

# Loudspeaker simulation with QuickField



**Vladimir Podnos**

**Director of Marketing and Support  
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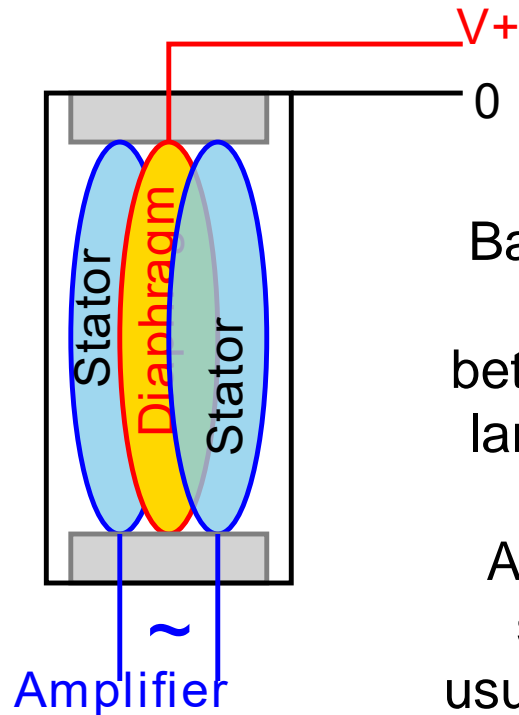
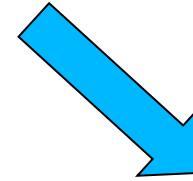
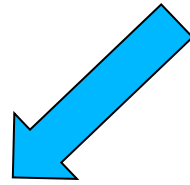


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**Support Engineer  
Tera Analysis Ltd.**

# Loudspeaker simulation with QuickField

Loudspeakers  
convert electromagnetic signals to acoustic waves



## Electrostatic

Based on electrostatic forces acting on a membrane between charged plates, like a large parallel plane capacitor

Advantages – small level of signal distortion, but they usually weight more, cost more

## Magnetic

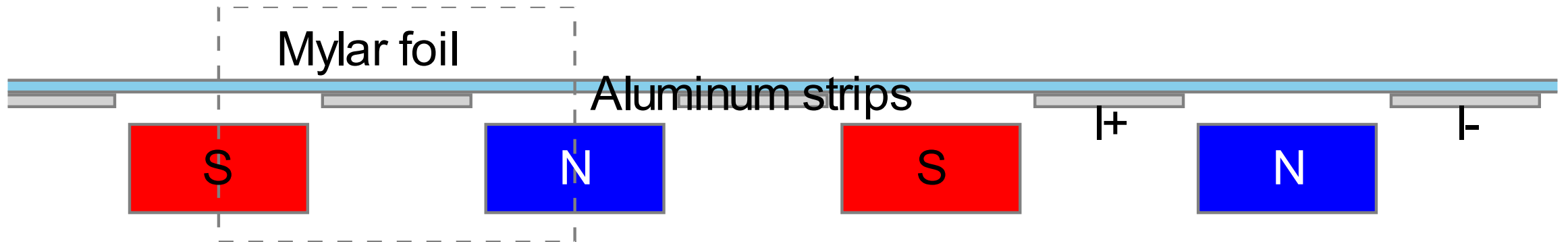
Based on magnetic forces between permanent magnets and electric currents

Many different constructions including cone, planar



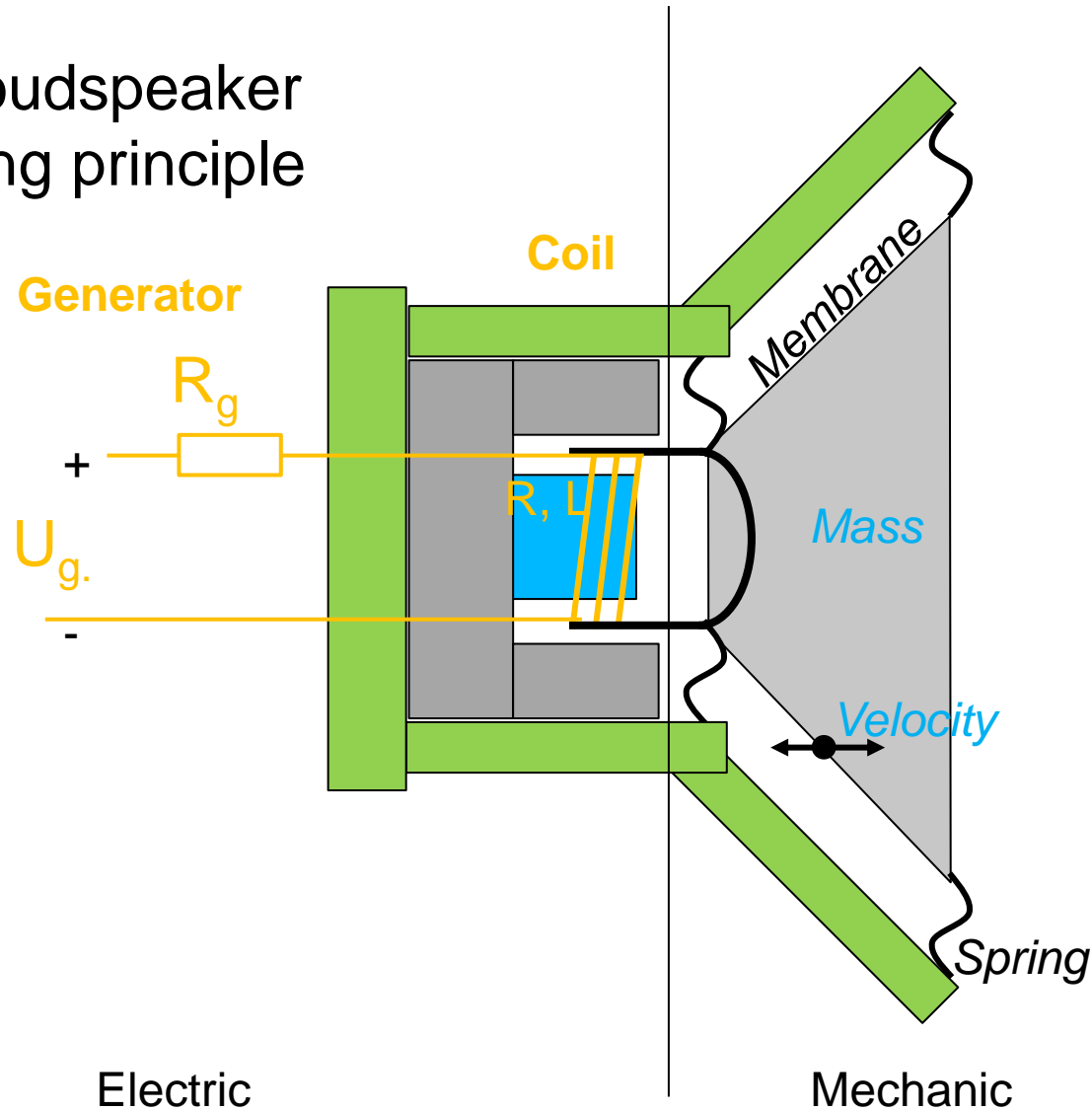
# Loudspeaker simulation with QuickField

