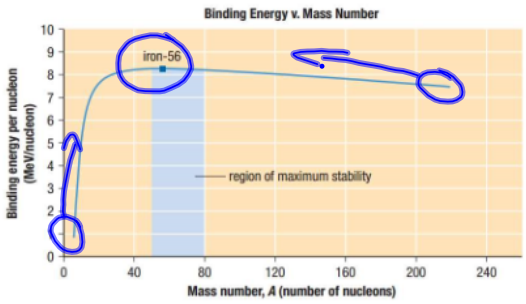
SPH3U 7.5 Nuclear Fusion

1. Mass-energy equivalence

Heavy nuclei:	want fission to become more stable.
Light nuclei:	want fusion to become more stable.
c^2:	$(3.0\times10^8)^2 = 930 \frac{MeV}{u}$



Determine the energy released when a deuterium atom (D) fuses with a tritium atom (T) to form helium, according to the nuclear reaction equation below. Use the given masses.

$^2_1H + {}^3_1H \rightarrow {}^4_2He + {}^1_0n + \text{energy}$

$m_D = 2.014\ 10$ u $\quad m_{He} = 4.002\ 60$ u $\quad c^2 = 930$ MeV/u

$m_T = 3.016\ 05$ u $\quad m_n = 1.008\ 67$ u

$\Delta m = m_D + m_T - m_{He} - m_n$

$= 2.01410 + 3.01605 - 4.00260 - 1.00867 = 0.01888$ u.

$E = \Delta m c^2 = (0.01888)(930\ MeV/u)$

$= 17.56$ MeV.

2. Controlled nuclear fusion

Proton-proton chain:	$4({}^1_1H) \rightarrow {}^4_2He + 2({}^0_{+1}e) + \text{energy}$. → happens in the sun.
Production of elements:	stars fuse particles together to create higher elements.
Carbon-nitrogen-oxygen cycle:	${}^{12}_6C \rightarrow {}^{13}_7N \rightarrow {}^{13}_6C \rightarrow {}^{14}_7N \rightarrow {}^{15}_8O \rightarrow {}^{15}_7N \rightarrow {}^{12}_6C + {}^4_2He$
Magnetic confinement:	in fusion, the substance (plasma) is very hot
The ITER Project:	experimental fusion reactor.

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