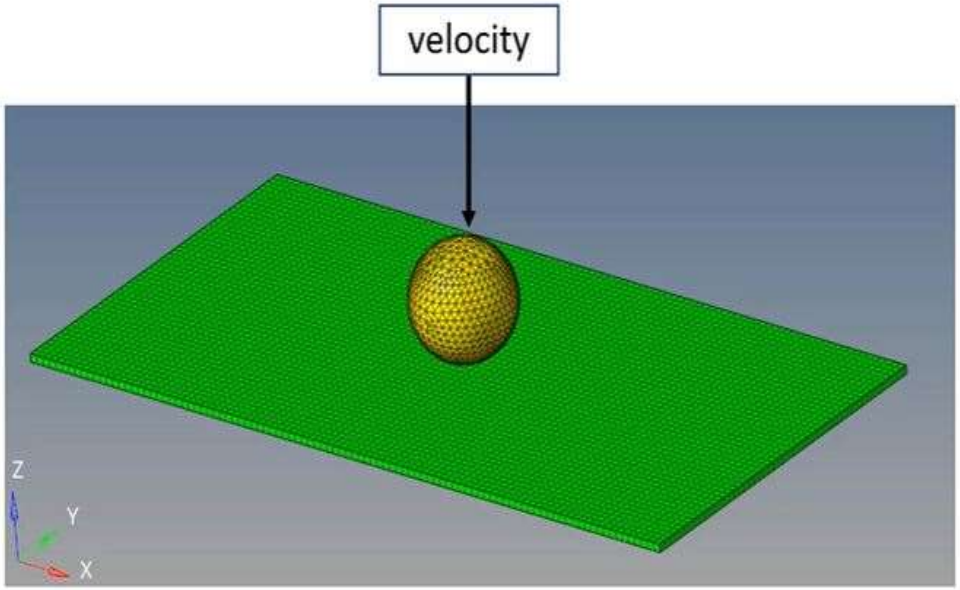
Ball Plate Impact Analysis

Objective:

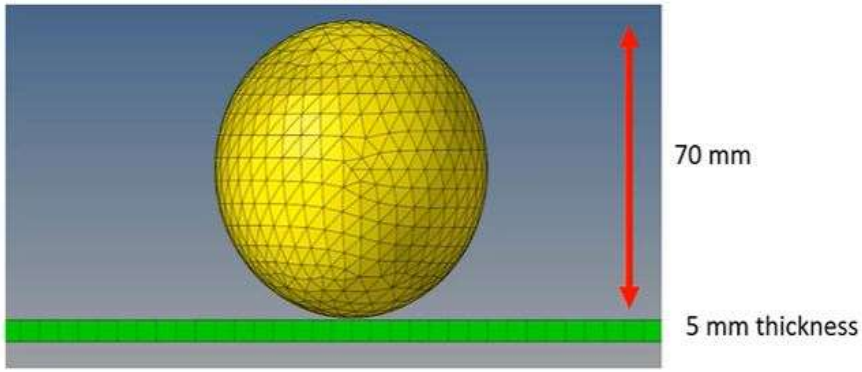
1. To find maximum stress and displacement of the plate
2. To observe the variation in kinetic and internal energy of the ball and plate

Ball Plate Impact Analysis



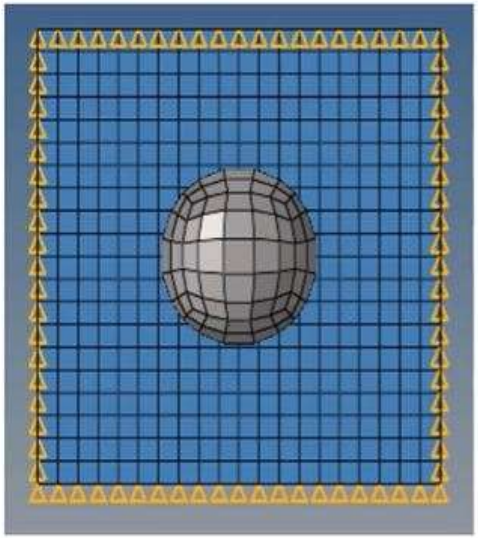
Steel

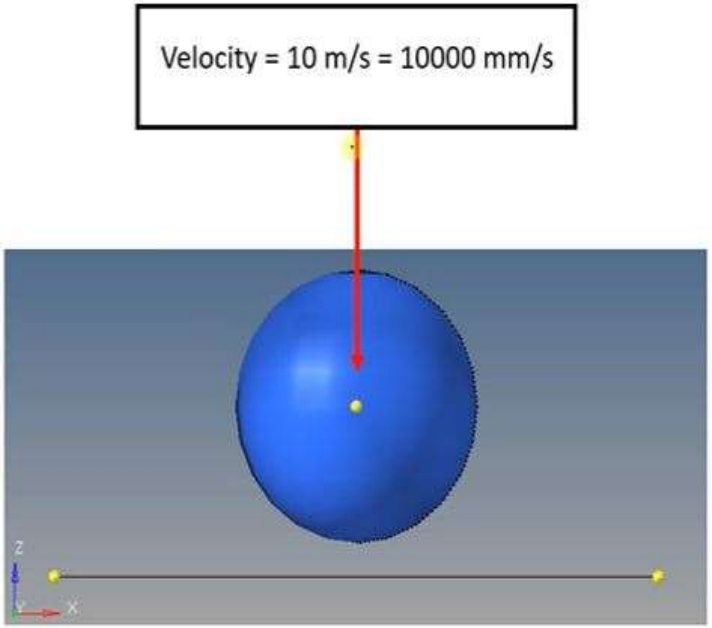
Aluminum



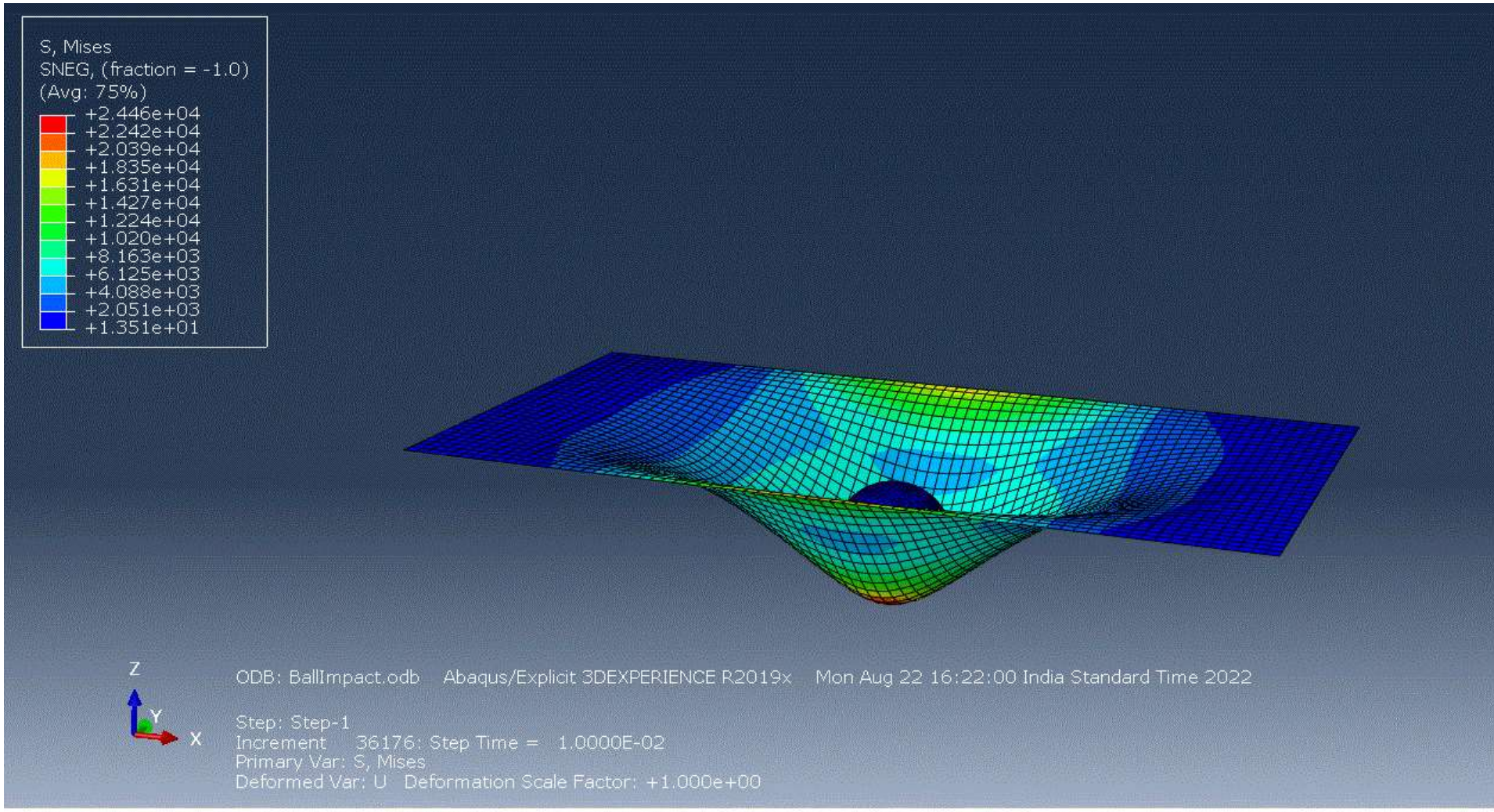
Material	Steel	Aluminum
density	7850 kg/m3 = 7.85 e-9 Tons/mm3	2850 kg/m3 = 2.85 e-9 Tons/mm3
Young modulus	210 Gpa = 210000 N/mm2	72 Gpa = 72000 N/mm2
Poisson ratio	0.3	0.33

