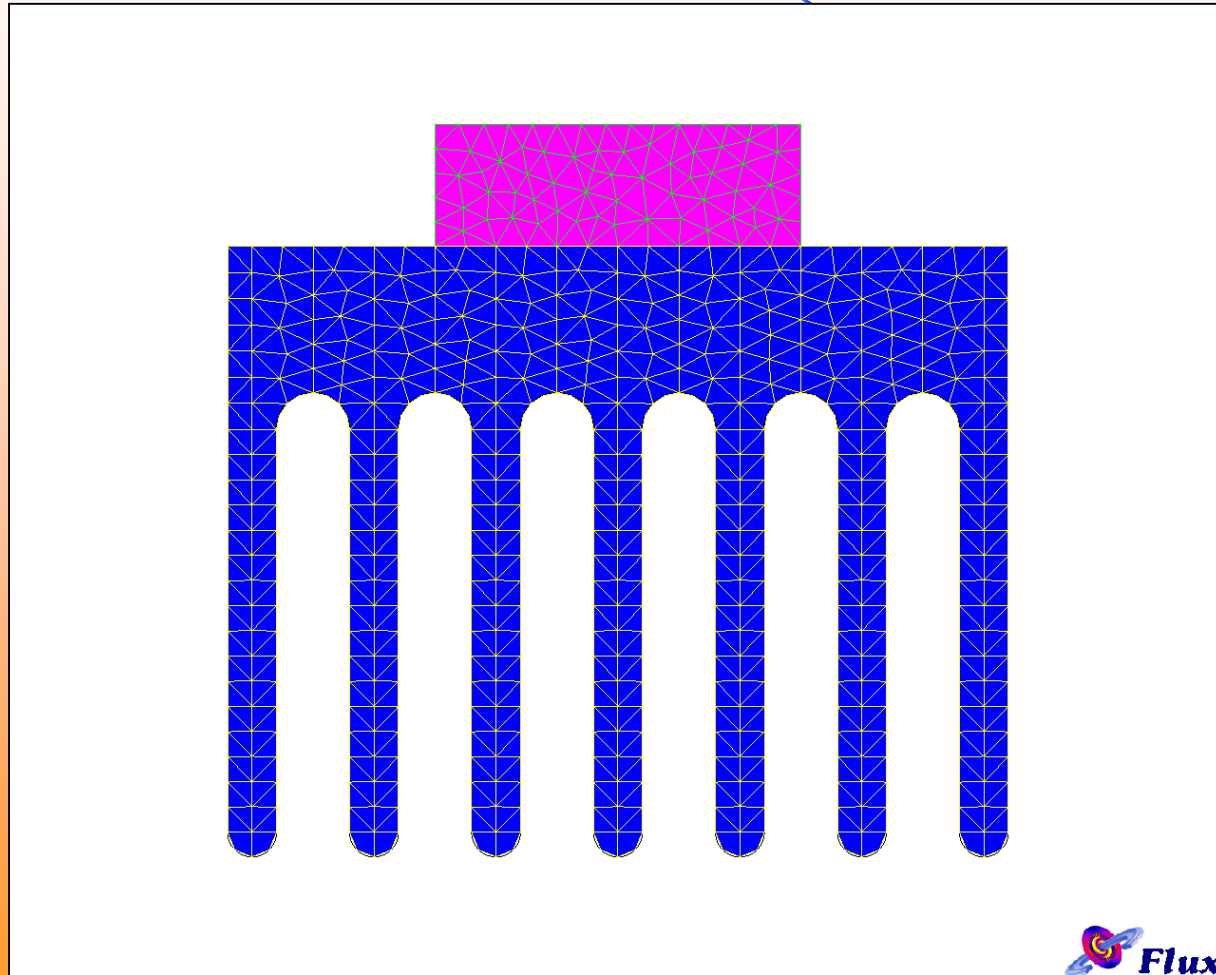


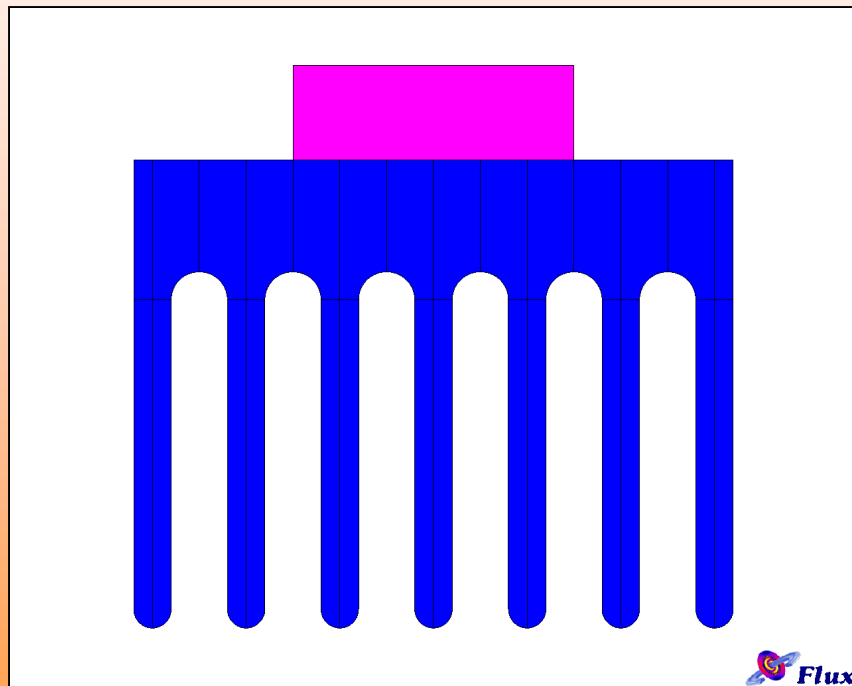
## *ANALISI TERMICA CON FLUX*

### ➤ Esempi

## ➤ Geometria & Mesh



## ➤ Physics



**SILICONE**

- Conducibilità Termica: **78 W/m °C**
- Capacità termica volumetrica: **1750000 J/m<sup>3</sup> °C**

**ALLUMINIO**

Conducibilità Termica

$$K(T) = K_a(1 + (T - T_0))$$

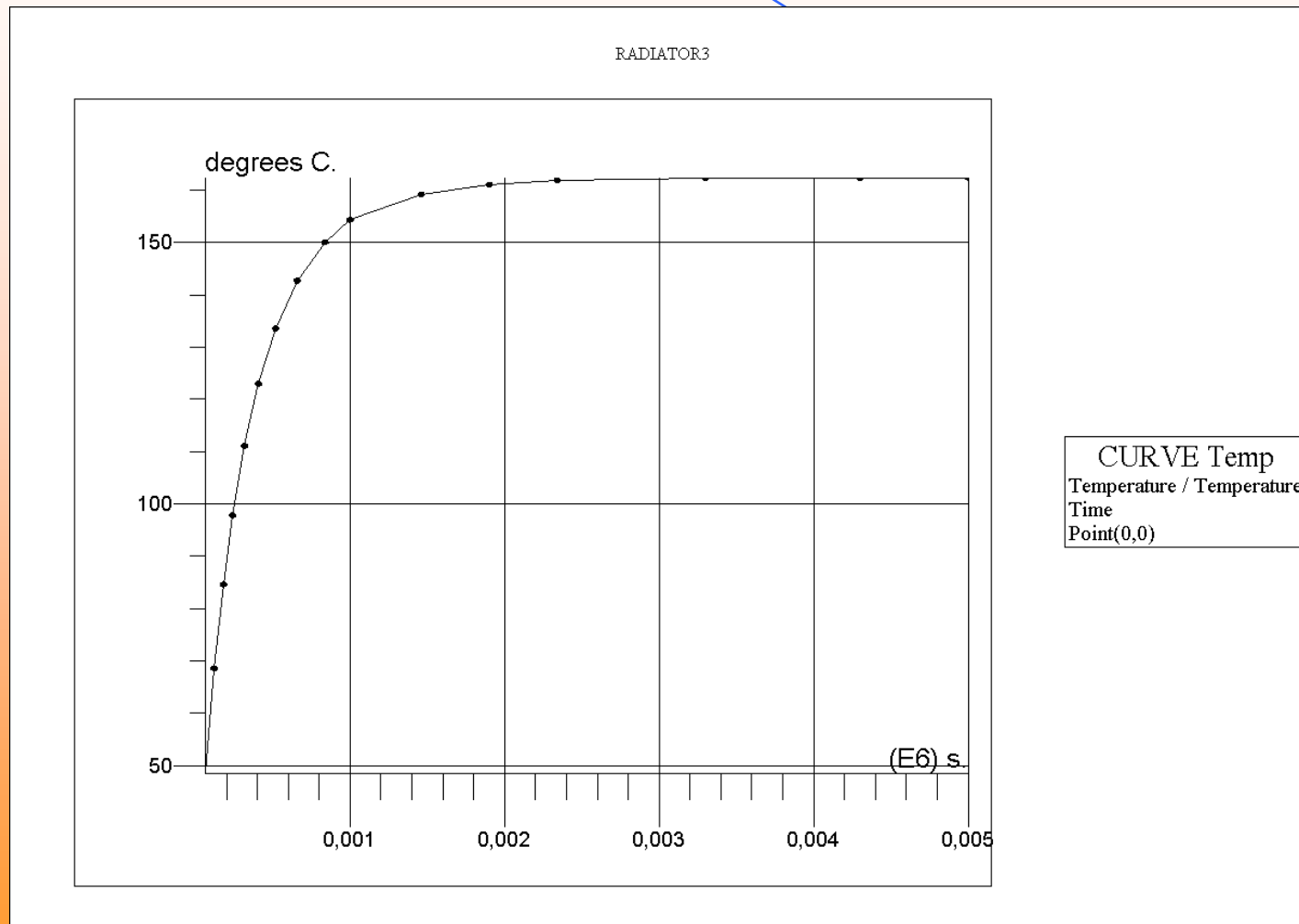
- $a = -0.0003 \text{ 1/}^\circ\text{C}$
- $K_a = 204 \text{ W/m }^\circ\text{C}$
- $T_0 = 0 \text{ }^\circ\text{C}$

Capacità termica

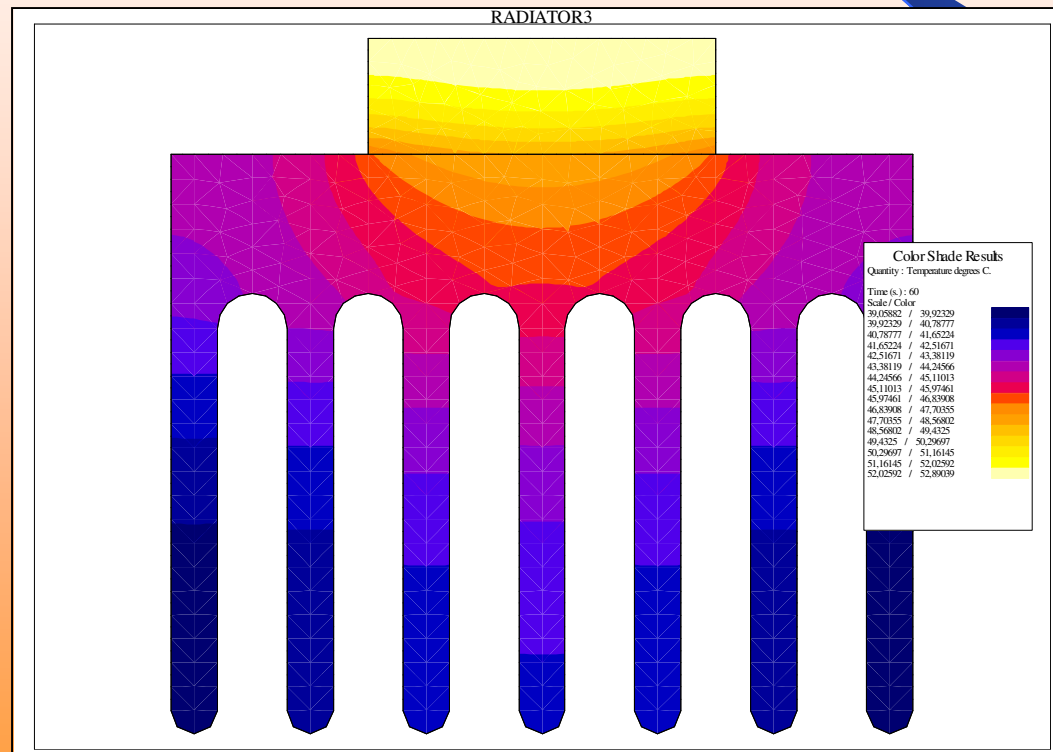
$$\text{RhoCp}(T) = \text{RhoCp}_a(1 + (T - T_0))$$

