Vacuum rf 6D Cooling

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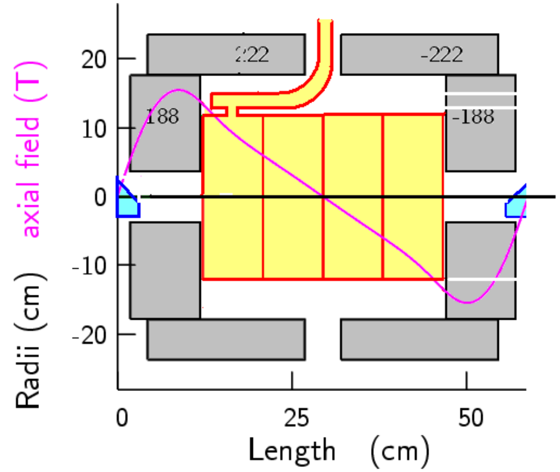
(BNL)

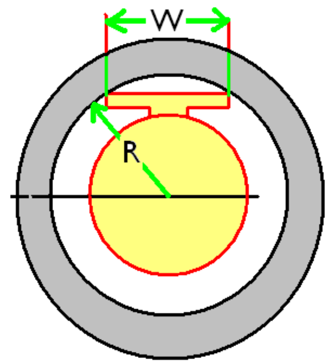
Tuesday 7/27/2013

Remarks

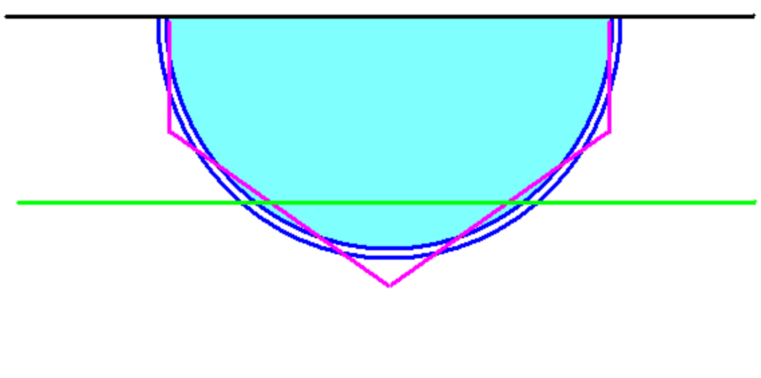
- Progress on out initial baseline
  - I have the longitudinal part of a 325 MHz bunch merger (later)
  - Diktys has a complete set of Balbekov Lattices for 'after the merge' (later)
- Progress on both sign Snakes
  - I have an early Planar snake giving Q$\approx$ 10 (similar to Balbekov's)
    but it may not be suitable for the first cooler after the phase rotation because it does not have a very wide momentum acceptance (like a FOFO)
  - Yuri has a new version of his Snake (later)

- We badly need a solution to bring rf to cavities with coils outside them





- We badly need a plausible design of 'wedge' absorbers (eg cylindrical)



- We have a way to use 650 MHz, after 325, with a snake, by gradual introduction that drags the bunches to their needed asymmetric locations