Planar magnetic speaker operating principle



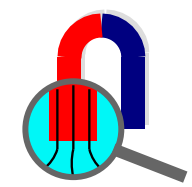
# Loudspeaker simulation with QuickField

Cone loudspeaker operating principle



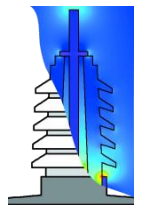
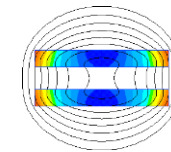
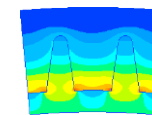
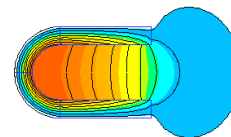
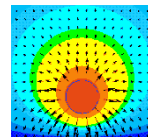
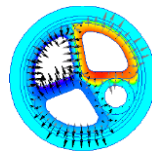
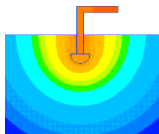
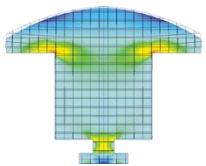
Sound waves in the air

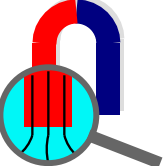
Acoustic



# QuickField Analysis Options

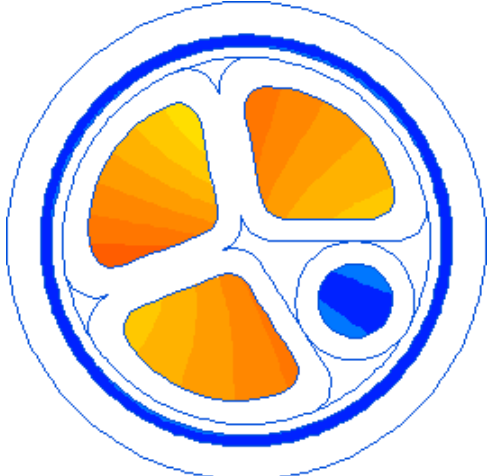
<b>Magnetic analysis suite</b>	Magnetostatics
	AC Magnetics
	Transient Magnetic
<b>Electric analysis suite</b>	Electrostatics (2D,3D) and DC Conduction (2D,3D)
	AC Conduction
	Transient Electric field
<b>Thermostructural analysis suite</b>	Steady-State Heat transfer (2D,3D)
	Transient Heat transfer
	Stress analysis





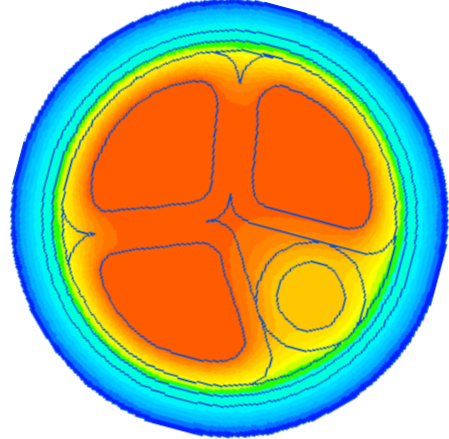
# MultiPhysics (2D)

