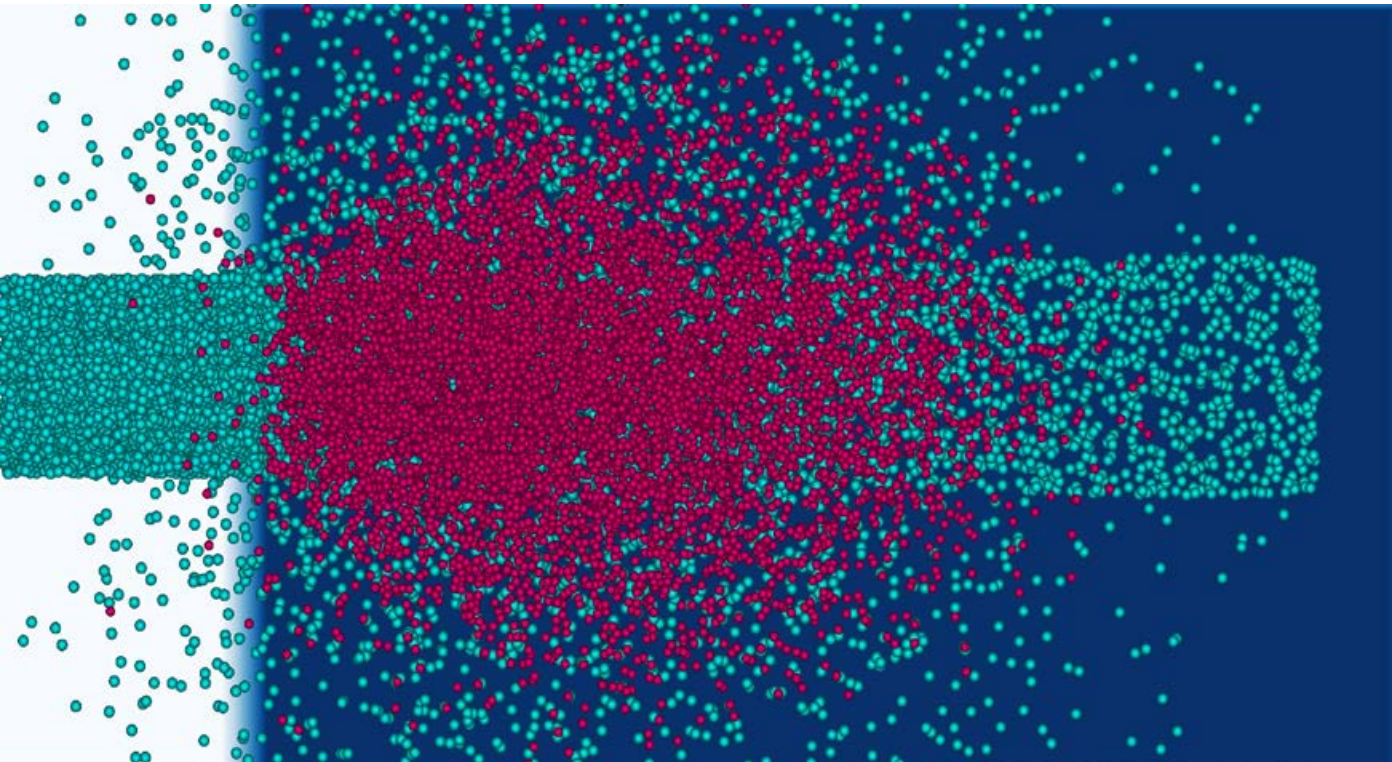


TECH-X

VSim

Electromagnetics and Plasma Simulation Software



SIMULATIONS EMPOWERING YOUR INNOVATIONS

VSIM 9 • MULTIPHYSICS • ELECTROMAGNETICS SELF-CONSISTENT CHARGED PARTICLE SIMULATION SOFTWARE

VSIm uses finite difference time domain (FDTD), particle-in-cell (PIC), finite volume, and direct-simulation Monte Carlo (DSMC) methods. Using VSIm, you can model antennas, photonics, vacuum electronics, multipacting, sputtering, laser-plasma interactions, and much more.