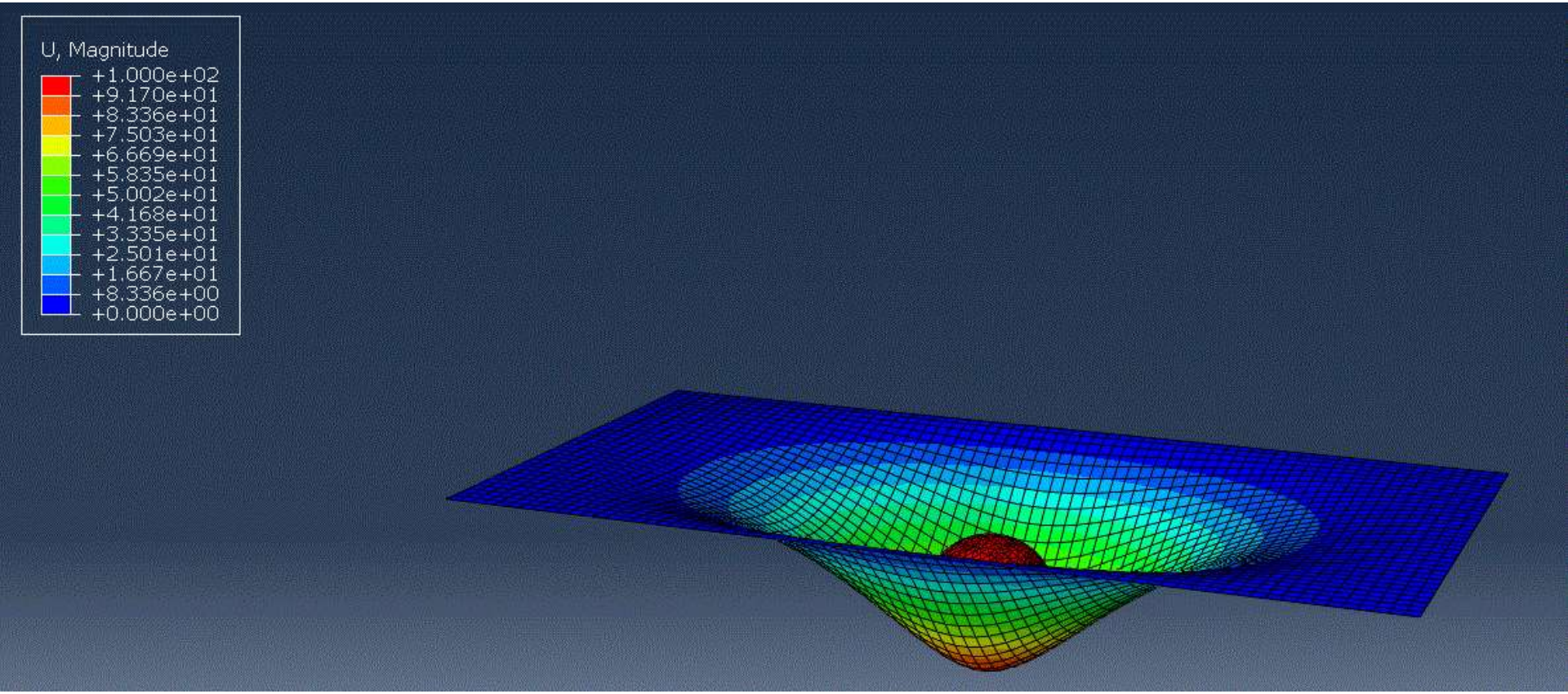
Boundary Conditions

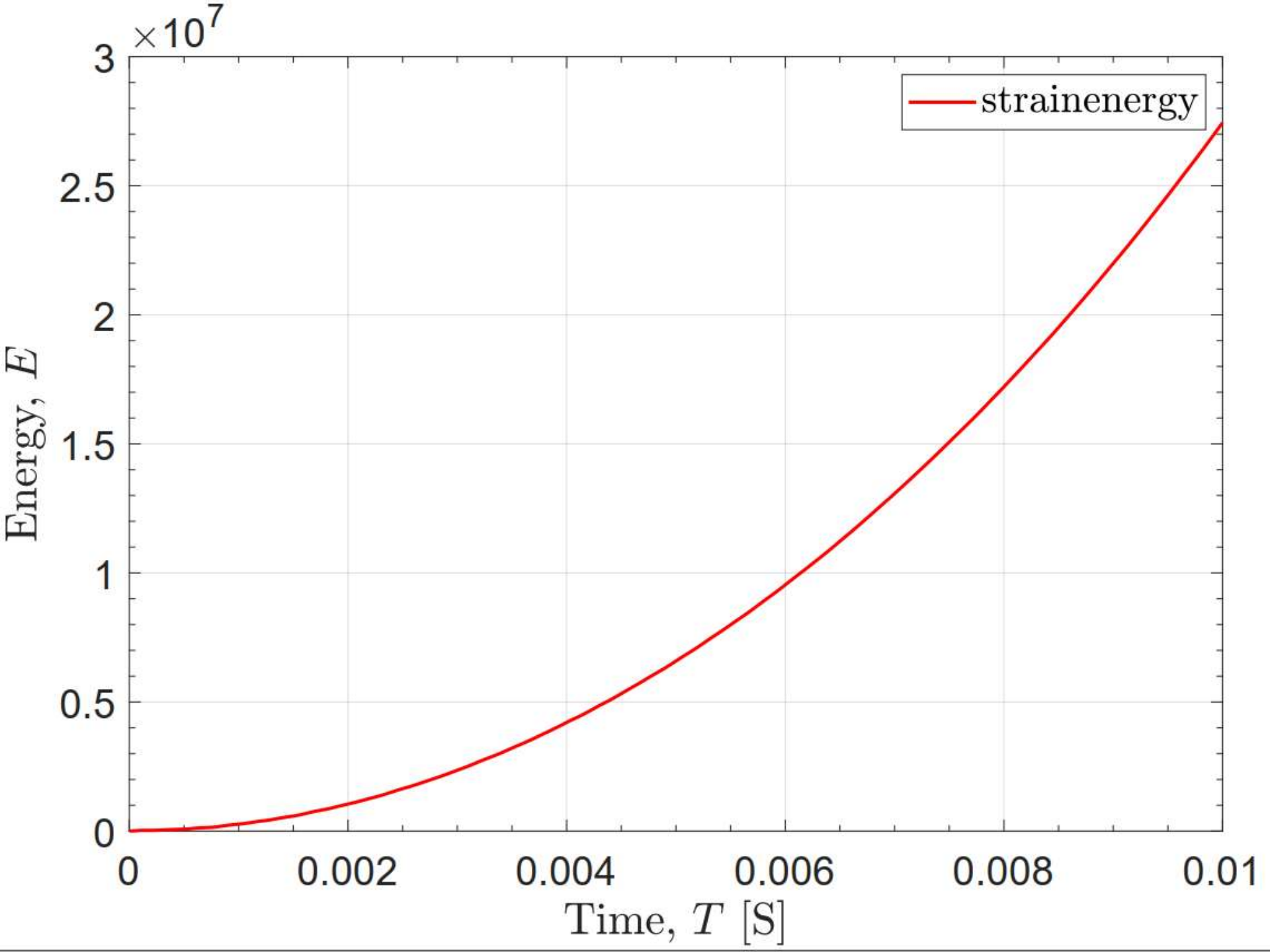


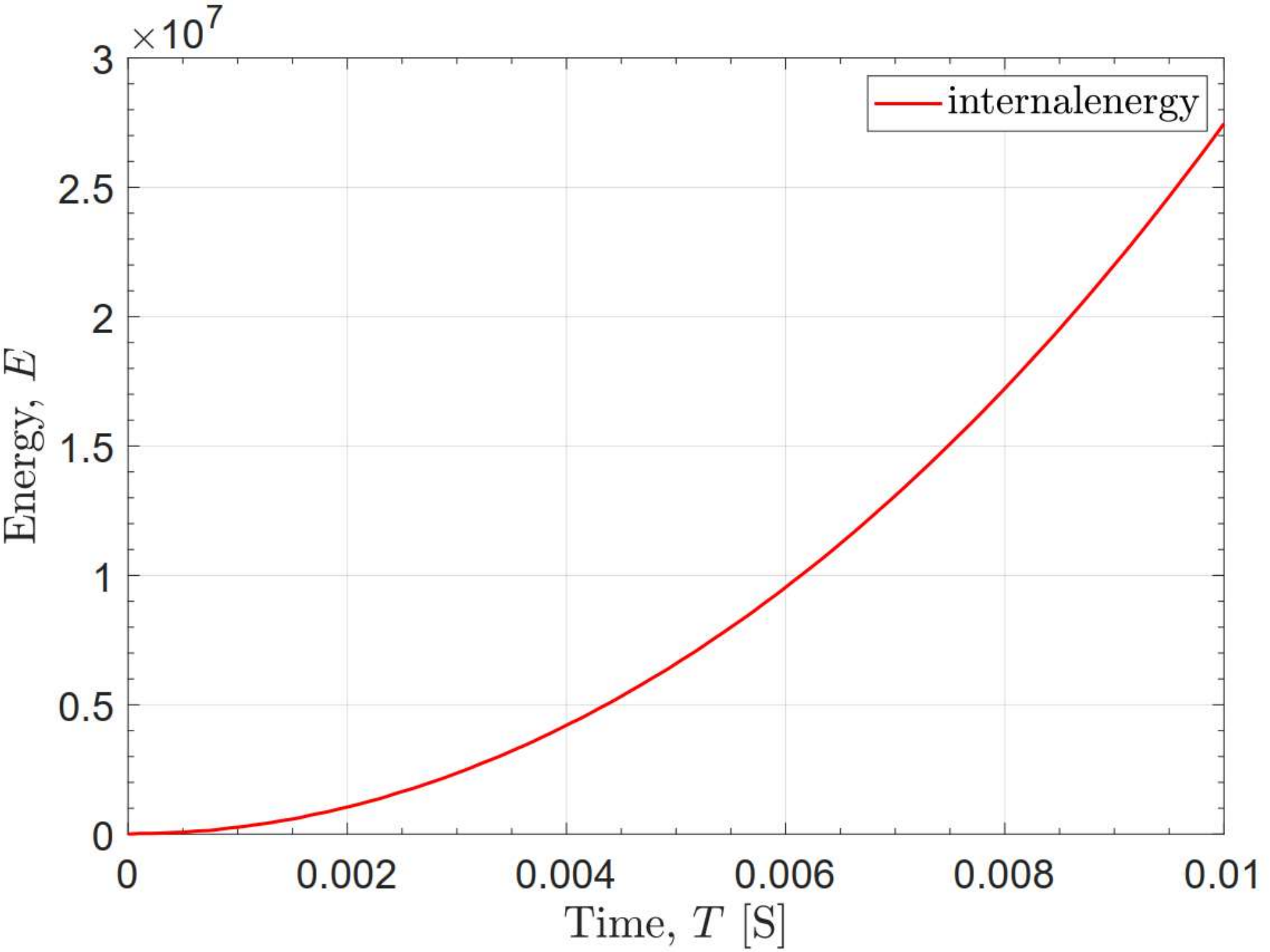


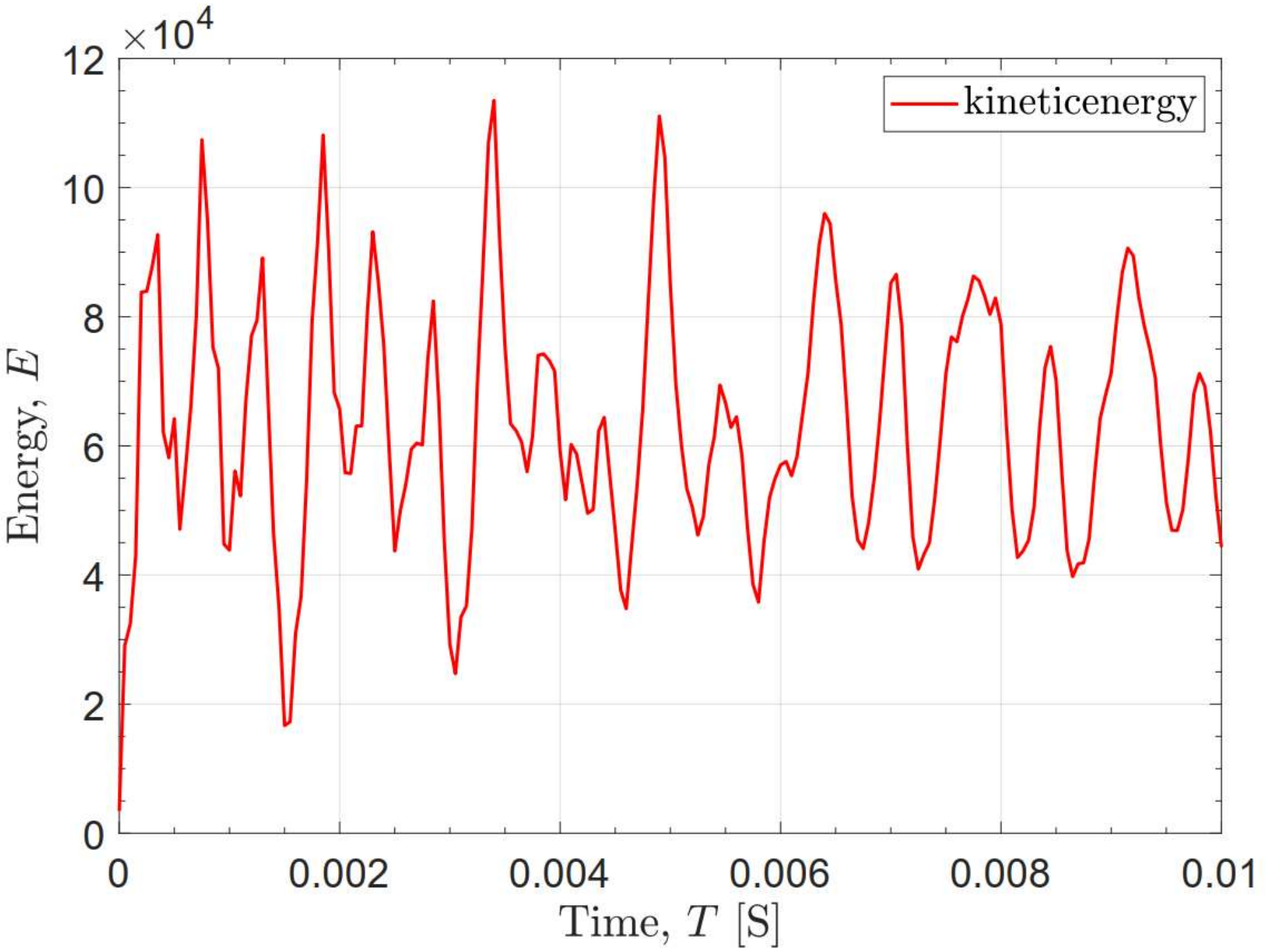
Results

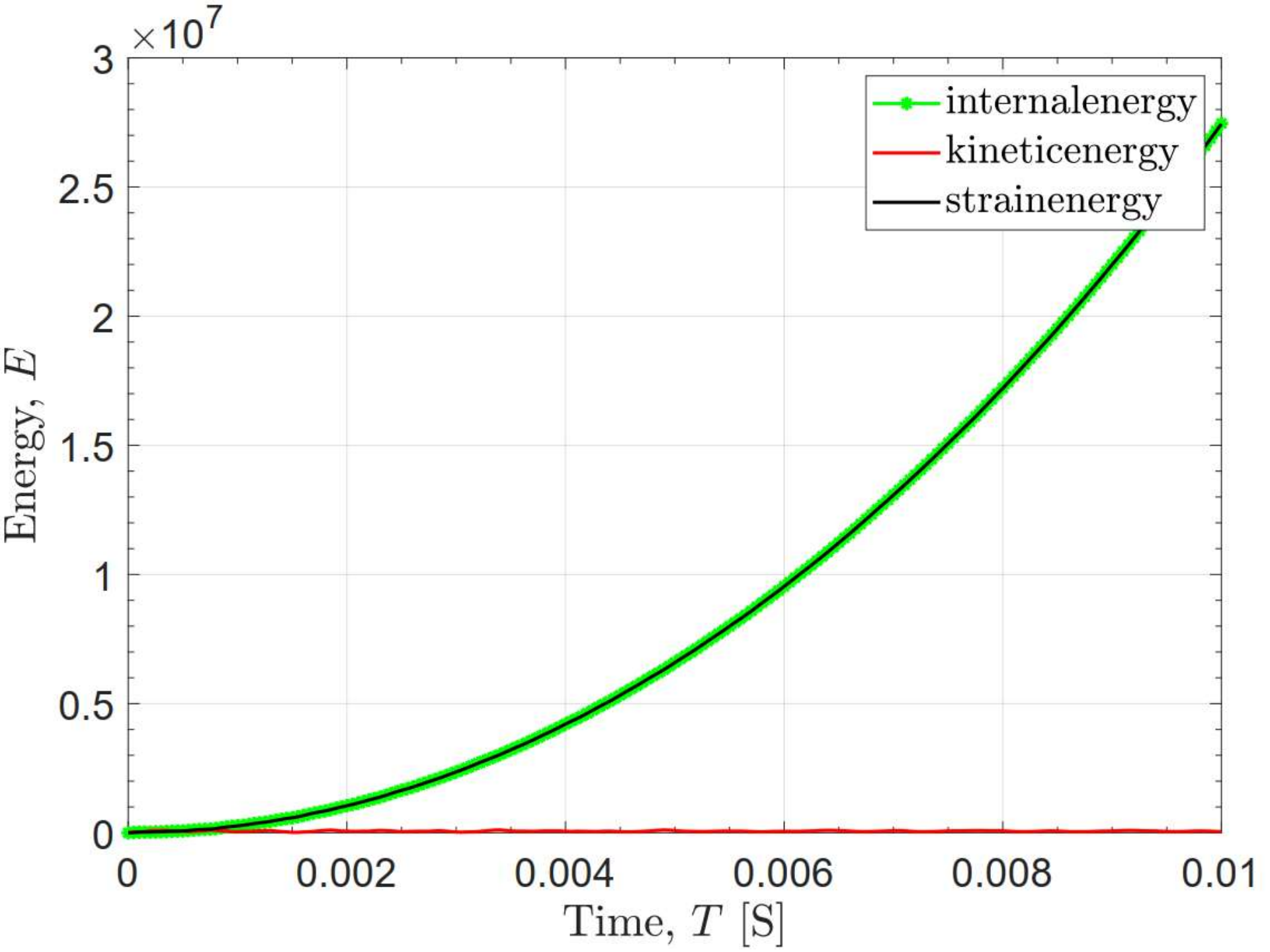

S, Mises
SNEG, (fraction = -1.0)
(Avg: 75%)
+2.446e+04
+2.242e+04
+2.039e+04
+1.835e+04
+1.631e+04
+1.427e+04
