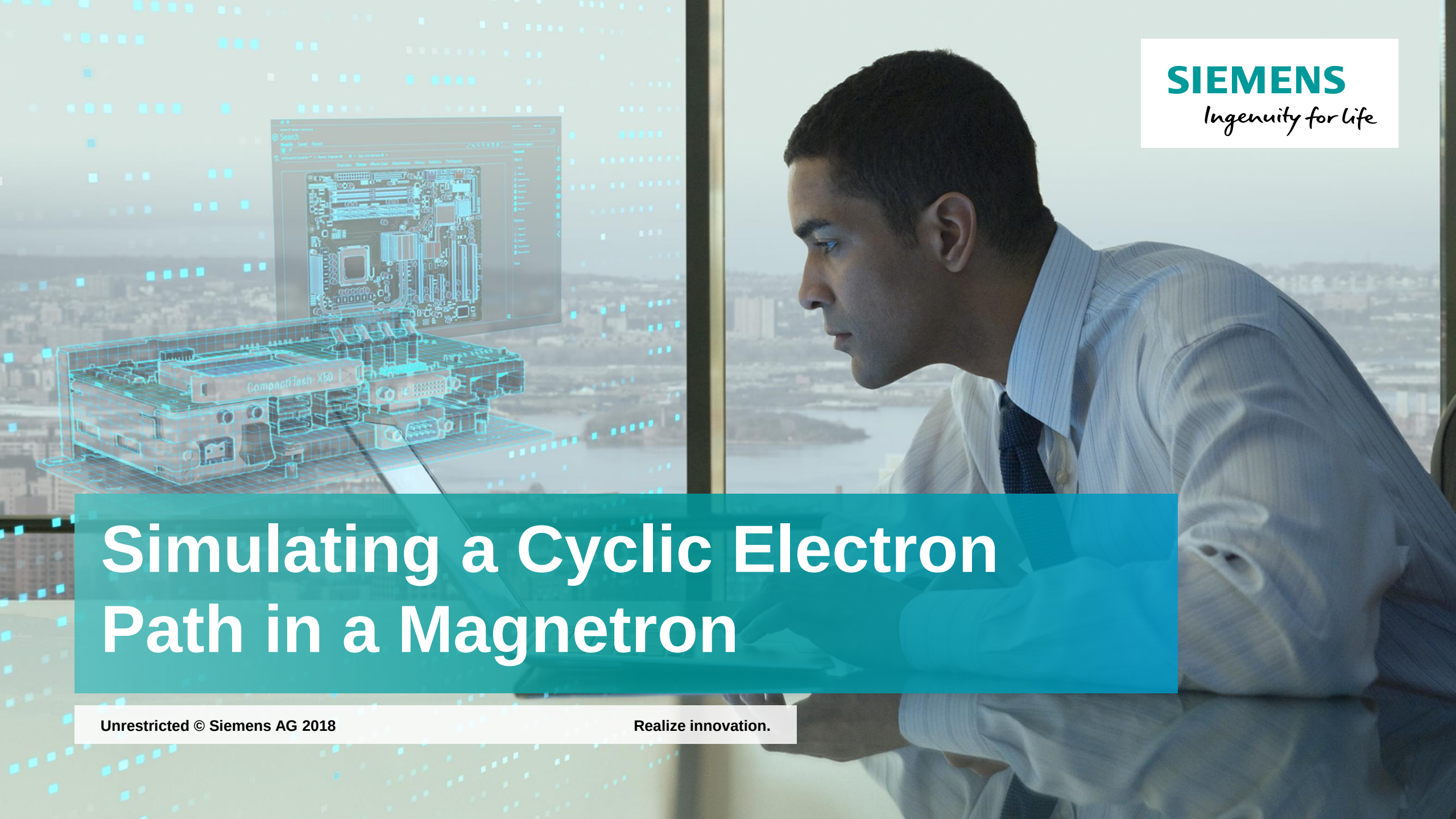

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Simulating a Cyclic Electron Path in a Magnetron

Simulating a Cyclic Electron Path in a Magnetron

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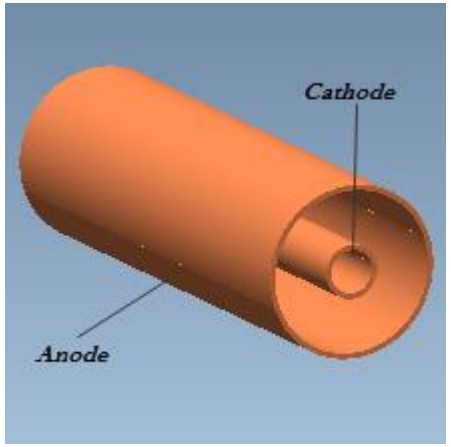
Magnetrons are typically used in microwave ovens and certain radar applications. The inside conductor is the cathode and the cylindrical shell on the outside is the anode. A coil is wrapped around the tube so that a magnetic field that is parallel to the axis of the tube is produced. The electric and magnetic fields are perpendicular to each other.



