Chapter 2: Atoms, Ions, and the Periodic Table

Sept 8, 2022

Chemistry Department, Cypress College

Class Announcements

- When uploading assignments, be certain that the file is in a readable format e.g. docx, png, jpeg, and pdf
- This week only, any late HW assignments will not be penalized 50%; submit late assignments by the Sept 8th at 11:59pm
- Quiz #2 released this Fri, Sept 9 at 11am and due Tues, Sept 12 at 11am
- Homework #2 released this Fri, Sept 9 at 11am and due Fri, Sept 16 at 11am

Lecture Weekly Agenda

- Finished Ch 2 - pg 56 – 88
- In-class Ch 2 worksheet
- Time permits, begin Ch 3

Outline

Scientific Notation

$$2.78 \times 10^{-8} - 5.689 \times 10^{-9} =$$

$$\frac{7.18 - 6.729}{2.51 \times 7.343} =$$

$$\frac{7.9 \times 10^{34}}{8.235 \times 10^{23}} =$$

Unit Conversion

Volume Conversion

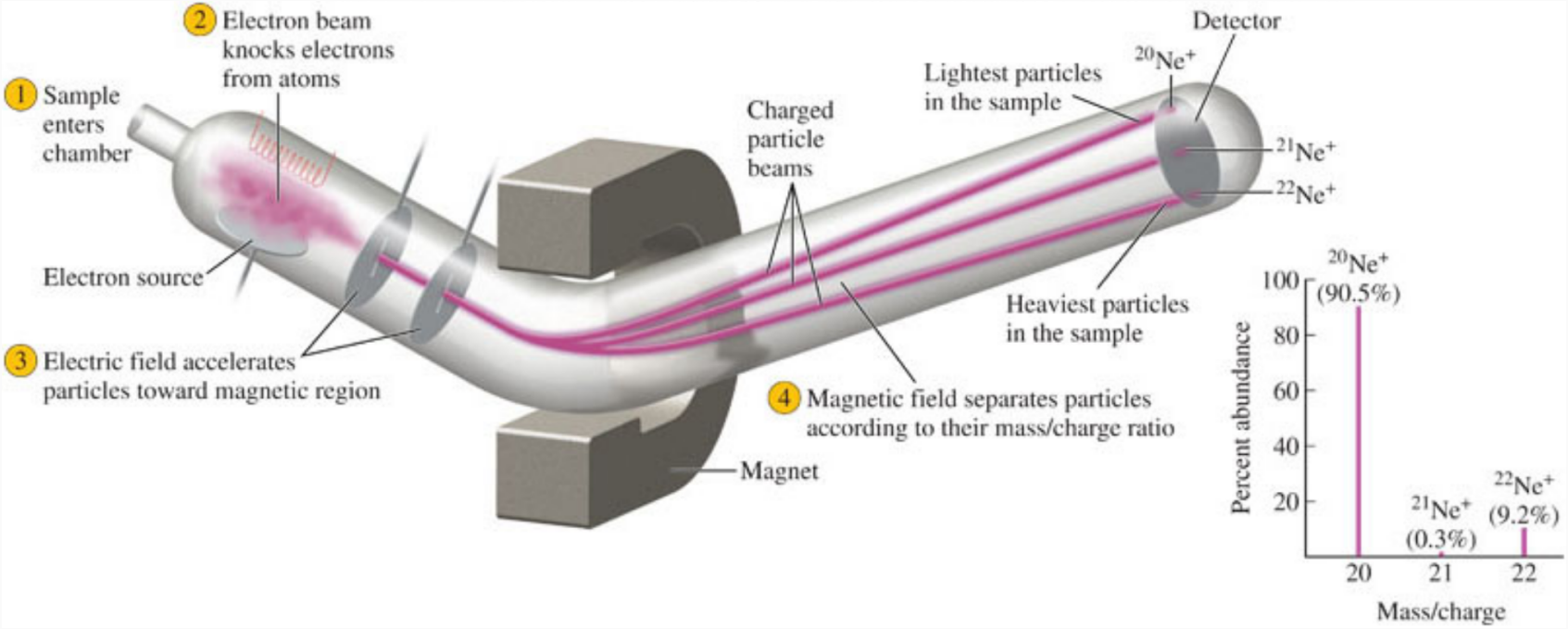
9.2m^3 to mm^3

581.74 mL to m^3

0.53 g/cm^3 to kg/m^3

Outline

Experiment: Mass Spectroscopy



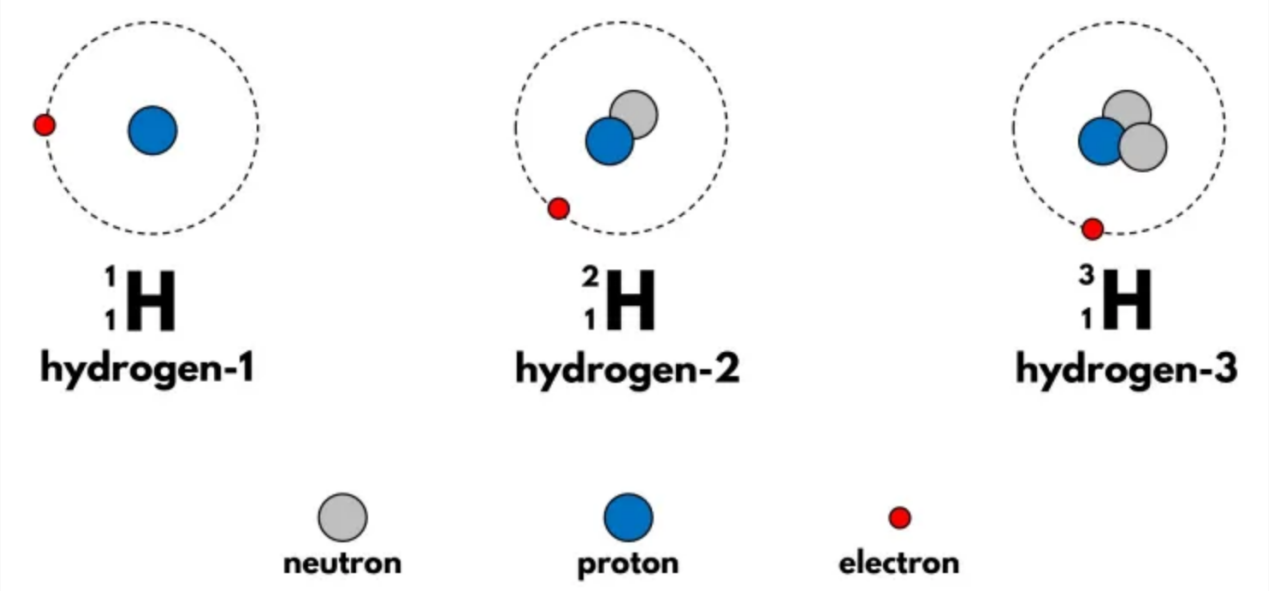
- Ionizes the atom and electric field accelerates atoms
- Time of flight - heavier atoms will travel slower than lighter ones
- Weighted average of atomic masses

Relative Atomic Mass

$$\text{Relative Atomic Mass} = (I_1 \times A_1) + (I_2 \times A_2) + \ldots \qquad (1)$$

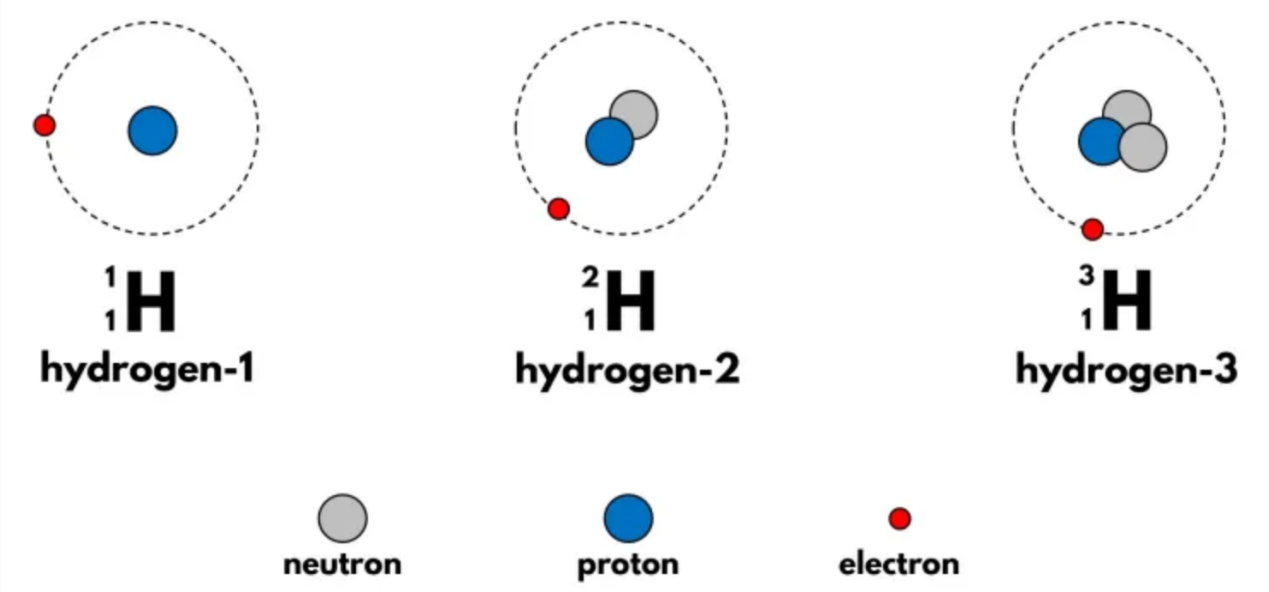
where I is the mass of the isotope, and A is the relative abundance between 0 and 1