+1.224e+04
+1.020e+04
+8.163e+03
+6.125e+03
+4.088e+03
+2.051e+03
+1.351e+01
Z
Y
X
ODB: BallImpact.odb Abaqus/Explicit 3DEXPERIENCE R2019x Mon Aug 22 16:22:00 India Standard Time 2022
Step: Step-1
Increment 36176: Step Time = 1.0000E-02
Primary Var: S, Mises
Deformed Var: U Deformation Scale Factor: +1.000e+00


U, Magnitude
+1.000e+02
+9.170e+01
+8.336e+01
+7.503e+01
+6.669e+01
+5.835e+01
+5.002e+01
+4.168e+01
+3.335e+01
+2.501e+01
+1.667e+01
+8.336e+00
+0.000e+00

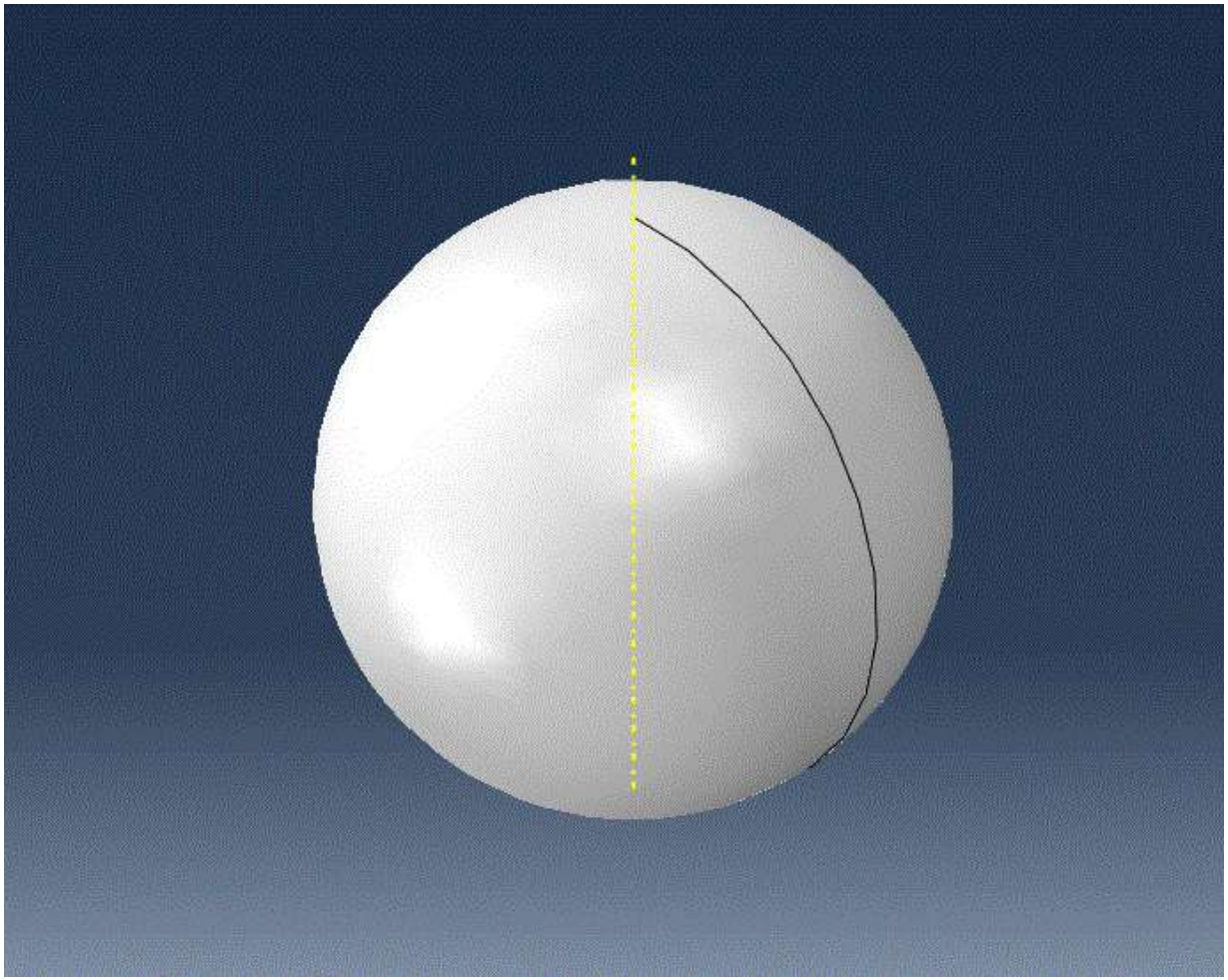

×10^7
3
2.5
2
1.5
1
0.5
0
Energy, E
strainenergy
0
0.002
0.004
0.006
0.008
0.01
Time, T [S]


×10^7
3
2.5
2
1.5
1
0.5
0
Energy, E
internalenergy
0
0.002
0.004
0.006
0.008
0.01
Time, T [S]