- $a = -0.003 \text{ 1/}^\circ\text{C}$
- $K_a = 2320000 \text{ W/m }^\circ\text{C}$
- $T_0 = 0 \text{ }^\circ\text{C}$

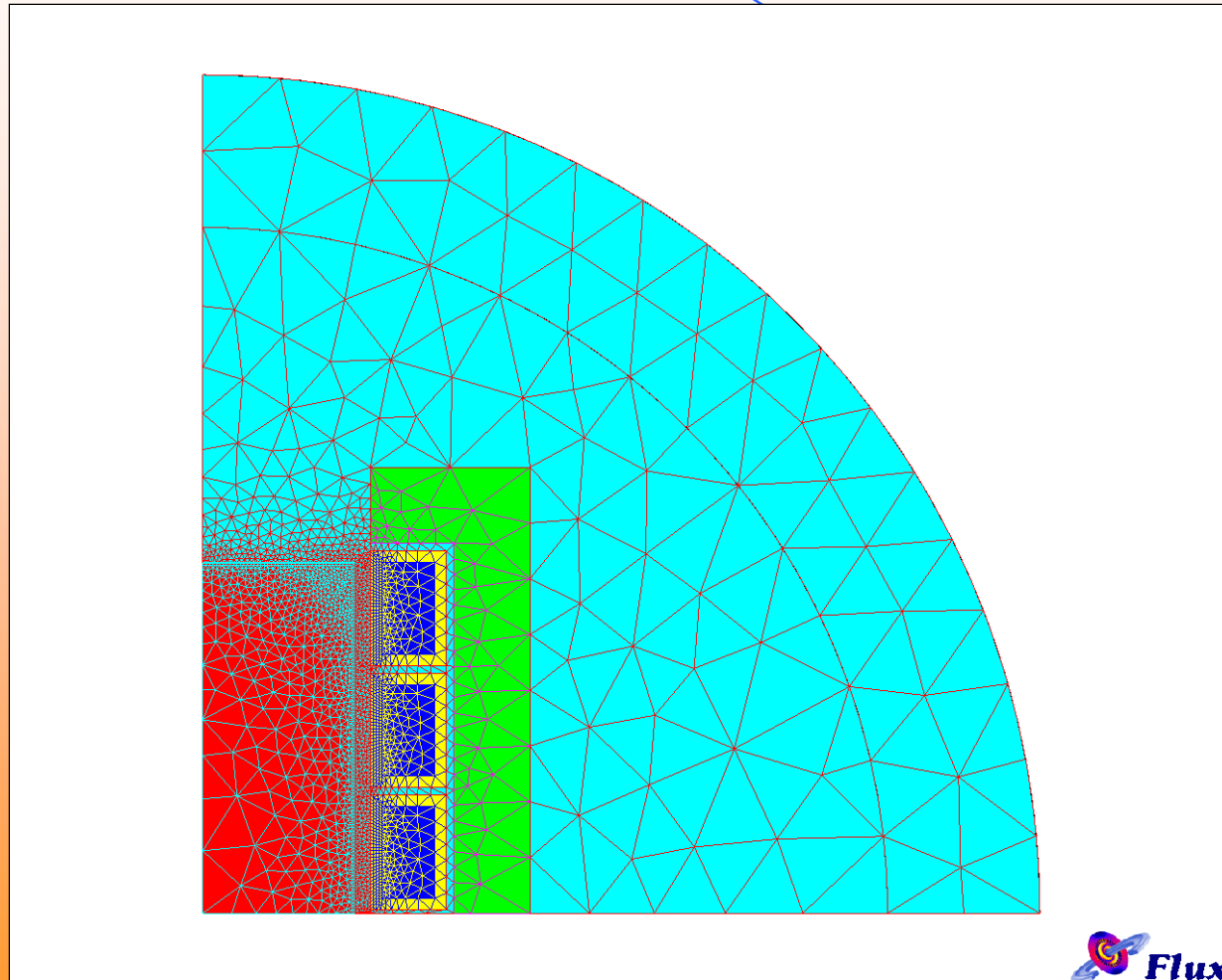
## ➤ Risultati



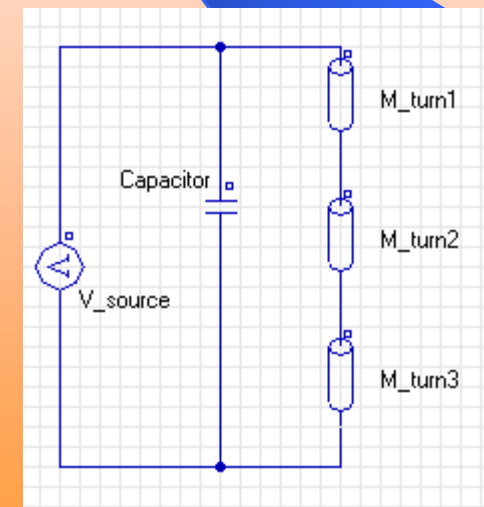
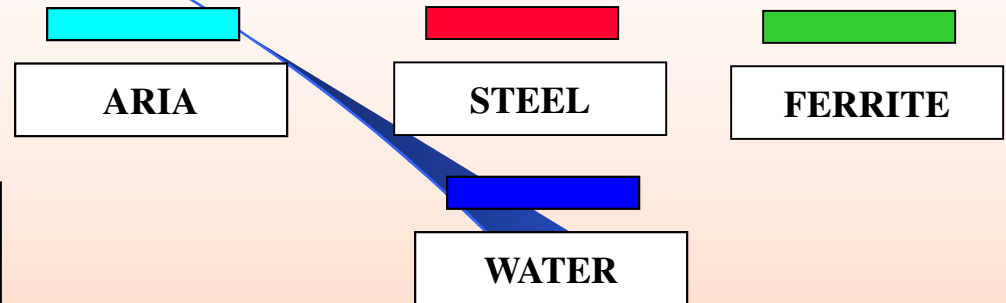
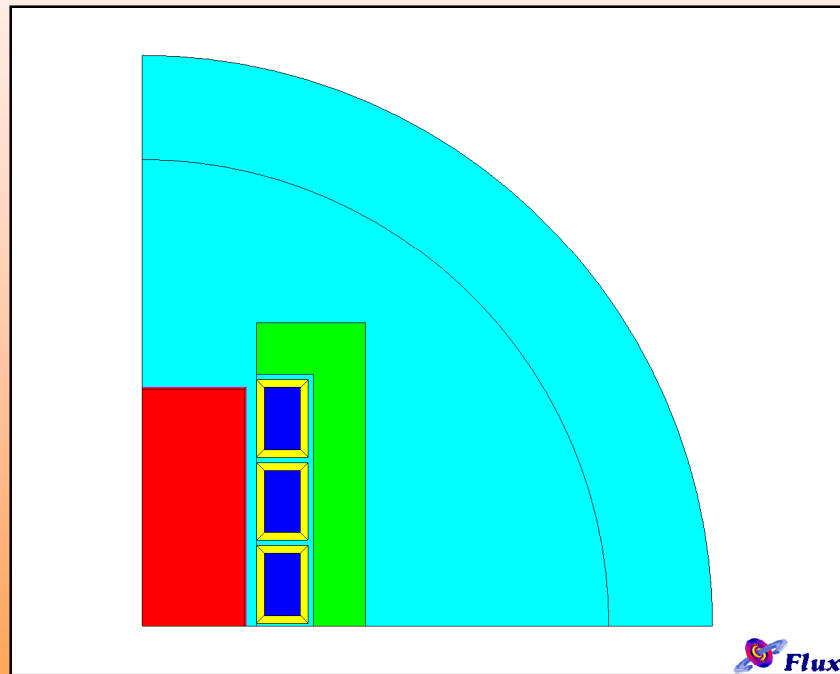
## Video della Simulazione



