Electromagnetic Spectrum Overview

Bohr's model of the hydrogen atom provides a framework for understanding the emission spectrum of hydrogen. According to Bohr's theory, electrons orbit the nucleus in discrete energy levels and can transition between these levels by absorbing or emitting photons of specific energies. The hydrogen spectrum consists of several series of lines, each corresponding to transitions of electrons between different energy levels. These series are named after the scientists who discovered them.

Hydrogen Emission Spectrum Series:

1. **Lyman Series (Ultraviolet Region)**:
   - **Transitions**: Electrons fall from higher energy levels ($n \geq 2$) to the first energy level ($n = 1$).
   - **Wavelength Range**: Approximately 10 nm to 122 nm.
2. **Balmer Series (Visible Region)**:
   - **Transitions**: Electrons fall from higher energy levels ($n \geq 3$) to the second energy level ($n = 2$).
   - **Wavelength Range**: Approximately 380 nm to 750 nm.
   - **Notable Lines**: H-alpha (656 nm, red), H-beta (486 nm, blue-green), H-gamma (434 nm, violet), H-delta (410 nm, violet).
3. **Paschen Series (Infrared Region)**:
   - **Transitions**: Electrons fall from higher energy levels ($n \geq 4$) to the third energy level ($n = 3$).
   - **Wavelength Range**: Approximately 820 nm to 1875 nm.
4. **Brackett Series (Infrared Region)**:
   - **Transitions**: Electrons fall from higher energy levels ($n \geq 5$) to the fourth energy level ($n = 4$).
   - **Wavelength Range**: Approximately 1450 nm to 4050 nm.
5. **Pfund Series (Infrared Region)**:
   - **Transitions**: Electrons fall from higher energy levels ($n \geq 6$) to the fifth energy level ($n = 5$).
   - **Wavelength Range**: Approximately 2280 nm to 7460 nm.

Table of Hydrogen Spectral Series:

Series Name	Final Energy Level (n_f)	Initial Energy Level (n_i)	Wavelength Range	Region
Lyman	1	2, 3, 4, ...	10 nm - 122 nm	Ultraviolet
Balmer	2	3, 4, 5, ...	380 nm - 750 nm	Visible
Paschen	3	4, 5, 6, ...	820 nm - 1875 nm	Infrared
Brackett	4	5, 6, 7, ...	1450 nm - 4050 nm	Infrared
Pfund	5	6, 7, 8, ...	2280 nm - 7460 nm	Infrared

Description of the Spectral Lines:

1. **Lyman Series**:
   - Transitions to the $n = 1$ level result in the emission of ultraviolet photons.
   - These lines are in the ultraviolet region, invisible to the naked eye.
2. **Balmer Series**:

- Transitions to the n = 2 level result in visible light photons.
- These lines include the well-known H-alpha line, which is red.

3. **Paschen Series**:
   - Transitions to the n = 3 level result in infrared photons.
   - These lines are in the infrared region, which is beyond visible light.
4. **Brackett Series**:
   - Transitions to the n = 4 level result in infrared photons, further beyond the Paschen series.
5. **Pfund Series**:
   - Transitions to the n = 5 level result in far-infrared photons.

Diagram Representation:

Below is a simple representation of the hydrogen atom transitions and their corresponding spectral series:

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```
      n = ∞
        |
        |
      n = 6  ___________
        |              |  Pfund Series (IR)
      n = 5  ___________|___________
        |                          |  Brackett Series (IR)
      n = 4  __________________________|___________
        |                                     |  Paschen Series (IR)
      n = 3  ____________________________________|___________
        |                                                |  Balmer Series (Visible)
      n = 2  _____________________________________________|___________
        |                                                           |  Lyman Series
  (UV)
      n = 1  ____________________________________________________________|
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This diagram shows the energy levels of the hydrogen atom and the series of lines corresponding to the transitions of electrons between these levels.