PTOLEMY Meeting 2018

E-gun simulation

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&

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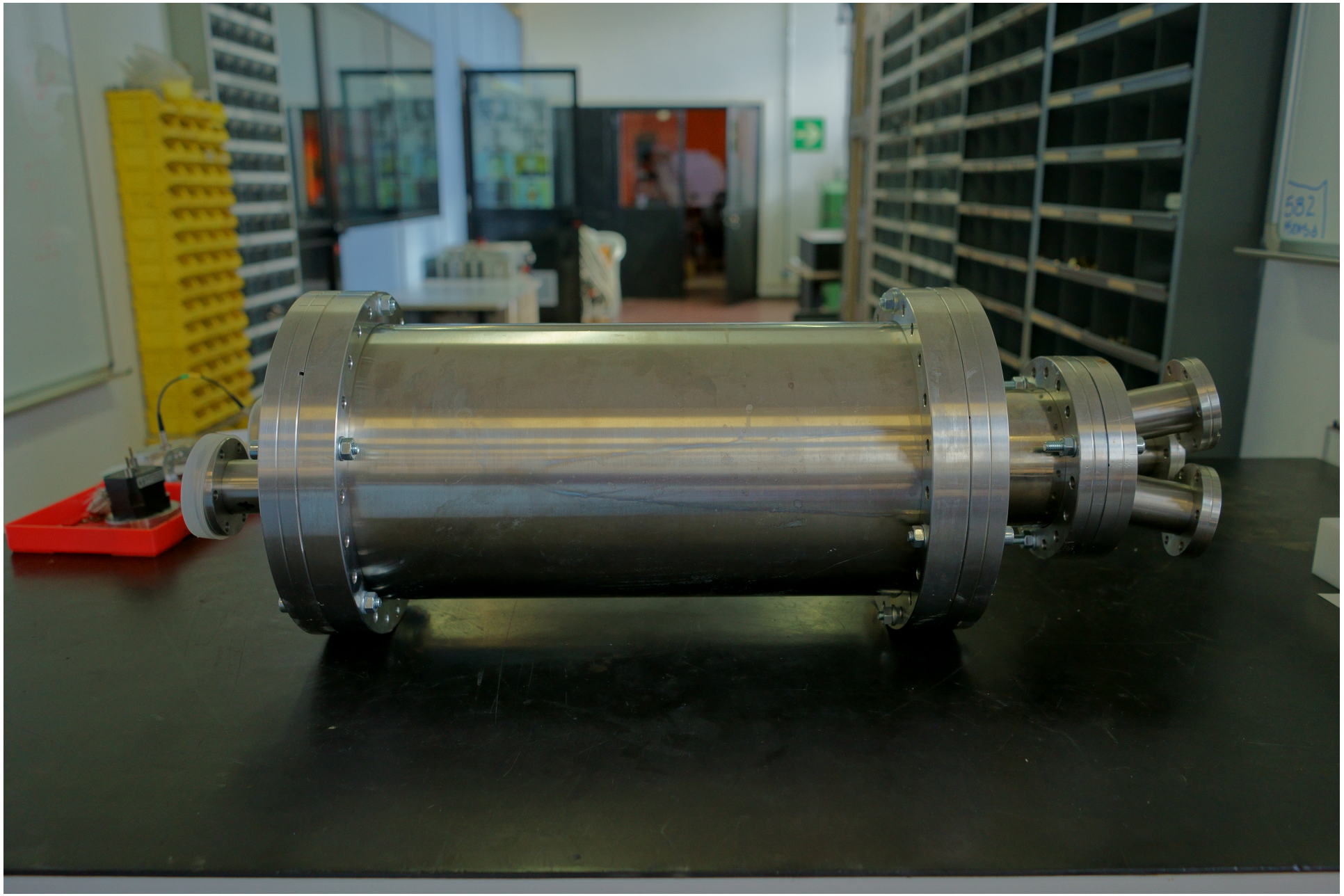
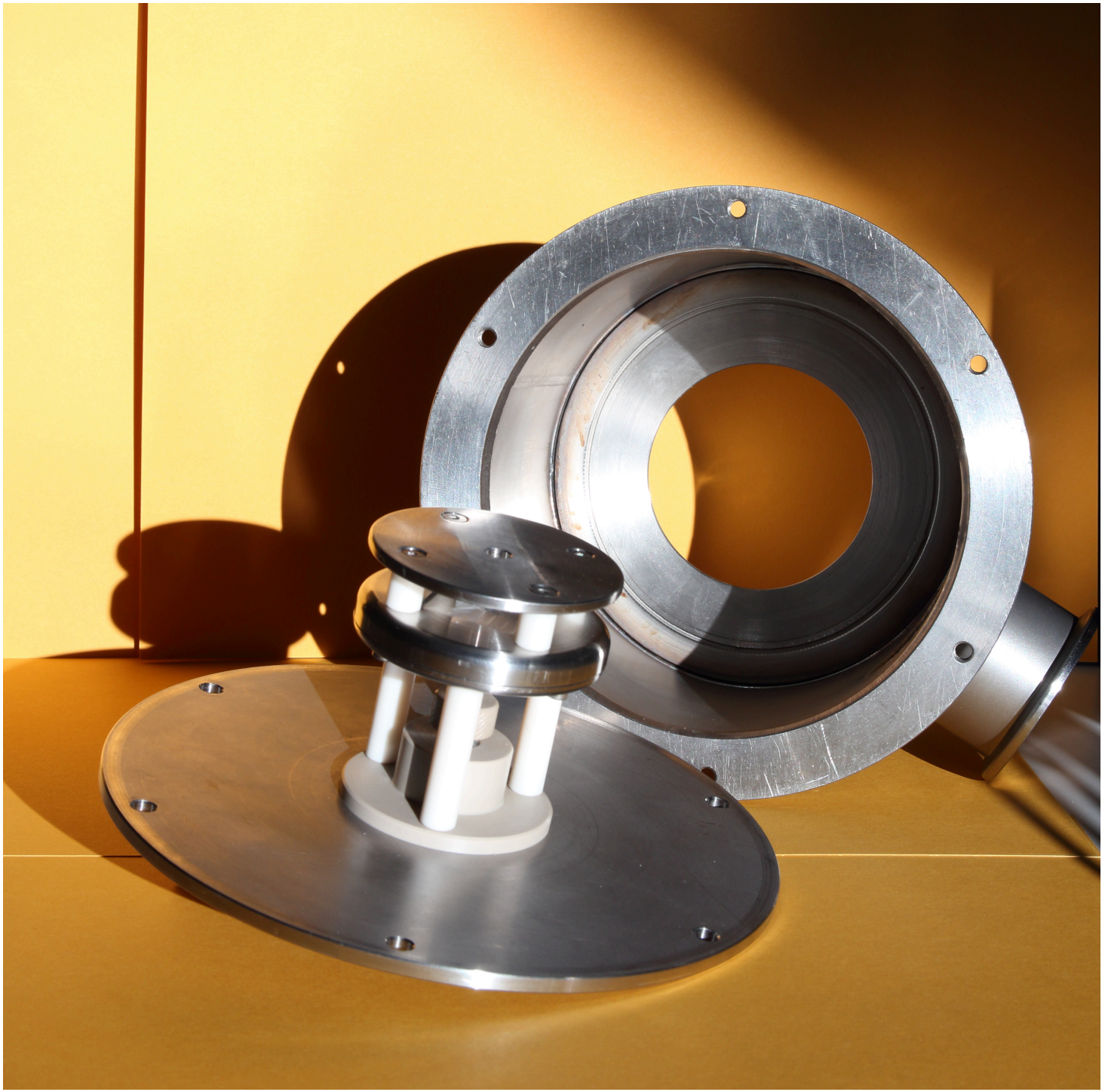
GSSI

