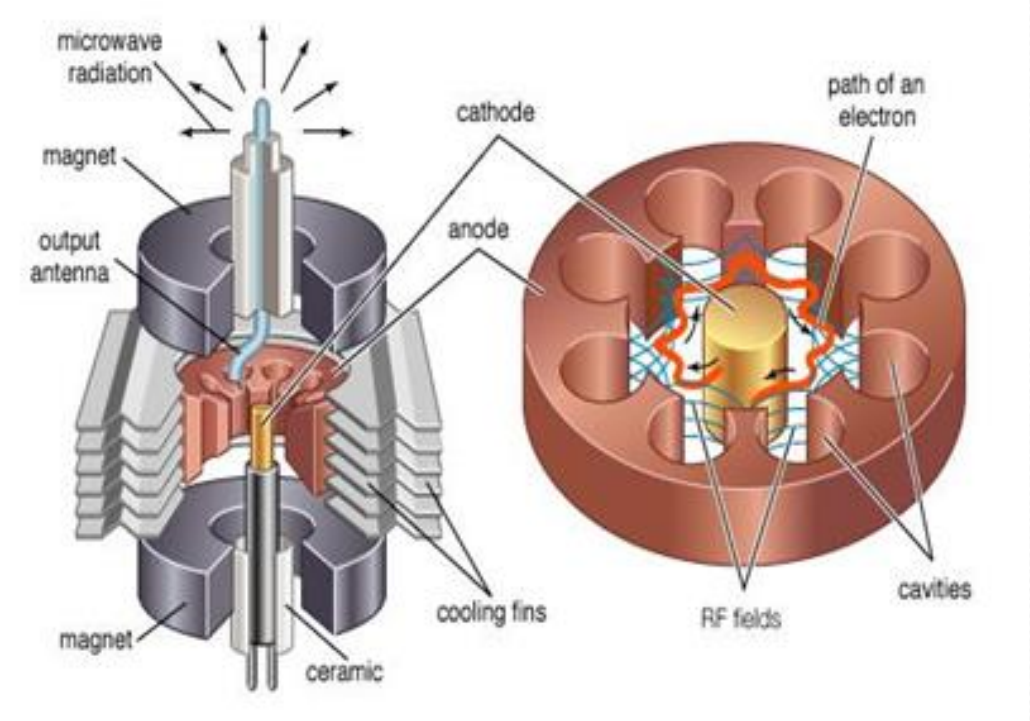
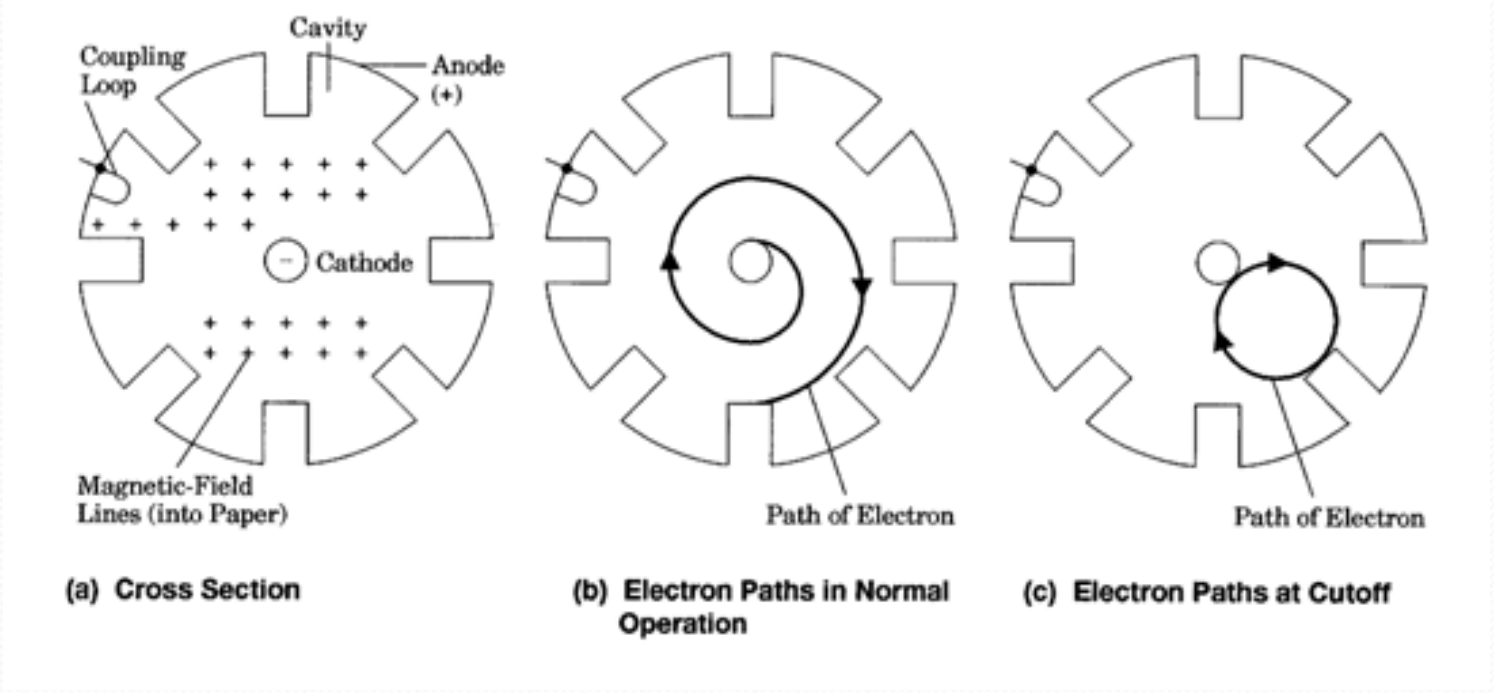
MAGNETRON