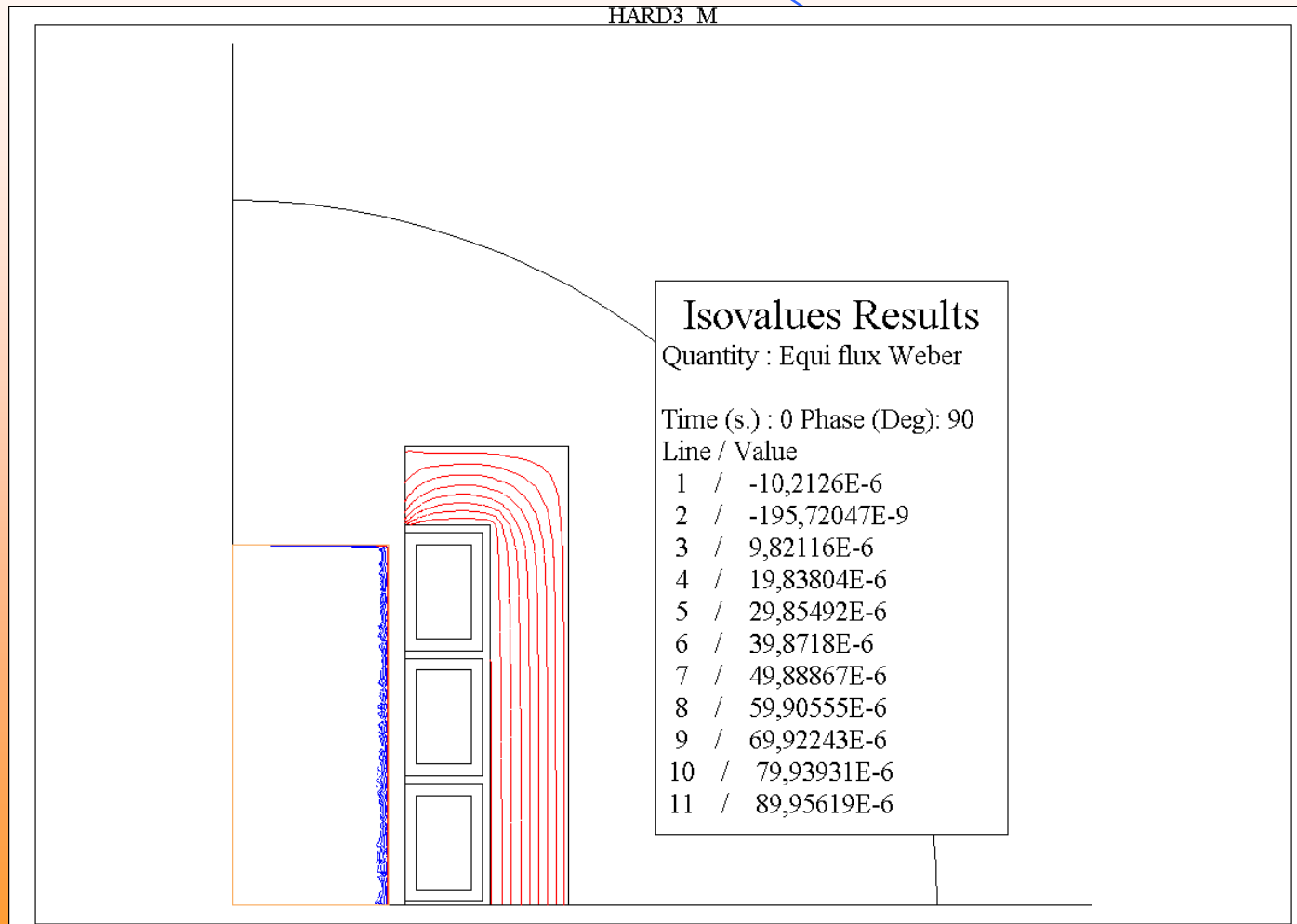
➤ Geometria & Mesh



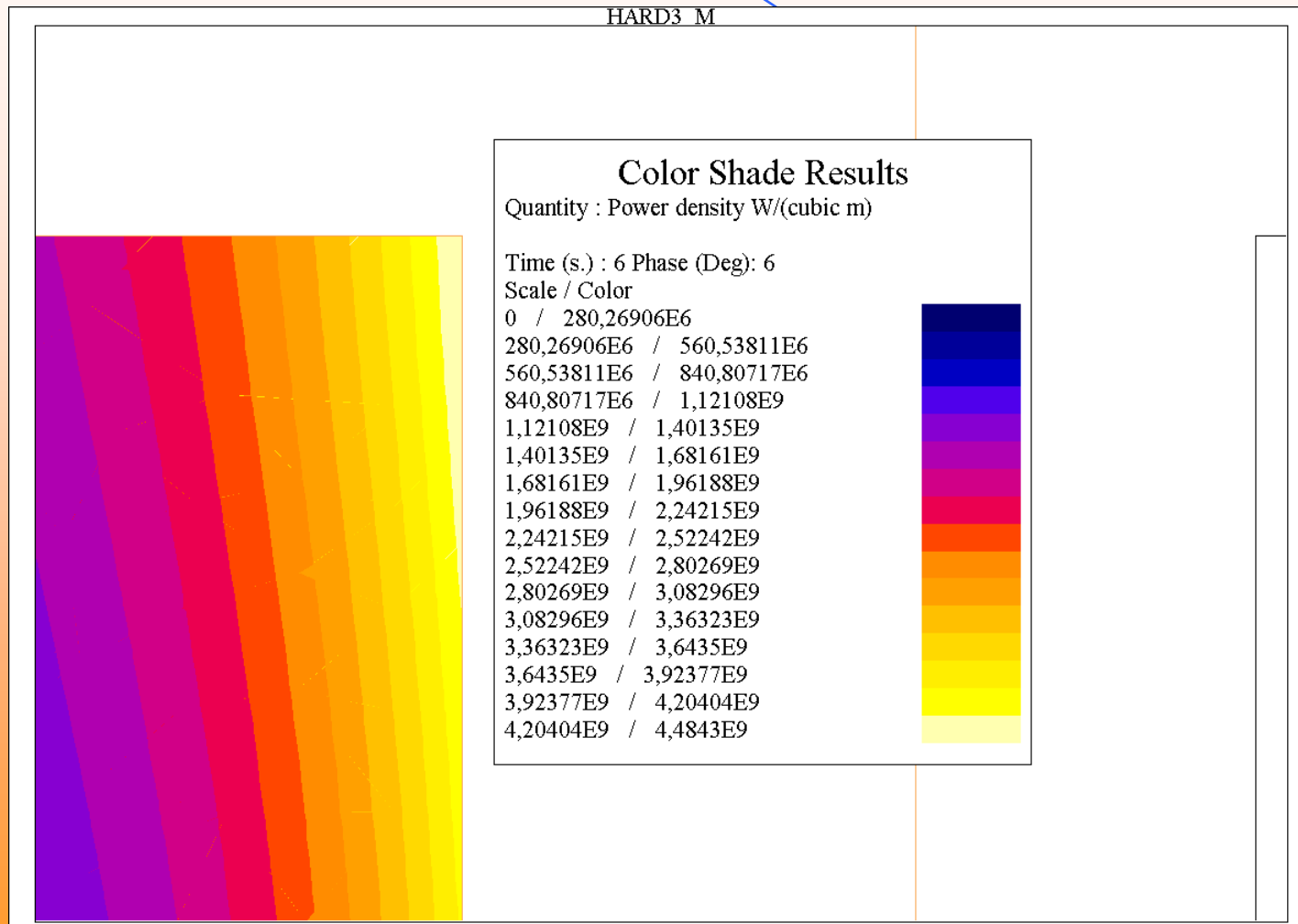
## ➤ Physics



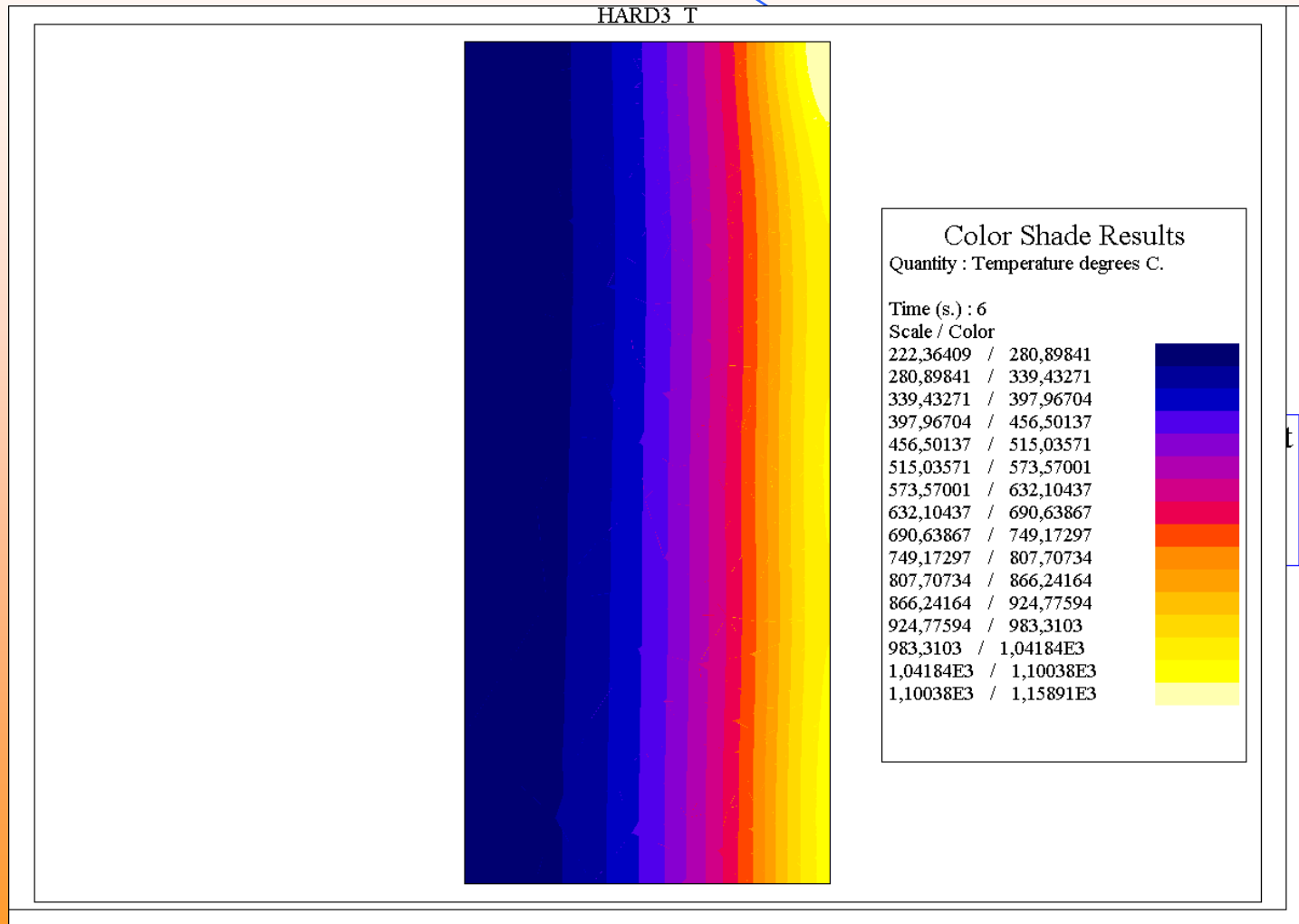
## ➤ Risultati



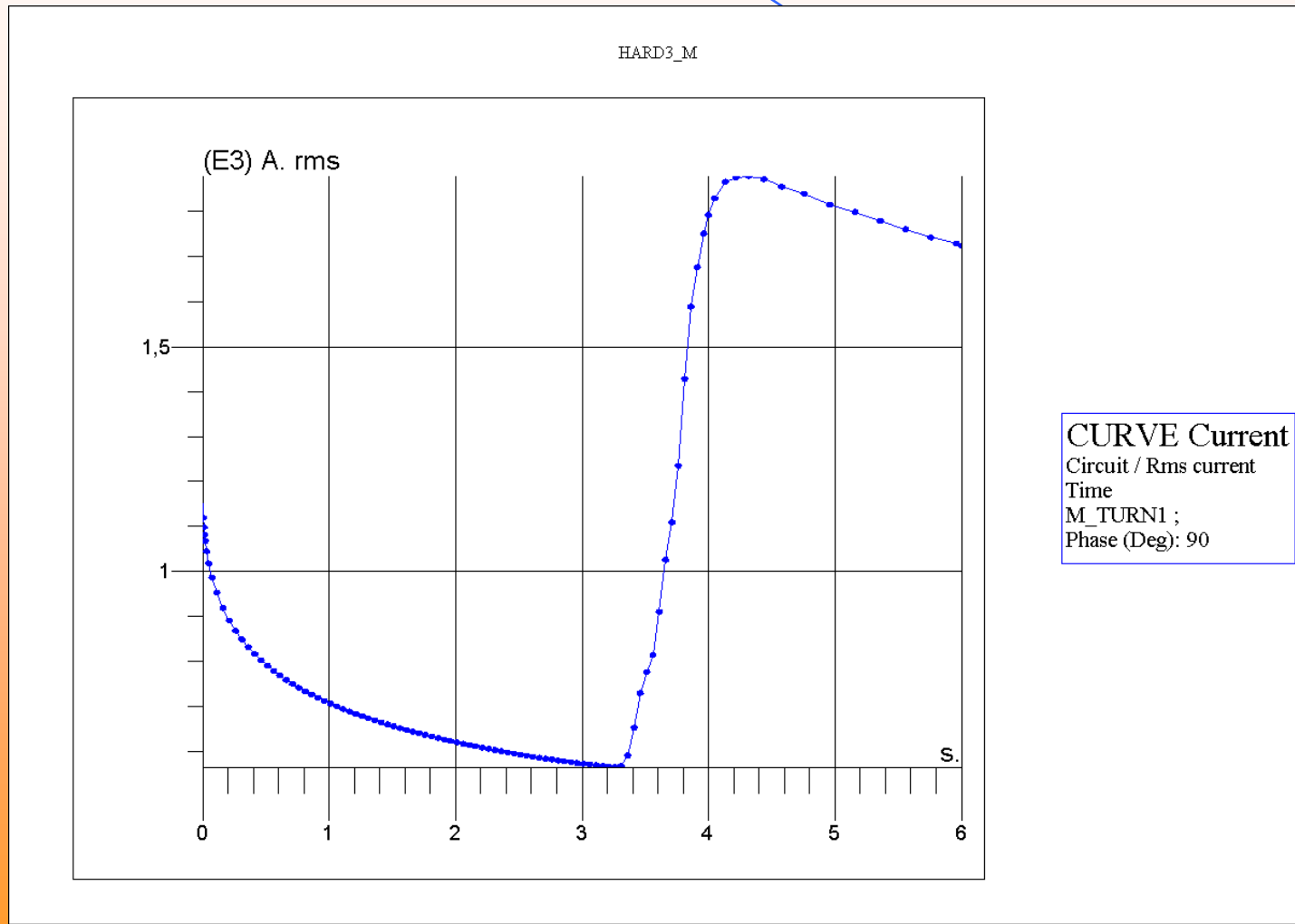
## ➤ Risultati



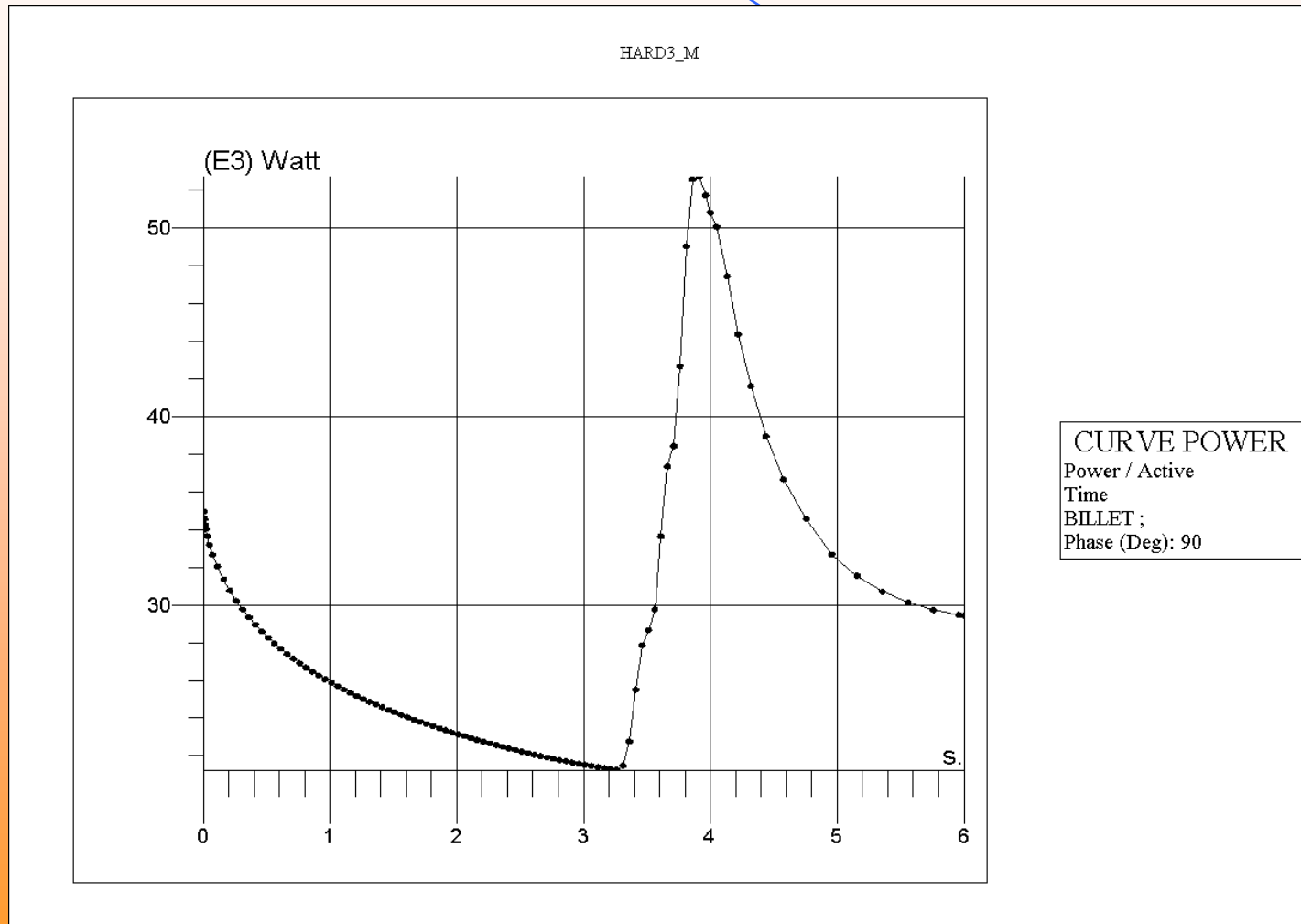
