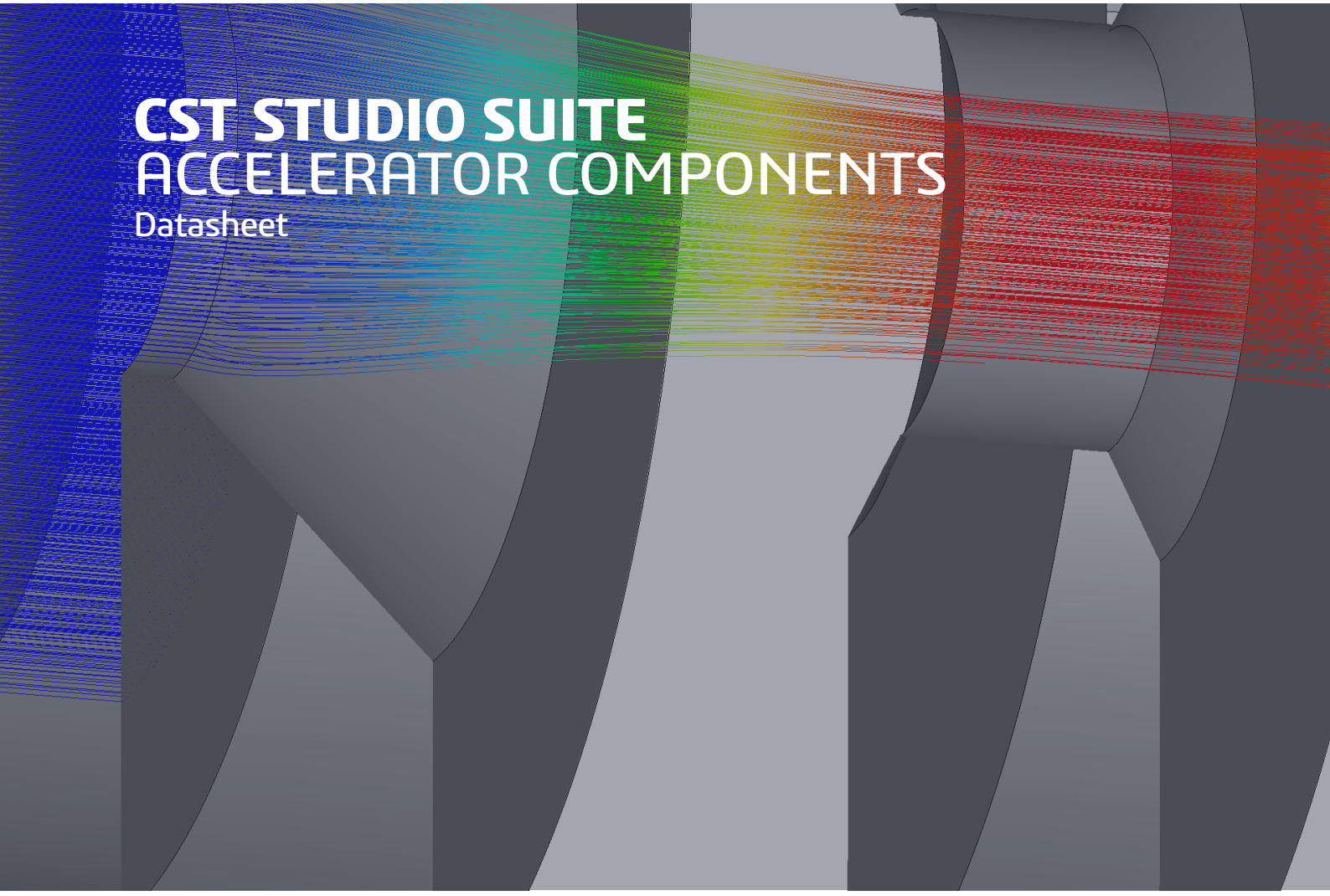
SIMULIA

3DEXPERIENCE®



CST STUDIO SUITE
ACCELERATOR COMPONENTS
Datasheet

CST Studio Suite® has been used in leading accelerator facilities in order to design accelerator cavities and other components, to analyze their performance, and to predict whether a device will work as intended. CST Studio Suite offers a powerful toolbox for these tasks.

