

# Simulation of Magnetic Flux Distribution of Stator and Rotor Coil of Superconducting Air Cored Wind Turbine Generator Using COMSOL Multiphysics

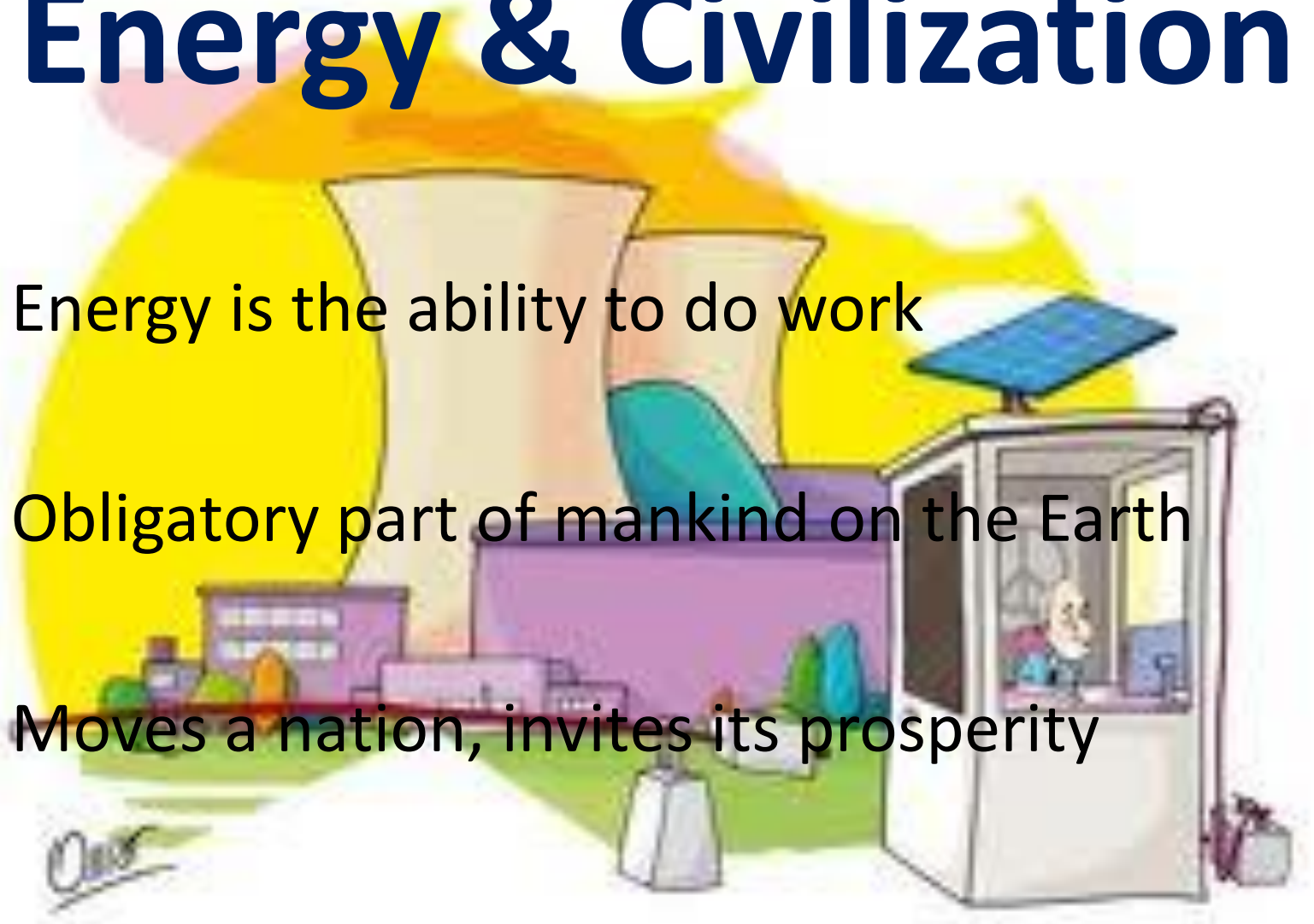
COMSOL  
CONFERENCE  
INDIA  
2012

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# Energy & Civilization

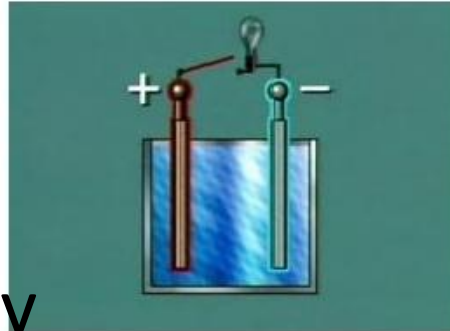
- Energy is the ability to do work
- Obligatory part of mankind on the Earth
