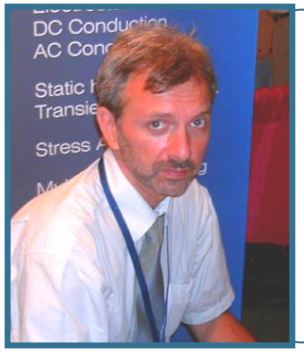
Actuators simulation with QuickField



Vladimir Podnos,
Director of Marketing and Support,
Tera Analysis Ltd.
Introduction

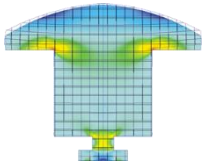
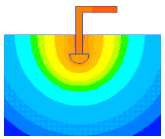
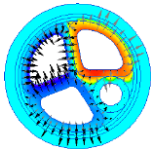
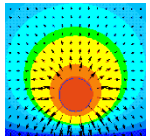
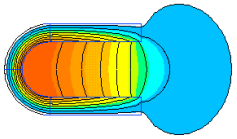
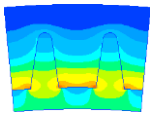
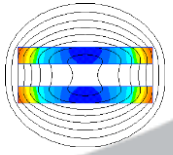
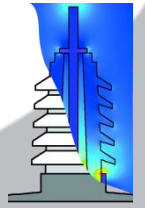
Alexander Lyubimtsev
Support Engineer
Tera Analysis Ltd.
Live demonstration

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

Electromagnetic actuators

QuickField Analysis Options

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

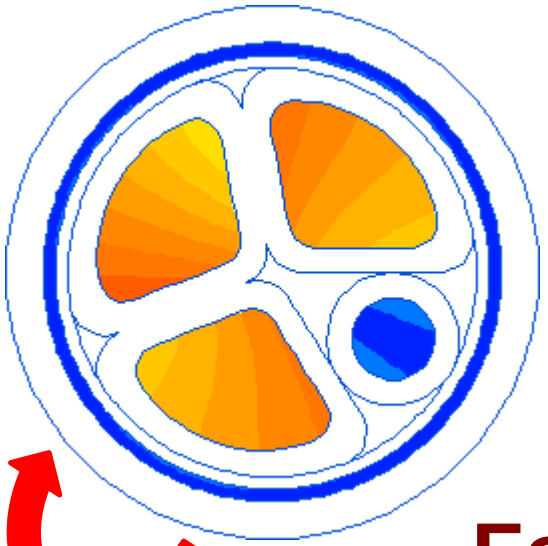









https://quickfield.com/pack.htm

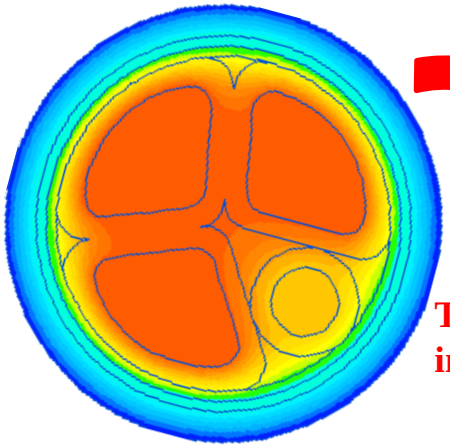
MultiPhysics (2D)

Temperature field

Electromagnetic fields



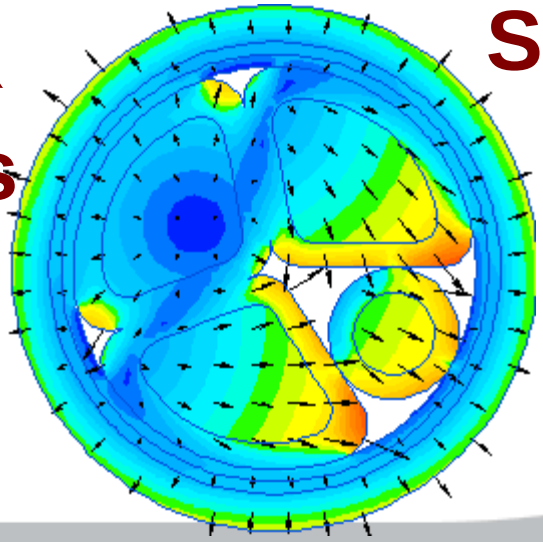
Losses



Temperature field import

Thermal Stresses

Forces



Magnetic state import

Stresses & Deformations

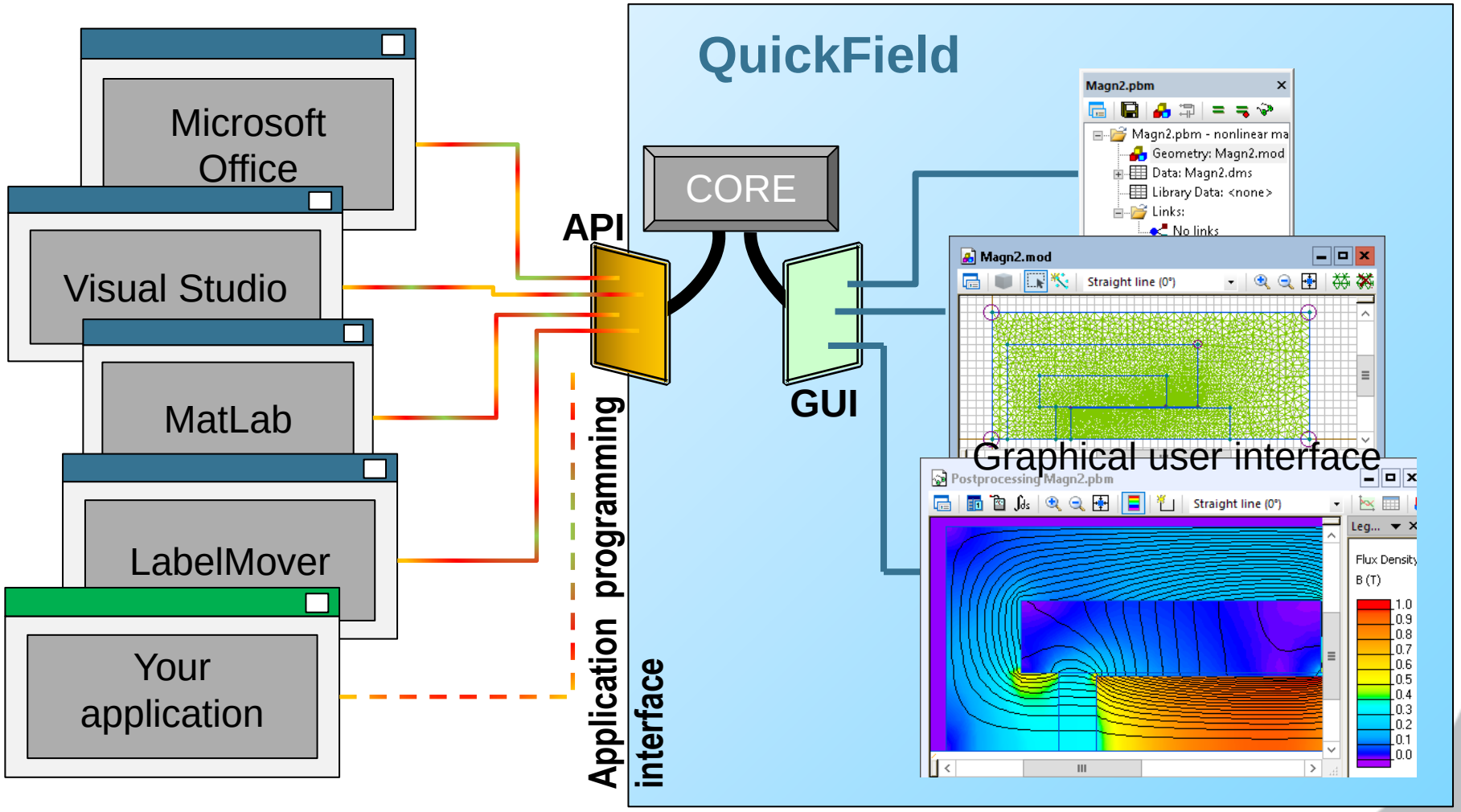
MultiPhysics (2D)

