INTEGRATED ENGINEERING SOFTWARE

BEAM OPTICS & CHARGED PARTICLE TRAJECTORY ANALYSIS SOFTWARE

Hybrid simulation tools for electromagnetic and particle trajectory design analysis

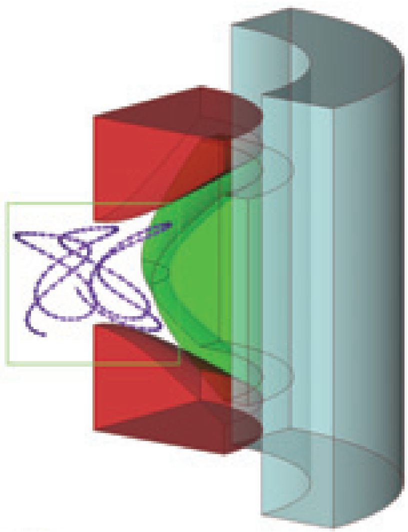
SOFTWARE THAT LIVES UP TO THE

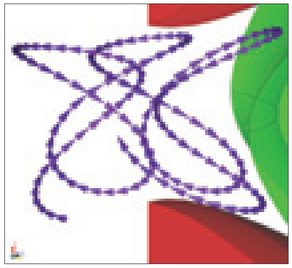
POWER OF YOUR IDEAS

INTEGRATED's LORENTZ suite of CAE programs provide sophisticated simulation and design tools customized for charged particle trajectory analysis.

For over 25 years, **INTEGRATED's** electric and magnetic field solvers have been known for their accuracy and ease of use. Building on this base, the **LORENTZ** suite has been continuously developed and improved since the first versions were introduced in 1998.

Several varieties of **LORENTZ** programs are available for applications involving electric, magnetic or combined field analysis.





Above: Ion trajectory in periodic model of a penning trap simulated in ***LORENTZ-EM***

Left: Close up of trajectory

Applications

LORENTZ programs can simulate a wide variety of charge particle beam trajectory and beam optics applications.

Examples include:

CHARGED PARTICLE BEAMS

- Electron guns
- Ion guns
- Ion implanters
- Nanotube field emitters
- Sputtering sources
- X-ray tubes
- Ion propulsion

BEAM OPTICS

- Focusing electrodes
- Steering magnets
- Electron microscopes
- Multipole beamline magnets

CHARGED PARTICLE TRAJECTORIES

- Ion mobility spectroscopy
- Ion traps
- Ion mass spectrometers
- Time of flight spectrometers
- Deflector plates
- Microchannel plates
- Multipaction
- Photomultiplier tubes

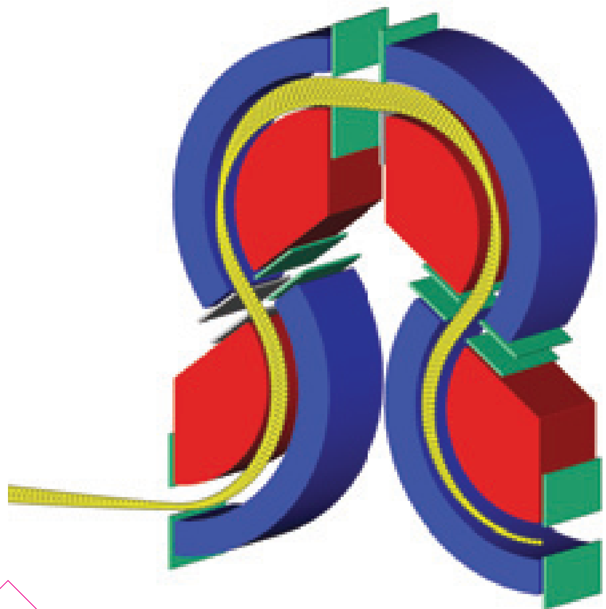
Electric Field Solvers

INTEGRATED's proven electric field solvers **ELECTRO** (2D/RS) and **COULOMB** (3D) provide the basis for the **LORENTZ-2E** (2D/RS) and **LORENTZ-E** (3D) beam analysis programs.

Beam trajectories can be accurately calculated for static, harmonic and quasi transient fields.

In addition to beam analysis, the **LORENTZ** programs contain the full analysis capabilities of **ELECTRO/COULOMB** and can be used to examine peak field values to identify possible insulation breakdown problems.

Electrostatic omega monochromator modeled in ***LORENTZ-E***

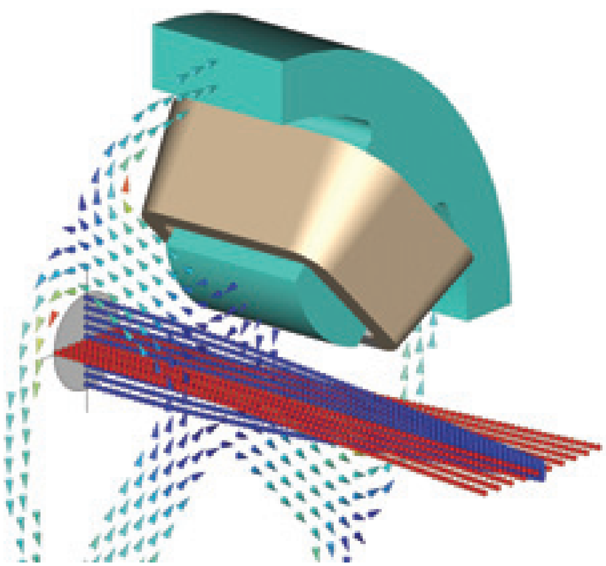


Magnetic Field Solvers

LORENTZ-2M (2D/RS) and **LORENTZ-M** (3D) compute particle trajectories influenced by magnetic field effects.