Electromagnetic fields



Losses  
→

Temperature field

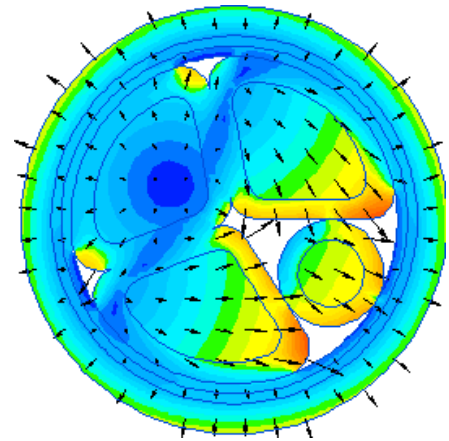


Temperature field import



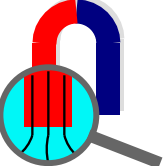
Magnetic state import

Forces  
→

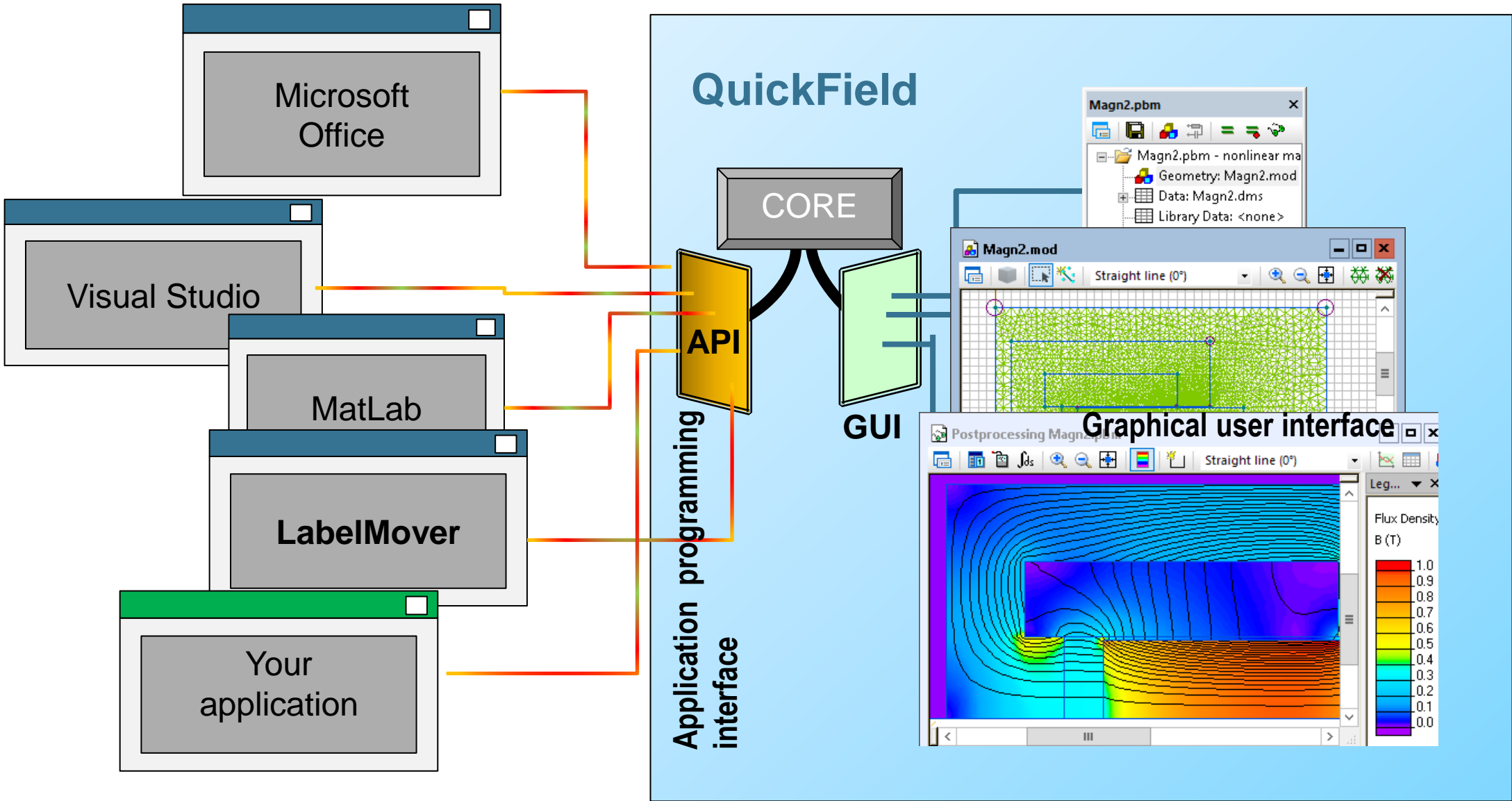


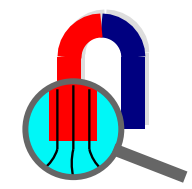
Thermal Stresses  
←

Stresses & Deformations



# QuickField API



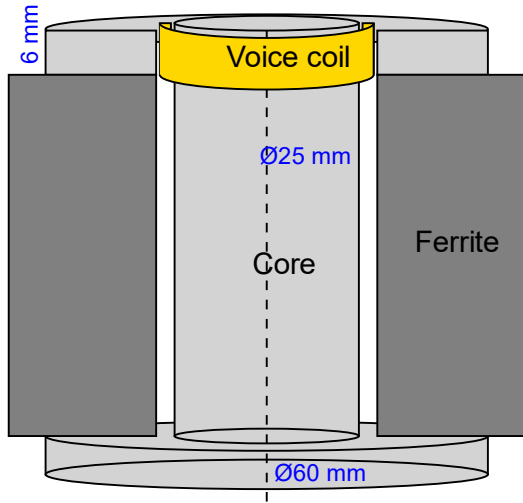


# QuickField Difference

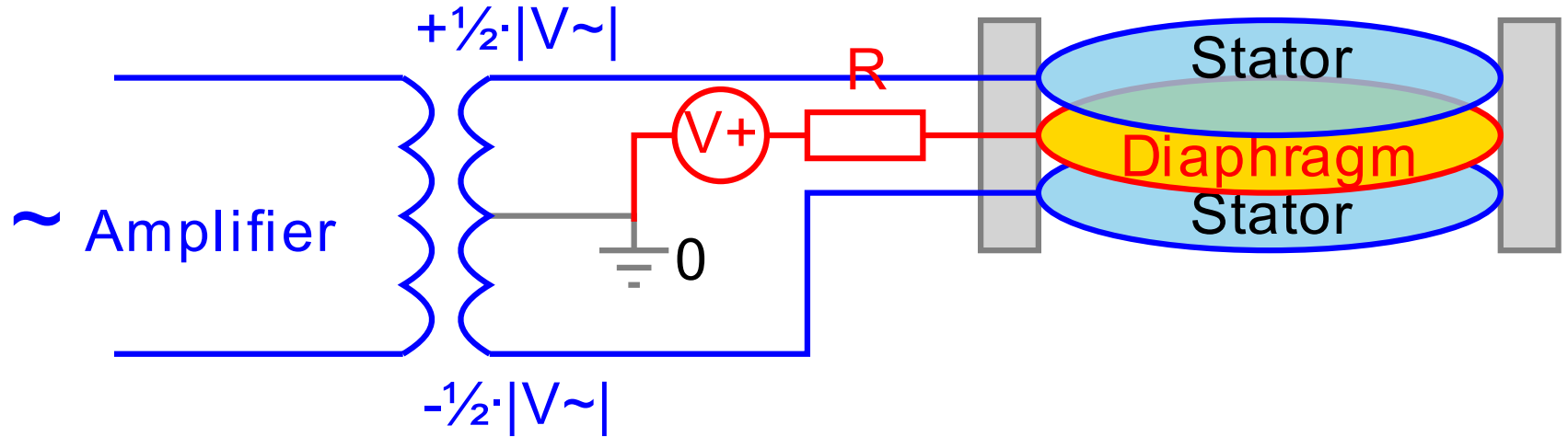




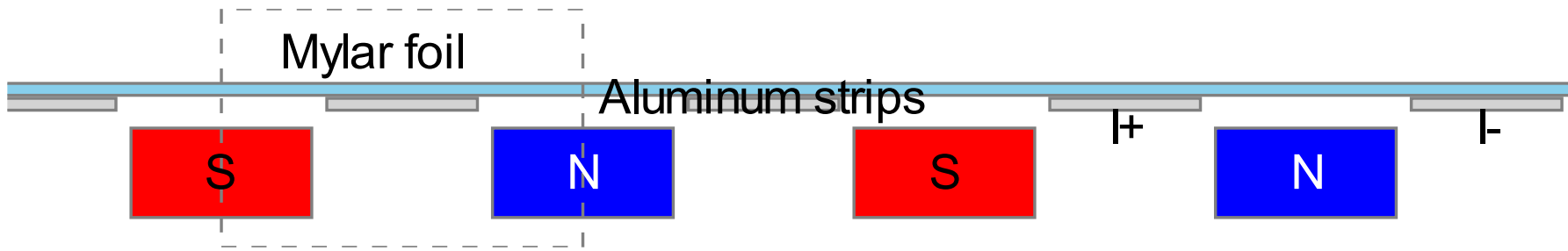
# Loudspeaker simulation with QuickField