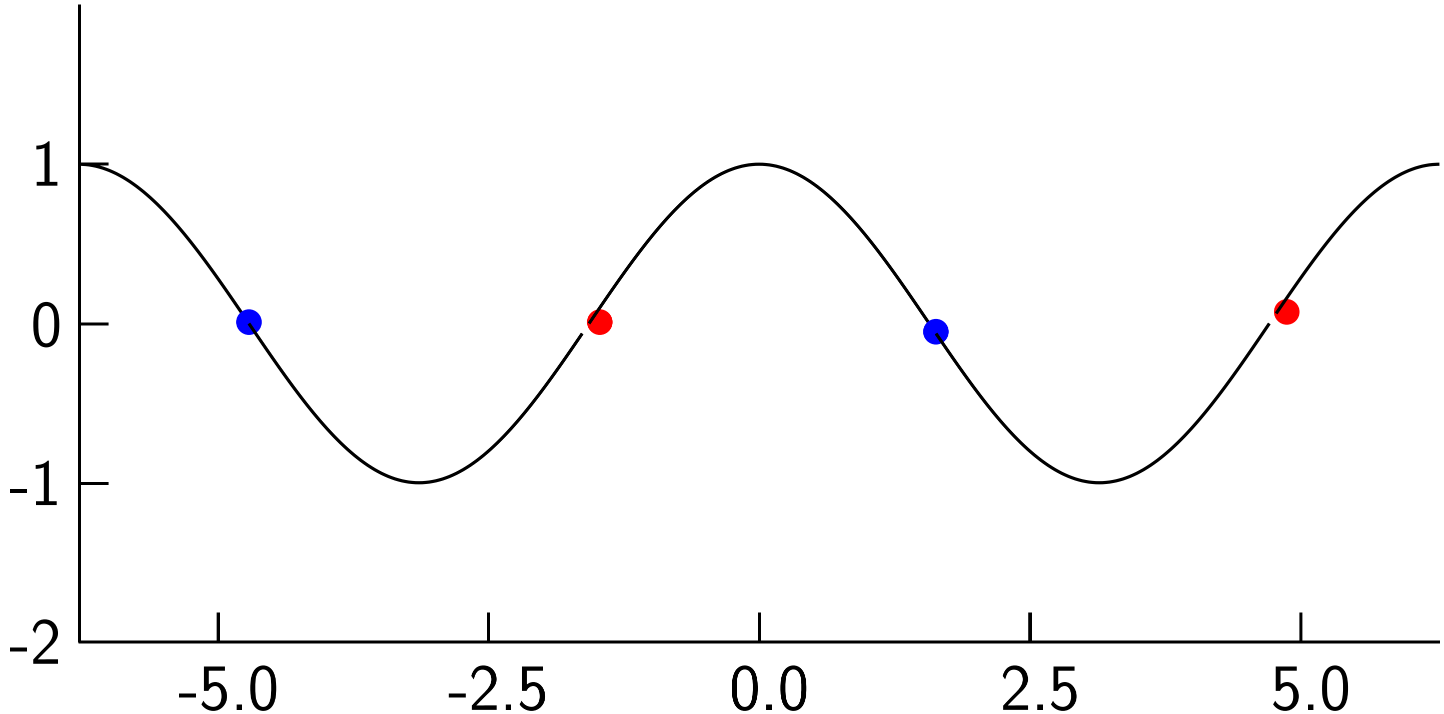


Fig. 1

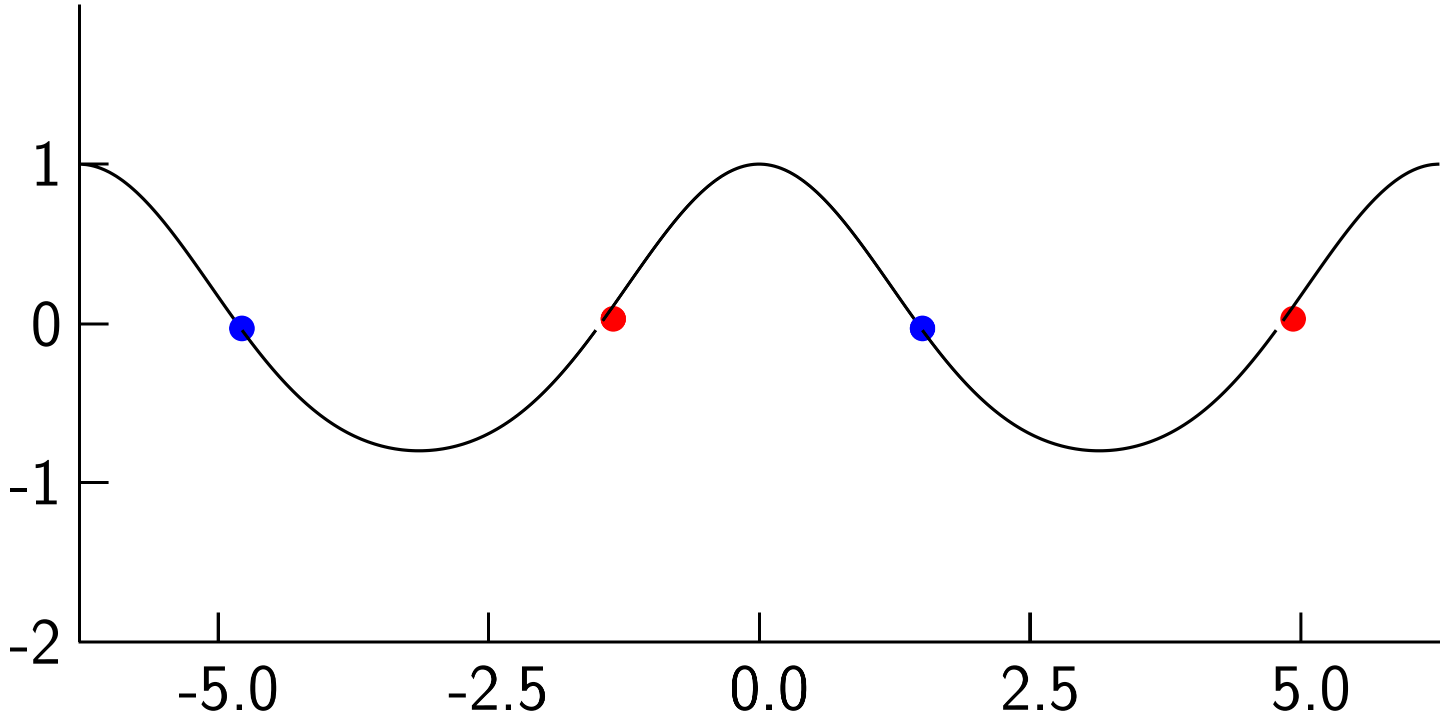


Fig. 2

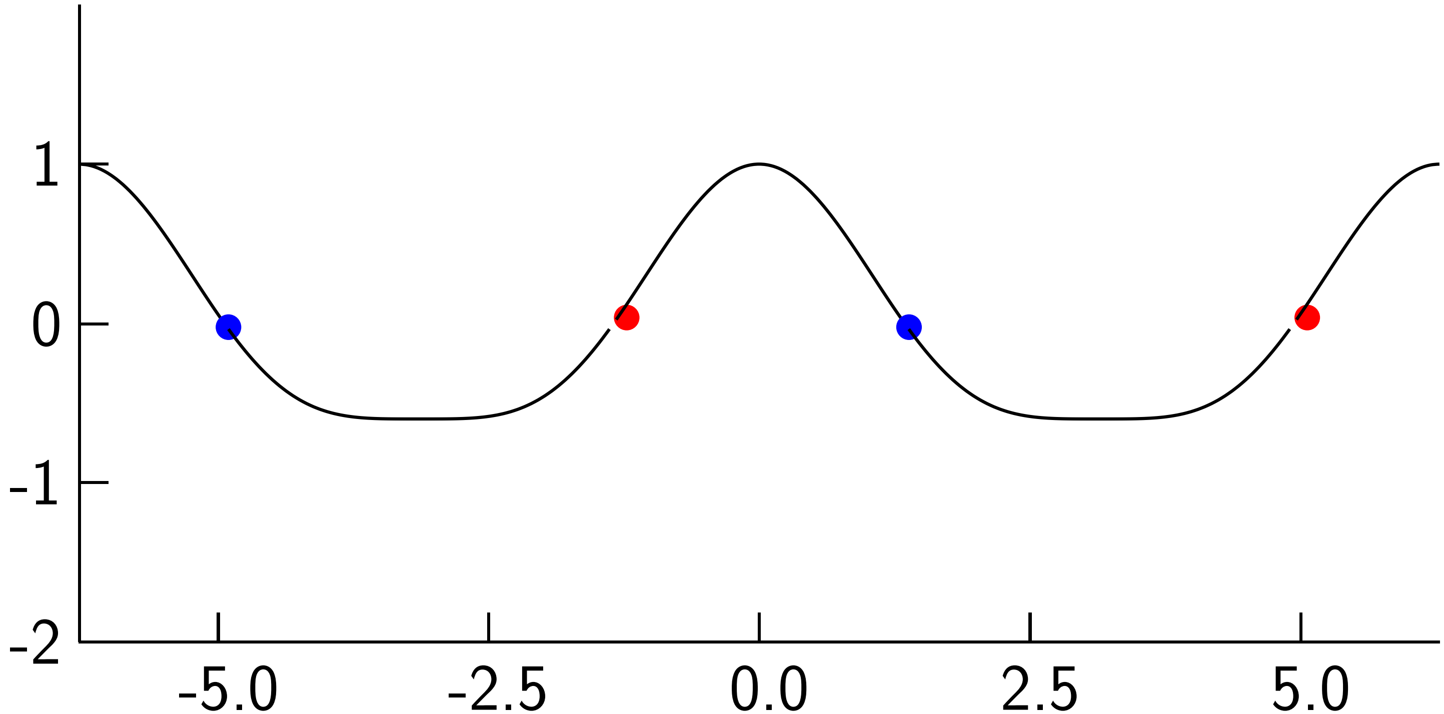


Fig. 3

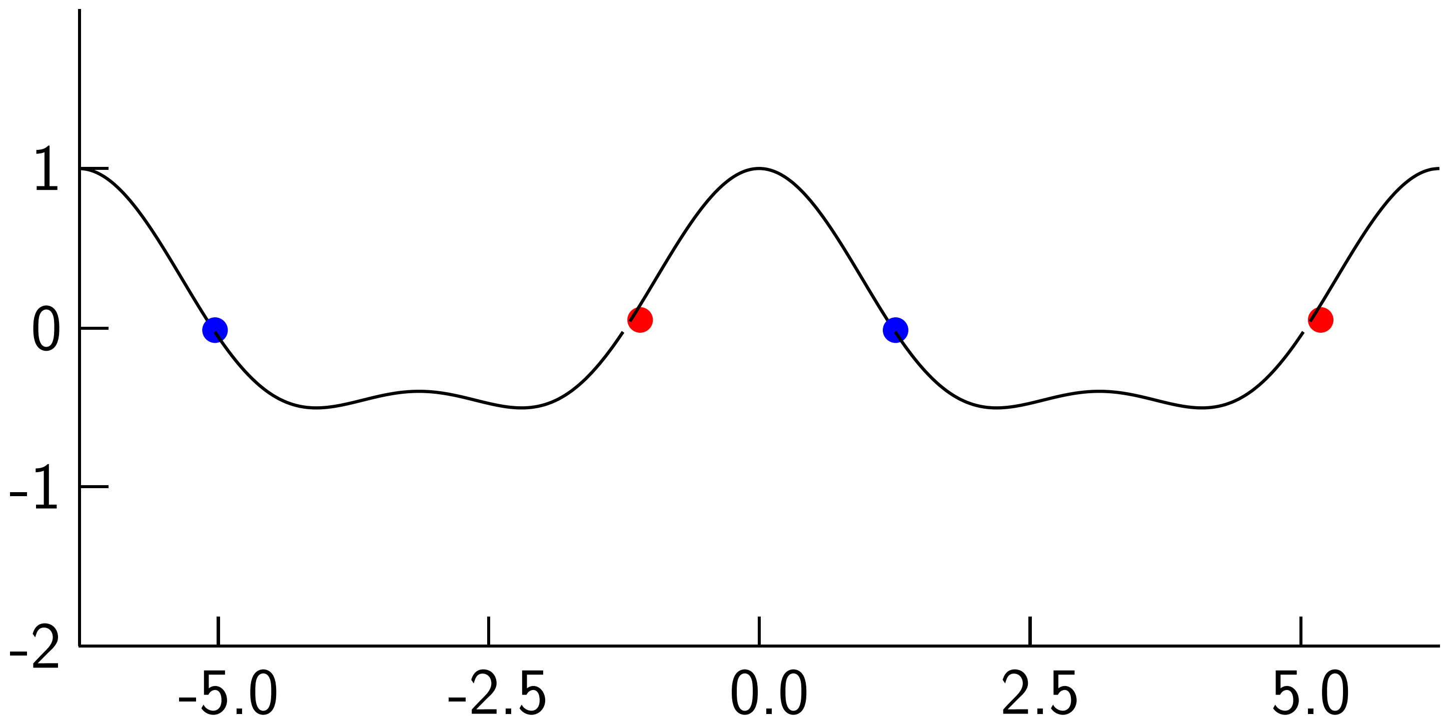


Fig. 4

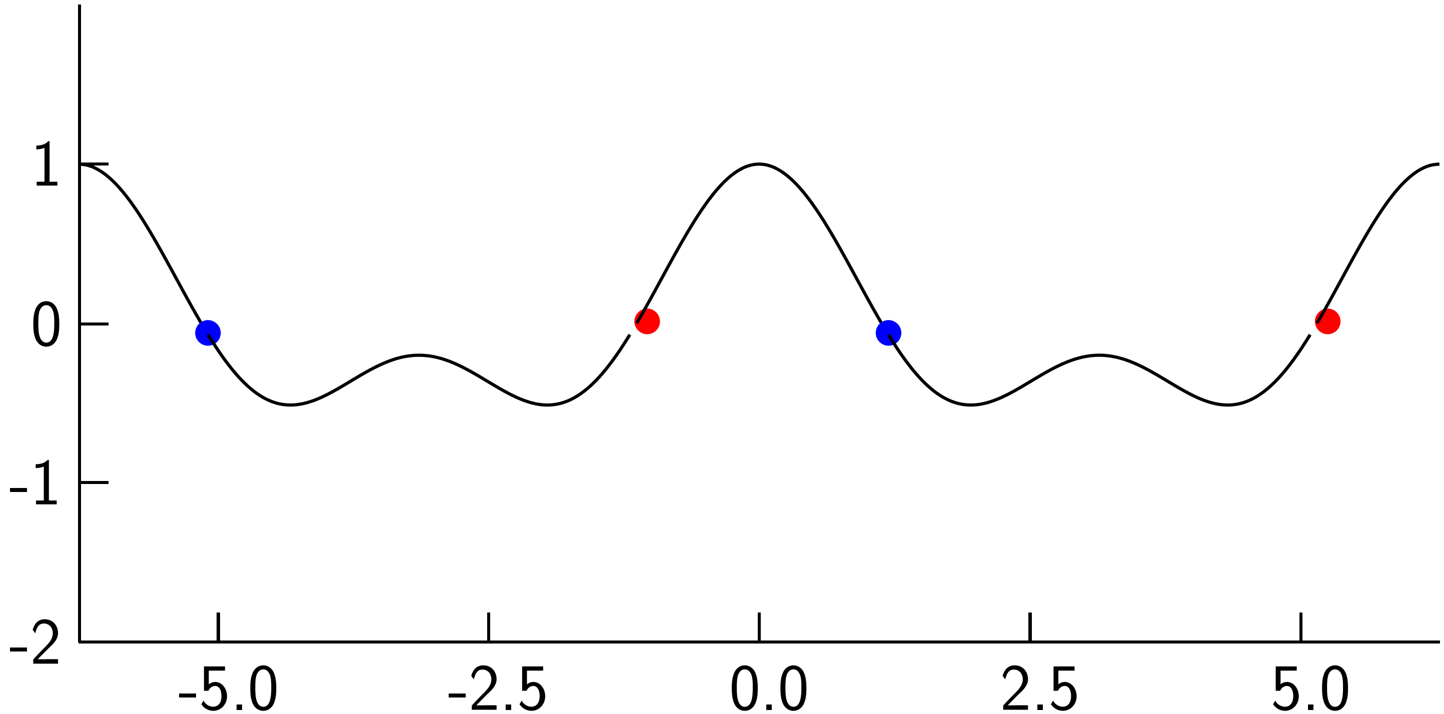


Fig. 5

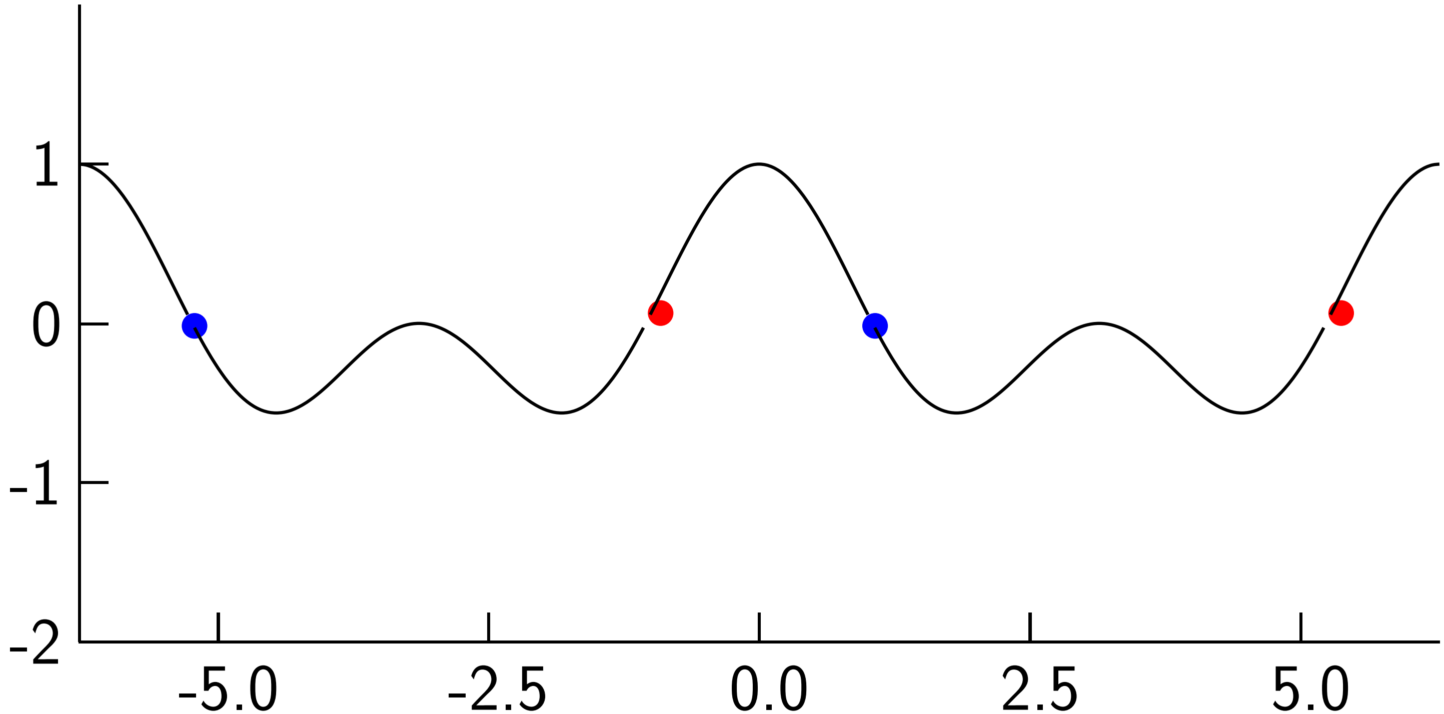


Fig. 6

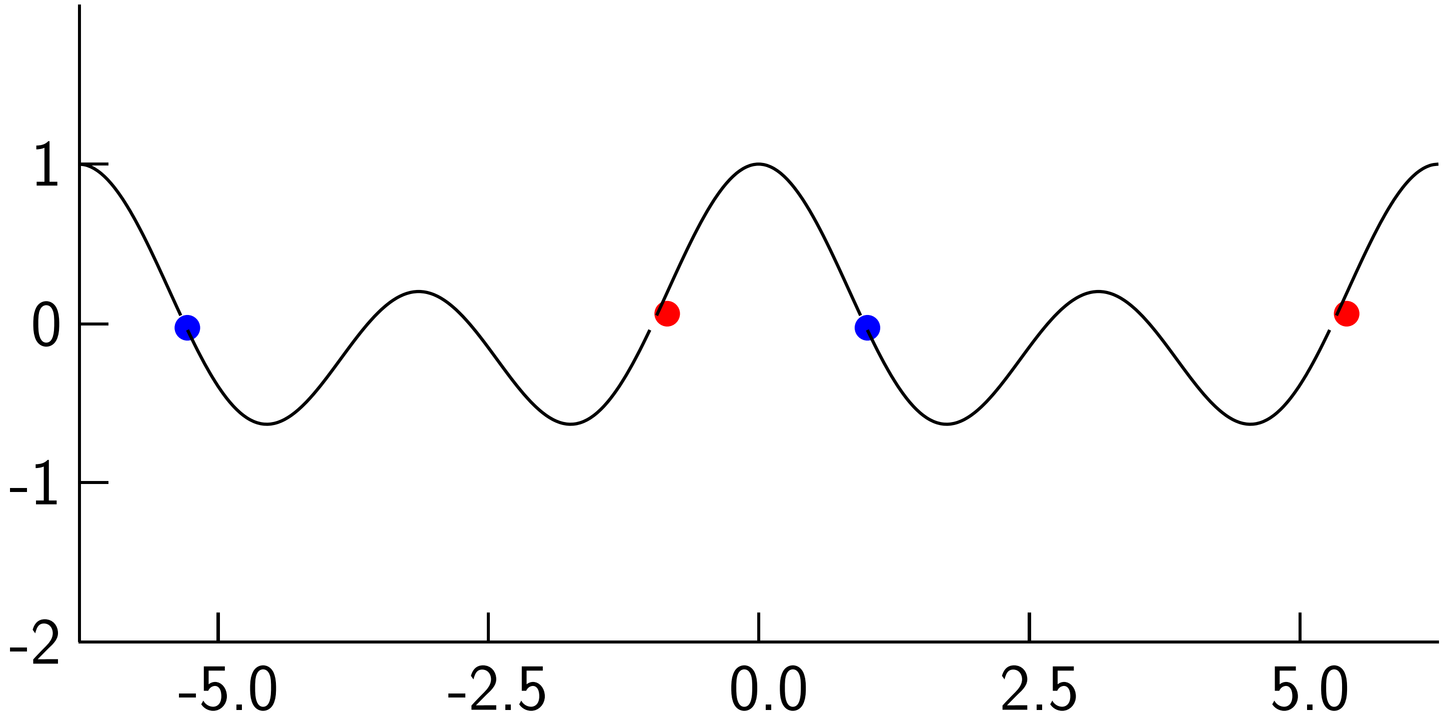


Fig. 7

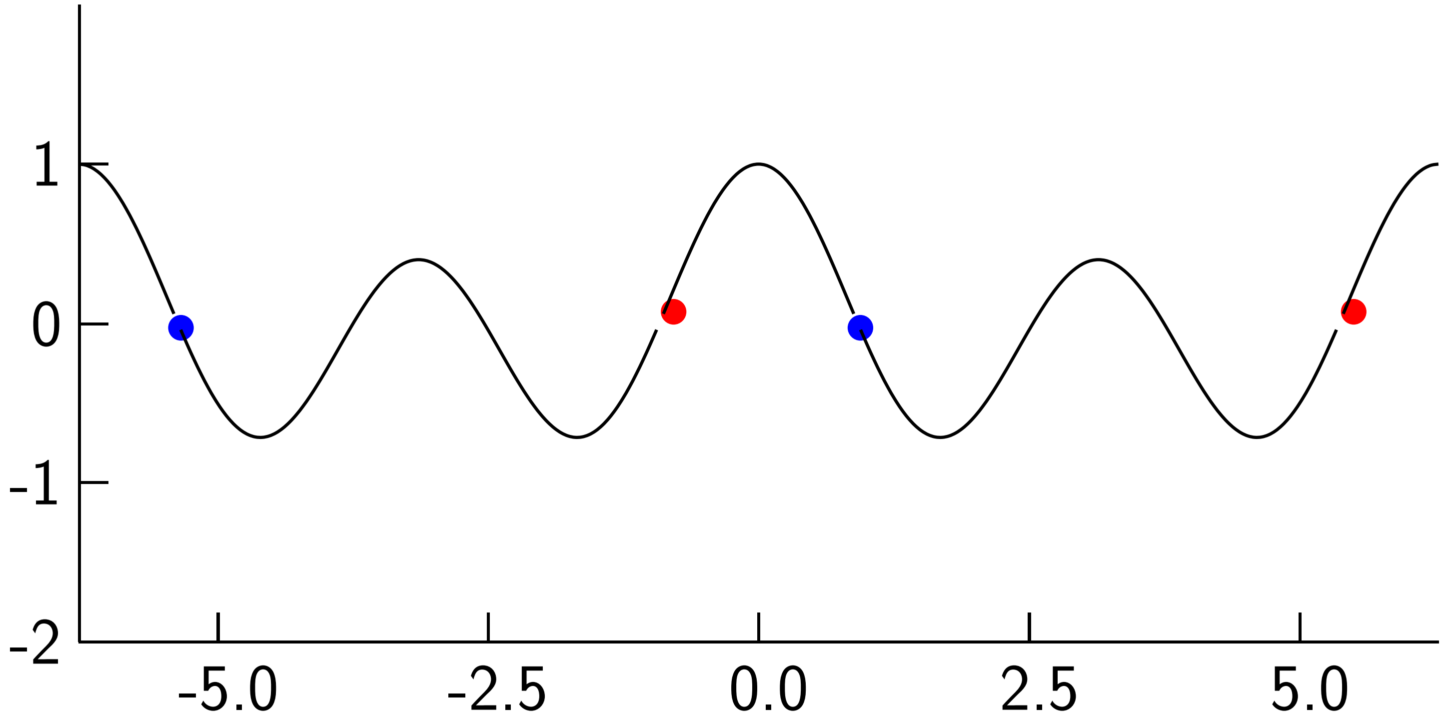


Fig. 8

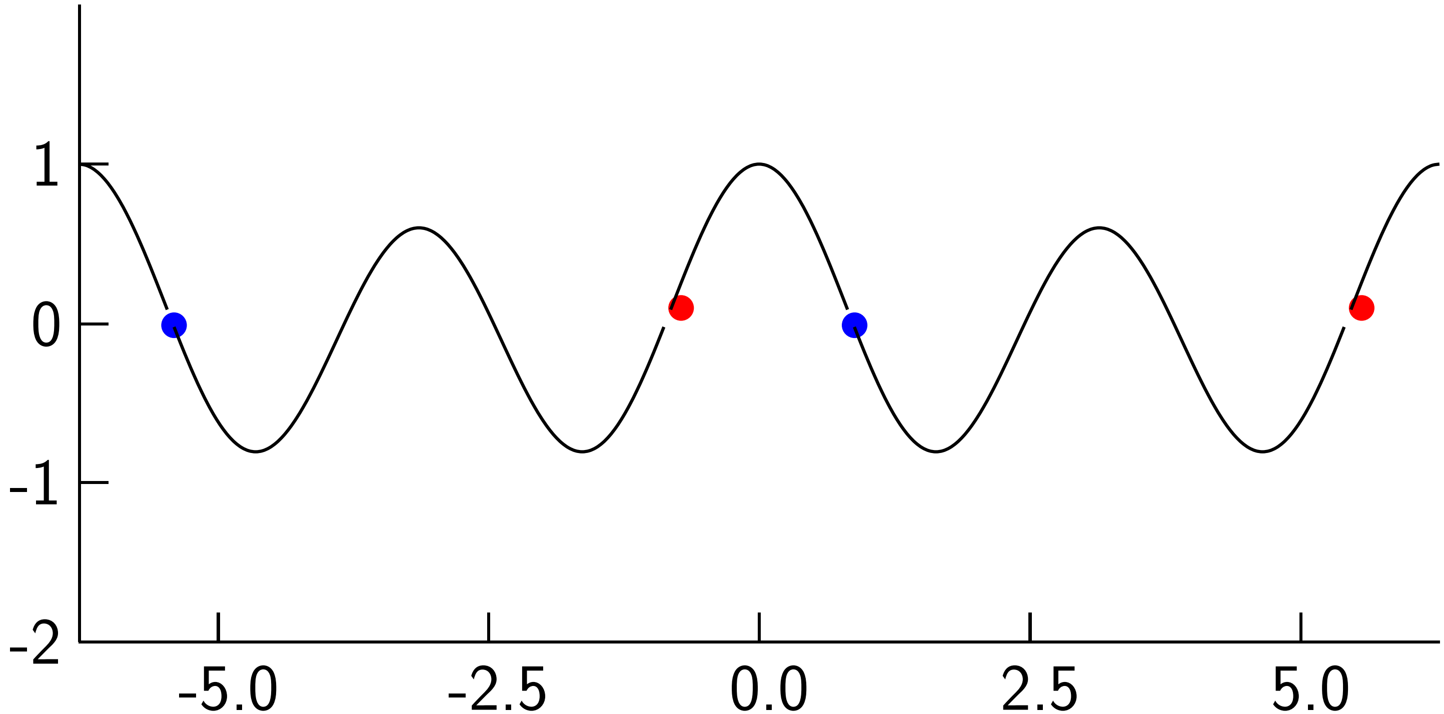


Fig. 9

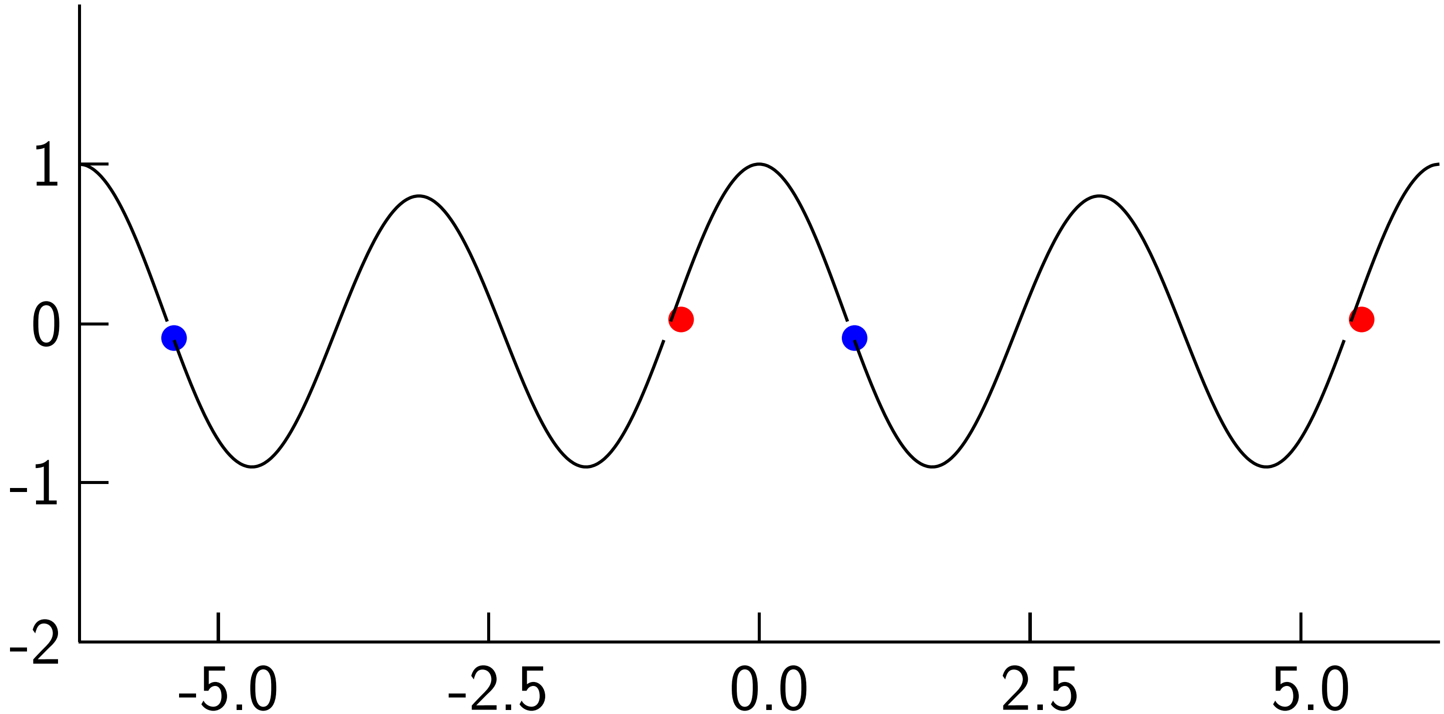


Fig. 10

Progression along longitudinal merge

Only 6 of the 21 bunches shown

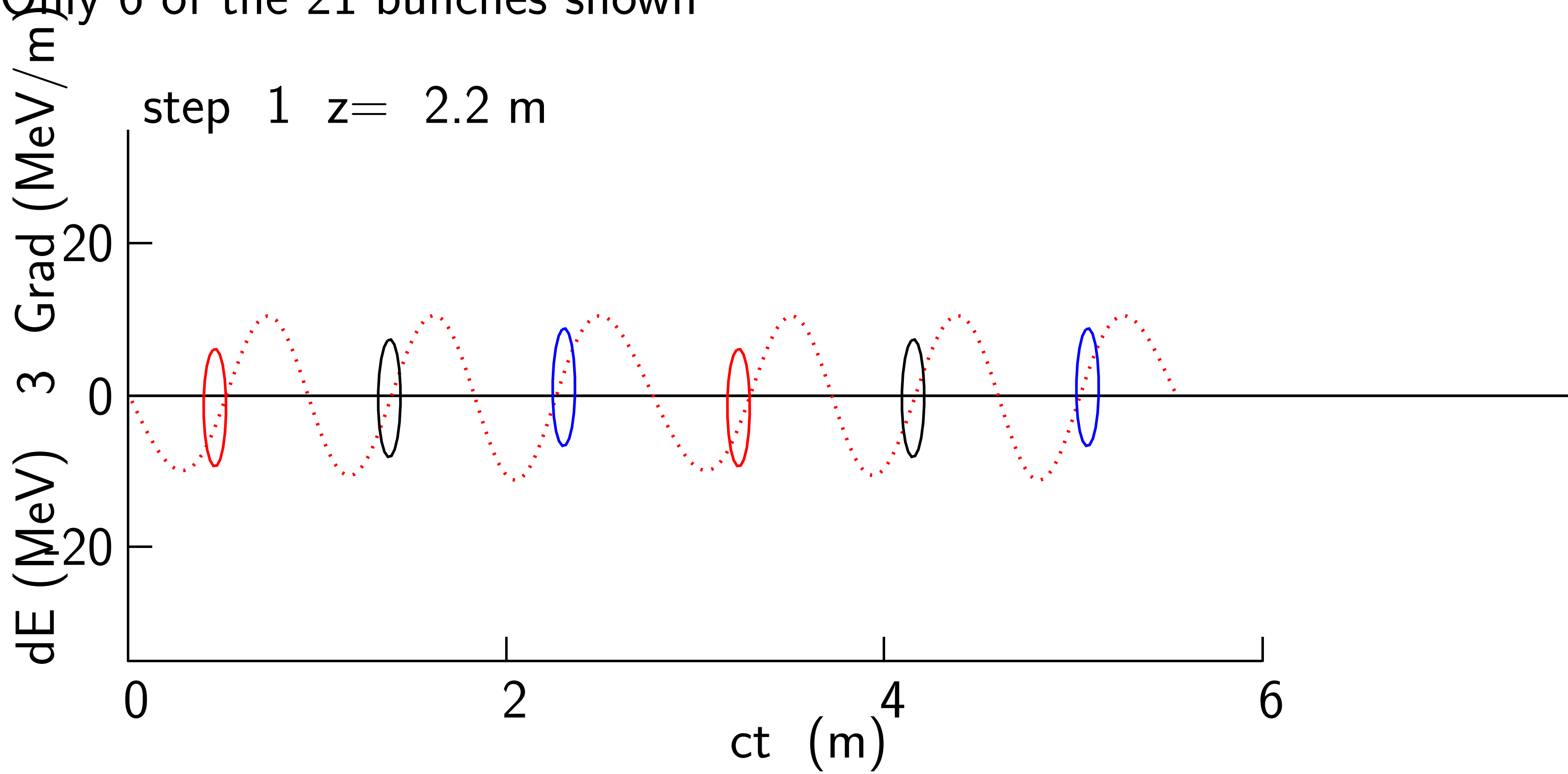


Fig. 1

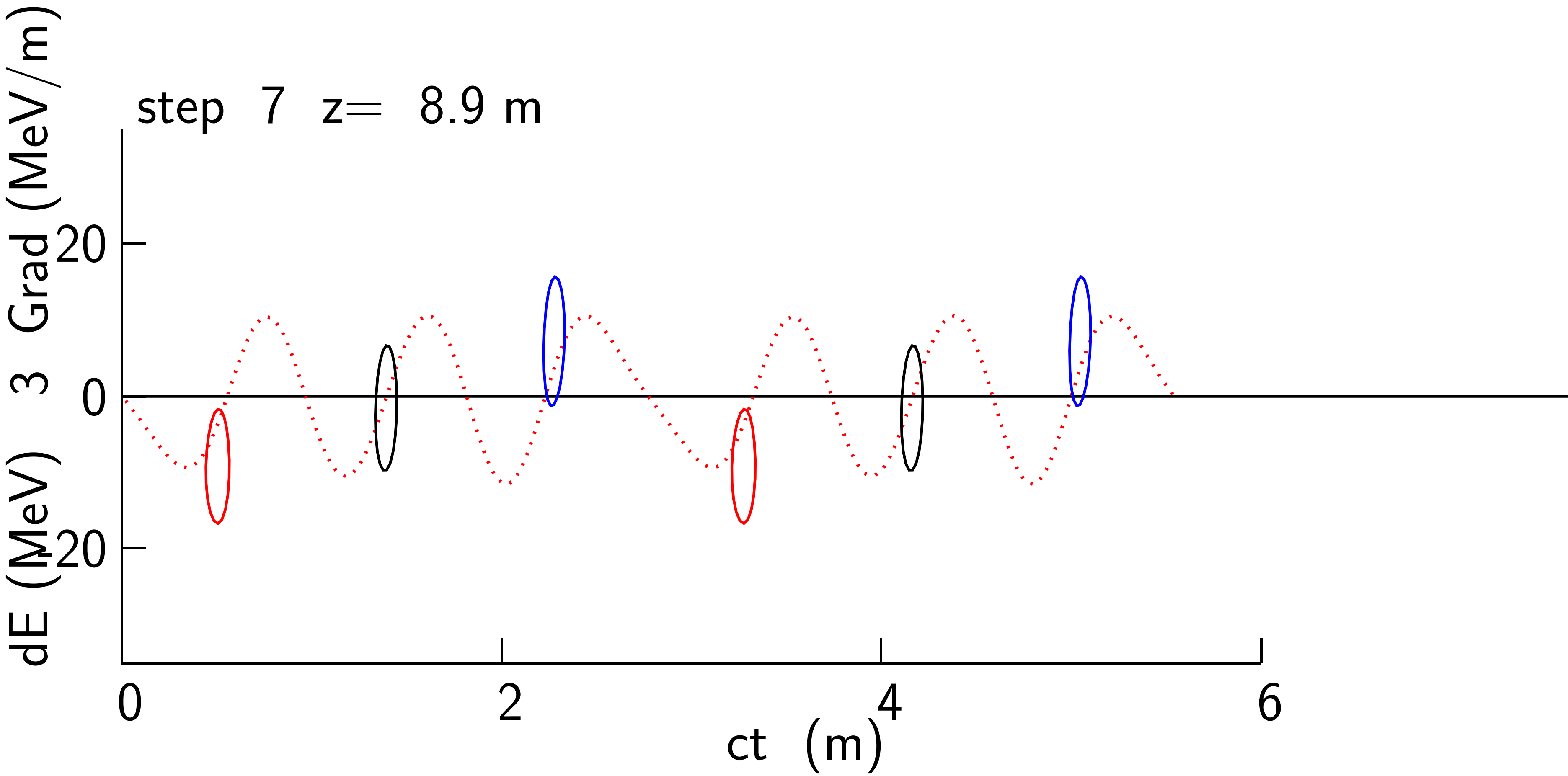


Fig. 2

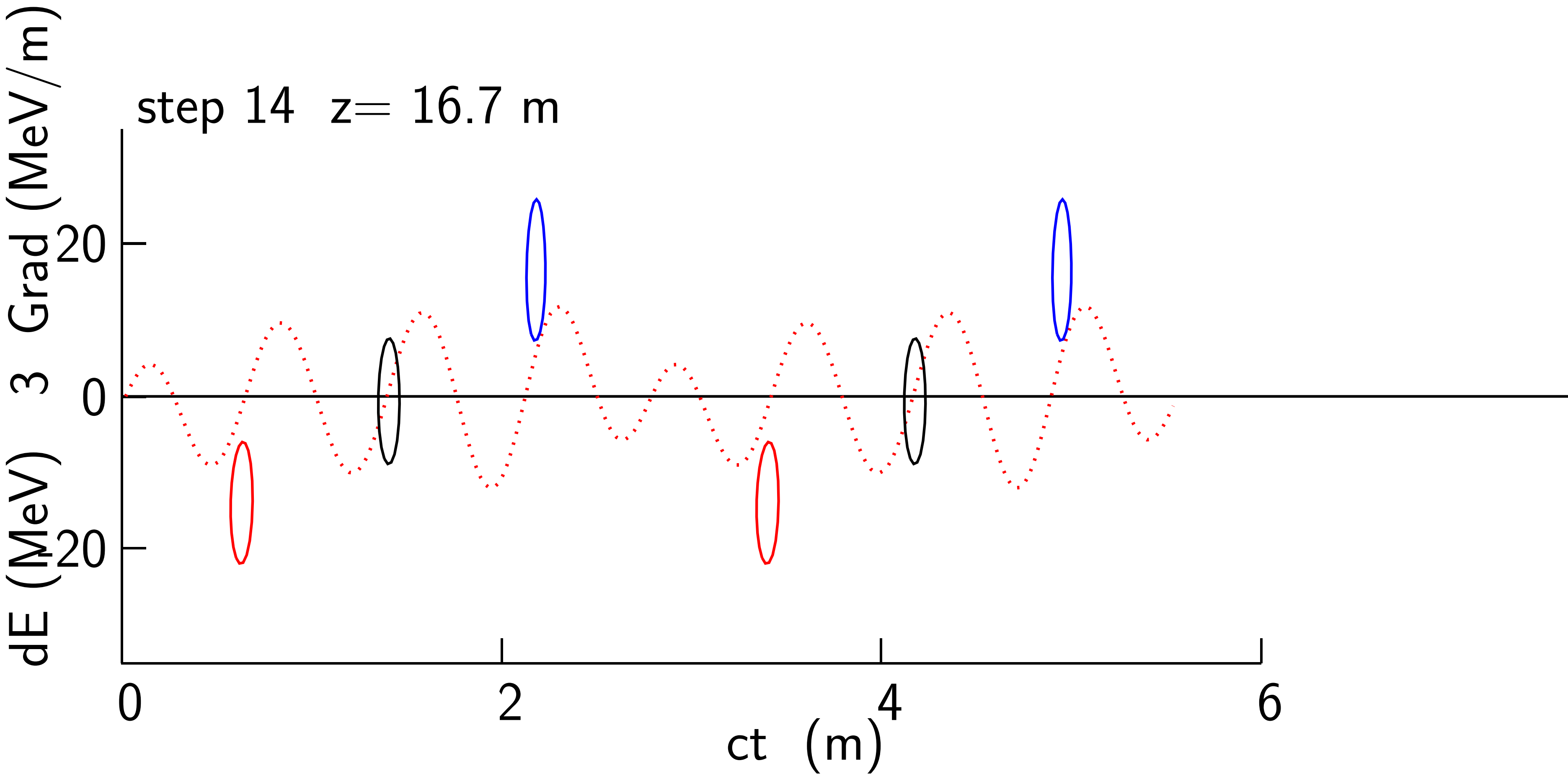


Fig. 3

