Turbo Pumps

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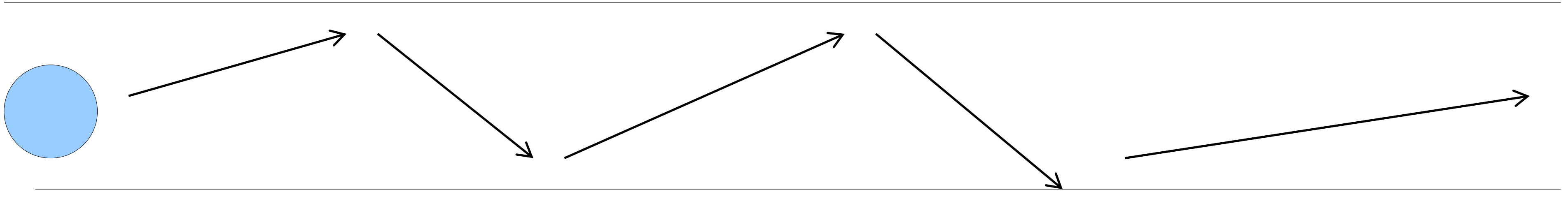
Outline

- Background
- Vacuum Pumps
- Turbo Pump Design
- Importance

Background: Pressure

- Gas molecules are in constant random motion
- In a container, the collisions of the gas molecules with the walls are what we measure as pressure (force/area)
- Vacuum: Absence of gas (no pressure!)
  - Viscous flow with no vacuum
  - Collisions between molecules become rare at high vacuum



Vacuum Pumps

- Removes gas from a chamber to create a vacuum
  - Useful when you interactions with gas must be minimized (eg. Electron beams)

Turbo Molecular Pumps

- Momentum Transfer
  - Titled rotor blades spin at up to 90,000 RPM
  - Gas molecules pass through the blades and pick up momentum when struck by the back of the blades
  - Some gas molecules more likely than others to make it throughD ´º-MAÄ M@ there(b)-3(a)-1(a)-1(k)-4ftlnd stlin

Typical Setup

Turbo Pump Characteristics

- Pumping Rates
  - 20 L/s to 3,000 L/s
  - Different gases pump at different rates
- Compression Ratio
  - Ratio between the partial pressure of a specific gas in the foreline vs. chamber (ie. after/before turbo)
  - eg. If $CR=10^8$ for Nitrogen and $P_{foreline} = 10^-$

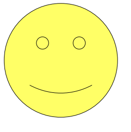
Other Characteristics

- Rotor design (SNECMA vs. Pfeiffer)
- Bearings
  - Ceramic, lubricated
    - Lubricant with low vapour pressure at UHV
  - Magnetic, levitating
    - Rotor shaft levitates without mechanical contact
    - No oil backflow, no mechanical wear!
- Throughput, Vacuum, Backpressure

SNECMA Design

Pfeiffer Design

Practical Importance

- Turbopumps are an essential part of nanotechnology
  - Science: SEM, EBL, FIB, LEED, XPS, thin film deposition
  - Engineering: Semiconductor fabrication, ion implantation, [your research here?]
- Advantages: Reliable, good performance, corrosion resistant, fast(!), clean
- If one breaks on you, you'll have to know how to find a replacement. 

Questions?

References

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