- Moves a nation, invites its prosperity

*Qas*

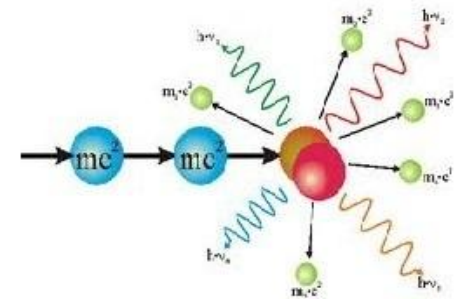


# Forms of Energy

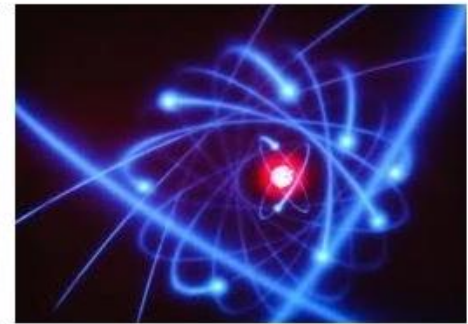
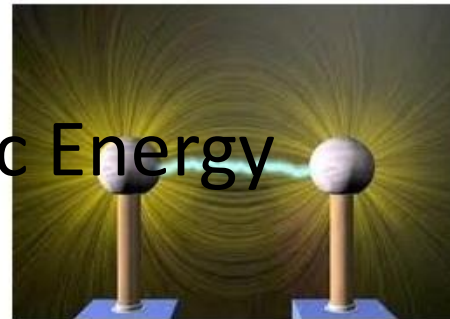
- Heat Energy



- Chemical Energy



- Electromagnetic Energy



- Nuclear Energy

- Mechanical Energy



# Energy Conversion

- Energy can be changed from one form to another
- Energy can be neither created nor destroyed by ordinary means

