Event driven simulation of a granular gas

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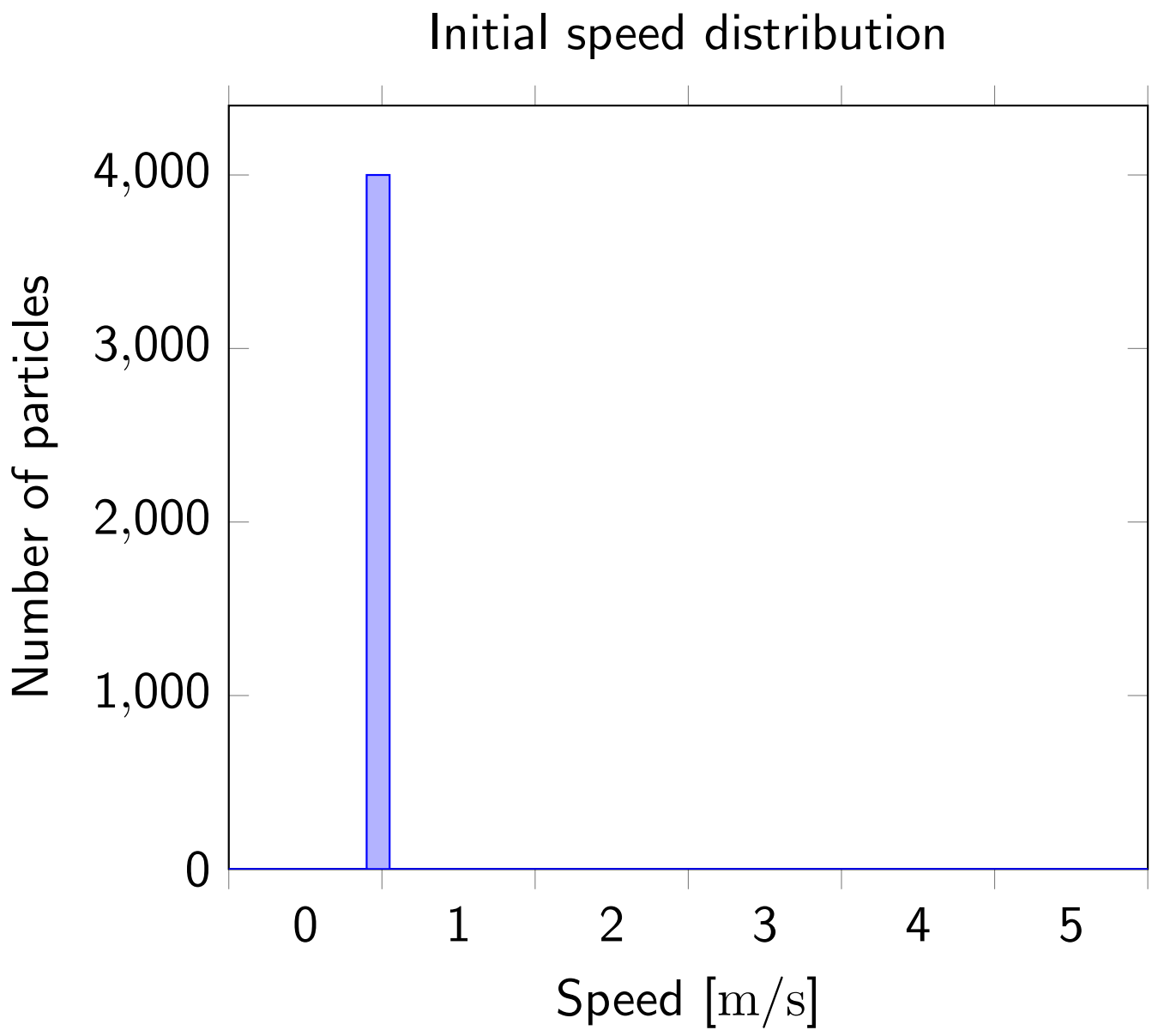
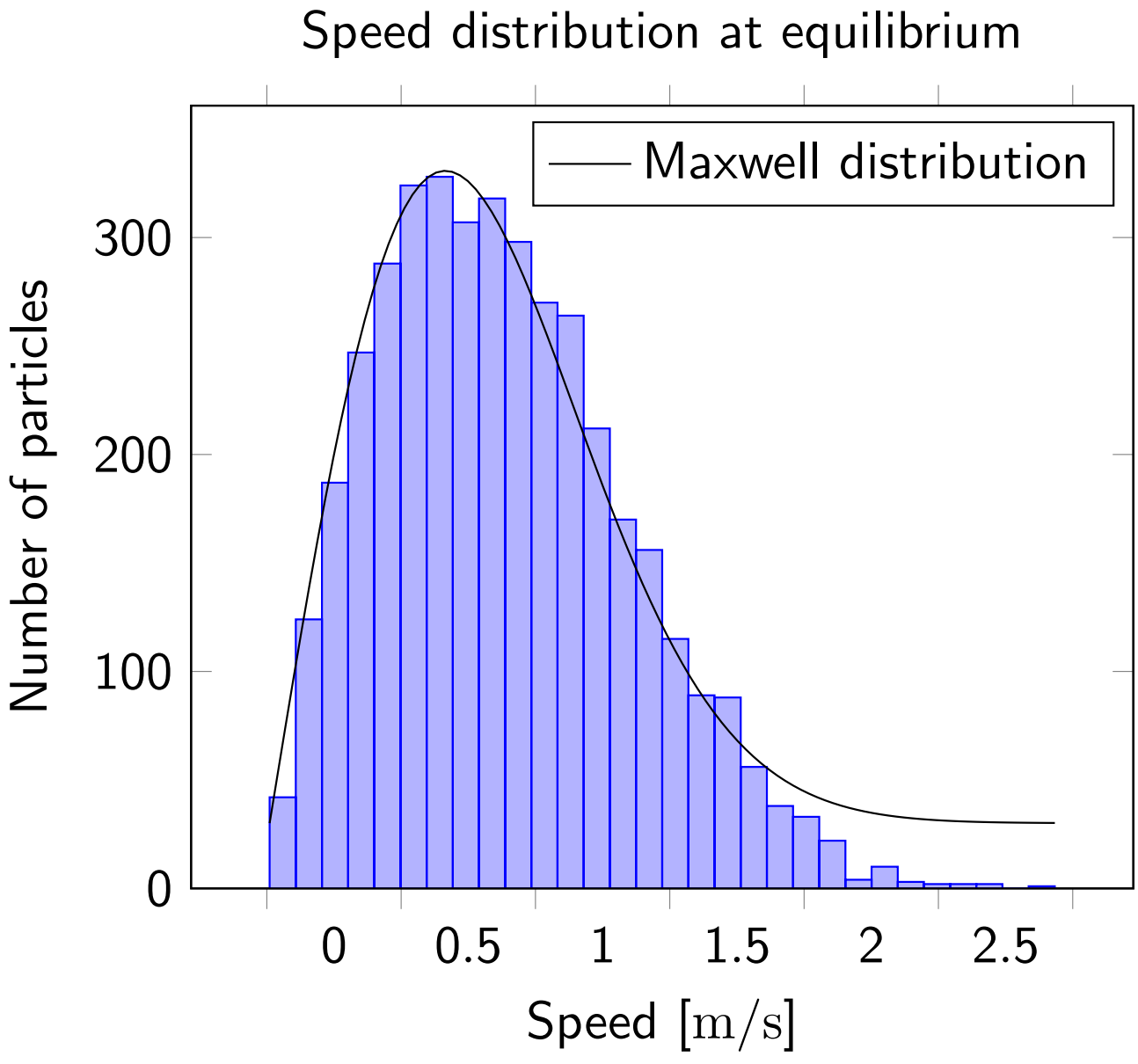
Task one: Speed distribution