Electrons move from the cathode to the anode, they are forced to travel on a path that is bent due to the magnetic field.

The trajectory of an electron in a magnetron can be simulated based on the fields present in the space between the cathode and the anode.

Using MagNet, ElecNet and the Trajectory Evaluator, the electric and magnetic field strengths are adjusted so that the path of the electron does not reach the anode and forms a cyclic trajectory.

CONTROLLING THE VOLTAGE IN THE MAGNETRON

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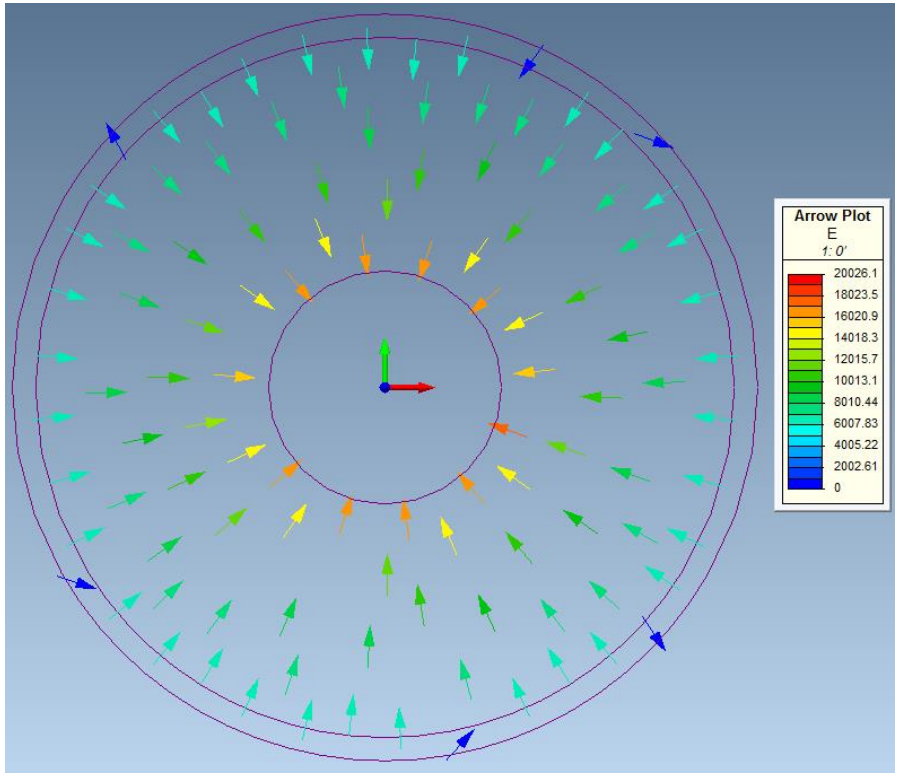
The voltage source is DC and is connected in series with the cathode and the anode terminals. By controlling the voltage level, the electric field strength in the cavity can be adjusted. To obtain the electric field, the electrostatic solver in ElecNet is used.



One Current Pulse

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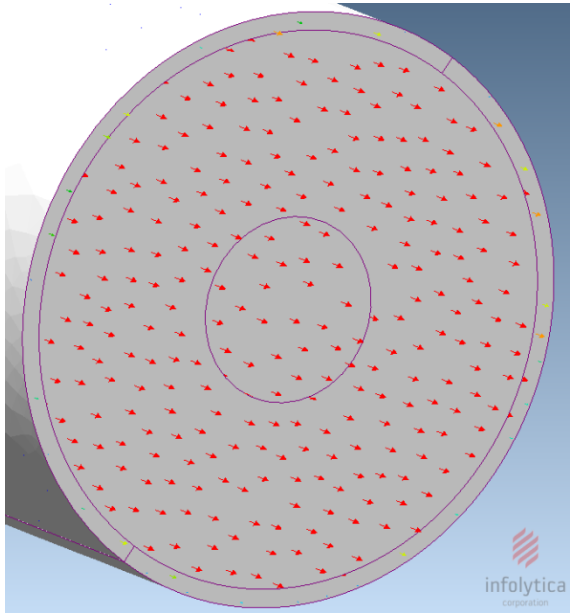
The outside coil, made of several turns, is connected in series with a DC current source so that a constant magnetic field is generated in the cavity. To obtain the magnetic field, the magnetostatic solver in MagNet is used.