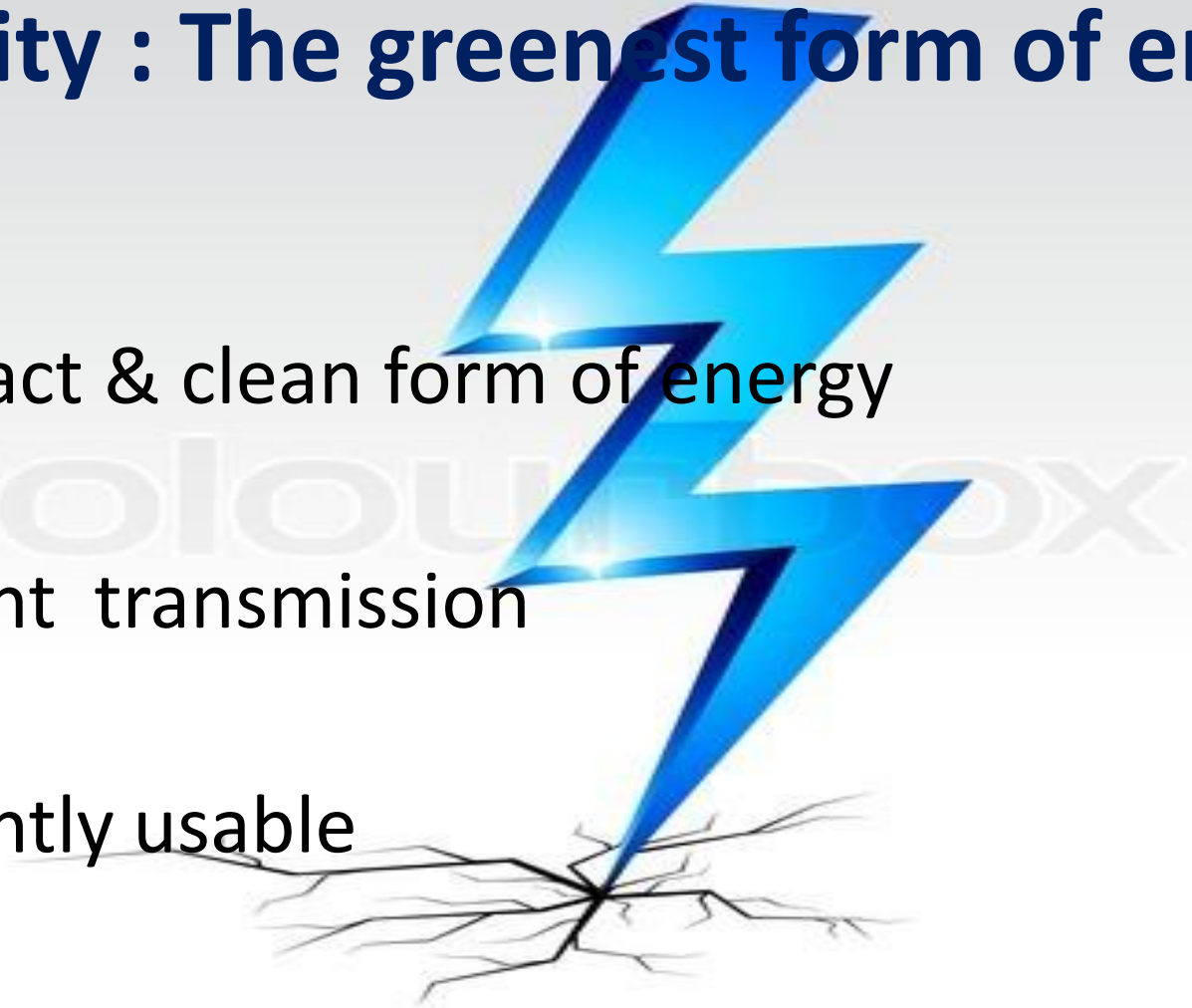
# The Sun : a giant energy factory



- Almost all of the energy we use comes from the sun
- Primary & Secondary source of energy
- Renewable & Nonrenewable source of energy

# Electricity : The greenest form of energy

- Compact & clean form of energy
- Efficient transmission
- Efficiently usable



# Different Electricity generation Methodologies

- From Fossil Fuel : Coal, Mineral oil, Natural Gas
  - Harmful To nature
  - Reduced reserves : Only for some years
- From Nuclear Energy : Environmental hazards, radiation
- From Renewable Energy recourses : Solar, Wind, Geo Thermal, Tidal, Bio-Gas, etc.



# Wind Energy



- A Renewable Primary Source of energy
- Cause of wind flow
- Energy contained in wind
- Wind energy converter: converts wind power into electricity



