



m E 1905

$$E = mc^2$$

(J) = E  
(kg) = m  
c = 2,99792 . 10<sup>8</sup> m/s = c

ΔE

$$\frac{\Delta E}{c^2}$$

$$\Delta E = \Delta mc^2$$

( Δm ΔE )  
( Δm ΔE )

$$\Delta m c^2$$

m = 1,67262 . 10<sup>-27</sup> kg E /1

1945 9 /2

8,4 . 10<sup>13</sup> J

E /1

$$E = mc^2$$

$$E = 1,67262 \cdot 10^{-27} \times (2,99792 \cdot 10^8)^2 = 1,50327 \cdot 10^{-10} \text{ J}$$

$$E = 1,50327 \cdot 10^{-10} \text{ J}$$

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$$\Delta m = \frac{\Delta E}{c^2}$$

$$\Delta m = \frac{8,4 \cdot 10^{13}}{(2,99792 \cdot 10^8)^2} = 9,3 \cdot 10^{-4} \text{ kg}$$

$$\Delta m = 9,3 \cdot 10^{-4} \text{ kg}$$

$$10^{-3} \text{ kg} = 1 \text{ g}$$

: -2

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(eV) l'électronvolt

: (MeV) mégaélectronvolt

$$1 \text{ MeV} = 10^6 \text{ eV}$$

$$1 \text{ eV} = 1,6022 \cdot 10^{-19} \text{ J}$$

$$1 \text{ MeV} = 1,6022 \cdot 10^{-13} \text{ J}$$

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$$: E = 1,50327 \cdot 10^{-10} \text{ J}$$

$$E = \frac{1,50327 \cdot 10^{-10}}{1,6022 \cdot 10^{-19}} = 9,3825 \cdot 10^8 \text{ eV} = 938,25 \text{ MeV}$$

	(kg)	(MeV)
( )	$9,1093897 \cdot 10^{-31}$	0,510999
	$1,6726231 \cdot 10^{-27}$	938,272
	$1,674929 \cdot 10^{-27}$	939,566
$\alpha({}_2^4\text{He})$	$6,64472 \cdot 10^{-27}$	3727,14

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$$1 \text{ u} = 1,66054 \cdot 10^{-27} \text{ kg}$$

$$\cdot \text{ MeV}/c^2 :$$

$$1 \text{ u} = 931,494 \text{ MeV}/c^2$$

: -3

.  $\Delta m$

$$\Delta m = [Z \cdot m(p) + (A - Z) \cdot m(n)] - m\left({}_Z^A X\right)$$

.  $\Delta m$



$$N = A - Z = 4 \quad Z = 3$$

$$m({}^7_3\text{Li}) = 7,01435\text{u}$$

$$\Delta m = [3m(p) + 4m(n)] - m({}^7_3\text{Li})$$

$$\Delta m = 3 \cdot 1,00727 + 4 \cdot 1,008674 - 7,01435 = 4,212 \cdot 10^{-2}\text{u}$$



$$E_\ell = \Delta mc^2 > 0$$

$$E_\ell = \Delta mc^2 = \left[ [Zm_p + (A - Z)m_n] - m({}^A_Z\text{X}) \right] c^2$$