With VSIm 9, Tech-X extends Visual Setup, an intuitive, tree-based simulation workflow that enables boolean construction and visual selection of geometric entities. VSIm 9 can import CAD objects in STEP, STL, POLY, and VTK formats. Visual Setup gives you the ability to easily define collisional plasma interaction with geometric objects and higher-order electromagnetic solvers.

VSIm 9 introduces a more extensive set of reactions, rapidly modeled using the no-time-counter method. The latest version of VSIm computes surface fields with even more accuracy than before. Secondary emission has been improved, and new emission diagnostics are available. An additional set of solvers for dielectrics has been developed, along with several examples demonstrating VSIm's use for studying photonic devices.

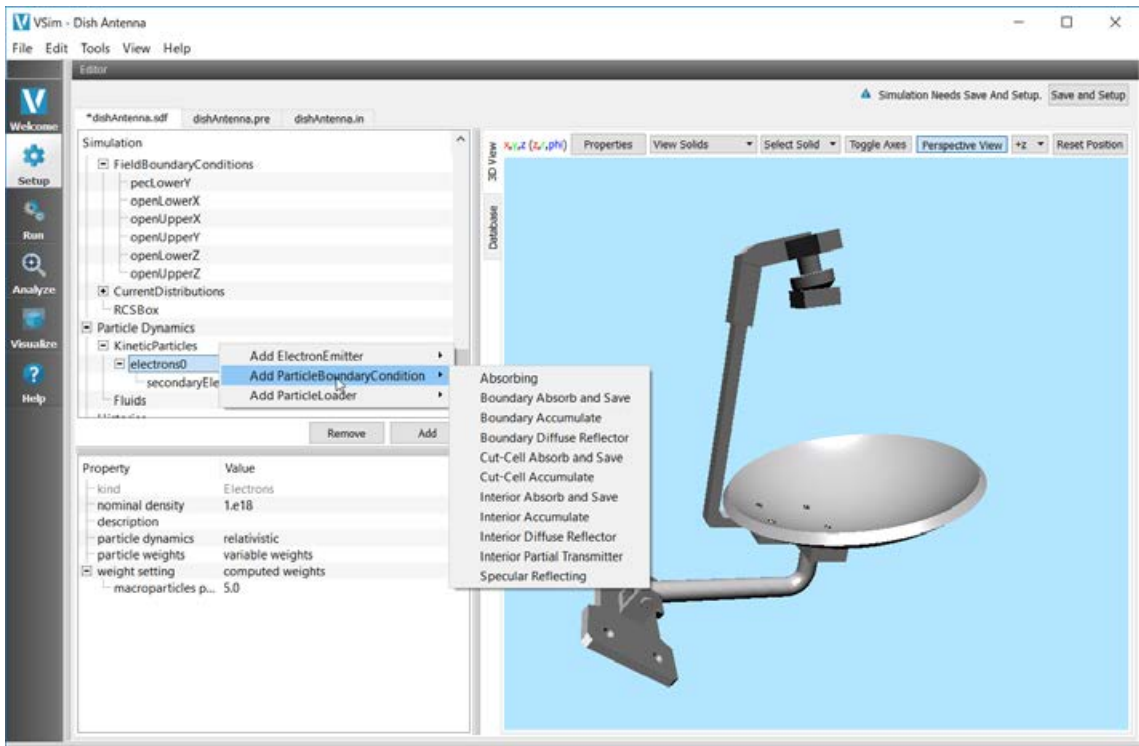
Many new analyzers, including those for S-parameter calculations and calculations of cavity figures of merit, are available in VSIm 9. Over a dozen examples for microwave amplifiers, photonics, and plasma discharges have been added to illustrate more capabilities, as well as provide further starting points, for your simulations.



VISUAL SETUP

VSim offers a visual interface for easy simulation setup. Using the GUI, create a geometry from common primitives or import a CAD file, and assign materials to shapes.

Add diagnostics to collect particle and field data in 3D, 2D, or 1D, then post-process the result. Use the GUI to choose dimensionality, solvers, and reactions.