$$N = 4000,\ T = 20000,$$

$$f_{\text{packing}} = 2.51\%,$$

$$r = 0.001,\ m = 0.001$$


Initial speed distribution
Number of particles
4,000
3,000
2,000
1,000
0
0
1
2
3
4
5
Speed [m/s]

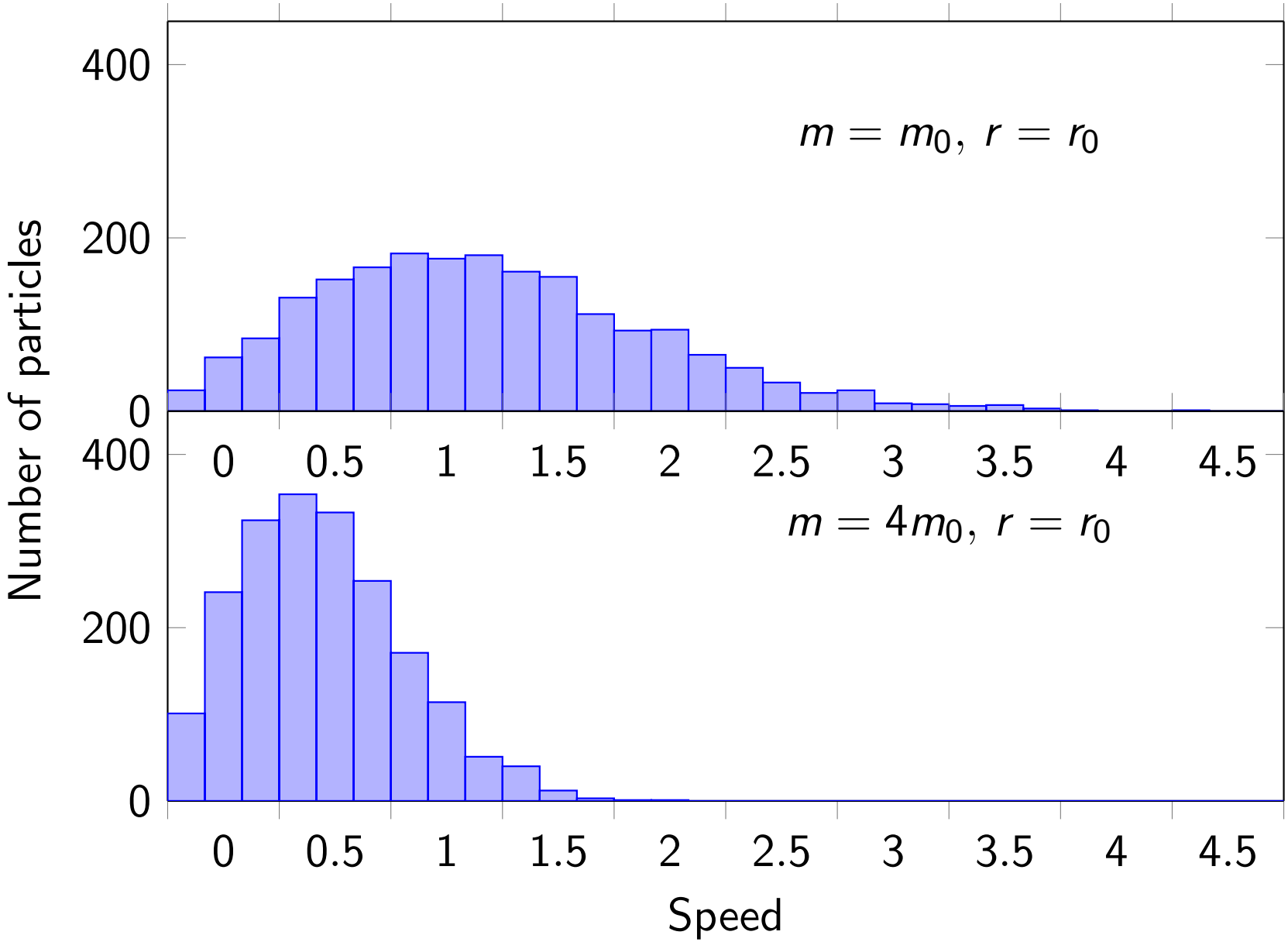

Speed distribution at equilibrium
Maxwell distribution
Number of particles
300
200
100
0
0
0.5
1
1.5
2
2.5
Speed [m/s]

