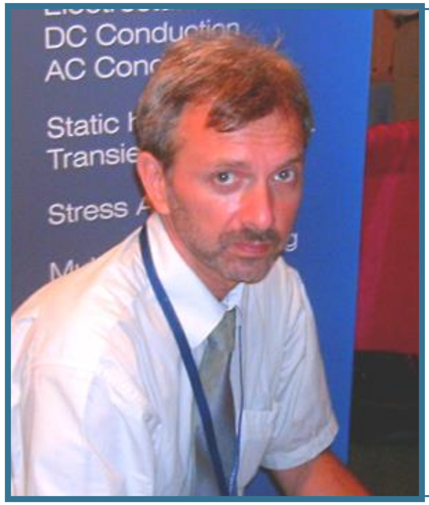
DC Magnetic simulation with QuickField



Vladimir Podnos

Director of Marketing and Support
Tera Analysis Ltd.

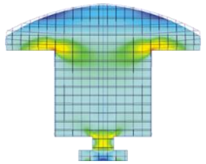
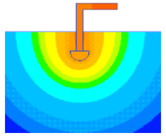
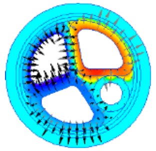
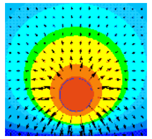
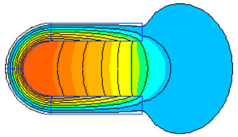
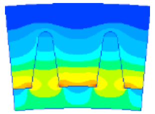
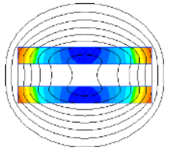
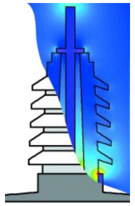
Alexander Lyubimtsev

Support Engineer
Tera Analysis Ltd.

https://quickfield.com/seminar/seminar_dc_magn.htm

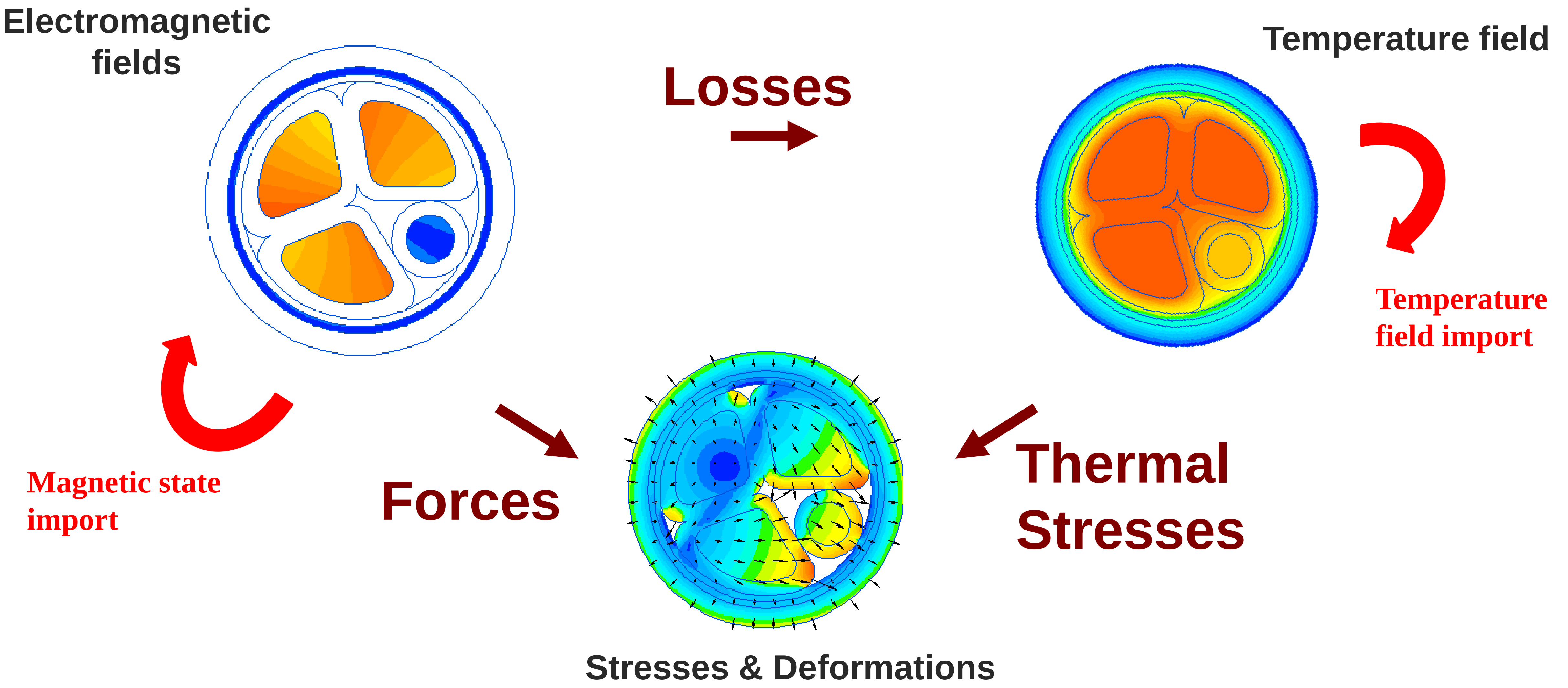
QuickField Analysis Options

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

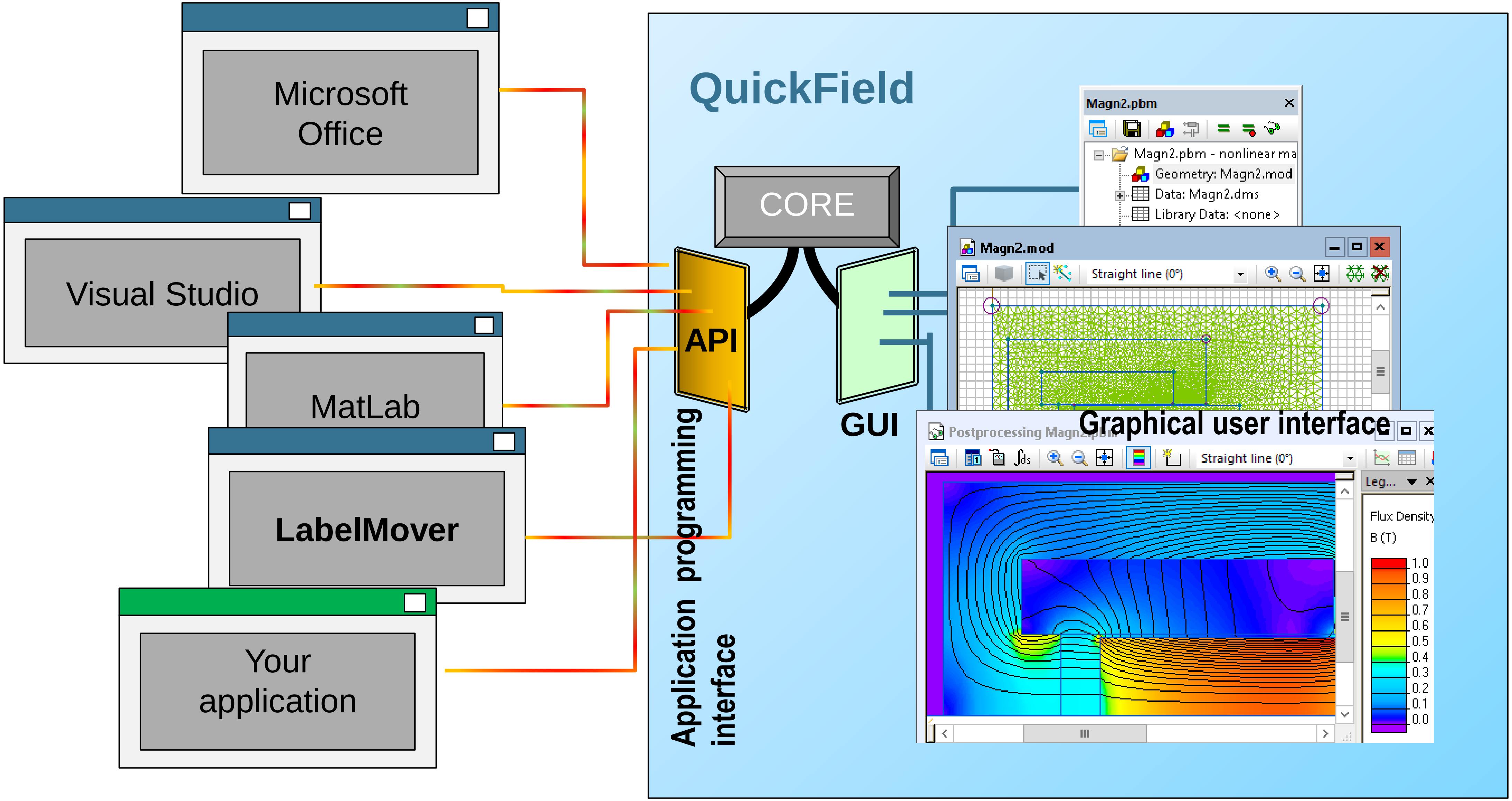
https://quickfield.com/pack.htm

MultiPhysics (2D)



https://quickfield.com/coupling.htm

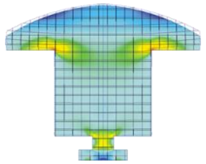
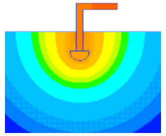
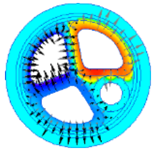
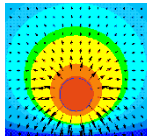
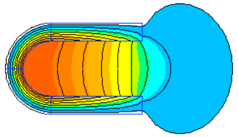
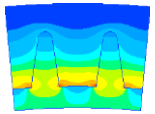
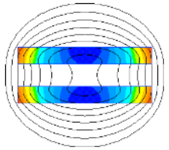
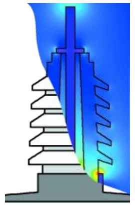
QuickField API



https://quickfield.com/programming.htm

QuickField Magnetostatics

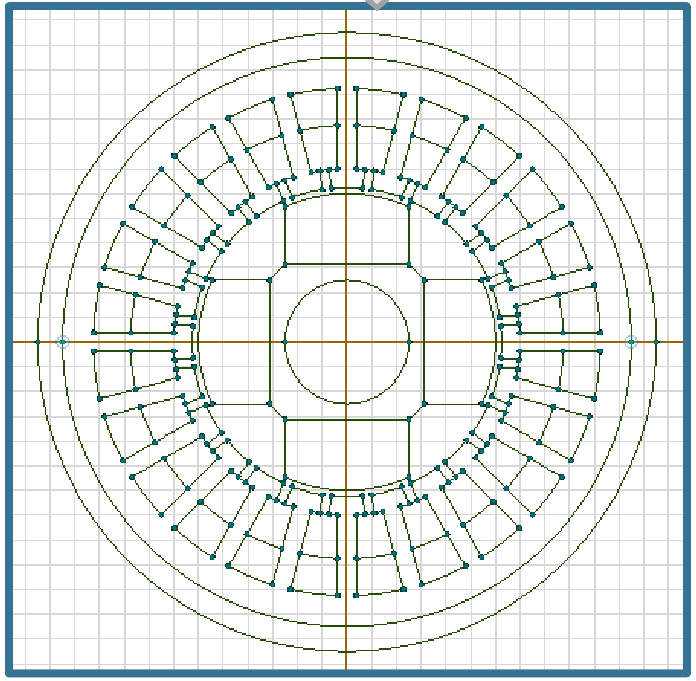
Magnetic analysis suite	Magnetostatics
	AC Magnetics
	Transient Magnetic
Electric analysis suite	Electrostatics (2D,3D) and DC Conduction (2D,3D)
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	Steady-State Heat transfer (2D,3D)
	Transient Heat transfer
	Stress analysis