Source problem ---> |*Transferred data*|---> **Destination problem**

Destination: DC magnetics / **Source**:	DC magnetics	AC magnetics	Transient magnetics	Static heat transfer	Transient heat transfer	Stress Analysis
DC magnetics	Magnetic permeability	Magnetic permeability	Initial magnetic field			Force
AC magnetics				Joule heat	Joule heat	Force
Transient magnetics			Initial magnetic field	Joule heat	Joule heat	Force
Electrostatics						Force
DC conduction				Joule heat	Joule heat	
AC conduction				Joule heat	Joule heat	Force
Transient electric						
Static heat transfer		Temperature			Initial temperatures	Temperature
Transient heat transfer		Temperature			Initial temperatures	Temperature
Stress Analysis						

https://quickfield.com/coupling.htm

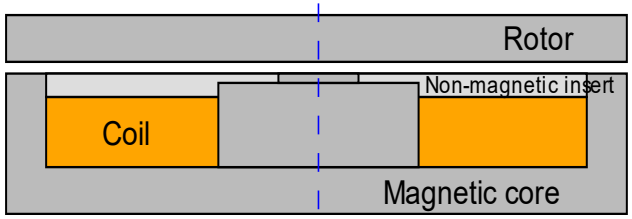
Open object interface



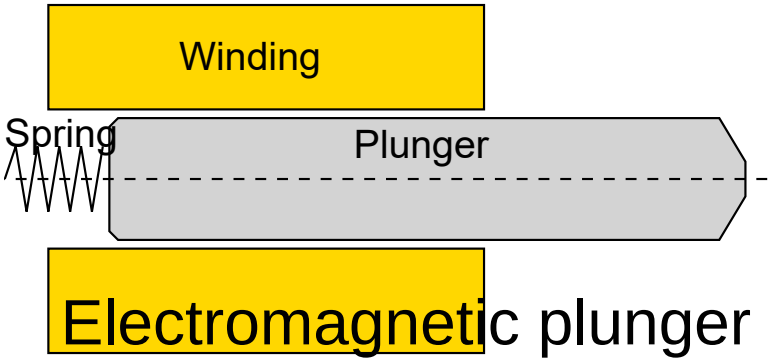
https://quickfield.com/programming.htm

QuickField Difference

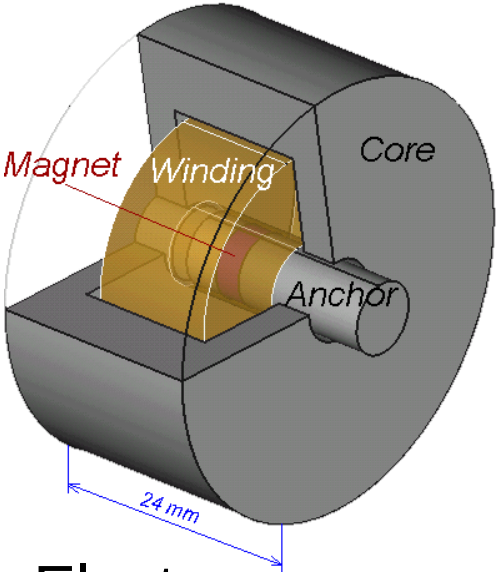
Actuators simulation with QuickField



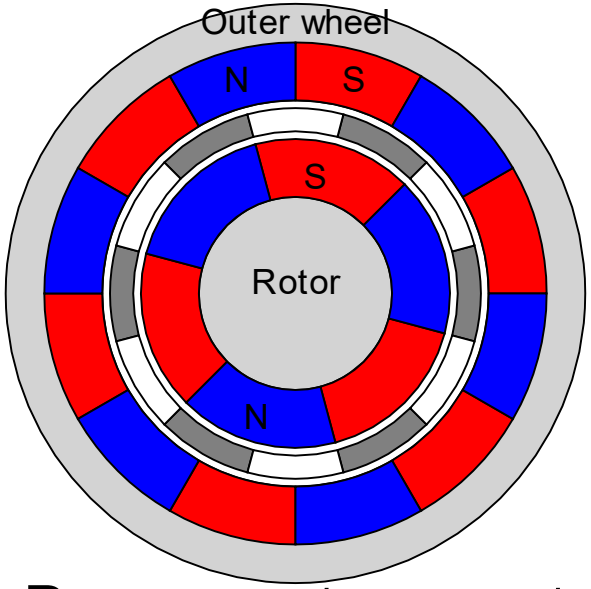
Electromagnetic clutch



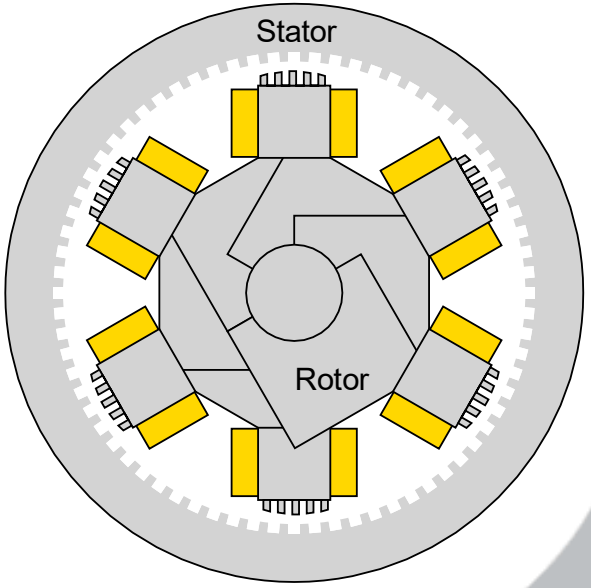
Electromagnetic plunger



Electropermanent magnet relay



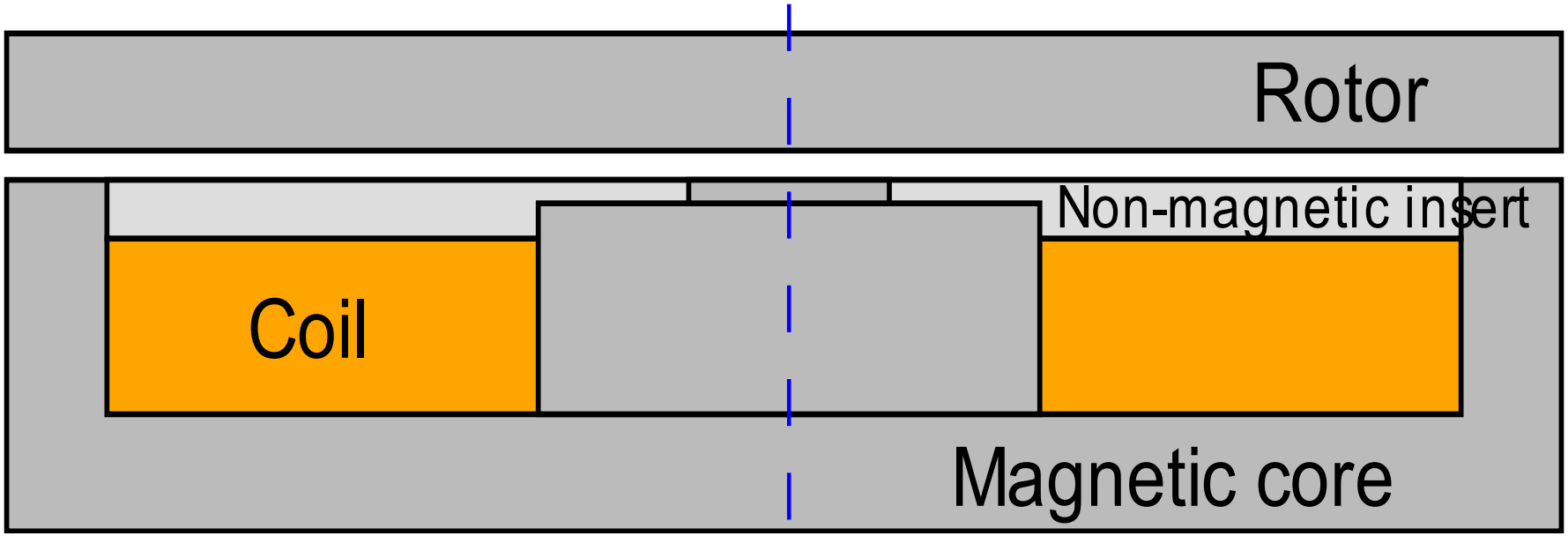
Permanent magnet gear wheels



Stepper motor torque

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

Electromagnetic clutch



Problem specification:

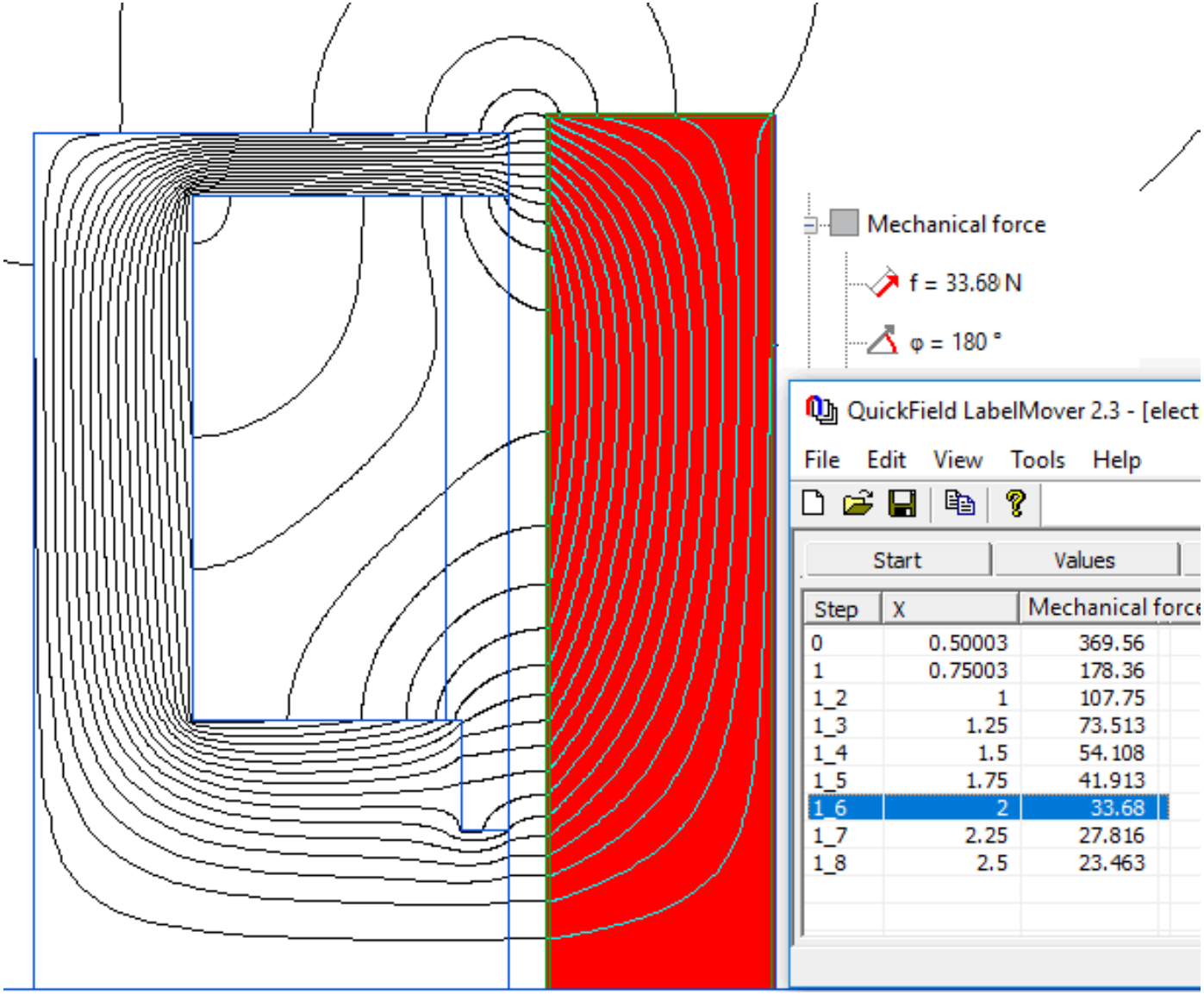
Ampere-turns in the coil *I* = 750 A
Steel magnetic permeability = 2000

Task:

Determine the dependence of the attraction force on the distance between the rotor and the electromagnet.

