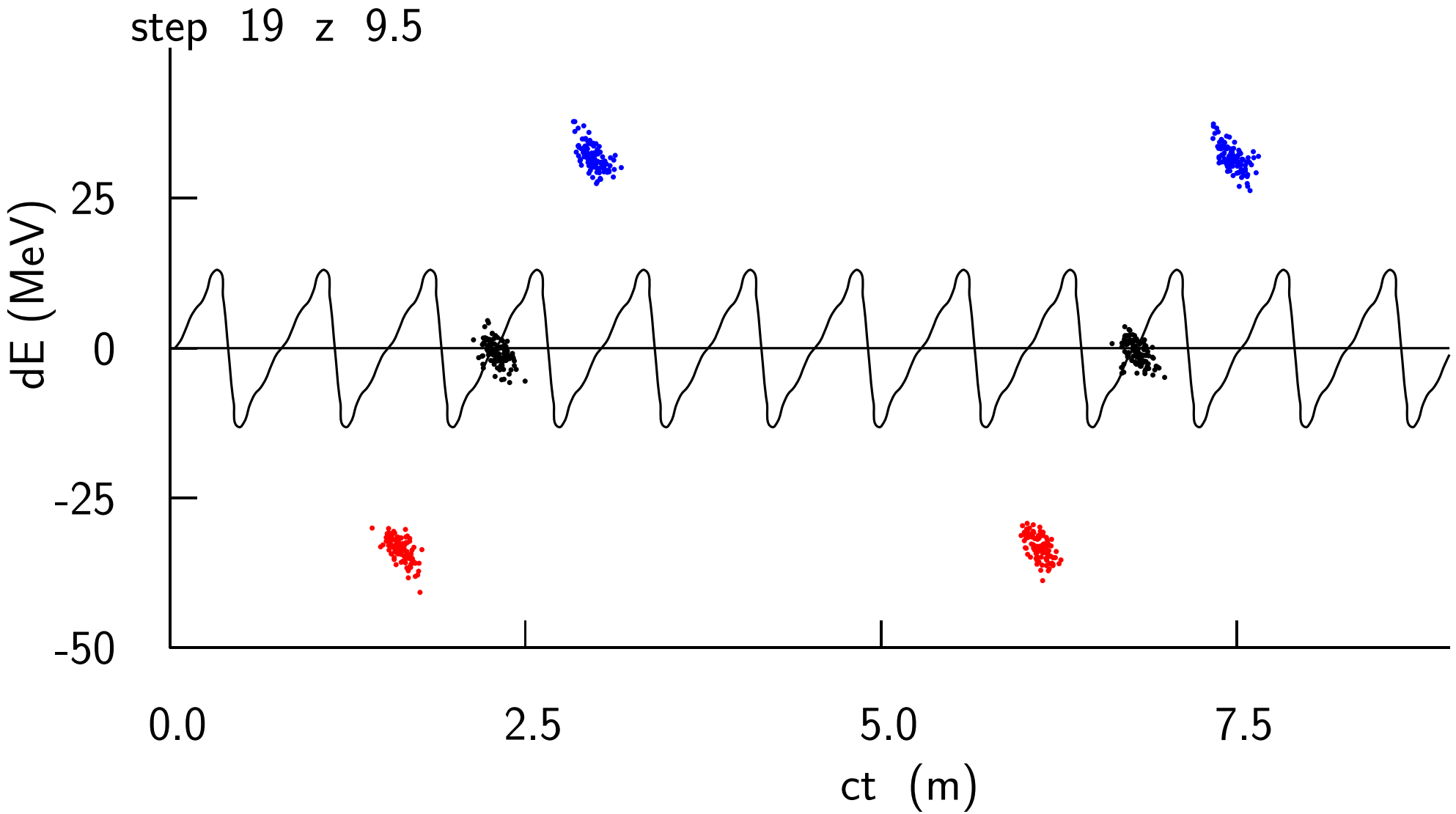


Fig. 20

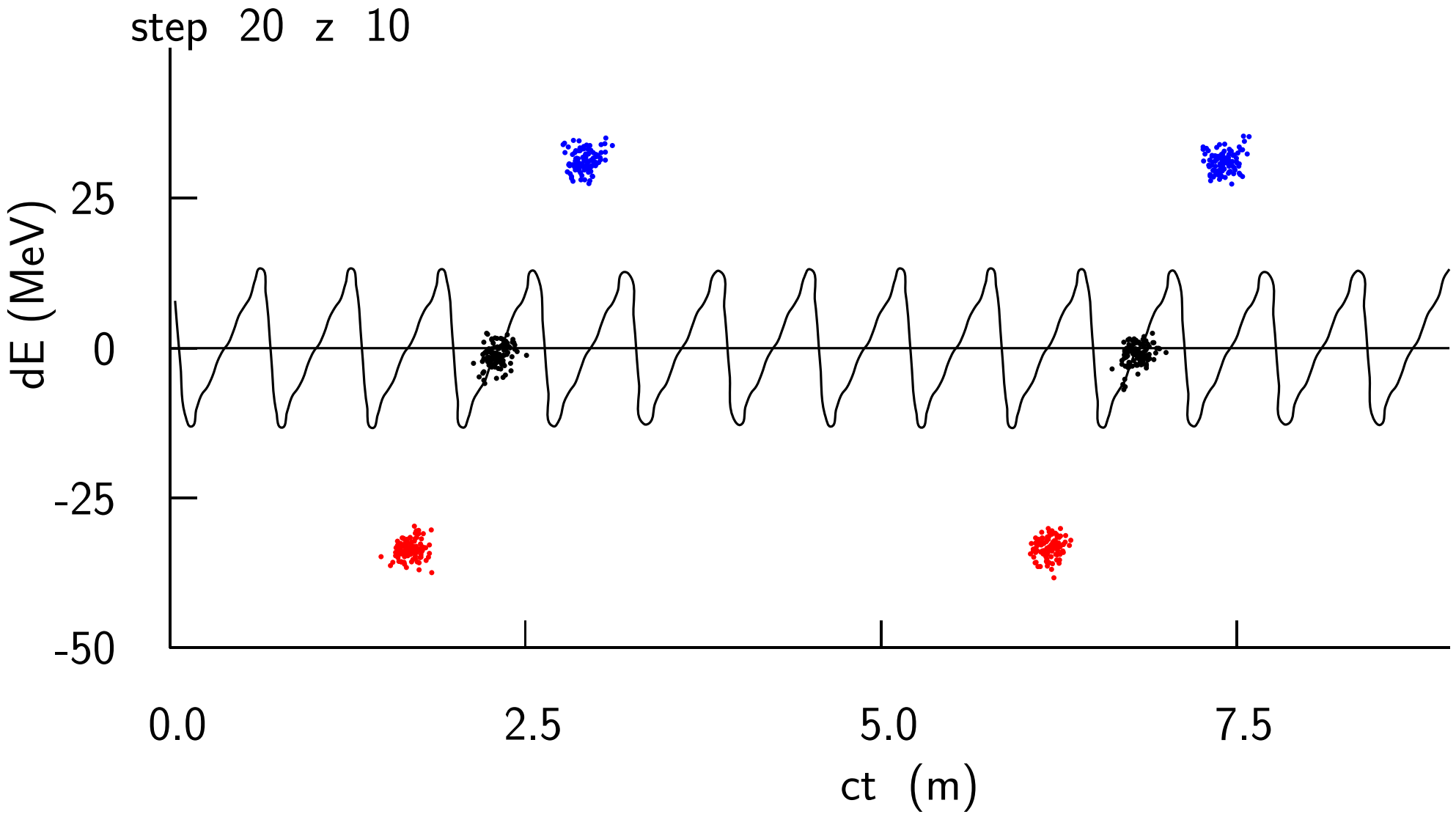


Fig. 21