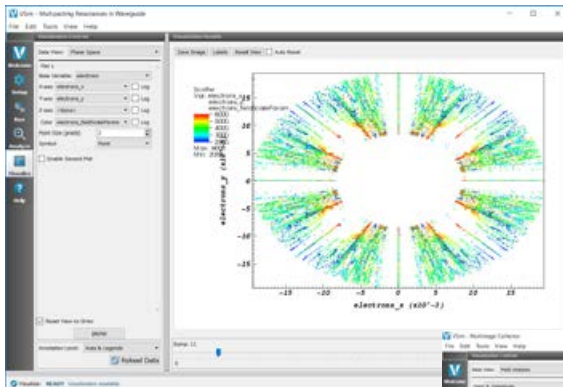
Write complex expressions then use Python functions to define boundary conditions, fields, and particle densities. Set grid resolution and absorbing layer size based on the wavelength in the material. Define the space and time profile of an electromagnetic source to study a particular mode or frequency range. See your geometry, particle source, and current source while they are displayed in the visual setup window as you build your simulation.

DATA ANALYSIS

VSim offers a wide variety of analyzers for post-processing of simulation data, such as:

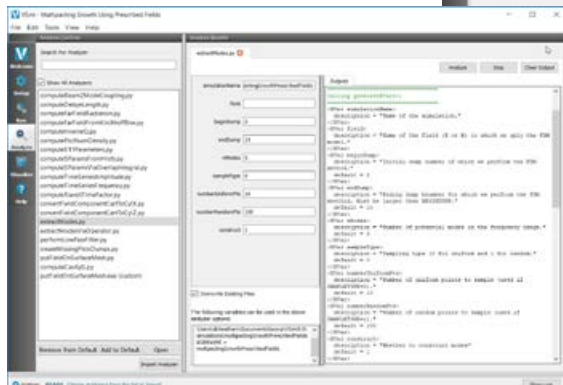
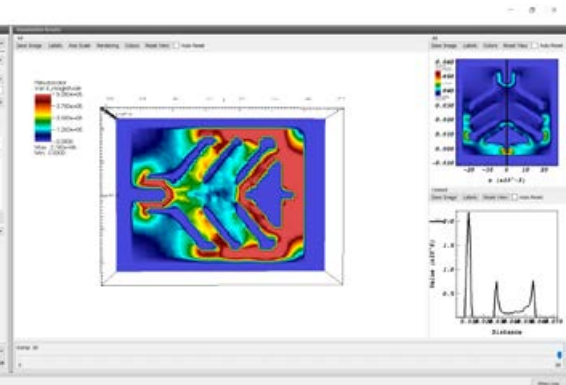
- Frequency and Mode Extraction
- S-parameter Calculations
- Data Binning
- Particle-density Measurements
- Far-field Calculations
- Many More

Using VSim's prepackaged analyzers as examples, it's easy to add your own custom analysis and visualize new data.



Phase space analysis.

Field analysis.

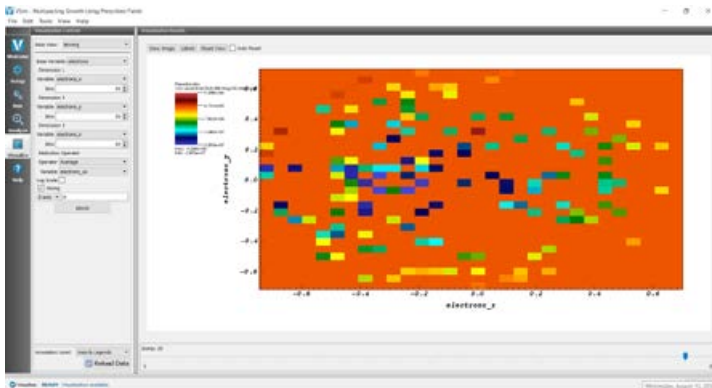
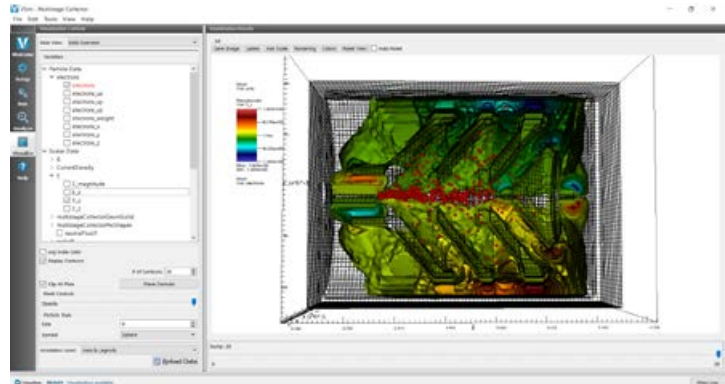


Data analysis window.