-4

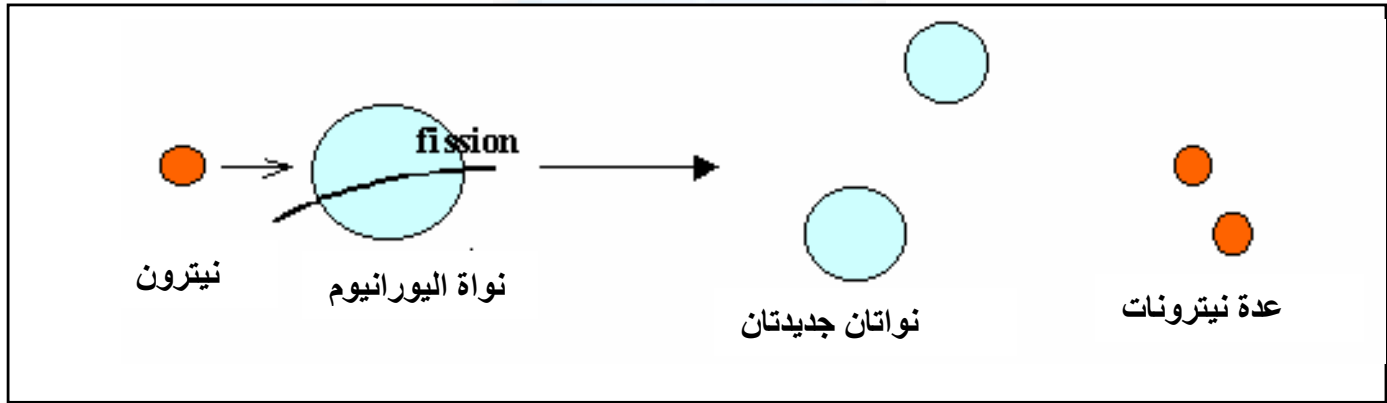
$$A \quad E_\ell$$

$$\cdot \text{MeV} \quad \frac{E_\ell}{A}$$

$$\frac{E_\ell}{A} = \frac{28,26}{4} = 7,065\text{MeV} \quad 4$$

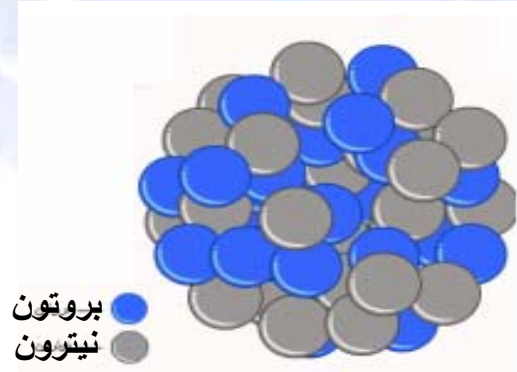