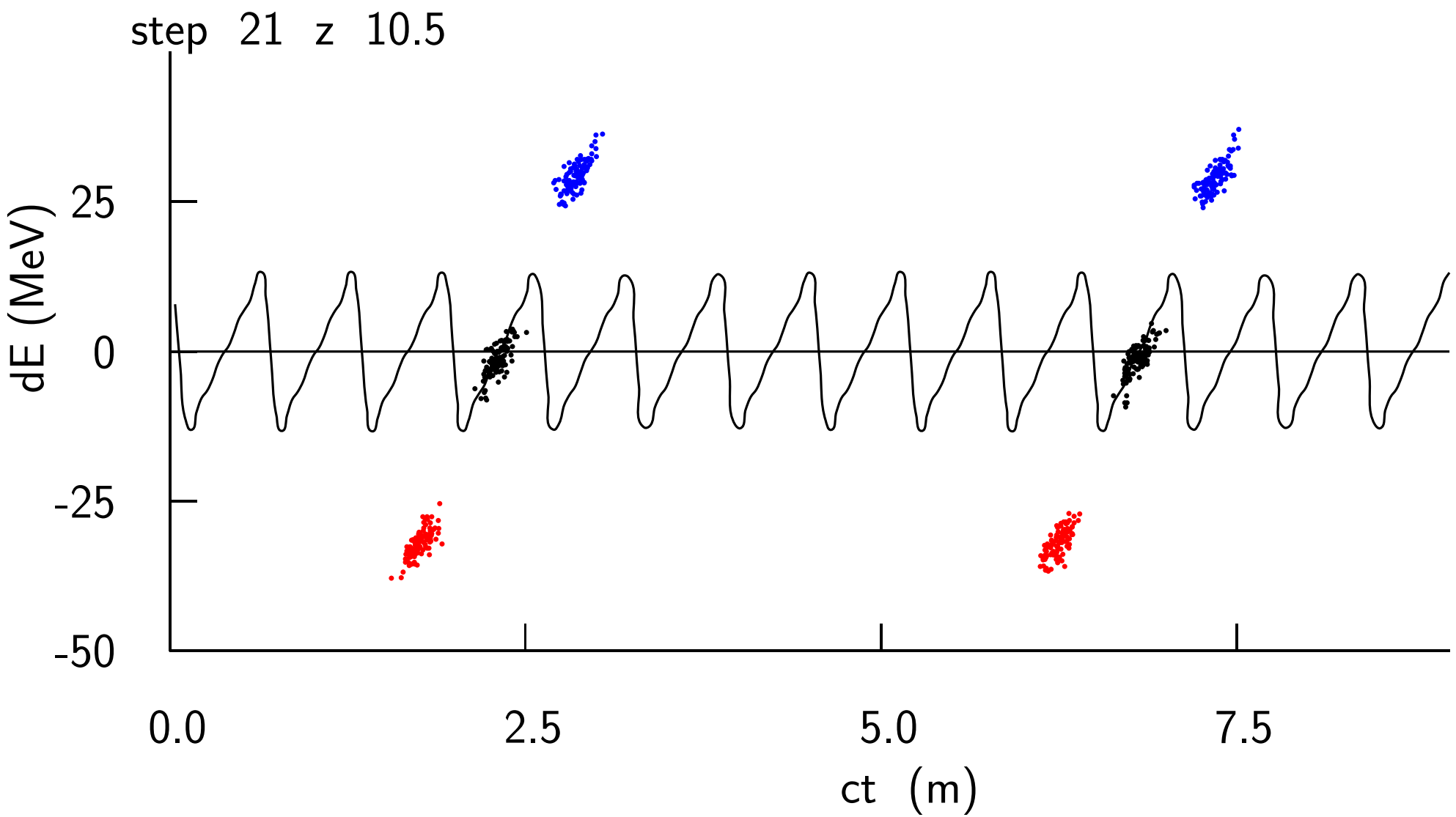


Fig. 22

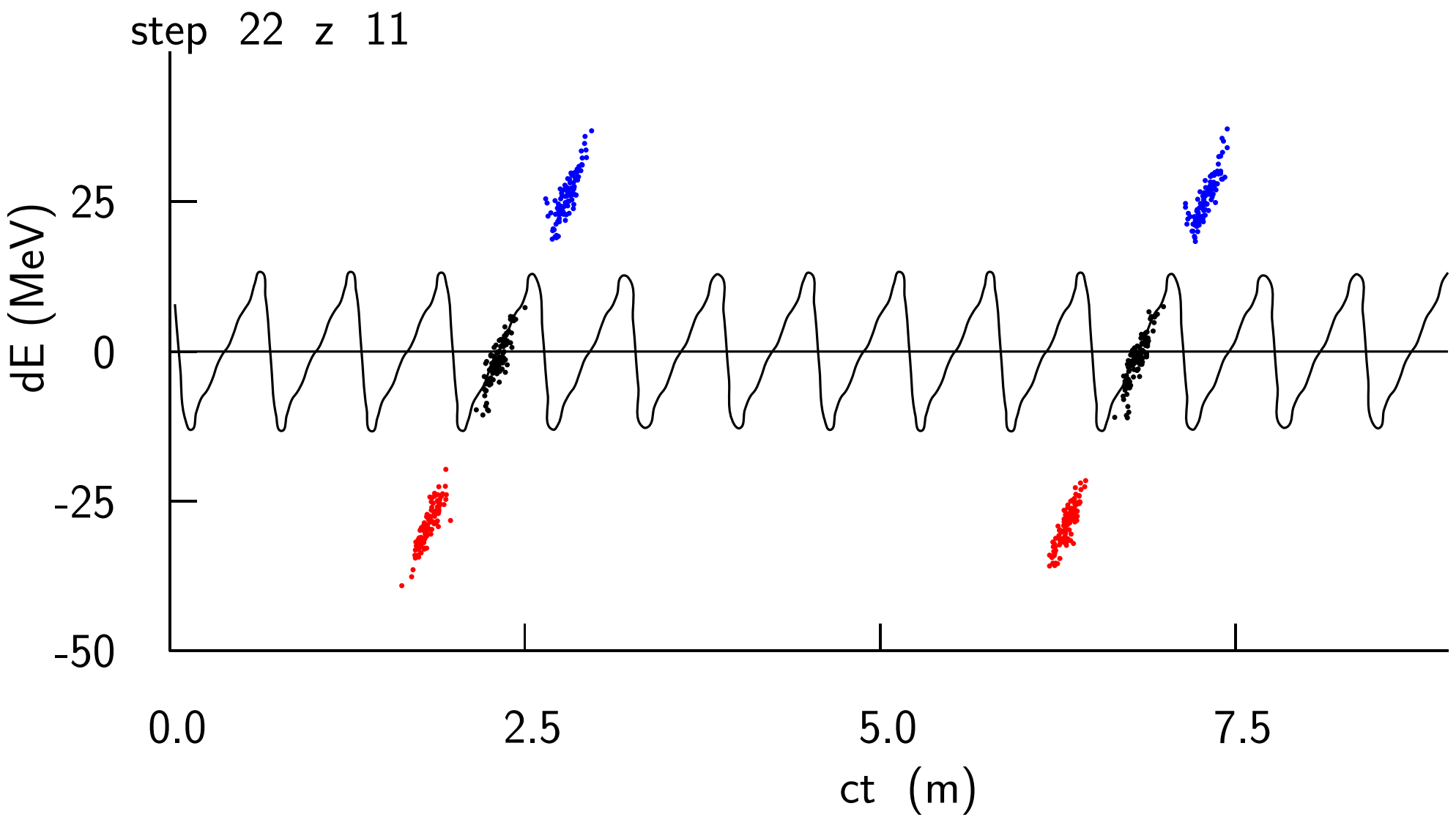