Hydrogen Isotopes and Applications



- Hydrogen ($^{1}_{1}\mathrm{H}$), deuterium ($^{2}_{1}\mathrm{D}$), and tritium ($^{3}_{1}\mathrm{T}$) have relative abundances of 99.84%, 0.0156%, and trace amounts, respectively
- **Q:** Which hydrogen isotope is the highest in abundance?

Hydrogen Isotopes and Applications

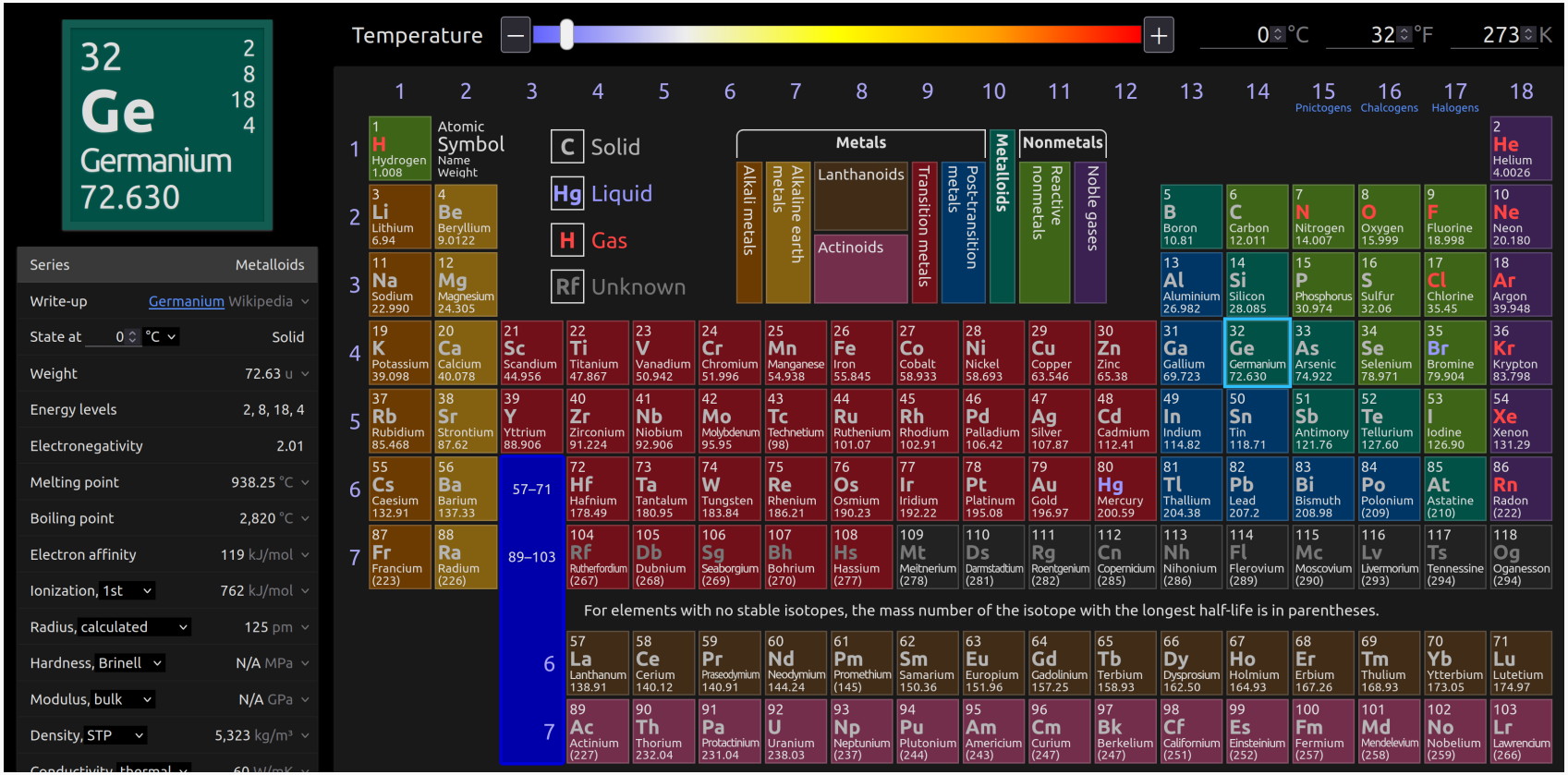


Applications

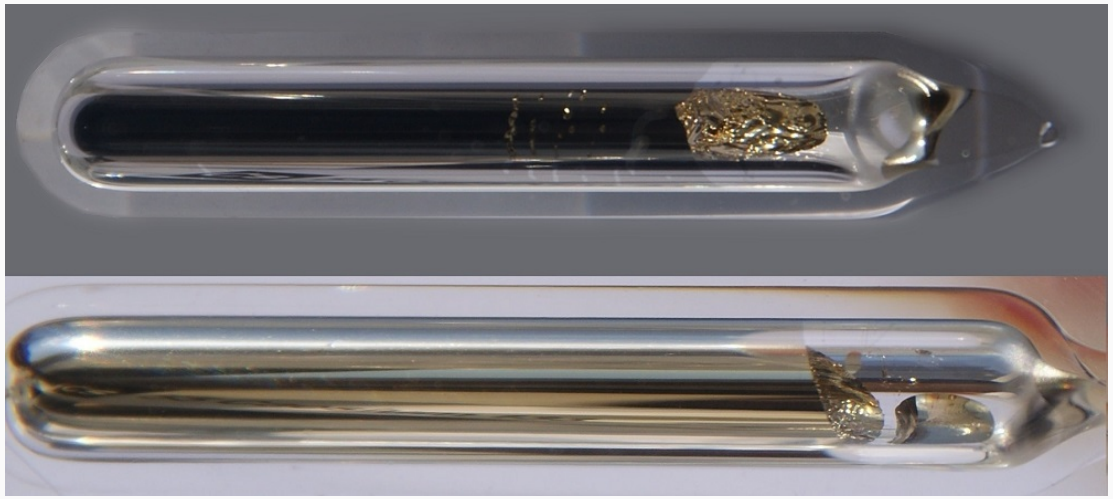
- Semiconductor production enhancing Si-H bond by preventing chemical erosion and Hot Carrier Effect
- Chemical labeling to track chemical reactions
- Medicinal chemistry - FDA approved the first deuterium-labeled drug (reference)

Outline

Review: Modern Period Table



Alkali Metal



- Lower densities than other metals
- Extremely soft metals
- Highly reactive e.g. forming H_2 when in contact with water
- Prefer to lose an electron