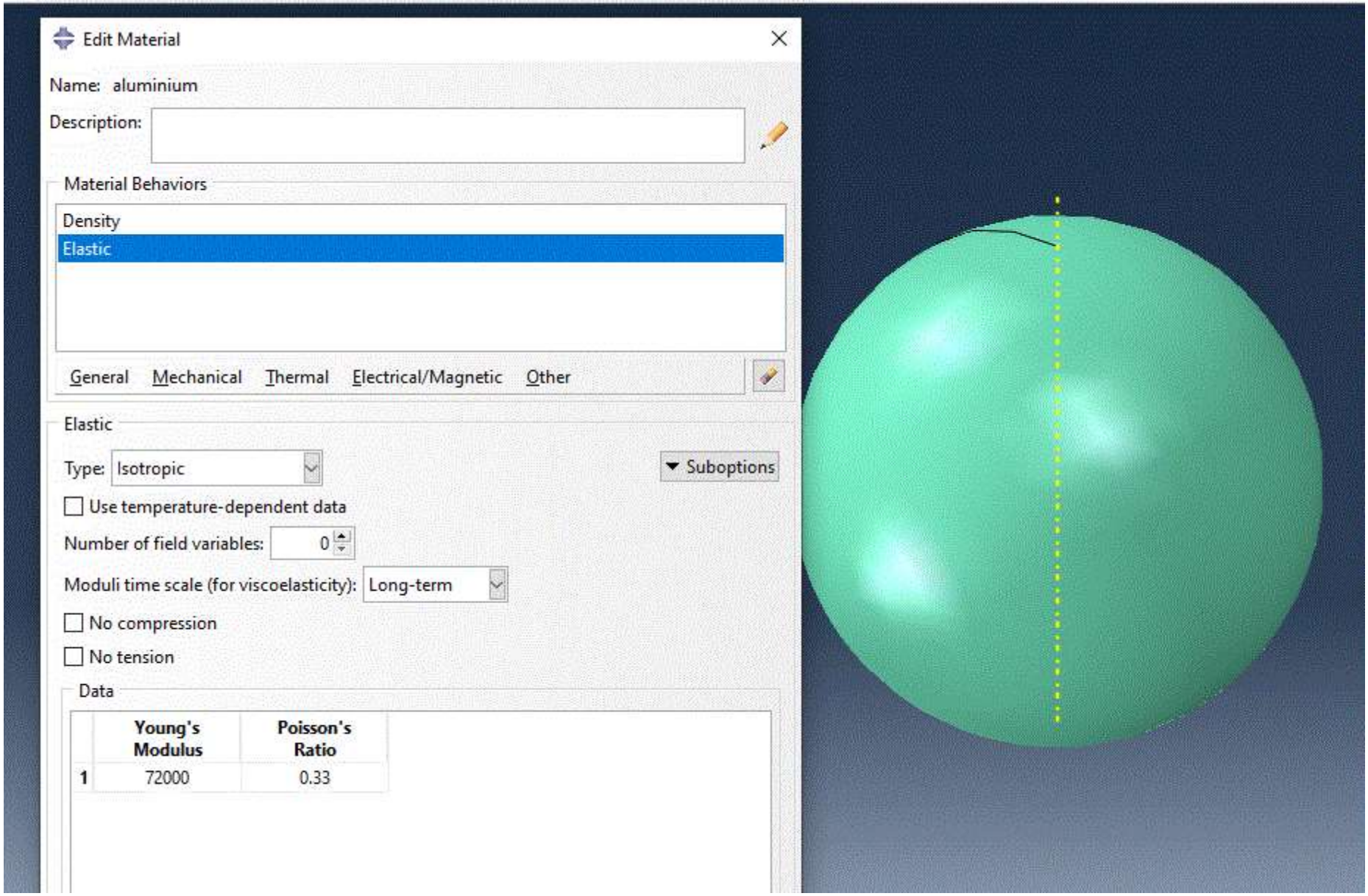

×10^4
12
10
8
6
4
2
0
Energy, E
kineticenergy
0
0.002
0.004
0.006
0.008
0.01
Time, T [S]

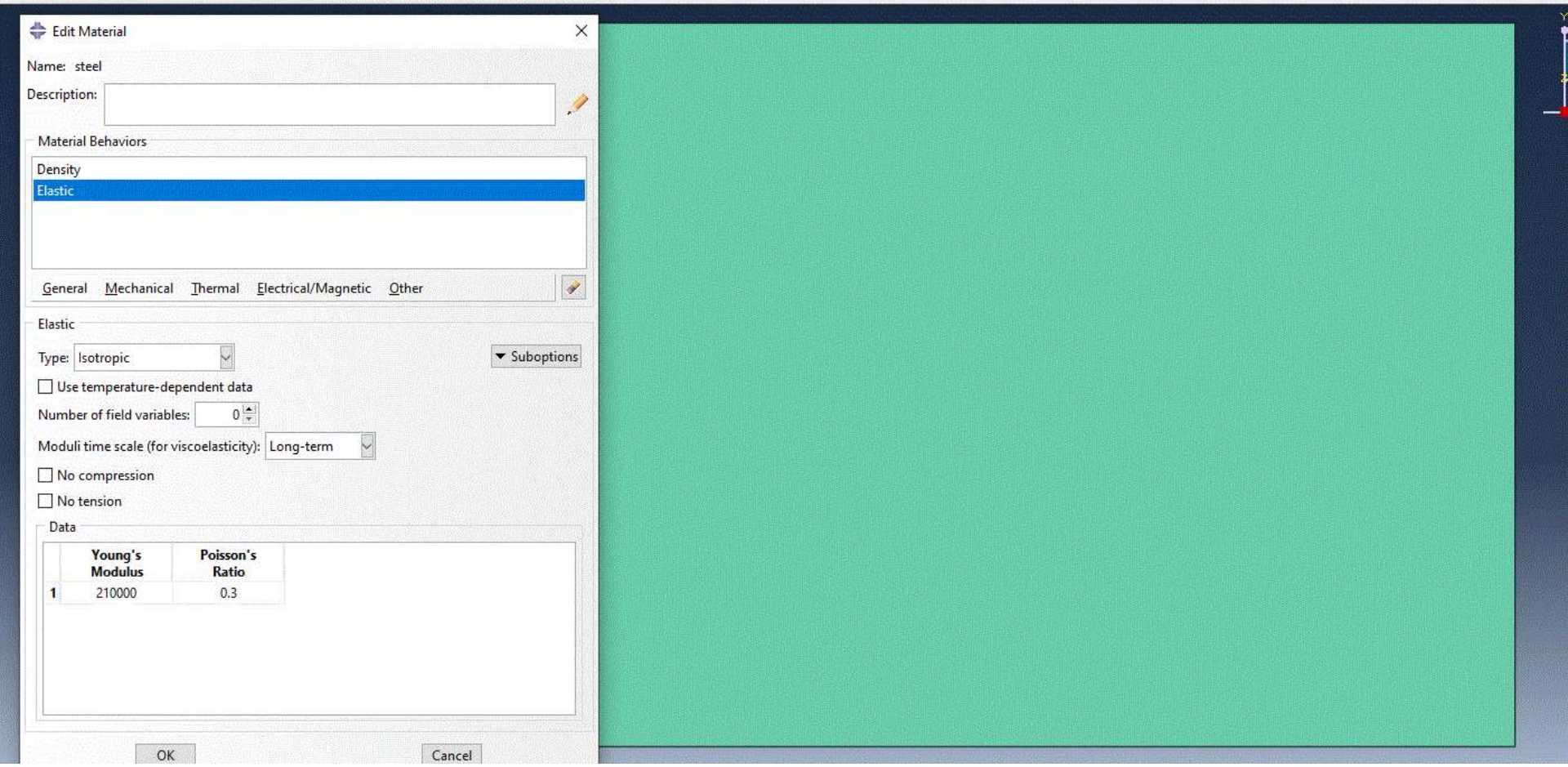

×10^7
3
2.5
2
1.5
1
0.5
0
Energy, E
0
0.002
0.004
0.006
0.008
0.01
Time, T [S]
internalenergy
kineticenergy
strainenergy