Fig. 23

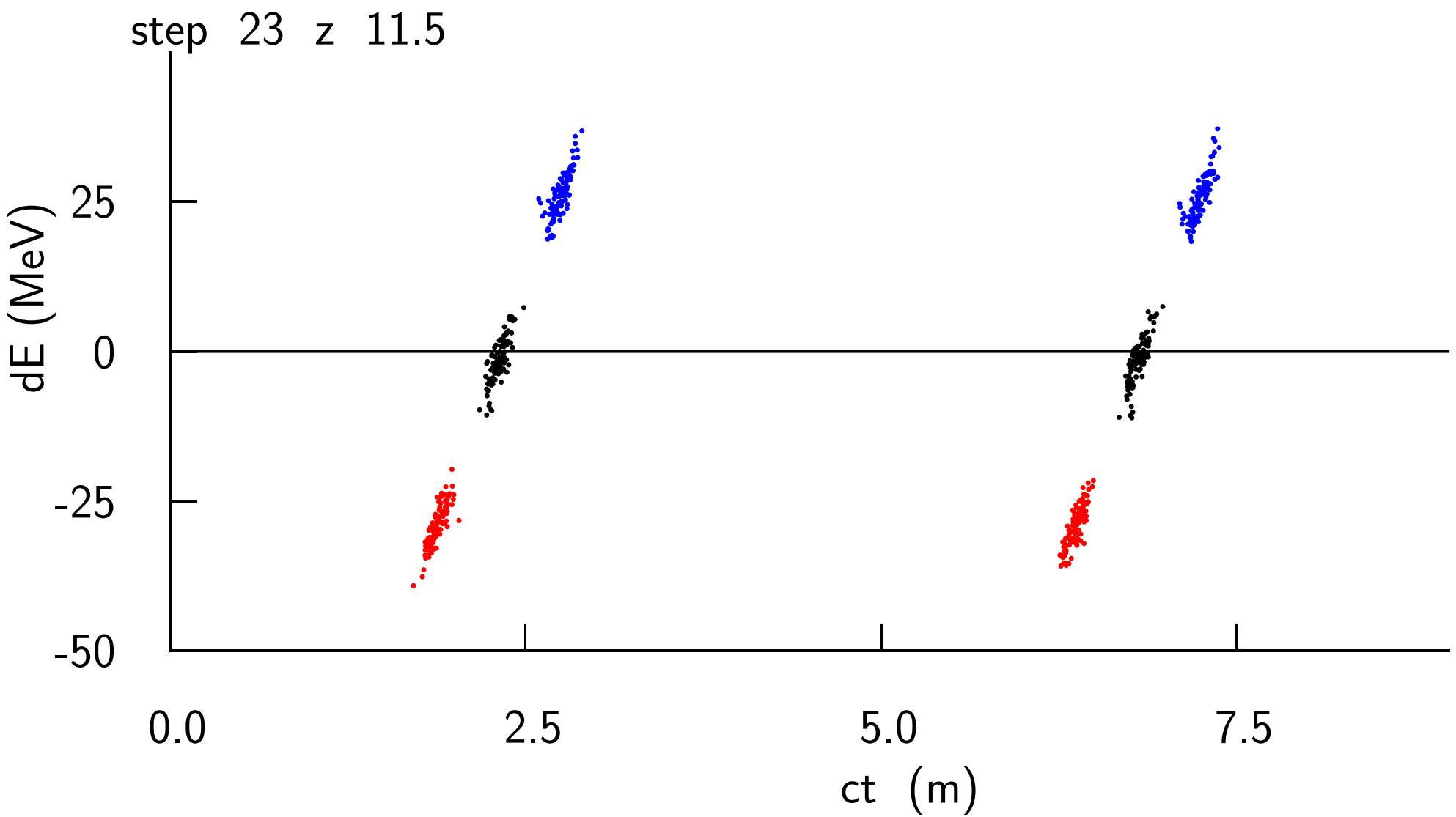


Fig. 24

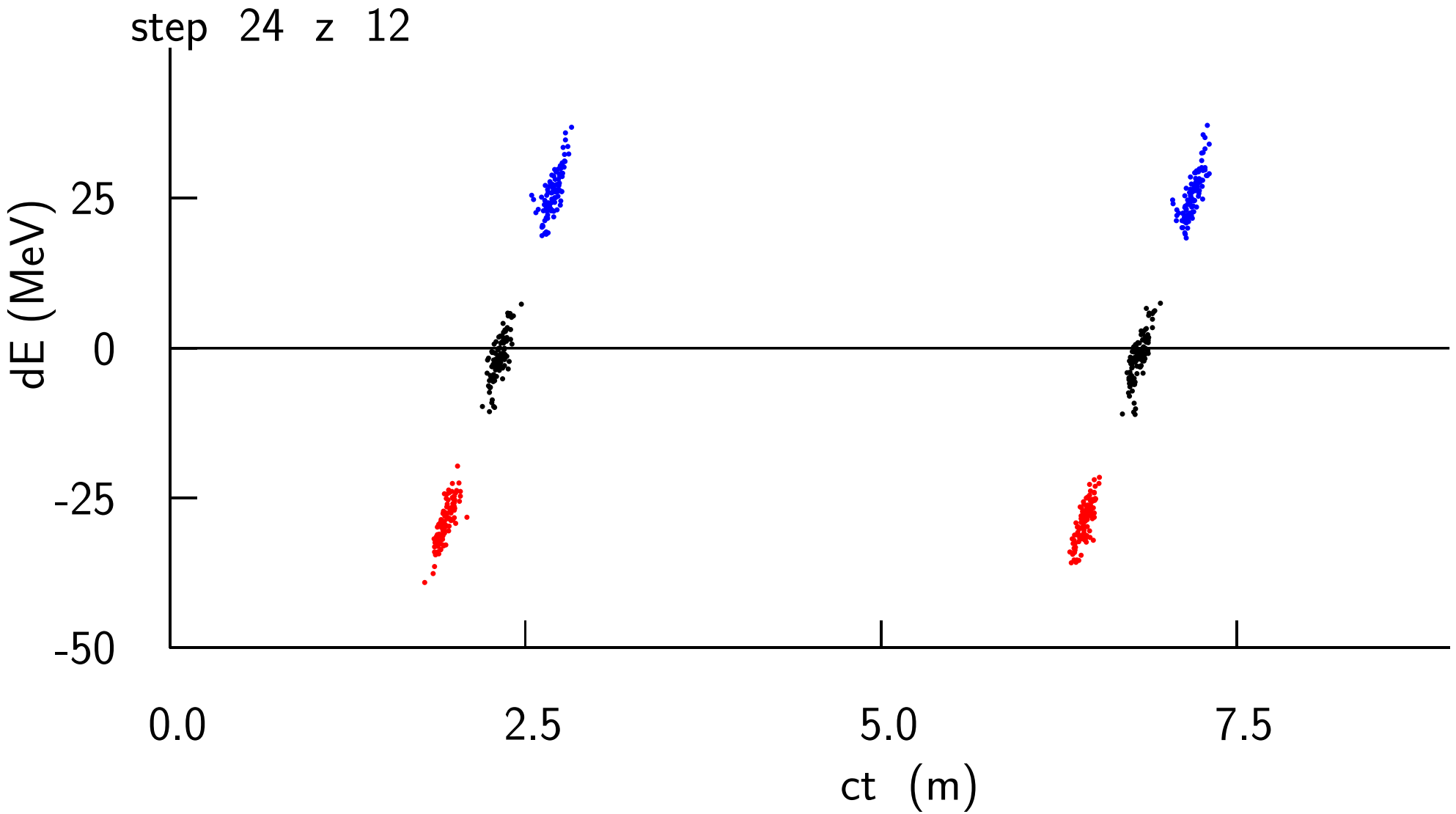


