BaBar Magnet
-
Forces during Quench

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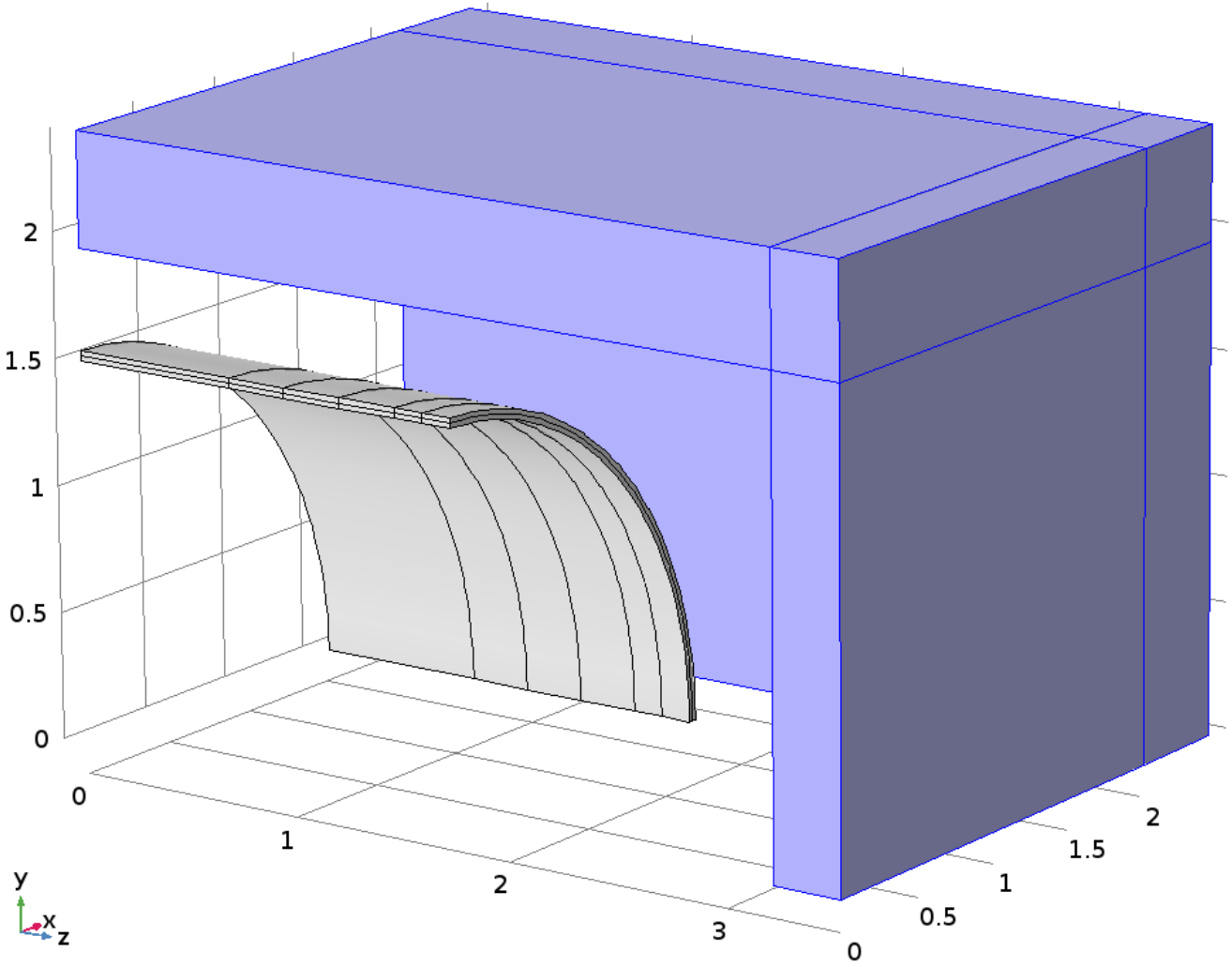
Energy Frontier Accelerator Group