# Electricity Generation from Wind

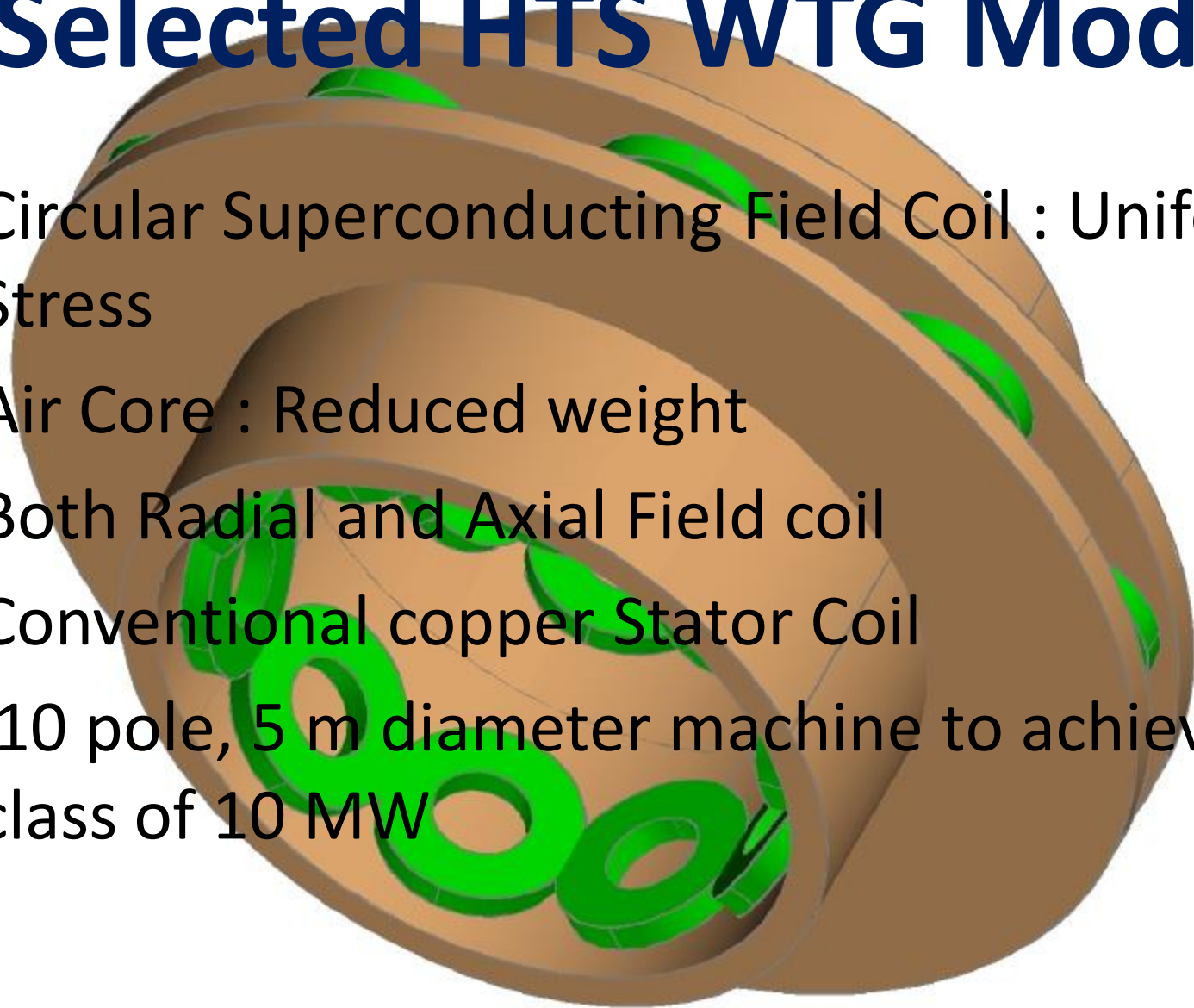
- Pollution free Green Methodology
- Continuously increasing popularity
- More effectiveness in large size wind turbine generator (> 5 MW WTG will produce more than 5 GW world wide by the year 2020)
- Offshore installation for better wind profile