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

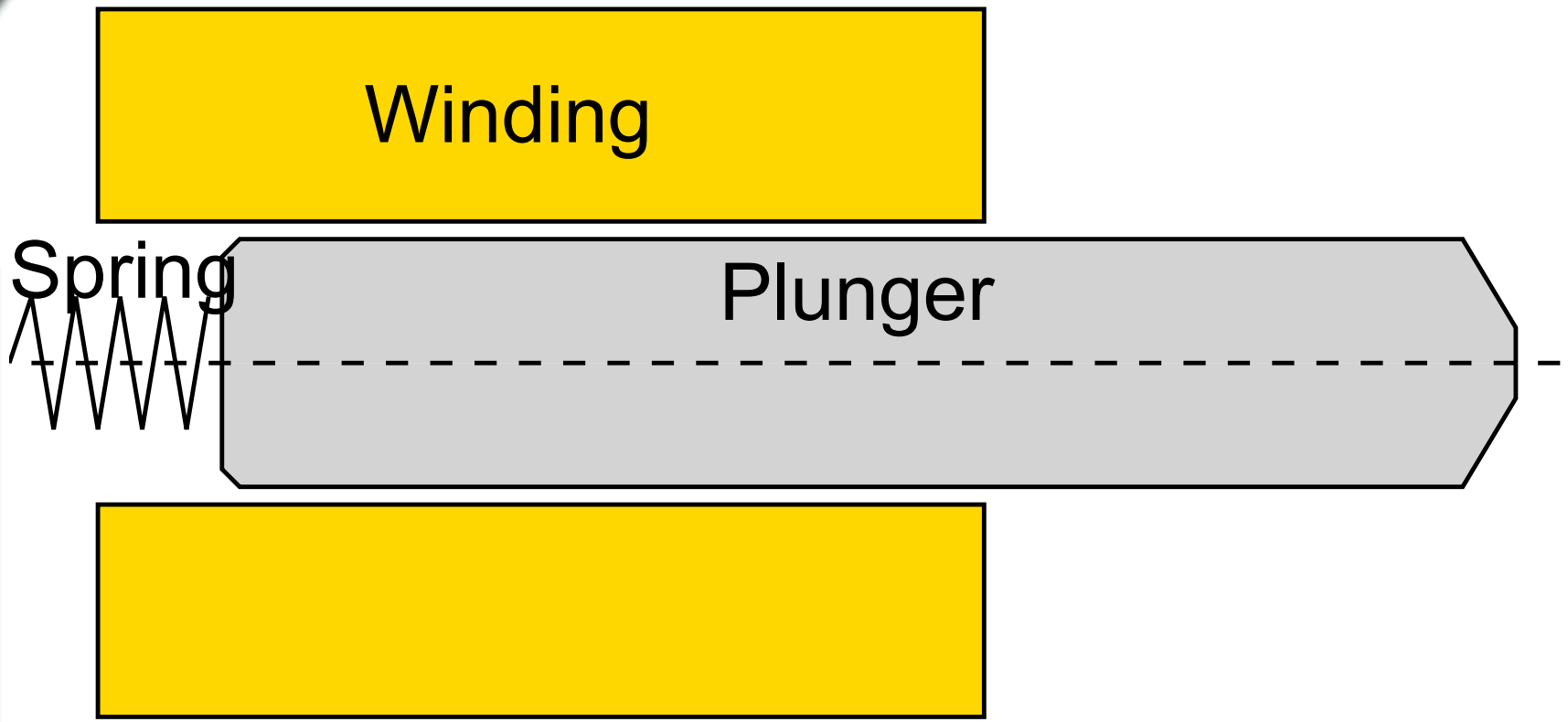
Electromagnetic clutch



Step	X	Mechanical force
0	0.50003	369.56
1	0.75003	178.36
1_2	1	107.75
1_3	1.25	73.513
1_4	1.5	54.108
1_5	1.75	41.913
1_6	2	33.68
1_7	2.25	27.816
1_8	2.5	23.463

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

Electromagnetic plunger



Problem specification:

Coil has 500 loops with current 1 A.
Plunger is made of steel with relative permeability μ = 1000
Spring rigidity coefficient 50 N/m.