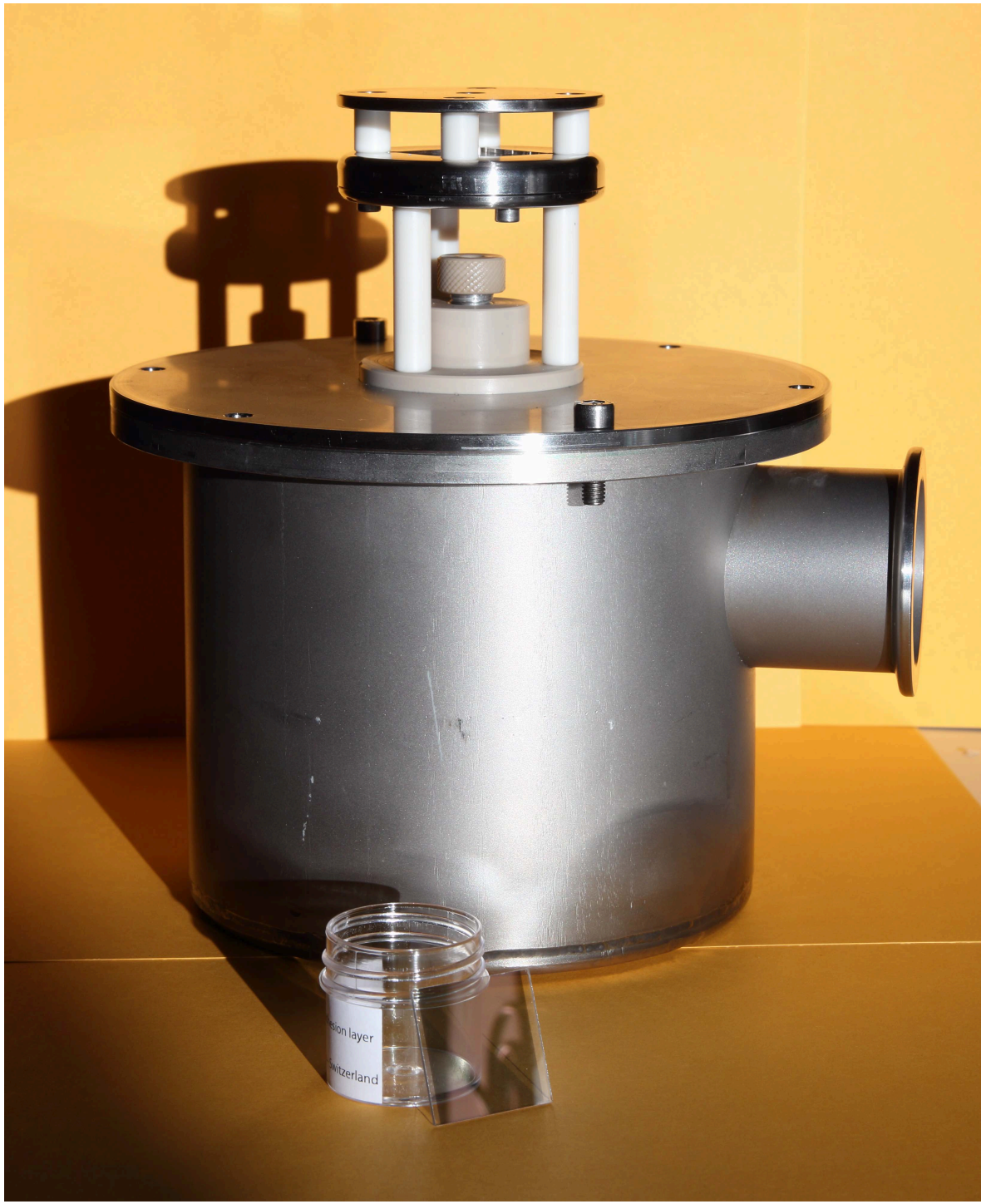
E-gun realization

PART I



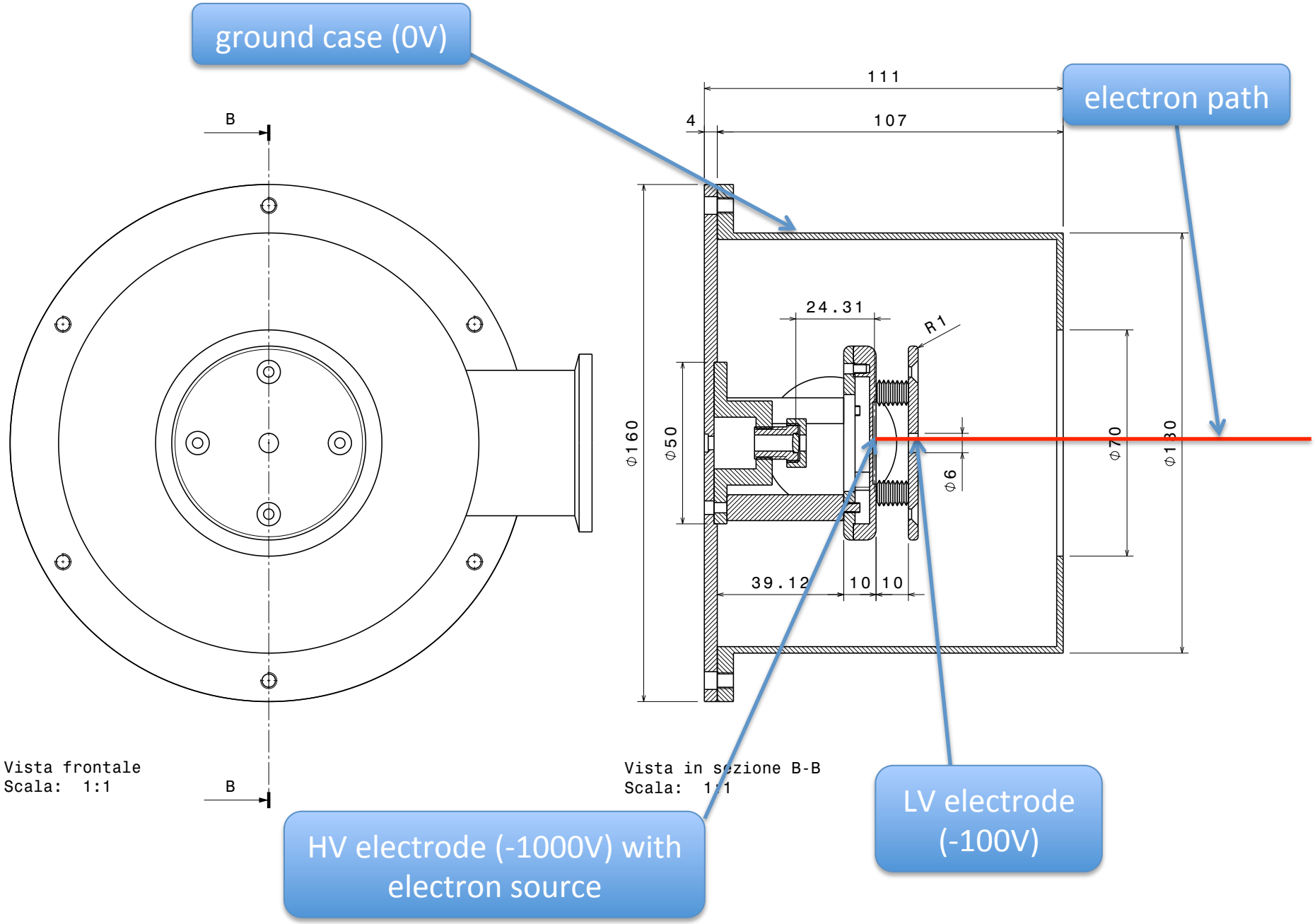

V5300
V5500
ANODE PLATE




sion layer
witzerland

E-gun simulations

PART II

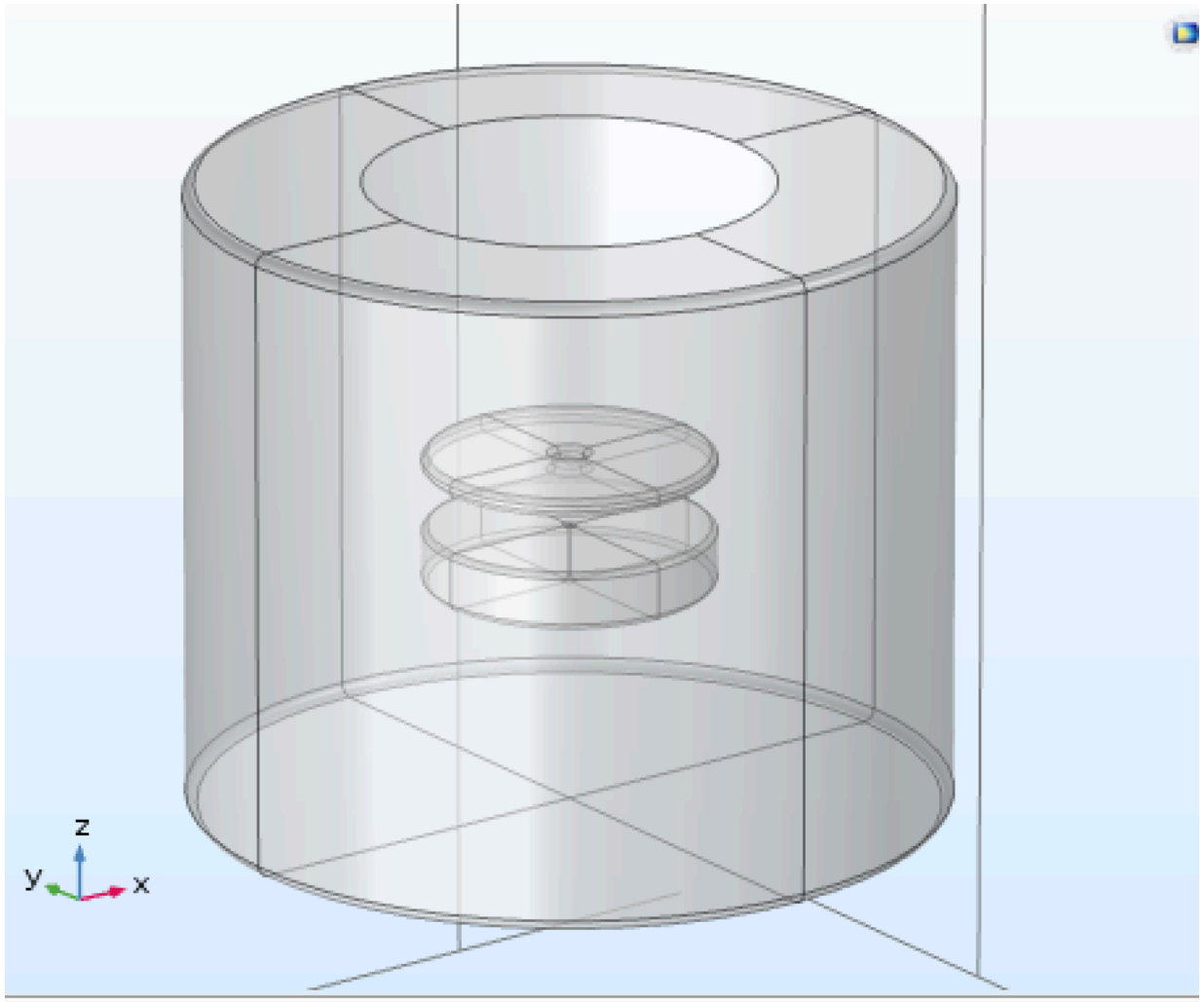

ground case (0V)
electron path
111
4
107
B
24.31
R1
Φ160
Φ50
Φ6
Φ70
Φ130
39.12
10
10
B
Vista frontale
Scala: 1:1
Vista in sezione B-B
Scala: 1:1
HV electrode (-1000V) with electron source
LV electrode (-100V)