# Direct Drive High Temperature Superconducting Wind Turbine Generator

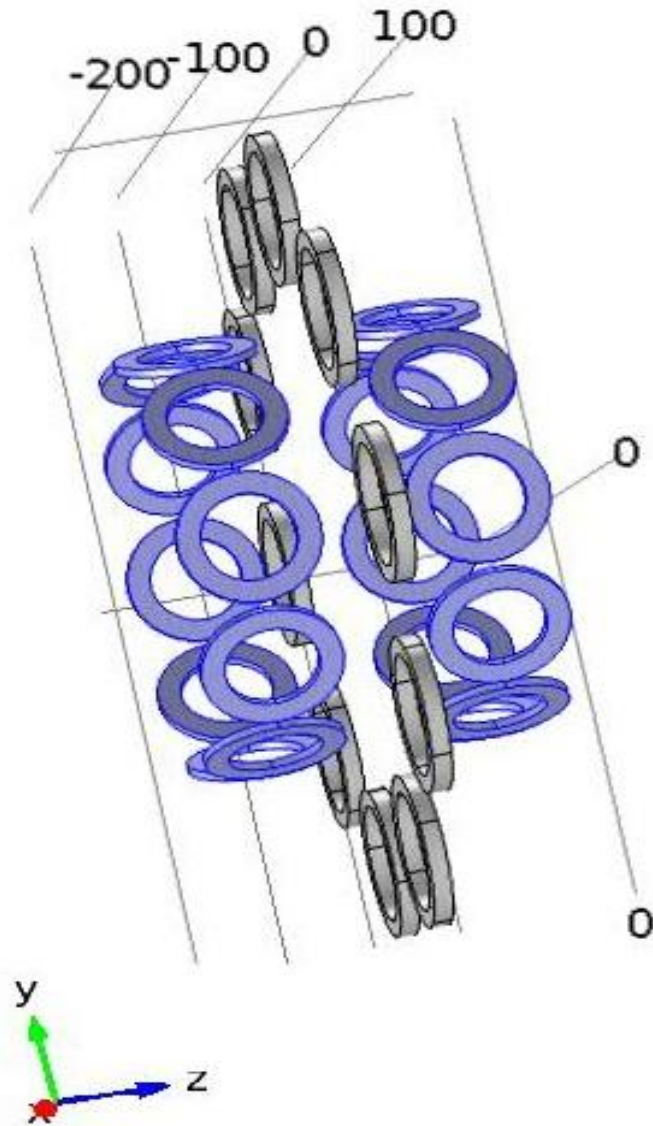
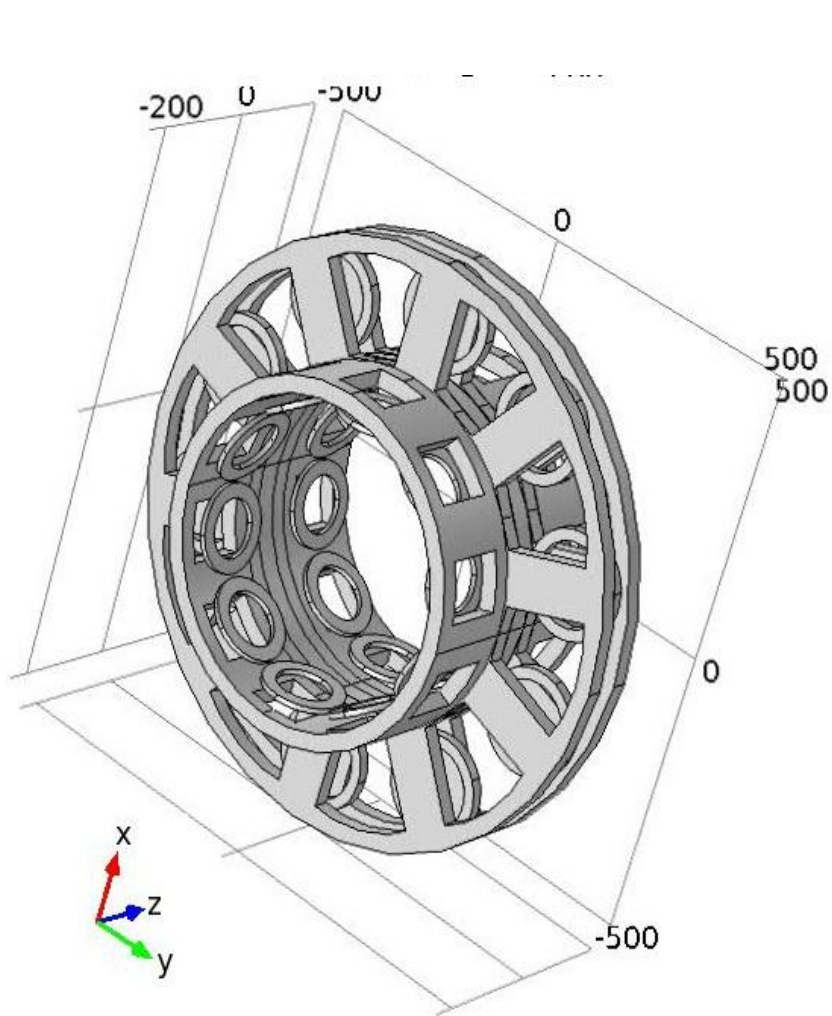
- No Gear Box : Light weight
- Low Speed Generator needed
- HTS Generator : High magnetic Flux
  - High Power density
  - Power Generation in low RPM
  - Reduced Weight
- Recent trend of designing WTG