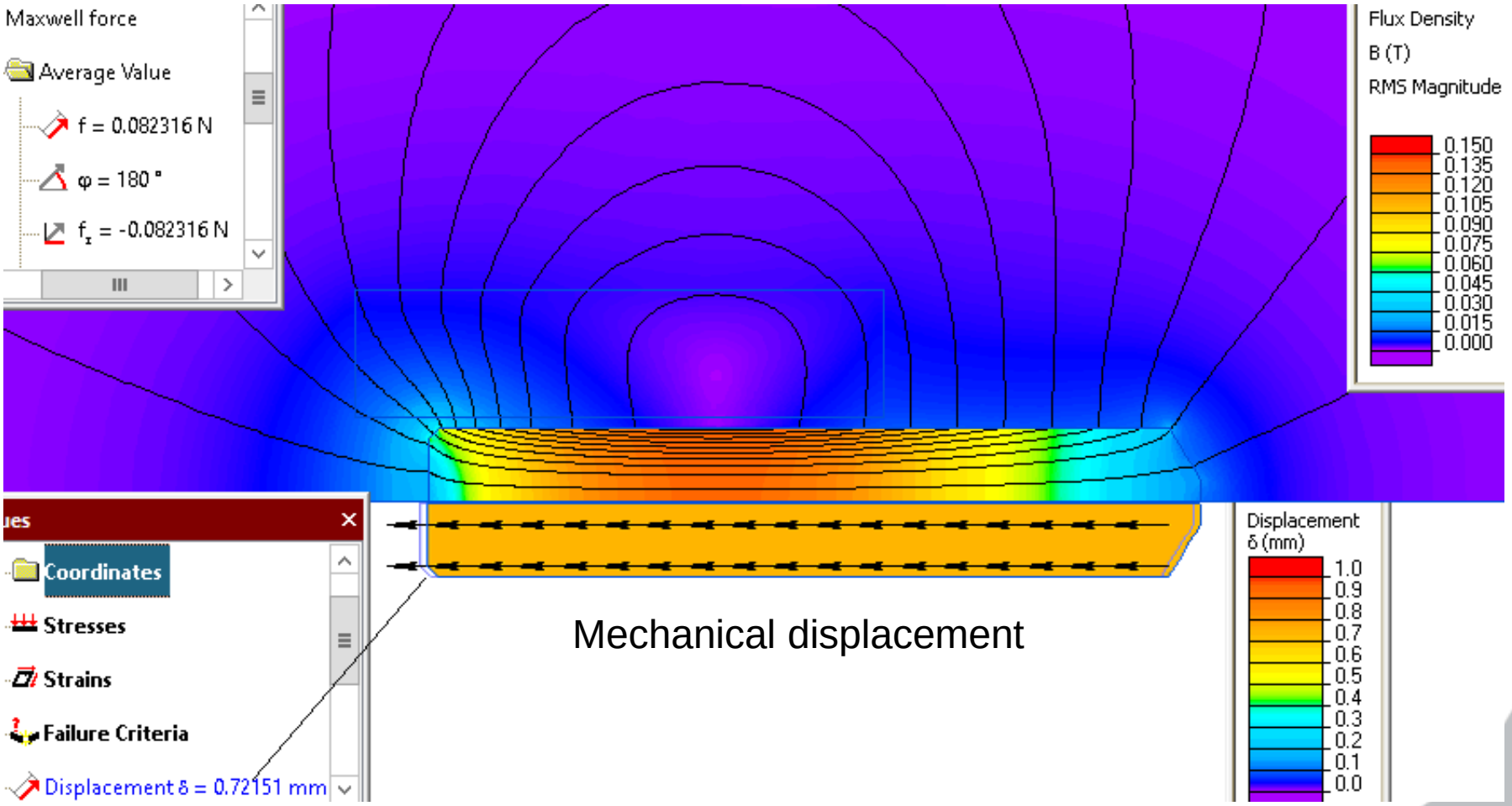
Task:

Estimate the plunger displacement at the given current.

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

Electromagnetic plunger

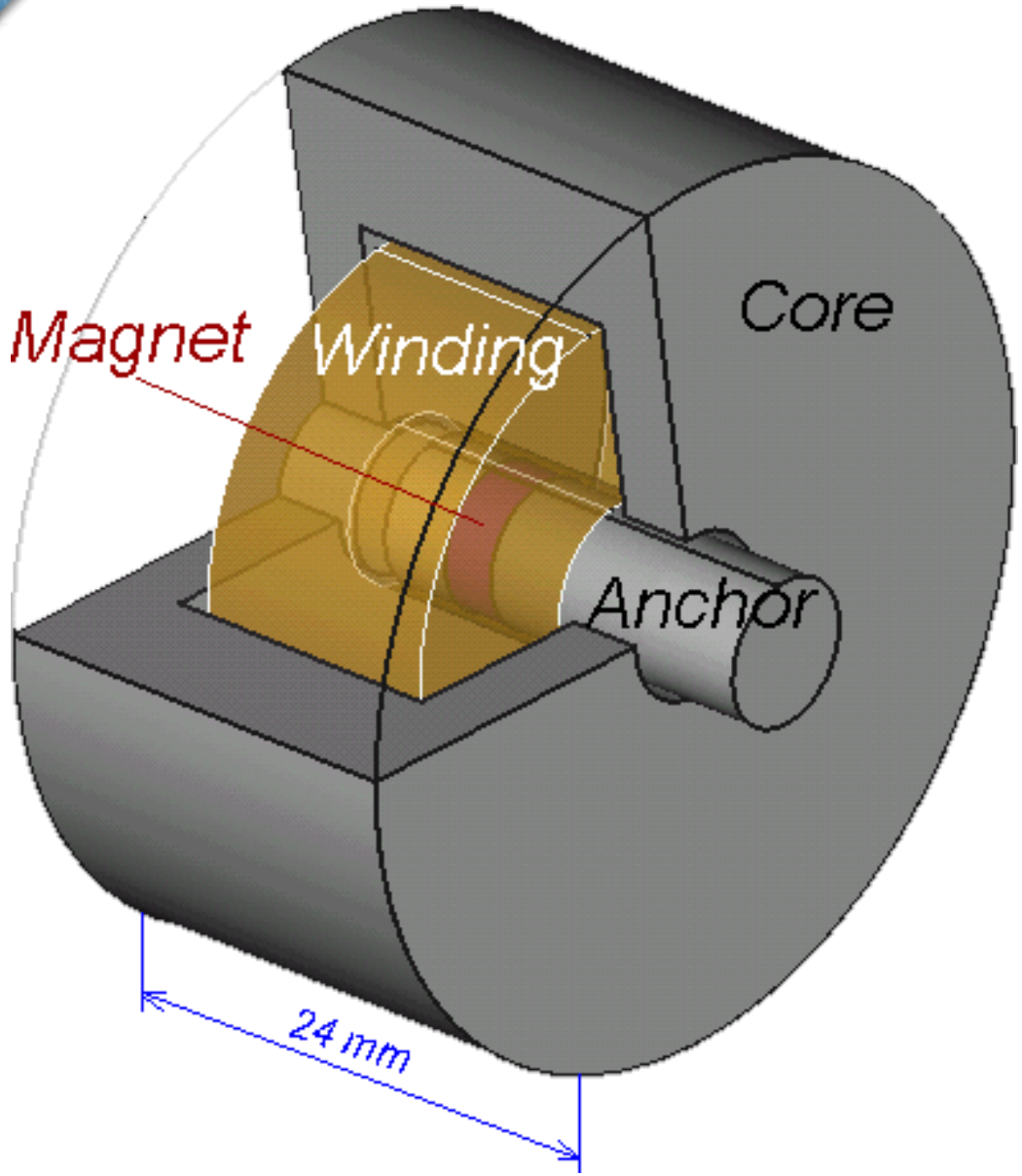
Magnetic field



Mechanical displacement

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

Electropermanent magnet relay



Problem specification:

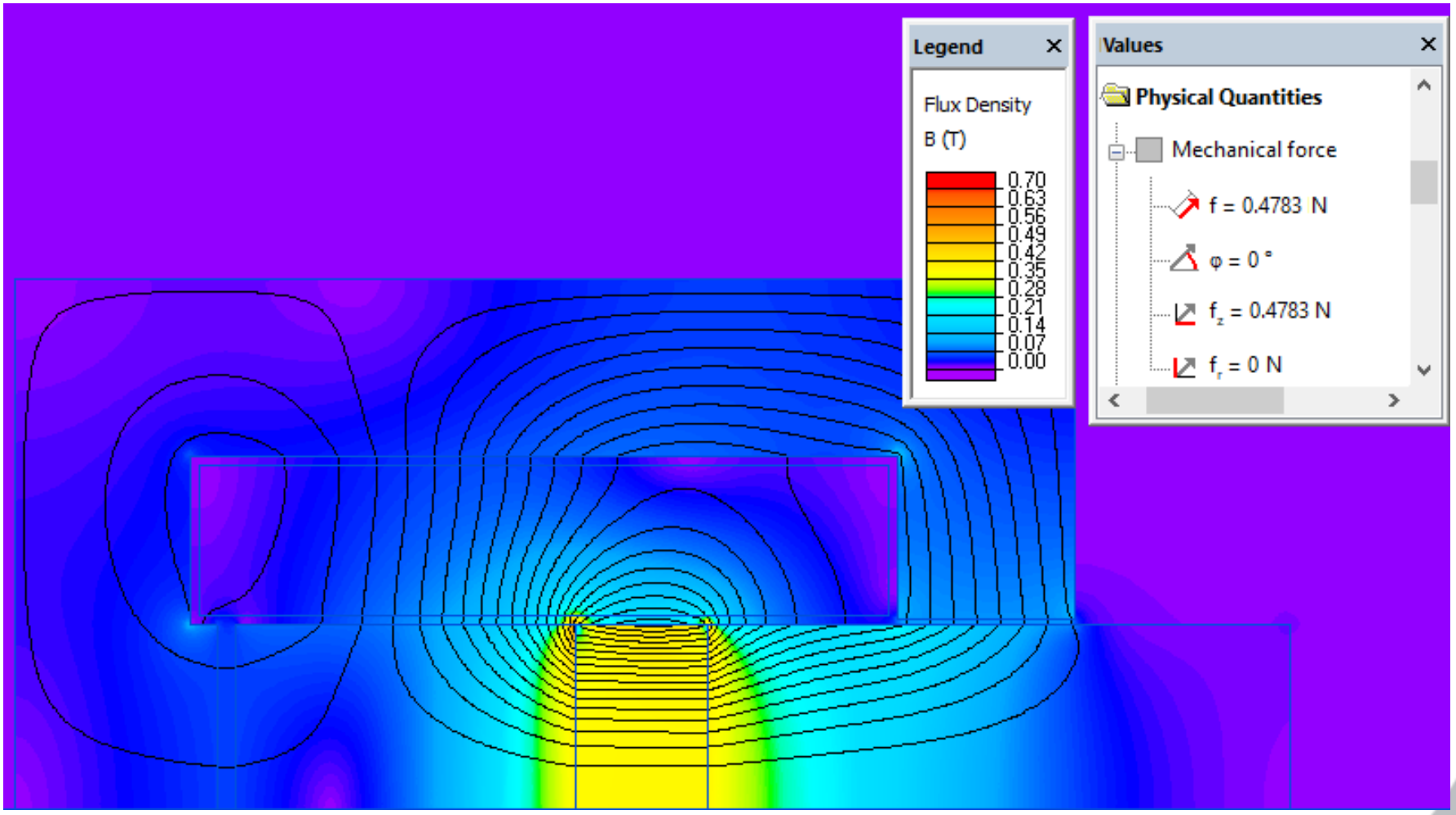
Permanent magnet coercive force H_c = 500 kA/m;
Winding material is copper;
Winding number of turns: 600;
Nominal current I_0 = 0.01 A;
Expected short-circuit current I_{max} = 1 A.

Task:

Determine the force acting on the anchor of the relay, with the operating current and short circuit current, as well as in the absence of the current in the winding.

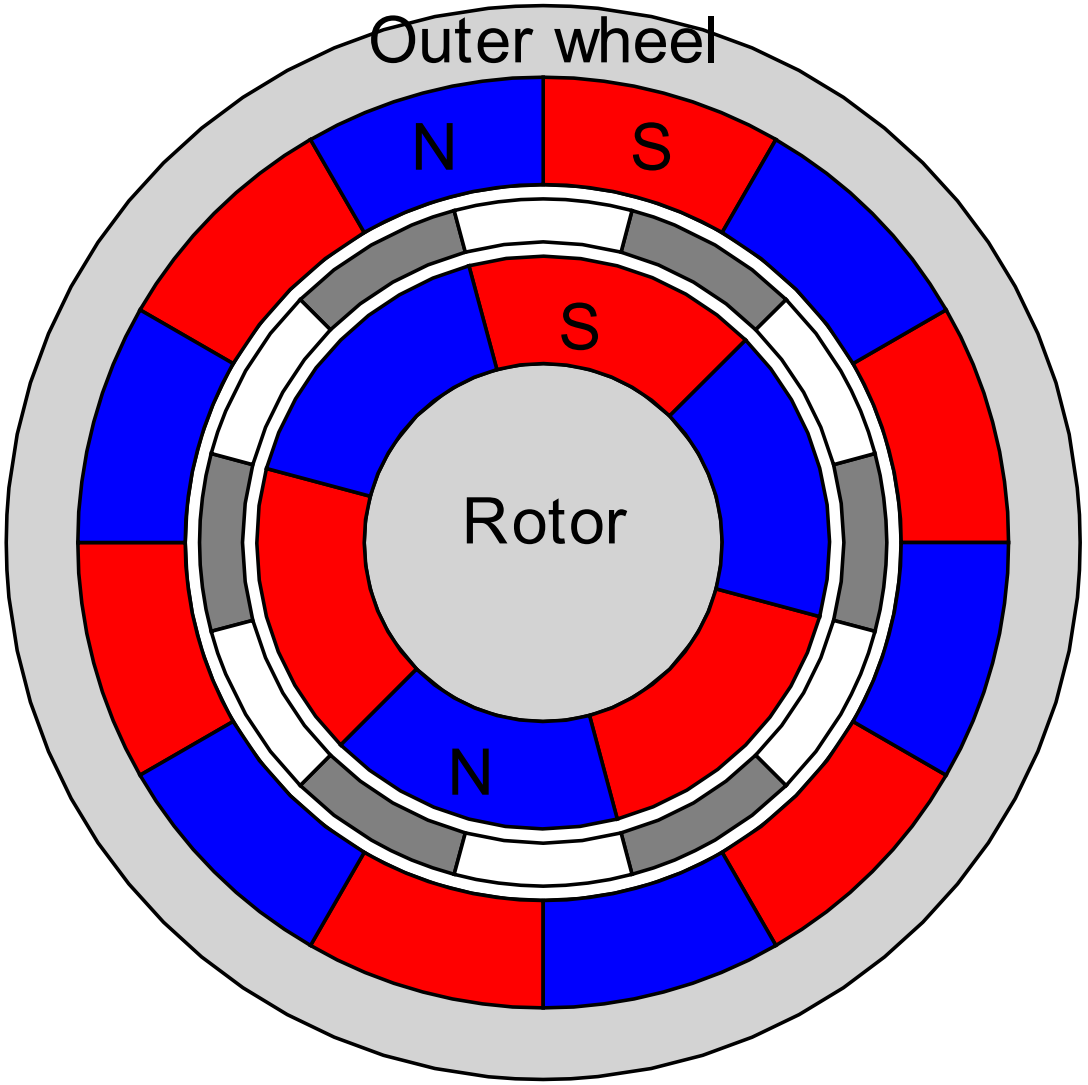
https://quickfield.com/advanced/electropermanent_magnet_relay.htm

