**Nuclides - Composite Particles**

A **nuclide** is a type of atom whose nuclei have specific numbers of protons and neutrons (both are called nucleons). Therefore, nuclides are *composite particles of nucleons*.

According to the standard model, up and down **quarks** are the basic components of nucleons. Thus, nuclides can also be considered *composite particles of quarks*.

The term **isotopes** is often used to mean nuclides, because a nuclide is usually an isotope of an element. Strictly speaking, isotopes are atoms with the same number of protons but different number of neutrons in their nuclei.

**Notation for a Nuclide**

The notation for a nuclide with mass number $A$ and atomic number $Z$ is represented by a symbol of its element $E$.

$$A^E_Z$$

For example

$$^{235}\text{U}$$

In the discussion of decay families, we have used a table to show the relationship of nuclides. This type of table is very convenient for showing nuclear properties. A portion of the table for very light nuclides is given below:

<table>
<thead>
<tr>
<th># of p</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 (# of n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1H, 99.99%</td>
<td>2H, 0.015%</td>
<td>3H, 12.26y</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>1.007825</td>
<td>2.0142</td>
<td>3.0160492</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>–</td>
<td>3He, 0.0001%</td>
<td>4He, 100%</td>
<td>5He</td>
<td>6He, 0.8 s</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>3.0160293</td>
<td>4.00260</td>
<td>5.01222</td>
<td>3.51 MeV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.018886</td>
</tr>
</tbody>
</table>

**Stable and Unstable Nuclides**

There are stable and radioactive nuclides. Stable nuclides exist for an indefinite period of time, and they are the constituents of ordinary material. Unstable nuclides emit subatomic particles, with $\alpha$, $\beta$, $\gamma$, $\text{^1_0n}$, $\text{^1_1p}$ being the most common. Few undergo nuclear fission. However, unstable
nuclides with long half-lives are also present in nature.

- **Stable nuclides** are not radioactive. They remain unchanged for an indefinite period.
- **Unstable nuclides** are radioactive, and they emit alpha, beta, gamma, or proton and they eventually convert to stable nuclides.

The study of nuclides is an experimental and observatory science. It involves data gathering, classification, organization, observation, and theorization about nature.

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