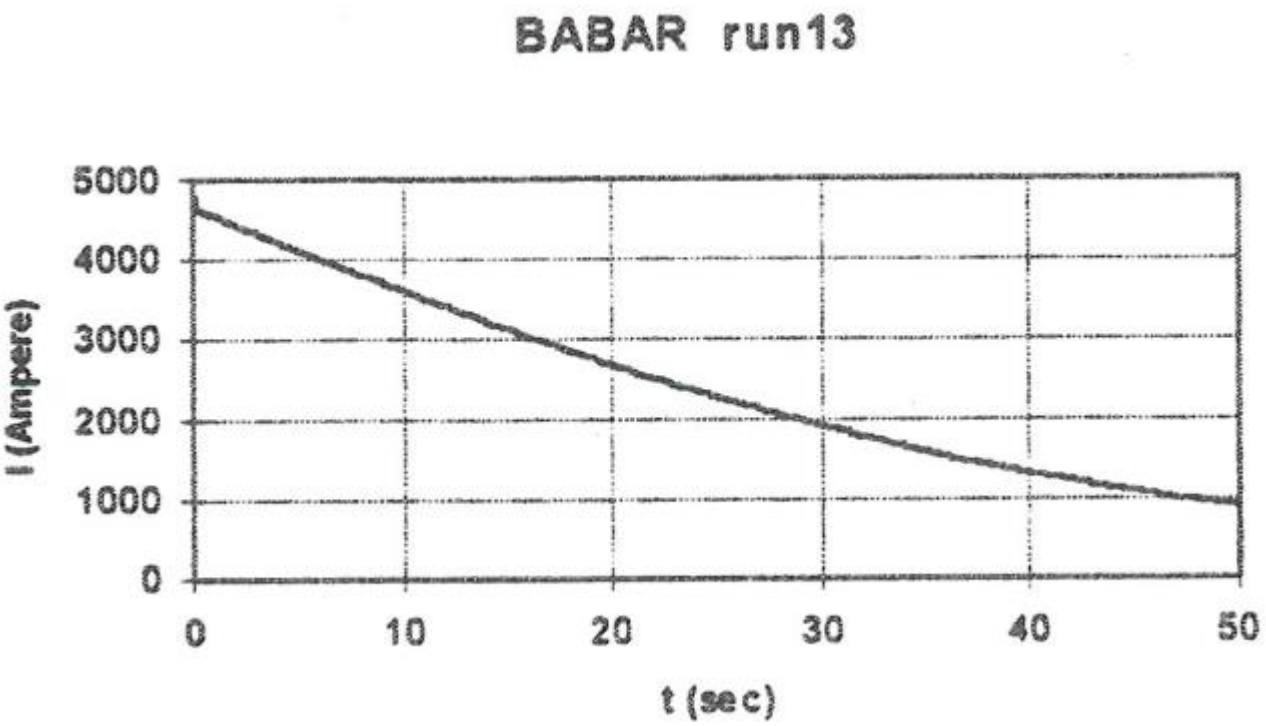
Forces During Quench



Simplified geometry from Brett Parker (not verified)