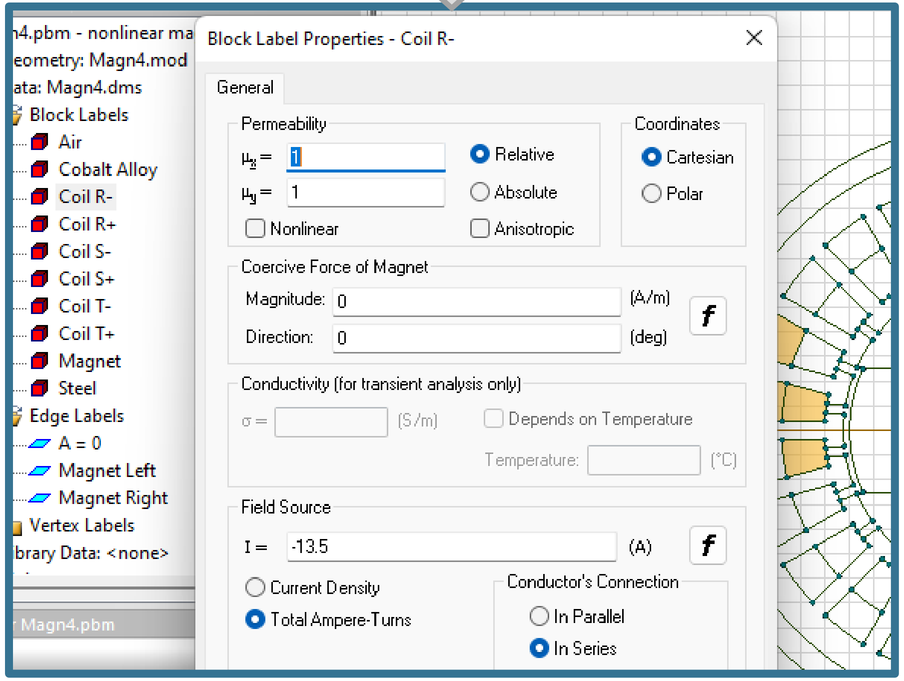
https://quickfield.com/pack.htm

QuickField Workflow

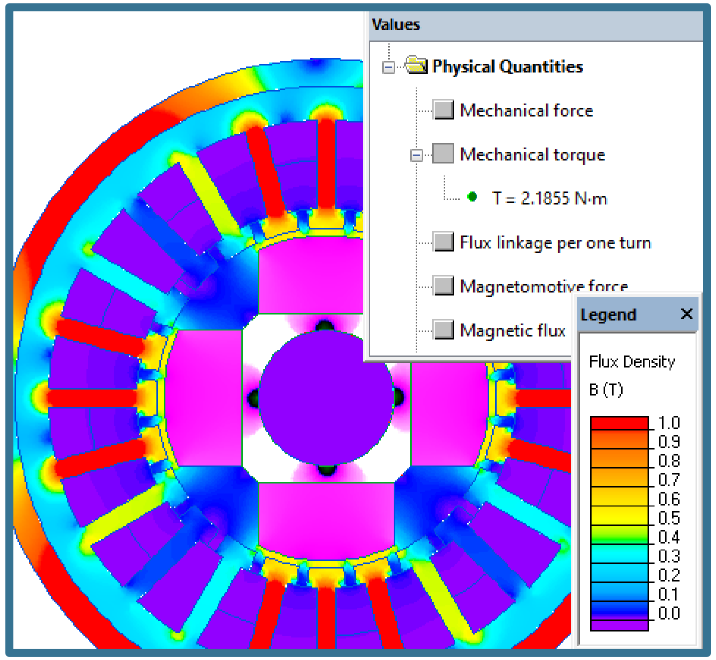
Problem setup



Geometry definition using the Model editor



Specifying the material properties, field sources and boundary conditions Using the Data Editor

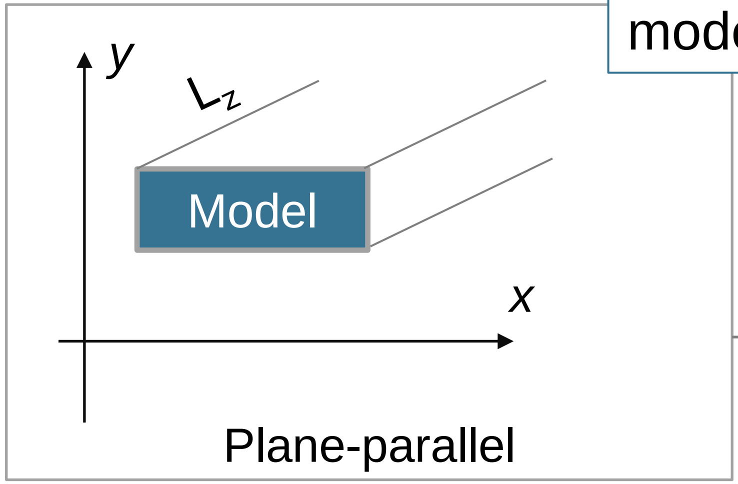


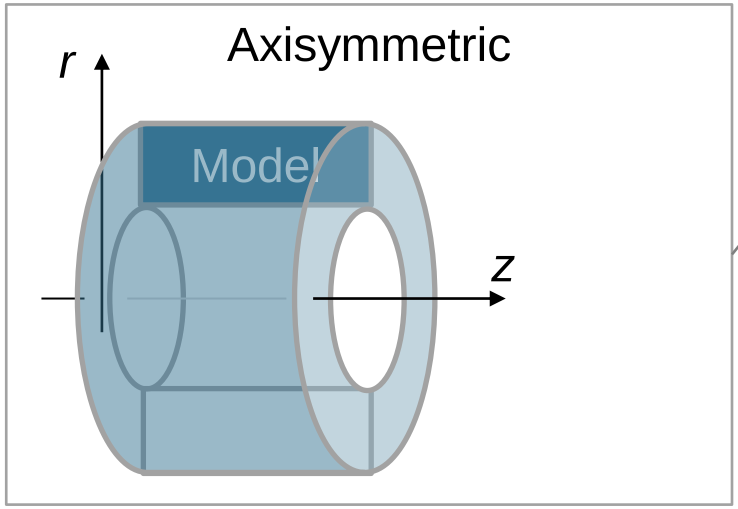
Results analysis using the Postprocessor

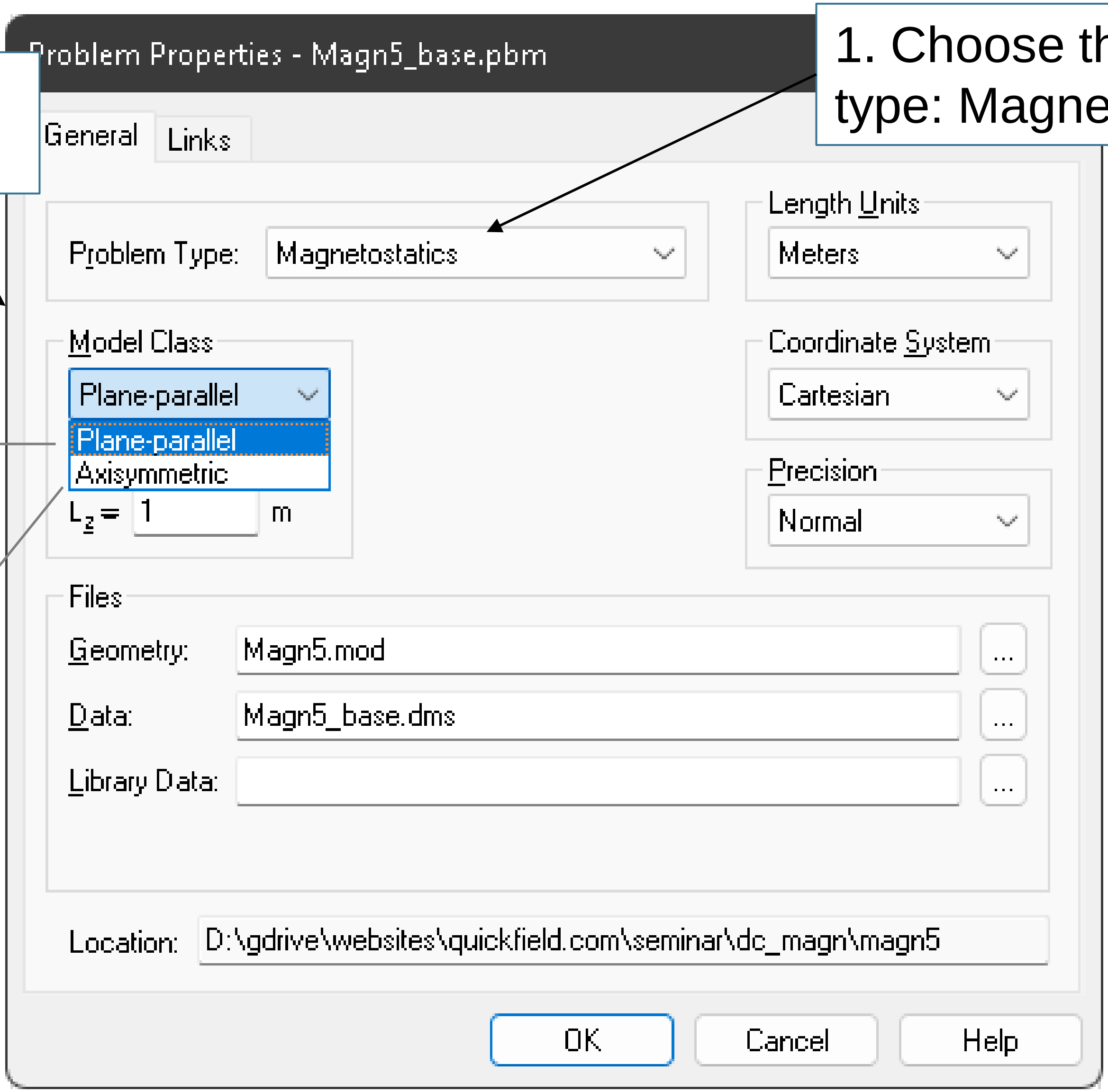
QuickField Magnetostatics. Problem setup