Fig. 25

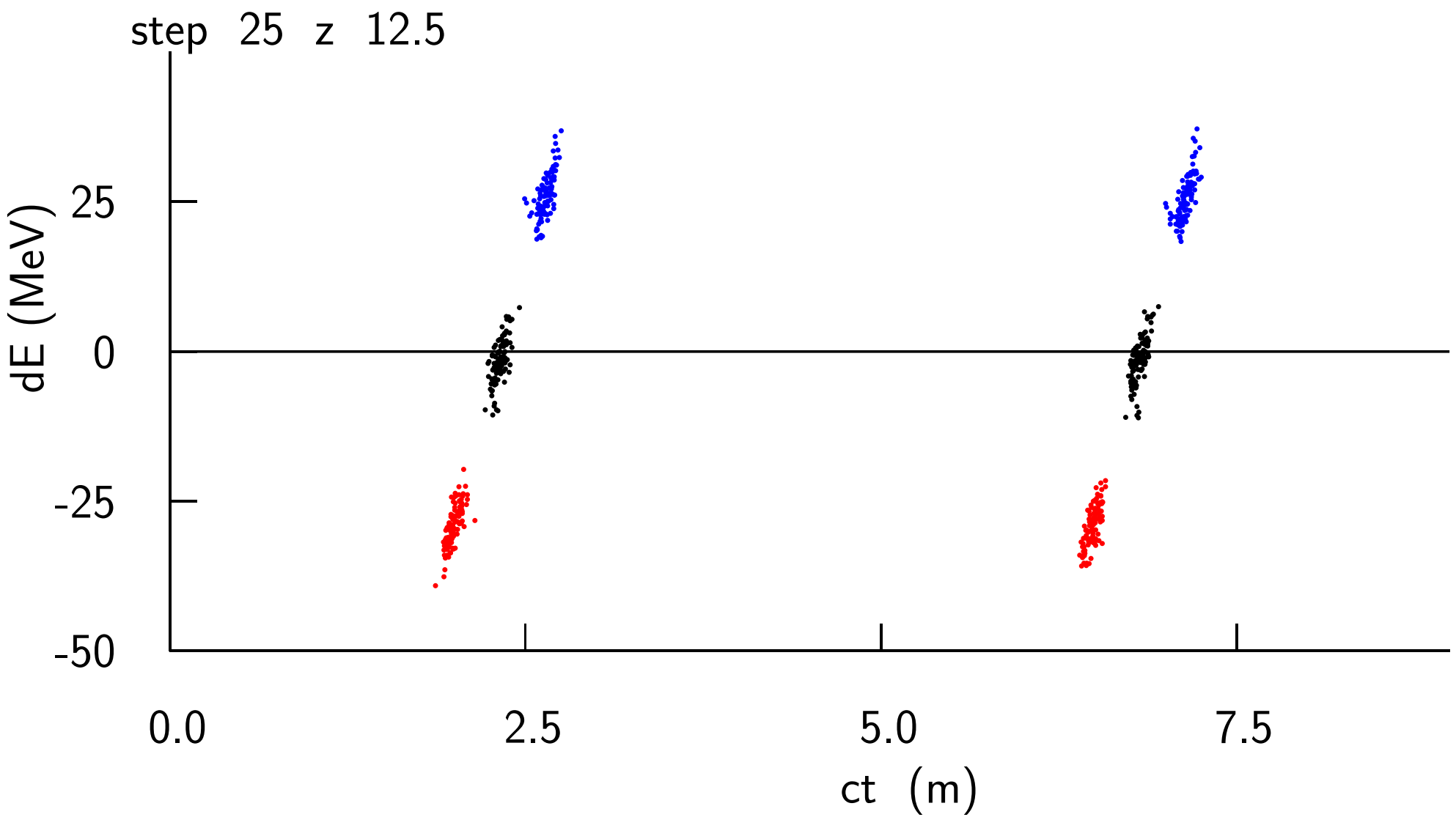


Fig. 26

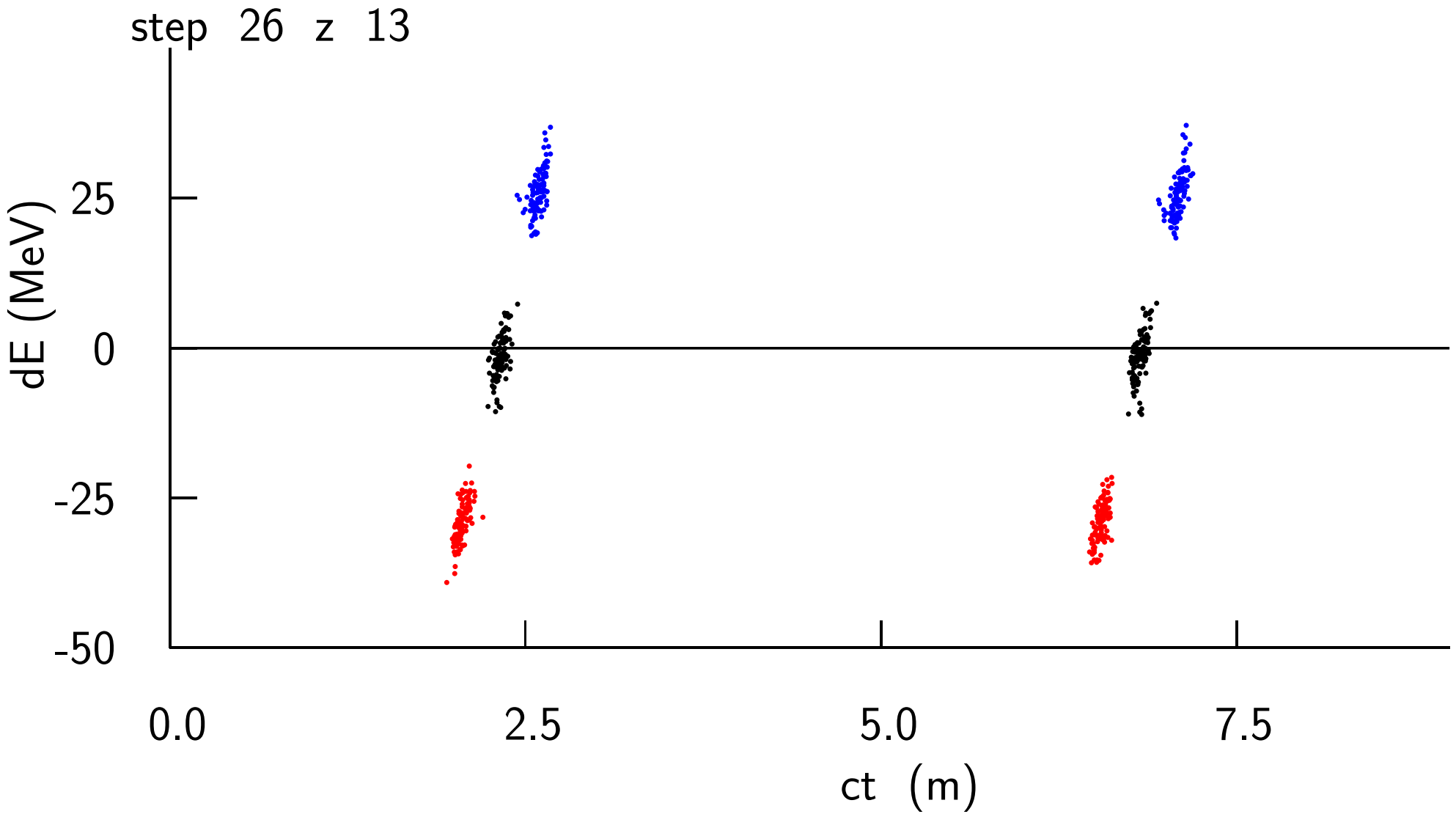