Forces evaluated using Maxwell Stress tensor

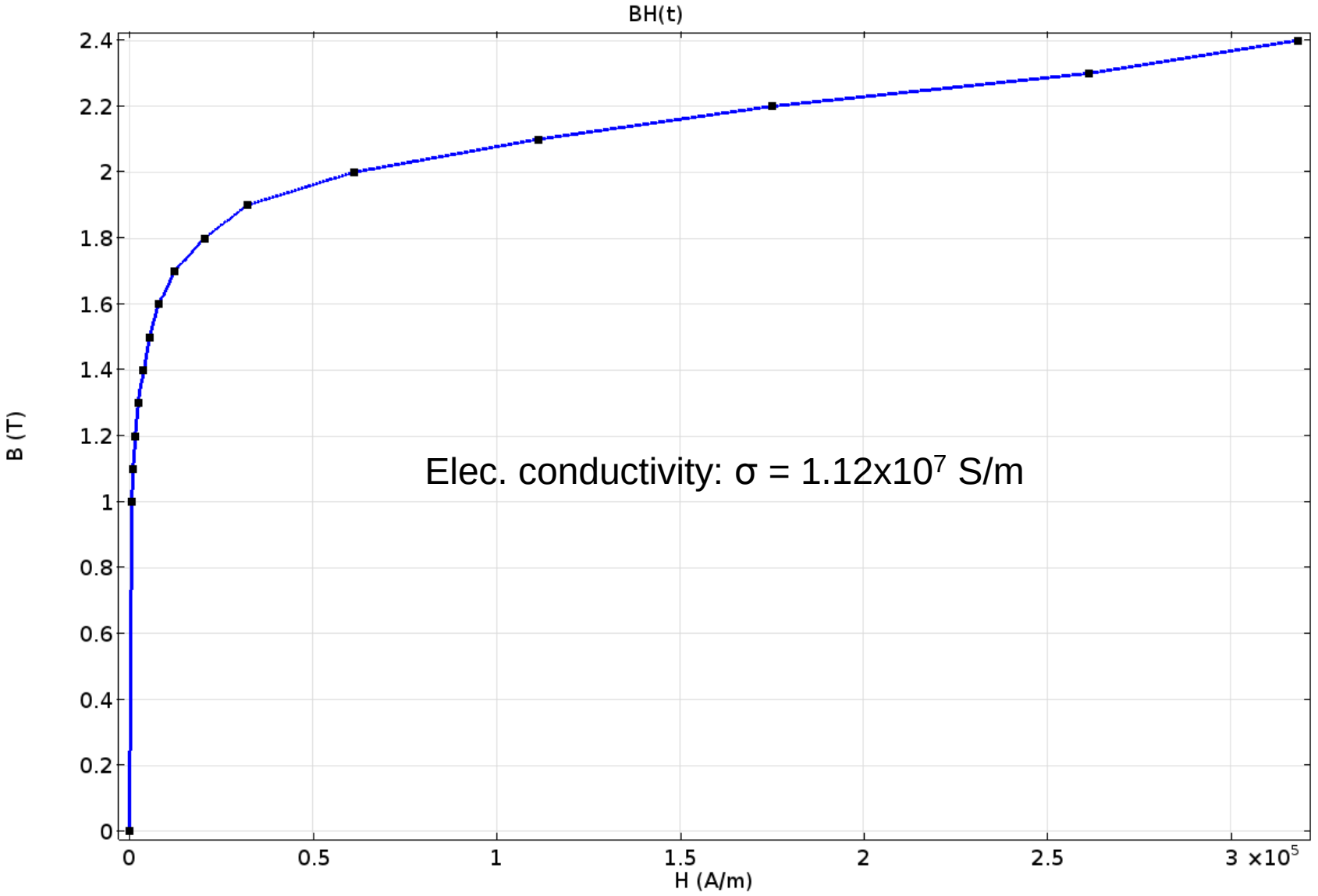
Current Decay



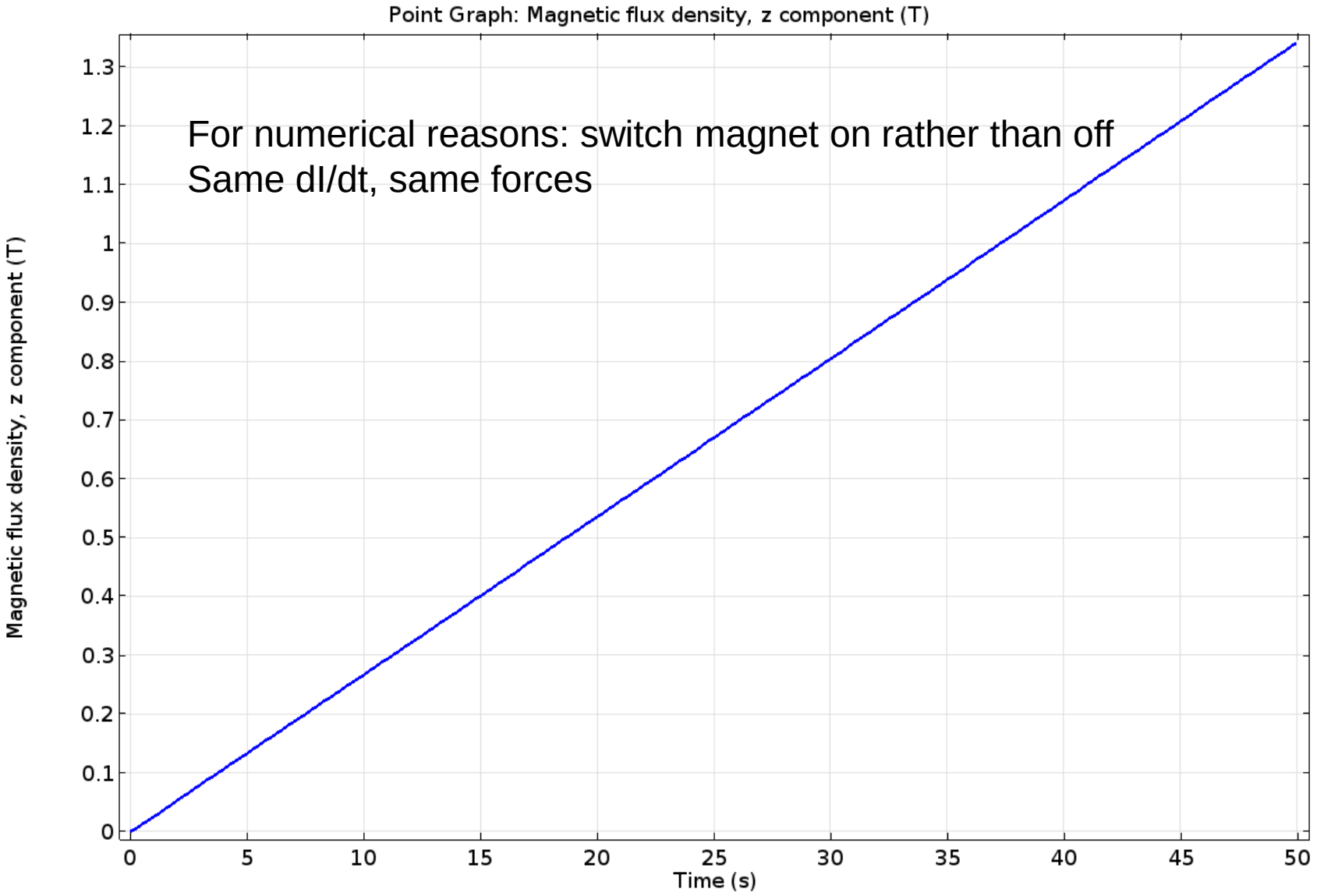
Assume dI/dt=const.= 90A/s
(current decays in 50s)