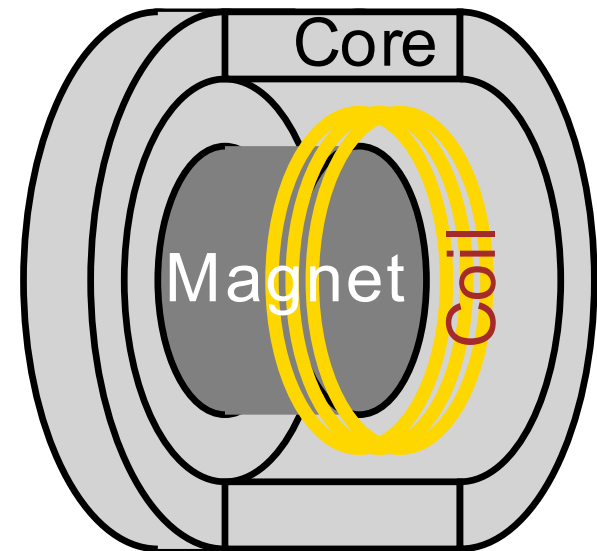
Voice coil motor



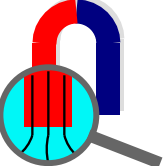
Electrostatic loudspeaker



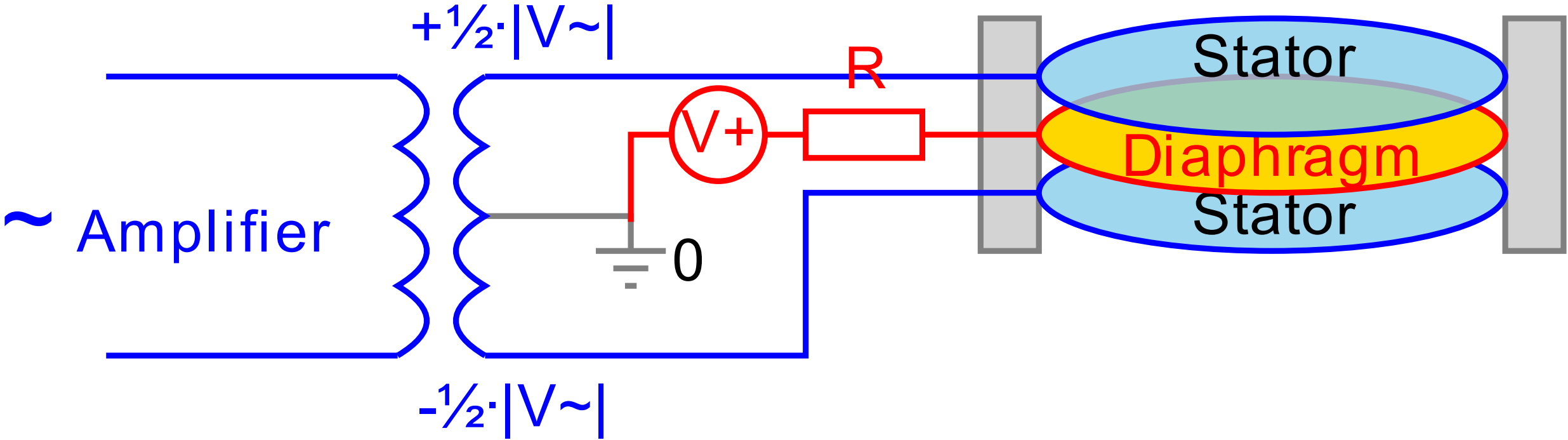
Magnetostatic loudspeaker



Loudspeaker



# Electrostatic speaker

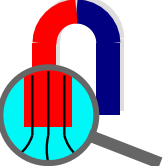


**Problem specification:**

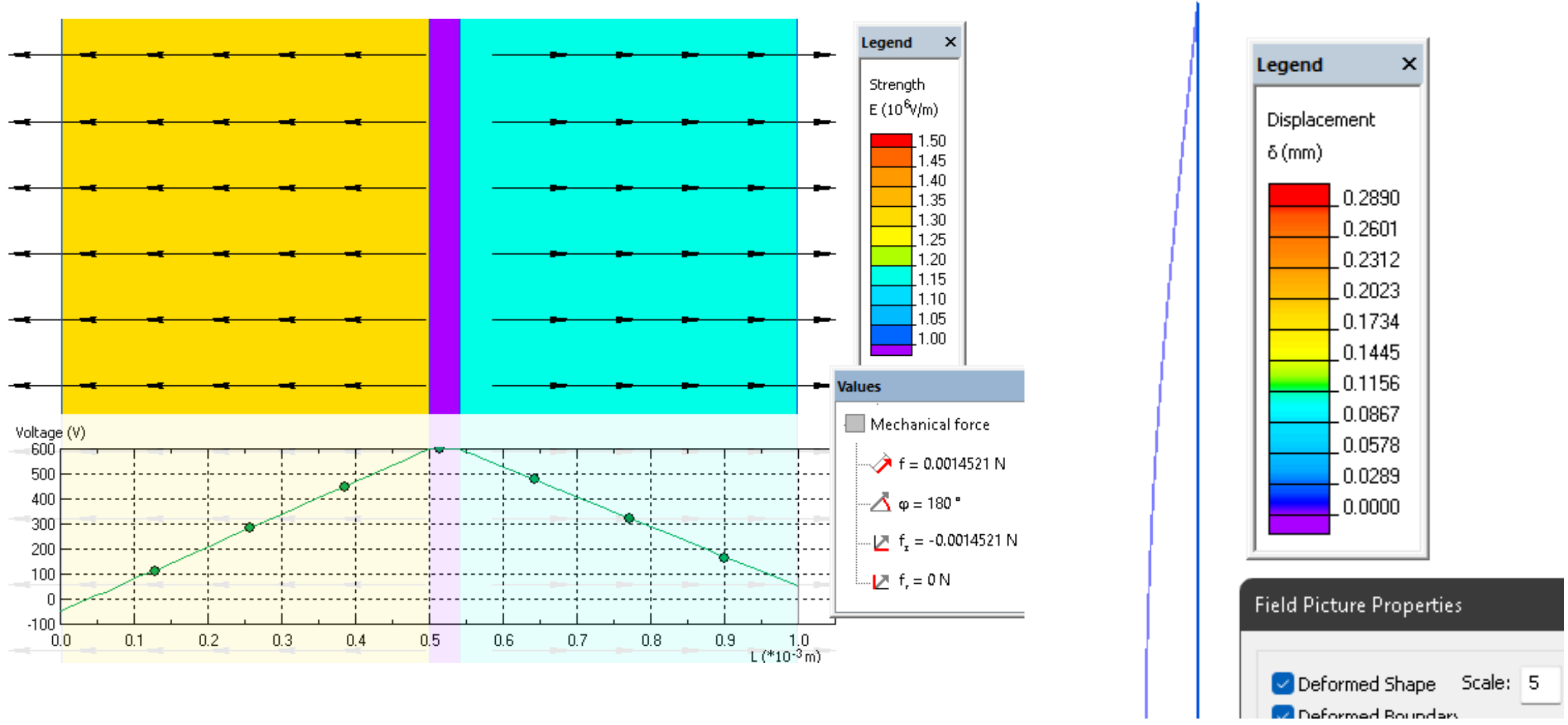
DC bias voltage 600 V;  
Amplifier voltage  $\sim 100V$ ;

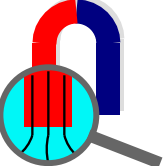
**Task:**

Calculate the electric force and the diaphragm displacement.