## ➤ Risultati



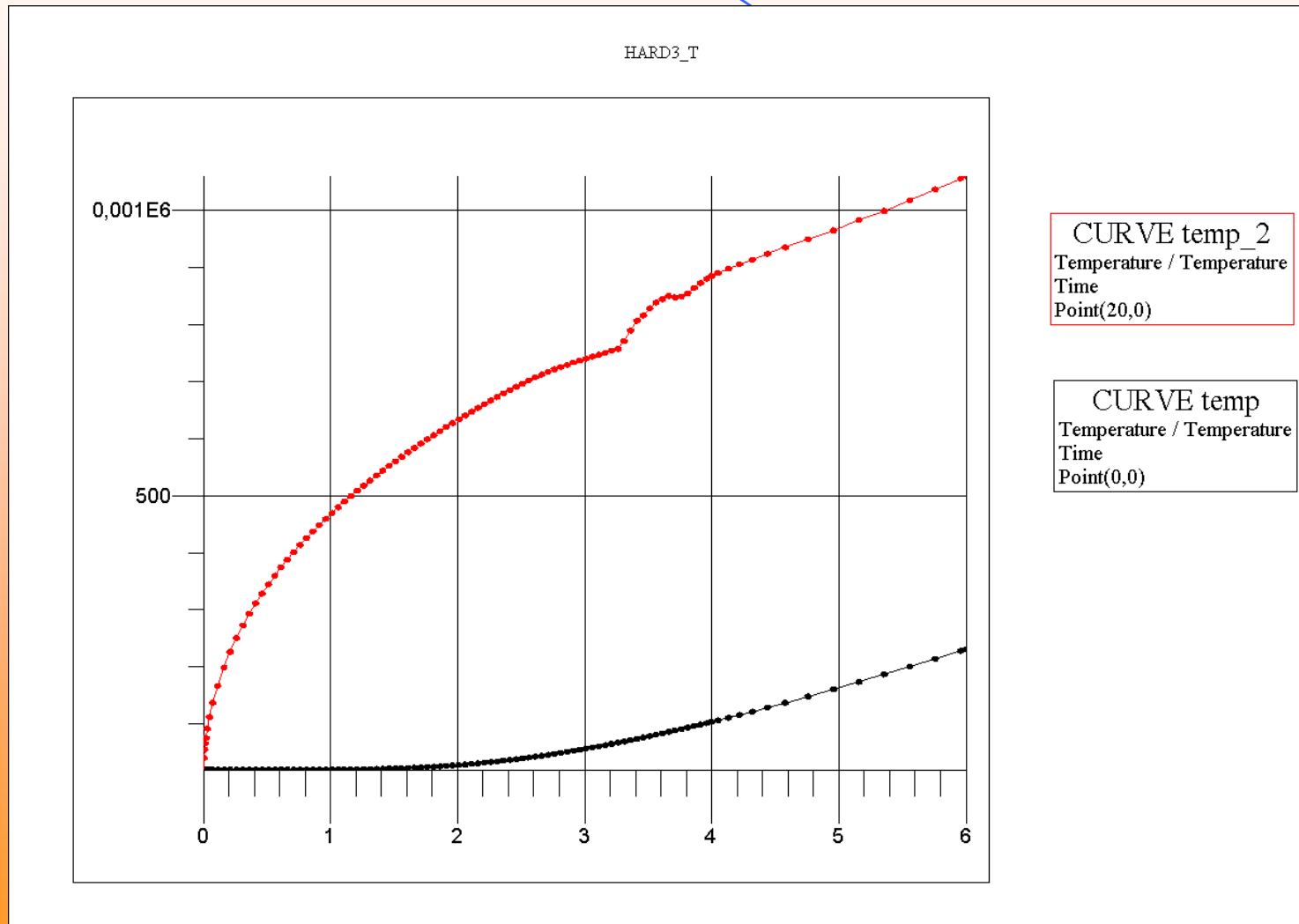
## ➤ Risultati



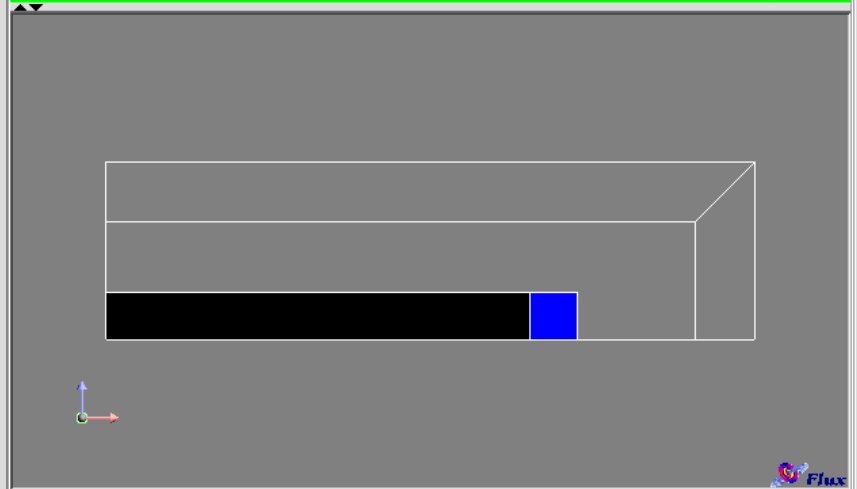
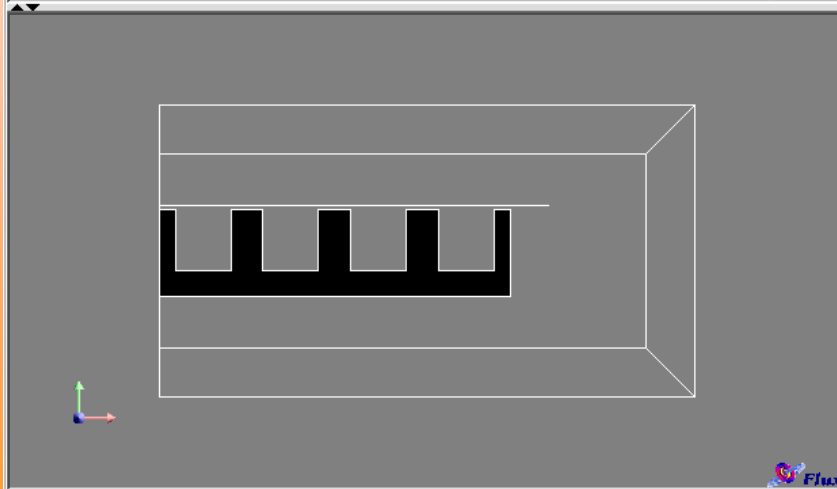
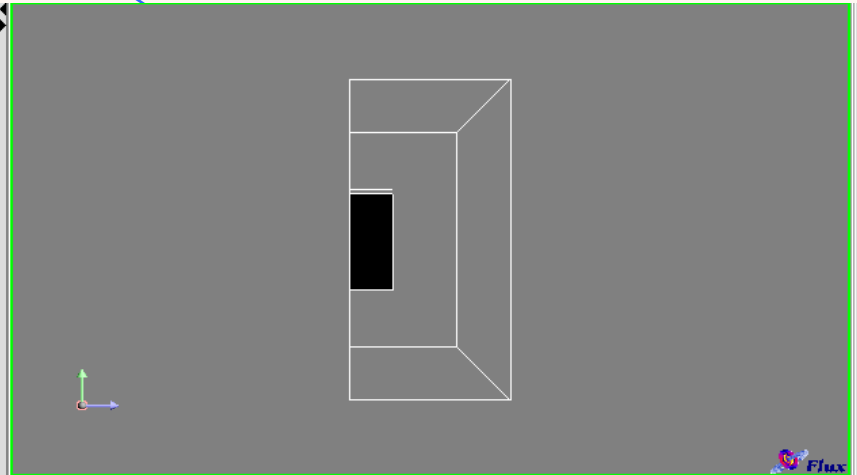
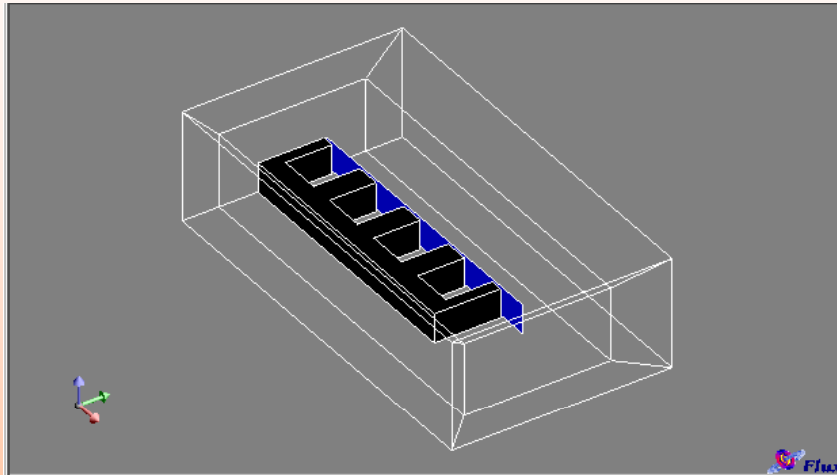
## ➤ Risultati