DATA VISUALIZATION

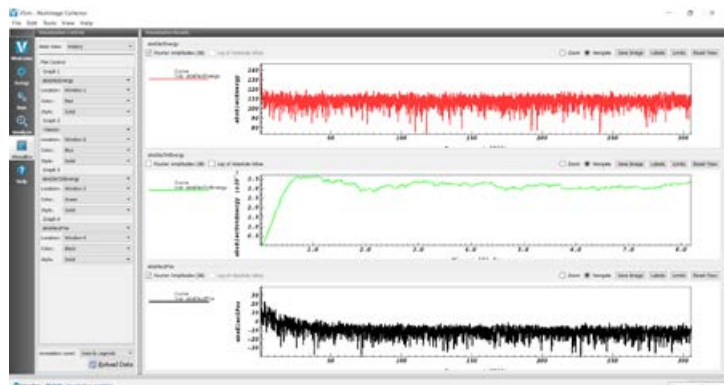
In addition to analysis, VSim offers powerful parallel 3D visualization of data: users can overlay fields, particles and surface meshes; rotate, zoom, pan, slice all data; as well as see data evolution in time.

Data overview with fields, particles, and meshes.



Data binning feature.

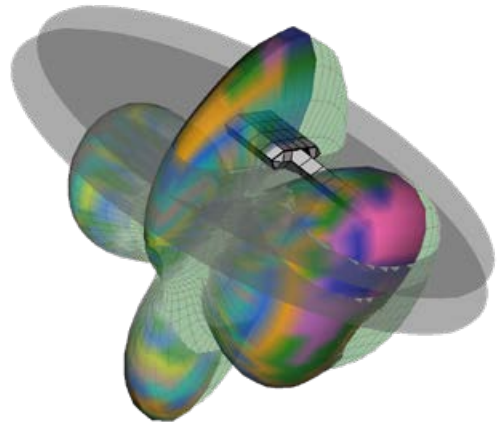
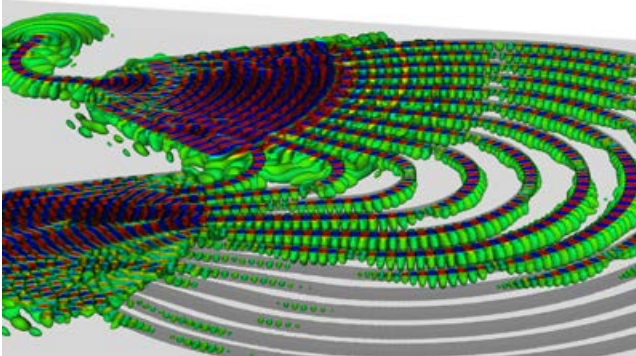
Histories feature, including number of particles, particle current, far fields, voltage measurements, and other data.



APPLICATIONS

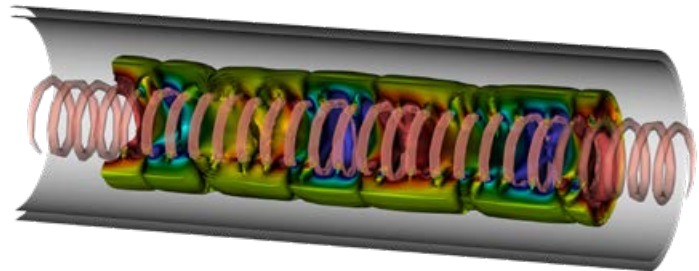
Photonics

Photonics simulation for engineering, microtechnology, and nanotechnology applications. Model photonic crystals and plasmonic structures. Simulate waveguides, Y-junctions, couplers, microrings and microdisks, and resonators.



Antennas in Complex Environments

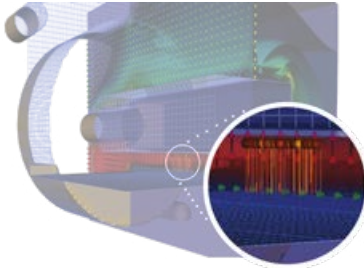
VSim is capable of simulating the full, self-consistent physics of complex antenna designs in the presence of plasmas and dielectrics. The plasma is modeled by particles or linear response functions. Dielectrics are modeled to second-order accuracy.