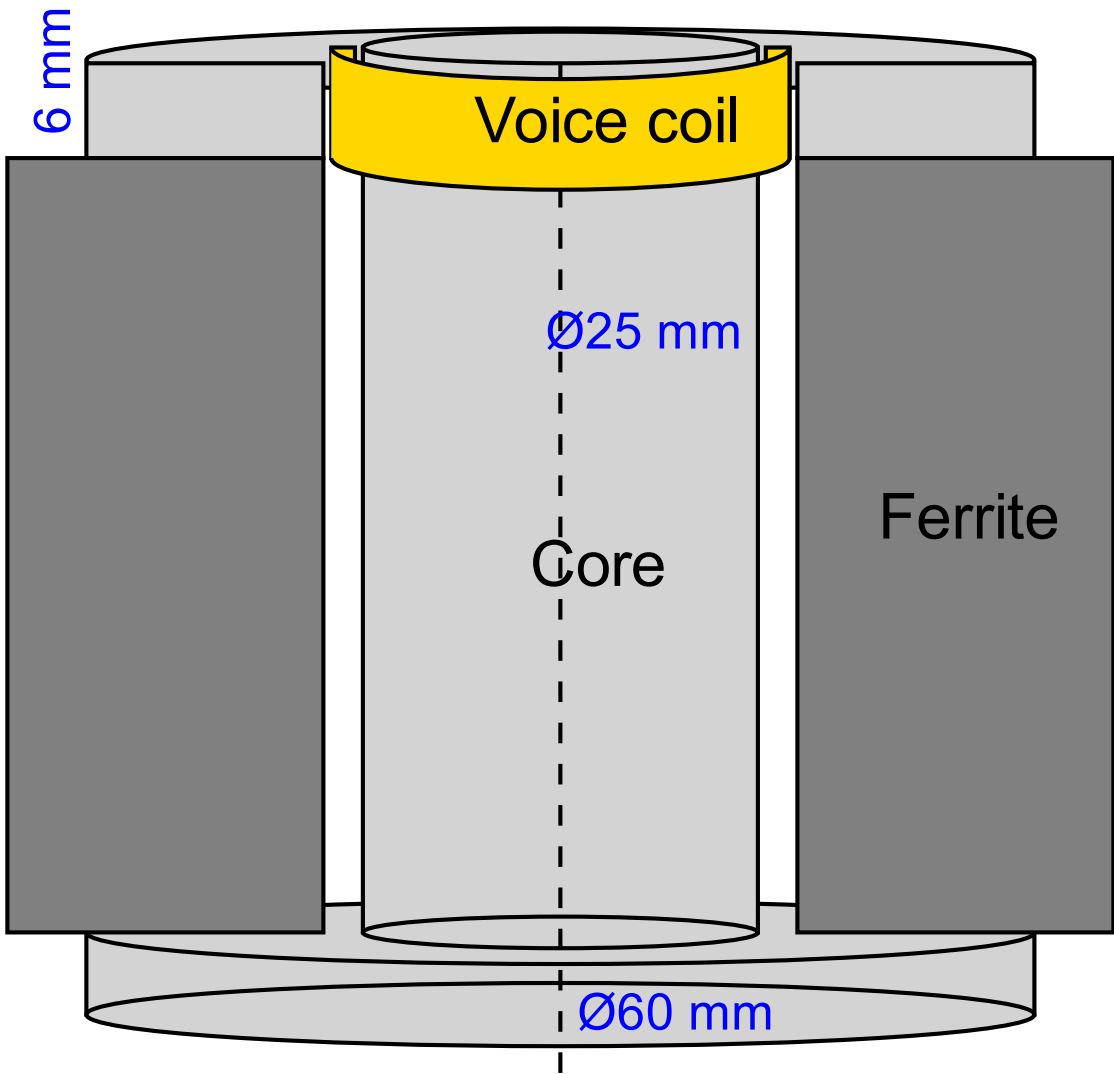


# Electrostatic speaker



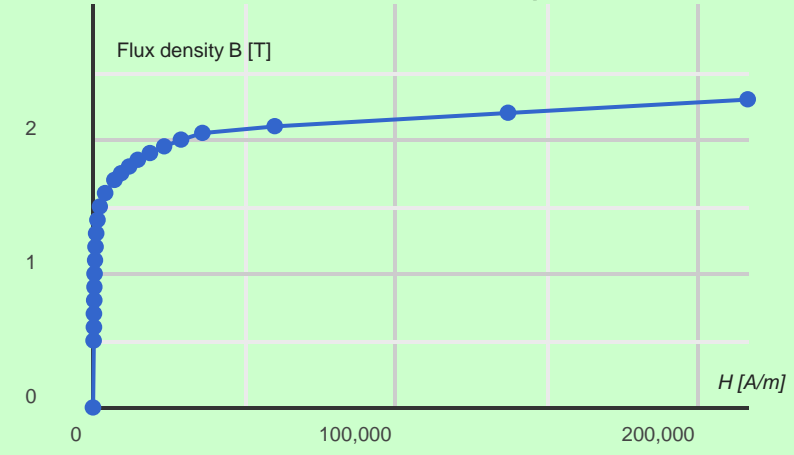


# Voice coil motor



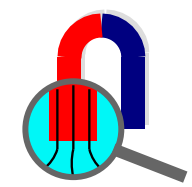
## Problem specification:

The material of the magnet is ferrite with coercive force  $H_c = 500 \text{ kA/m}$ ;  
Coil material - copper;  
Core material - soft magnetic steel

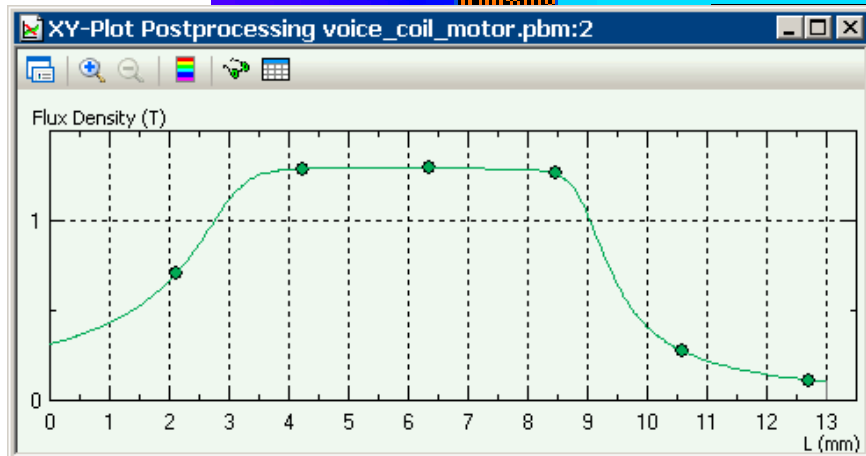
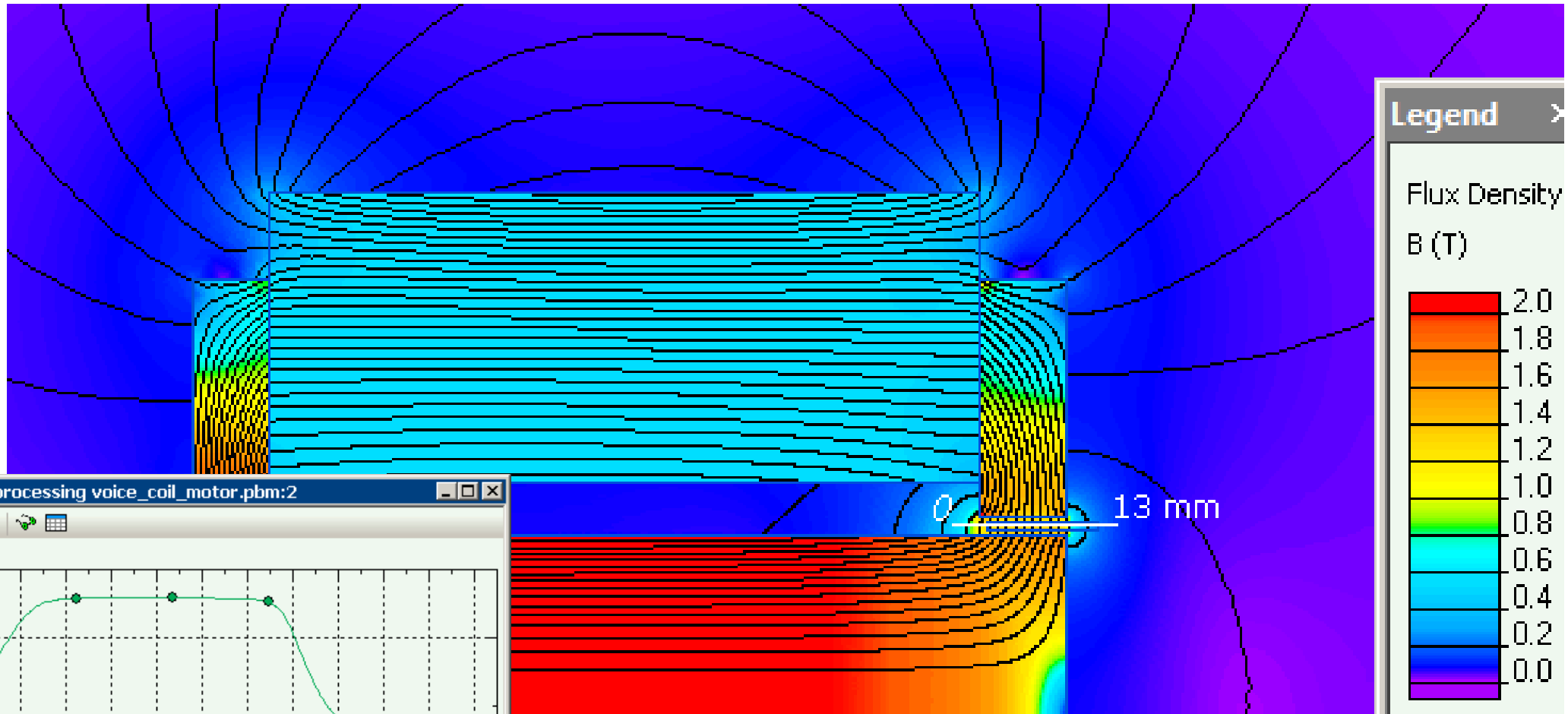