Simulation details

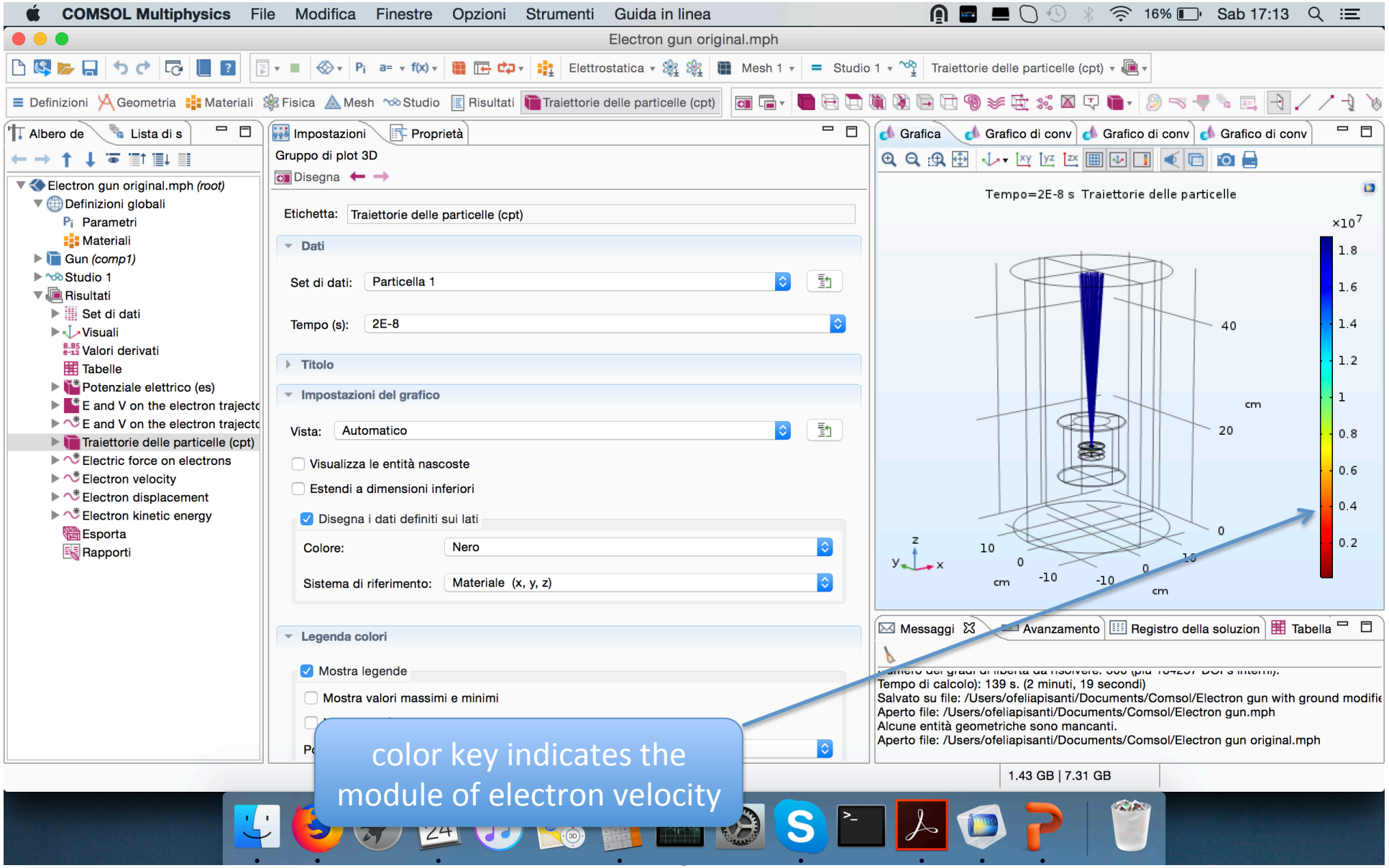
- Comsol Multiphysics 5.3 with Electrostatic and Particle tracking physics modules.
- The main geometrical characteristics of the apparatus are reproduced (to be refined).
- The simulation is performed in a given spatial region that extends outside the gun (30x50 cm rectangle).
- Electrons are emitted from a square 0.55x0.55 mm at the level of the HV electrode.
- For the moment, all the electrons emitted have the same kinetic energy, 0.05 eV, but the results have been checked against a variation of 50% of this energy.
- Preliminary results…

Original geometry:

- LV electrode with a central hole of 6 mm diameter
- ground case with a central hole of 7 cm diameter

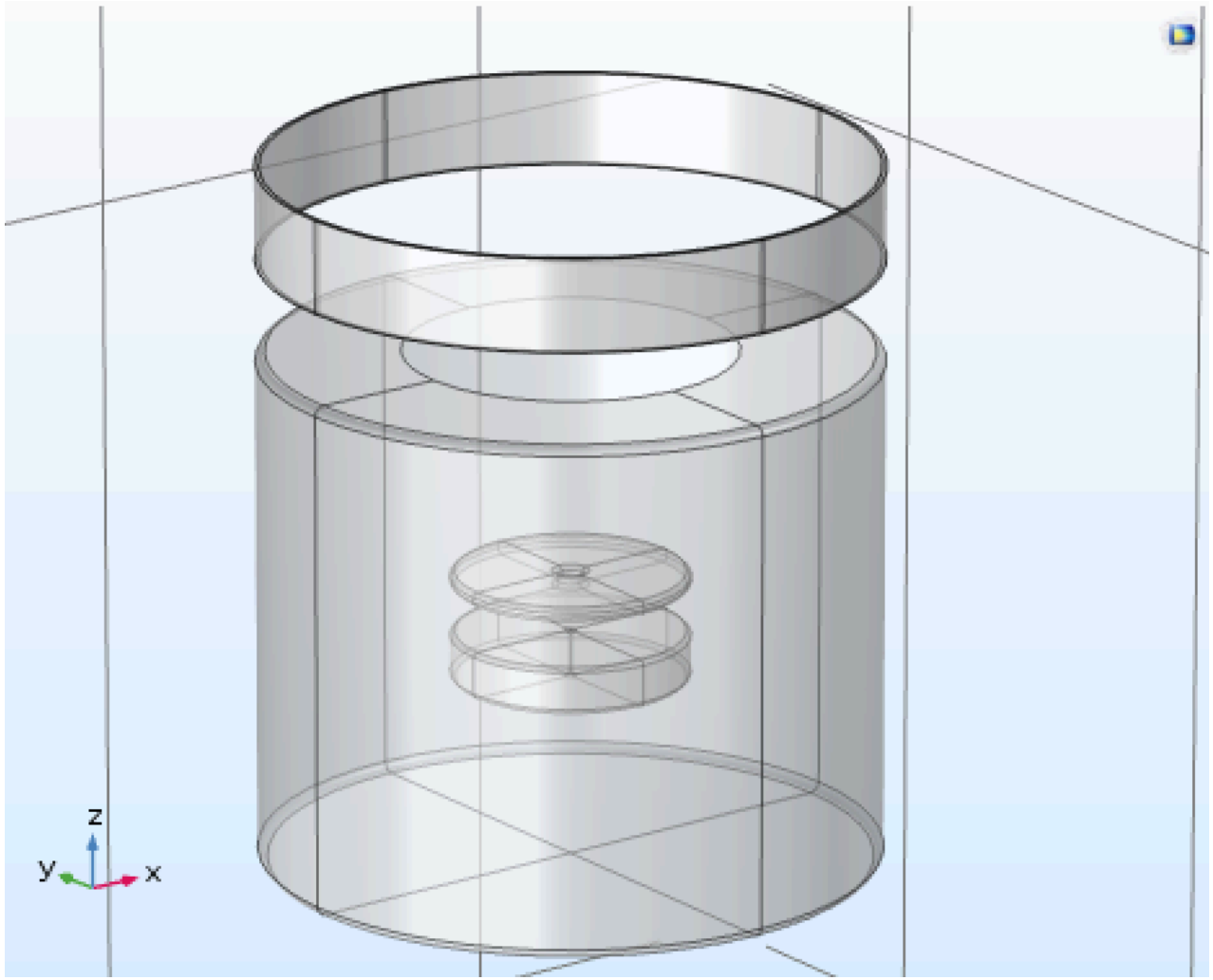


Electrons are de-focused and their energy not convenient for the extraction.

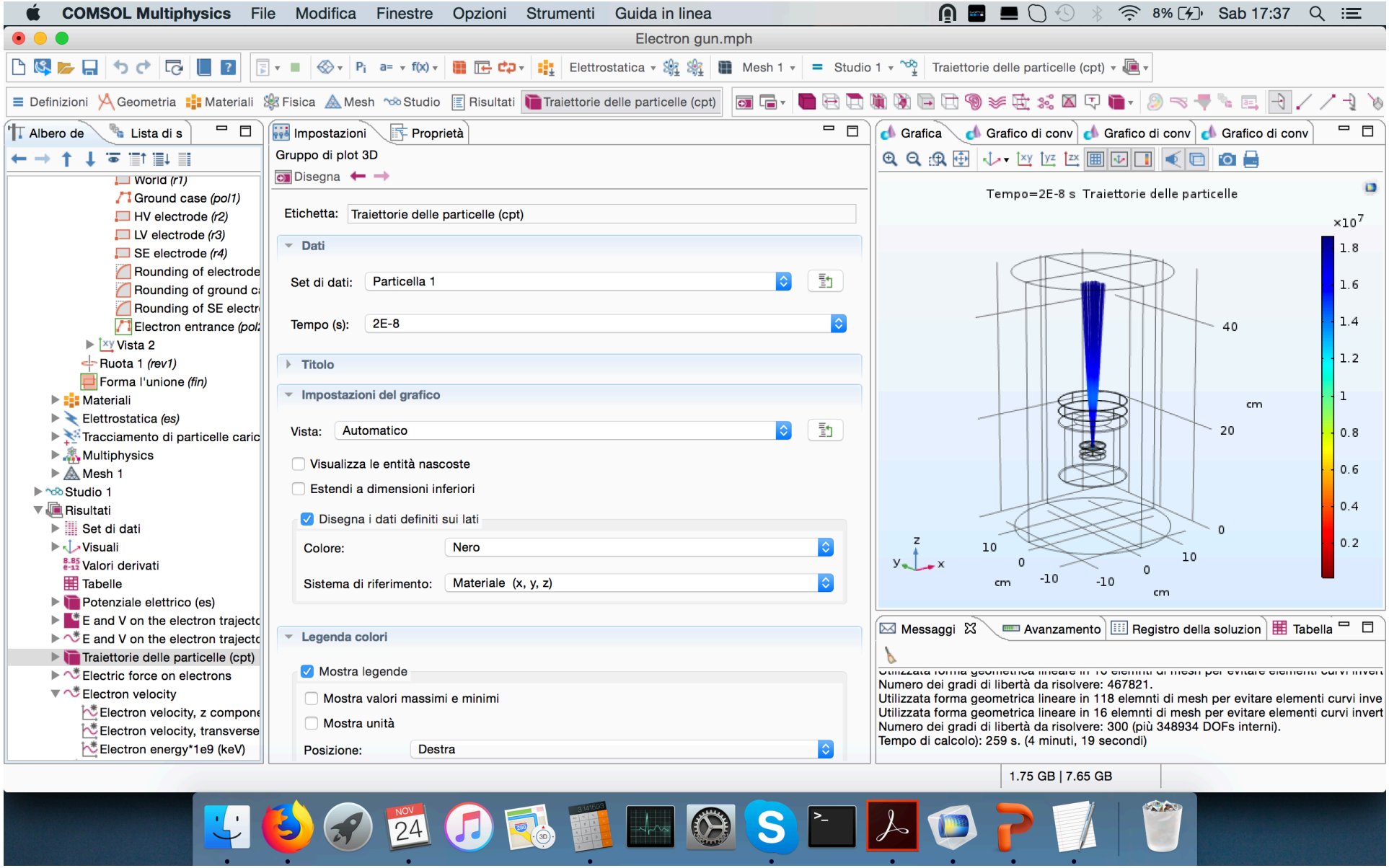


Modified geometry:

- stopping electron electrode (-980V)