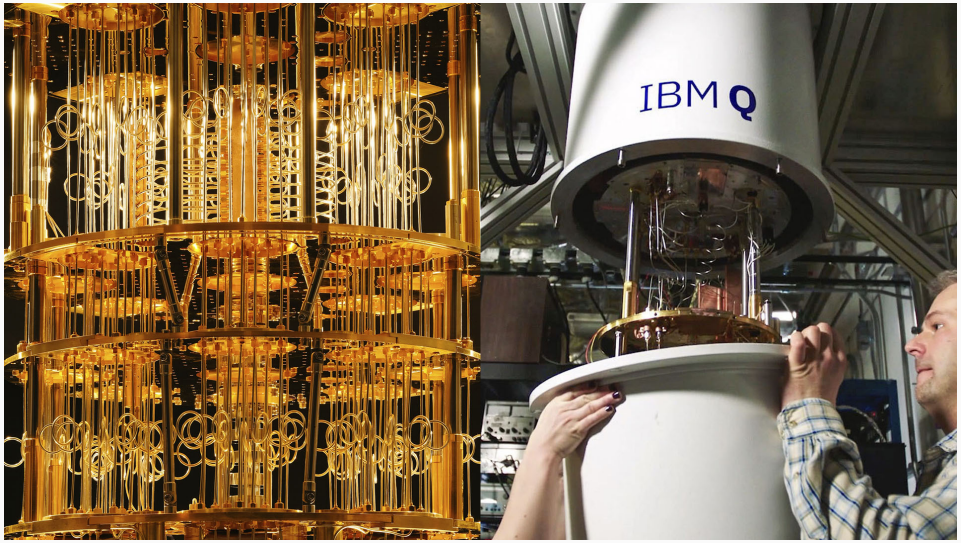
Alkaline Earth Metal

- Fairly reactive metals
- Can form solutions with a pH greater than 7 (more basic or alkaline)
- Calcium and magnesium important for life
- Prefer to lose 2 electrons

Transition Metals

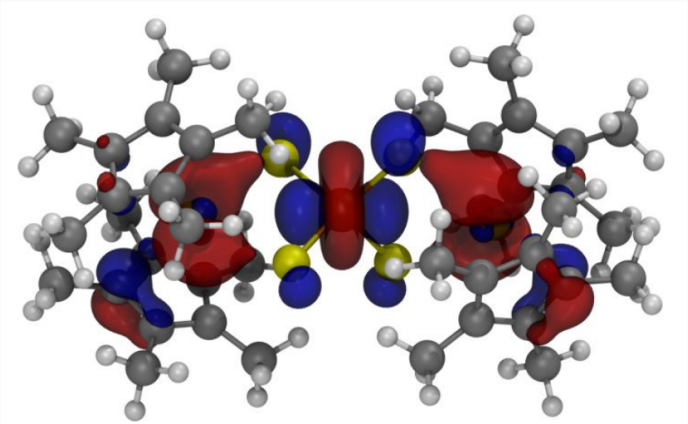
- Easily malleable and great conductors of heat and electricity
- High melting points except mercury (liquid at Room temperature)
- High densities
- Oxidation states (ability to gain/lose electrons) can vary between 1+ to 6+