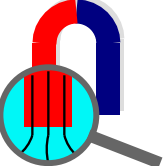
## Task:

Calculate the magnetic flux density in the air gap along the voice coil height.

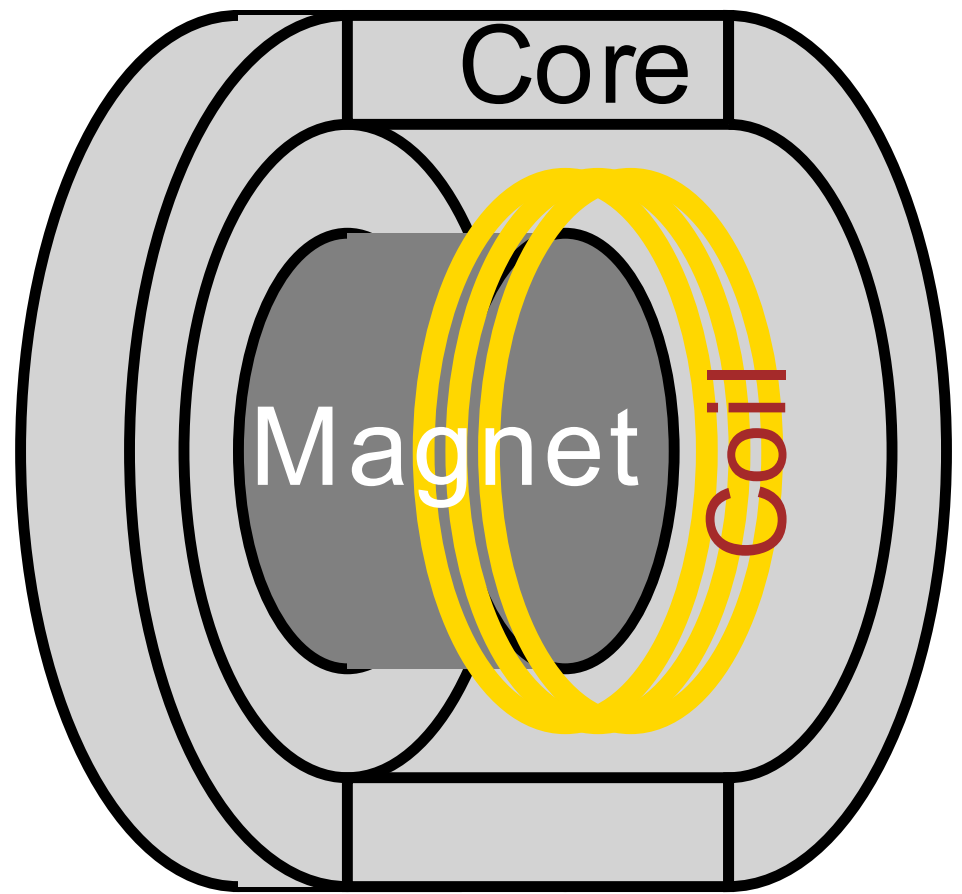


# Voice coil motor



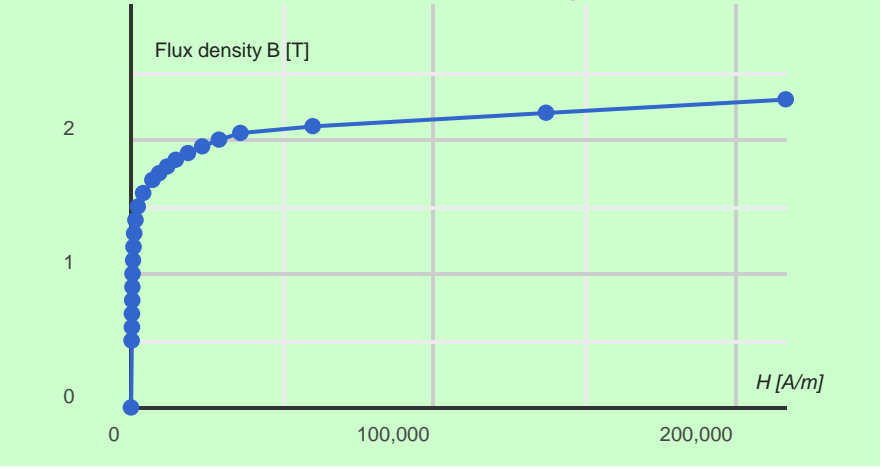


# Dynamic loudspeaker

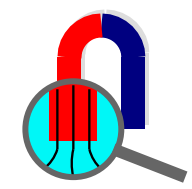