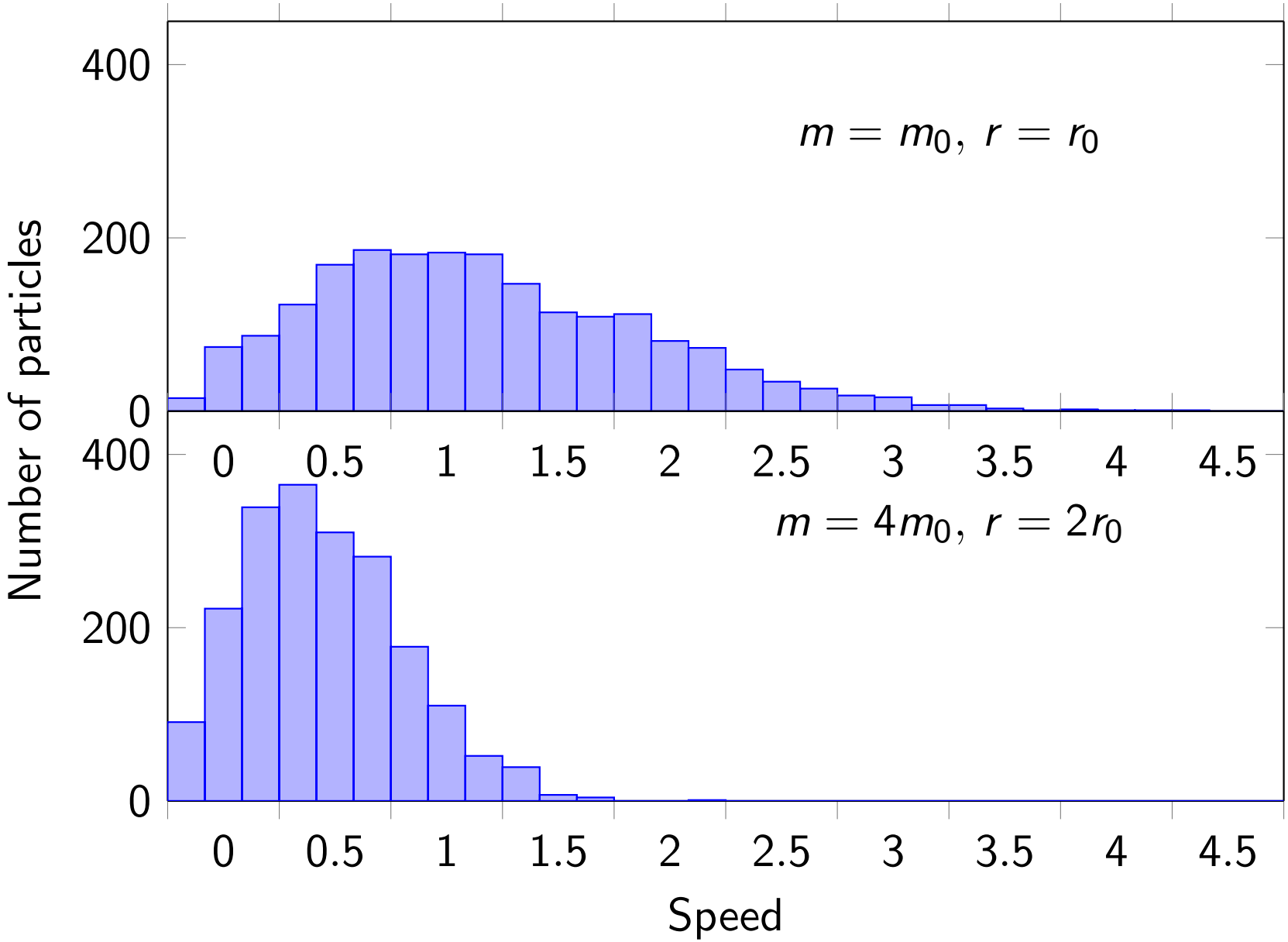
Task two: Several gas components

$$N_1 = N_2 = 2000,\ T = 20000,$$

$$f_{\text{packing}} = 2.51\%,$$

$$r_1 = r_0 = 0.001,\ m_1 = 4m_0 = 0.004$$


Number of particles
400
200
0
$m = m_0,\ r = r_0$
400
200
0
$m = 4m_0,\ r = r_0$