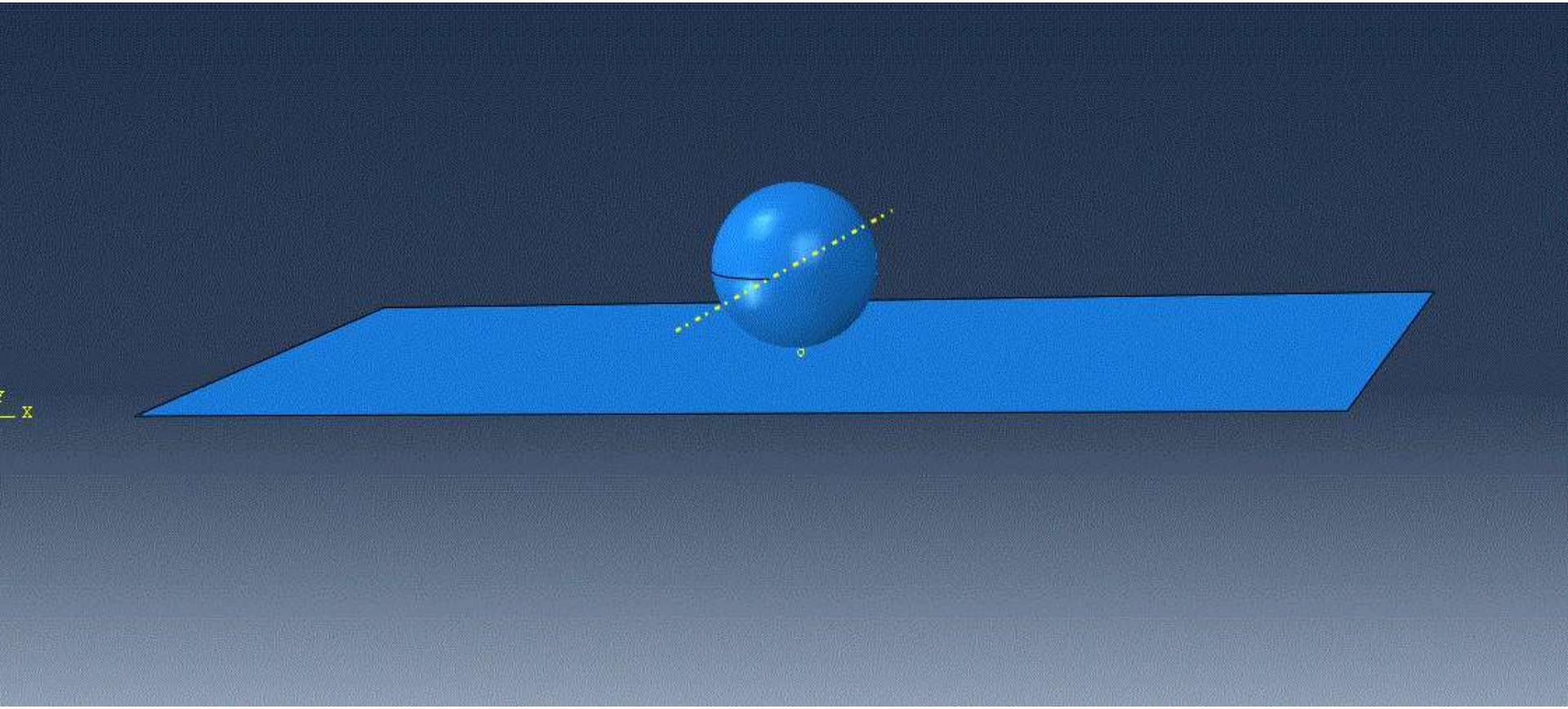
Extra Slides: Steps taken in Abaqus to complete the analysis