ELECTRON/ION GUN SIMULATION

The geometry of a particle source design can be optimized easily within the parametric user interface of CST Studio Suite. Magnets and electrodes can be modeled and the emitted current from the gun is evaluated by an emission model in the Particle Tracking Solver. CST Studio Suite supports several emission models ranging from space-charge limited and thermionically limited models to field emission and plasma sheath emission for plasma ion sources, and other data can be imported. The conformal mesh support allows very complicated geometries as gridded guns to be modeled and enables the simulation of small deformations very accurately.

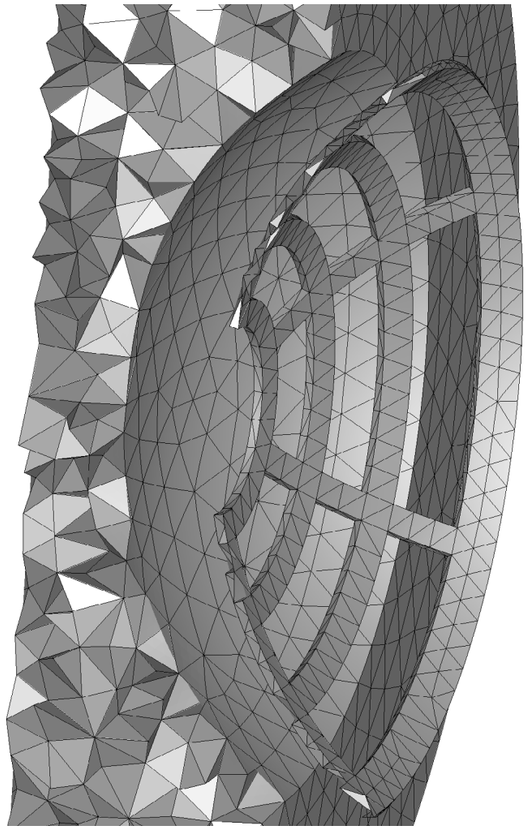
DASSAULT SYSTEMES

CAVITIES

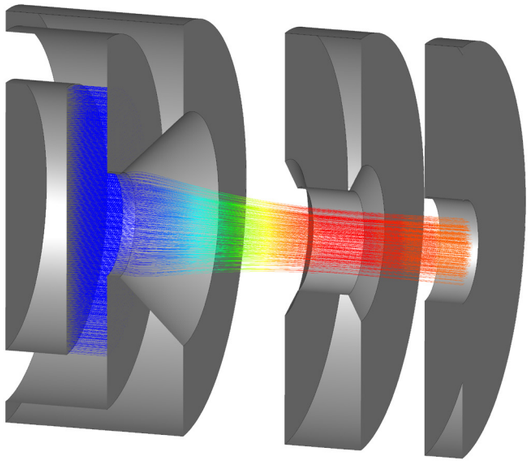
A big portion of an accelerator consists of cavities. These can easily be simulated with the sophisticated Eigenmode Solver. The user can choose between conformal hexahedral or tetrahedral meshes. Dielectric and surface losses can be included, and the solver can evaluate Q factors as well as accelerator specific quantities such as shunt impedance and R/Q. The multiphysics approach of CST Studio Suite also enables a coupling to thermal and mechanical solvers to obtain the detuning of cavities due to thermal expansion orthe Lorentz force.

MULTIPACTION

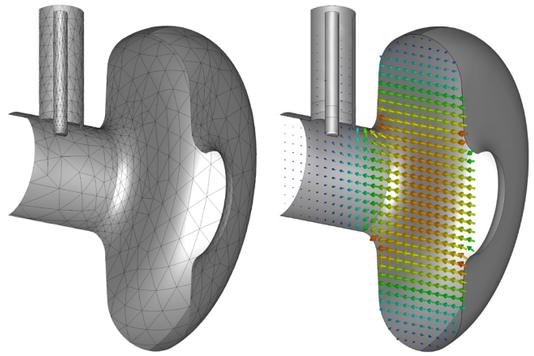
RF breakdown in vacuum (Multipaction) is an additional important aspect in accelerator design, as it can adversely affect the operation of the device. With the Particle-in-Cell (PIC) Solver, this can be simulated easily with the secondary electron emission property. The solver supports the Furman and Vaughan models, as well as user import for measured data. The fields responsible for the breakdown can be either calculated within the PIC Solver or loaded from a previous Eigenmode Solver simulation. The latter is a very efficient approach, since the steady state is imported directly.