## ➤ Risultati

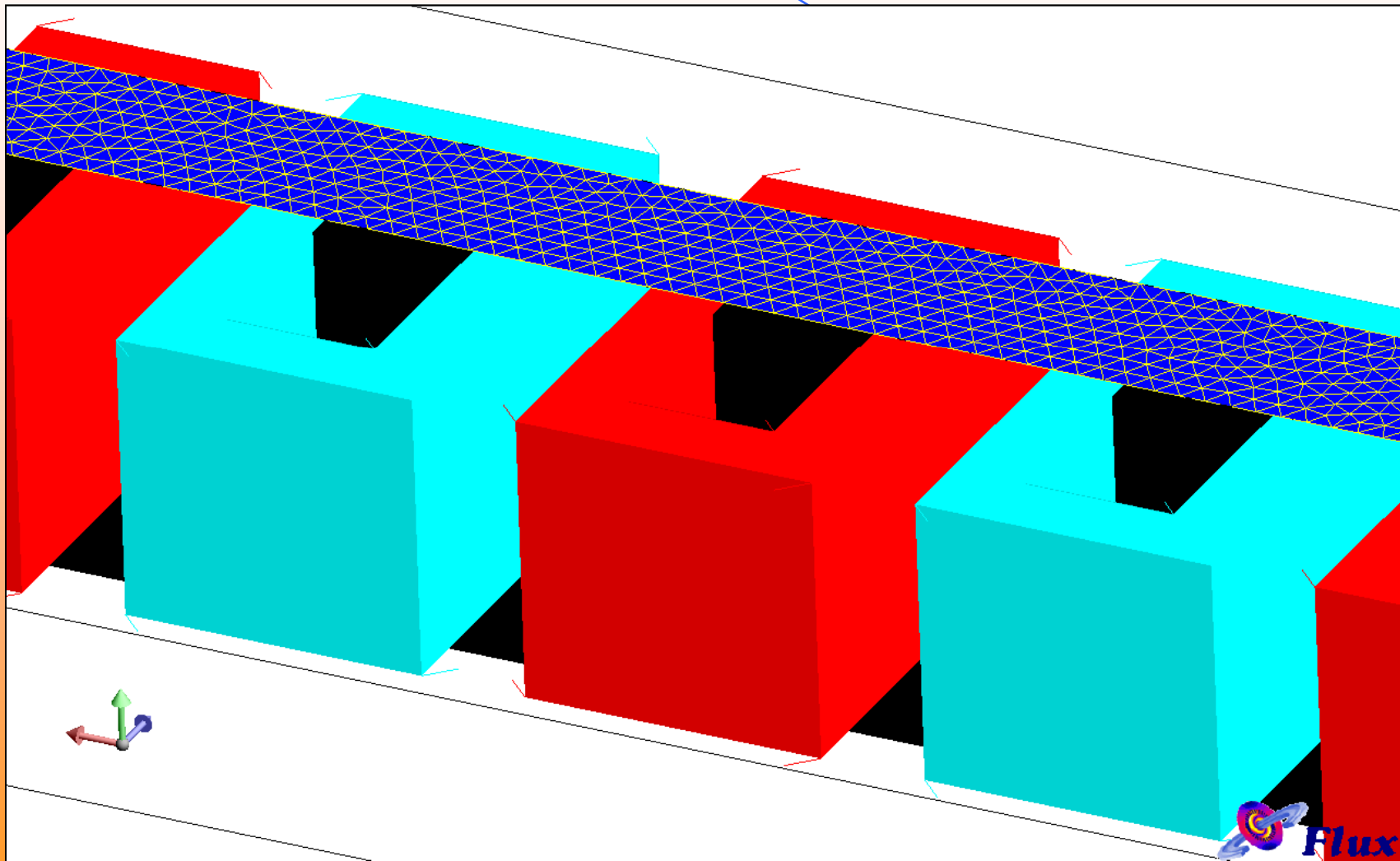


➤ Geometria & Mesh

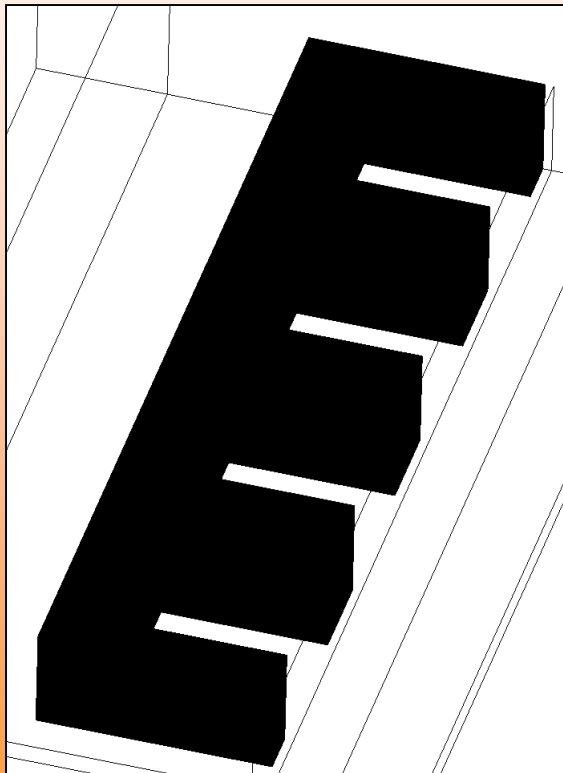


**Si sfruttano le simmetrie nei piani  $xy$  e  $yz$**

➤ Geometria & Mesh



## ➤ Physics



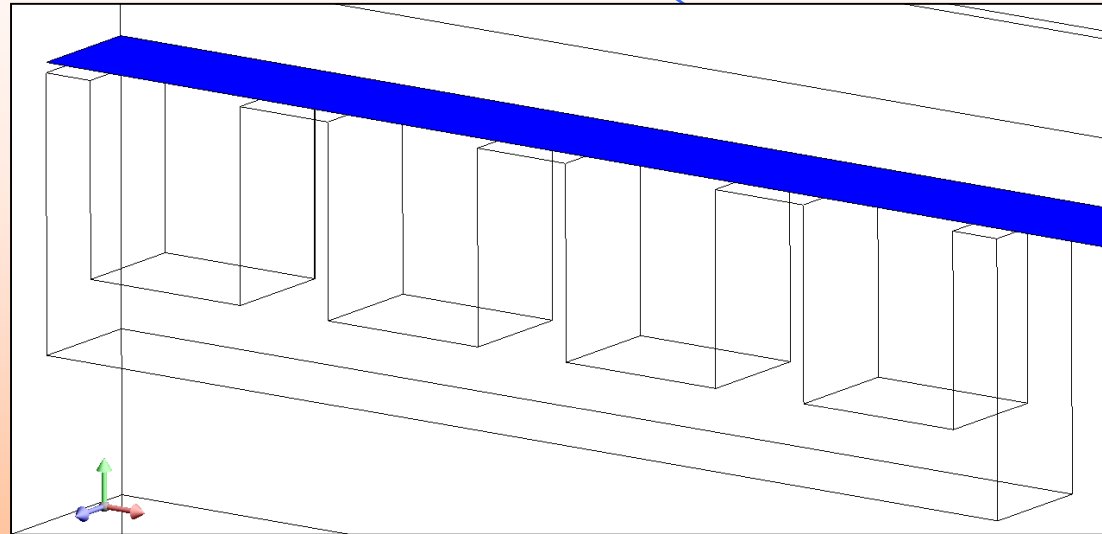
NUCLEO

MATERIALE: FERRITE		Unità di Misura
Permeabilità magnetica relativa	2200	
Magnetizzazione di saturazione	0,49	T

## ➤ Physics



## LAMINA

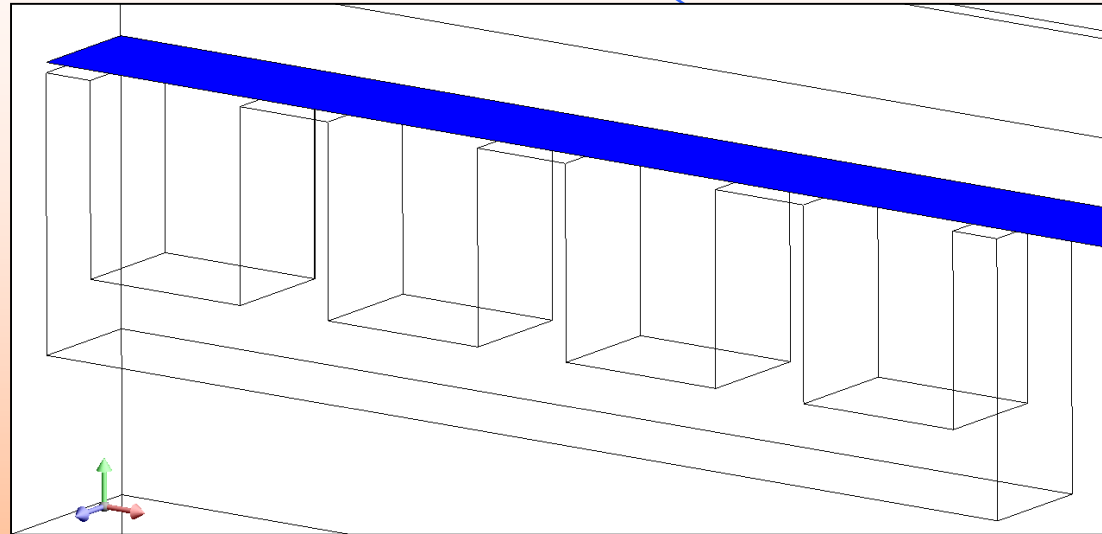


MATERIALE: AISI1010		Unità di Misura
Permeabilità magnetica relativa	300	
Resistività elettrica	1,8e-7	Ohm m
Conducibilità termica	63,9	W/m K
Calore Specifico	434	J/Kg K
Peso Specifica	7832	Kg/m <sup>3</sup>
Diffusività termica 18,08	18,08	m <sup>2</sup> /s
Spessore	0,2	mm