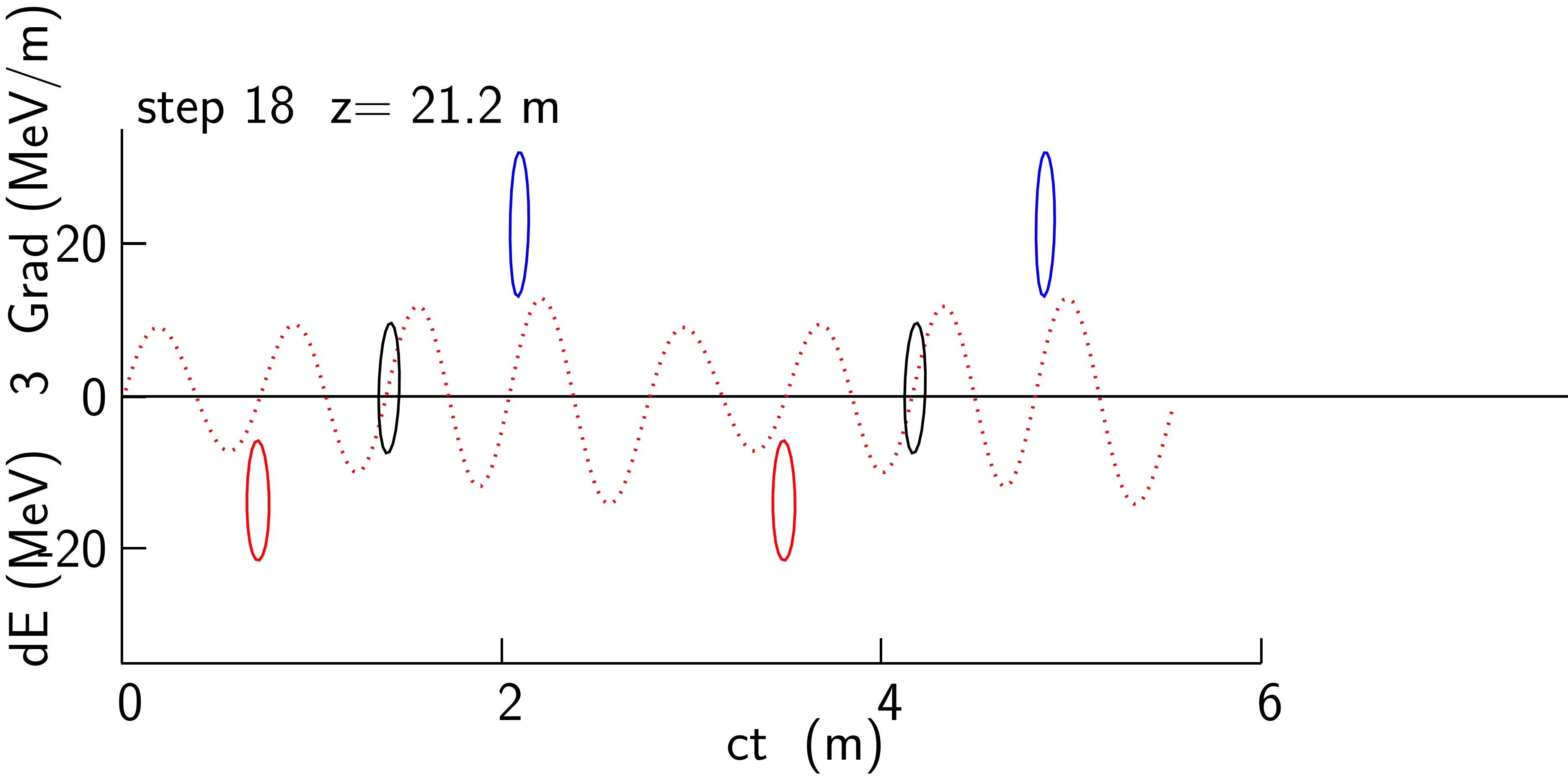


Fig. 4

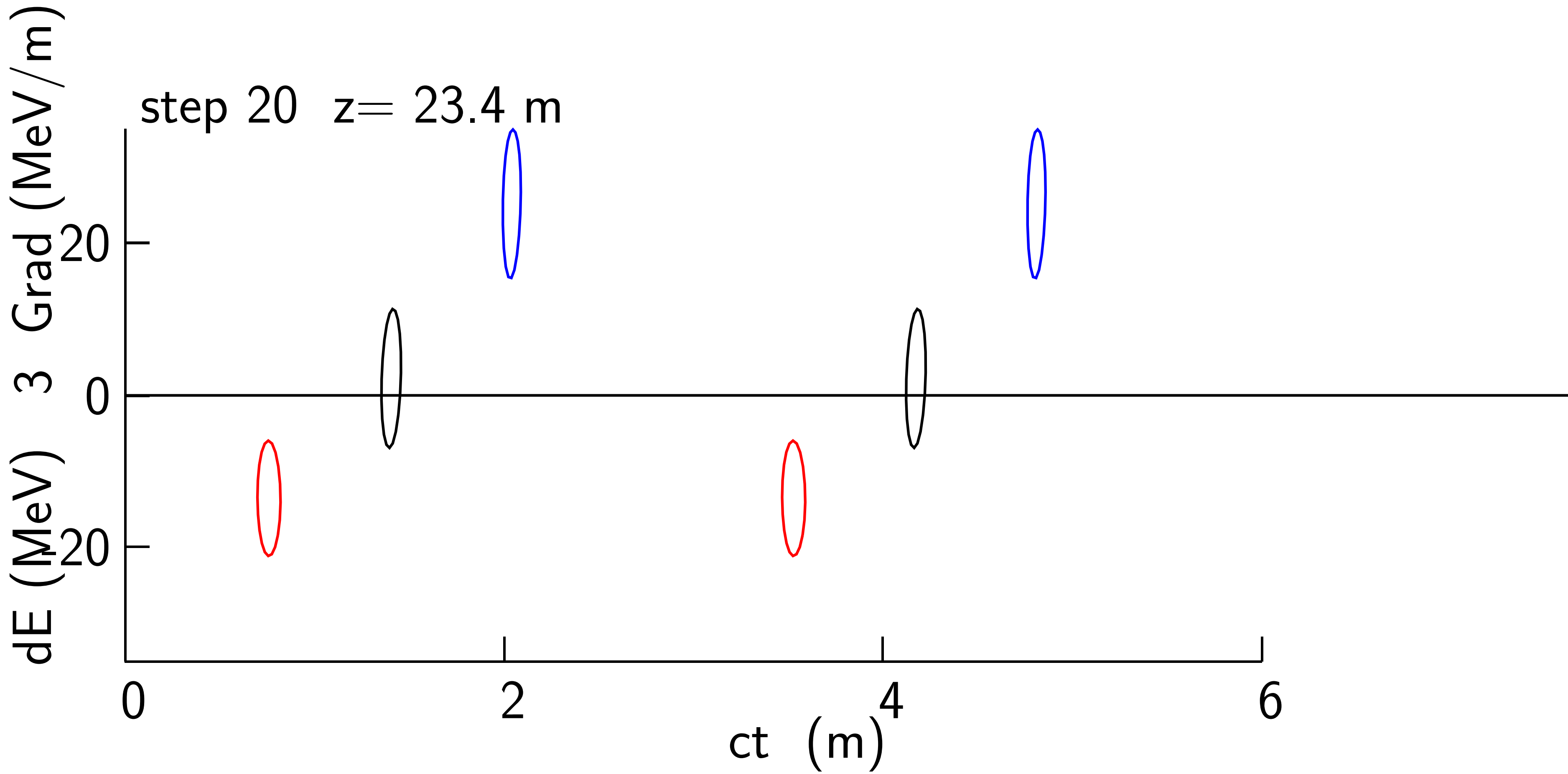


Fig. 5

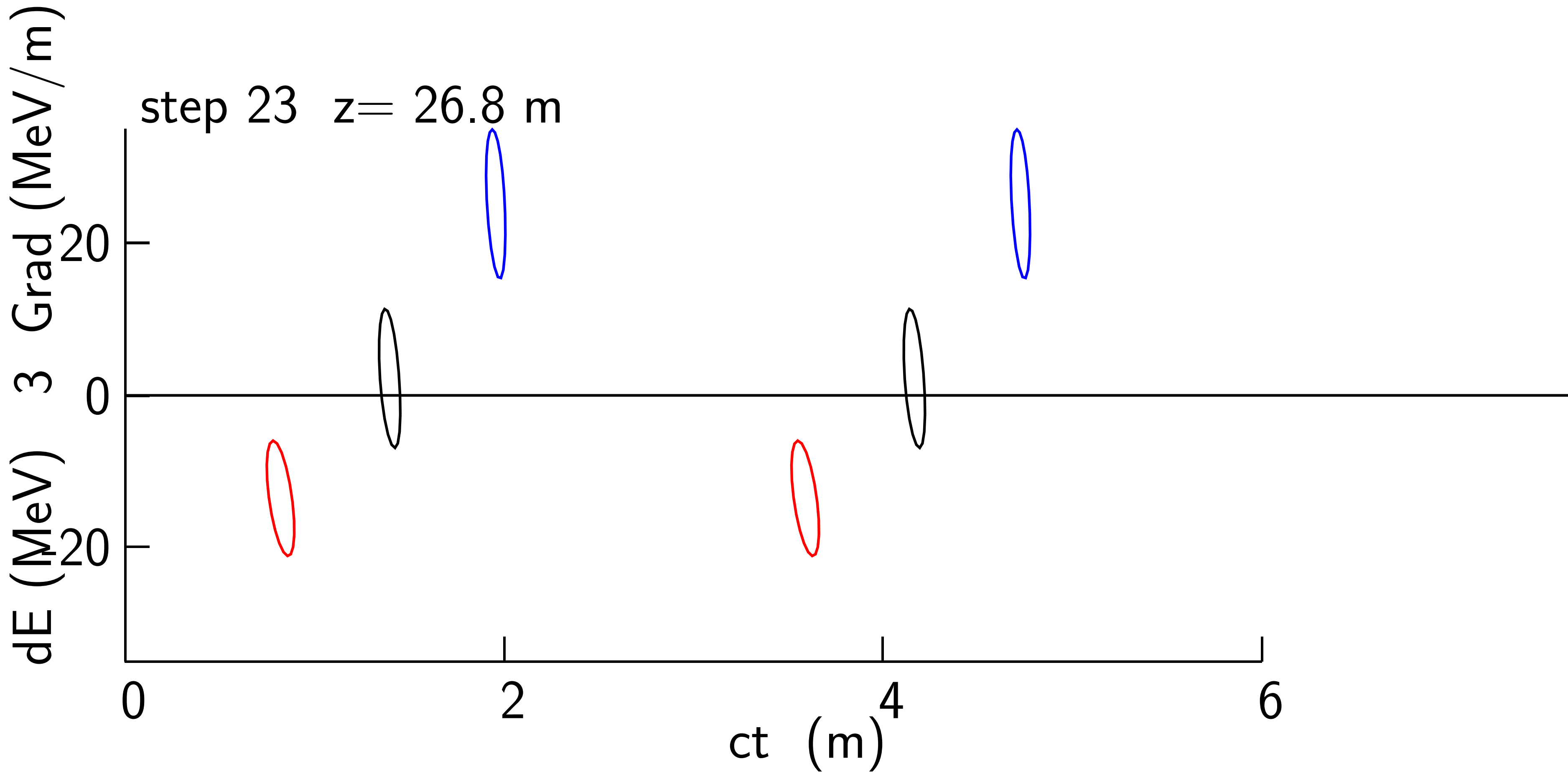


Fig. 6

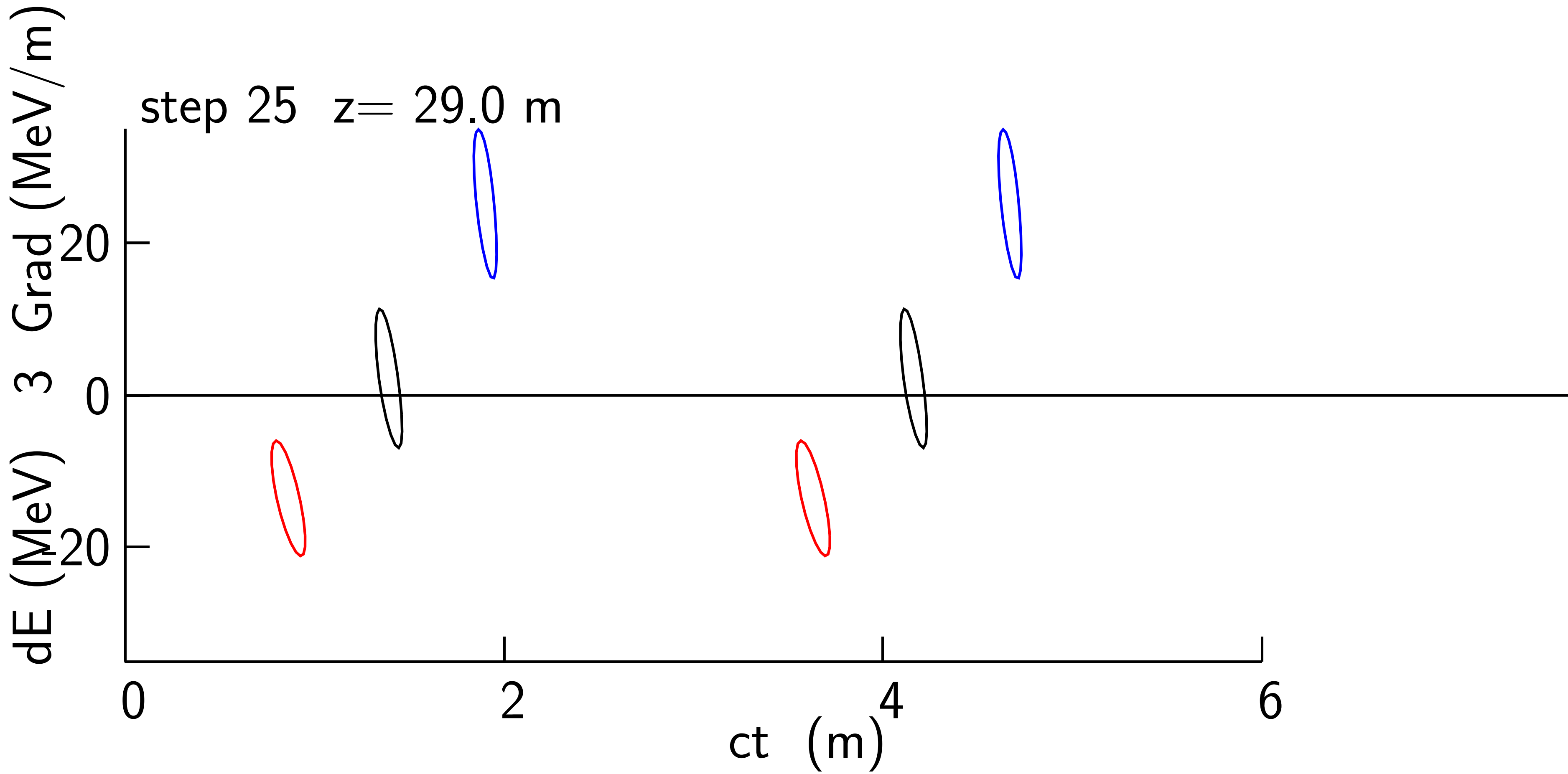


Fig. 7

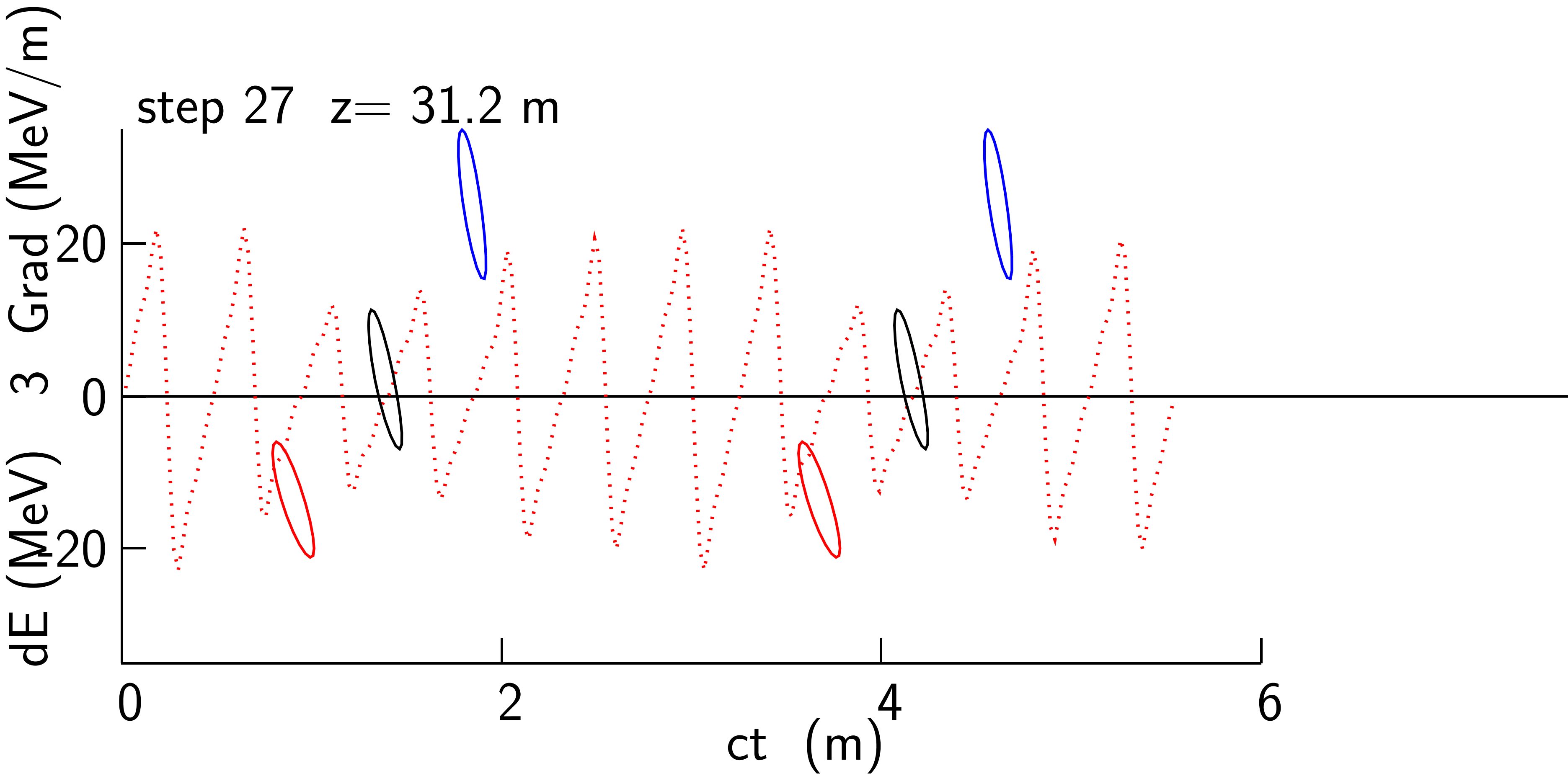


Fig. 8

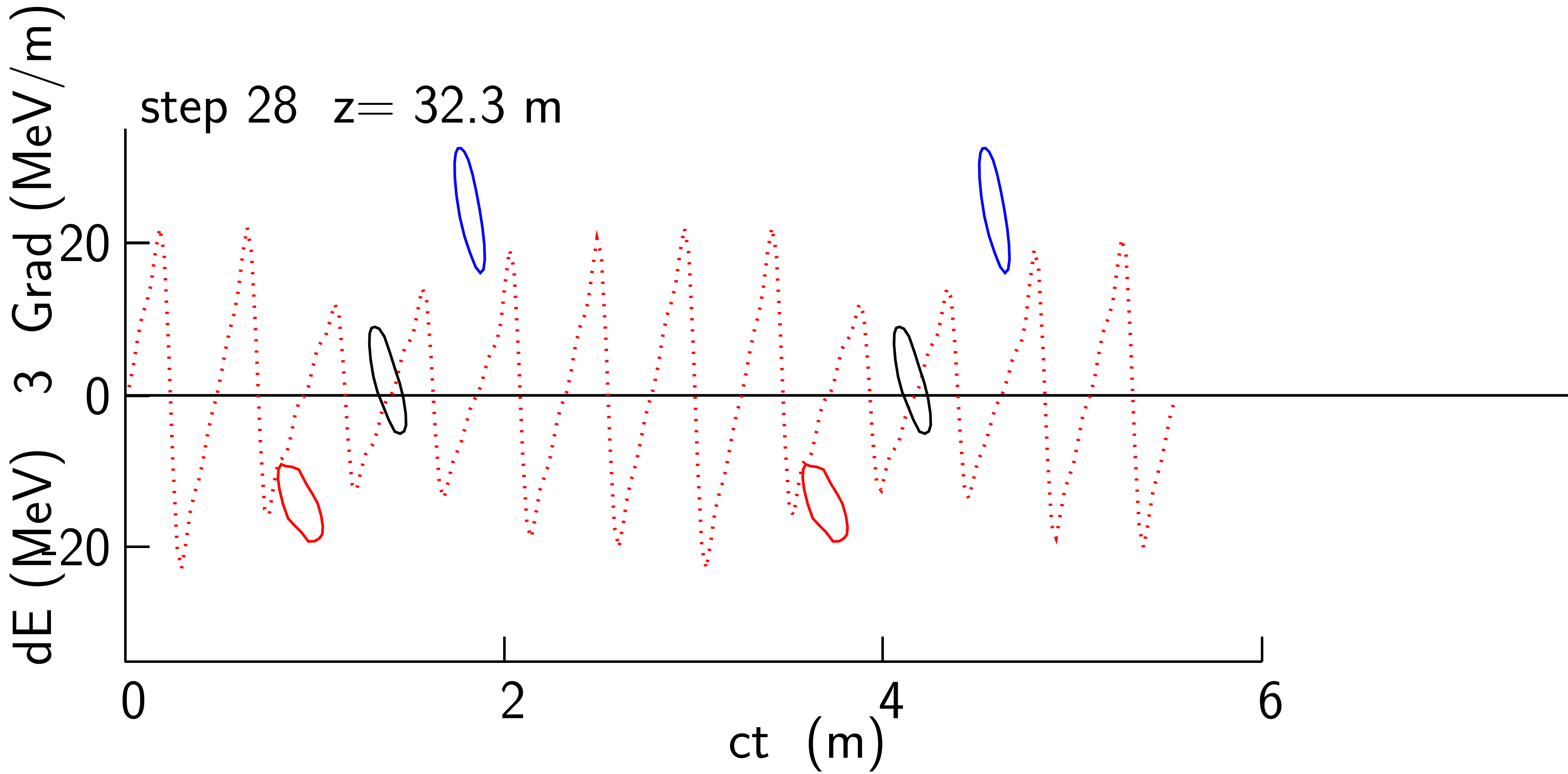


Fig. 9

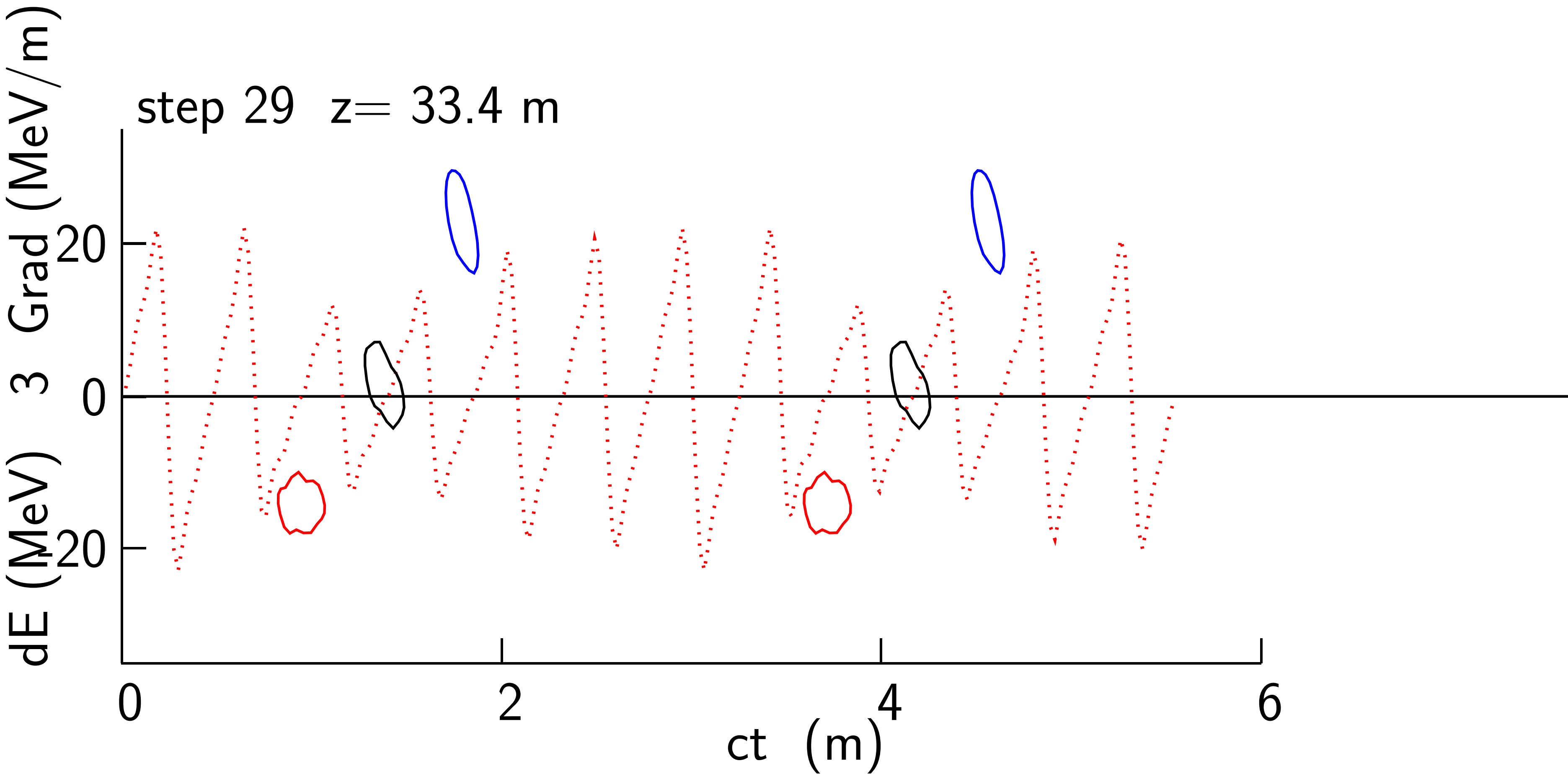


Fig. 10

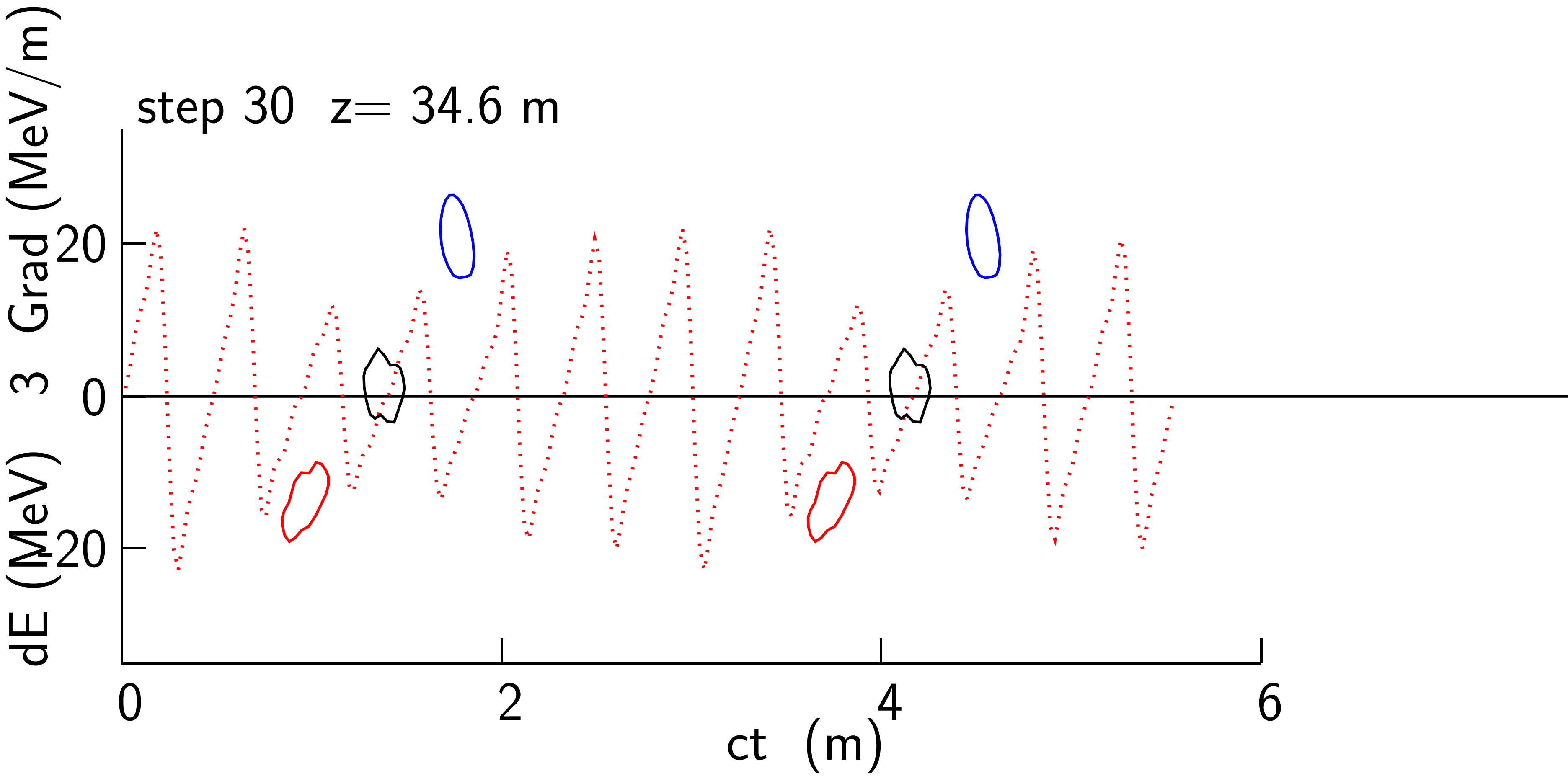


Fig. 11

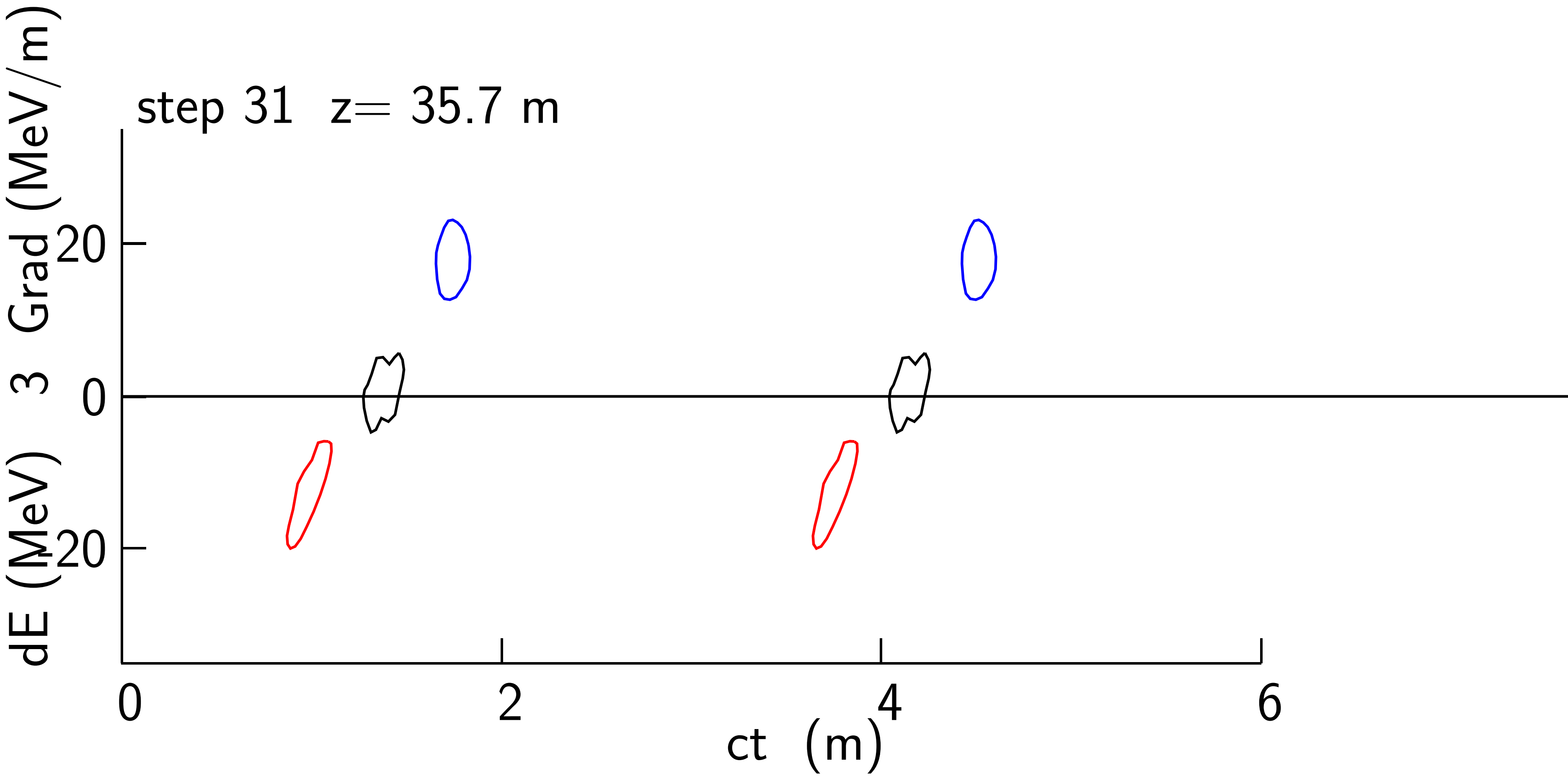


Fig. 12

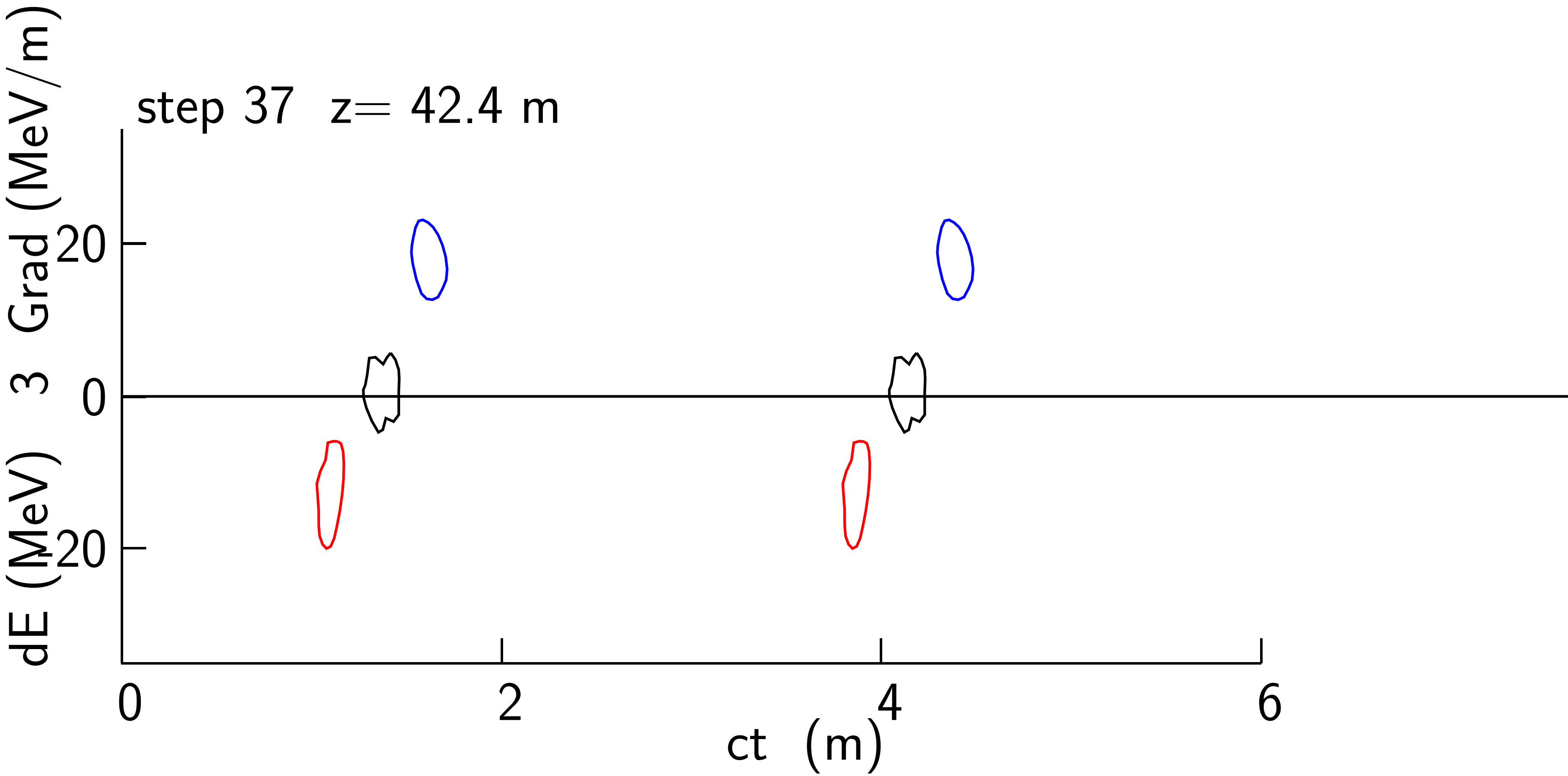


Fig. 13

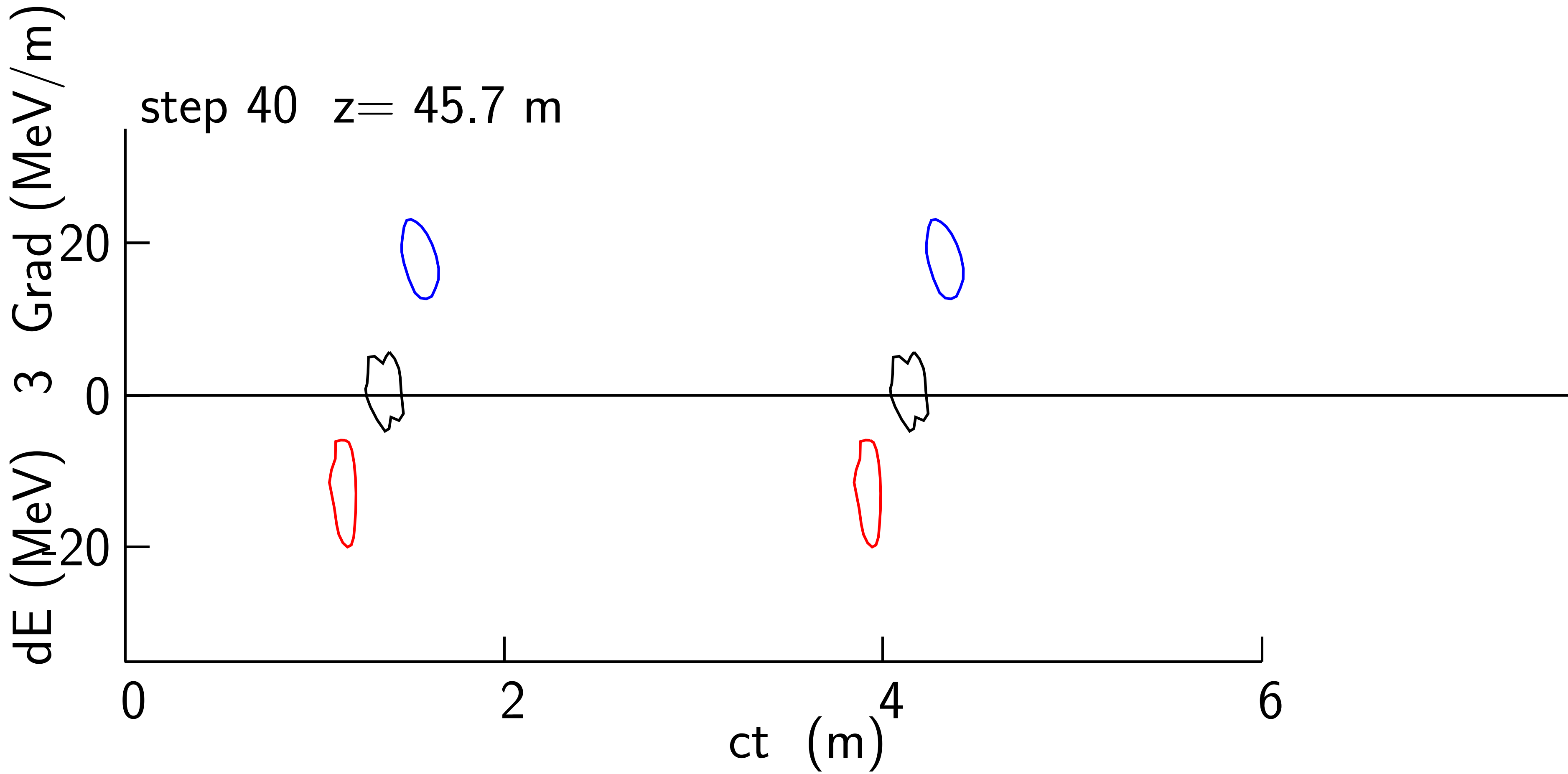


Fig. 14

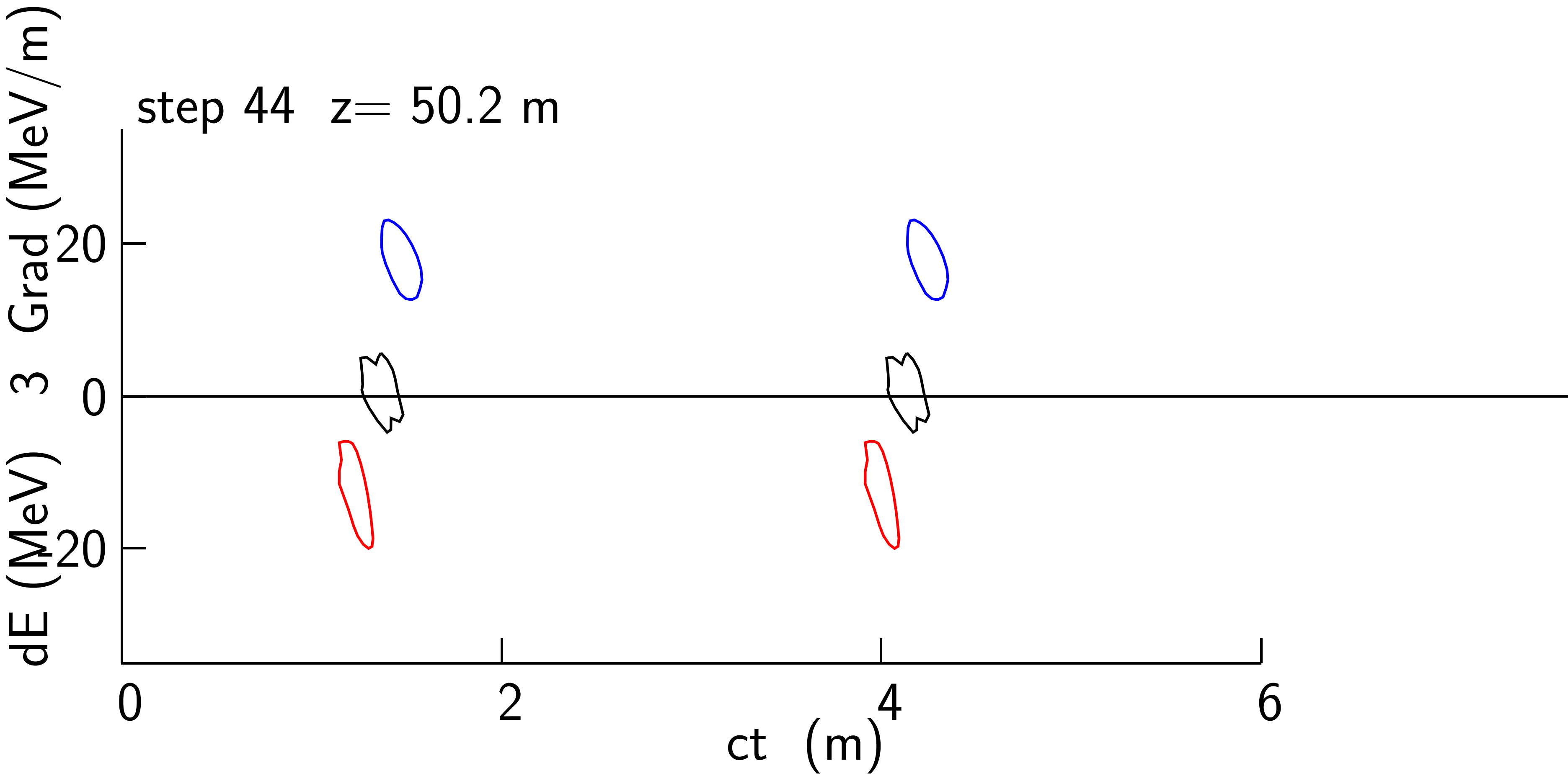


Fig. 15

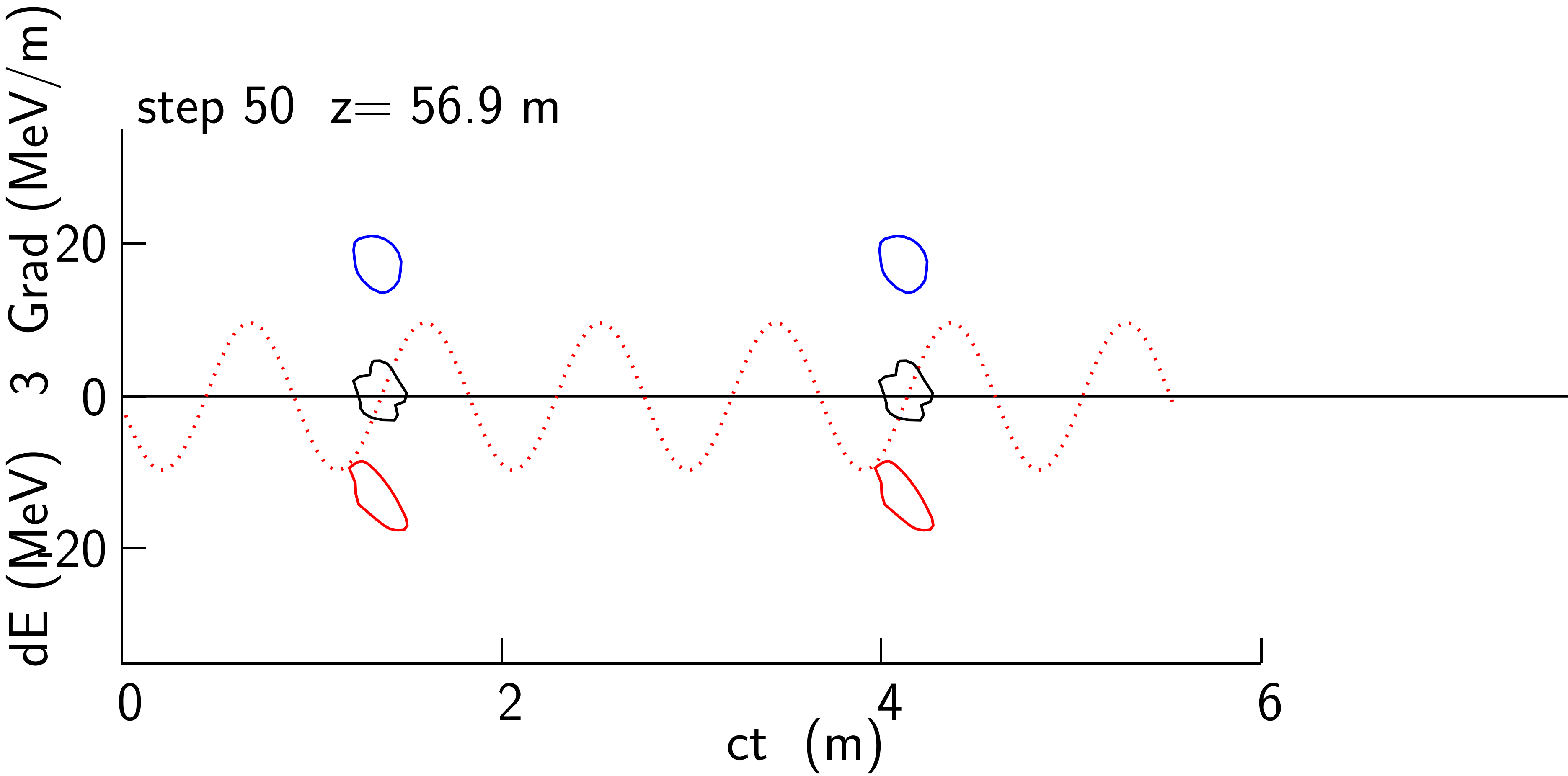


Fig. 16

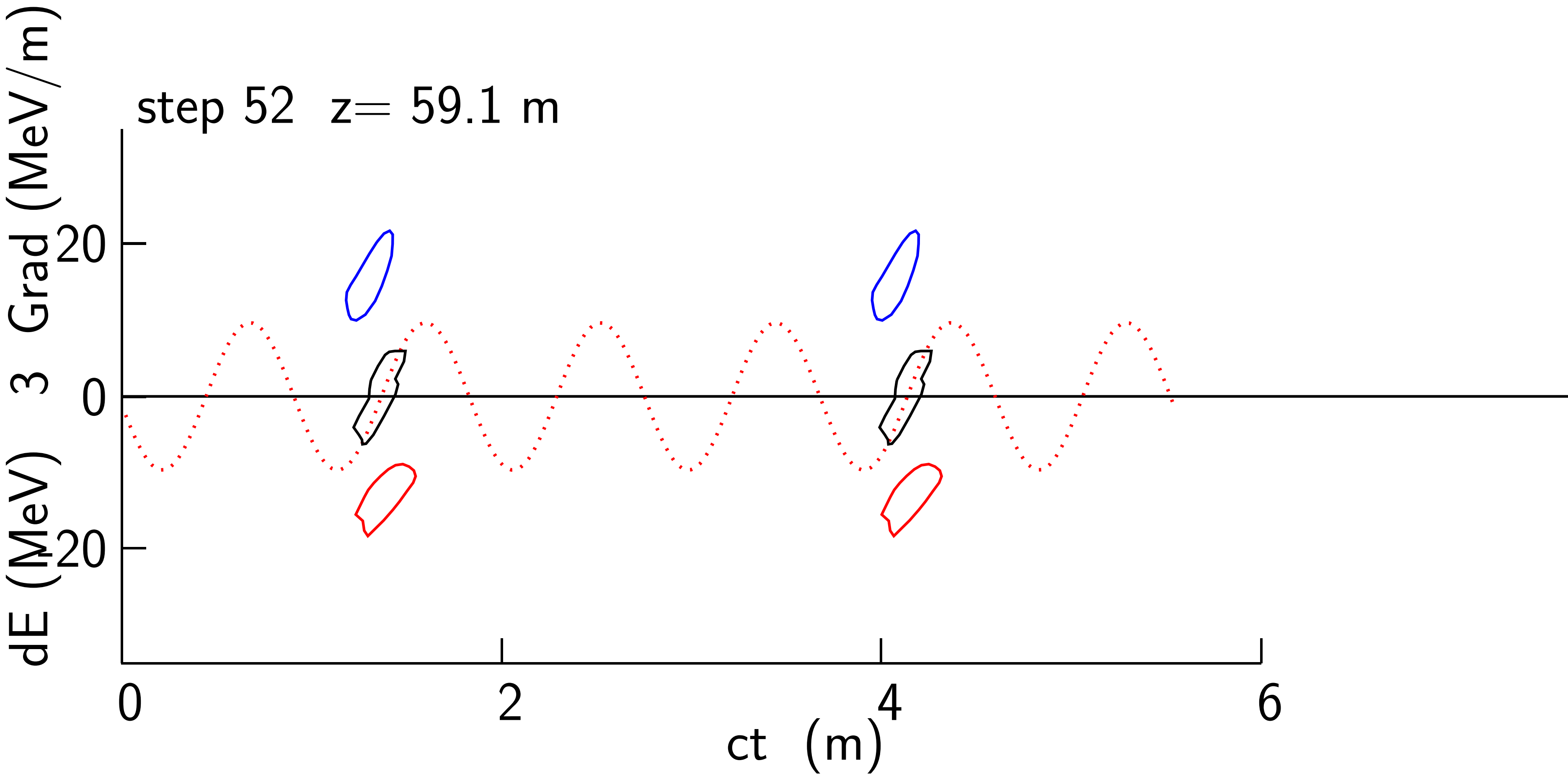


Fig. 17