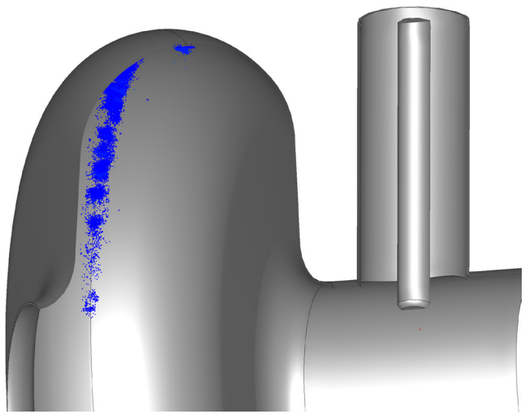
Meshing: Conformal mesh of a grid in an electron gun.



Particle tracking: Plasma ion source.



Cavities: Mesh of an Eigenmode simulation and resulting acceleration mode.



Multipaction: Multipacting particles at the equator of a cavity.

PIC – SELF CONSISTENT PARTICLE SIMULATION

The Particle-in-Cell (PIC) Solver is useful for simulating bunching in a LINAC cavity or the effect of the space charge inside the beam. The PIC Solver supports field imports from the Eigenmode Solver and static solvers, and fields can also be generated inside the PIC Solver. The movement of the particles is calculated in time domain in a self-consistent manner.

WAKEFIELD SOLVER – IMPEDANCE AND LOSS FACTOR

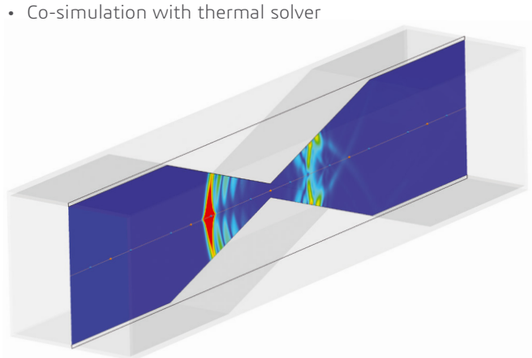
The Wakefield Solver directly evaluates the wake potential while a bunched beam is moving through a structure. The bunch form can be either Gaussian or user defined. To obtain the wake potential, both direct and indirect integration schemes are available. The termination of the beam pipe can be done with a special beam boundary operator also available for non relativistic beams. The wake impedance as Fourier transform of the wake potential is directly given by the solver and special post processing is available to increase the sampling or add a filter. The Wakefield Solver supports MPI cluster computing to accelerate simulations.

MAGNETS

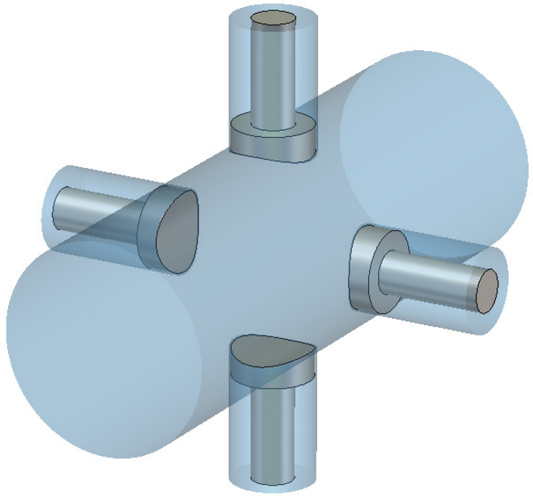
Magnetic components can be simulated by a combination of magnetostatic, useful for designing and analyzing the magnetic fields in isolation, and Particle Tracking Solver, which can plot particle trajectories and calculate focusing and steering effects. Conformal hexahedral and tetrahedral meshes are available in both cases.