Path of the Electron in the Magnetron

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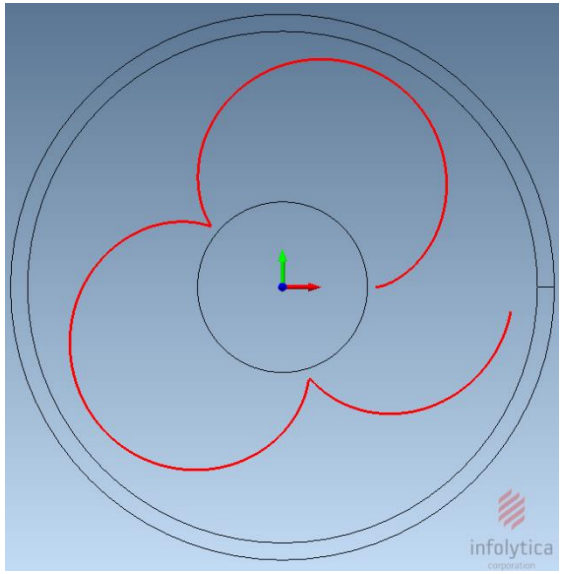
The electron path is obtained from the Trajectory Evaluator; it uses the magnetic and electric fields and calculates the electron's path based on mass and initial position, as well as the travel time.

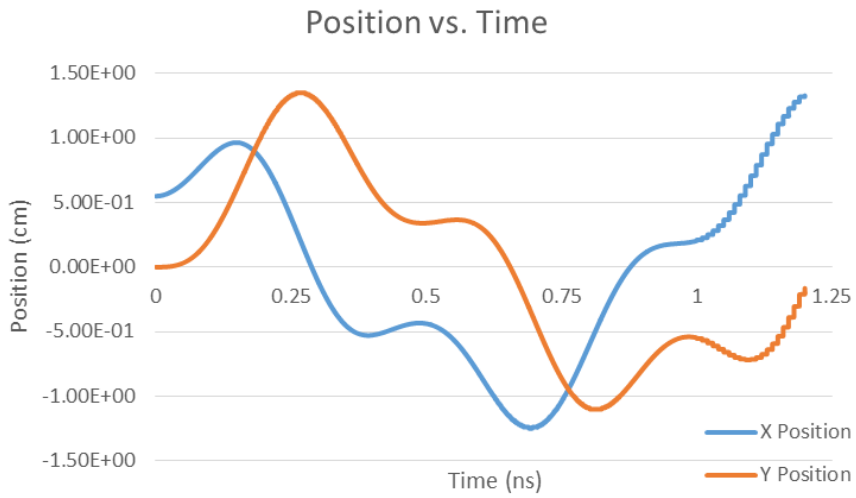
The path, which proceeds counter-clockwise, is shown in magenta.



Electron Postion Vs. Time

The Trajectory Evaluator can also calculate the coordinates of the electron, as well as its velocity and acceleration over time (see the next two graphs).

Only the x and y-components of the quantities are examined as the electron travels on the xy plane only.



Electron Velocity Vs. Time

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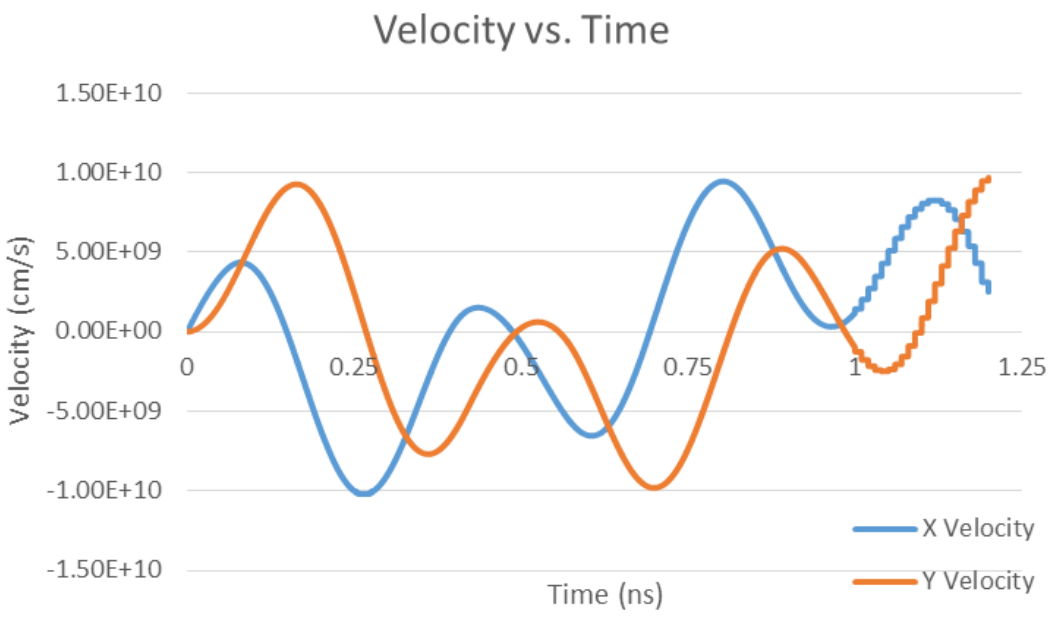
This graph plots the velocity of the electron as it travels on the cyclic path in the magnetron.



Electron Acceleration Vs. Time

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This graph plots the acceleration of the electron as it travels on the cyclic path in the magnetron.