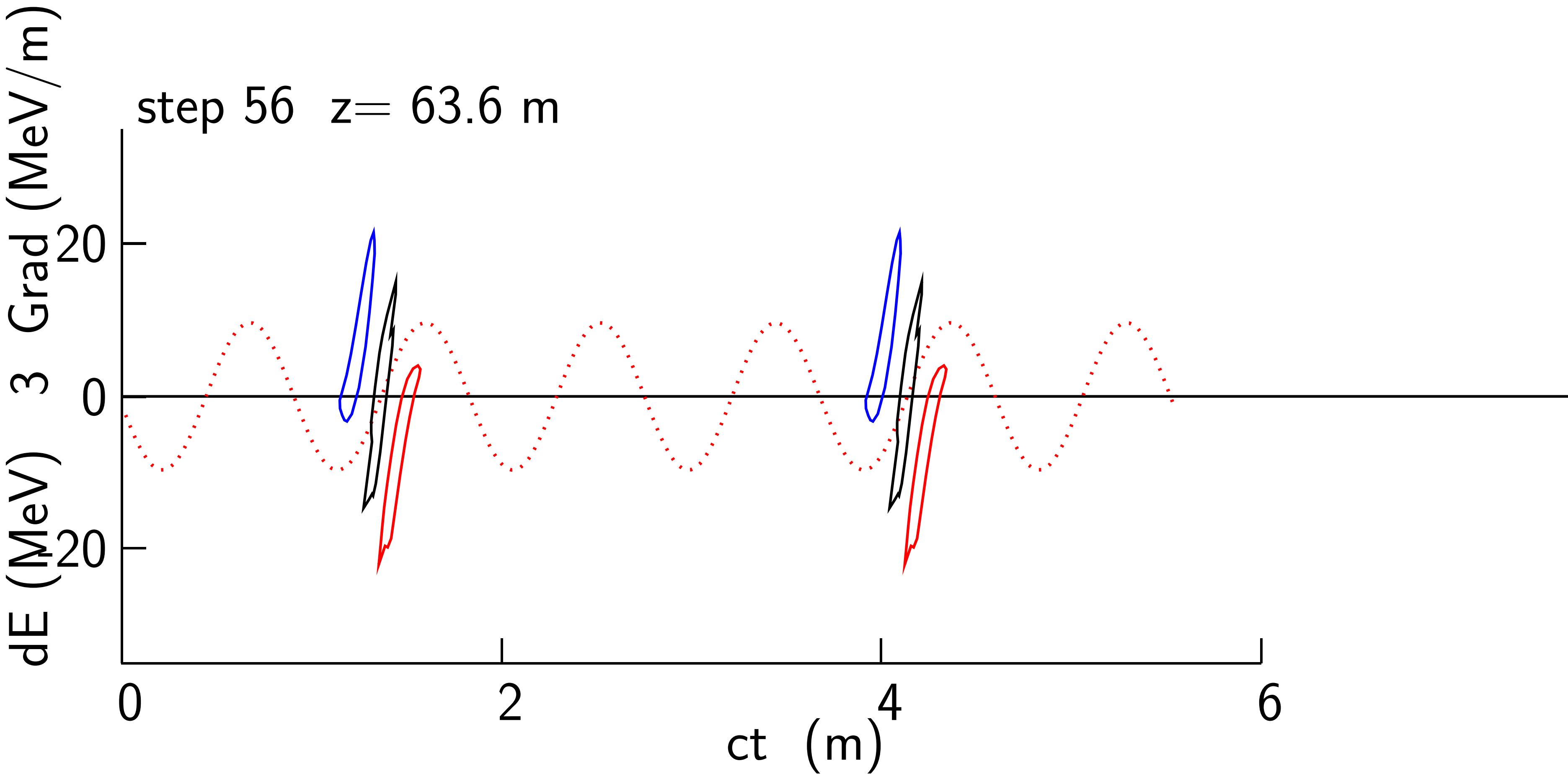


Fig. 18

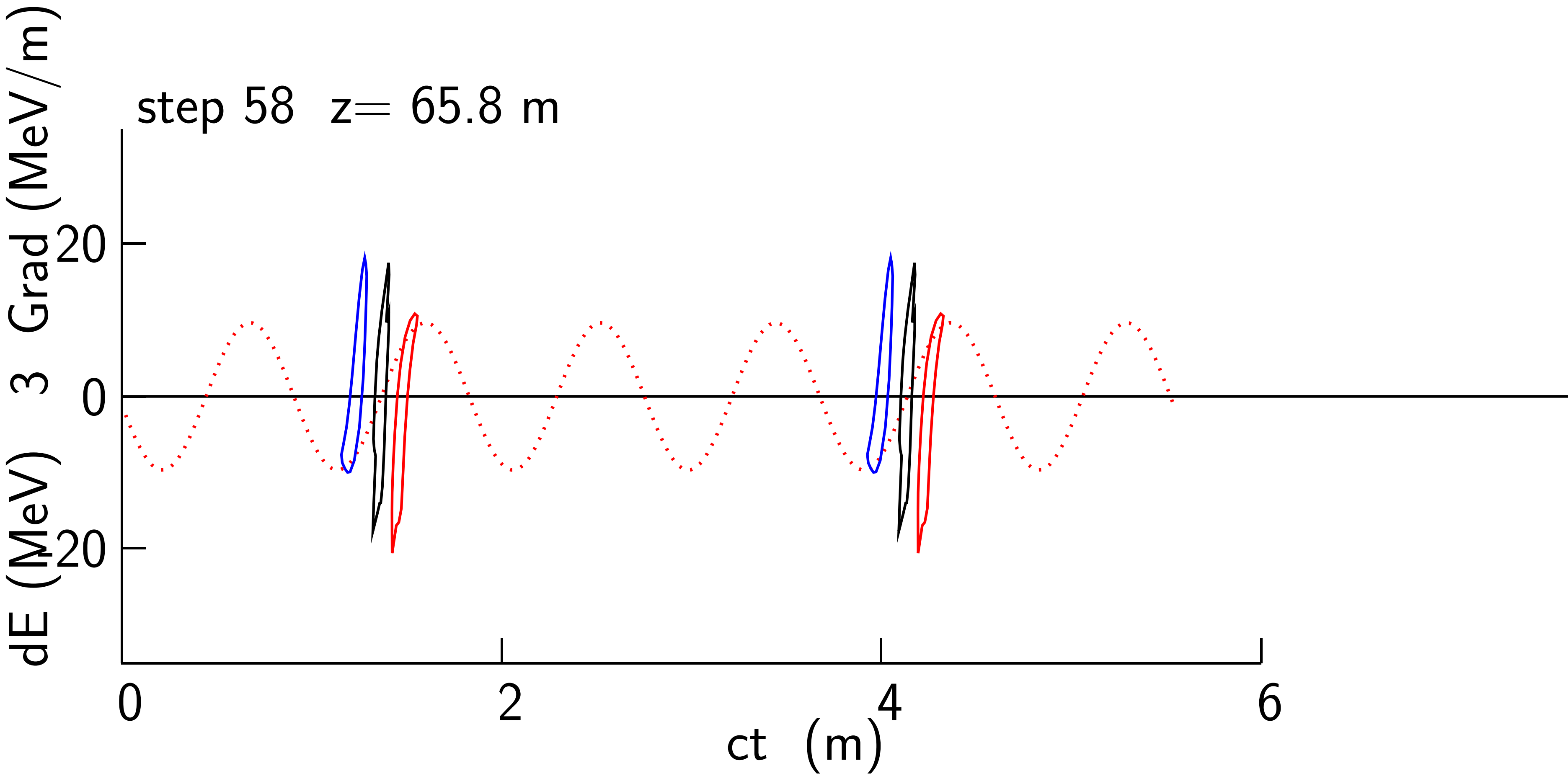


Fig. 19

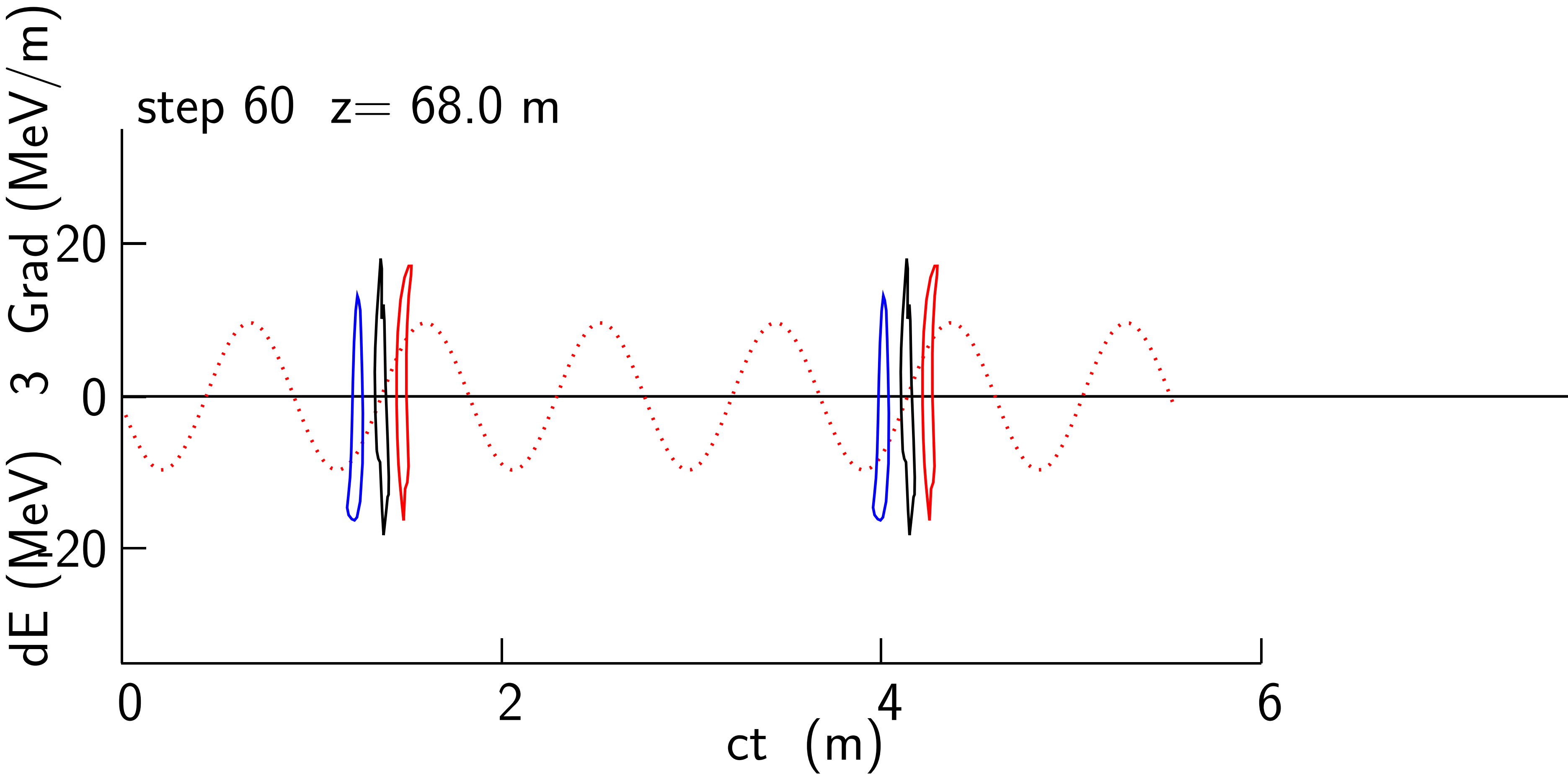
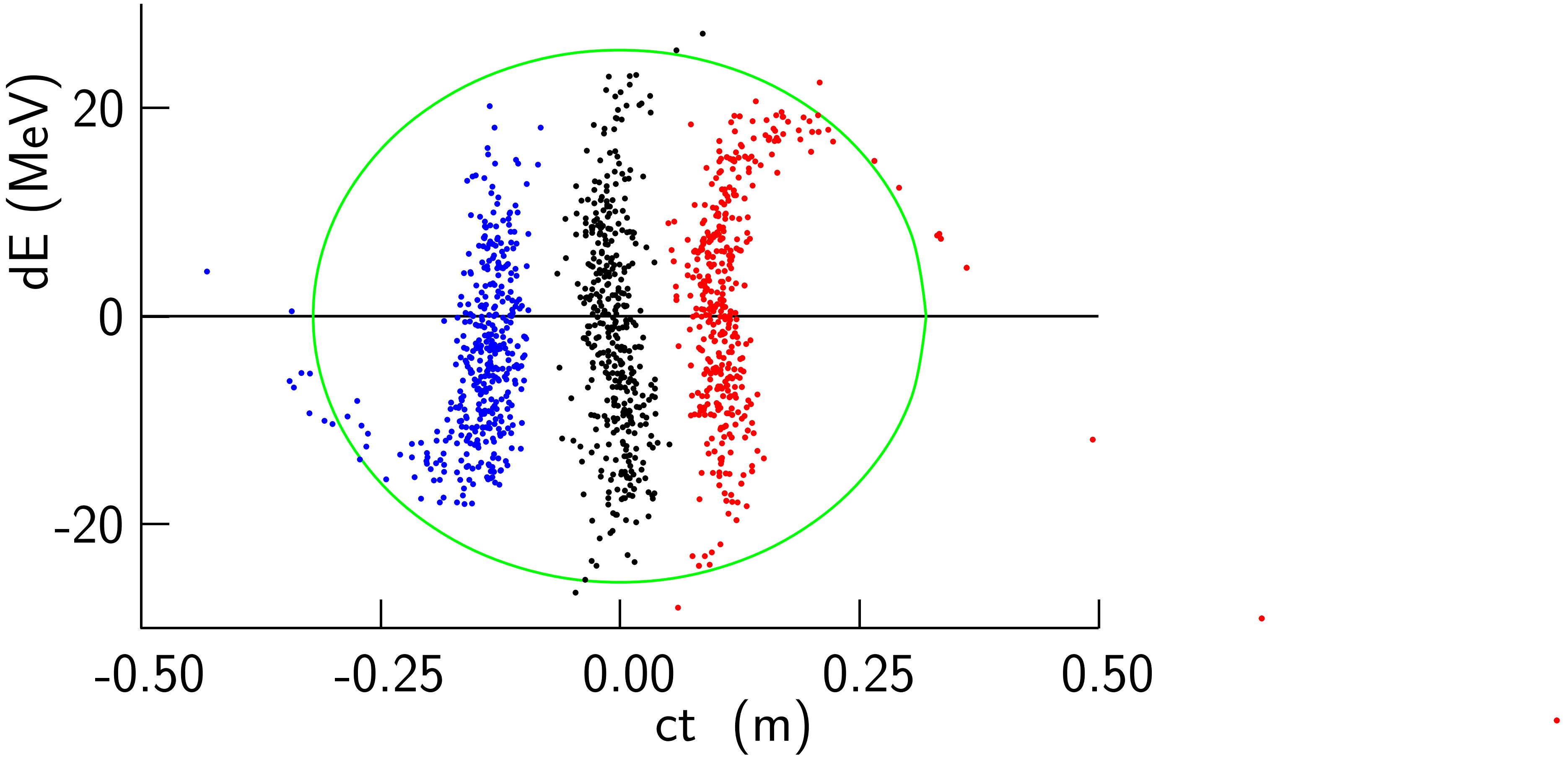


Fig. 20

Scatter at end for combined all bunches



Harmonics used

k m	L	stage	harm	freq MHz	grad MV/m	phase deg
0	1.1	1	1	108	-0.32	14.7
0	1.1	1	2	217	-0.89	8.3
0	1.1	1	3	325	-6.80	4.0
0	1.1	1	4	433	-1.21	12.0
0	1.1	1	5	542	-0.43	10.3
1	2.2	1	1	108	-0.32	14.7
1	2.2	1	2	217	-0.88	8.3
1	2.2	1	3	325	-6.81	4.0
1	2.2	1	4	433	-1.19	12.1
1	2.2	1	5	542	-0.42	10.4
2	3.3	1	1	108	-0.33	14.7
2	3.3	1	2	217	-0.90	8.3
2	3.3	1	3	325	-6.80	4.0
2	3.3	1	4	433	-1.23	12.0
2	3.3	1	5	542	-0.44	10.3
3	4.5	1	1	108	-0.35	14.7
3	4.5	1	2	217	-0.95	8.2
3	4.5	1	3	325	-6.76	3.9