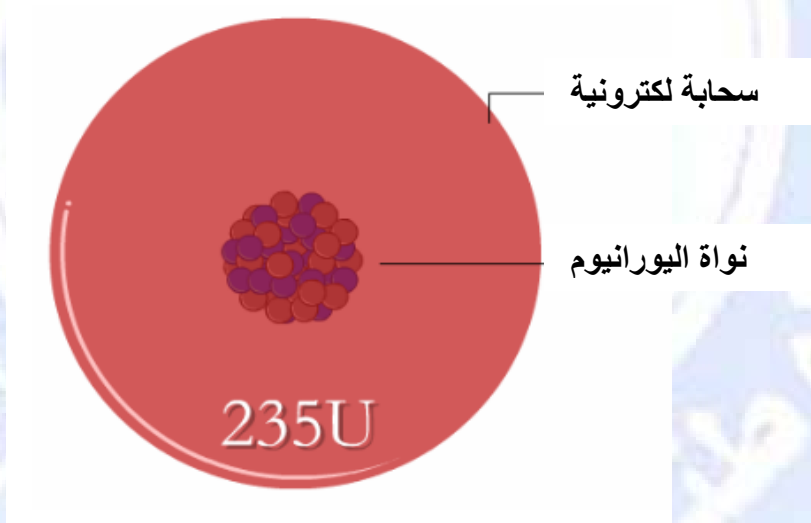
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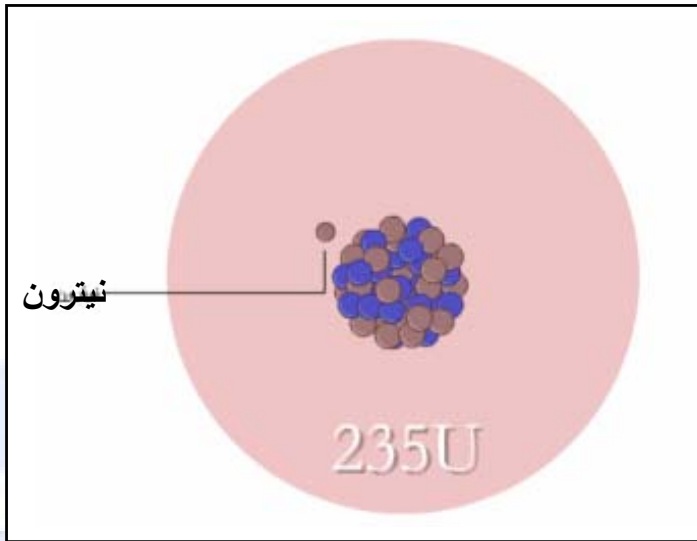
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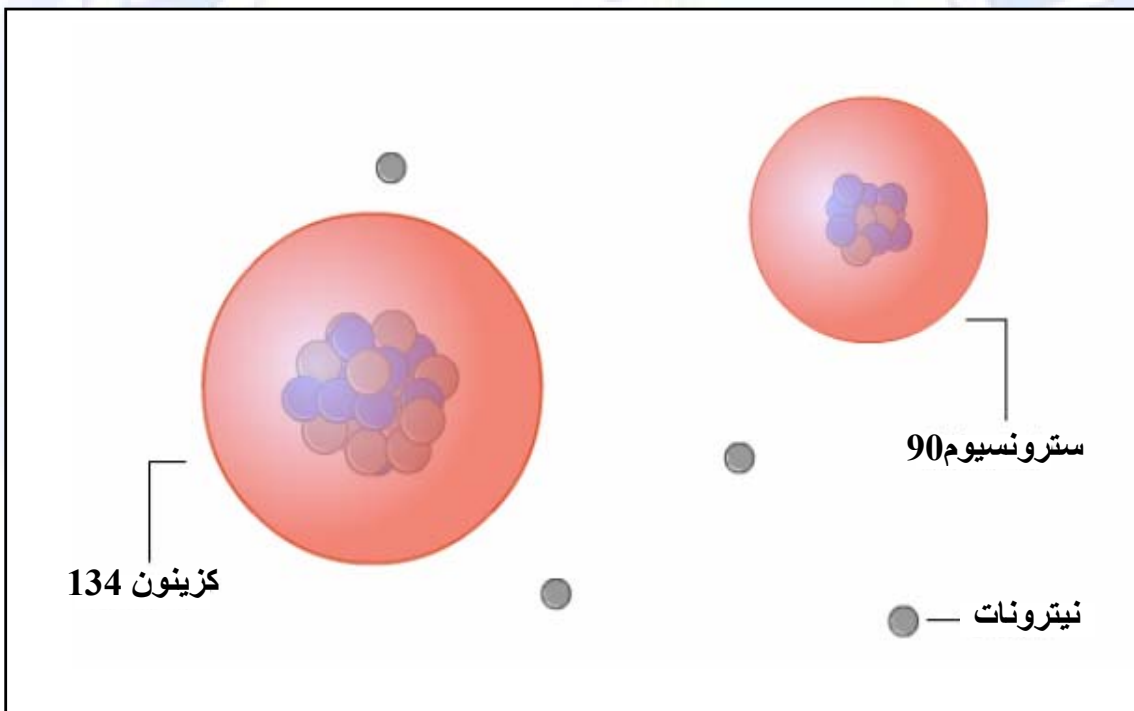
235