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Speed

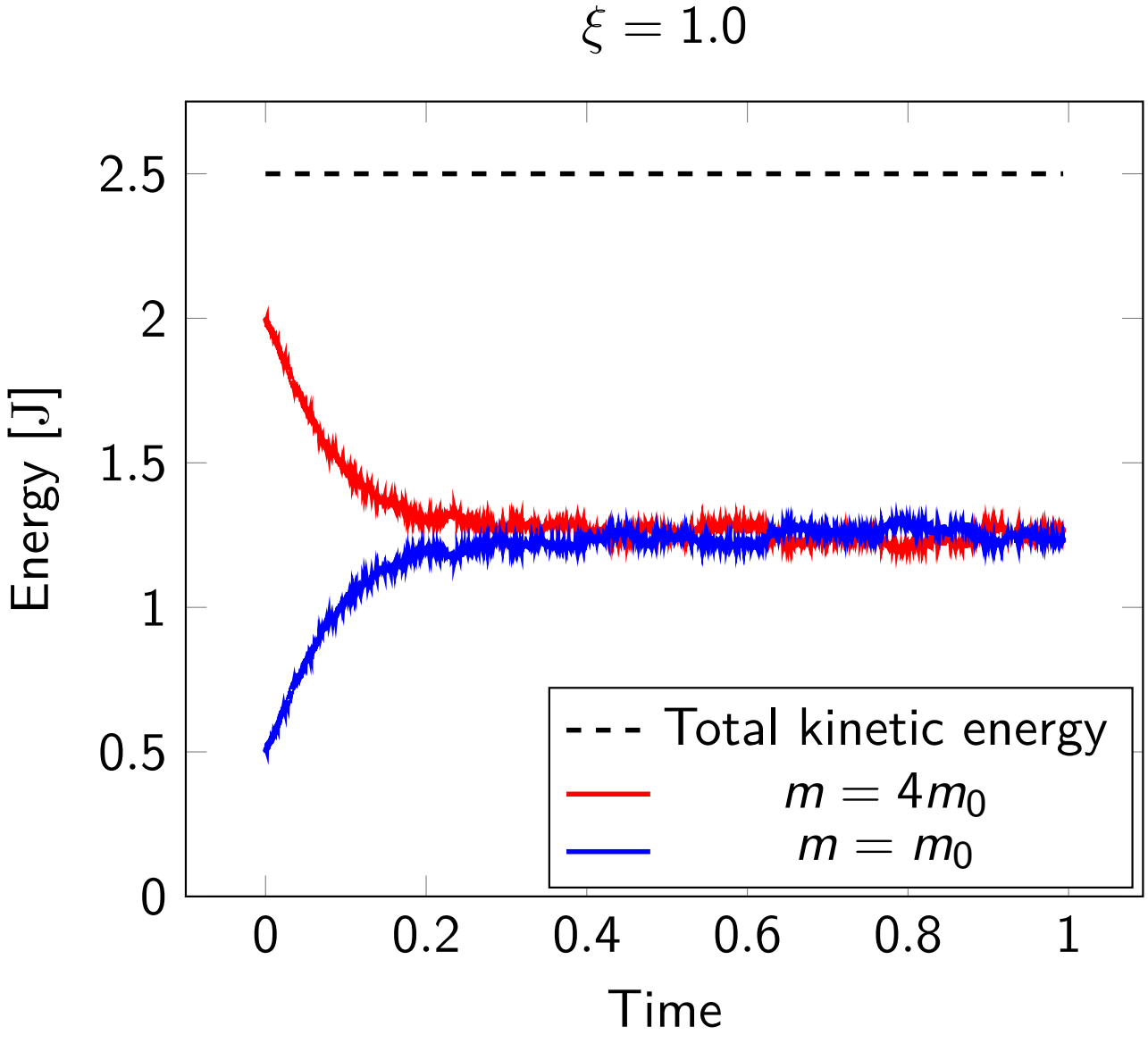

Number of particles
400
200
0
$m = m_0,\ r = r_0$
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
400
200
0
$m = 4m_0,\ r = 2r_0$
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Speed