1. Choose the problem type: Magnetostatics

2. Choose the model class

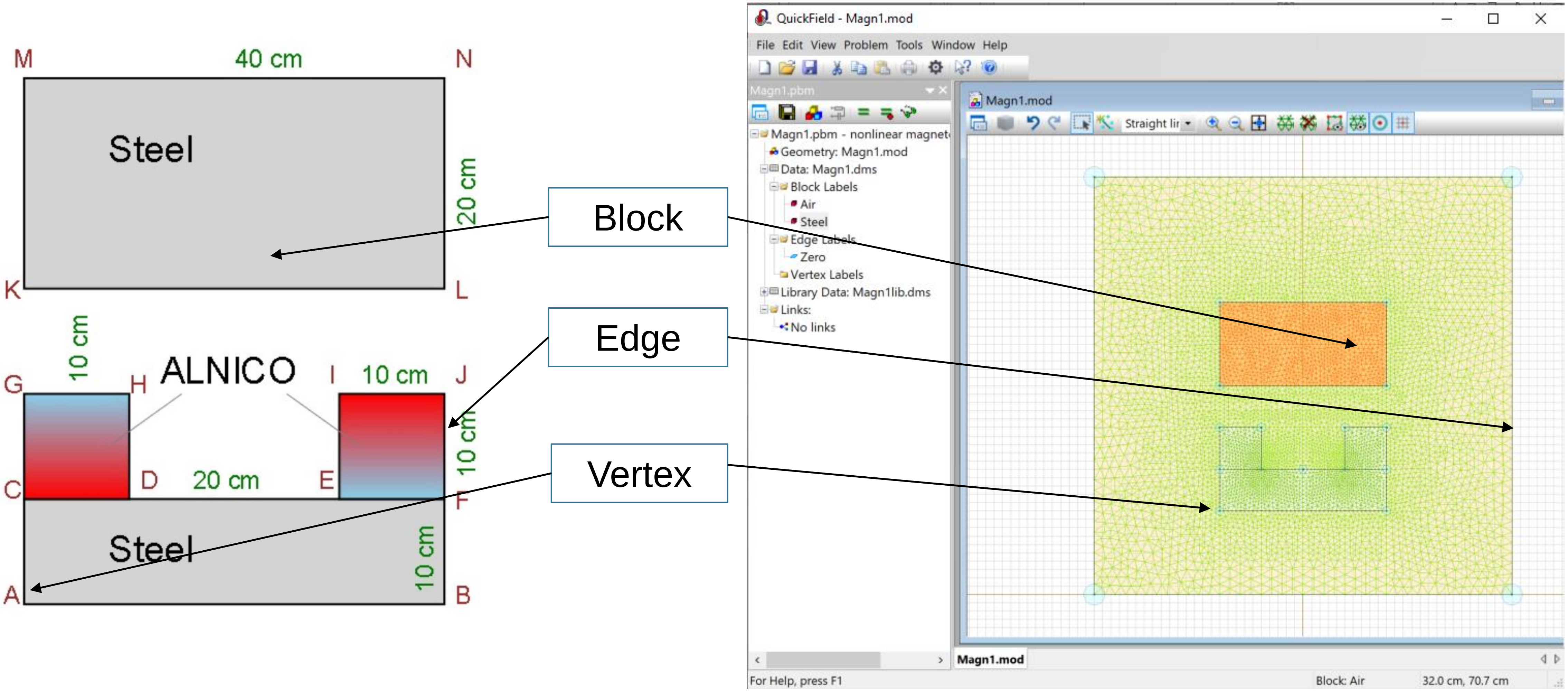






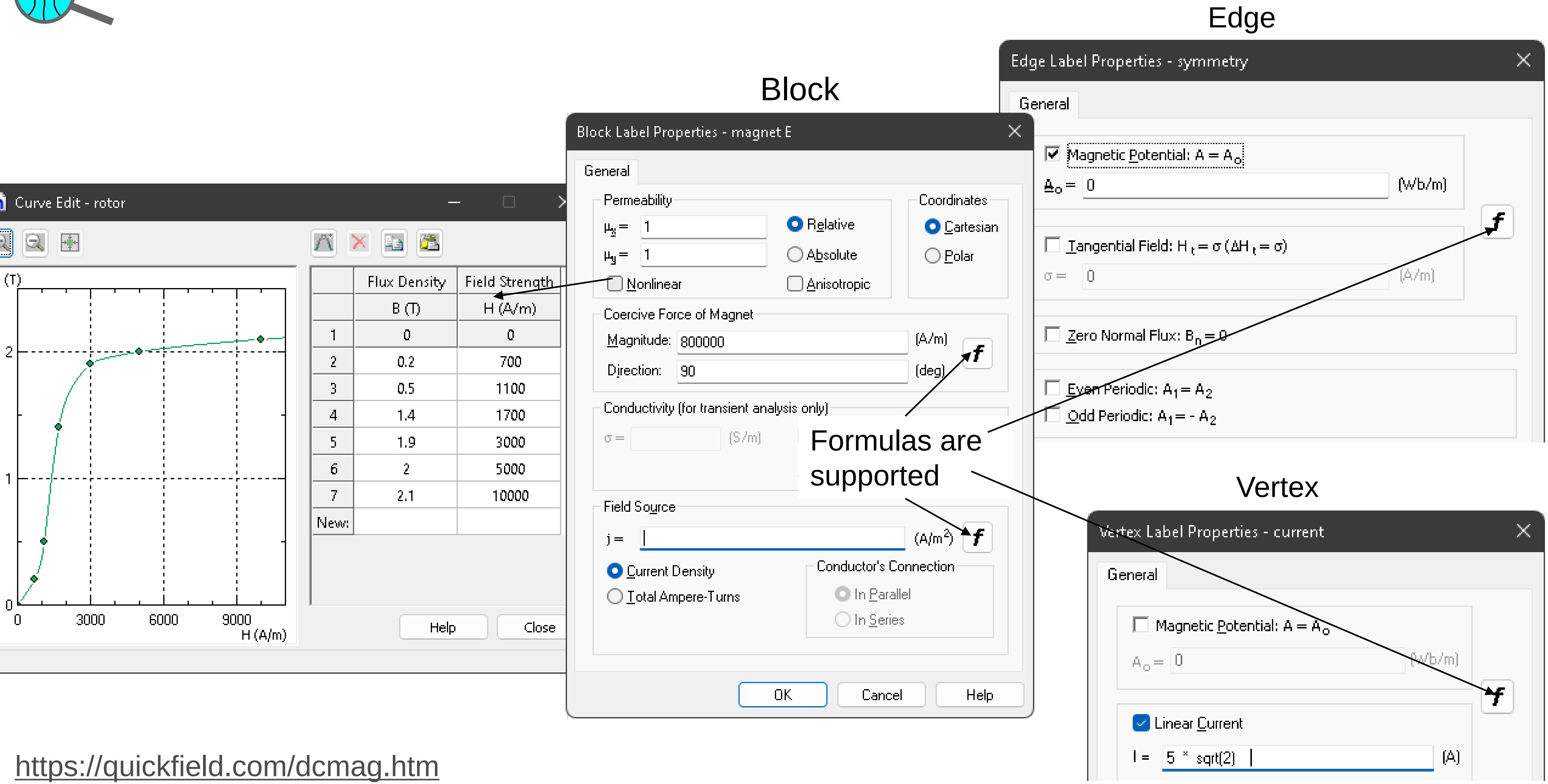
https://quickfield.com/dcmag.htm

QuickField Magnetostatics. Geometry



https://quickfield.com/prep.htm

QuickField Magnetostatics. Label properties



https://quickfield.com/dcmag.htm

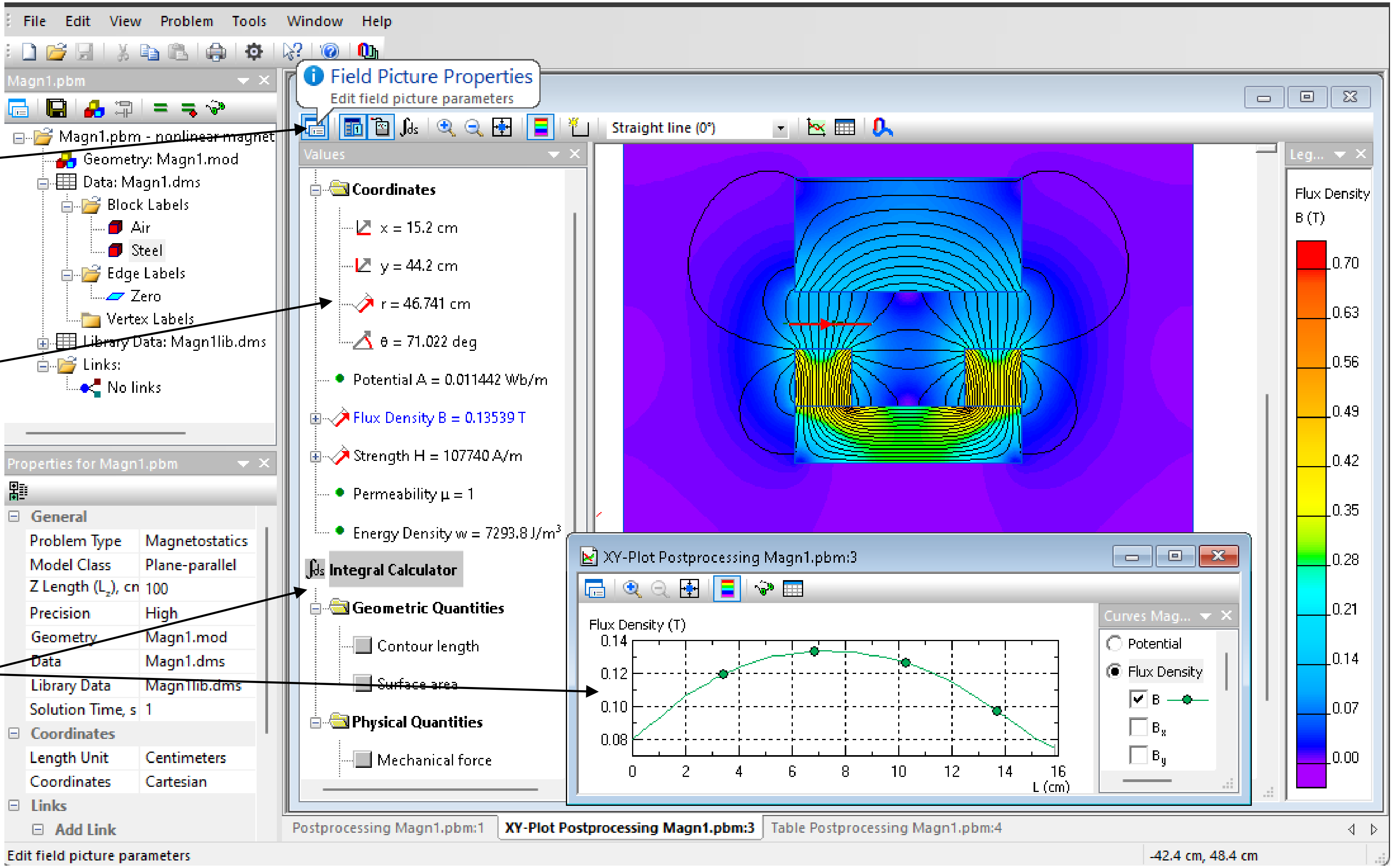
QuickField Magnetostatics. Results

Results analysis is the most complicated part, having more options. Generally the following types of result analysis are available:

Field maps showing the space distribution of different field parameters

Field parameters in arbitrary point

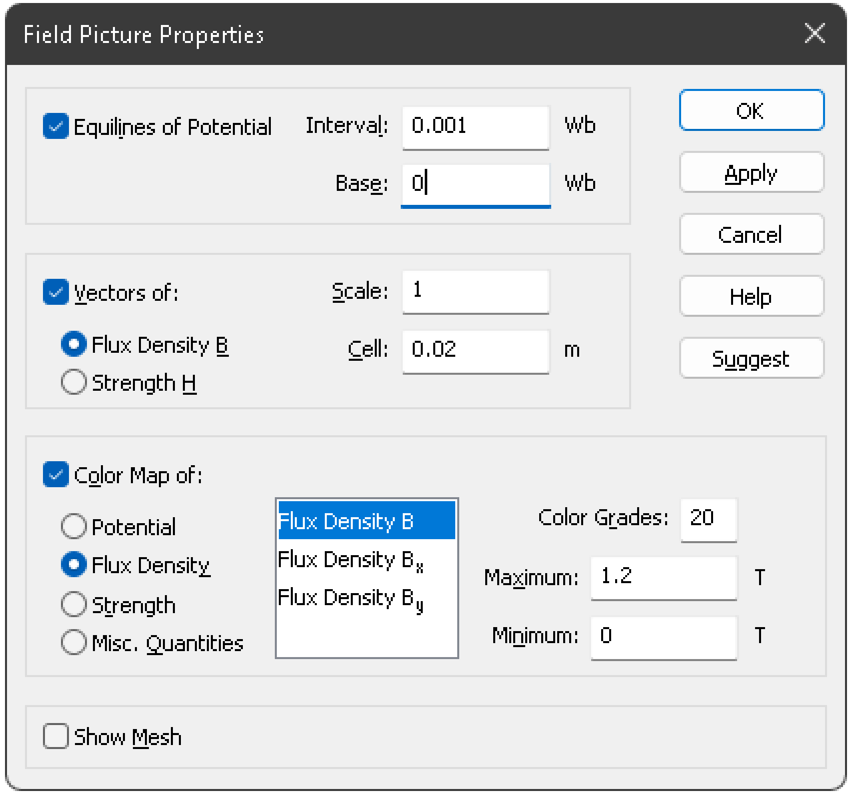
Contour analysis, including field parameters distribution and integral calculations