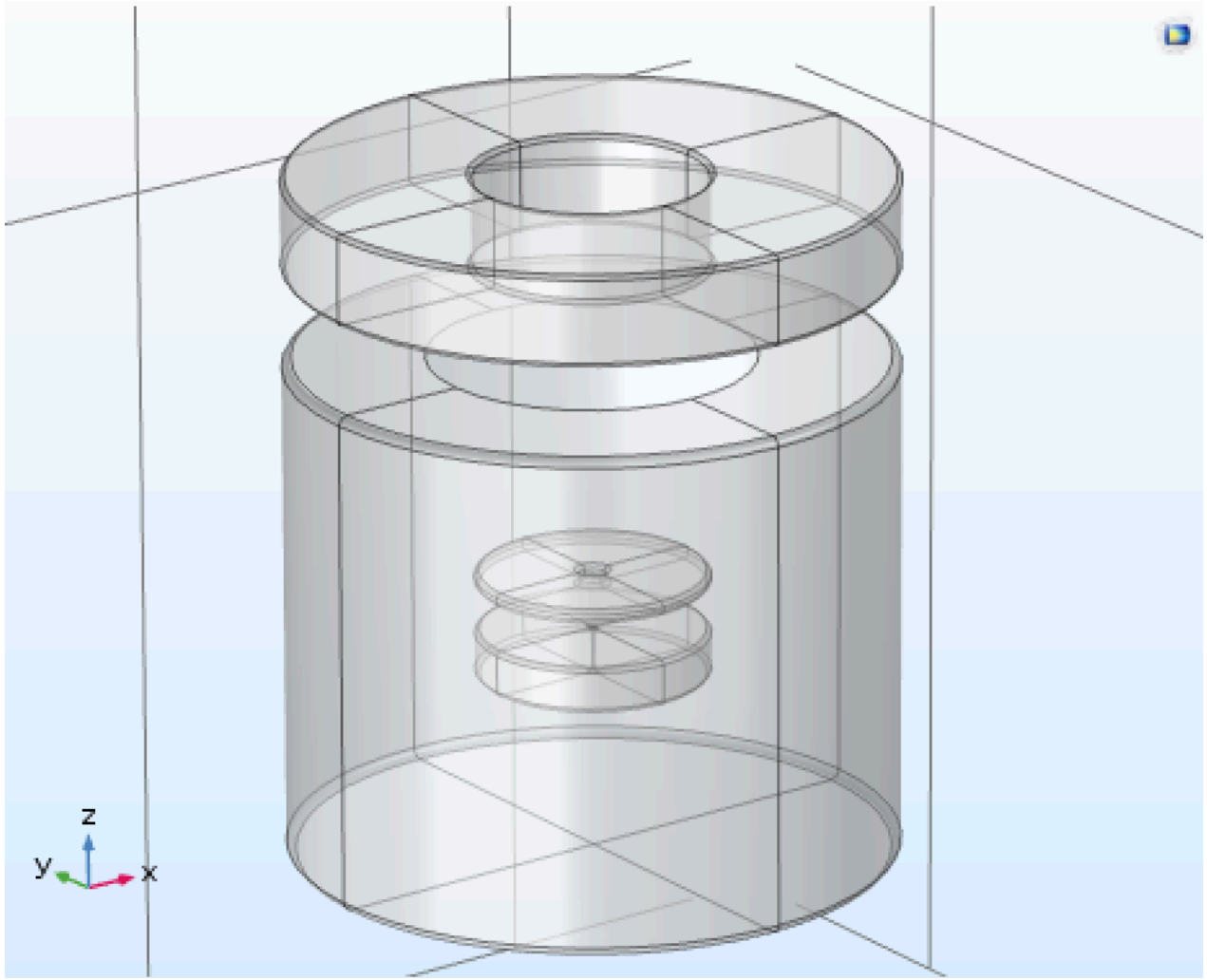


No relevant electron focusing and still electron energy is too large.

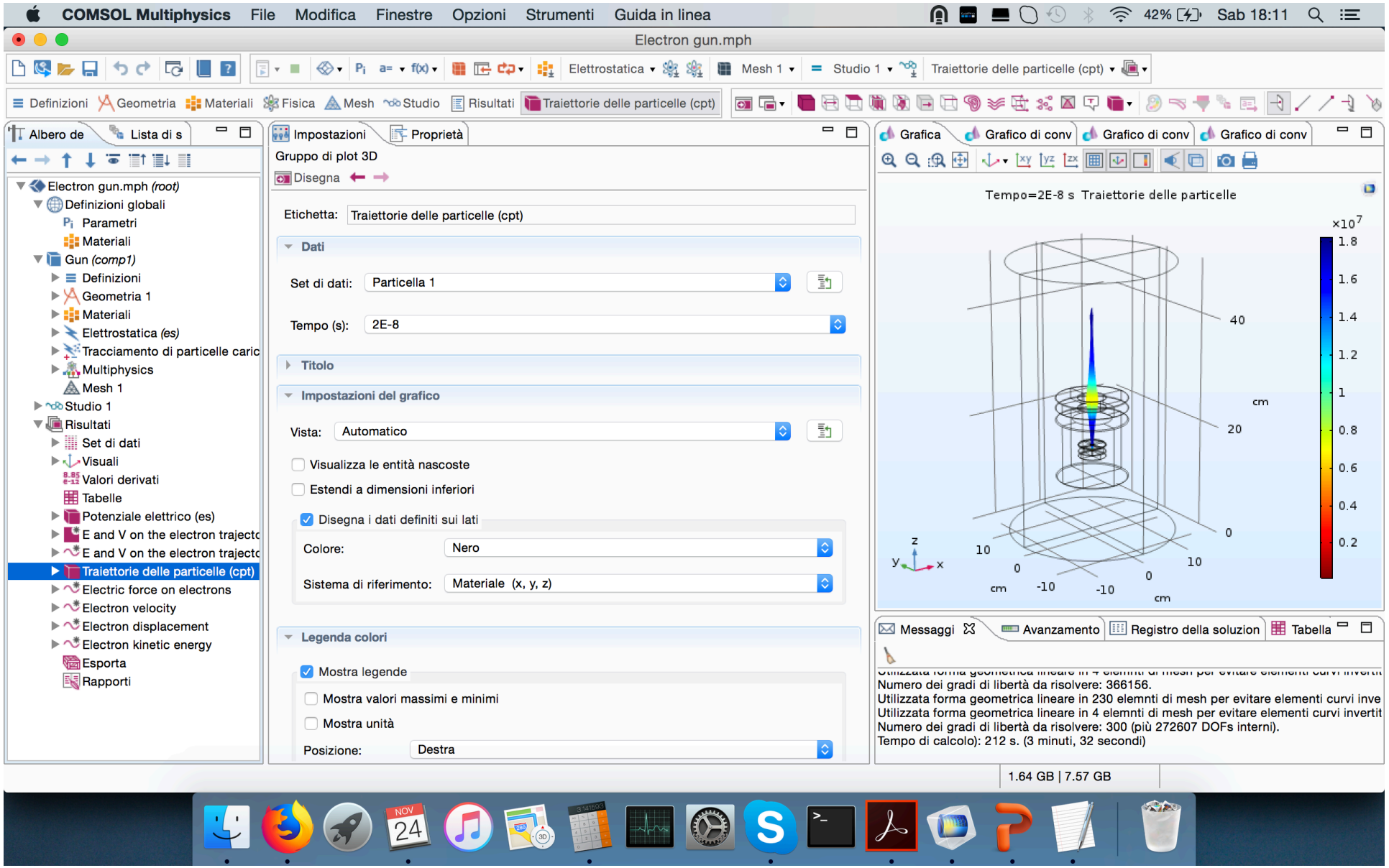


Modified geometry II (case A):