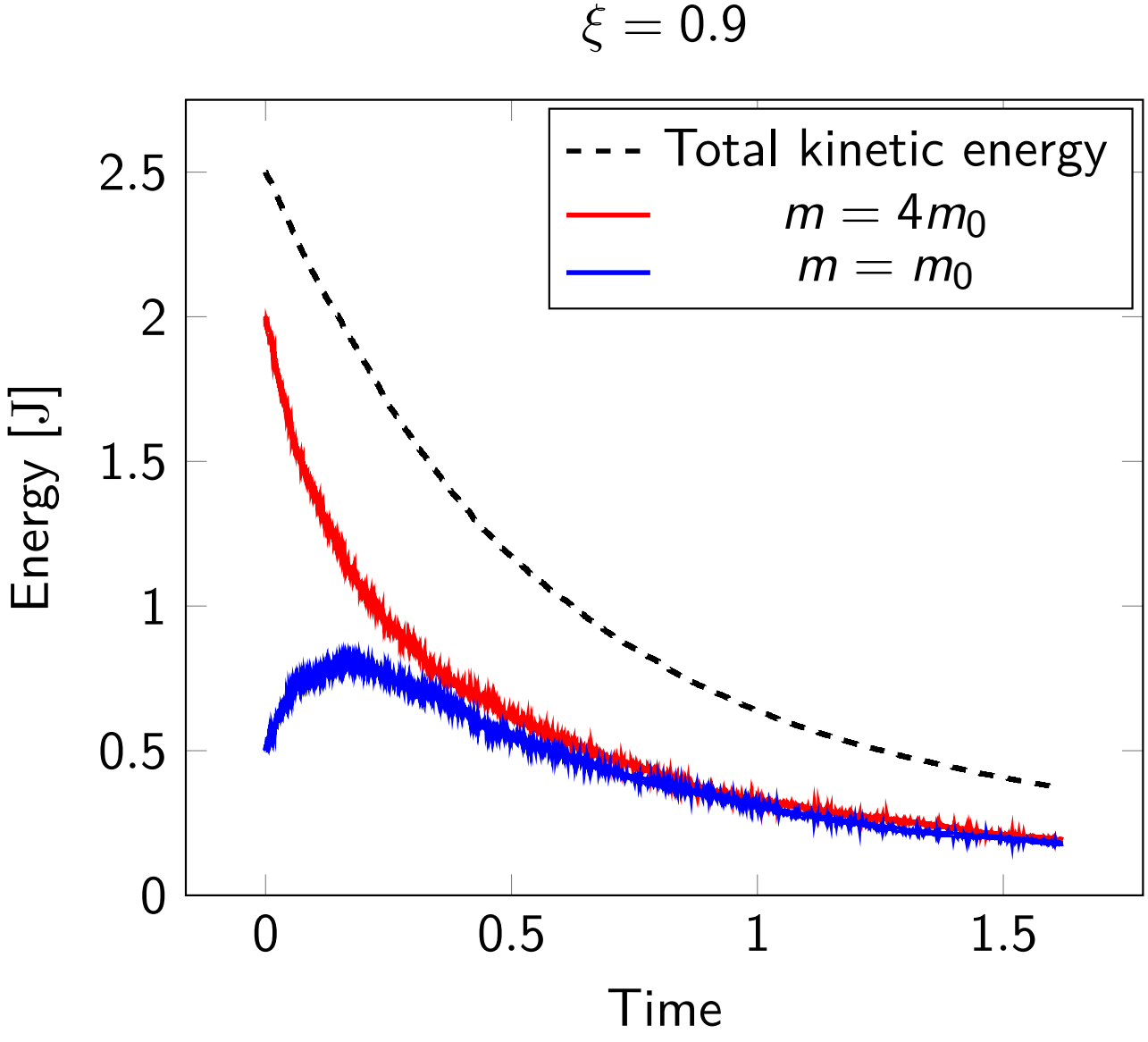
Task three: Thermal equilibrium

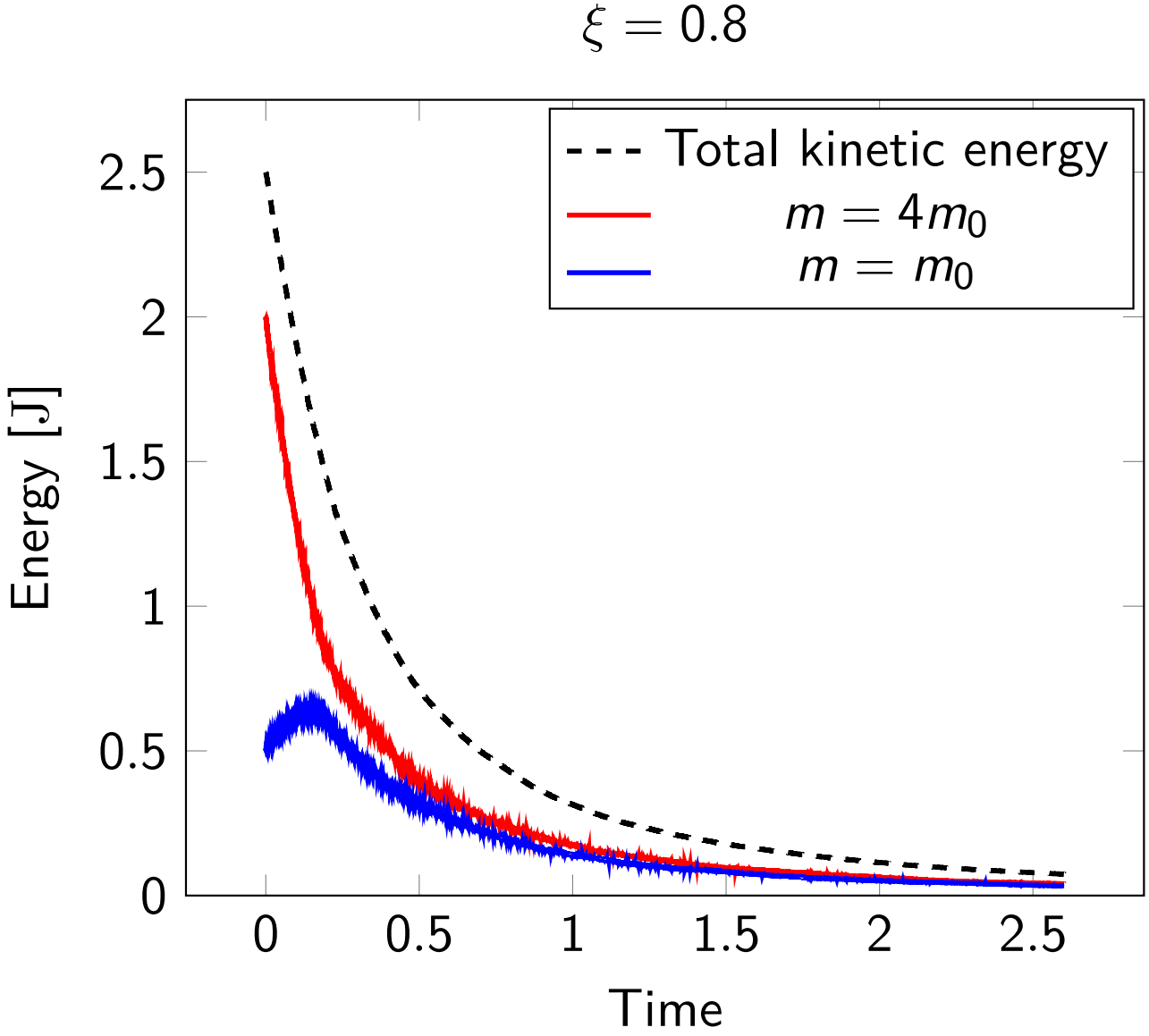
$$N_1 = N_2 = 1000,\ T = 20000,$$

$$f_{\text{packing}} = 3.14\%,$$

$$r_1 = 2r_0 = 0.002,\ m_1 = 4m_0 = 0.004$$


$\xi = 1.0$
Energy [J]
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
Time
Total kinetic energy
$m = 4m_0$
$m = m_0$


$\xi = 0.9$
Total kinetic energy
$m = 4m_0$
$m = m_0$
Energy [J]
Time
0
0.5
1
1.5
2
2.5
0
0.5
1
1.5