- The magnetron is a high-powered vacuum tube that generates microwaves using the interaction of a stream of electrons with a magnetic field.

- High-power oscillator
- Common in radar and microwave ovens
- Cathode in center, anode around outside
- Strong dc magnetic field around tube causes electrons from cathode to spiral as they move toward anode
- Current of electrons generates microwaves in cavities around outside


microwave radiation
magnet
output antenna
magnet
ceramic
cooling fins
cathode
anode
path of an electron
RF fields
cavities



(a) Cross Section

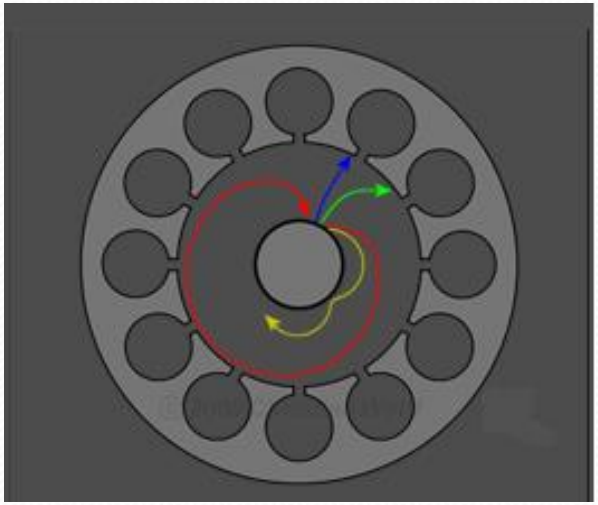
(b) Electron Paths in Normal Operation

(c) Electron Paths at Cutoff

operation

- In a magnetron, the source of electrons is a heated cathode located on the axis of an anode structure containing a number of microwave resonators.
- Electrons leave the cathode and are accelerated toward the anode, due to the dc field established by the voltage source E.
- The presence of a strong magnetic field B in the region between cathode and anode produces a force on each electron which is mutually perpendicular to the dc field and the electron velocity vectors, thereby causing the electrons to spiral away from the cathode in paths of varying curvature, depending upon the initial electron velocity at the time it leaves the cathode.

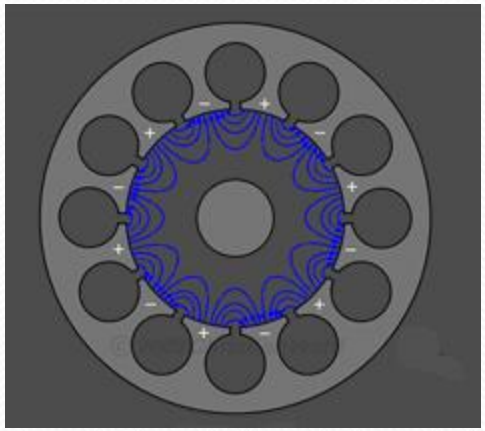
The electron path under the influence of different strength of the magnetic field

- 
- As this cloud of electrons approaches the anode, it falls under the influence of the RF fields at the vane tips, and electrons will either be retarded in velocity, if they happen to face an opposing RF field, or accelerated if they are in the vicinity of an aiding RF field.

- Since the force on an electron due to the magnetic field B is proportional to the electron velocity through the field, the retarded velocity electrons will experience less "curling force" and will therefore drift toward the anode, while the accelerated velocity electrons will curl back away from the anode.

- The result is an automatic collection of electron "spokes" as the cloud nears the anode with each spoke located at a resonator having an opposing RF field.

- On the next half cycle of RF oscillation, the RF field pattern will have reversed polarity and the spoke pattern will rotate to maintain its presence in an opposing field.



The high-frequency electrical field