- stopping electron electrode with central hole of 5 cm diameter

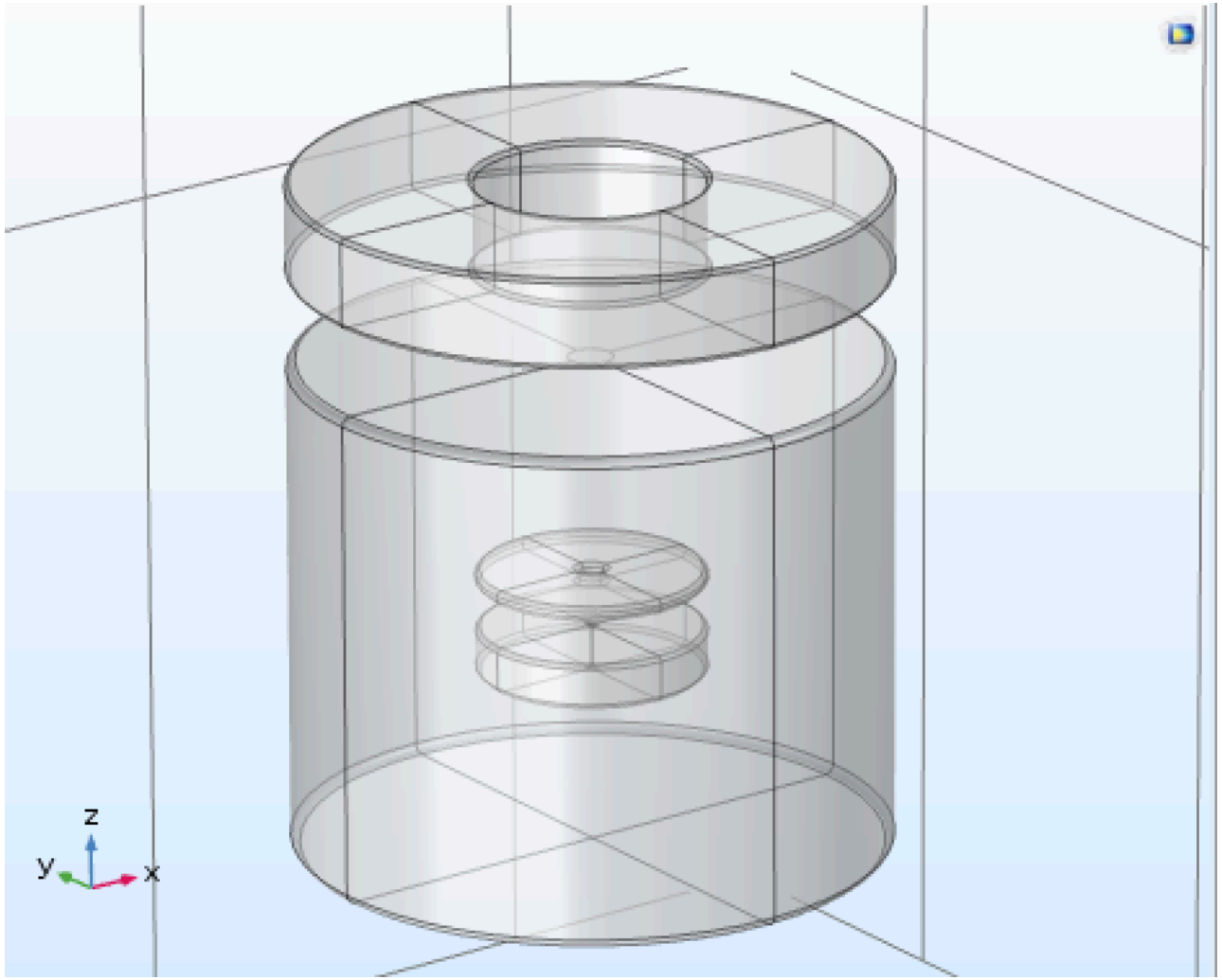


Electrons gets focused and slowed down

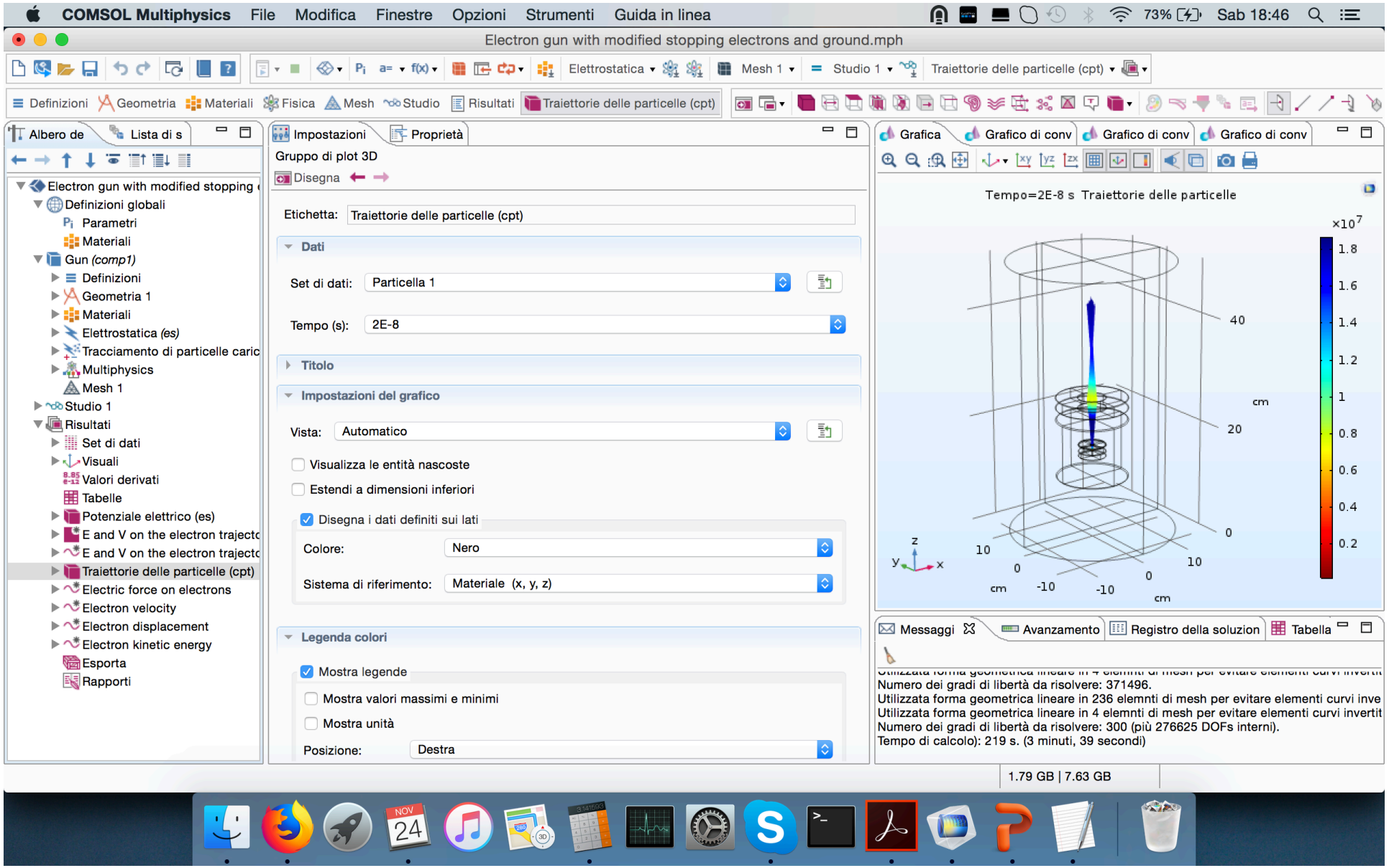


Modified geometry III (case B):

- stopping electron electrode with central hole of 5 cm diameter
- ground case with central hole of 1 cm diameter