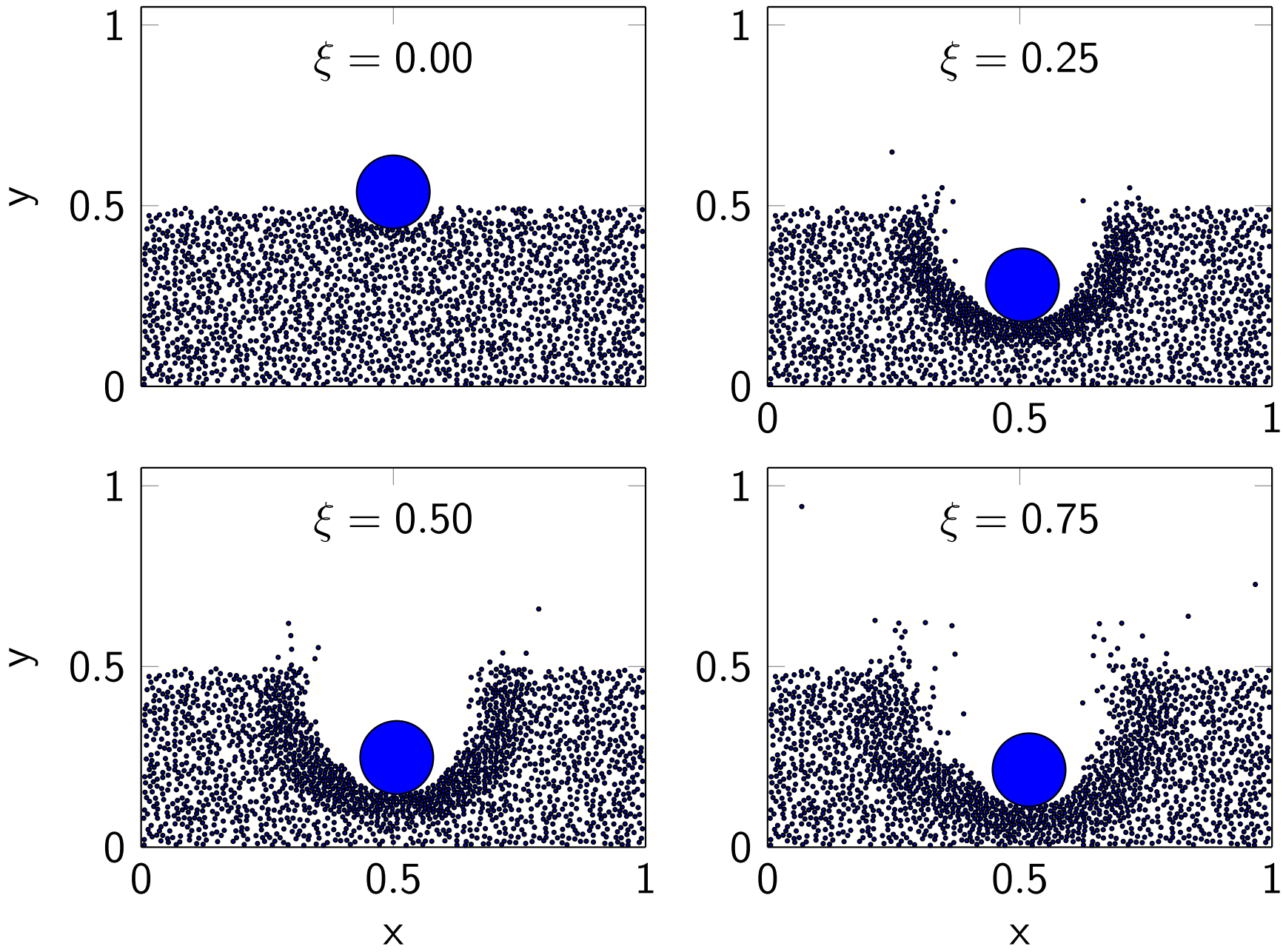

$\xi = 0.8$
Total kinetic energy
$m = 4m_0$
$m = m_0$
Energy [J]
Time
0
0.5
1
1.5
2
2.5