RF Devices

VSim enables computation of the performance of radiation generating devices without requiring actual device construction. Optimize dispersion and attenuation, and tune the power output of a traveling wave tube. Compute the normal modes and their frequencies for RF cavities.

APPLICATIONS



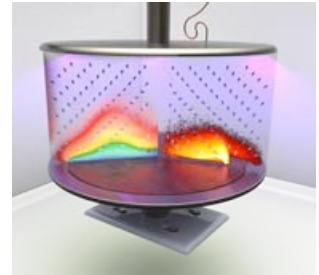
Multipacting

Accurately simulate multipacting effects by scanning multiple power levels in one run. Each particle has a scaling parameter that multiplies the electromagnetic field, allowing multiple power or voltage levels to exist simultaneously. Import external fields and customize emission surfaces, and track electrons. Pre-built or custom

secondary emission yield models can be imported for multipacting simulations.

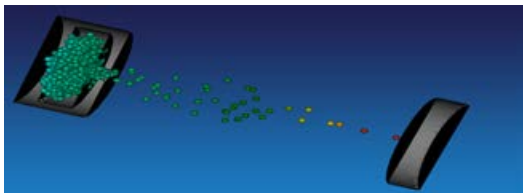
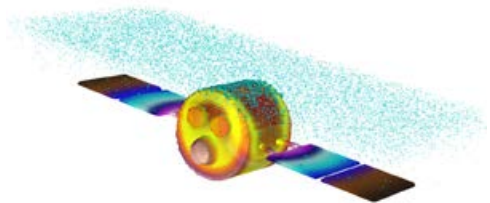
Sputtering

VSim provides a powerful set of tools critical for successful simulation of erosion and deposition in a magnetron sputtering device. Set up ionization, excitation, scattering, sputtering, secondary emission, and many other interactions easily in the VSimComposer GUI. Include feedback to model external circuitry, and import external fields, particle distributions, and your own geometry.



Space Applications

VSim is used in the prediction of surface charge build-up on spacecraft bodies operating in different space environments, where the ion sources may be natural solar wind or human-made space plasma resulting from electric thruster plasma plumes.



Ion Sources

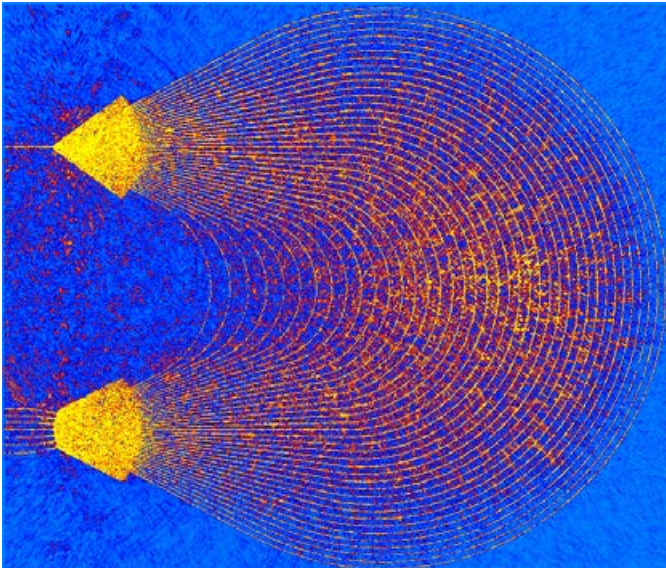
VSim's powerful self-consistent electrostatic solvers accurately calculate the potential within ion sources and can simulate effects that fluid codes cannot. Track particles to

study the evolution of the plasma. Import CAD geometry or create your own using the GUI's Constructive Solid Geometry feature.