Fig. 27

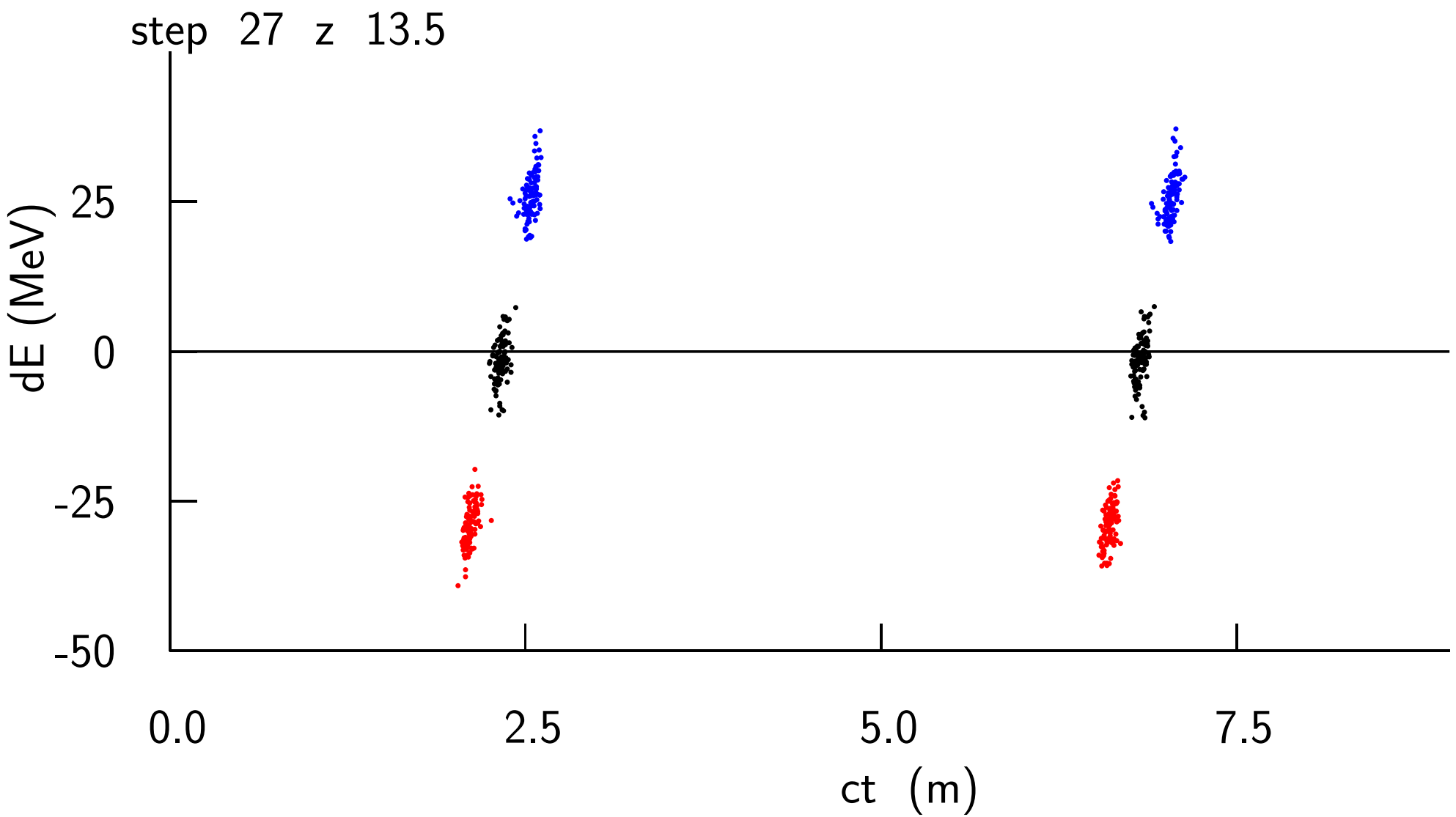


Fig. 28

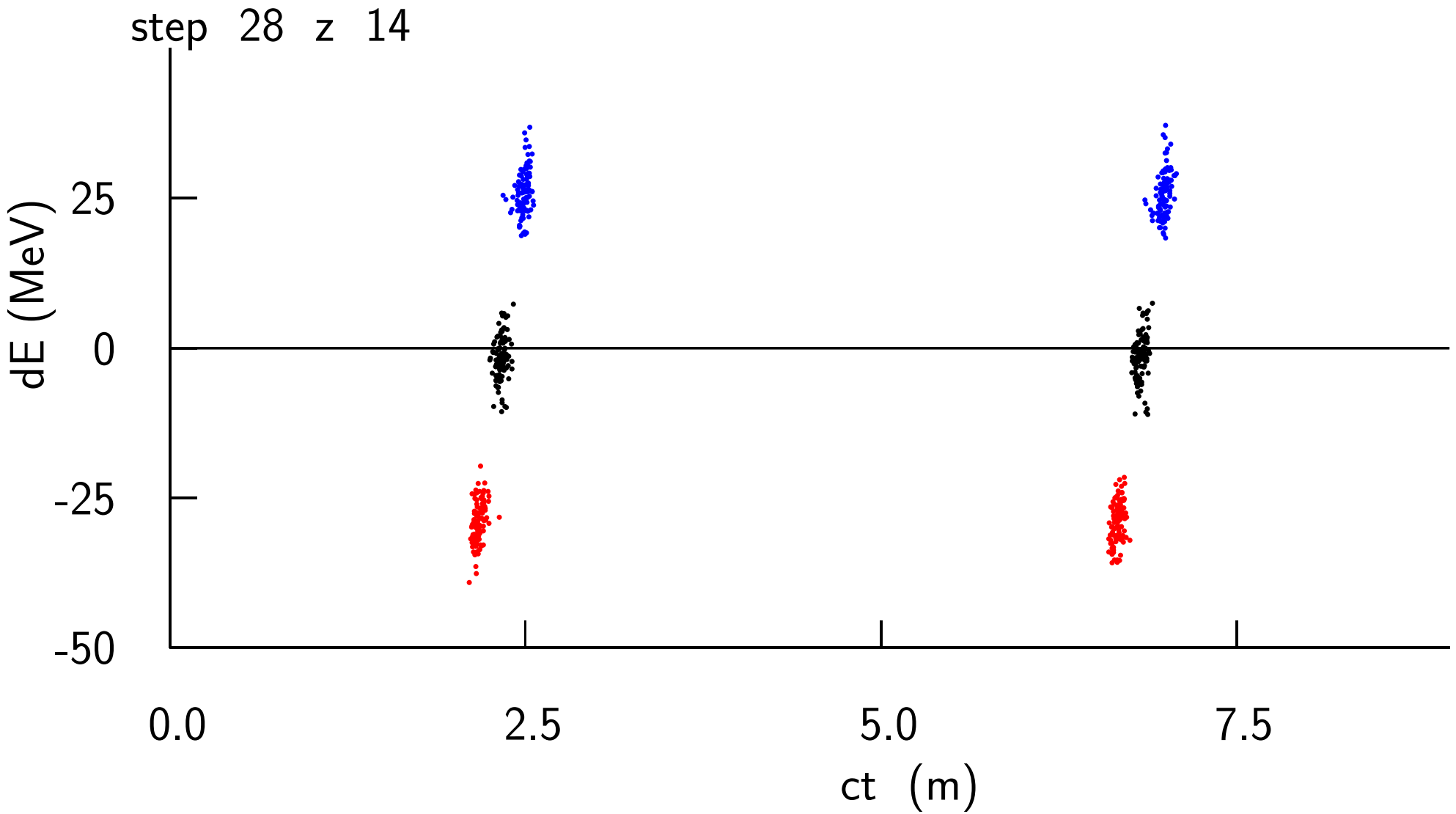