Provided PDF: Quench Protection Review 1996

Material Properties Iron

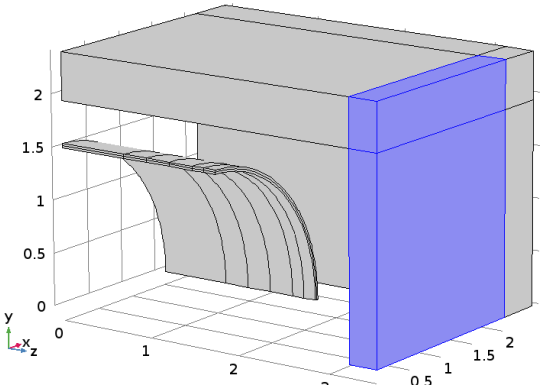


Field At Center Magnet

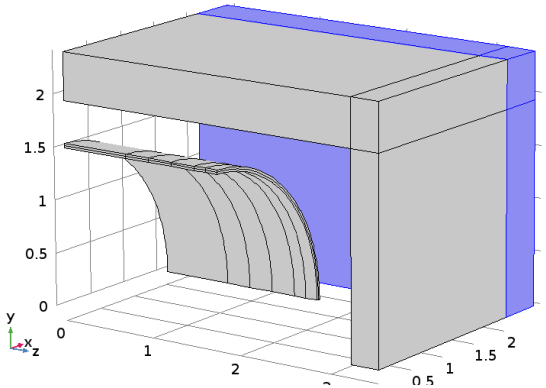


Identifiers

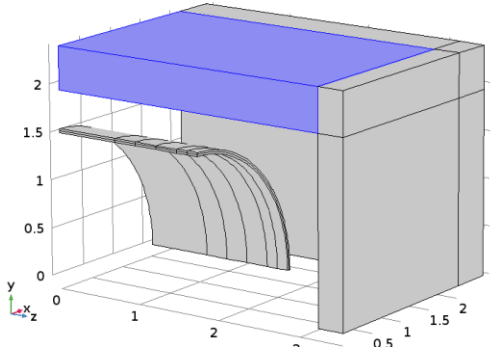
Front



Side



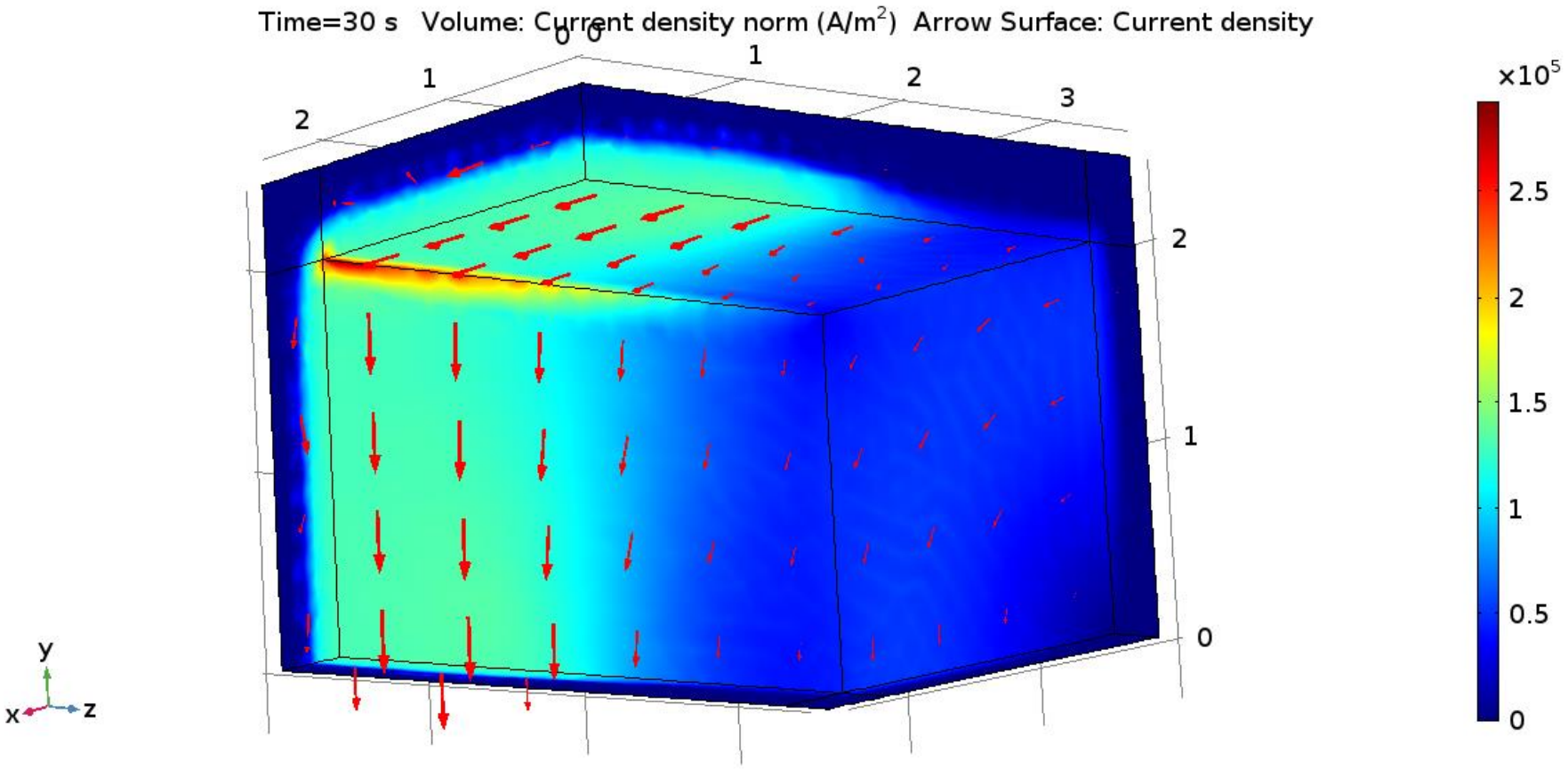
Top



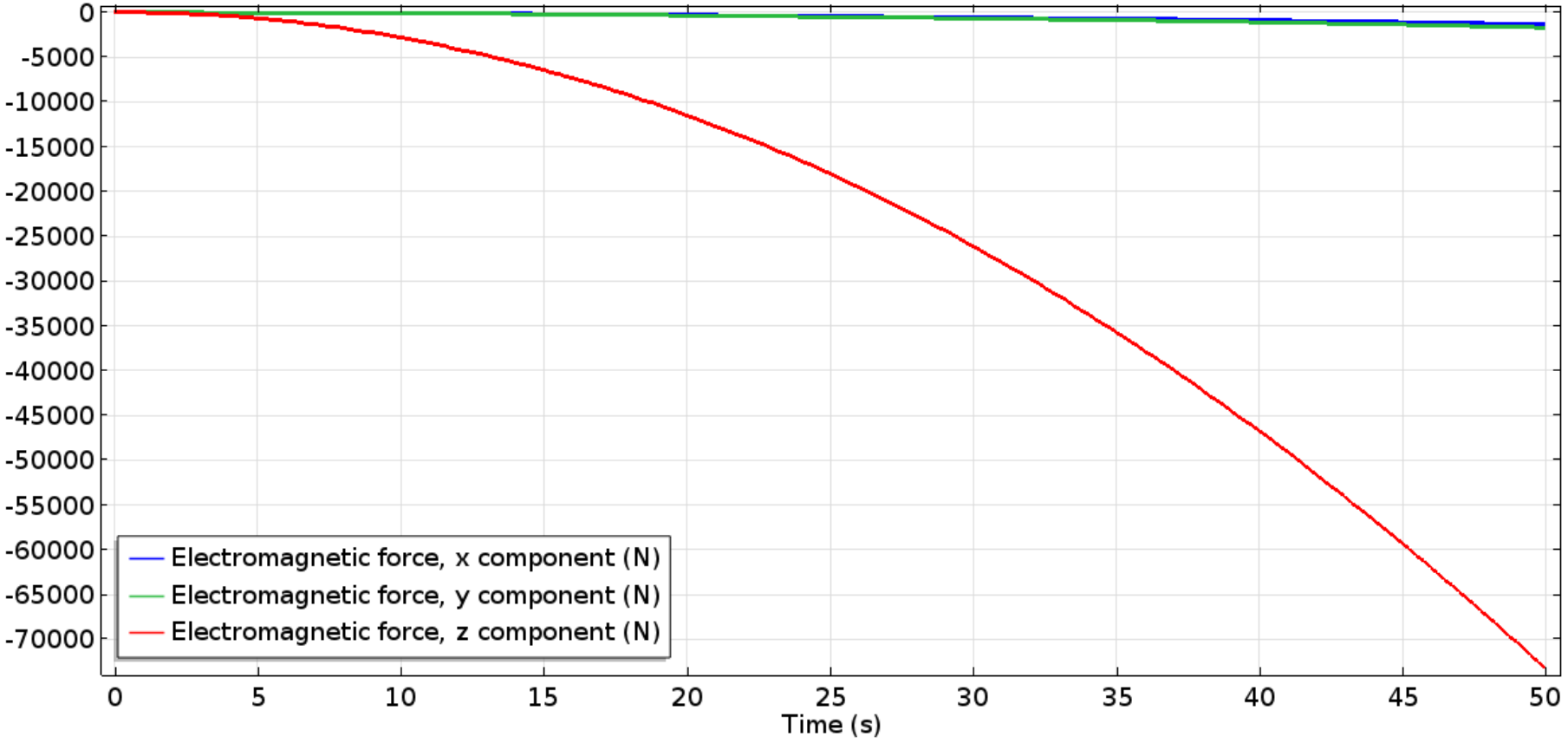
Forces are for 1/8th of the entire geometry (symmetry **not** considered)