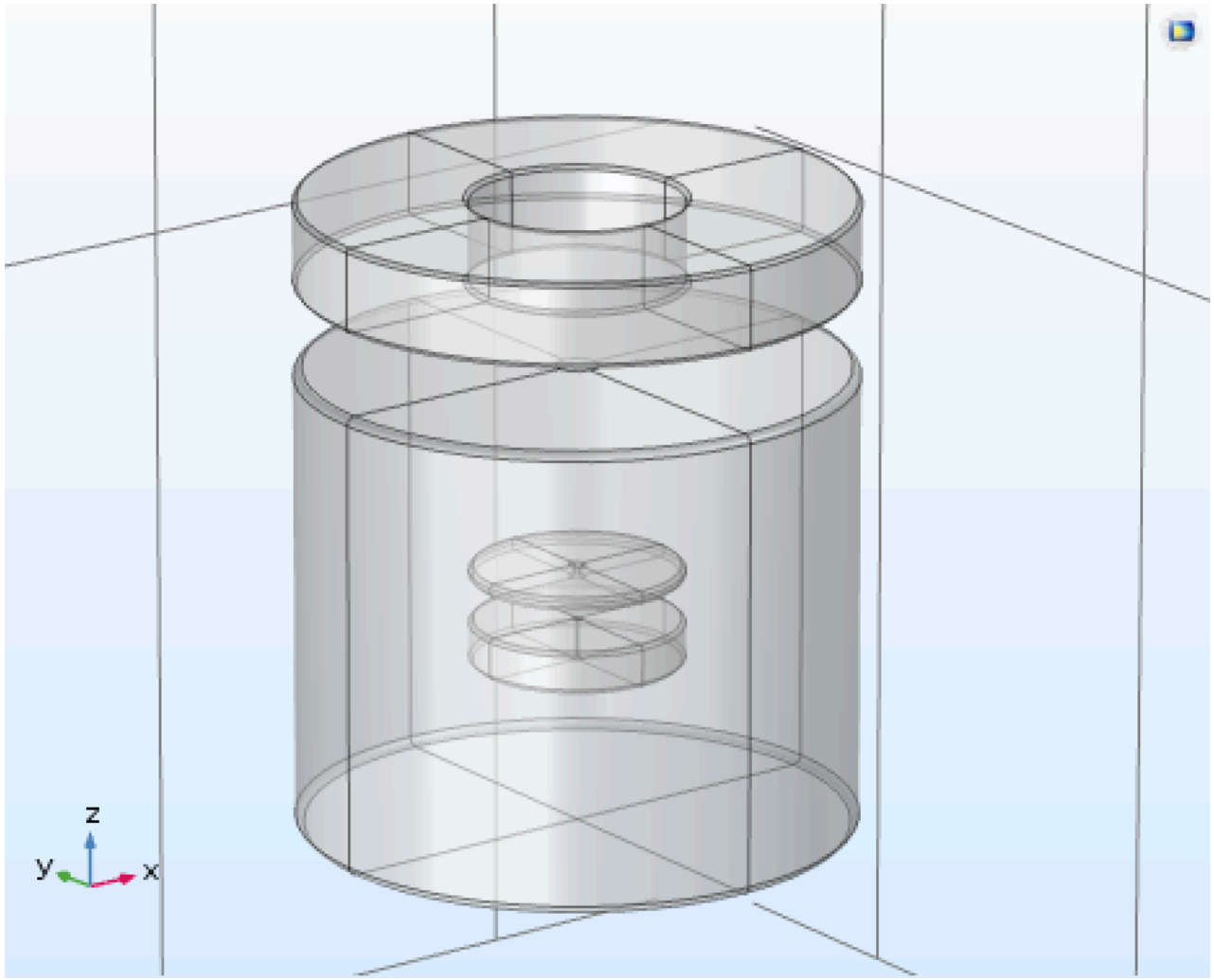


Slight improved focusing…

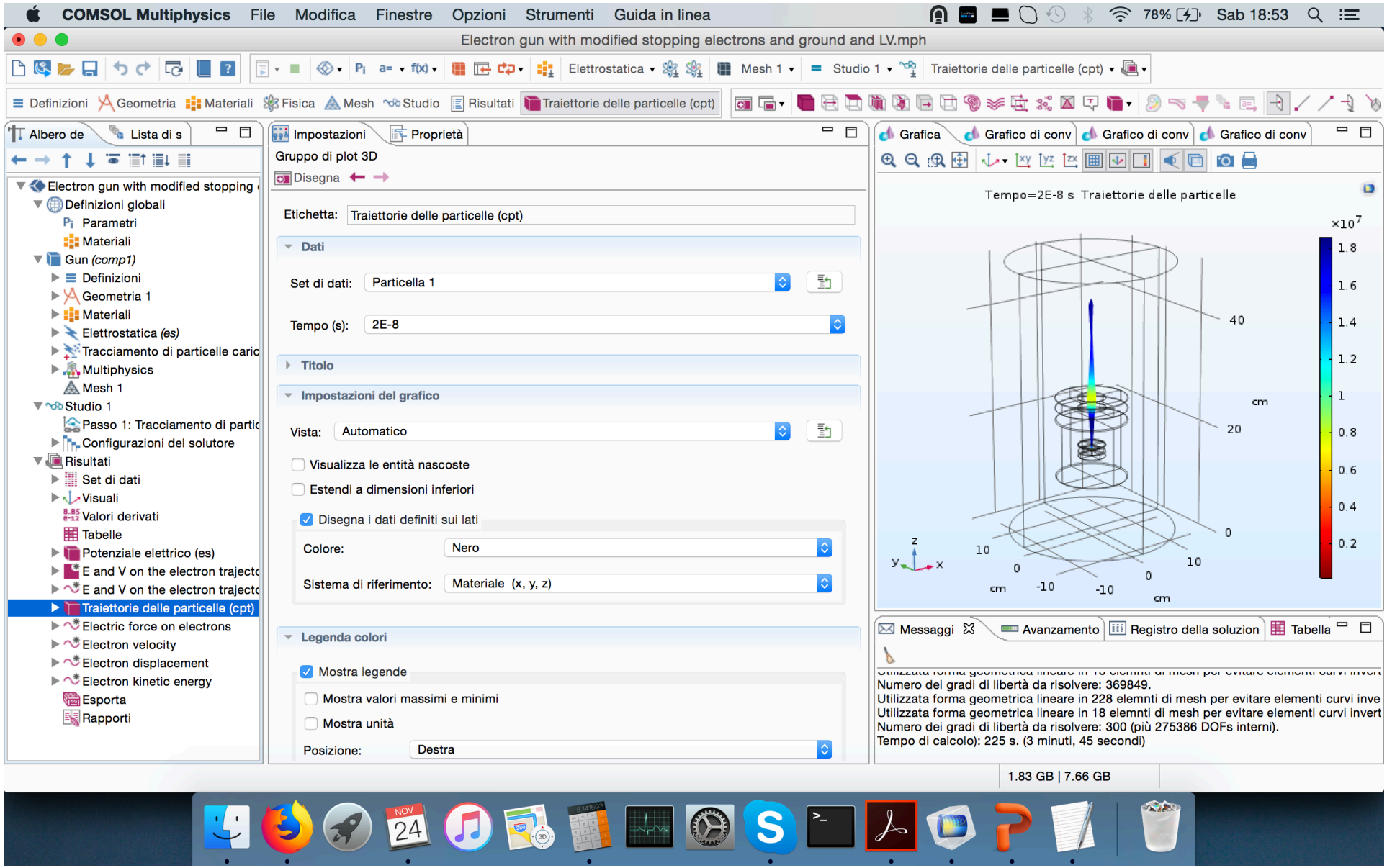


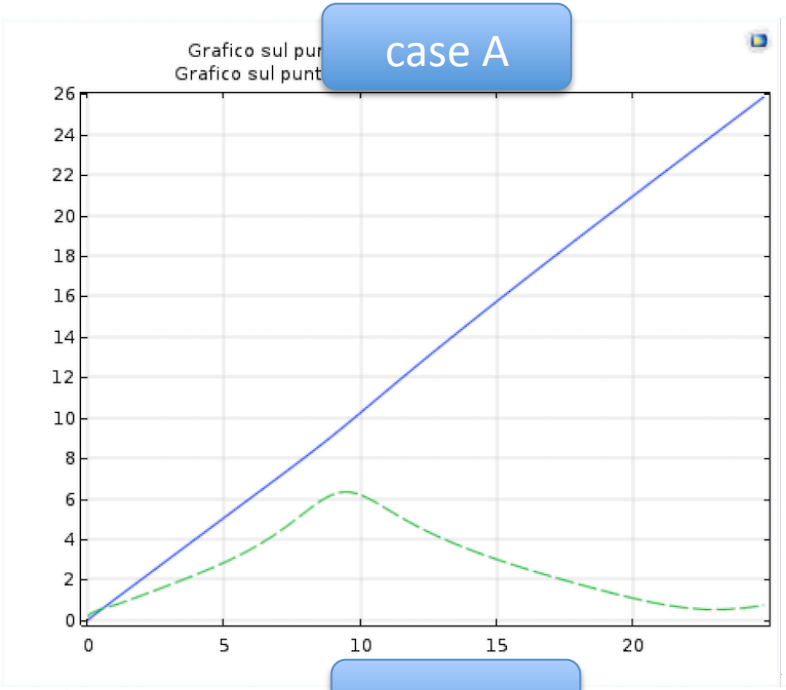
Modified geometry IV (case C):

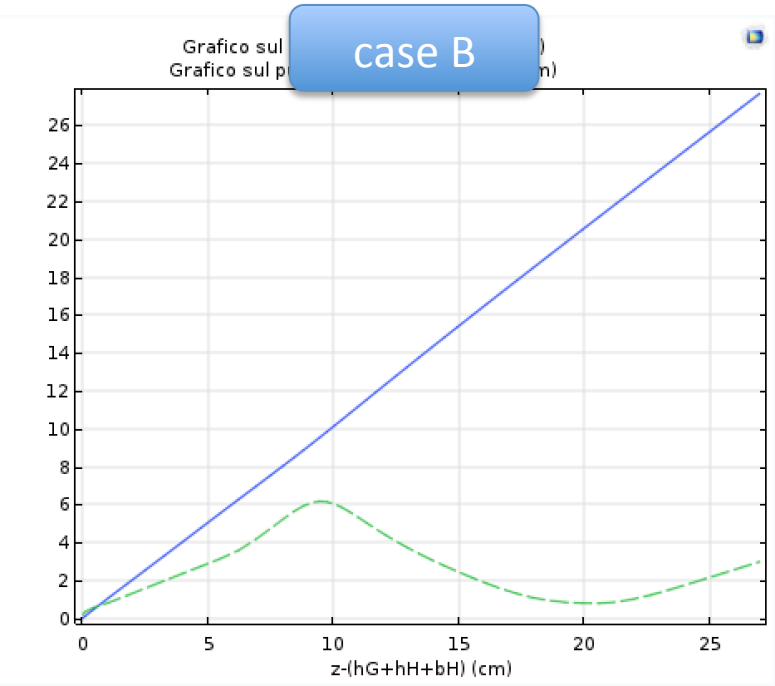
- stopping electron electrode with central hole of 5 cm diameter
- ground case with central hole of 1 cm diameter
- LV electrode with central hole of 2 mm diameter

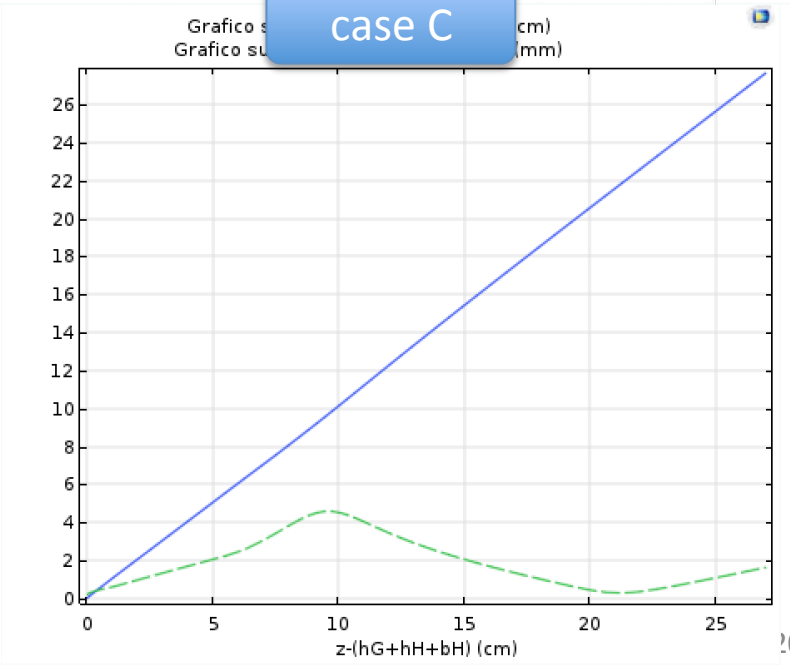


… further improvement.





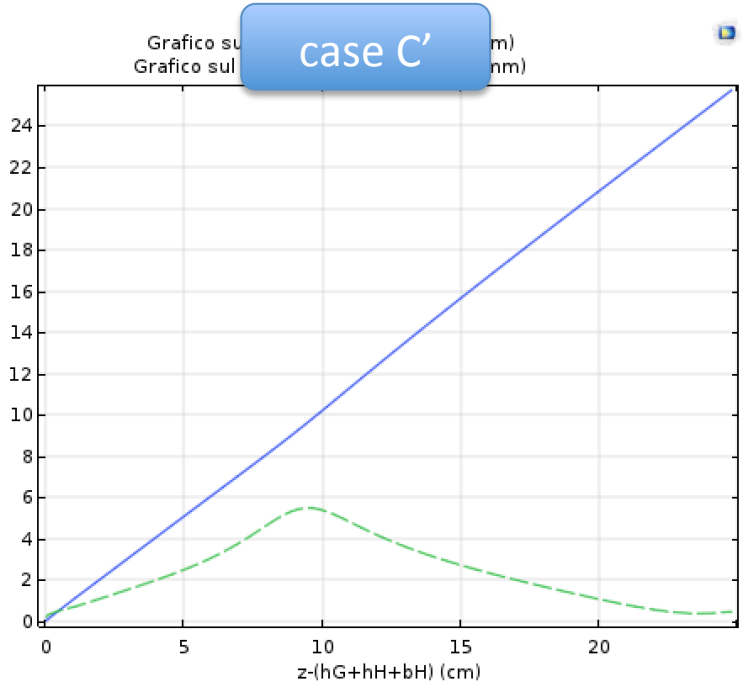


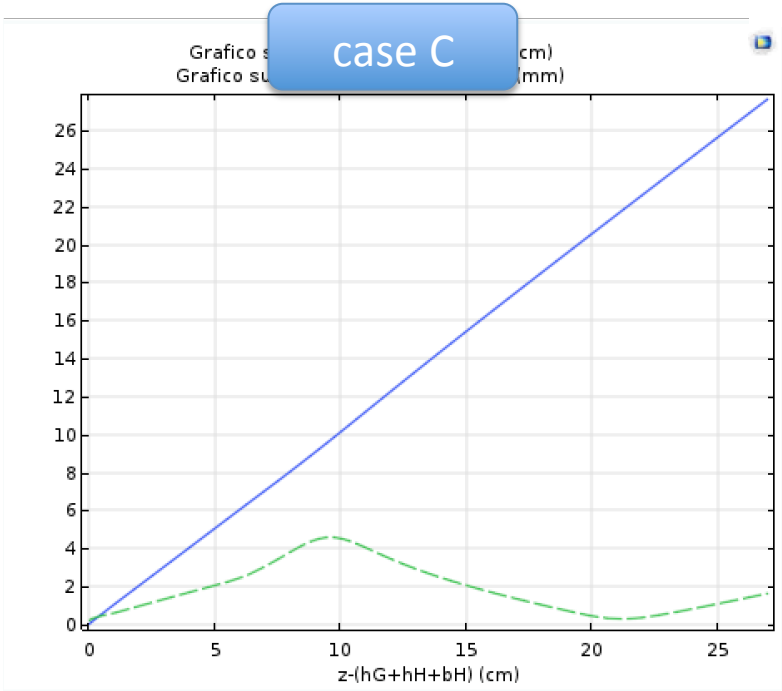


Average electron transverse displacement (green dashed line, in mm) as a function of the distance from the electron injection point.