## Problem specification:

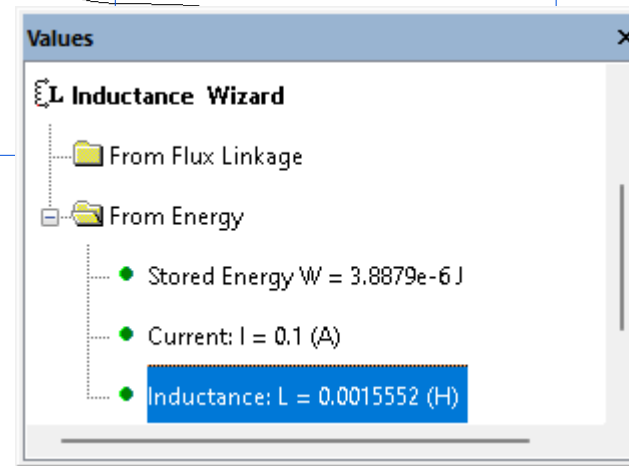
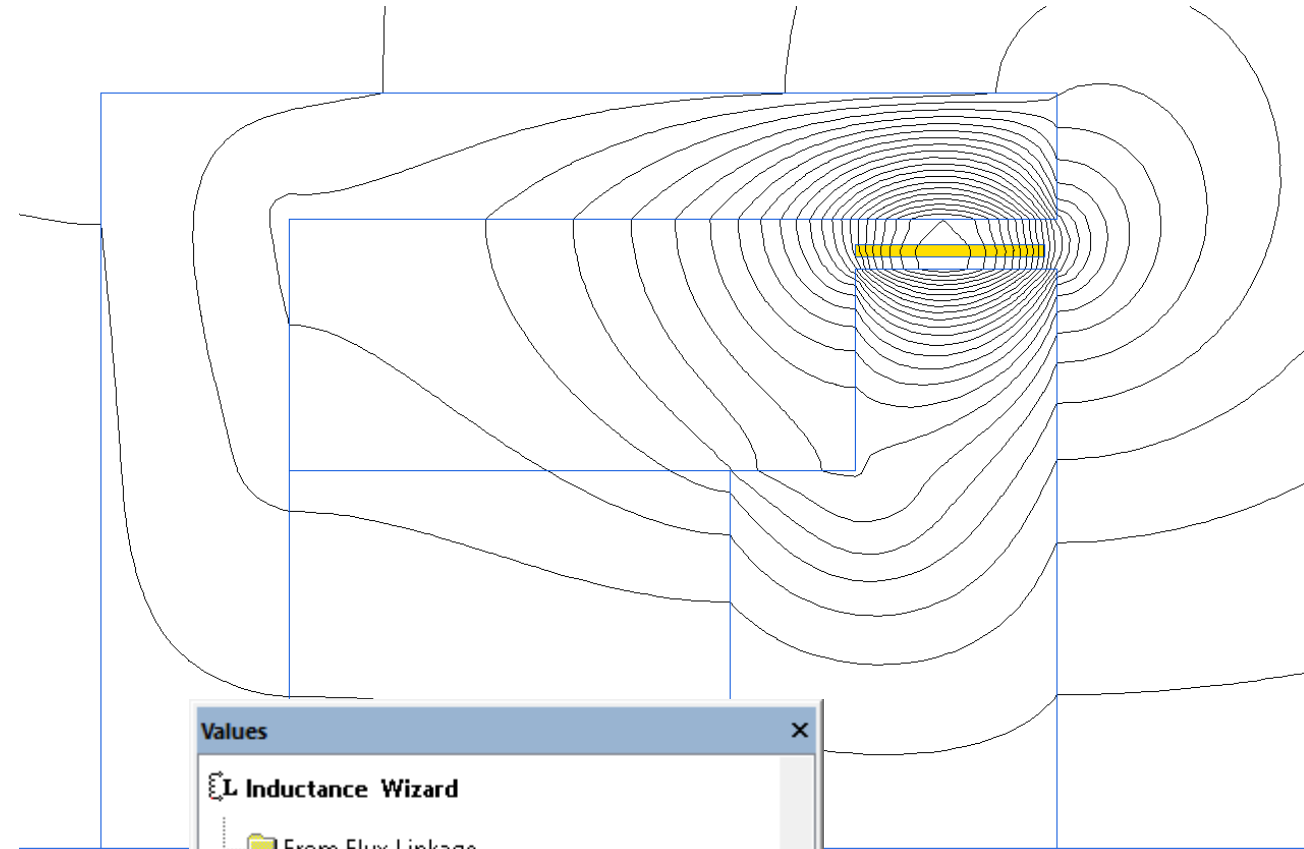
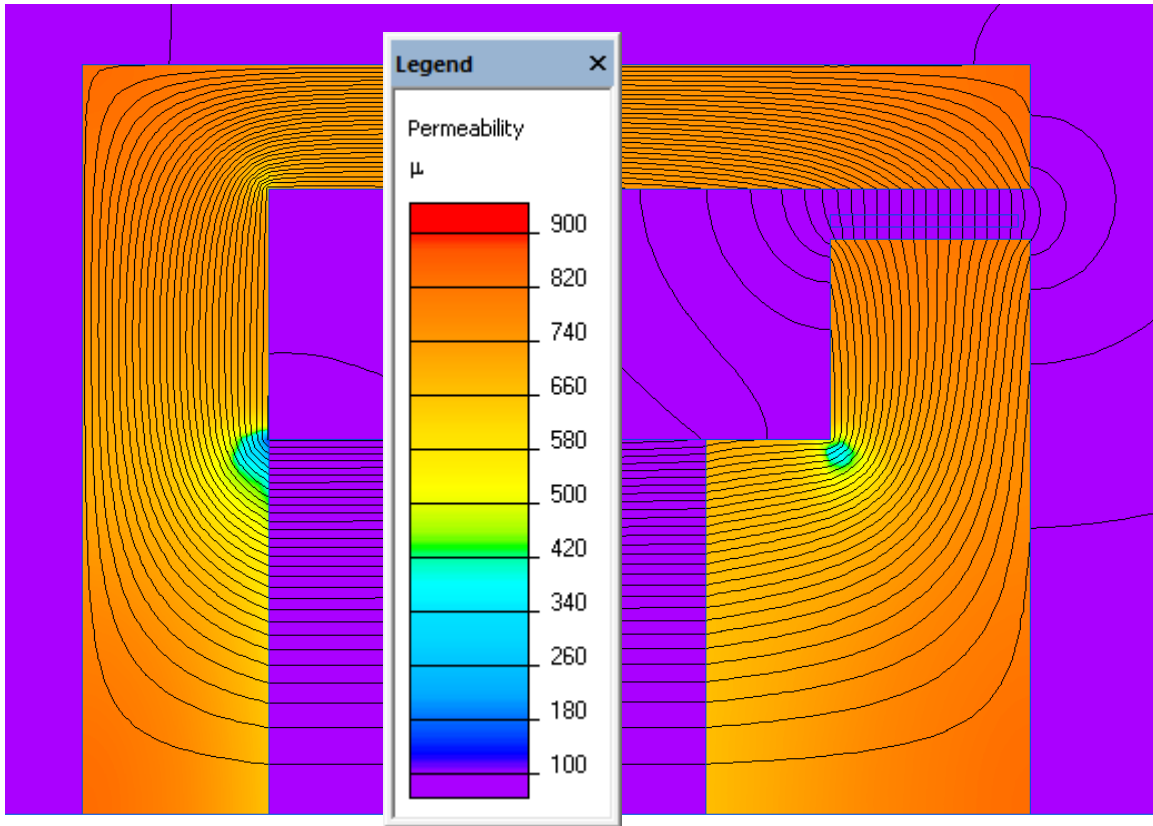
The material of the magnet is ferrite with coercive force  $H_c = 500 \text{ kA/m}$ ;  
Coil material - copper;  
Core material - soft magnetic steel