Eddy Currents

Very small (<1A/mm^2)

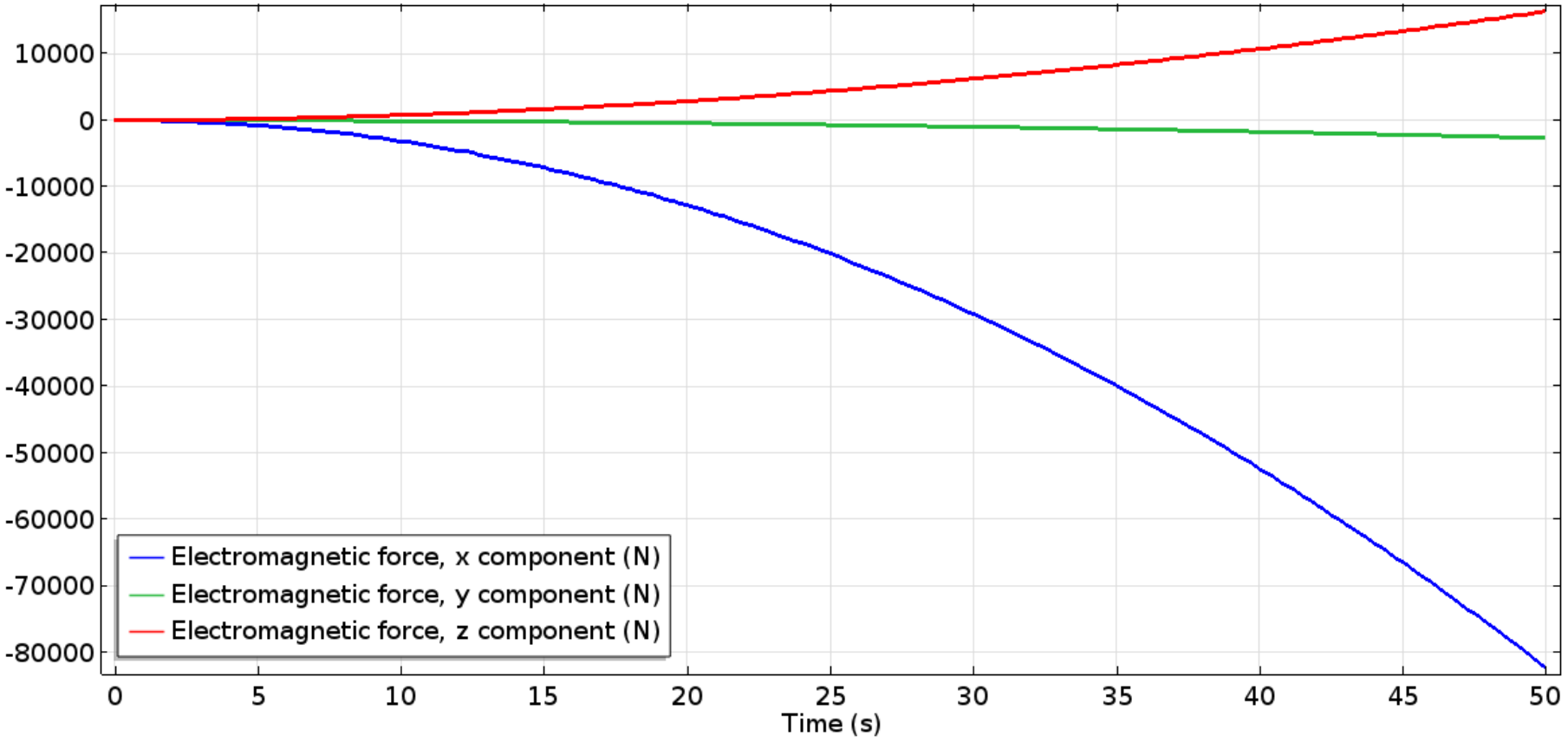


Front


0
-5000
-10000
-15000
-20000
-25000
-30000
-35000
-40000
-45000
-50000
-55000
-60000
-65000
-70000
0
5
10
15
20
25
30
35
40
45
50
Time (s)
Electromagnetic force, x component (N)
Electromagnetic force, y component (N)
Electromagnetic force, z component (N)