## ➤ Physics



LAMINA

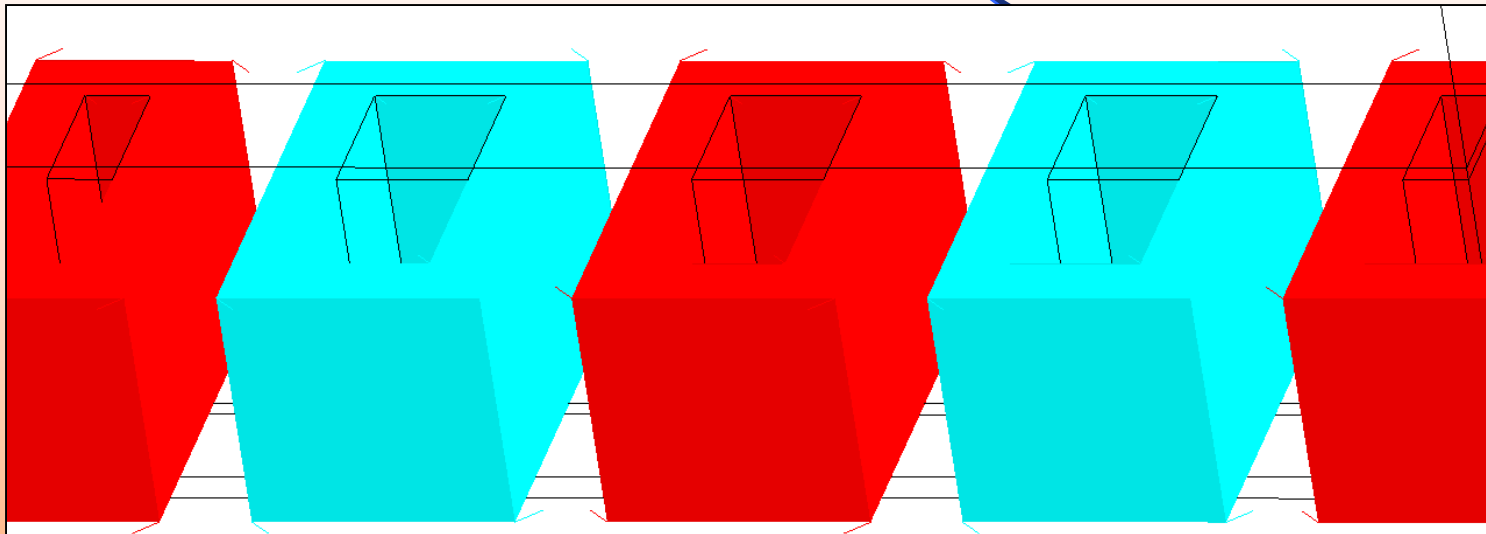


La LAMINA è stata modellizzata come *Face Region* indicando lo spessore.

L'utilizzo della *Volume Region* appesantisce notevolmente il modello in quanto è necessaria una *Mesh* molto fine

## ➤ Physics

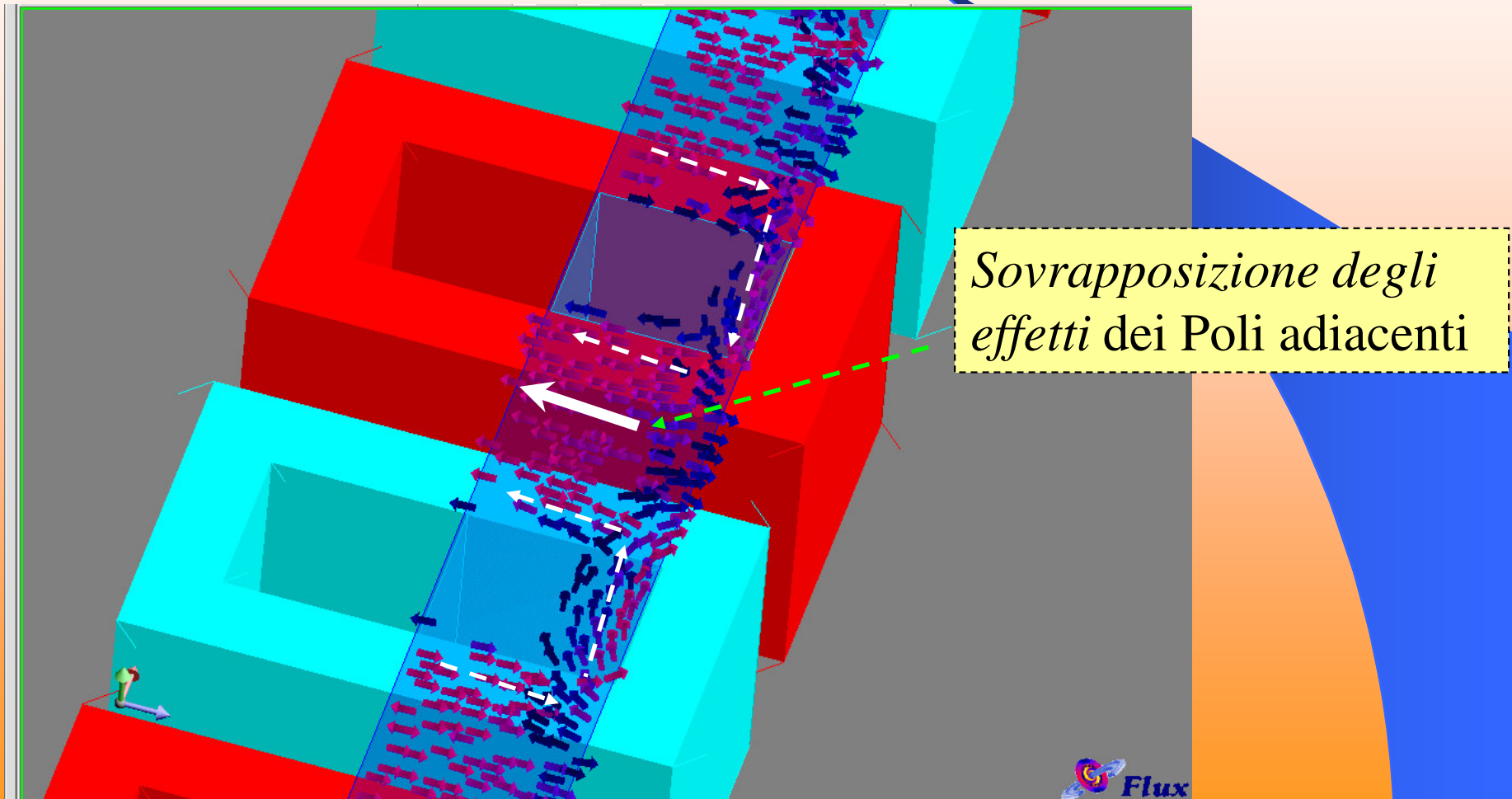
### BOBINE



MATERIALE: RAME		Unità di Misura
Frequenza	50k	Hz
Corrente	36	A <sub>rms</sub>
Numero di Spire	3	