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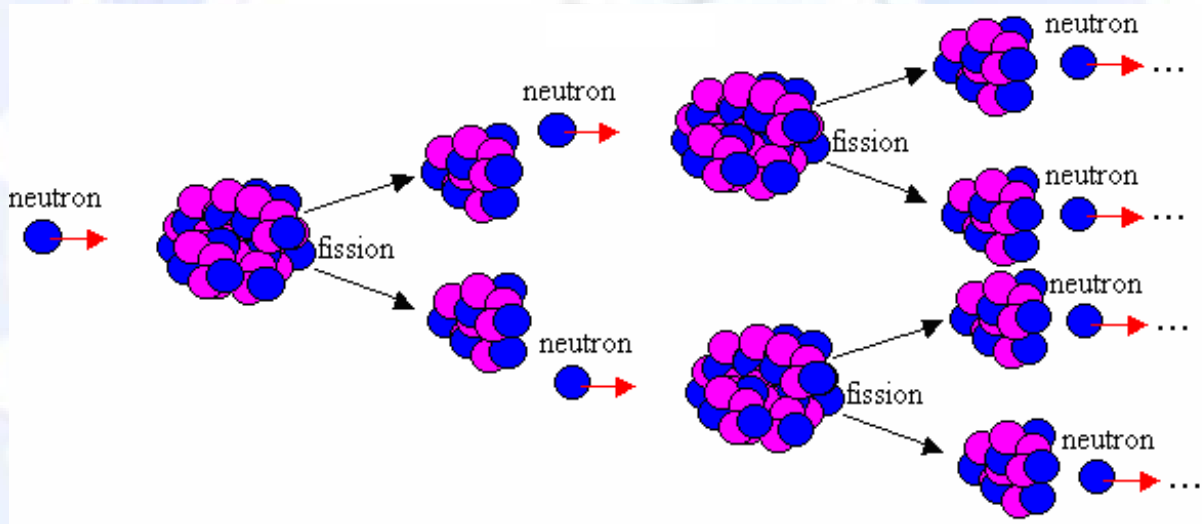
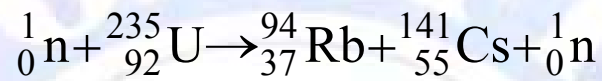
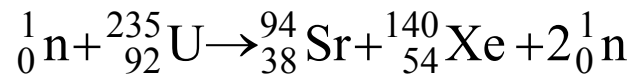




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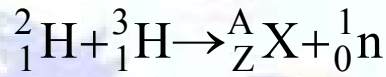
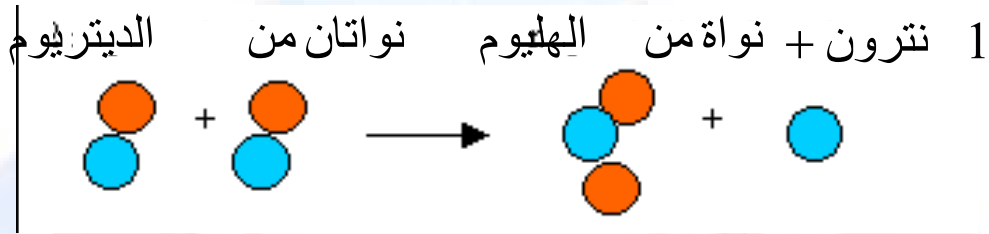


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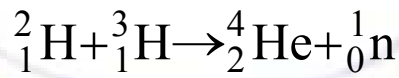
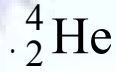


محطة نووية لإنتاج الطاقة الكهربائية

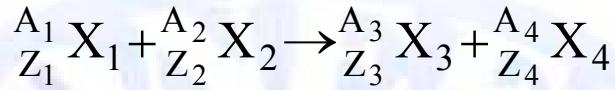
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$$\begin{aligned} A &= 4 & 2 + 3 &= A + 1 \\ Z &= 2 & 1 + 1 &= Z + 0 \end{aligned}$$



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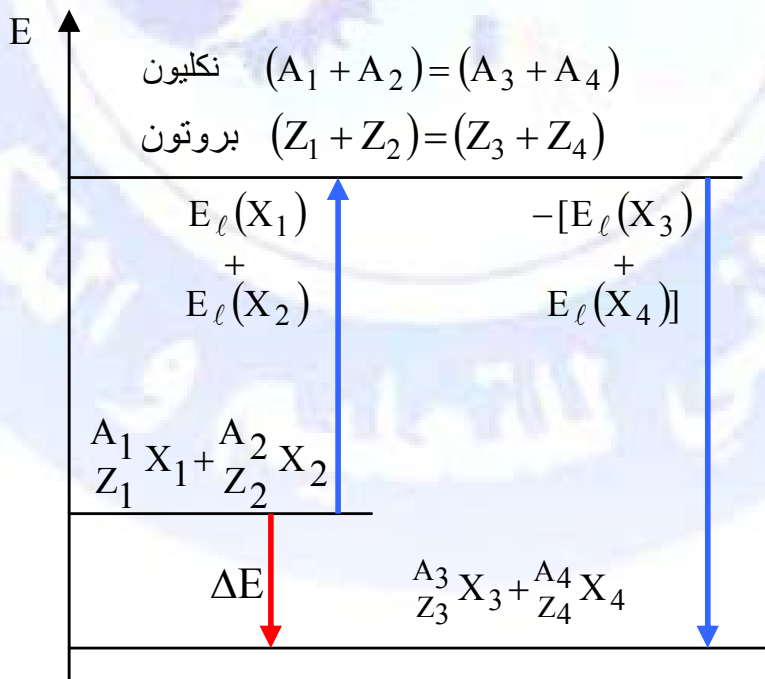
:  $\Delta E$