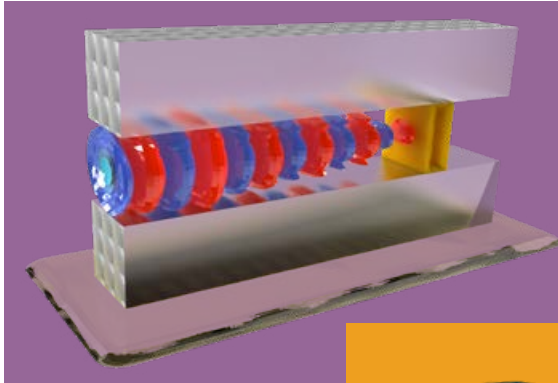
PACKAGES

VSim

VSim raises the standard for electromagnetic and kinetic plasma simulations. Use cutting-edge high-performance algorithms to design and analyze devices up to millions of cubic wavelengths in volume. Include kinetically modeled charged and neutral particles to self-consistent Electromagnetic and Electrostatic field solves. Implicitly model neutral and charged fields and their interactions with kinetically modeled particles. Combine VSim packages to customize your simulation environment. You can use VSim for Electromagnetics to solve for fields inside of a high field cavity, then add features from VSim for Microwave Devices to study effects of field emission. Start with one of a wide range of built-in example simulations that demonstrate both classical physics problems and real life devices. VSim's variety of starter simulations cover capacitively coupled plasma chambers, ion thrusters, satellite charging, radar antennas, klystrons, helix traveling wave tubes, as well as waveguide demultiplexers and other photonic structures. Modify an included example to suit your needs or set up a simulation from scratch by using VSim's powerful visual interface.

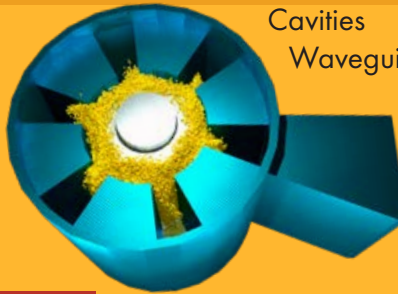


PACKAGES



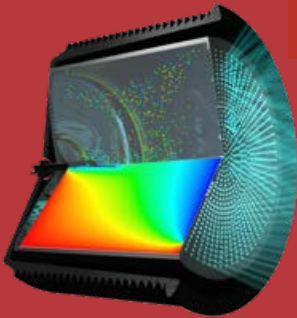
Electromagnetics

- Antennas
- Electrostatics
- Photonics
- Scattering
- Specific Absorption Rate (SAR)



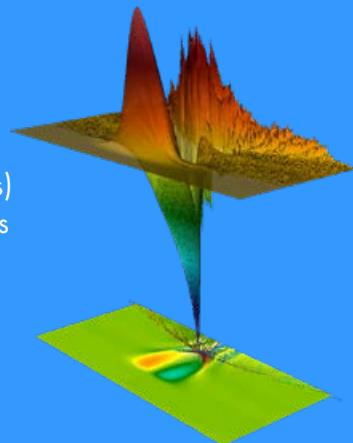
Microwave Devices

- Cavities
- Waveguides
- Multipacting
- Magnetron
- Gyrotron
- Klystron
- Traveling Wave Tubes (TWTs)
- Electron Guns
- Multistage Depressed Collectors (MDCs)



Plasma Discharges

- Capacitively Coupled Plasmas (CCPs)
- Thrusters
- Particle Beams



Plasma Acceleration

- Laser Plasma
- Accelerators (LPAs)
- Beam Accelerators

CAPABILITIES

The capabilities listed on this page are found in all VSim packages.

Works in 3D-2D-1D
Distributed memory parallelism
Periodic boundaries
Histories
Prescribed fields (functional, user defined, or imported)
Open source data format with visualization annotations

Particles

Charged particles
Variably weighted charged particles
Non relativistic particles
Relativistic charged particles
Tagged particles for particle tracking
Depositors and interpolators, area weighting and 1st order

Electromagnetics

Explicit electromagnetics
Current sources
Charge densities
Conducting slab boundaries
Slab isotropic dielectrics
Auxiliary differential equations

Surface Interactions

Absorbing slab boundaries
Emitting slab boundaries

Grid

Cylindrical coordinates
Spatially varying grid
Moving Window

Statics

Electrostatics
Magnetostatics—including nonlinear and anisotropic

Post-processing

Particle binning
Spectrograph analysis
Customizable Python scripts





CAPABILITIES

Extensive Set of Physical Processes

PARTICLE REACTIONS AVAILABLE IN VSim PLASMA PACKAGES

Binary (In)Elastic: $A + B \rightarrow A + B$

Electron Scatter: $e + A \rightarrow e + A$

Binary Excitation: $A + B \rightarrow A^* + B$

Charge Exchange: $A^+ + B \rightarrow A + B^+$

Binary Reaction: $A + B \rightarrow C + D$

Electron Attachment: $e + A \rightarrow A^-$

Negative Ion Detachment: $A^- + B \rightarrow A + B + e$

Impact Ionization: $A + B \rightarrow A + B^+ + e$

Electron Ionization: $A + e \rightarrow A^+ + 2e$

Dissociative Ionization:

$AB + e \rightarrow A^+ + B + 2e$

$AB + e \rightarrow A^+ + B^+ + 3e$

Field Ionization: $A + E \rightarrow A^+ + e$

Decay:

$A \rightarrow B + \gamma$

$A \rightarrow B$

Binary Recombination: $A^+ + e \rightarrow A$

Three Body Recombination: $A^- + e \rightarrow A + 2e$

Dissociative Recombination: $AB^+ + e \rightarrow A + B$

Electron Impact Dissociation: $AB + e \rightarrow A + B + e$

SURFACE PROCESSES CUSTOMIZABLE BY SHAPE

AVAILABLE FOR SLAB OR CONFORMAL BOUNDARIES

Sputtering
Secondary Electron Emission from Multiple
Shapes and Materials
Fowler-Nordheim Field-Induced Emission

Richardson-Dushman Thermionic Emission
Child-Langmuir Space Charged Limited Emission
Laser-Induced Emission
User-Defined Emission

FEATURES

VSIM PACKAGE	ELECTROMAGNETICS	MICROWAVE DEVICES	PLASMA ACCELERATION	PLASMA DISCHARGES
Embedded boundaries	●	●		●
BASIC ELECTROMAGNETICS				
Dey-Mittra	●	●	●	●
Cerenkov filter	●	●	●	
ADVANCED ELECTROMAGNETICS				
Controlled dispersion	●	●	●	
Anisotropic dielectrics	●			
Second-order dispersive dielectrics	●			
Linear plasma dielectric	●			
Kirchhoff Box	●			
Full field/scattered field	●			
PML boundaries	●	●	●	
MAL boundaries	●	●	●	
Port boundaries	●	●		
ADVANCED PARTICLE DYNAMICS				
Field-scaled particles		●		
Higher order particles			●	
ADVANCED PARTICLE BOUNDARY CONDITIONS				
Partially transparent absorbers		●		●
Absorbing embedded BC		●		●
Reflecting embedded BC		●		●

Get all the VSim packages or
buy only the packages you need.

FEATURES

VSIM PACKAGE	ELECTROMAGNETICS	MICROWAVE DEVICES	PLASMA ACCELERATION	PLASMA DISCHARGES
Collisions			●	●
Field ionization			●	
EMITTERS				
Prescribed emission		●		●
Field emission		●		
Fowler-Nordheim emission		●		
Thermionic emission		●		
Space-charge limited emission		●		
Laser-induced emission		●		
SECONDARY EMITTERS				
Electron-induced electron emission		●		●
Ion-induced secondary electron emission				●
Sputtering				●
Dynamic particle weight management		●		●
FLUIDS				
Cold relativistic fluid			●	
Static background gas			●	●
Euler fluid				●
DYNAMIC GRID				
Boosted frame			●	
Moving window			●	
Envelope Model			●	
Circuit equations		●		●
Feedback control		●		●
Electrostatics with embedded boundaries	●			●

SCALABILITY



From laptops to desktops to supercomputer clusters, we have you covered. Our parallel processing simulation capabilities stand ready to enable your research and technology breakthroughs.

VSim runs on some of the world's largest supercomputers, including NERSC's CORI and Edison systems, ORNL's Summit and Titan clusters, and KAUST's Shaheen supercomputer. Got a big problem? Talk to Tech-X.

SERVICES

Tech-X offers consulting and training services for all our simulation software. Initial free support comes with every purchase of a VSim package to quickly get you up and running. In addition, we offer consulting services from our experts to help you use VSim to its fullest extent to solve your most challenging problems.

VSim users are among the most advanced engineers and scientists in the world. Tech-X sponsors two user events each year where industry device designers can mix with laboratory and academic researchers for simulation training from our application engineers and product developers.