Fig. 29

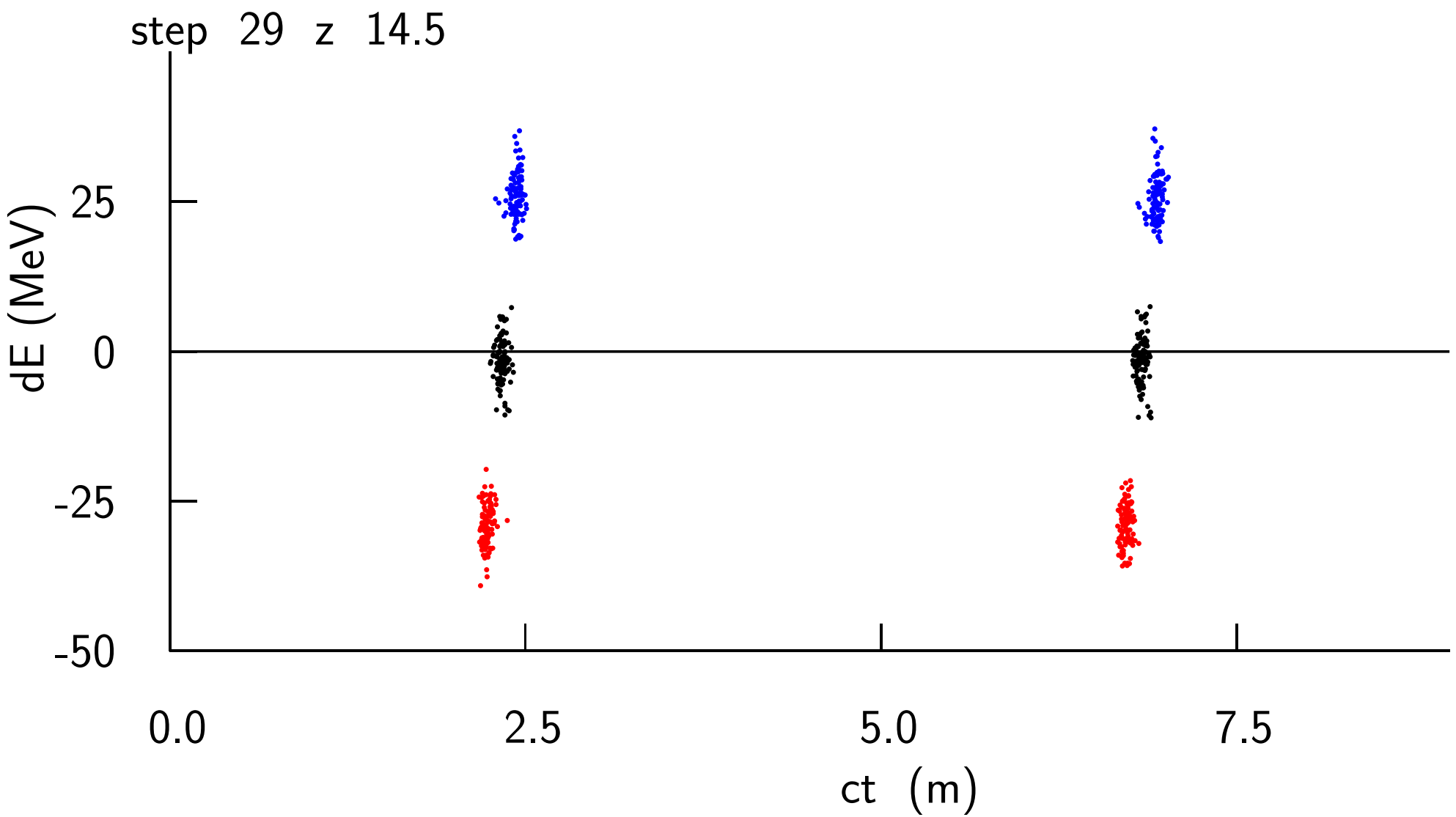


Fig. 30

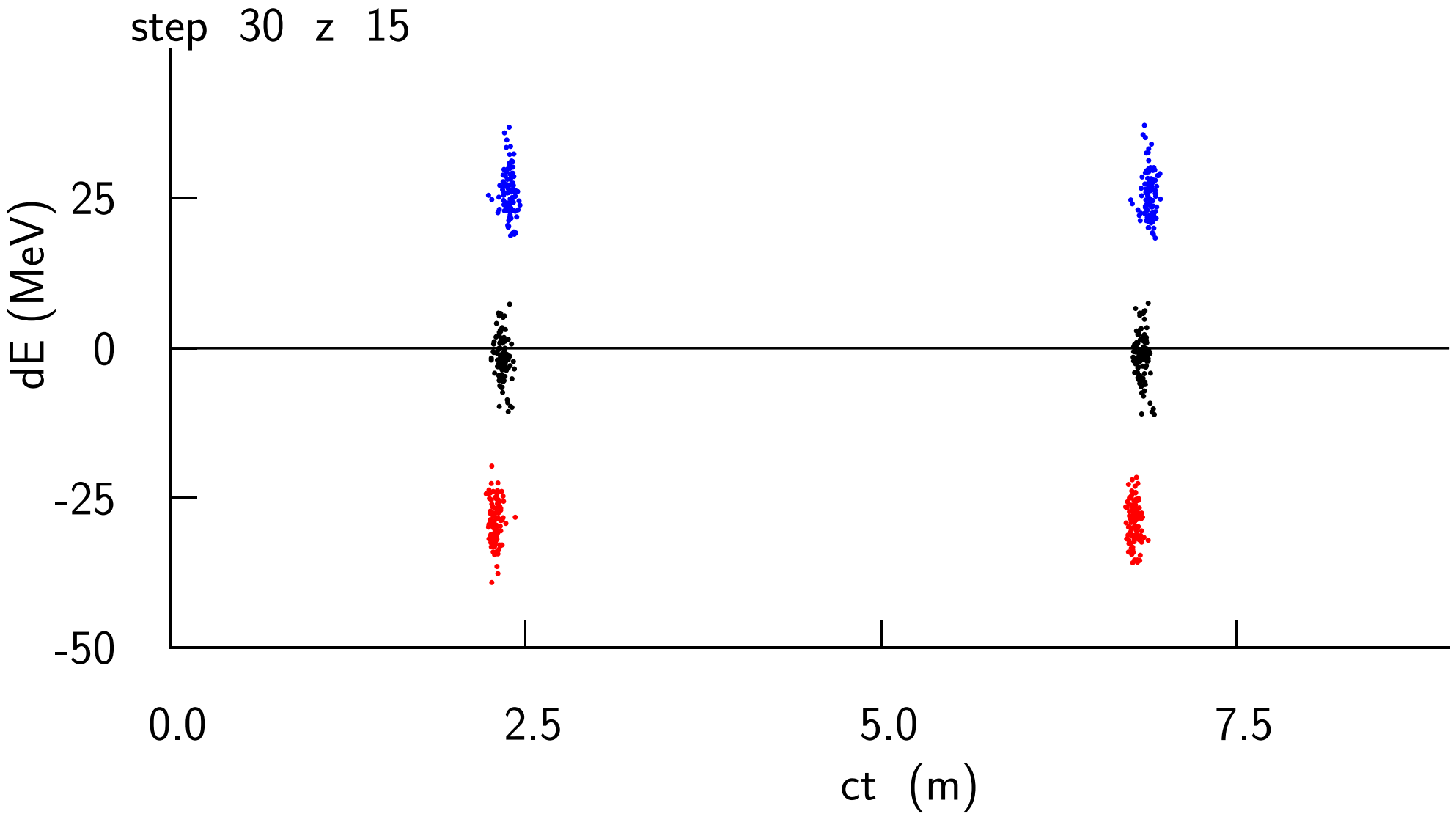