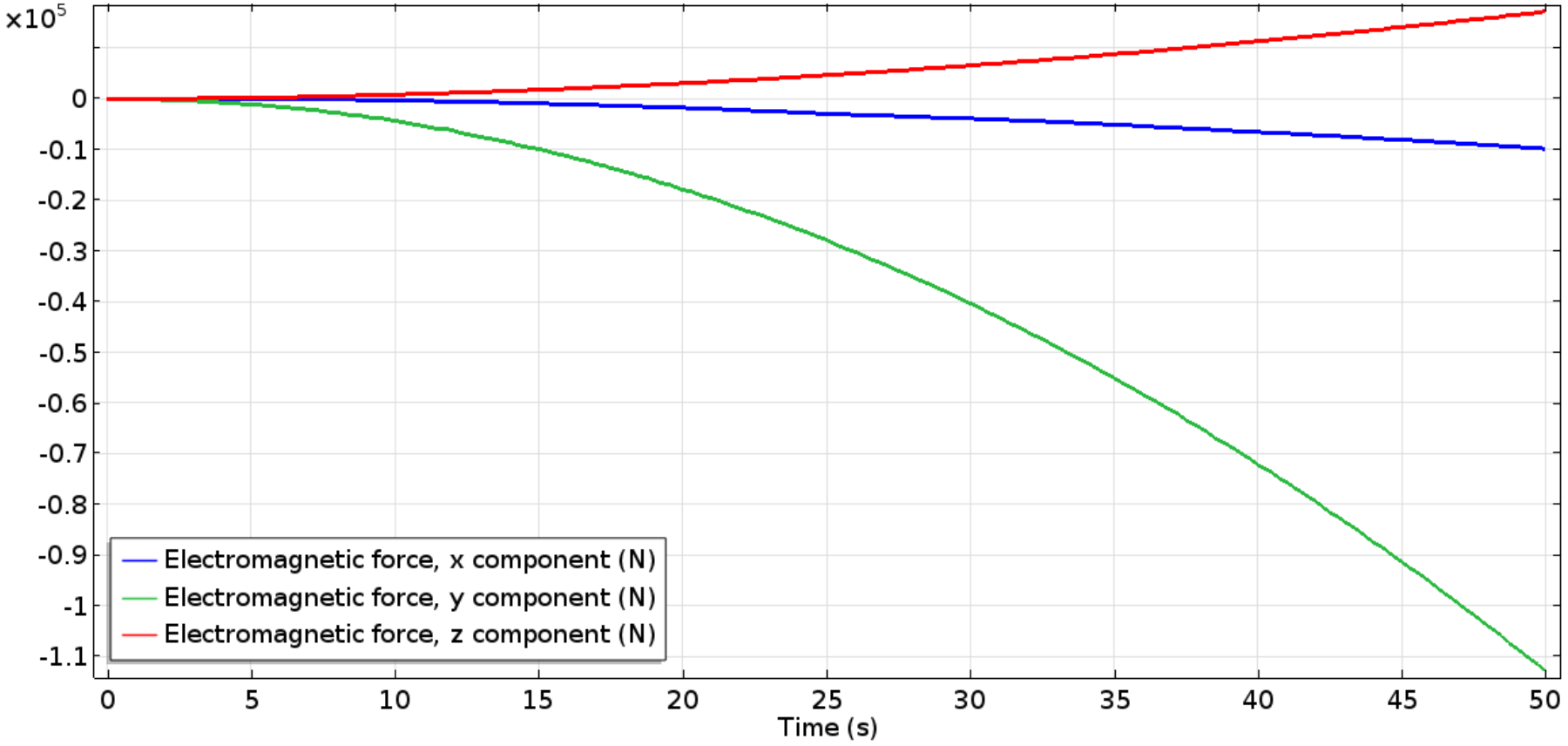
Side

F_z, F_y: Internal forces

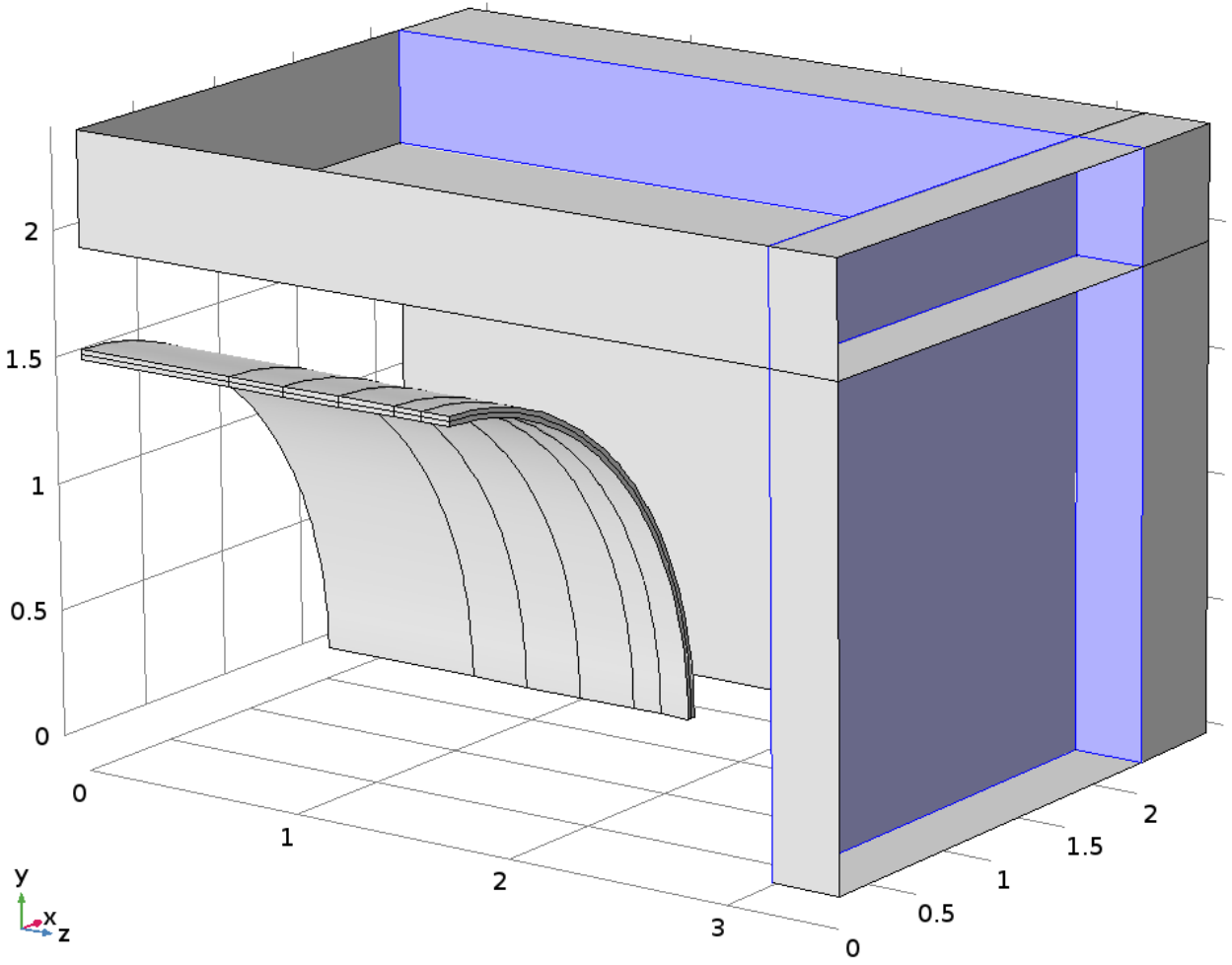


Top

F_x, F_z: Internal forces

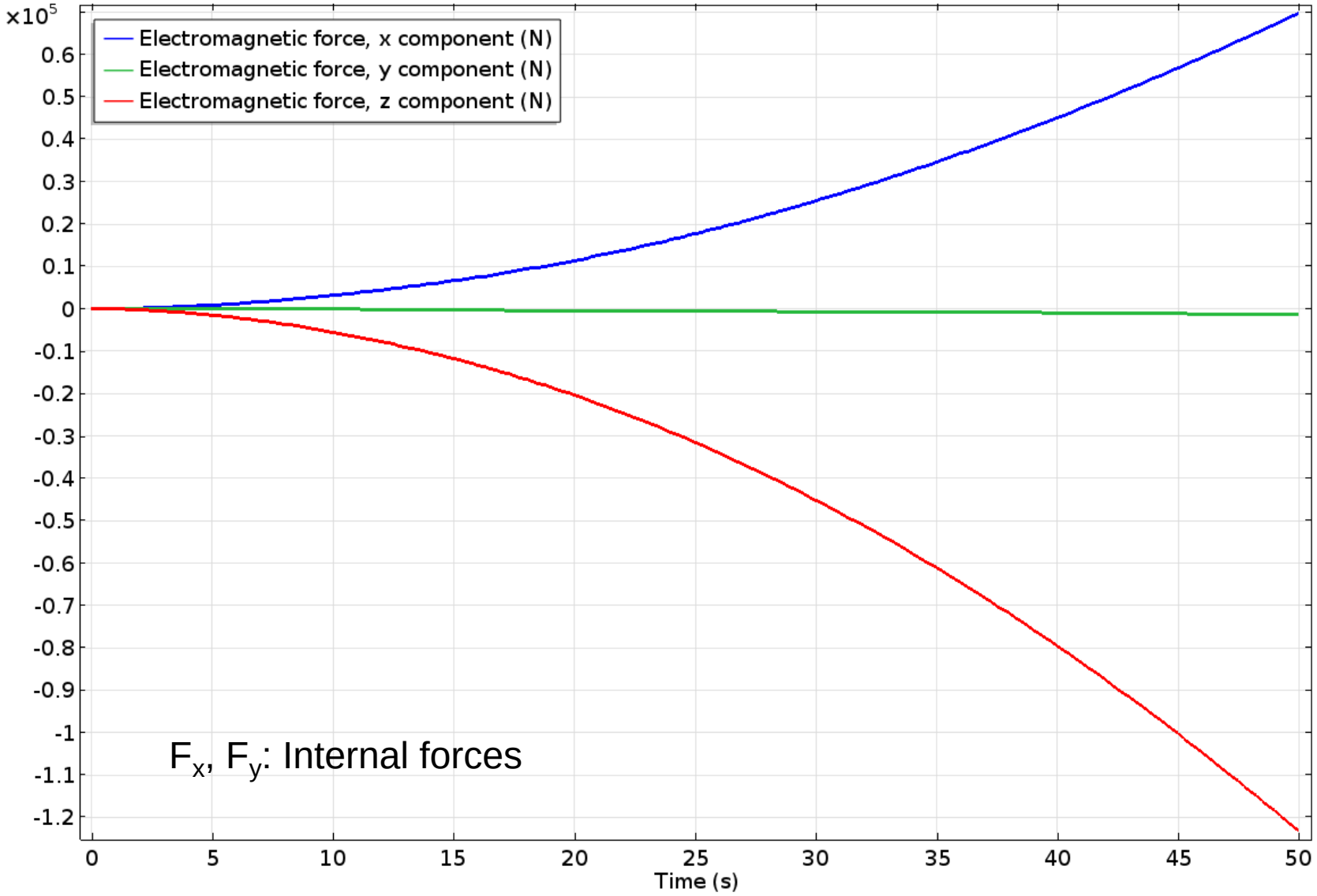


Assume Insulation Between Iron

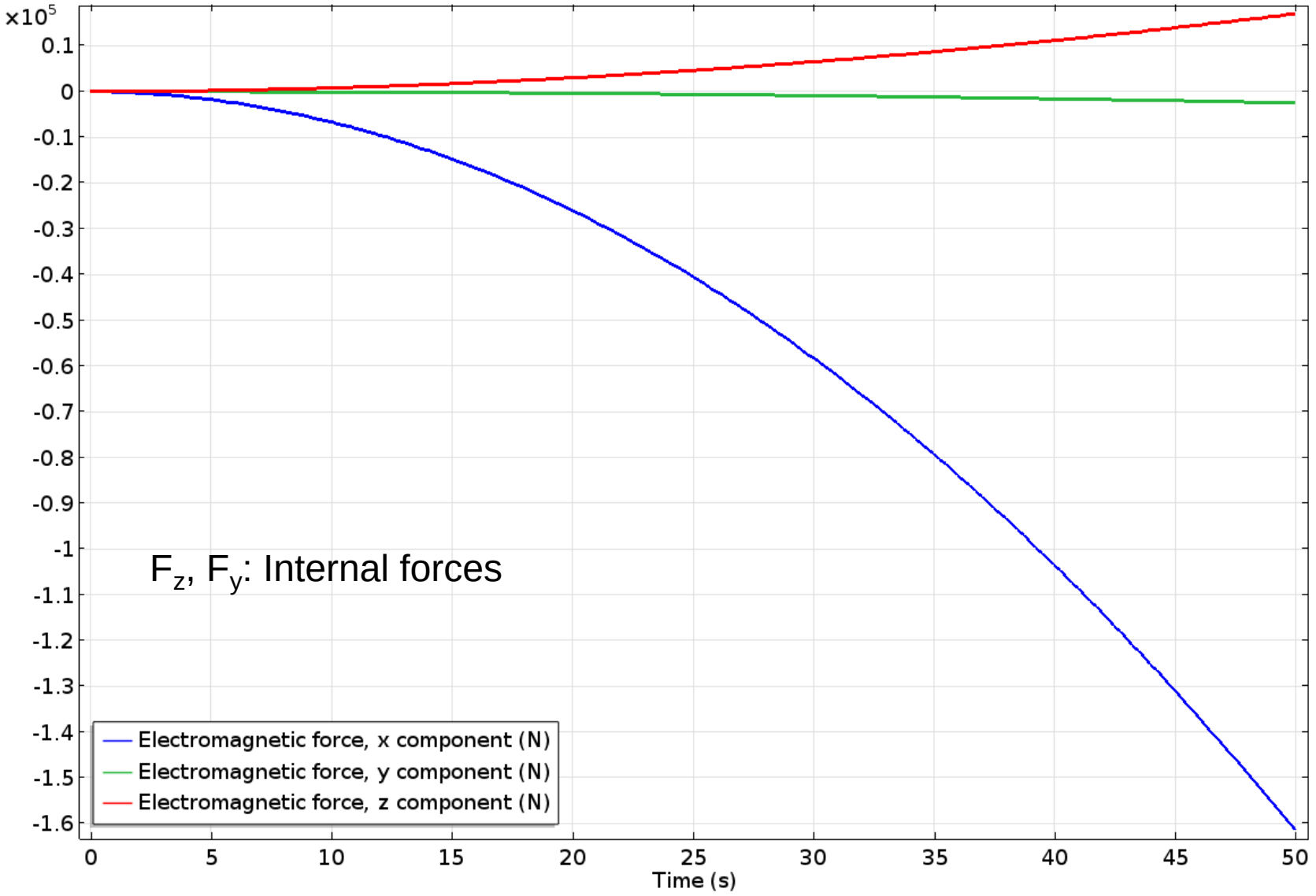


2mm gap
Implemented as boundary condition