Electropermanent magnet relay



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

Permanent magnet gear wheels



Problem specification:

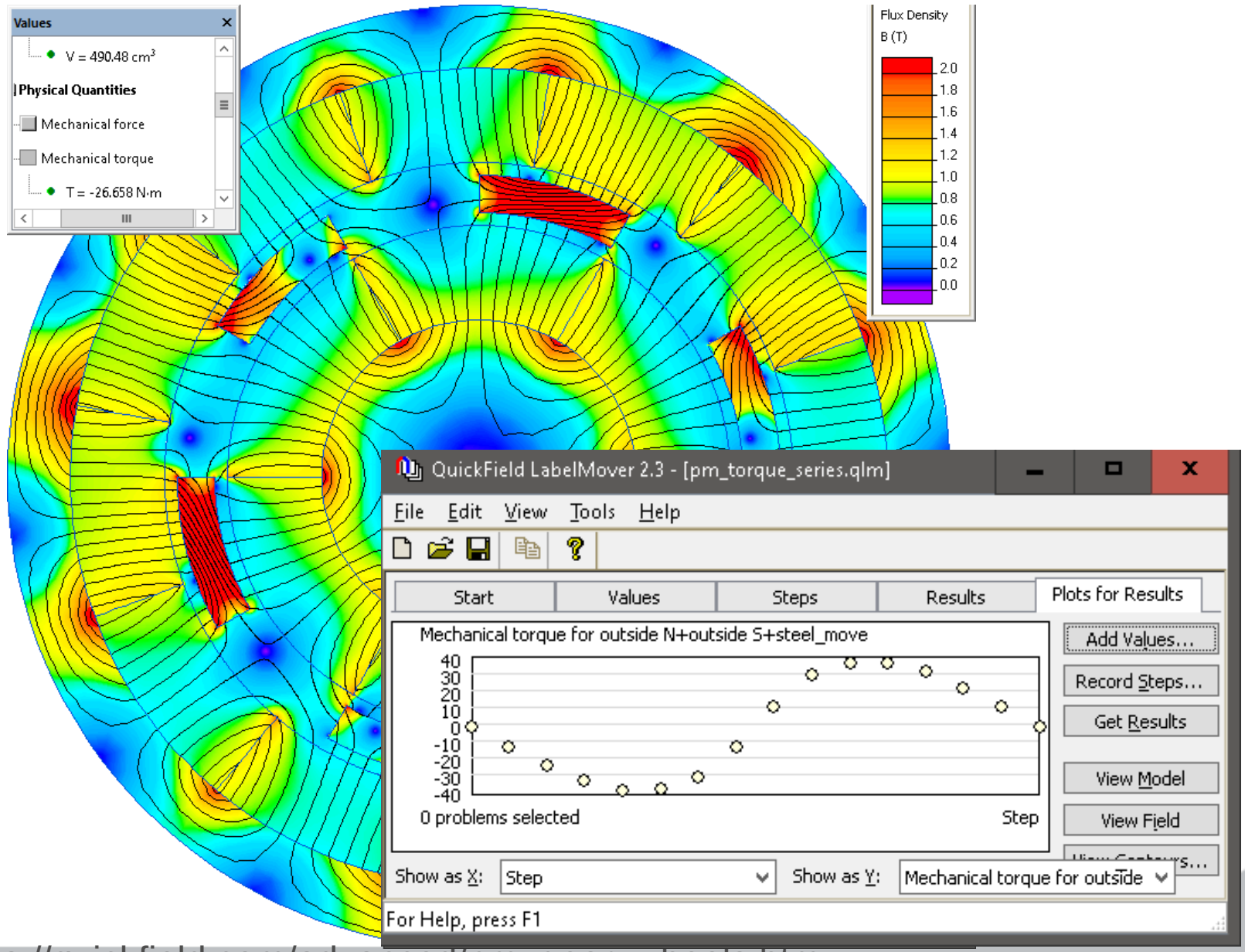
Coercive force of permanent magnets
Hc = 800 kA/m.
Relative magnetic permeability of steel
μ = 1000

Task:

Determine the static torque as a function of magnetic wheels position.