Tech-X is committed to technical excellence and innovation. Our scientists and software engineers work together to deliver quantifiable results. We combine academic research skills with a commercial software company sensibility to deliver high quality, cutting edge software that takes advantage of the latest hardware and software advances.

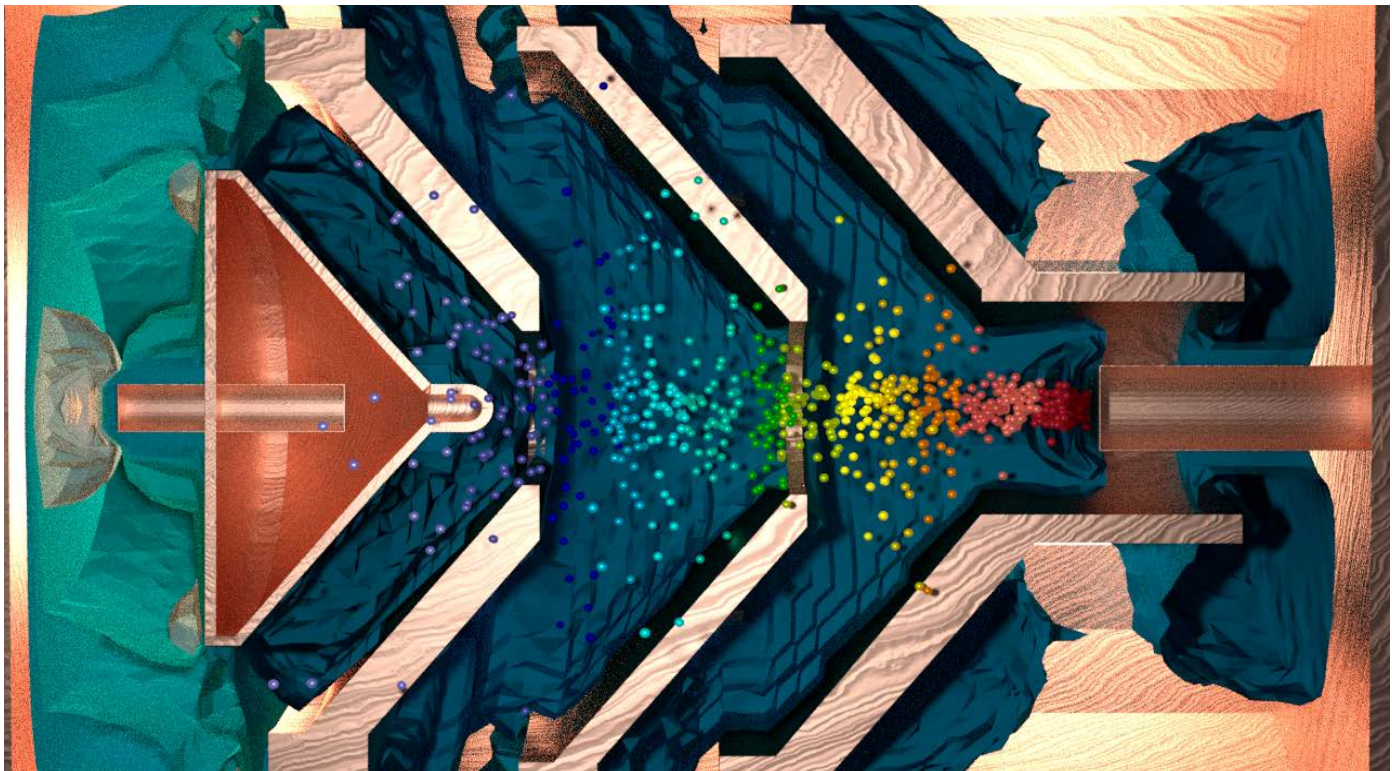
With VSim's flexible pricing model, you pay only for the simulation capabilities you need. Whether you need a custom set of physics features or run an HPC cluster, we will work with you to meet your requirements.

Tech-X supports the future of science and technology. Educational and classroom pricing is available to qualified institutions.

Contact Tech-X today to let us know how we can help with your simulation needs: sales@txcorp.com



©TECH-X Corporation  www.txcorp.com  sales@txcorp.com



VSim ELECTROMAGNETICS AND PLASMA SIMULATION