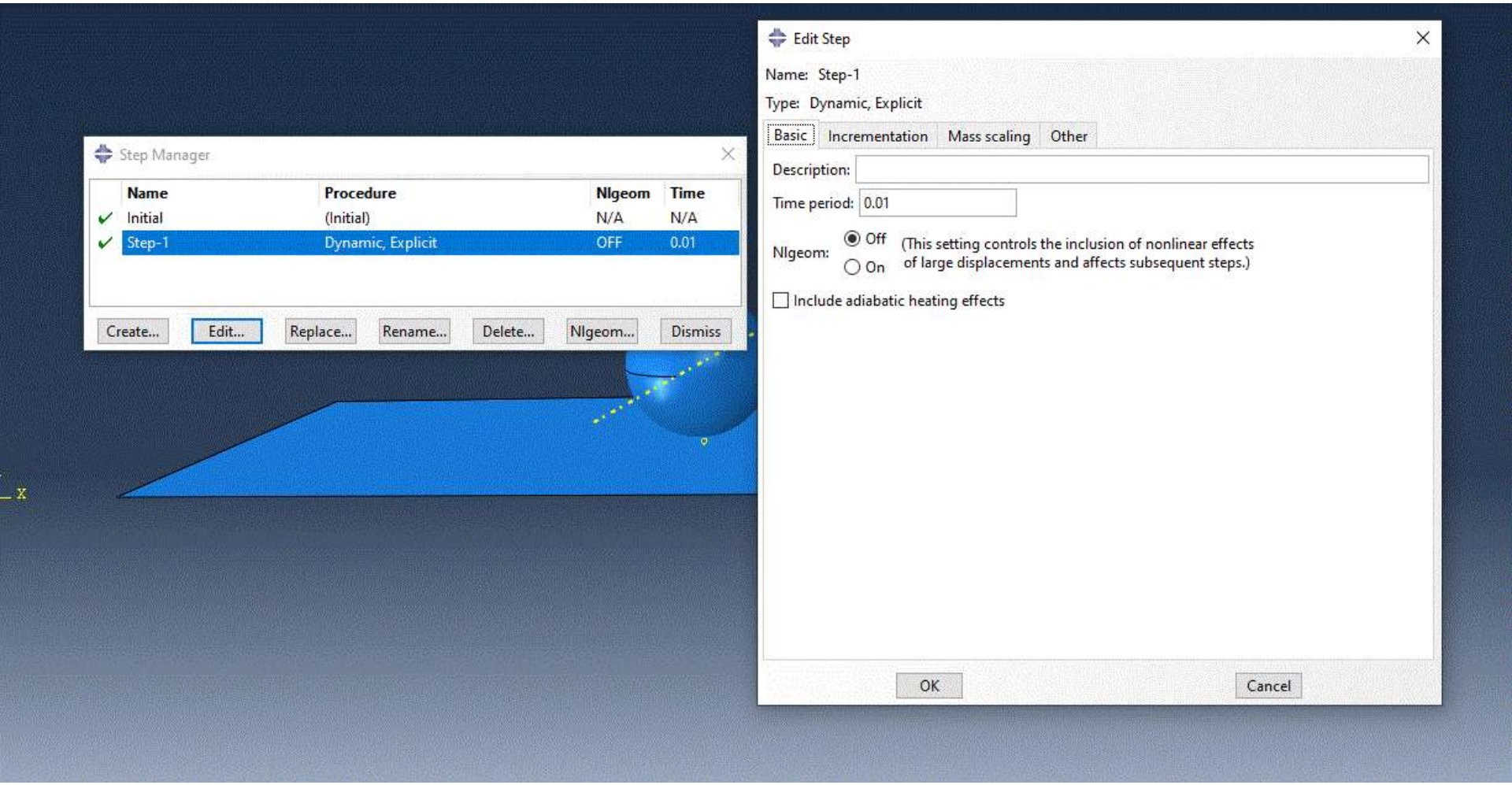


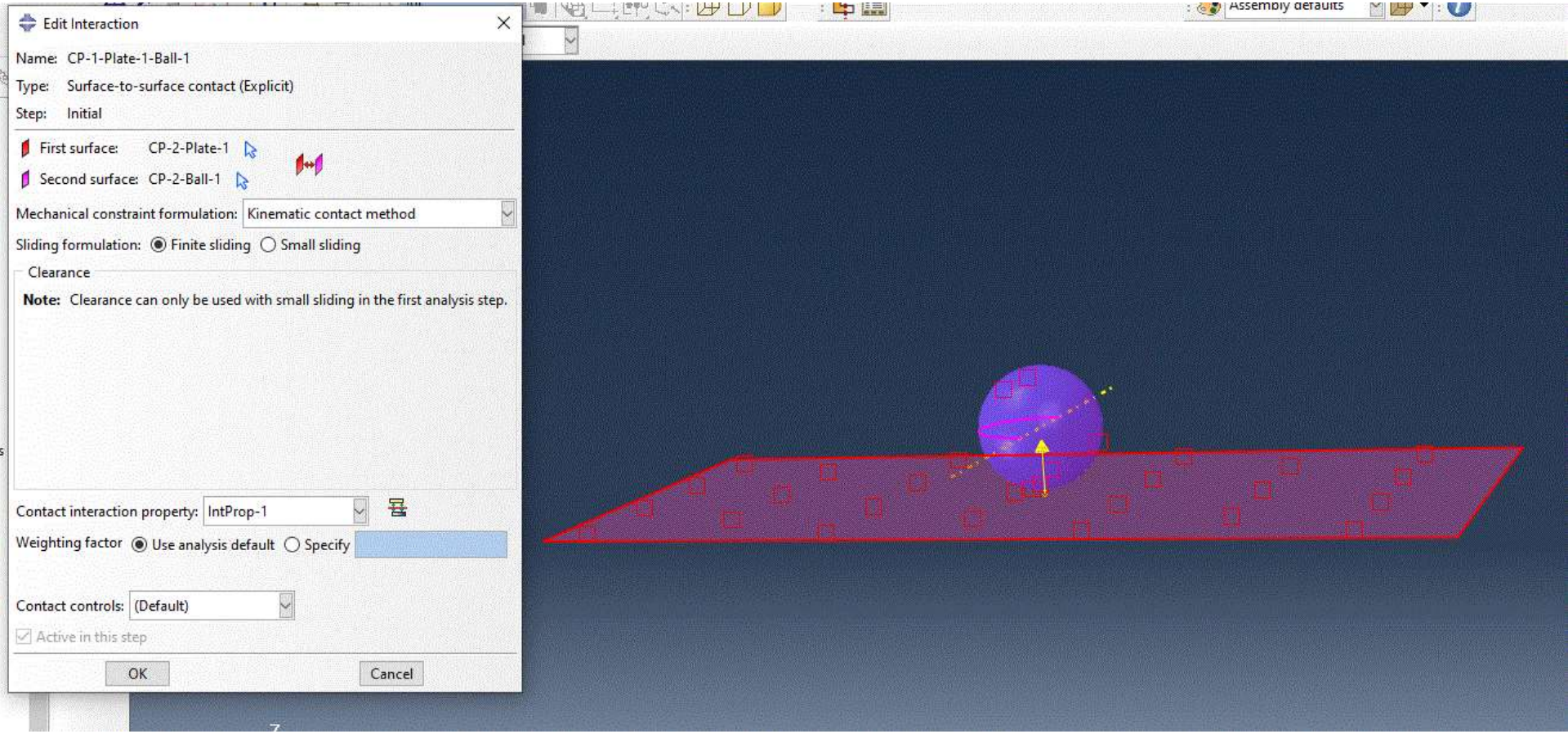

Y
Z
X

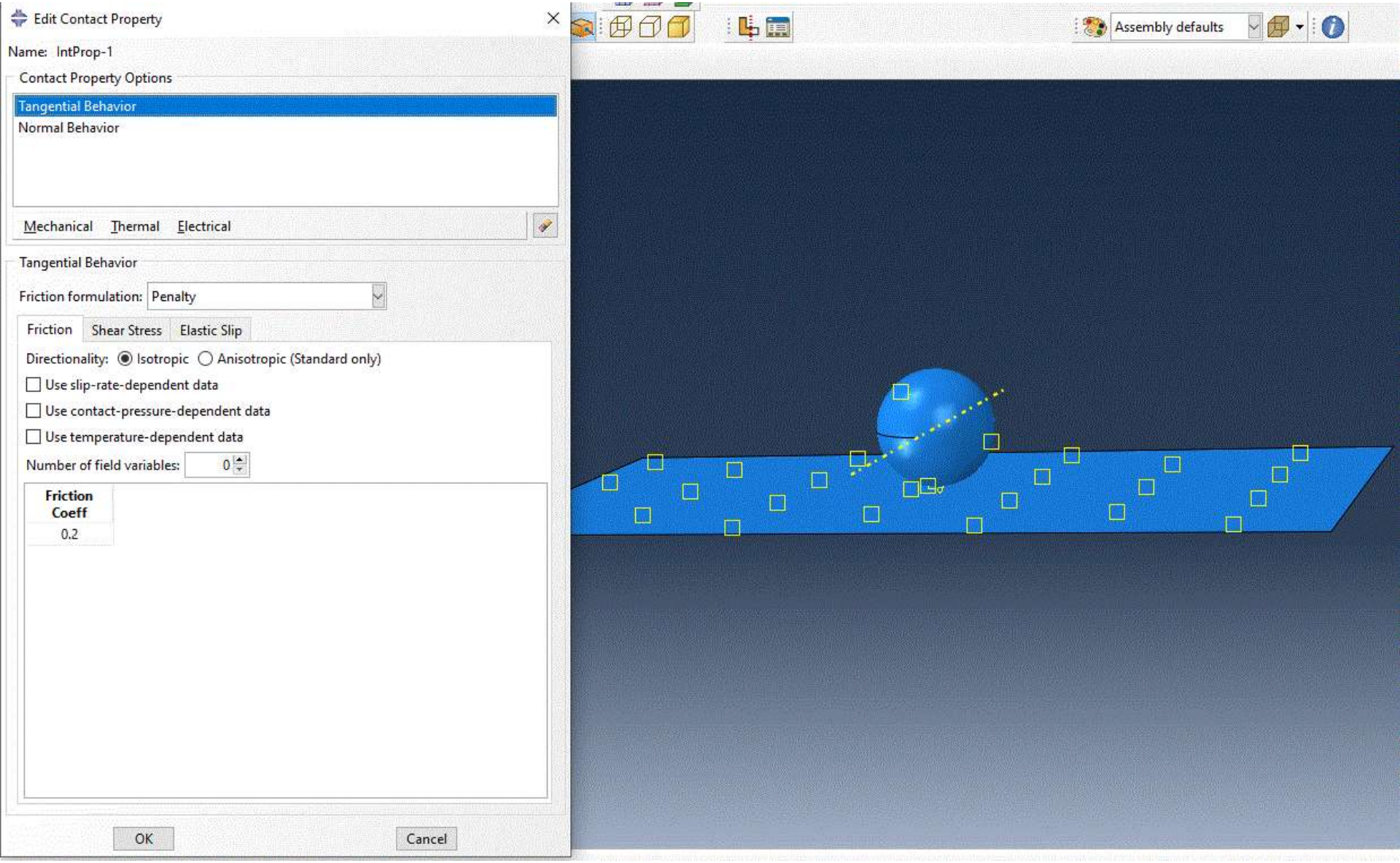

Edit Material
Name: aluminium
Description:
Material Behaviors
Density
Elastic
General
Mechanical
Thermal
Electrical/Magnetic
Other
Elastic
Type: Isotropic
Suboptions
Use temperature-dependent data
Number of field variables: 0
Moduli time scale (for viscoelasticity): Long-term
No compression
No tension
Data
Young's Modulus
Poisson's Ratio
1
72000
0.33