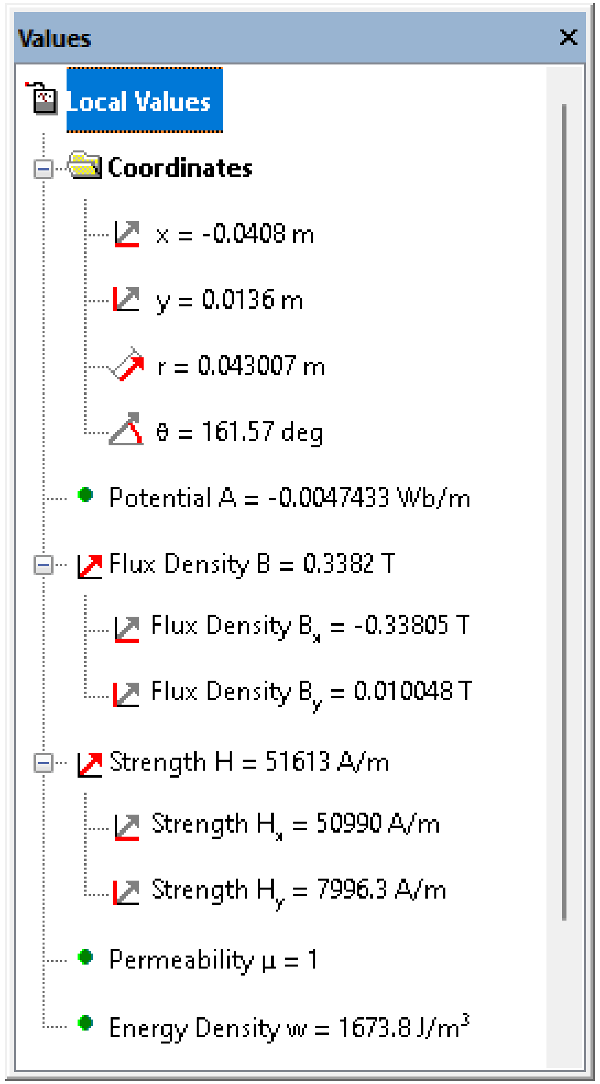
https://quickfield.com/post.htm

QuickField Magnetostatics. Results

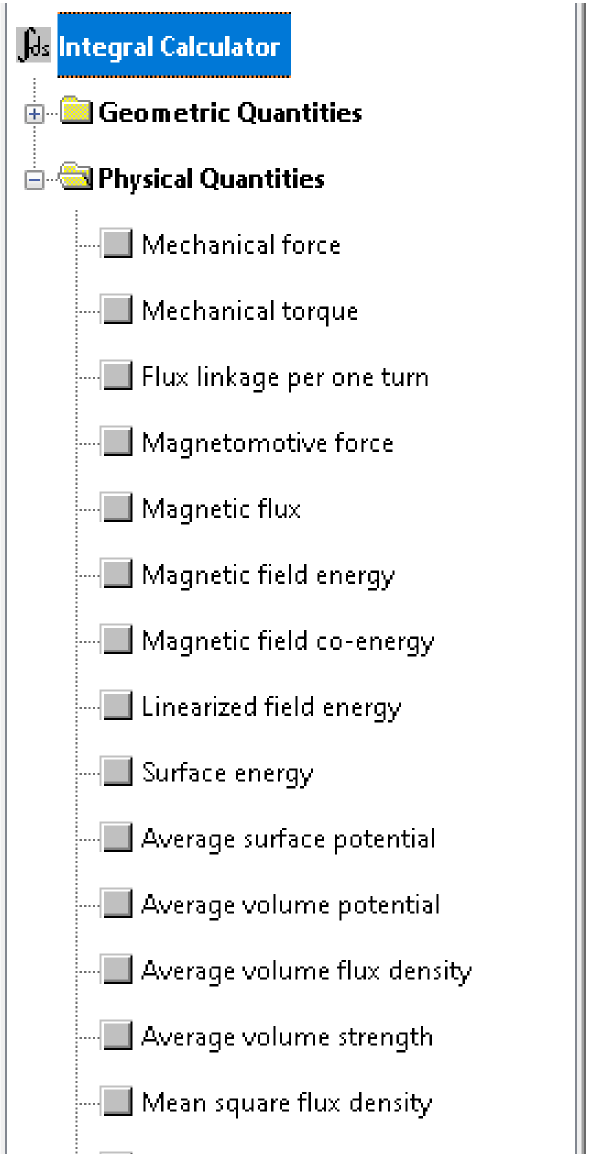
Field maps



Local field data

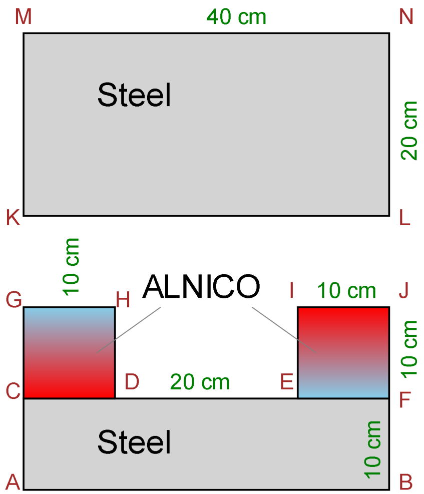


Integrals

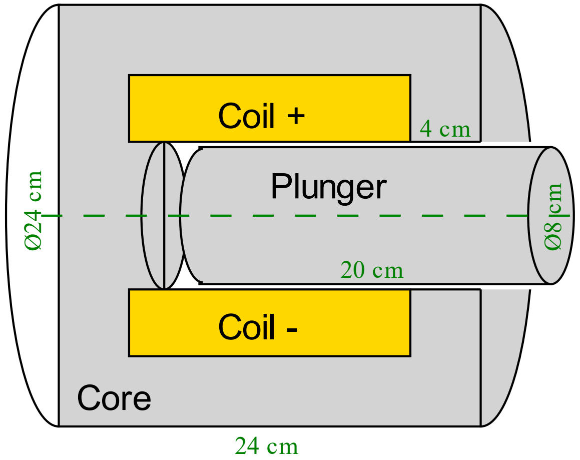


QuickField Difference

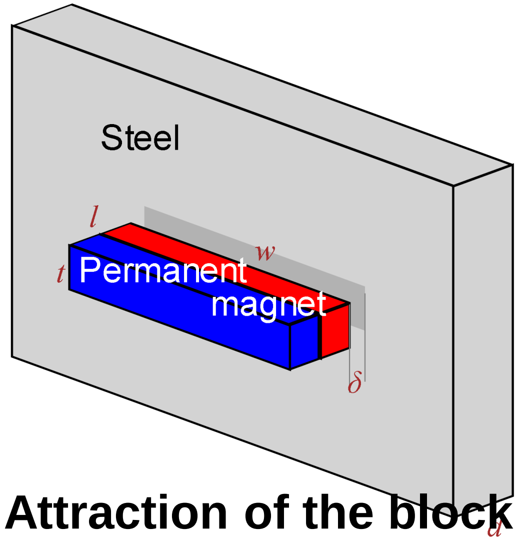
Magnetostatics simulation with QuickField



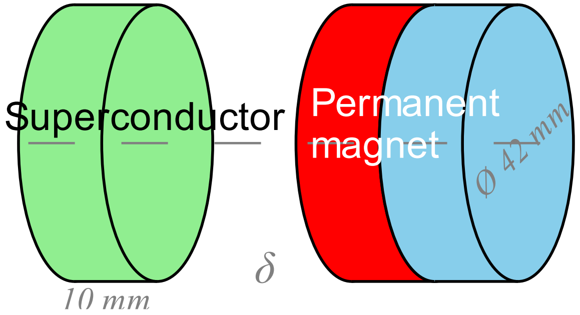
Nonlinear permanent magnet



Solenoid actuator force

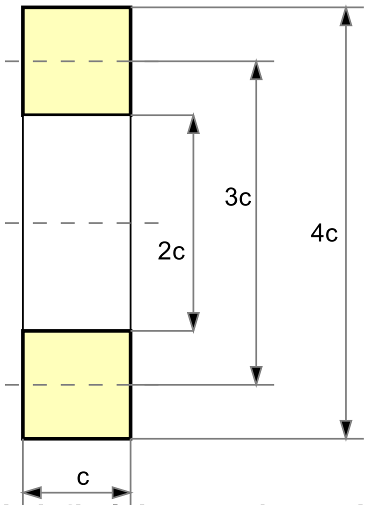


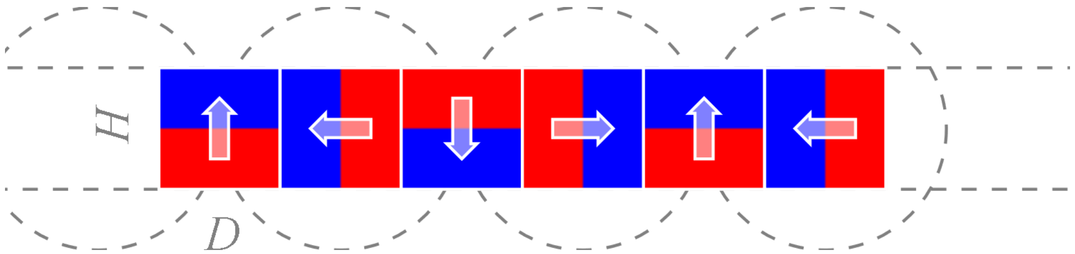
Attraction of the block magnet to the steel plate



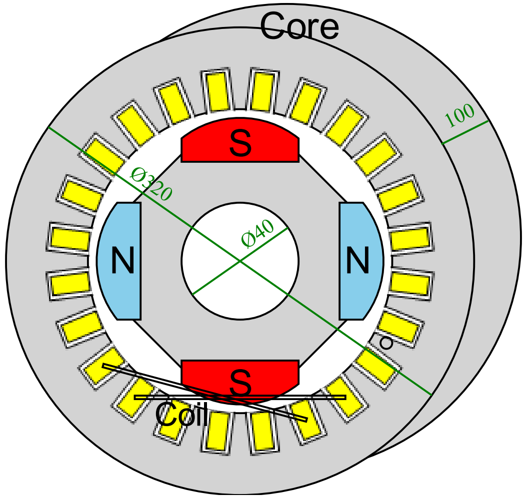
Superconductor levitation

Brooks coil





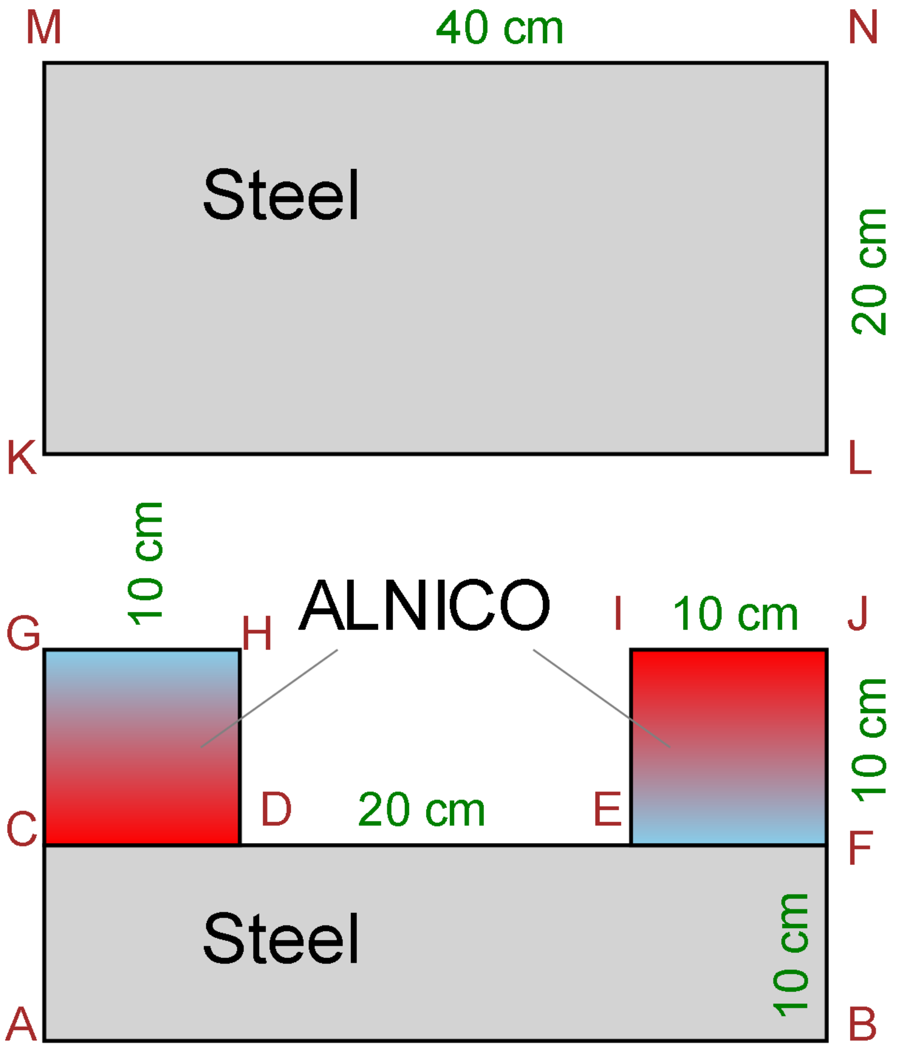
Halbach array



Armature winding inductance

https://quickfield.com/seminar/seminar_dc_magn.htm

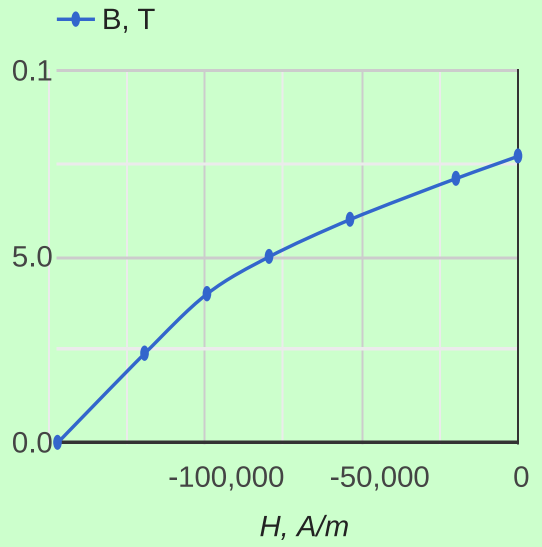
Nonlinear permanent magnet



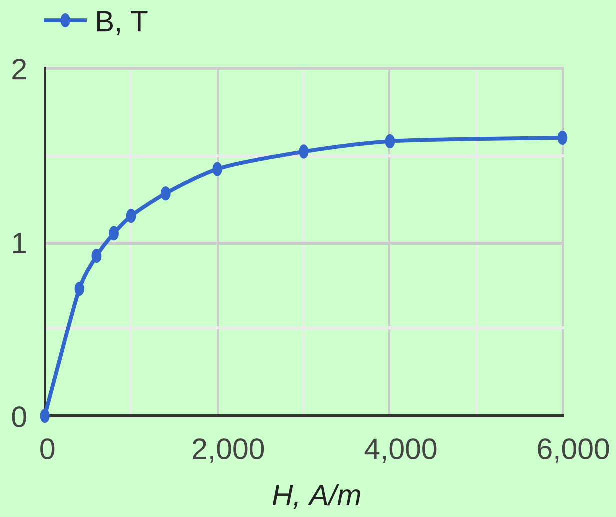
Problem specification:

The permanent magnets coercive force is 147 kA/m,

ALNICO BH-curve:



Steel BH-curve:

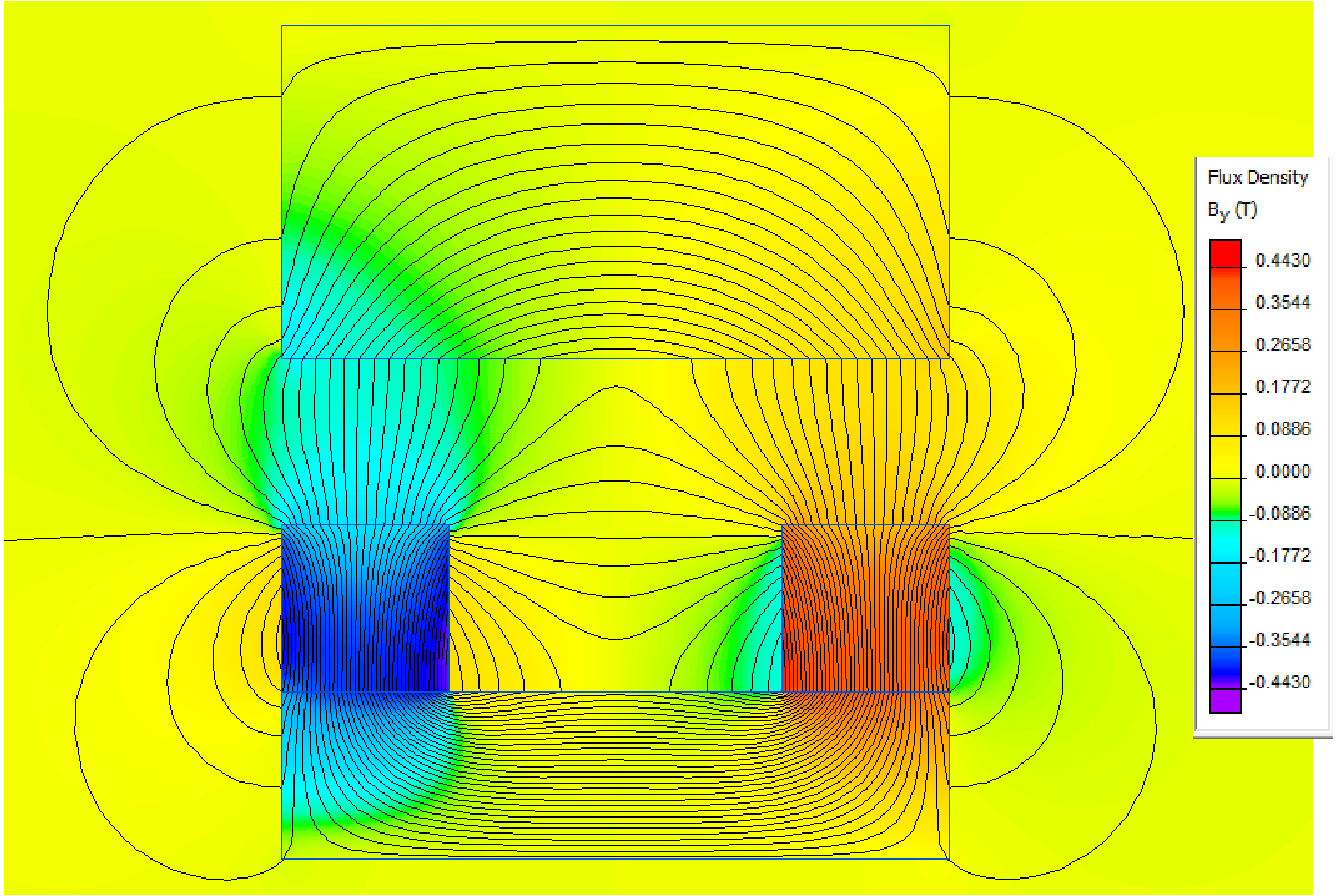


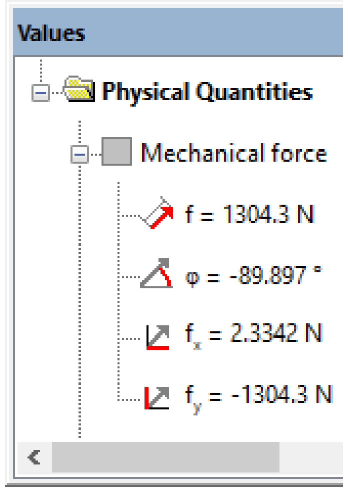
Task:

Calculate the force as a function of the yoke position.

https://quickfield.com/advanced/magn1.htm

Nonlinear permanent magnet

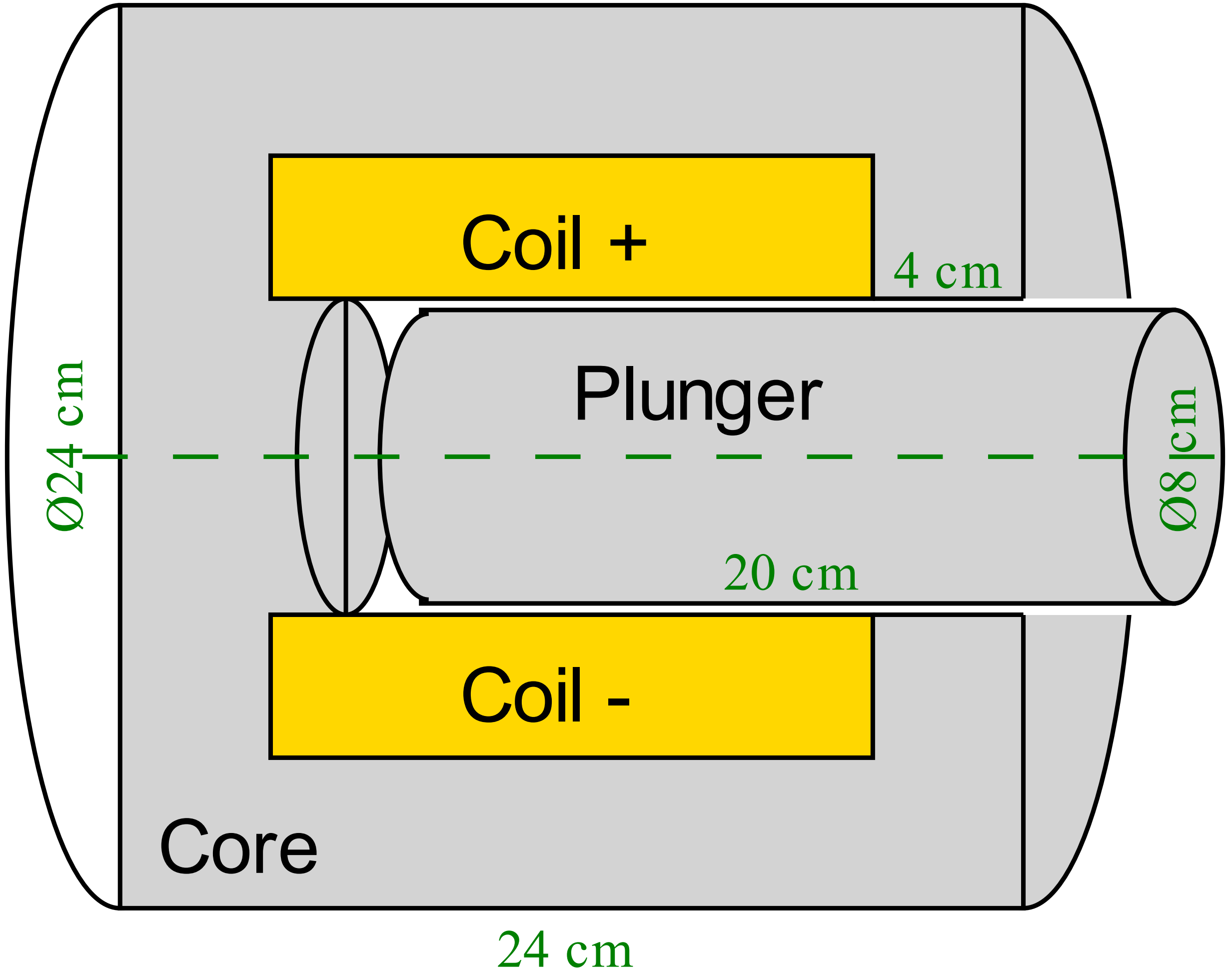




General	
Problem Type	Magnetostatics
Model Class	Plane-parallel
Z Length (L_z), cm	100

https://quickfield.com/advanced/magn1.htm

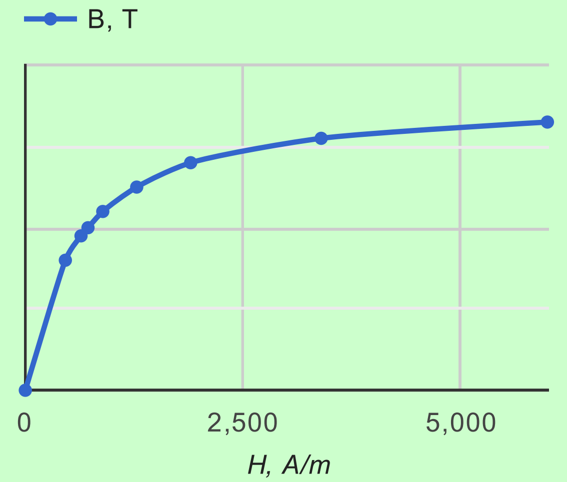
Solenoid actuator force



Problem specification:

Current density in the coil j = 1 A/mm²;

The BH-curve for the core and the plunger:

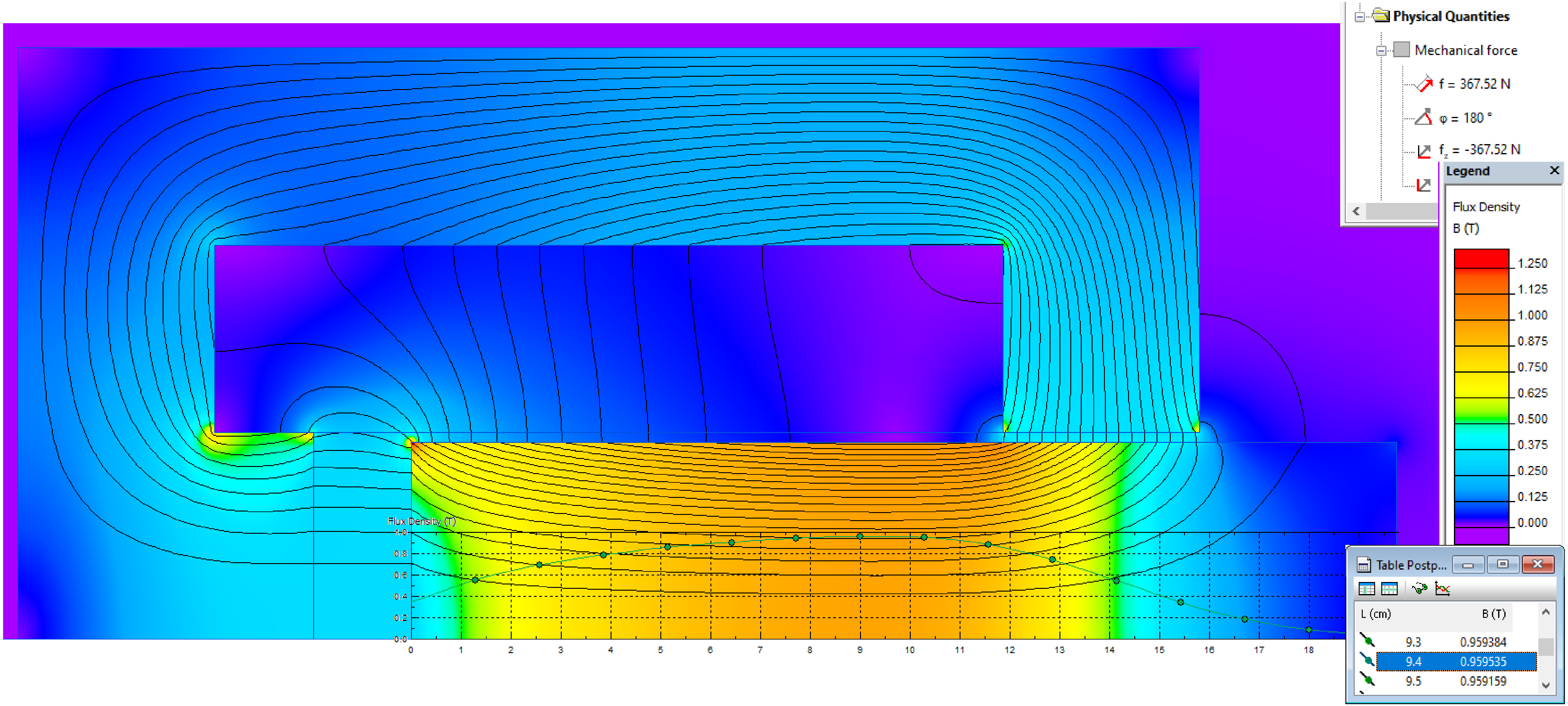


Task:

Calculate the force as a function of the plunger position.