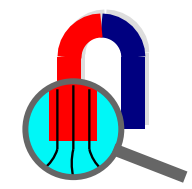


**Task:**  
Calculate the coil inductance.

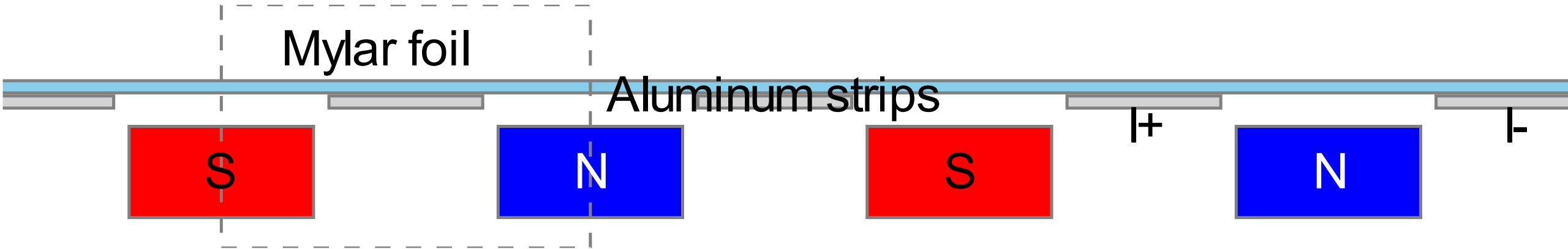


# Loudspeaker





# Magnetostatic speaker



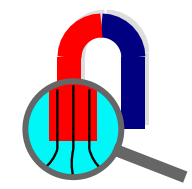
## Problem specification:

The material of the magnet is ferrite with coercive force  $H_c = 500$  kA/m;  
Strip current 0.1 A

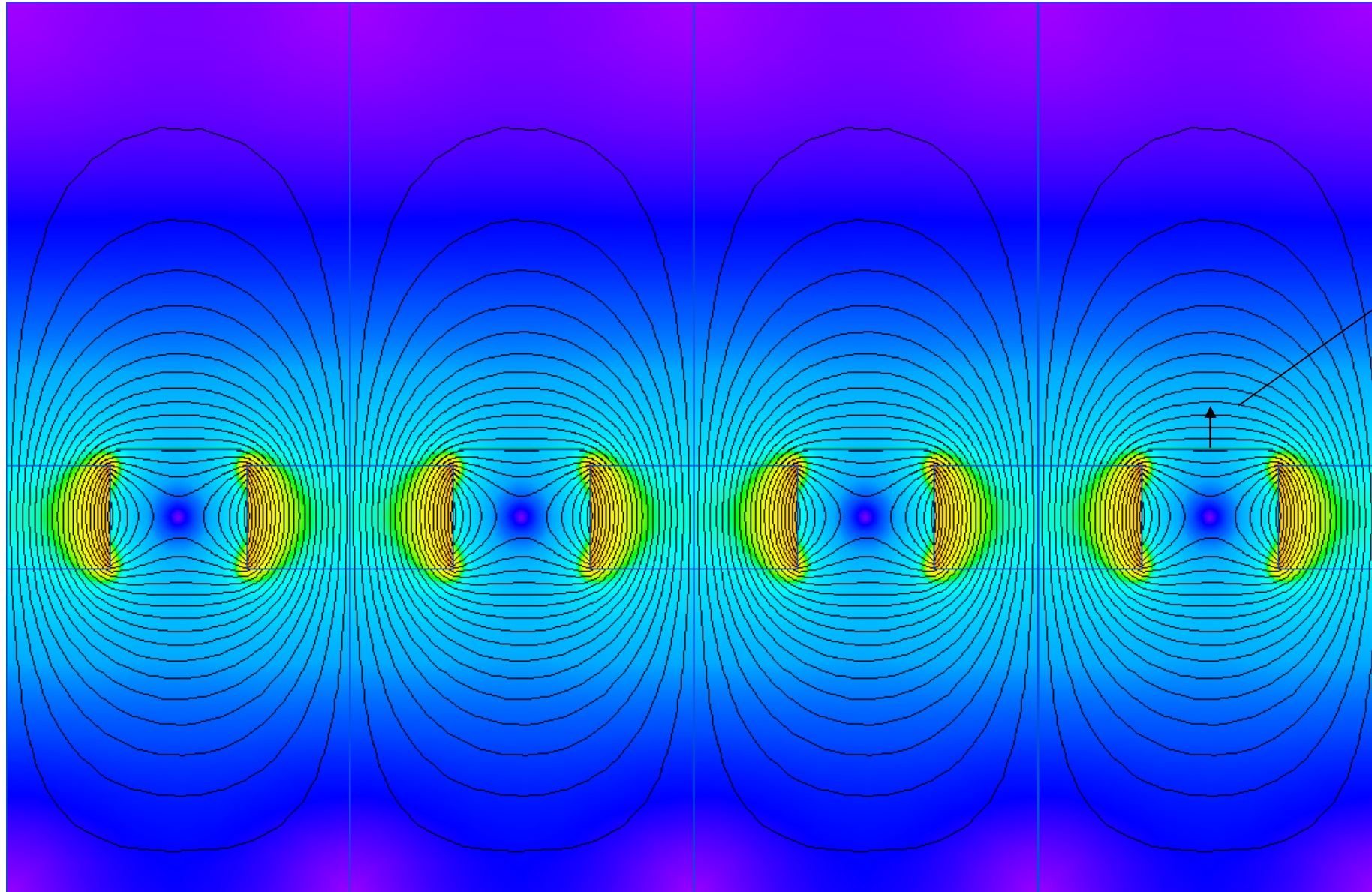
## Task:

Calculate the magnetic force acting on the diaphragm.



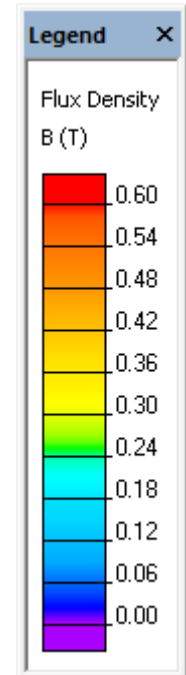


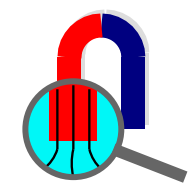
# Magnetostatic speaker



Values

- Physical Quantities
  - Mechanical force
    - $f = 0.033105 \text{ N}$





**This recording is over**

**More recordings and simulation  
examples at  
[www.quickfield.com](http://www.quickfield.com)**

Your feedback is welcome: [support@quickfield.com](mailto:support@quickfield.com)