GENERAL FEATURES OF CST STUDIO SUITE

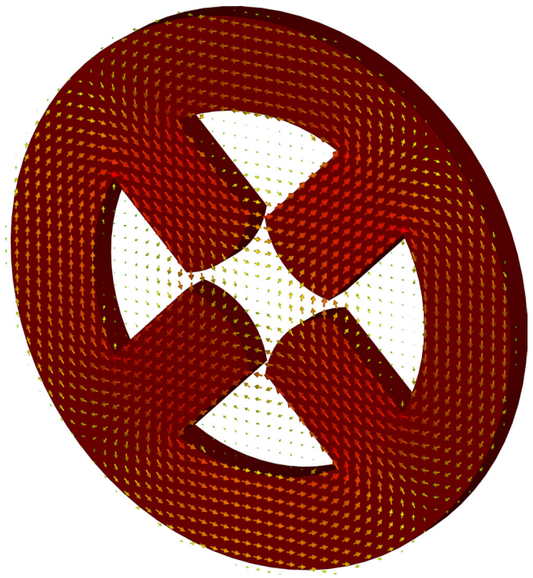
- Intuitive parametric 3D modeling and optimization
- VBA compatible macro language
- Powerful user-definable postprocessing
- Perfect Boundary Approximation (PBA)®
- Particle monitoring and emittance calculation
- VBA access to all particle data
- Import of external fields
- Shunt impedance, R/Q, and transit time factor
- Periodic boundaries and mode dispersion diagrams
- Co-simulation with thermal solver

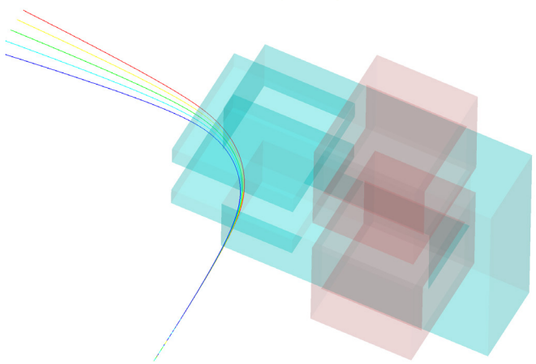


Wakefield: Collimator.

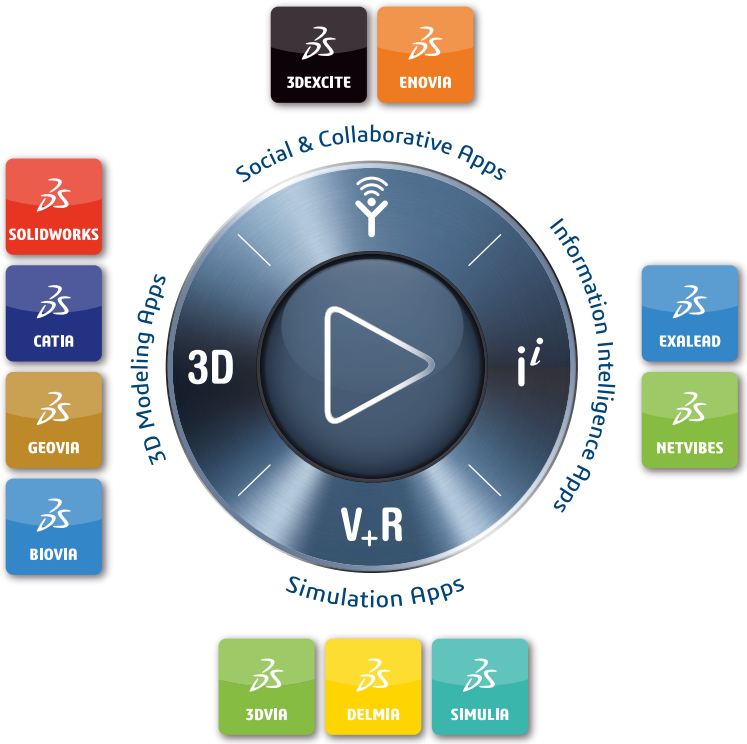


Monitor: The Wakefield Solver can also be used to obtain the output signals of beam position monitors.





Beam optics: Magnetic field of a quadrupole magnet (top) and particle trajectory for particles of different energy proceeding through a dipole field (bottom).



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