Fig. 31

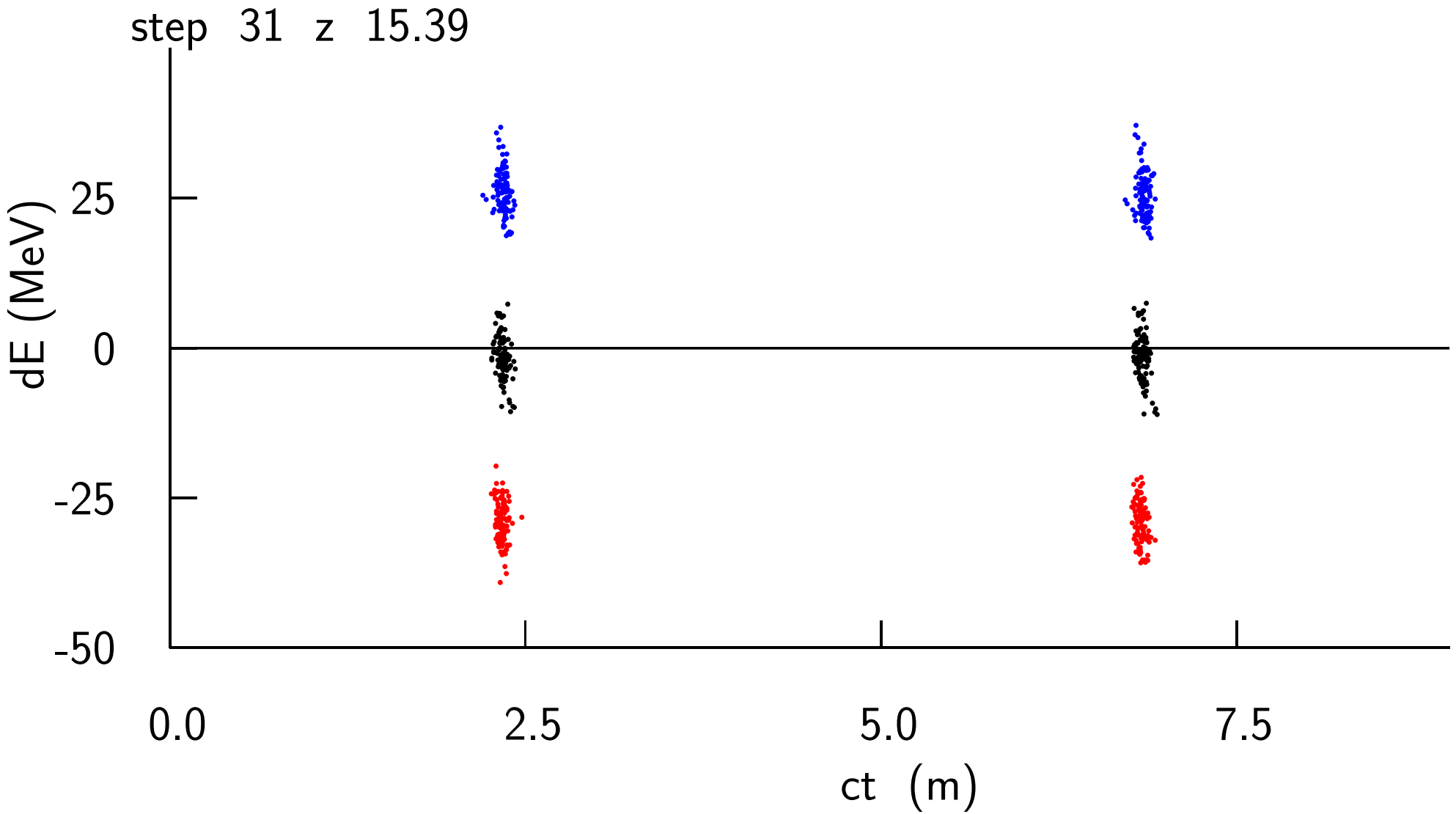
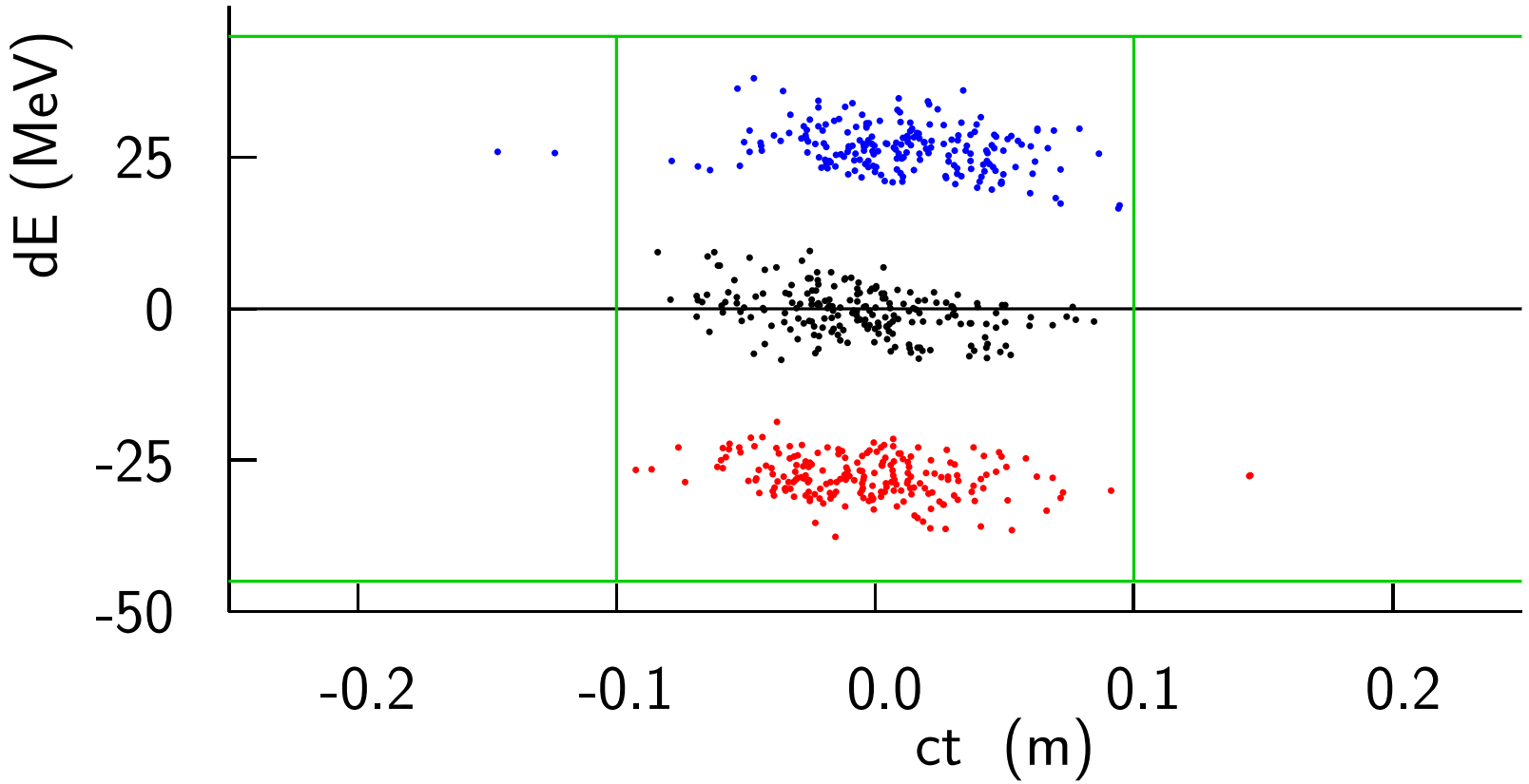