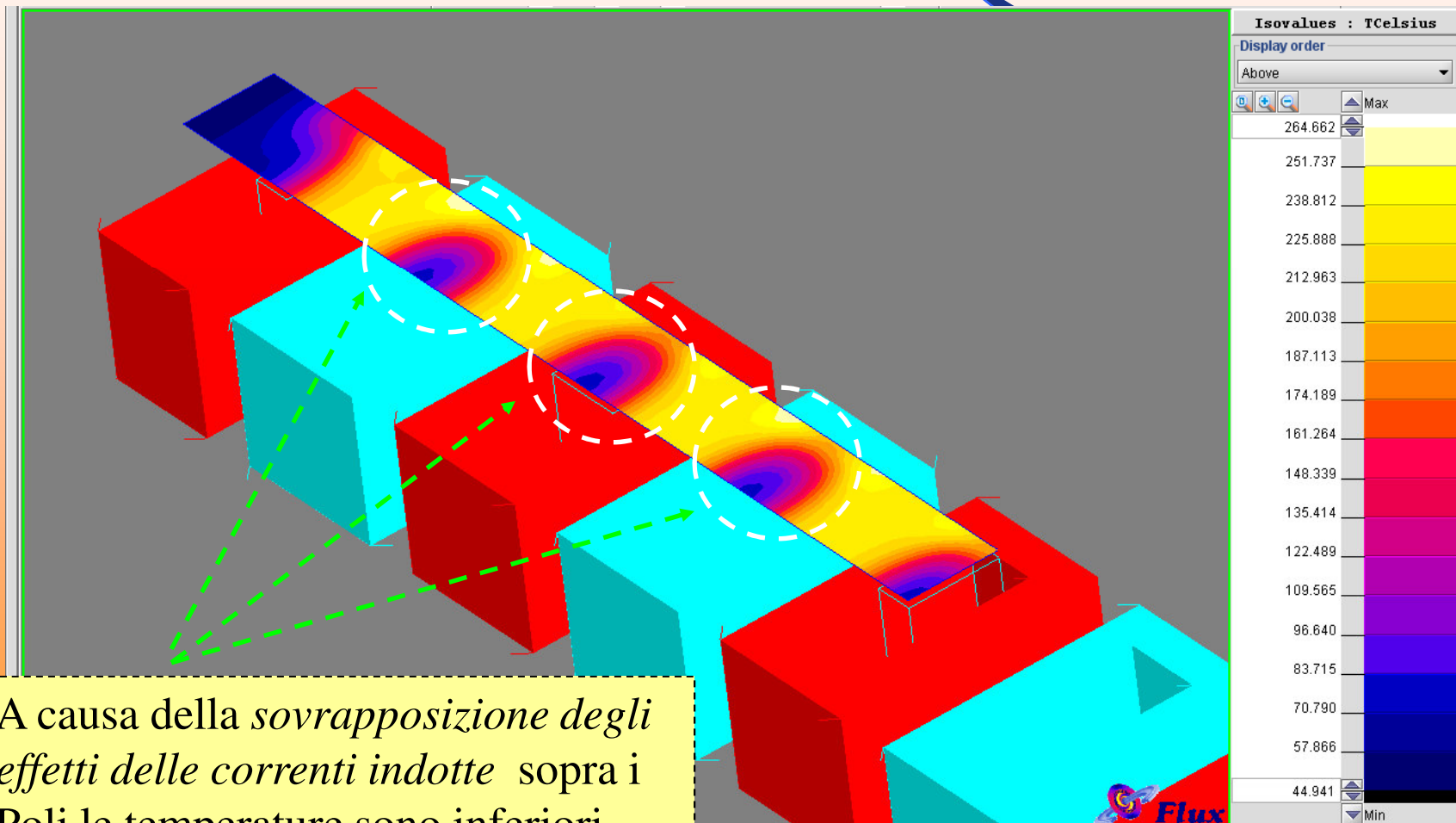
➤ Risultati 

Distribuzione della densità di Corrente



## ➤ Risultati

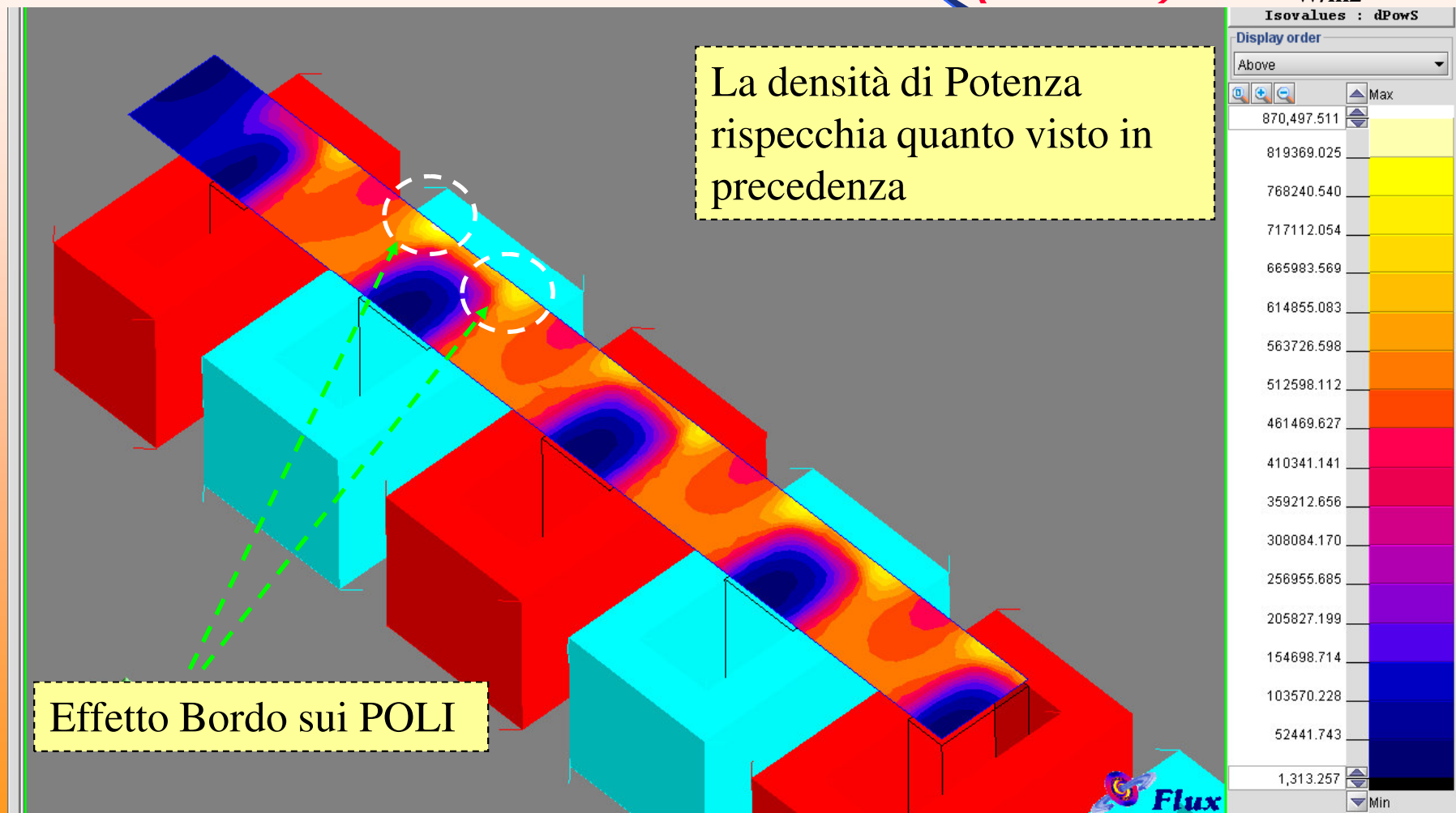
### Distribuzione della Temperatura sulla LAMINA ( $t=2,5\text{ s}$ )



A causa della *sovrapposizione degli effetti delle correnti indotte* sopra i Poli le temperature sono inferiori

## ➤ Risultati

Distribuzione della densità di Potenza ( $t=15\text{ s}$ )