Actinides and Lanthanides

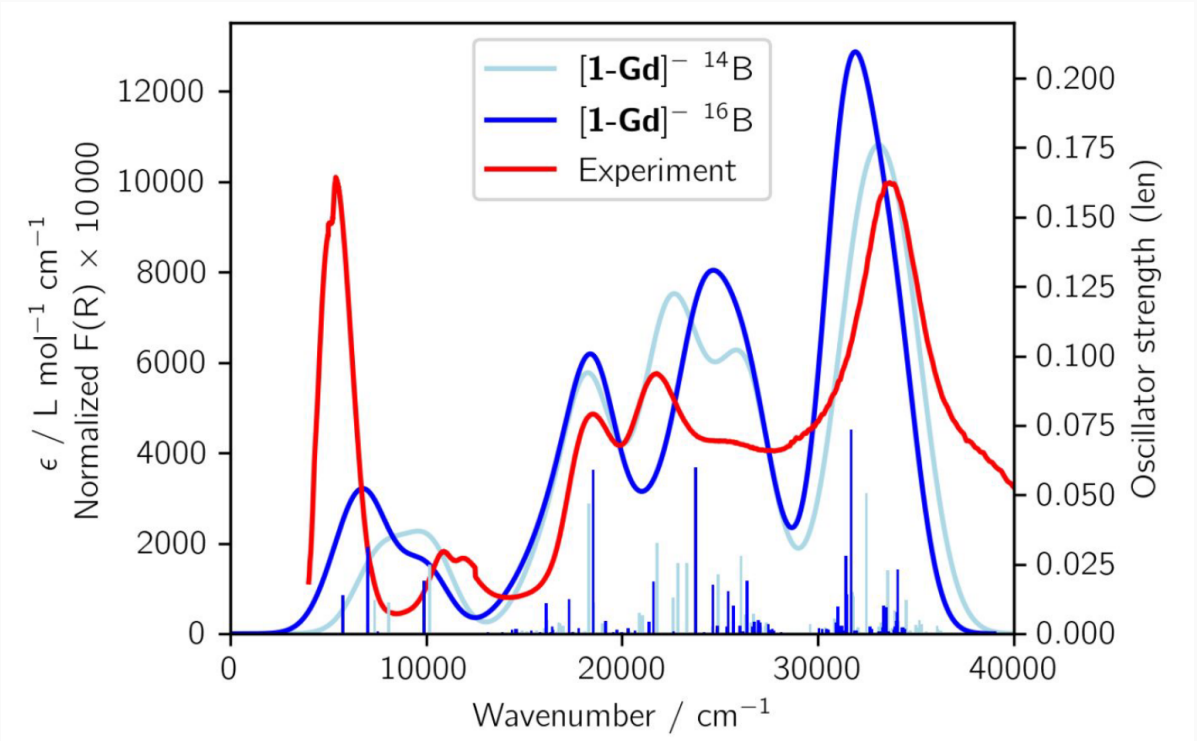


- Radioactive due to instability
- Silvery/silvery-white luster in metallic form
- Potential application to quantum computers and nuclear power
- Oxidation states can range from 2+ to 7+