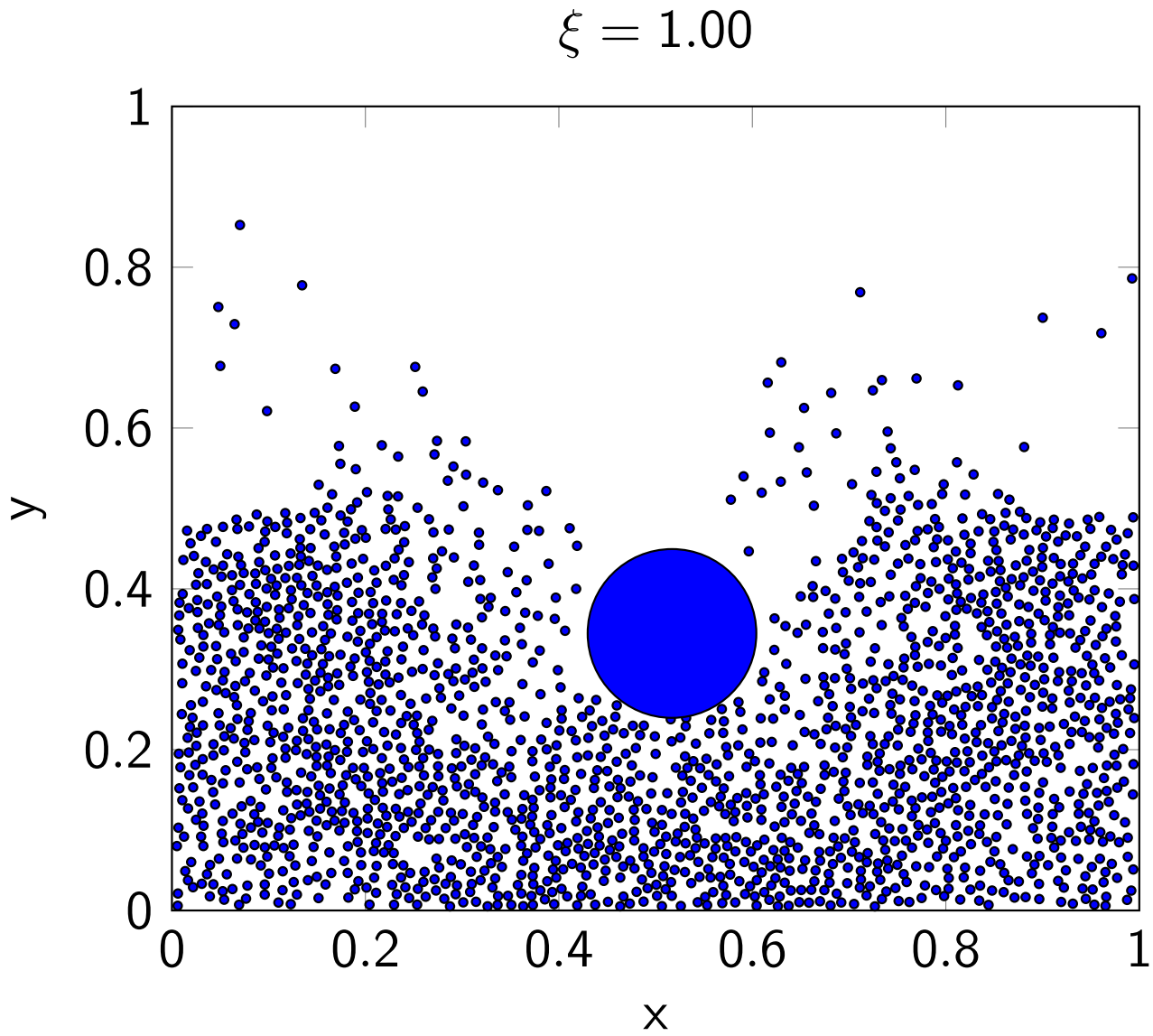
Task four: Simulating crater formation

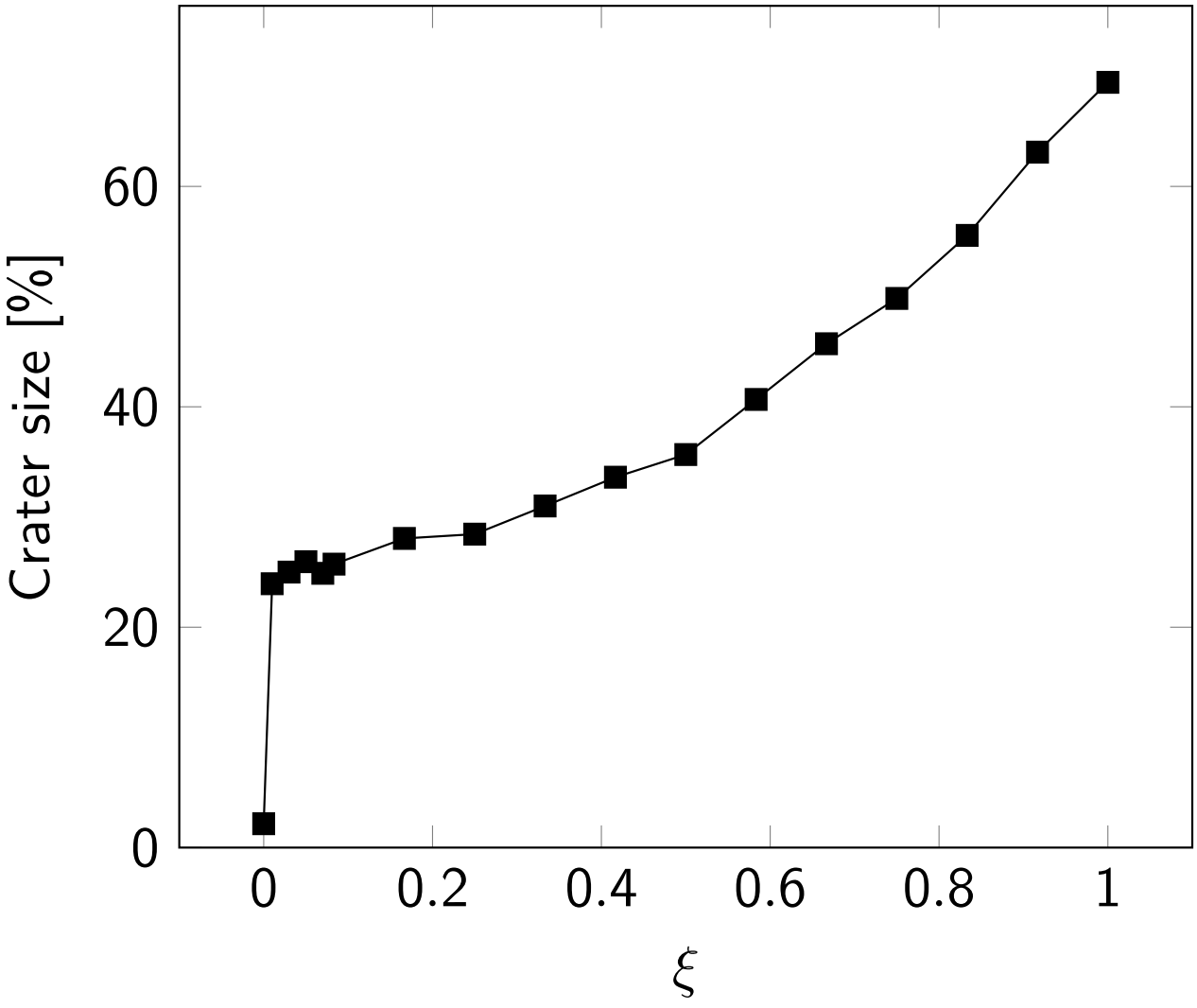
$$N = 1800 + 1,\ T = 10000$$

$$f_{\text{packing}} = 56\%,$$

$$m = 25m_0,\ r = 25r_0$$


$\xi = 0.00$
$\xi = 0.25$
$\xi = 0.50$
$\xi = 0.75$
y
x
0
0.5
1


$\xi = 1.00$
1
0.8
0.6
0.4
0.2
0
y
0
0.2
0.4
0.6
0.8
1
x


Crater size [%]
0
20
40
60
0
0.2
0.4
0.6
0.8
1
ξ