$$\Delta E = [E_\ell(X_1) + E_\ell(X_2)] - [E_\ell(X_3) + E_\ell(X_4)]$$

$$\Delta E = [m(X_3) + m(X_4) - m(X_1) - m(X_2)]c^2$$

$$\Delta E = E_{\text{نواتج}} - E_{\text{متفاعلات}} = (m_{\text{نواتج}} - m_{\text{متفاعلات}})c^2$$

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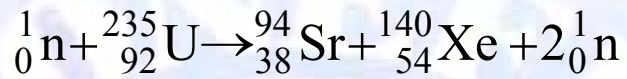
$$\Delta E < 0$$

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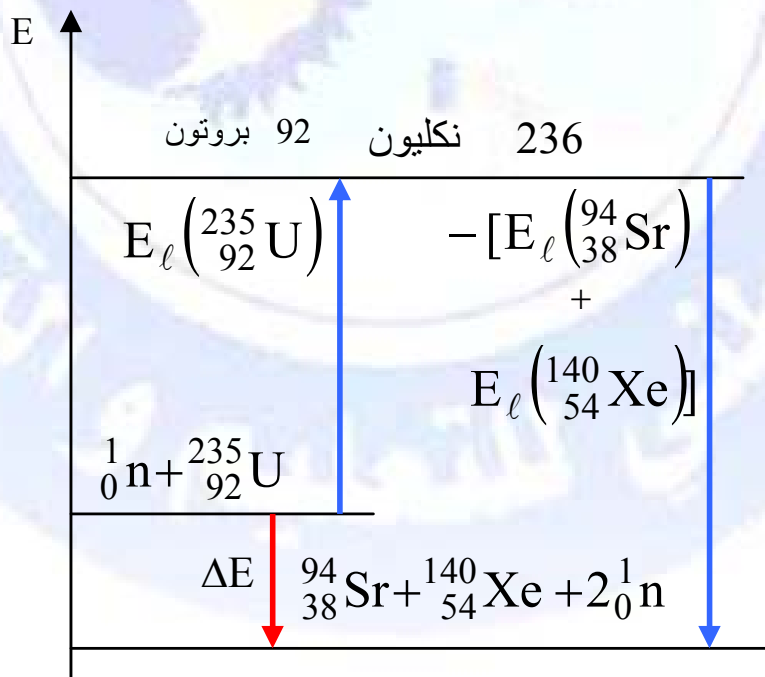
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$$\Delta E = [2m_n + m({}_{54}^{140}\text{Xe}) + m({}_{38}^{94}\text{Sr}) - m({}_{92}^{235}\text{U}) - m_n]c^2$$

$$\Delta E = [m_n + m({}_{54}^{140}\text{Xe}) + m({}_{38}^{94}\text{Sr}) - m({}_{92}^{235}\text{U})]c^2$$

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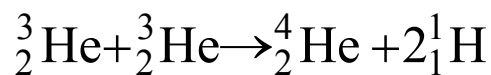