3	4.5	1	4	433	-1.32	12.0
3	4.5	1	5	542	-0.46	10.0
4	5.6	1	1	108	-0.37	14.8
4	5.6	1	2	217	-1.02	8.1
4	5.6	1	3	325	-6.70	3.8
4	5.6	1	4	433	-1.46	11.9
4	5.6	1	5	542	-0.50	9.7
5	6.7	1	1	108	-0.41	14.9
5	6.7	1	2	217	-1.11	8.0
5	6.7	1	3	325	-6.60	3.7
5	6.7	1	4	433	-1.66	11.8
5	6.7	1	5	542	-0.55	9.2
6	7.8	1	1	108	-0.46	14.9
6	7.8	1	2	217	-1.21	7.8
6	7.8	1	3	325	-6.47	3.4
6	7.8	1	4	433	-1.91	11.6
6	7.8	1	5	542	-0.62	8.4

k	L m	stage	harm	freq MHz	grad MV/m	phase deg
7	8.9	1	1	108	-0.50	14.9
7	8.9	1	2	217	-1.32	7.5
7	8.9	1	3	325	-6.29	3.2
7	8.9	1	4	433	-2.22	11.4
7	8.9	1	5	542	-0.68	7.5
8	10.0	1	1	108	-0.55	14.8
8	10.0	1	2	217	-1.42	7.1
8	10.0	1	3	325	-6.04	2.8
8	10.0	1	4	433	-2.58	11.1
8	10.0	1	5	542	-0.75	6.2
9	11.1	1	1	108	-0.59	14.5