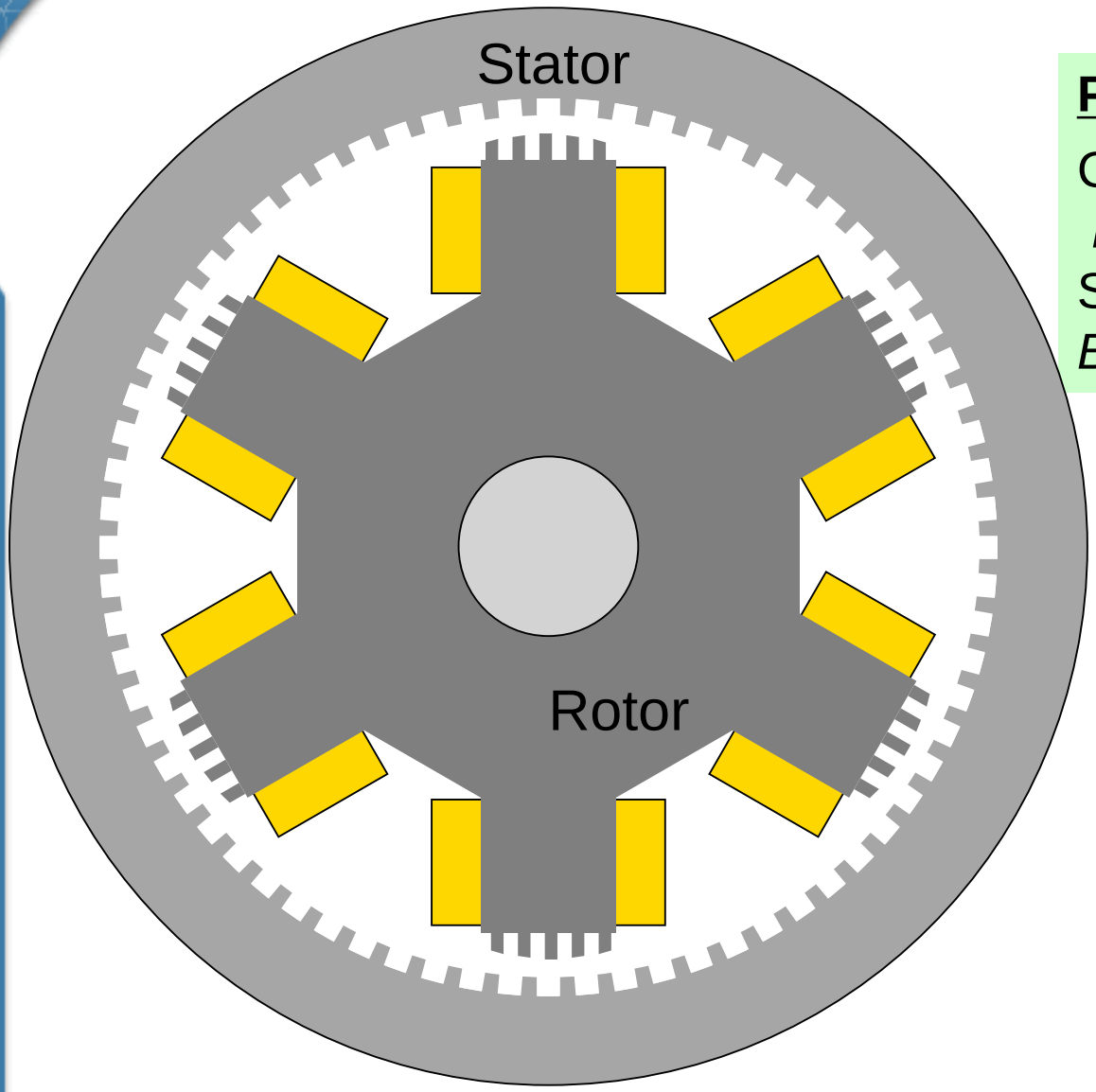
https://quickfield.com/advanced/pm_gear_wheels.htm

Permanent magnet gear wheels



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

Stepper motor torque



Problem specification:

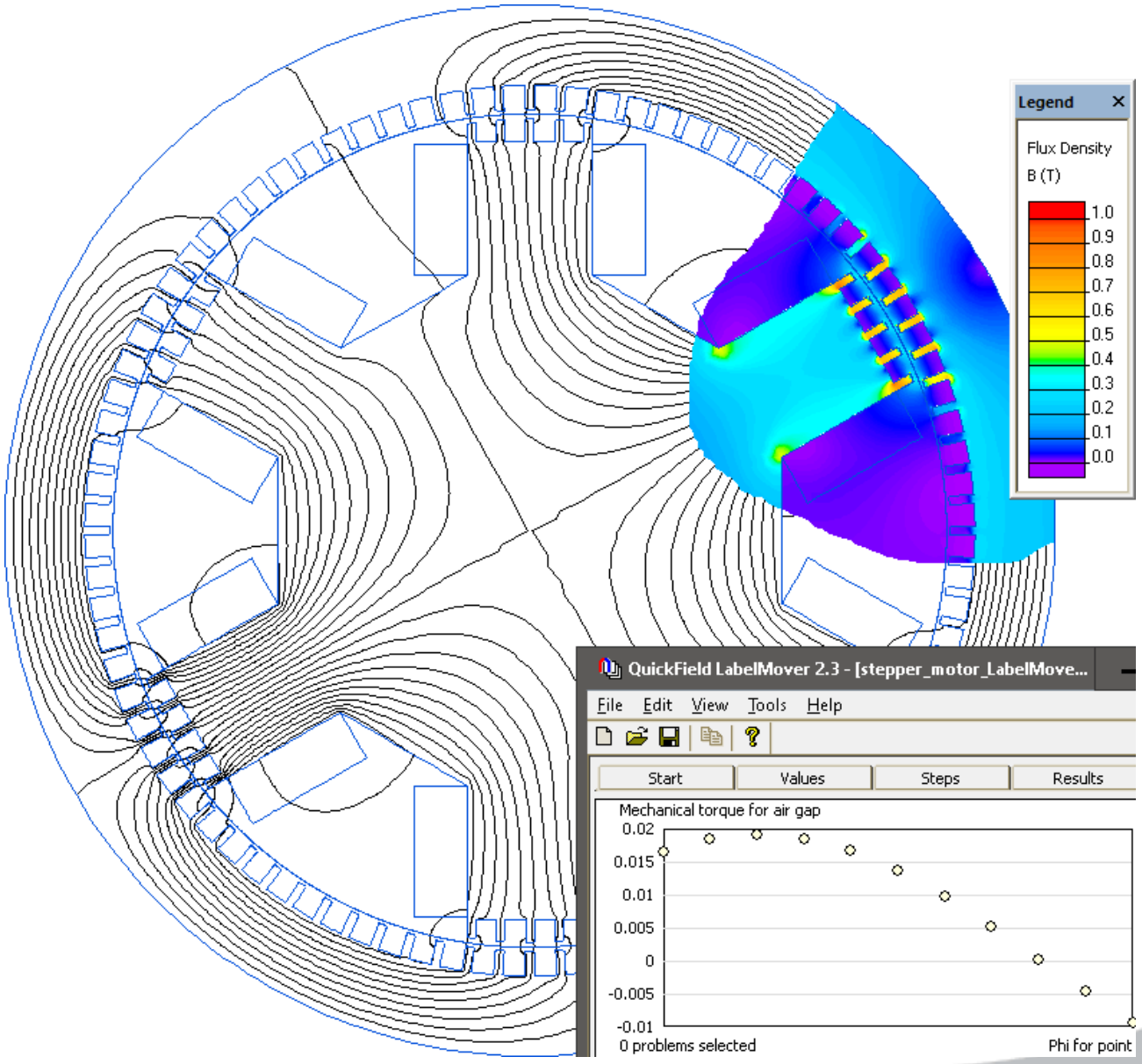
Coil current
I = 100 * 4 Ampere-turn
Steel magnetic permeability:
BH-curve

Task:

Calculate torque vs. rotor position.

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

Stepper motor torque



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