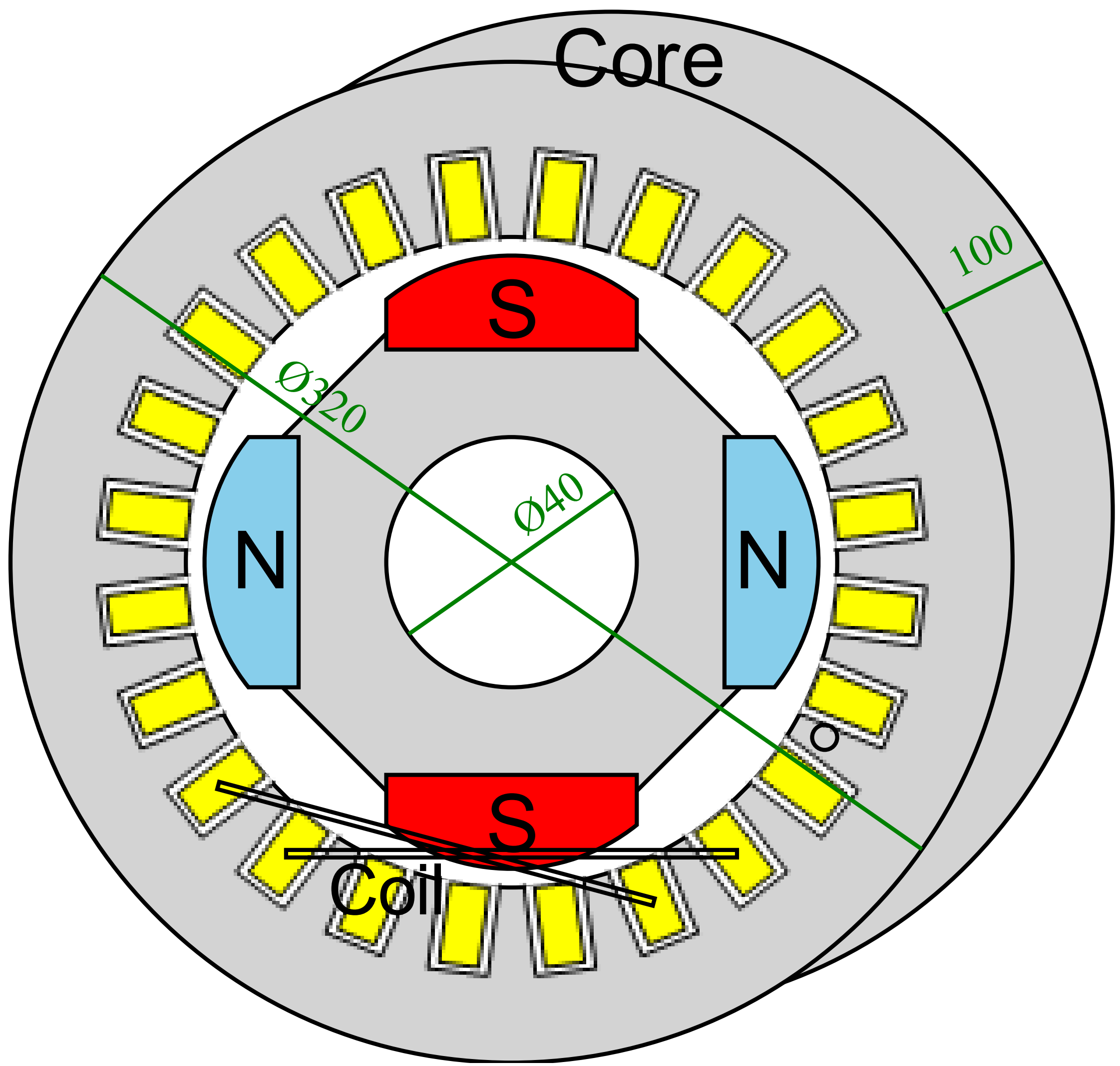
https://quickfield.com/advanced/magn2.htm

Solenoid actuator force



https://quickfield.com/advanced/magn2.htm

Armature winding inductance

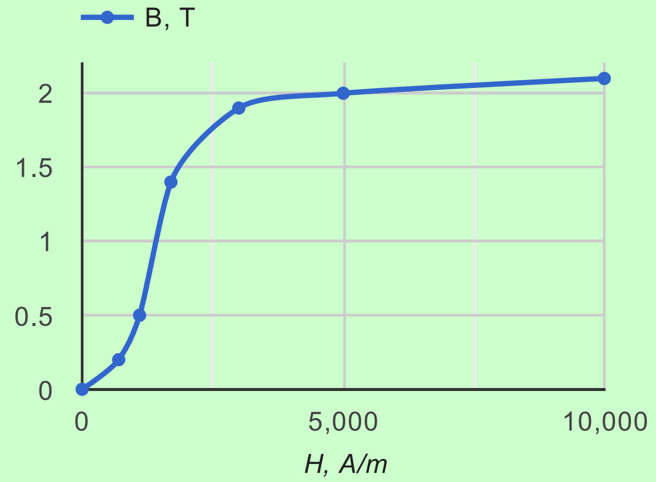


Problem specification:

3-phase stator winding scheme: A-A, Z-Z, B-B, X-X, C-C, Y-Y, slot current 200 A, number of turns 100,

Permanent magnet coercive force H_c = 820 kA/m, remanence Br = 1.1 T;

Steel core B-H curve:

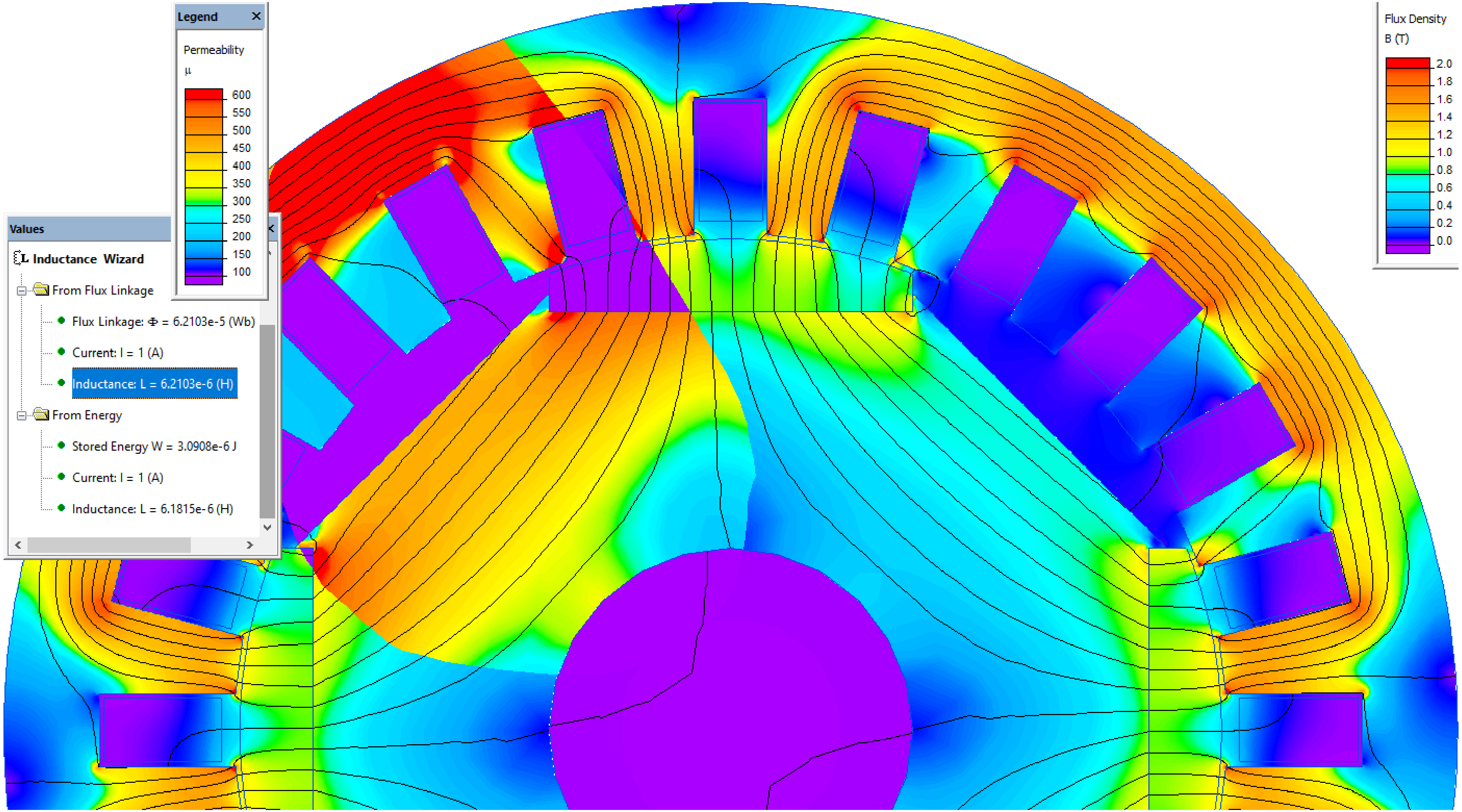


Task:

Calculate the phase coil inductance for the normal operating conditions.

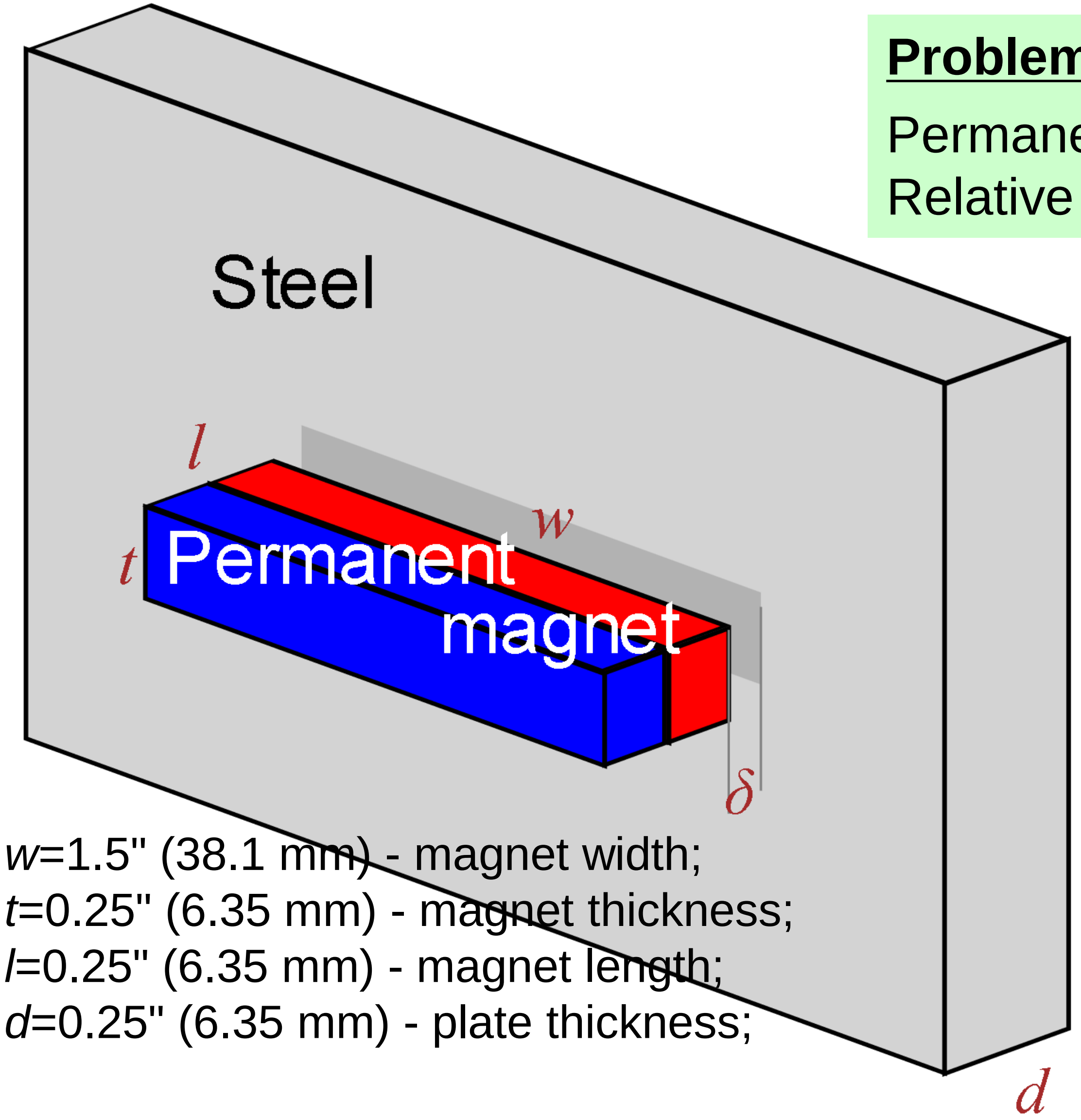
https://quickfield.com/advanced/magn5.htm

Armature winding inductance



https://quickfield.com/advanced/magn5.htm

Attraction of the block magnet to the steel plate



w=1.5" (38.1 mm) - magnet width;
t=0.25" (6.35 mm) - magnet thickness;
l=0.25" (6.35 mm) - magnet length;
d=0.25" (6.35 mm) - plate thickness;

Problem specification:

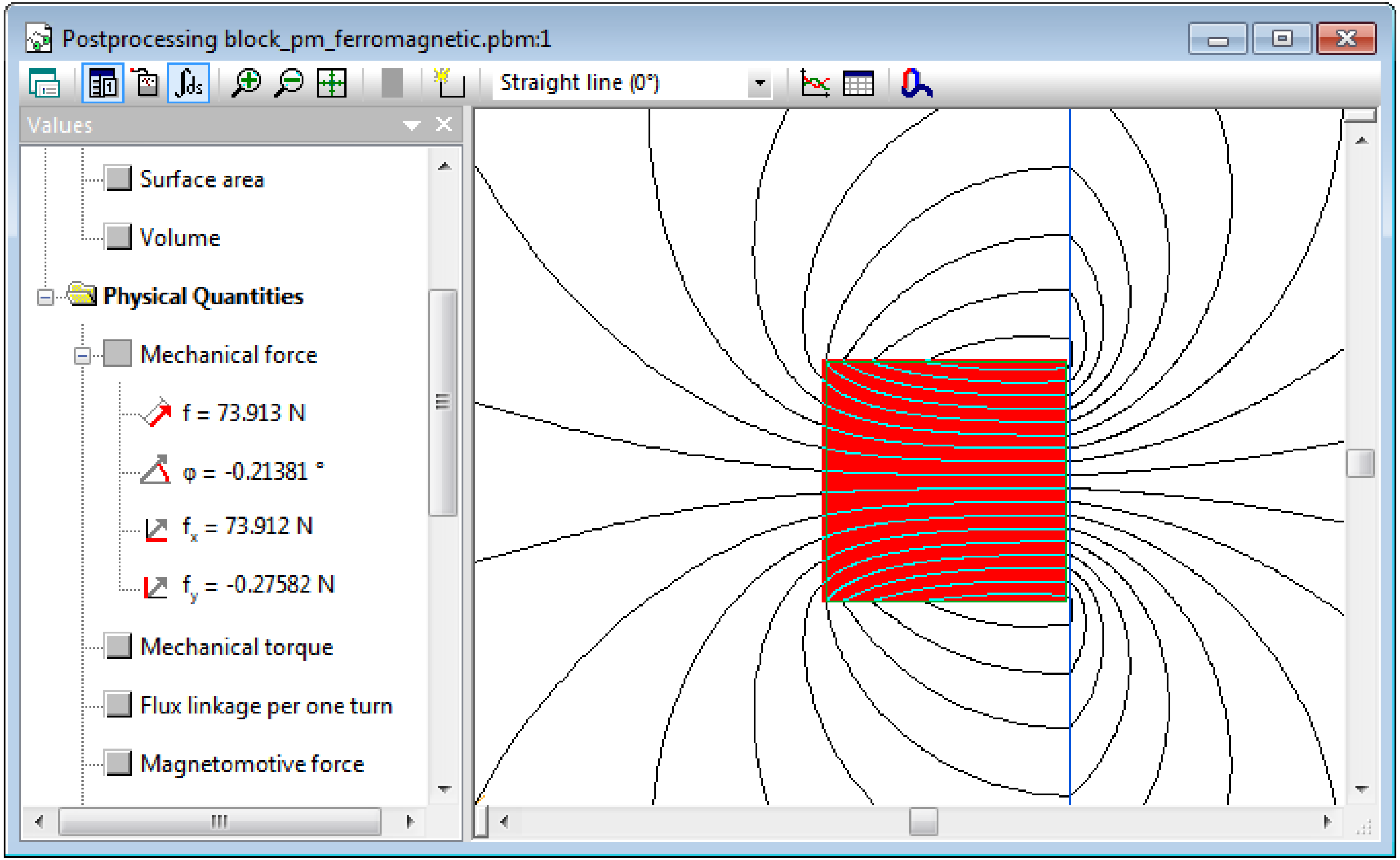
Permanent magnet grade N35: H_c = 954930 A/m, B_r = 1.26 T;
Relative magnetic permeability of steel μ_{steel} = 1000.

Task:

Calculate the pulling force of the magnet attraction to the steel plate.

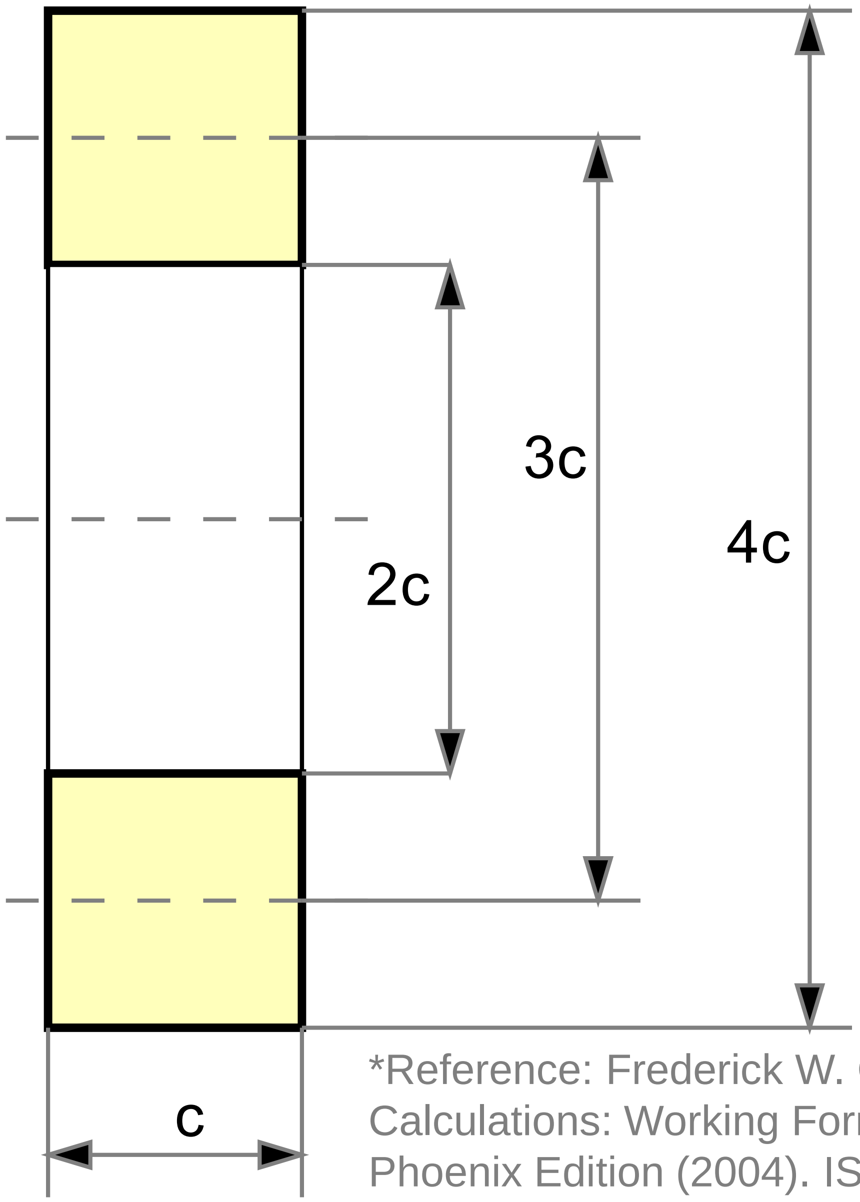
https://quickfield.com/advanced/block_pm_ferromagnetic.htm

Attraction of the block magnet to the steel plate



https://quickfield.com/advanced/block_pm_ferromagnetic.htm

Brooks coil



Problem specification:

Current I = 1 A, number of turns N = 200, c = 20 mm.

Task:

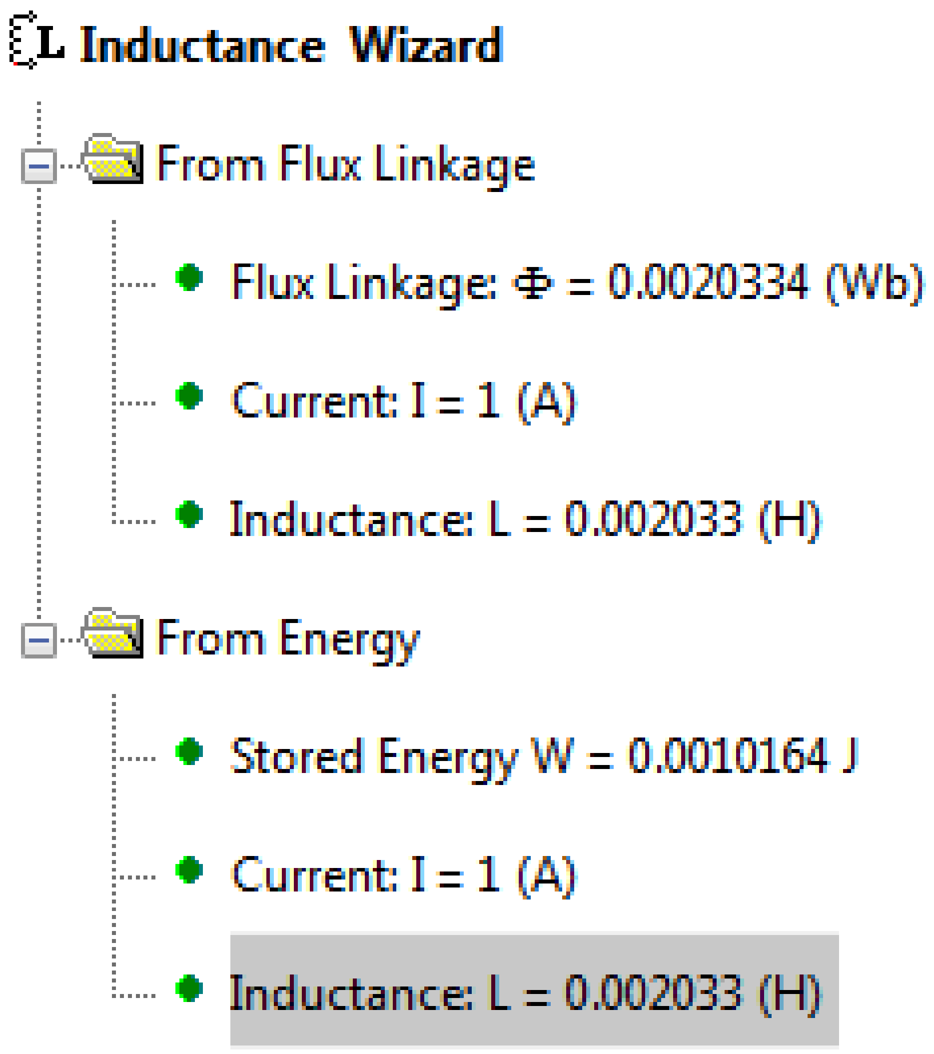
Calculate the inductance

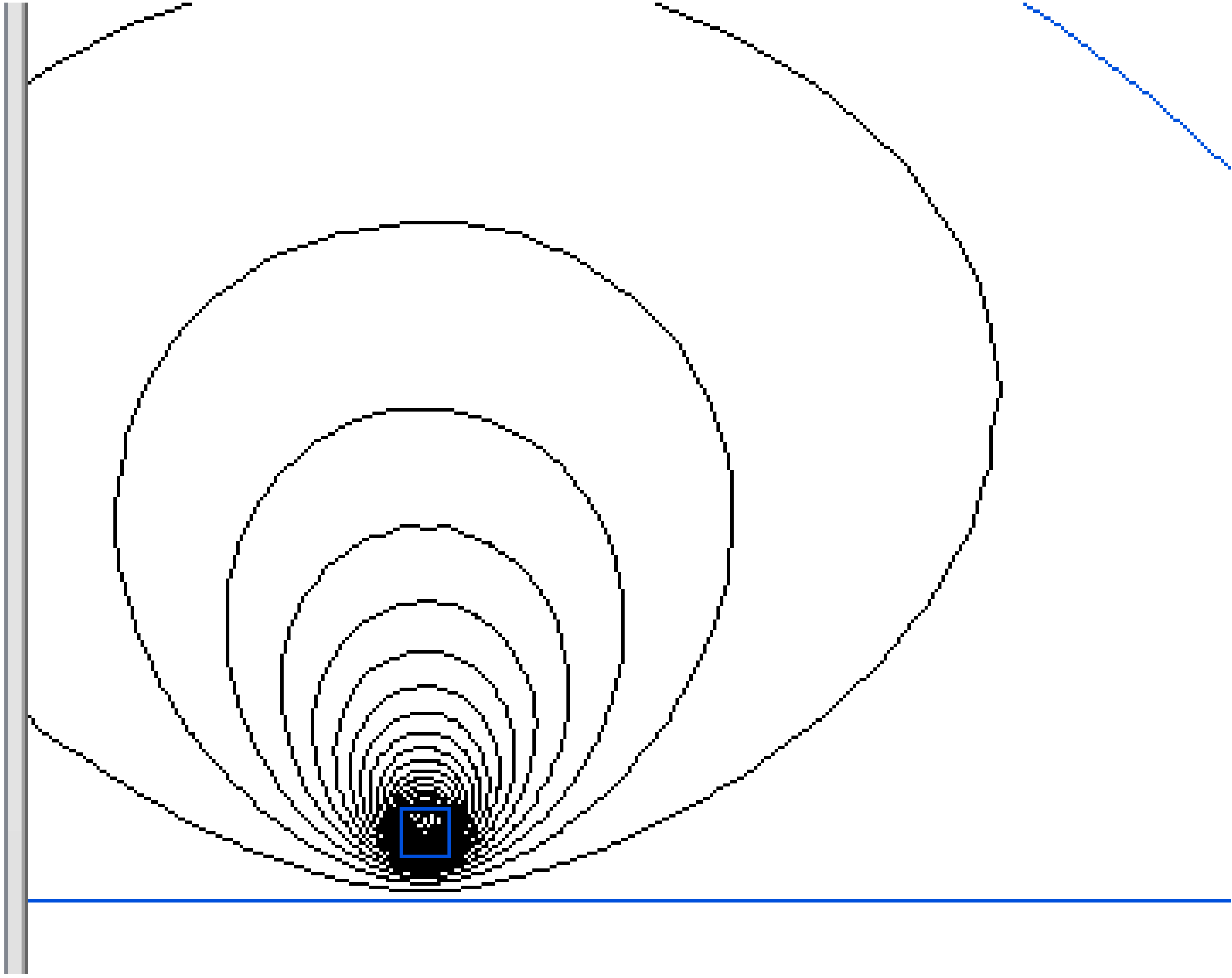
Brooks coil inductance can be calculated using equation*:
$L = 1.6994 \cdot 10^{-6} \cdot (3/2 \cdot c) \cdot N^2$

*Reference: Frederick W. Grover, Inductance Calculations: Working Formulas and Tables, Dover Phoenix Edition (2004). ISBN 0486495779. Page 98.