The **LORENTZ** programs are based on **INTEGRATED's MAGNETO** (2D/RS) and **AMPERES** (3D) software packages. As such, they provide a complete range of analysis options for design of magnetic systems, including flux density, saturation, inductance and force calculations.

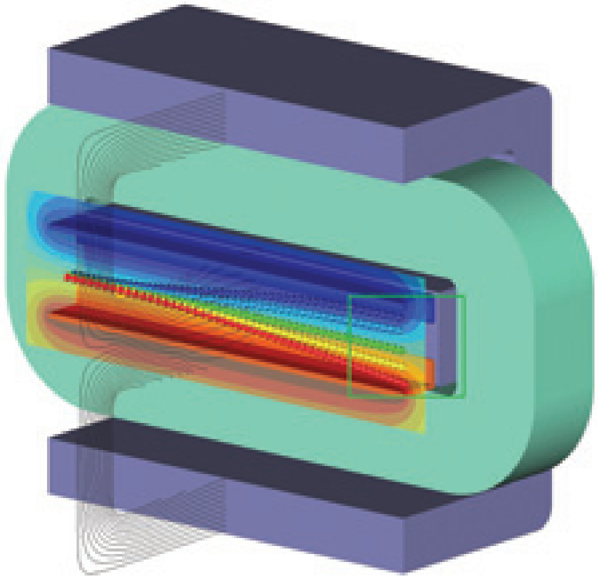
*Periodic model of a quadrupole magnet modeled in **LORENTZ-M***

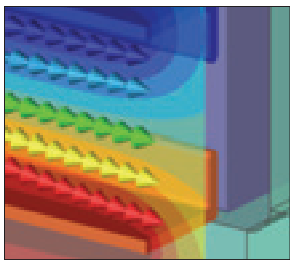


Hybrid Electric and Magnetic Field Solvers

LORENTZ-2EM (2D/RS) and **LORENTZ-EM** (3D) compute beam trajectories under the influence of both electric and magnetic fields simultaneously.

The hybrid programs combine the full capabilities of **ELECTRO/MAGNETO** (2D/RS) or **COULOMB/AMPERES** (3D) and are particularly useful for designing mass or energy filters.





*Above: Wien filter modeled in **LORENTZ-EM***

Left: close up of electrodes and trajectories

OPTIMIZE YOUR DESIGNS

USING LORENTZ API, PARAMETRIC AND/OR SCRIPTING CAPABILITIES

All **LORENTZ** programs include **API**, **Parametric** and **Scripting** capability.

Parametrics provides an easy to learn GUI based method of testing sensors through their range of operating conditions, as well as modifying basic designs to obtain optimum performance.

The **INTEGRATED API** enables the direct control of program functions by utility scripts or macros created in tools such as Excel and Visual Studio. **Scripting** can control the entire process of model creation and testing.

Specialized Beam Analysis Physics Options

Modeling the components of particle beam systems requires the assignment of specialized physical properties (in addition to the physical properties required for the field solution). **LORENTZ** programs come with a complete range of physics options that make it easy to define even the most complex beam simulation problems.

Components that can be simulated include:

- **Emitters**
- **Collectors**
- **Reflectors**
- **Secondary Emitters**
- **Wind Tunnels**
- **Residual Gas**

Physical properties that can be modeled include:

- **Space Charge**
- **Surface Charge Accumulation**
- **Emission Regimes** (including **Child's Law, Richardson Dushman, Schottky, Extended Schottky, Fowler Nordheim,** and **Enhanced Fowler Nordheim**)
- **Meniscus Simulation** of plasma sources
- **Viscous Drag Forces**
- **Random Scattering** due to residual gas
- **External Fields** (based on measured and/or calculated values which can be added to or used in place of the simulated electric and/or magnetic fields)

LORENTZ Solver Methods

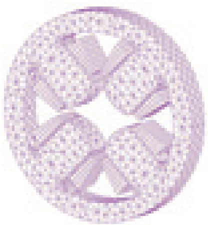
All **LORENTZ** packages provide the choice of **Boundary Element Method (BEM)** or **Finite Element Method (FEM)** field solvers. **BEM** is often the preferred method for electric problems and precise calculations of fields in open regions. **FEM** often provides faster solutions for heavily saturated magnetic problems.

An additional advantage to having both solution methods is the ability to confirm the validity of models using two independent solvers based on entirely different mathematical formulations.

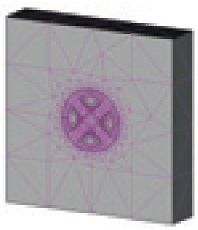
Trajectory Solvers

All **LORENTZ** packages provide the choice of four different **Ordinary Differential Equation (ODE)** solvers for trajectory computations:

- Constant Step **Runge-Kutta 4 (RK4)**
- **Adaptive Runge-Kutta 5 (RK5)**
- **Adaptive Runge-Kutta 853 (RK853)**
- **Adaptive Bulirsch-Stoer**



*Symmetric model of a quadrupole magnet solved using **BEM**. No artificial boundary box or meshing of open regions is required.*



*Symmetric model of a quadrupole magnet solved using **FEM**. A boundary box to limit the model space is required, as is meshing of the entire simulation space.*

PUT OUR SOFTWARE TO THE TEST

Send us your model, whatever the level of complexity. **We will show you how to get results from your exact design** – no packaged demos.

Contact us for an evaluation and start improving productivity today. A live demo is also available.

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