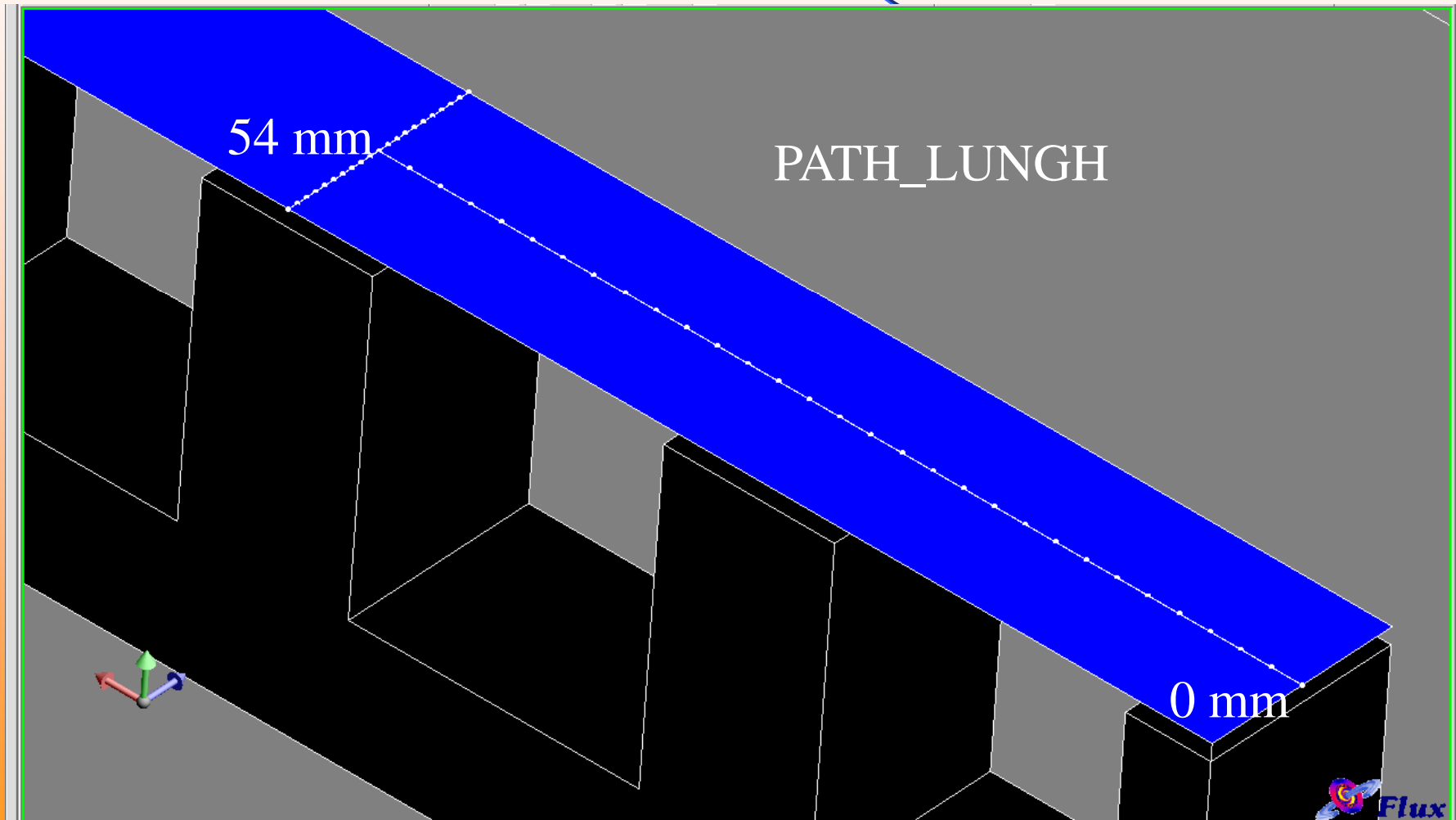


Effetto Bordo sui POLI

La densità di Potenza rispecchia quanto visto in precedenza

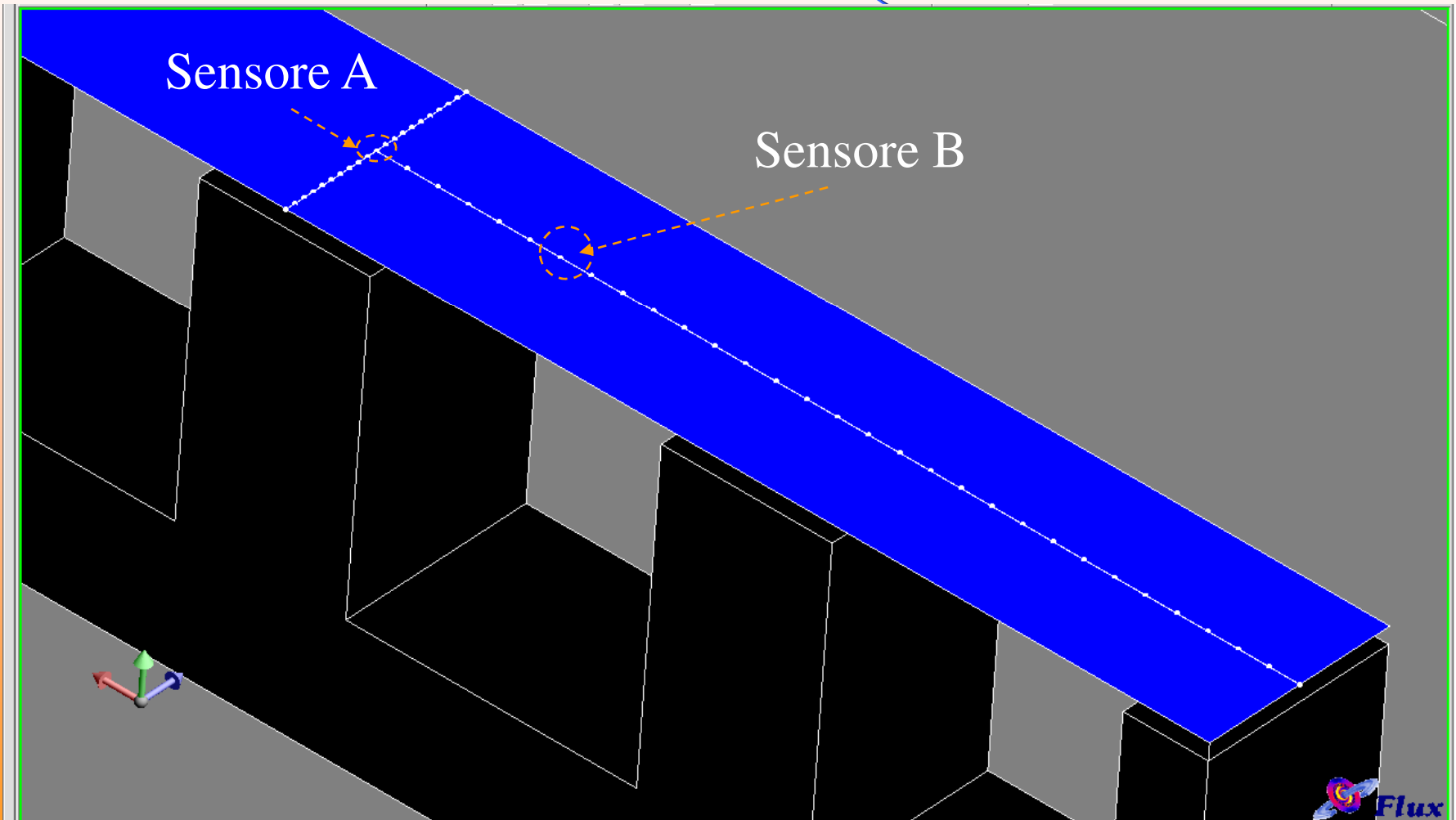
➤ Risultati 

PATH di CALCOLO

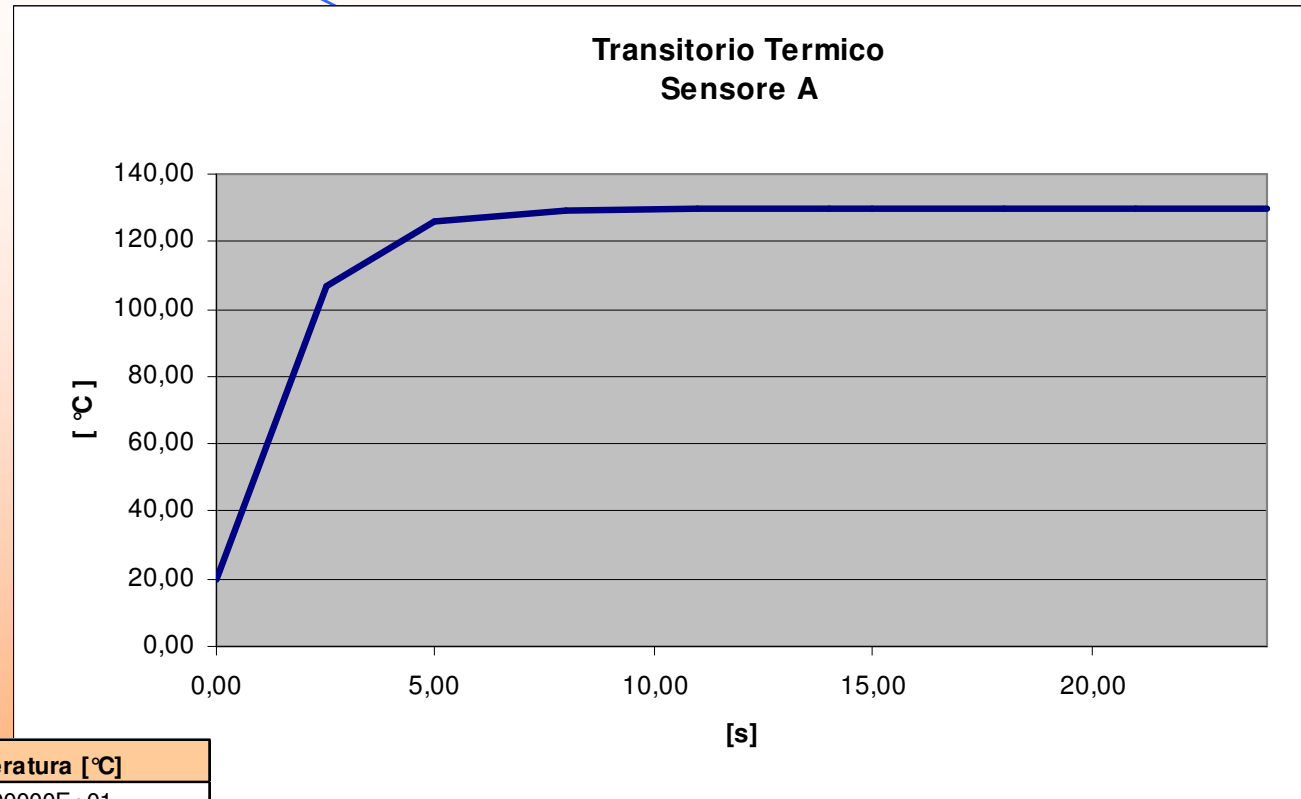


➤ Risultati 

SENSORI VIRTUALI

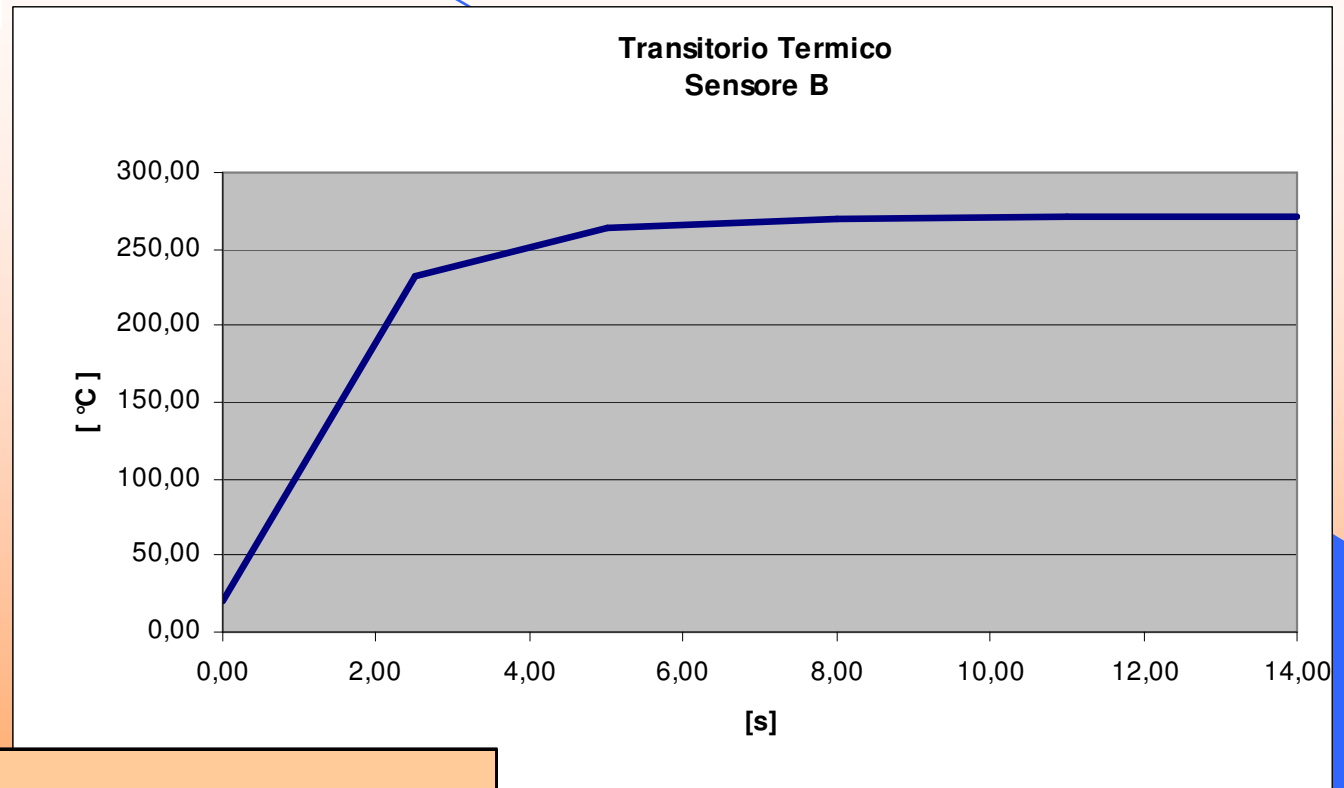


## ➤ Risultati



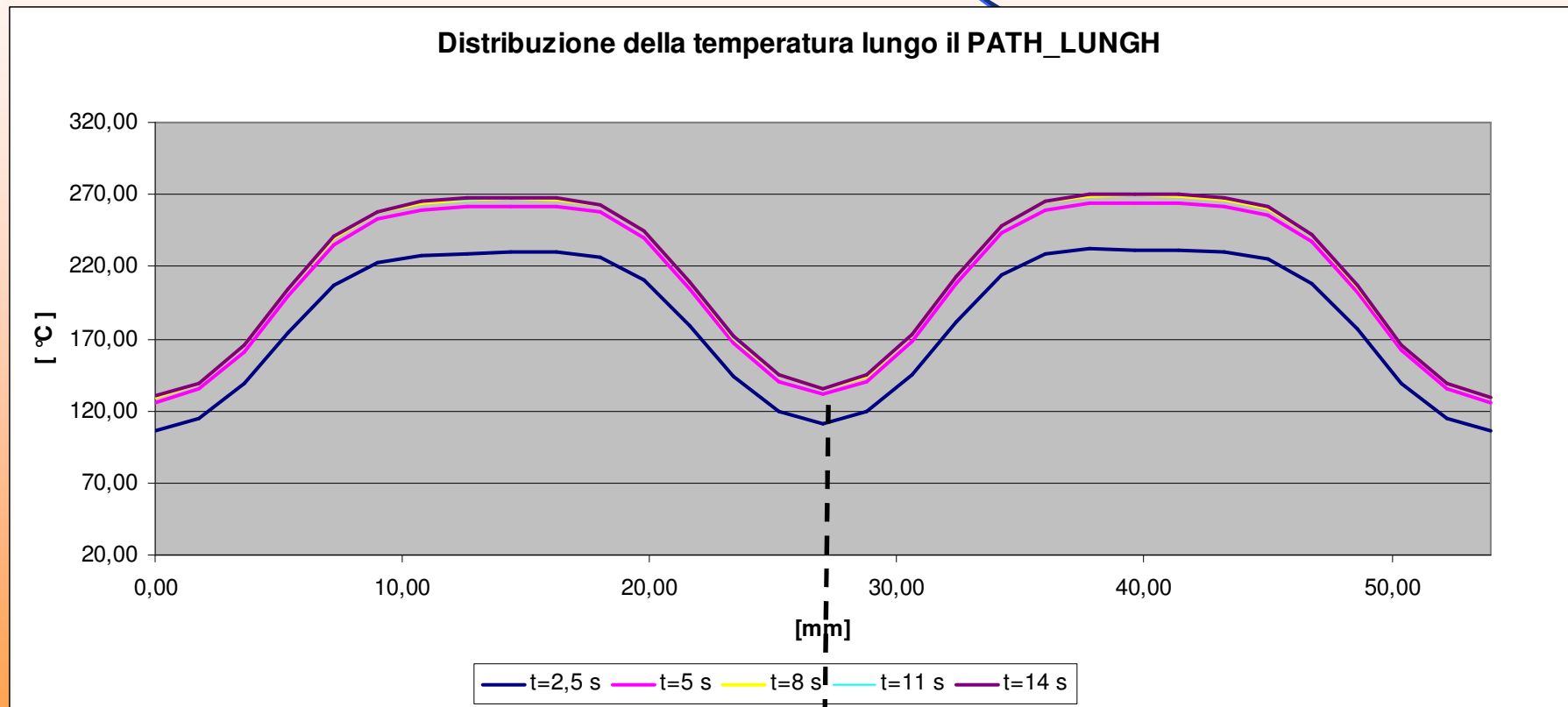
Tempo [s]	Temperatura [°C]
0,0000000E+00	2,0000000E+01
2,5000000E+00	1,0650676E+02
5,0000000E+00	1,2565113E+02
8,0000000E+00	1,2928347E+02
1,1000000E+01	1,2982016E+02
1,4000000E+01	1,2989710E+02
1,5000000E+01	1,2990557E+02
1,8000000E+01	1,2990914E+02
2,1000000E+01	1,2990964E+02
2,4000000E+01	1,2990971E+02

## ➤ Risultati



Tempo [s]	Temperatura [°C]
0,00000000E+00	2,00000000E+01
2,50000000E+00	2,31884764E+02
5,00000000E+00	2,64653527E+02
8,00000000E+00	2,69816559E+02
1,10000000E+01	2,70497356E+02
1,40000000E+01	2,70587790E+02

## ➤ Risultati



Centro del POLO

## ➤ Commenti

Le simulazioni sono state eseguite con il software ad elementi finiti FLUX3D mediante il modulo di *accoppiamento magnetotermico*.

Questo modulo permette di analizzare i *transitori termici* dovuti ai fenomeni elettromagnetici di induzione tenendo conto anche della frequenza di alimentazione e conseguentemente dell'*effetto pelle*.

I tempi di calcolo per ogni *time step* sono dell'ordine di 90 minuti.

Per spessori molto piccoli possono verificarsi dei problemi di convergenza della soluzione in quanto è necessaria una *Mesh* molto fine ed adeguata all'effetto pelle.