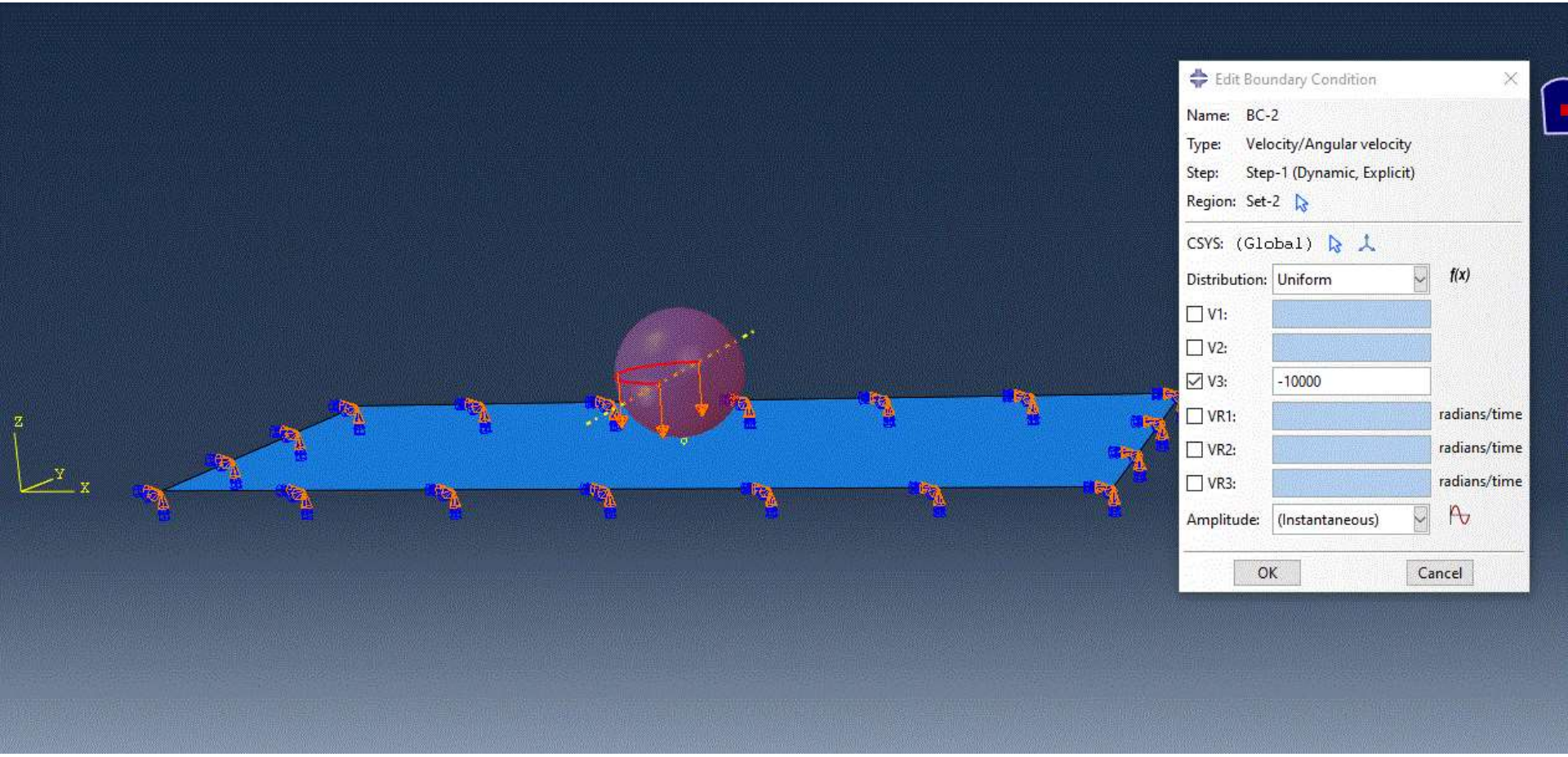

Edit Material
Name: steel
Description:
Material Behaviors
Density
Elastic
General
Mechanical
Thermal
Electrical/Magnetic
Other
Elastic
Type: Isotropic
Suboptions
Use temperature-dependent data
Number of field variables: 0
Moduli time scale (for viscoelasticity): Long-term
No compression
No tension
Data
Young's Modulus
Poisson's Ratio
1
210000
0.3
OK
Cancel

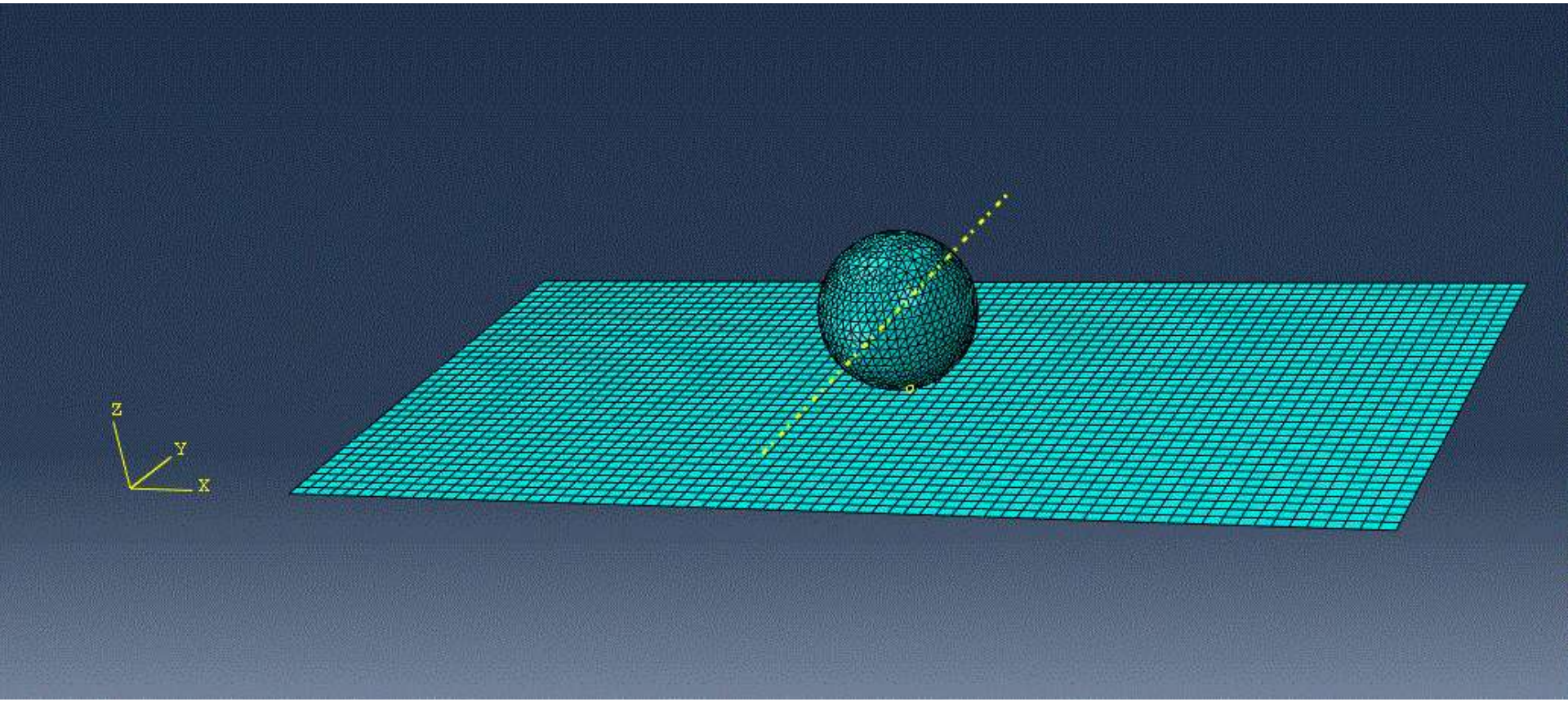

Y
X


Step Manager
Name
Procedure
Nlgeom
Time
Initial
(Initial)
N/A
N/A
Step-1
Dynamic, Explicit
OFF
0.01
Create...
Edit...
Replace...
Rename...
Delete...
Nlgeom...
Dismiss
Edit Step
Name: Step-1
Type: Dynamic, Explicit
Basic
Incrementation
Mass scaling
Other
Description:
Time period: 0.01
Nlgeom:
Off
On
(This setting controls the inclusion of nonlinear effects of large displacements and affects subsequent steps.)
Include adiabatic heating effects
OK
Cancel


Edit Interaction
Name: CP-1-Plate-1-Ball-1
Type: Surface-to-surface contact (Explicit)
Step: Initial
First surface: CP-2-Plate-1
Second surface: CP-2-Ball-1
Mechanical constraint formulation: Kinematic contact method
Sliding formulation: Finite sliding Small sliding
Clearance
Note: Clearance can only be used with small sliding in the first analysis step.
Contact interaction property: IntProp-1
Weighting factor Use analysis default Specify
Contact controls: (Default)
Active in this step
OK
Cancel
Assembly defaults


Edit Contact Property
Name: IntProp-1
Contact Property Options
Tangential Behavior
Normal Behavior
Mechanical
Thermal
Electrical
Tangential Behavior
Friction formulation: Penalty
Friction
Shear Stress
Elastic Slip
Directionality: Isotropic Anisotropic (Standard only)
Use slip-rate-dependent data
Use contact-pressure-dependent data
Use temperature-dependent data
Number of field variables: 0
Friction Coeff
0.2
OK
Cancel
Assembly defaults


Z
Y
X
Edit Boundary Condition
Name: BC-2
Type: Velocity/Angular velocity
Step: Step-1 (Dynamic, Explicit)
Region: Set-2
CSYS: (Global)
Distribution: Uniform
f(x)
V1:
V2:
V3: -10000
VR1: radians/time
VR2: radians/time
VR3: radians/time
Amplitude: (Instantaneous)
OK
Cancel




```
Total number of nodes: 5472
Total number of elements: 16411
      13855 linear tetrahedral elements of type C3D4
      2556 linear quadrilateral elements of type S4R
```