Case C': like case C, but with ground case original

This implies that the modification in the ground case can help.





Average electron transverse displacement (green dashed line, in mm) as a function of the distance from the electron injection point.

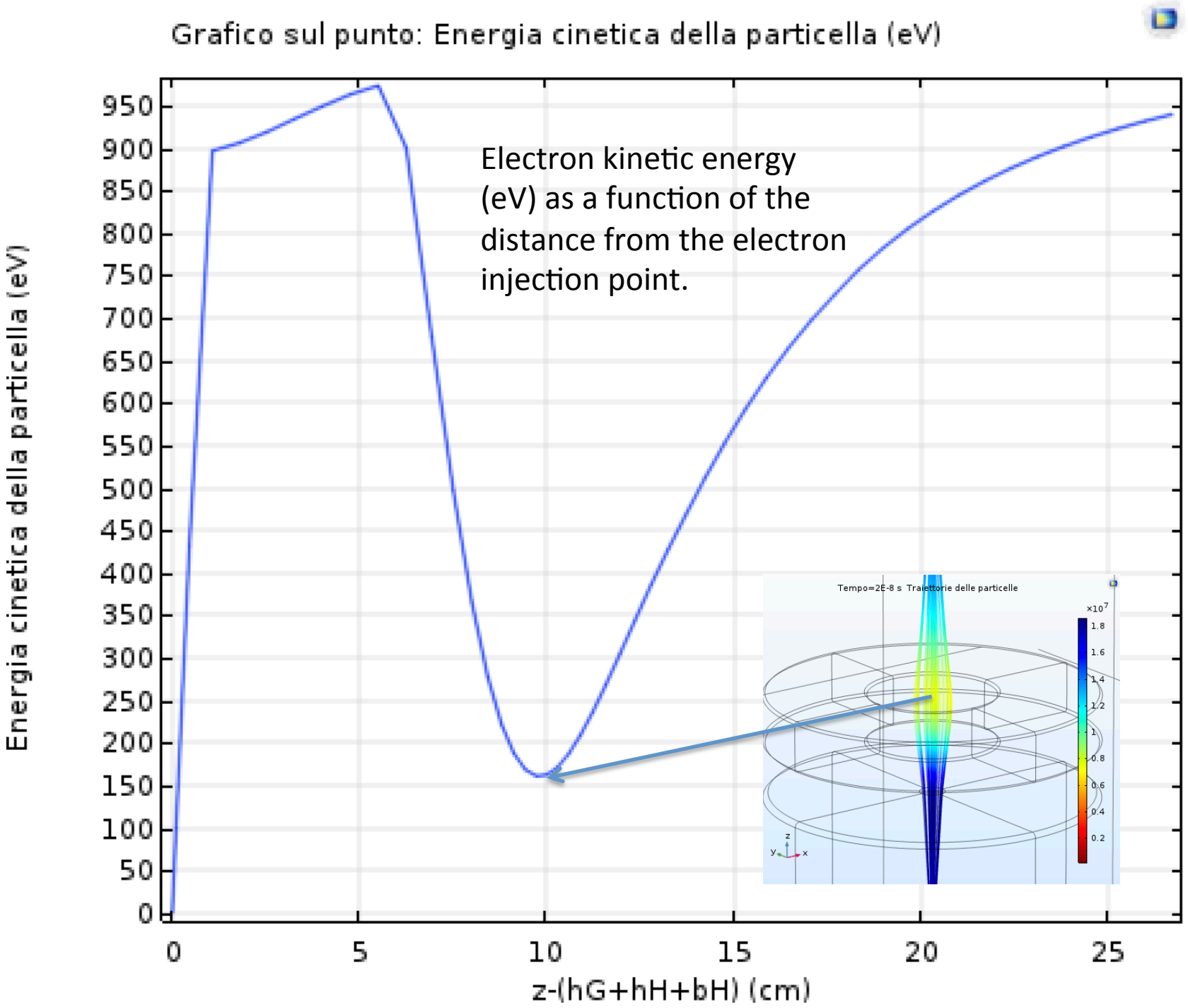
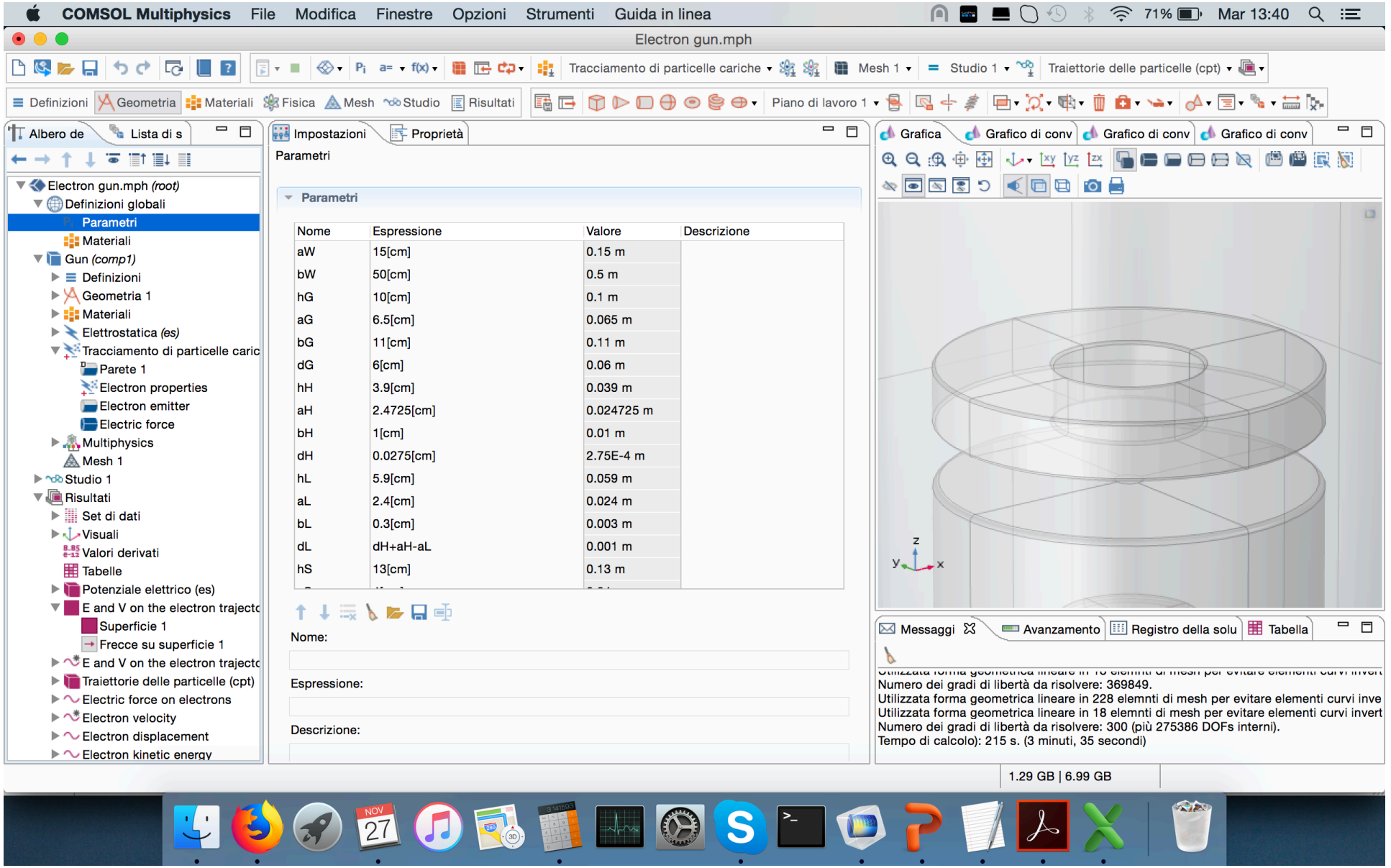
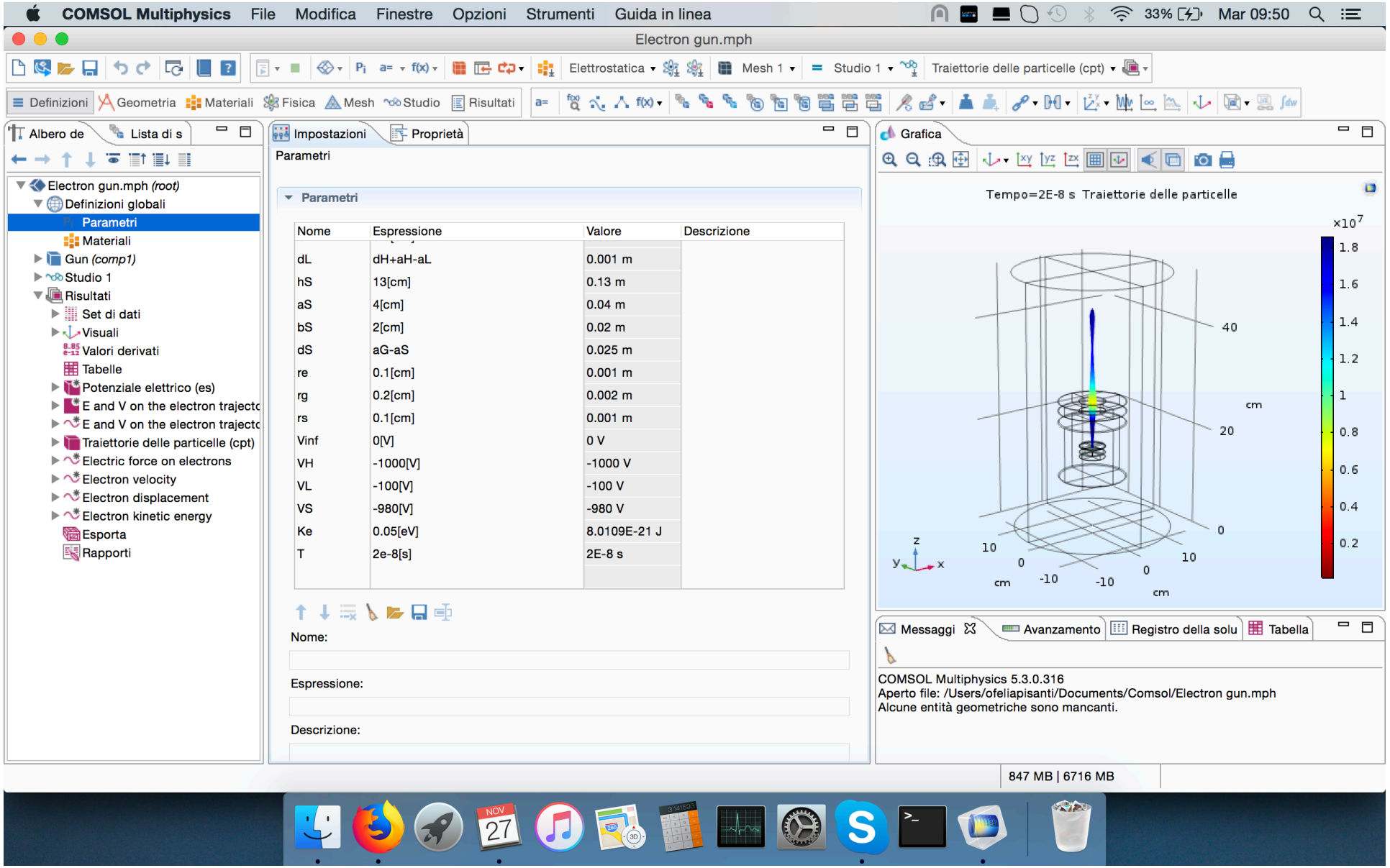


