



# ION PUMPS

Ion pumps remove gases from their environment by turning them into solid materials.



## ION PUMP OPERATION

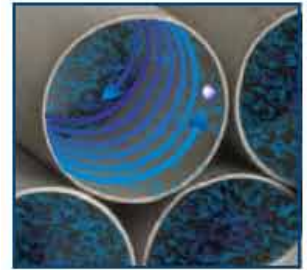
### Step 1: Create a high magnetic field

Permanent magnets located outside the vacuum are used to generate a strong magnetic field. This field is used to contain and guide electrons within circular anode rings.



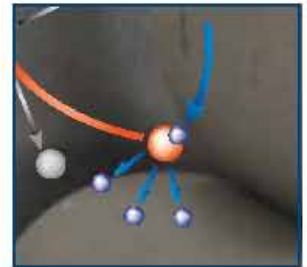
### Step 2: Generate a cloud of electrons

High voltage is applied to the element assembly after rough pumping. Electrons are pulled into the anode tube assembly, generate a cloud of spinning electrons, and become trapped by the high magnetic field.



### Step 3: Ionize gas molecules

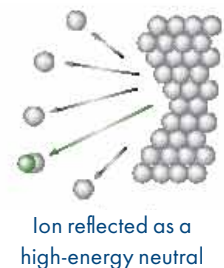
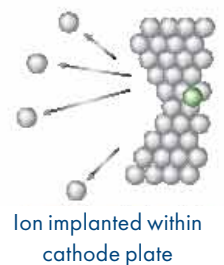
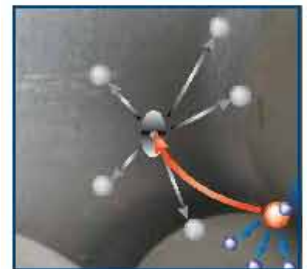
As gases move into the anode assembly, they are struck by electrons. Electrons are removed from the gas molecule's valence shell in the collision and the gas molecule now has a positive charge. This is called a positive ion. The positive ion is forced by the high voltage field at high velocity out of the anode tube toward the cathode plate.



### Step 4: Capture gas ions

When the positive ion reaches the cathode plate, its velocity creates a physical impact called sputtering. Cathode materials are ejected toward the anode tube and the ion behaves in one of two ways:

- Chemical Reaction – reactive gas ions react with cathode materials and form new solid compounds. For example, an ionized oxygen molecule will take an electron from and readily react with a titanium cathode atom creating a solid titanium oxide.
- Physical Reaction – heavier gas ions, like argon, impact the cathode, acquire an electron, and bounce back (reflect) toward the anode assembly. These reflected ions are called high energy neutrals because they still have enough energy to implant themselves physically in pump surfaces and stop contributing to the vacuum environment pressure.



## ION PUMP APPLICATIONS

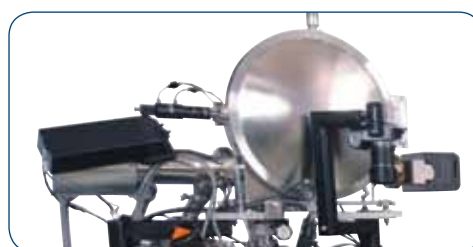
TECHNOLOGY	ION PUMP SIZE (I/S)			
	.2 - 3	3 - 20	20 - 75	100+
<b>INDUSTRY AND MEDICAL PROCESSES</b>				
RADAR	X			
TRAVELING WAVE TUBES (TWT)	X			
KLYSTRONS	X			
X-RAY TUBE EVACUATION	X	X		
X-RAY SOURCES	X	X		
TREATMENT & DIAGNOSTICS		X	X	
<b>SEMICONDUCTOR</b>				
CRITICAL DIMENSION SEM (CD SEM)		X	X	
LITHOGRAPHY			X	X
<b>INSTRUMENTATION</b>				
ELECTRON MICROSCOPES (SEM/TEM)		X	X	
FOCUSED ION BEAM (FIB)		X	X	
SCANNING PROBE MICROSCOPE (SPM)		X	X	X
SURFACE ANALYSIS (AES, XPS, SIMS, EDX)			X	X
MASS SPECTROMETRY (MS)			X	X
MOLECULAR BEAM EPITAXY (MBE)			X	X
<b>HIGH ENERGY PHYSICS</b>				
ACCELERATORS			X	X
BOOSTERS			X	X
STORAGE RINGS			X	X
FRONT ENDS			X	X
BEAM LINES			X	X
END STATIONS			X	X
FREE ELECTRON LASERS (MBE)			X	X
LASER INTERFEROMETERS			X	X



**Industry and Medical Processes**



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**Instrumentation**



**High Energy Physics**

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