Fig. 32

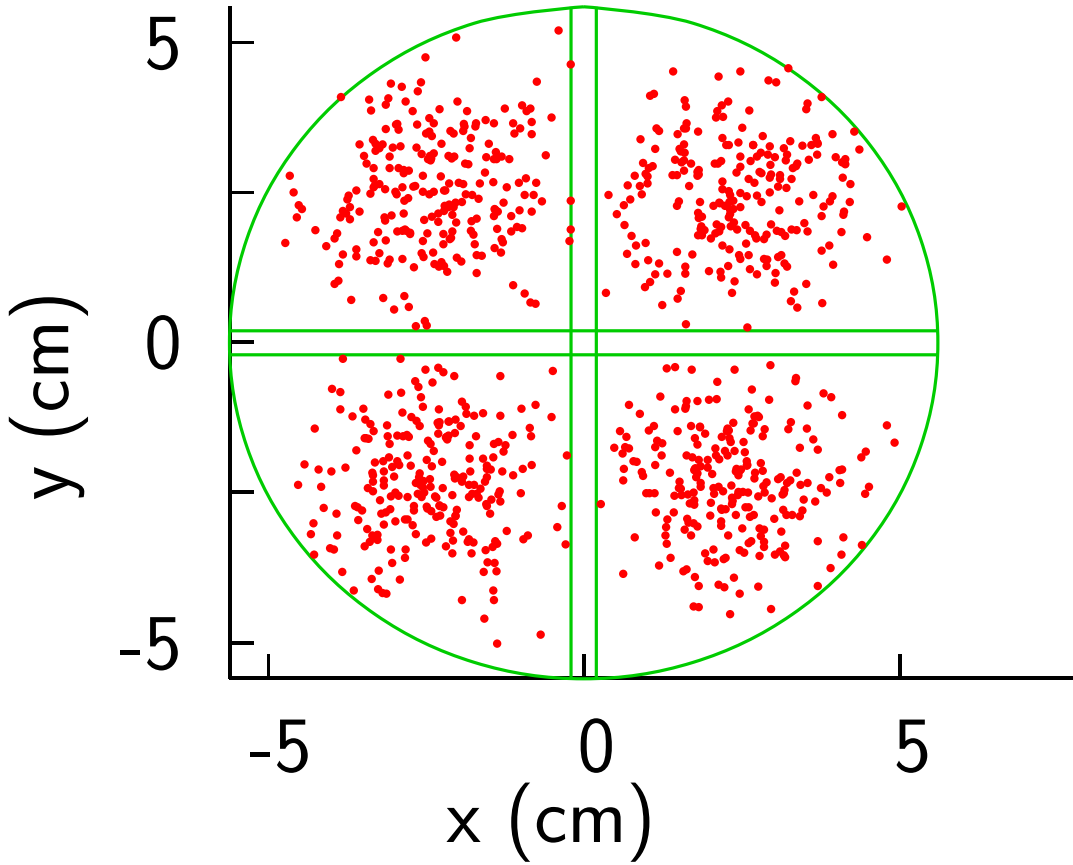
Detail at end



old emitz=1.3 (mm) new emit=6.3 (mm) ratio 4.8 transm=0.99

Transverse

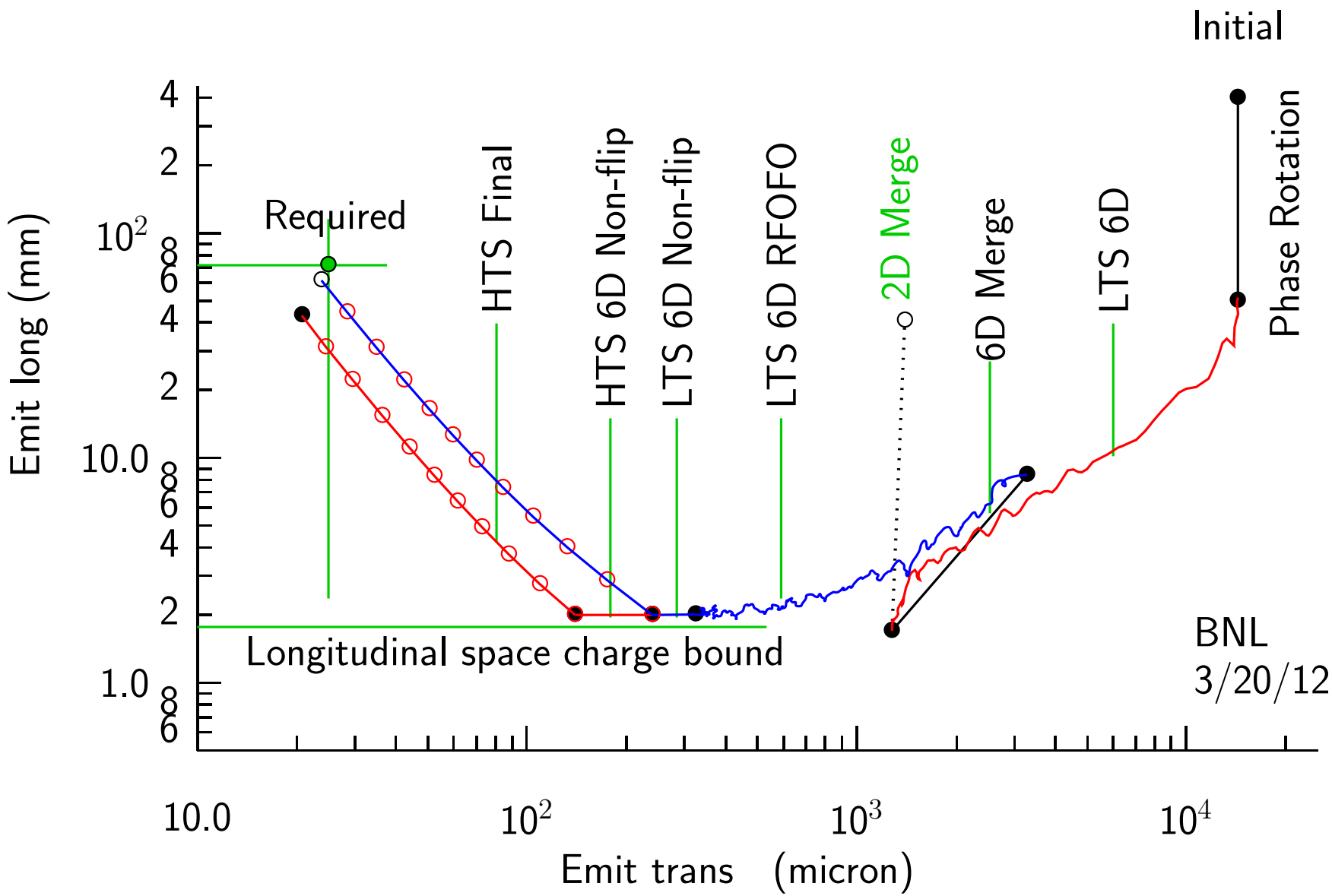
- There are now 12/3=4 bunches spaced by ct=4.5 m
- x and y kickers send these bunches into 4 different channels
- that transport them different lengths (trombone) to bring them to the same time
- where they can be captured into one larger channel



new emit x = 2.57 × old emit x
new emit y = 2.57 × old emit y
Transmission 95 %
But aberrations in the Fan-Out has not yet been simulated

New (3/20/12) Cooling Sequence

ICOOL Simulations of 6D cooling are for Guggenheim lattices



Next Tasks

- Simulate merge using files from end of 6D before merge
  quick
- Simulate RFOFO 6D cooling after merge using output from merge
  quick
- The same using Non-flip lattices
  a little longer
- See if this can be done in a simple lattice
  this should be possible - just needs a crazier wave form
- Simulate merge with ICOOL or G4Beamline
  This will take time