9	11.1	1	2	217	-1.51	6.6
9	11.1	1	3	325	-5.72	2.2
9	11.1	1	4	433	-3.01	10.8
9	11.1	1	5	542	-0.82	4.4
10	12.3	1	1	108	-0.62	13.9
10	12.3	1	2	217	-1.56	5.8
10	12.3	1	3	325	-5.31	1.5
10	12.3	1	4	433	-3.50	10.4
10	12.3	1	5	542	-0.87	2.0
11	13.4	1	1	108	-0.63	12.8
11	13.4	1	2	217	-1.56	4.7
11	13.4	1	3	325	-4.80	0.5
11	13.4	1	4	433	-4.04	9.8
11	13.4	1	5	542	-0.90	178.6
12	14.5	1	1	108	-0.61	10.8
12	14.5	1	2	217	-1.50	3.0
12	14.5	1	3	325	-4.17	178.9
12	14.5	1	4	433	-4.62	9.2
12	14.5	1	5	542	-0.89	173.6
13	15.6	1	1	108	-0.55	7.0
13	15.6	1	2	217	-1.35	0.3
13	15.6	1	3	325	-3.43	176.6
13	15.6	1	4	433	-5.23	8.4
13	15.6	1	5	542	-0.84	165.6

k	L m	stage	harm	freq MHz	grad MV/m	phase deg
14	16.7	1	1	108	-0.45	179.1
14	16.7	1	2	217	-1.12	175.4