# Selected HTS WTG Model

- Circular Superconducting Field Coil : Uniform Stress
- Air Core : Reduced weight
- Both Radial and Axial Field coil
- Conventional copper Stator Coil
- 10 pole, 5 m diameter machine to achieve a class of 10 MW



# Generator Model



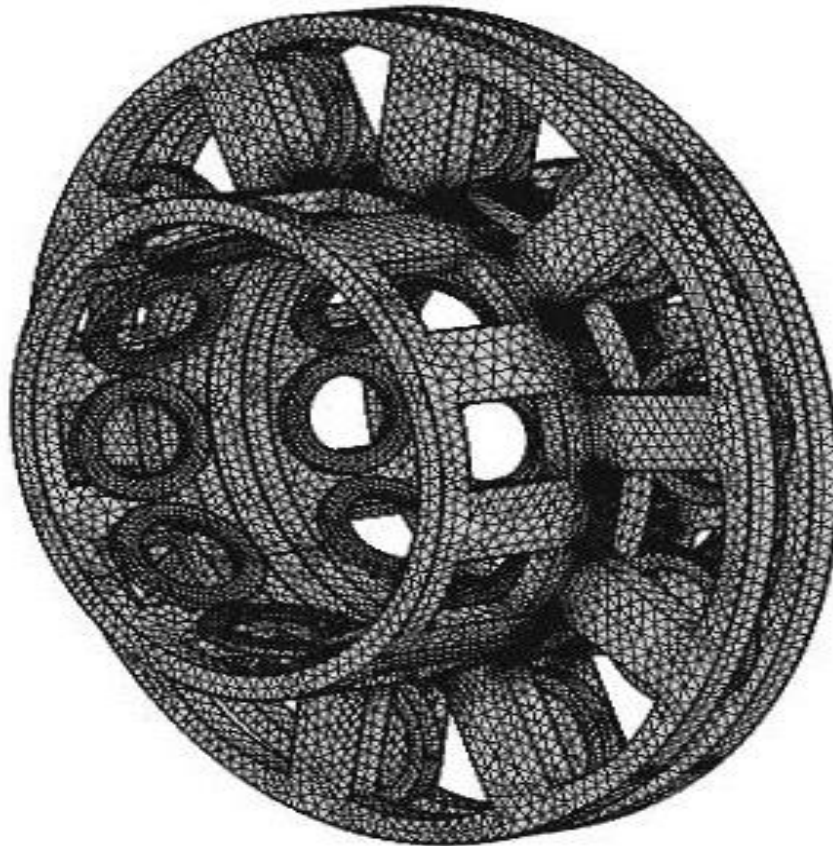
# Use of Comsol Multiphysics

- Model Geometry Was created by inbuilt 3D cad tool
- Material properties were assigned
- AC/DC module was selected as physics setting
  - Magnetic and Electric field
  - AV Formulation
- Study portal : Stationary Study
- Animation