Front

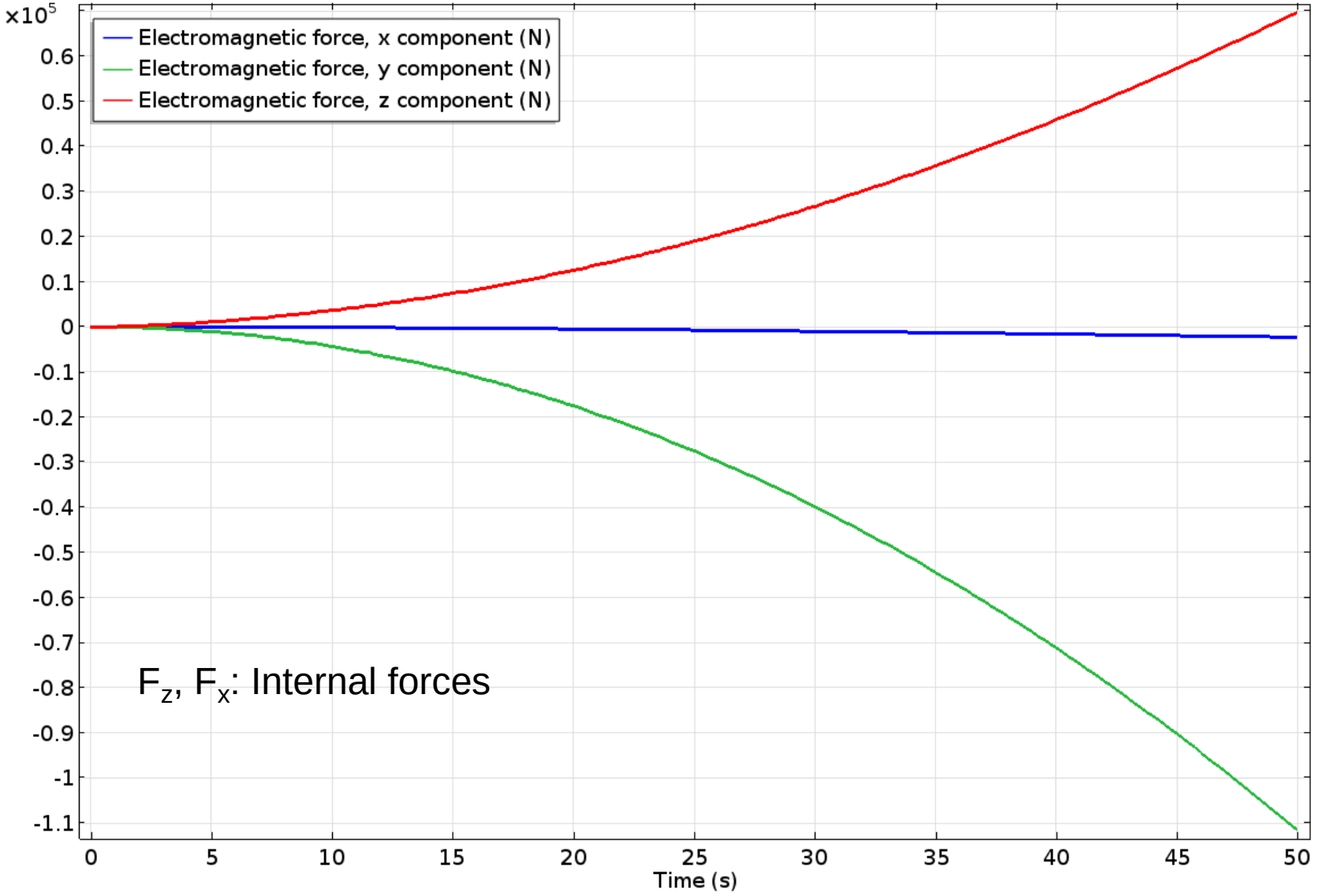

×10^5
Electromagnetic force, x component (N)
Electromagnetic force, y component (N)
Electromagnetic force, z component (N)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
0
5
10
15
20
25
30
35
40
45
50
Time (s)
F_x, F_y: Internal forces

Side



F_z, F_y: Internal forces

Top


×10^5
Electromagnetic force, x component (N)
Electromagnetic force, y component (N)
Electromagnetic force, z component (N)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
0
5
10
15
20
25
30
35
40
45
50
Time (s)
F_z, F_x: Internal forces