Grafico sul punto: Energia cinetica della particella (eV)
Energia cinetica della particella (eV)
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
z-(hG+hH+bH) (cm)
Electron kinetic energy (eV) as a function of the distance from the electron injection point.
Tempo=2E-8 s Traiettorie delle particelle
x10^7
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
z
y
x

BACKUP SLIDES


COMSOL Multiphysics File Modifica Finestre Opzioni Strumenti Guida in linea
Mar 13:40
Electron gun.mph
Definizioni Geometria Materiali Fisica Mesh Studio Risultati
Mesh 1
Studio 1
Piano di lavoro 1
Albero de
Lista di s
Electron gun.mph (root)
Definizioni globali
Parametri
Materiali
Gun (comp1)
Definizioni
Geometria 1
Materiali
Elettrostatica (es)
Parete 1
Electron properties
Electron emitter
Electric force
Multiphysics
Mesh 1
Studio 1
Risultati
Set di dati
Visuali
Valori derivati
Tabelle
Potenziale elettrico (es)
Superficie 1
Frecce su superficie 1
Traiettorie delle particelle (cpt)
Electric force on electrons
Electron velocity
Electron displacement
Electron kinetic energy
Impostazioni
Proprietà
Parametri
Parametri
Nome
Espressione
Valore
Descrizione
aW 15[cm] 0.15 m
bW 50[cm] 0.5 m
hG 10[cm] 0.1 m
aG 6.5[cm] 0.065 m
bG 11[cm] 0.11 m
dG 6[cm] 0.06 m
hH 3.9[cm] 0.039 m
aH 2.4725[cm] 0.024725 m
bH 1[cm] 0.01 m
dH 0.0275[cm] 2.75E-4 m
hL 5.9[cm] 0.059 m
aL 2.4[cm] 0.024 m
bL 0.3[cm] 0.003 m
dL dH+aH-aL 0.001 m
hS 13[cm] 0.13 m
Nome:
Espressione:
Descrizione:
Grafica
Grafico di conv
Grafico di conv
Grafico di conv
z
y
x
Messaggi
Avanzamento
Registro della solu
Tabella
Numero dei gradi di libertà da risolvere: 369849.
Utilizzata forma geometrica lineare in 228 elemnti di mesh per evitare elementi curvi inve
Utilizzata forma geometrica lineare in 18 elemnti di mesh per evitare elementi curvi invert
Numero dei gradi di libertà da risolvere: 300 (più 275386 DOFs interni).
Tempo di calcolo): 215 s. (3 minuti, 35 secondi)
1.29 GB | 6.99 GB


COMSOL Multiphysics File Modifica Finestre Opzioni Strumenti Guida in linea
Mar 09:50
Electron gun.mph
Elettrostatica
Mesh 1
Studio 1
Traiettorie delle particelle (cpt)
Definizioni Geometria Materiali Fisica Mesh Studio Risultati
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Valori derivati
Tabelle
Potenziale elettrico (es)
E and V on the electron trajecto
E and V on the electron trajecto
Traiettorie delle particelle (cpt)
Electric force on electrons
Electron velocity
Electron displacement
Electron kinetic energy
Esporta
Rapporti
Impostazioni
Proprietà
Parametri
Parametri
Nome
Espressione
Valore
Descrizione
dL dH+aH-aL 0.001 m
hS 13[cm] 0.13 m
aS 4[cm] 0.04 m
bS 2[cm] 0.02 m
dS aG-aS 0.025 m
re 0.1[cm] 0.001 m
rg 0.2[cm] 0.002 m
rs 0.1[cm] 0.001 m
Vinf 0[V] 0 V
VH -1000[V] -1000 V
VL -100[V] -100 V
VS -980[V] -980 V
Ke 0.05[eV] 8.0109E-21 J
T 2e-8[s] 2E-8 s
Nome:
Espressione:
Descrizione:
Grafica
Tempo=2E-8 s Traiettorie delle particelle
×10^7
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
40
20
0
cm
10
0
-10
-10
0
10
cm
cm
z
y
x
Messaggi
Avanzamento
Registro della solu
Tabella
COMSOL Multiphysics 5.3.0.316
Aperto file: /Users/ofeliapisanti/Documents/Comsol/Electron gun.mph
Alcune entità geometriche sono mancanti.
847 MB | 6716 MB

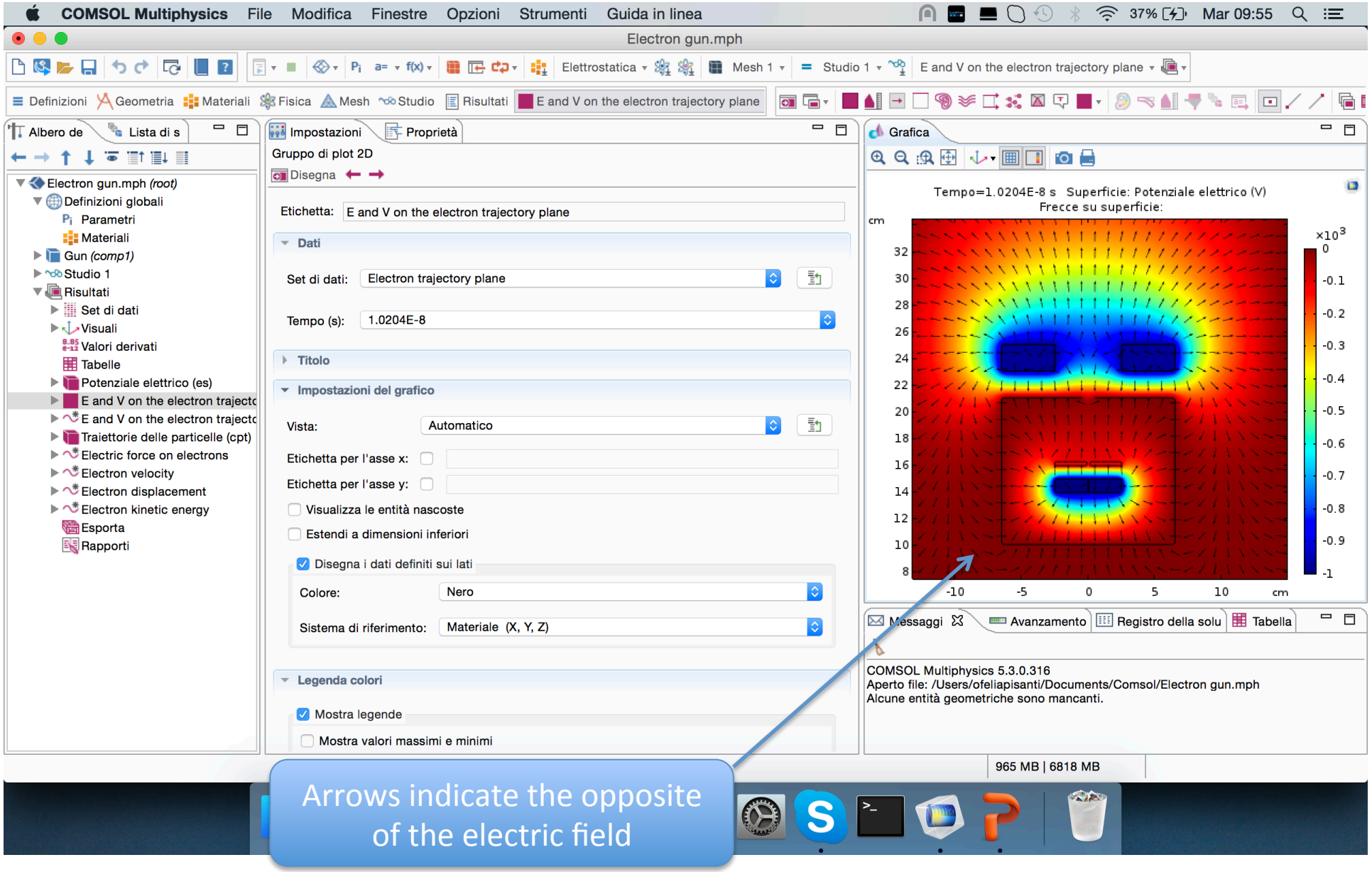
COMSOL Multiphysics File Modifica Finestre Opzioni Strumenti Guida in linea
Electron gun.mph
Definizioni Geometria Materiali Fisica Mesh Studio Risultati E and V on the electron trajectory plane
Albero de Lista di s
Electron gun.mph (root)
Definizioni globali
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Tabelle
Potenziale elettrico (es)
E and V on the electron trajecto
E and V on the electron trajecto
Traiettorie delle particelle (cpt)
Electric force on electrons
Electron velocity
Electron displacement
Electron kinetic energy
Esporta
Rapporti
Impostazioni Proprietà
Gruppo di plot 2D
Disegna
Etichetta: E and V on the electron trajectory plane
Dati
Set di dati: Electron trajectory plane
Tempo (s): 1.0204E-8
Titolo
Impostazioni del grafico
Vista: Automatico
Etichetta per l'asse x:
Etichetta per l'asse y:
Visualizza le entità nascoste
Estendi a dimensioni inferiori
Disegna i dati definiti sui lati
Colore: Nero
Sistema di riferimento: Materiale (X, Y, Z)
Legenda colori
Mostra legende
Mostra valori massimi e minimi
Grafica
Tempo=1.0204E-8 s Superficie: Potenziale elettrico (V)
Frecce su superficie:
cm
×10^3
Messaggi Avanzamento Registro della solu Tabella
COMSOL Multiphysics 5.3.0.316
Aperto file: /Users/ofeliapisanti/Documents/Comsol/Electron gun.mph
Alcune entità geometriche sono mancanti.
965 MB | 6818 MB
Arrows indicate the opposite of the electric field