https://quickfield.com/advanced/brooks_inductor.htm

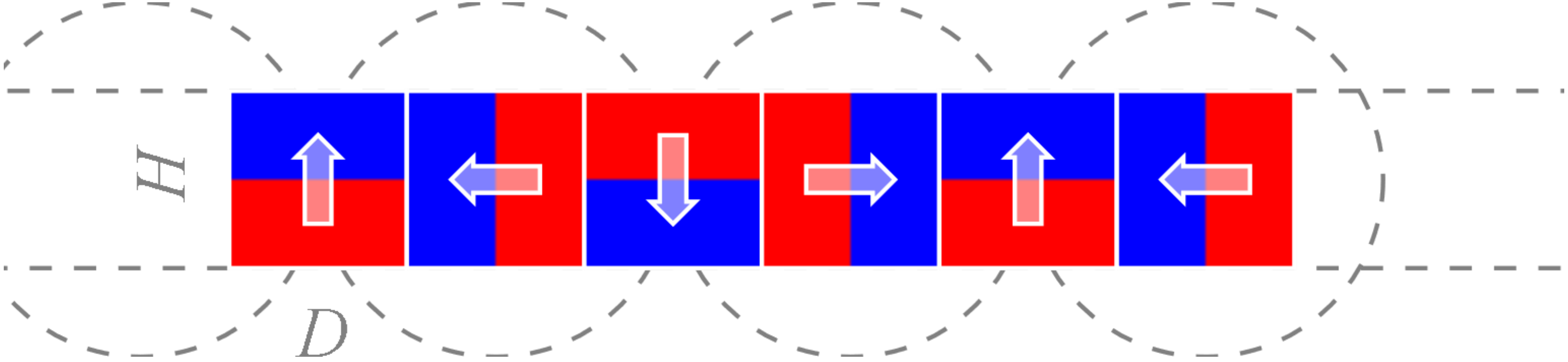
Brooks coil





https://quickfield.com/advanced/brooks_inductor.htm

Halbach array



D = 0.5 inch, H = 0.5 inch,

Problem specification:

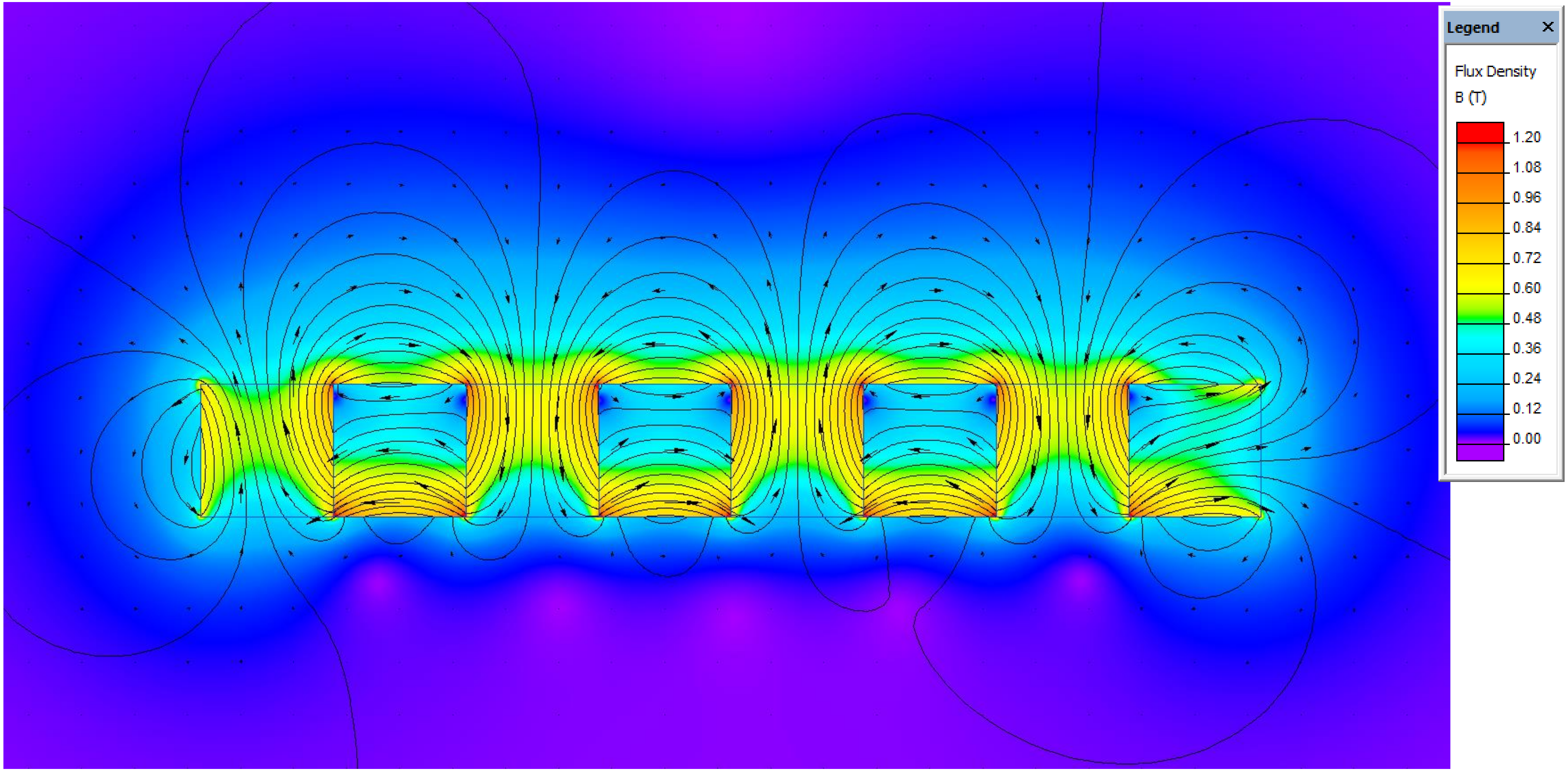
Permanent magnet coercive force Hc = 750 kA/m; remanence Br = 1.1 T

Task:

Calculate the magnetic field distribution.

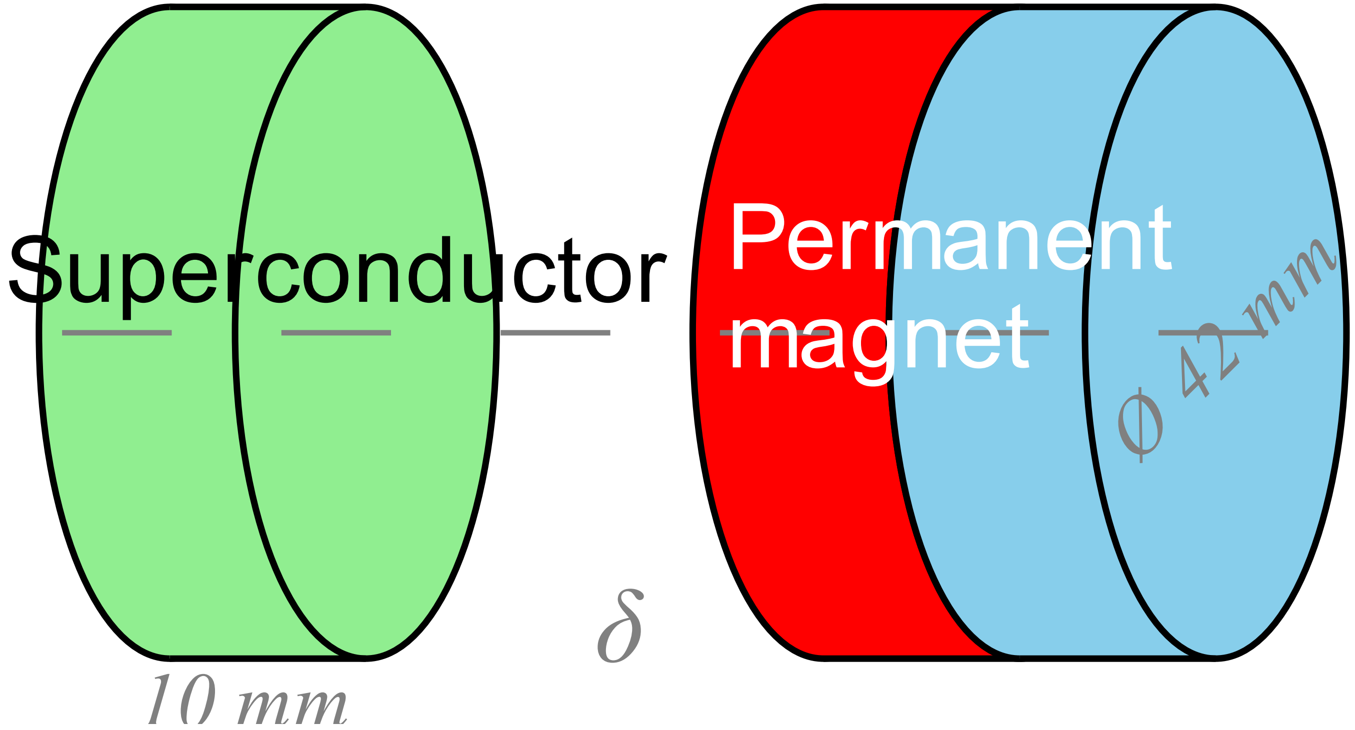
https://quickfield.com/advanced/halbach_array.htm

Halbach array



https://quickfield.com/advanced/halbach_array.htm

Superconductor levitation



Problem specification:

Permanent magnet coercive force Hc = 575 kA/m

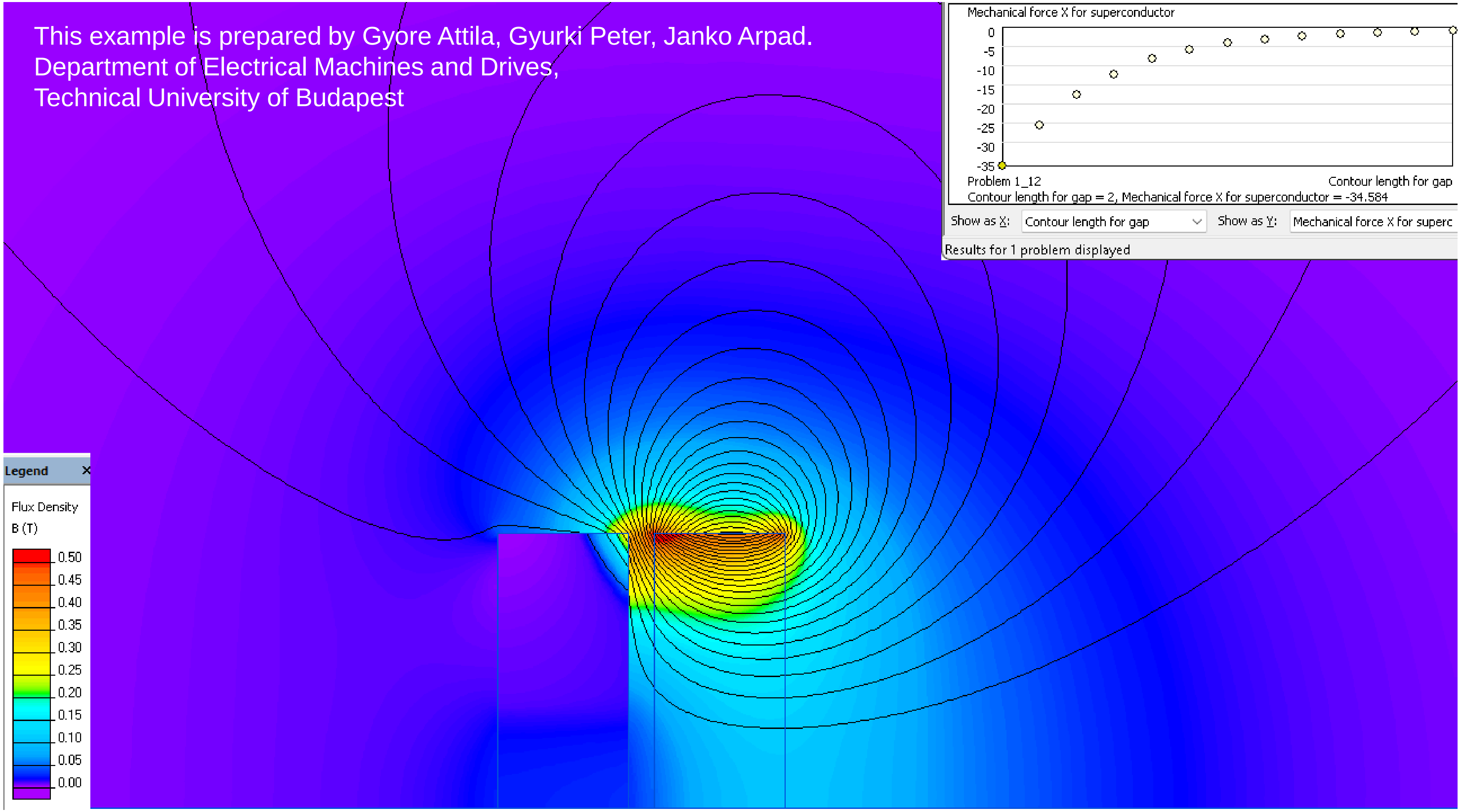
Task:

Calculate the magnetic force acting on a superconductor.

This example is prepared by Gyore Attila, Gyurki Peter, Janko Arpad.
Department of Electrical Machines and Drives,
Technical University of Budapest

https://quickfield.com/advanced/superconductor_levitation.htm

Superconductor levitation



https://quickfield.com/advanced/superconductor_levitation.htm

This recording is over

More recordings and simulation examples at www.quickfield.com

Your feedback is welcome: support@quickfield.com