# Meshing of the Model

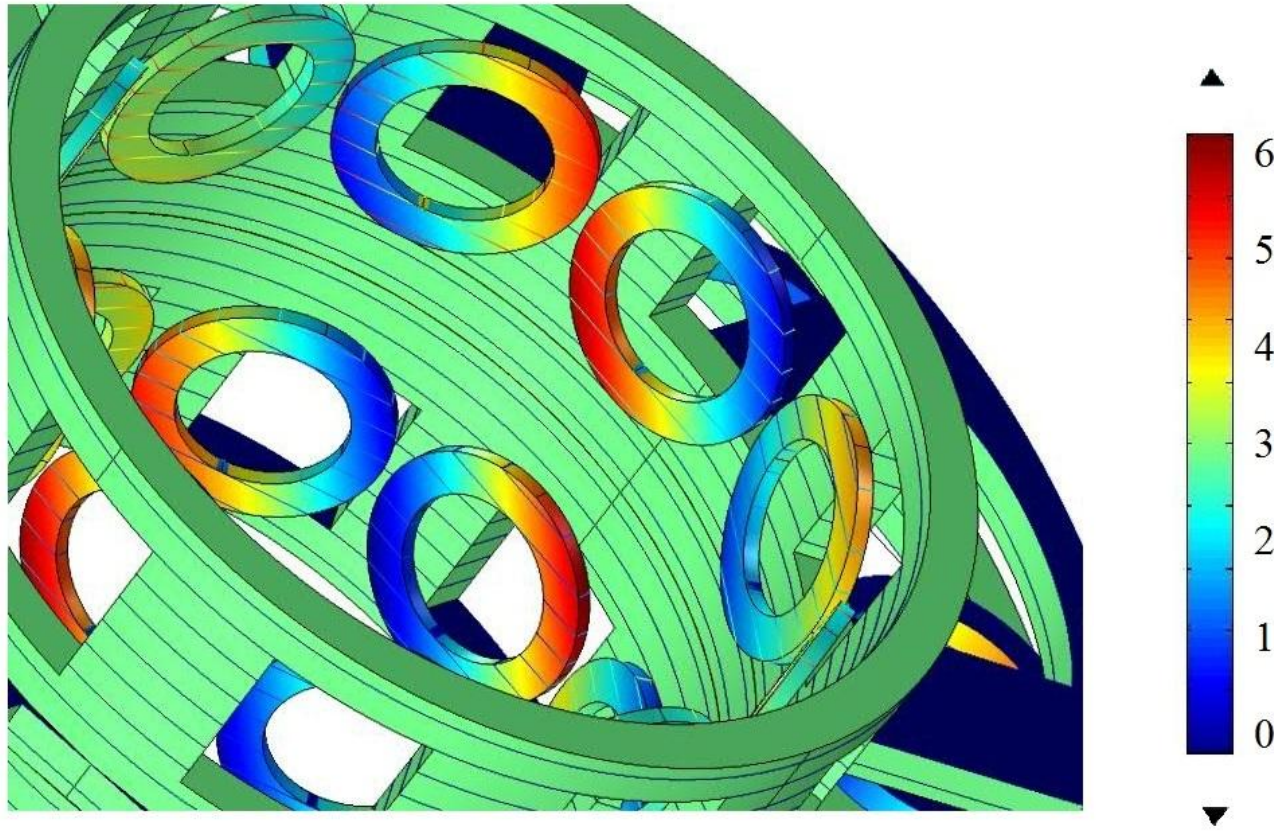
- Tetrahedral Mesh : 3D mesh element
- Different size of mesh element
  - Finer mesh for superconducting coil surface
  - Fine mesh for stator coil
  - Coarser mesh for surrounding air