14	16.7	1	3	325	-2.58	172.5
14	16.7	1	4	433	-5.82	7.4
14	16.7	1	5	542	-0.75	151.8
15	17.8	1	1	108	-0.33	160.3
15	17.8	1	2	217	-0.81	165.0
15	17.8	1	3	325	-1.66	163.8
15	17.8	1	4	433	-6.35	6.3
15	17.8	1	5	542	-0.66	126.7
16	19.0	1	1	108	-0.27	116.7
16	19.0	1	2	217	-0.49	135.5
16	19.0	1	3	325	-0.80	134.9
16	19.0	1	4	433	-6.76	4.9
16	19.0	1	5	542	-0.73	89.7
17	20.1	1	1	108	-0.41	75.8
17	20.1	1	2	217	-0.50	74.1
17	20.1	1	3	325	-0.78	55.0
17	20.1	1	4	433	-6.97	3.3
17	20.1	1	5	542	-1.09	59.5
18	21.2	1	1	108	-0.65	58.5
18	21.2	1	2	217	-0.88	43.4
18	21.2	1	3	325	-1.51	25.5
18	21.2	1	4	433	-6.92	1.4
18	21.2	1	5	542	-1.69	41.7
19	22.3	1	1	108	-0.89	50.8
19	22.3	1	2	217	-1.28	32.1
19	22.3	1	3	325	-2.15	15.9
19	22.3	1	4	433	-6.53	179.0
19	22.3	1	5	542	-2.43	30.4
27-30	31.2	3	3	325	0.53	23.7
27-30	31.2	3	6	650	8.81	10.2
27-30	31.2	3	12	1300	4.09	17.4
27-30	31.2	3	18	1950	2.16	23.5
27-30	31.2	3	24	2600	1.13	28.4
49-60	55.8	5	3	325	-1.13	0.1

Gradients are averages over step length and are here assumed superimposed

My simulation has only one dimension using my own basic program

Bao could start making a deck for ICOOL with these harmonics

- Length of each step (1-60) is 111.5 cm
- median muon energy 130 MeV
- initial distributions used

$\epsilon_{\parallel}$	1.7	mm
$\beta_{\parallel}$	0.7	m
$\epsilon_{\perp}$	1.3	mm
$\beta_{\perp}$	10	m

- I suggest he starts using a uniform focusing field of 2 T
- I will now work on the transverse merge of 7 to one