Materials for Quantum Computing: Lanthanide Complexes

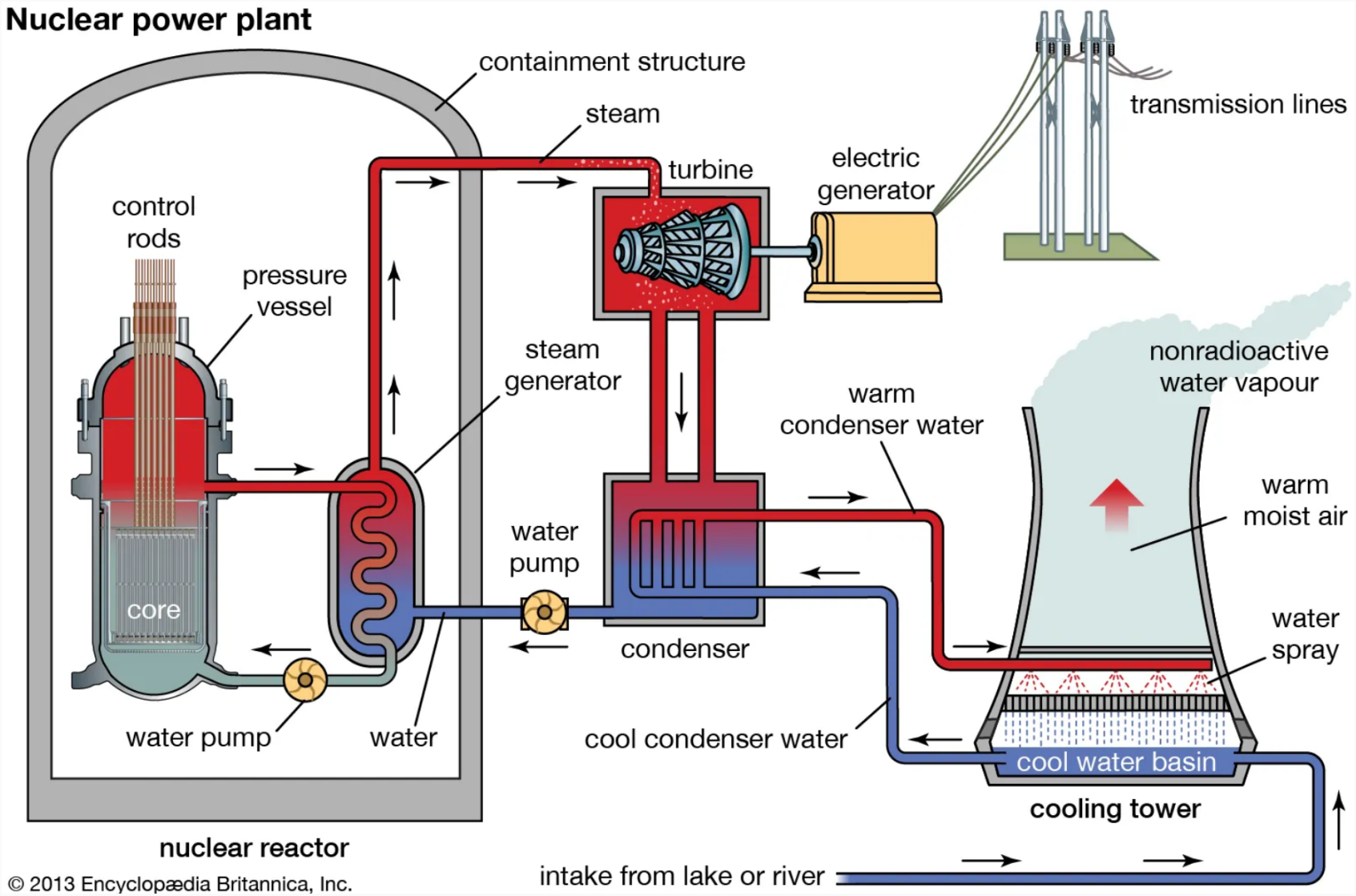


$[\mathbf{1\text{-}Gd}]^{-1}$ HOMO



- Understanding the electronic structure
- Hysteresis - electronic spin memory
- Lanthanide MoS_4 research article

Nuclear Power Plants



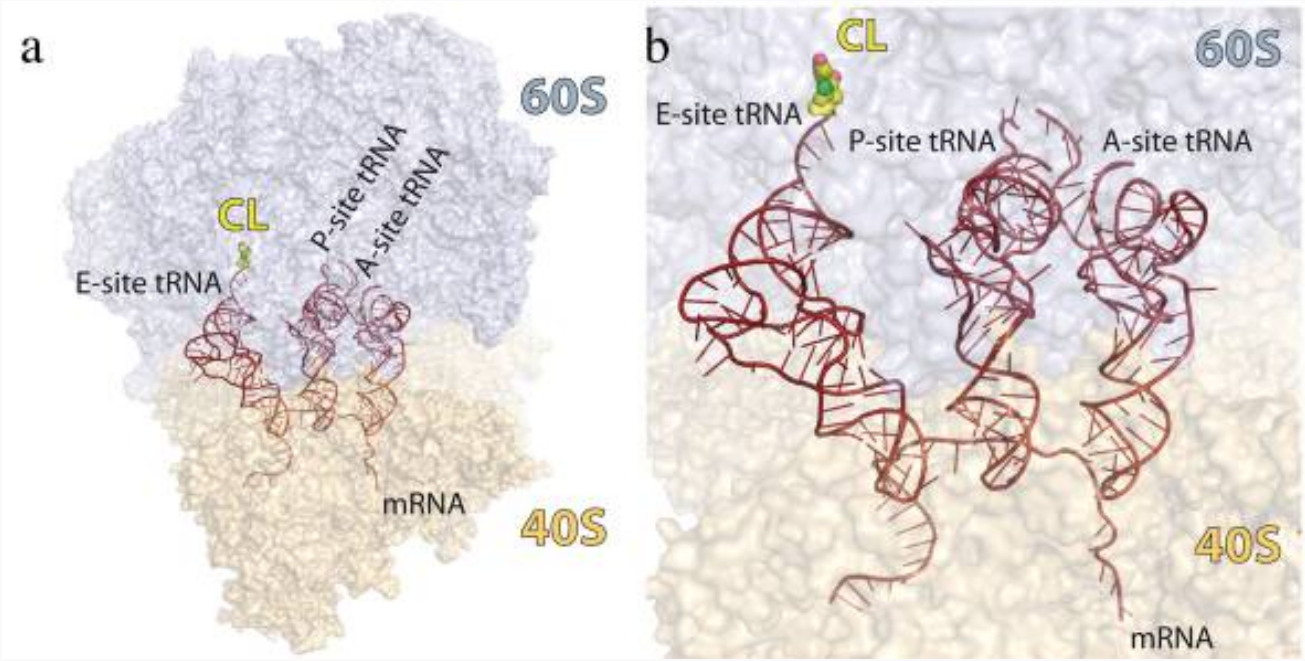
Halogens

- Fairly toxic and form acids when combined with hydrogen
- Readily react with metals to form salts e.g. NaCl
- Important for drug development due to their "sticky" nature
- Prefers to gain an electron

Cancer Therapeutics

- Chlorolissoclimide is a potent cancer drug that is naturally found in sea squirts
- Understanding the structure–activity relationships e.g. interactions between drug and ribosome

My Research Project: Chlorolissoclimide



- Chlorolissoclimide research article

Noble Gases

- Colorless, odorless, tasteless, and non-flammable under standard conditions
- Extremely non-reactive and most stable elements
- Do not like to gain or lose electrons

Practice: Periodic Table

Group the elements into the following groups

- Br
- K
- Mg
- Al
- Mn
- Ar
- U

Practice

What is the charge of the ions for each of the following elements?

- Al
- P
- Br
- S