# Meshing of the Model





# Simulation of Magnetic Flux Distribution

## Distribution

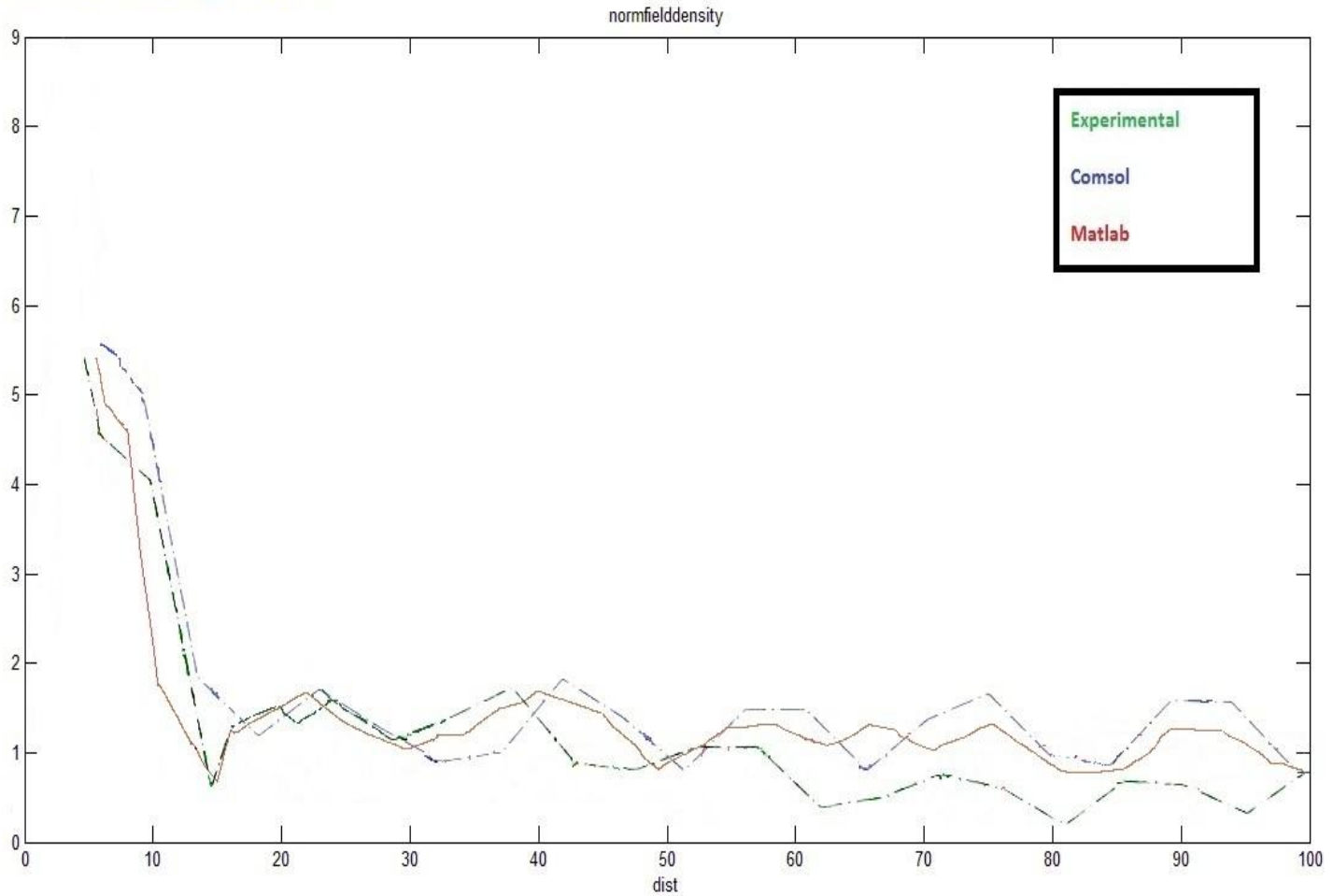




# Comparative Study

Note new toolbar buttons: [data brushing](#) & [linked plots](#)   [Play video](#)

x



# Animation