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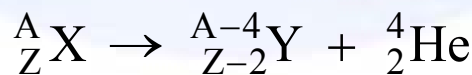
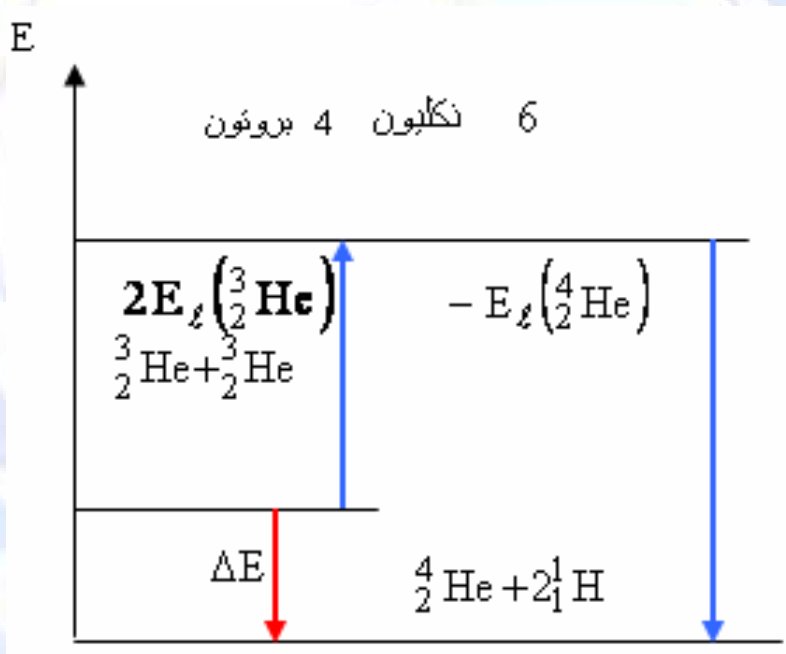
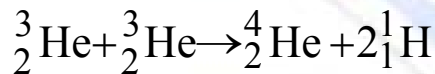
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$$\Delta E = [2m({}_1^1\text{H}) + m({}_2^4\text{He}) - 2m({}_2^3\text{He})]c^2$$

$$m({}_2^3\text{He}) = 3,0149\text{u}; m({}_2^4\text{He}) = 4,0015\text{u}; m({}_1^1\text{H}) = 1,0073\text{u}$$

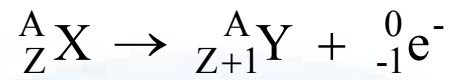
$$\Delta E = -12,8 \text{ MeV}$$



$$\Delta E = [m({}_{Z-2}^{A-4}\text{Y}) + m({}_2^4\text{He}) - m({}_Z^A\text{X})]c^2$$

-  $\beta^-$

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$$\Delta E = [m({}^A_{Z+1} Y) + m_e - m({}^A_Z X)]c^2$$

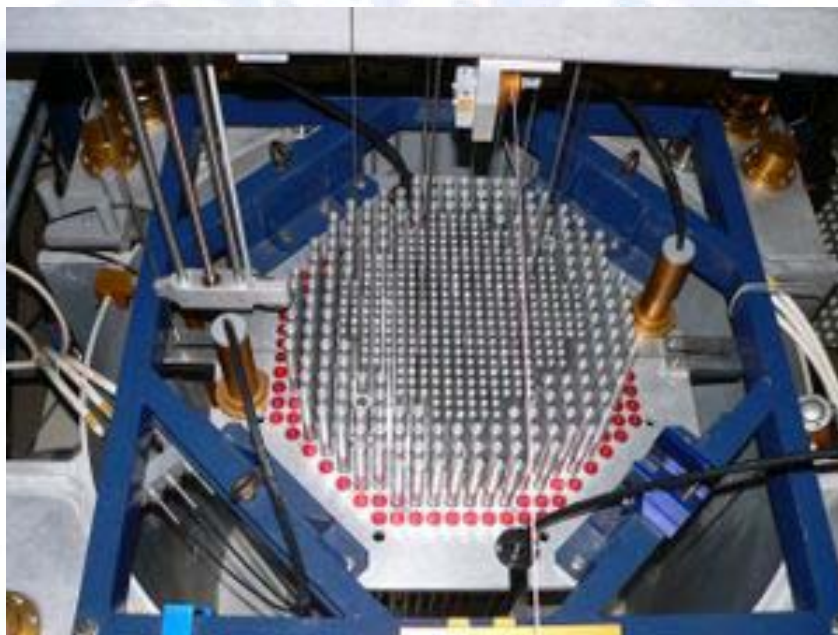
-  $\beta^+$

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$$\Delta E = [m({}^A_{Z-1} Y) + m_e - m({}^A_Z X)]c^2$$



CROCUS

1942

34

6

Léo Szilard

Enrico Fermi

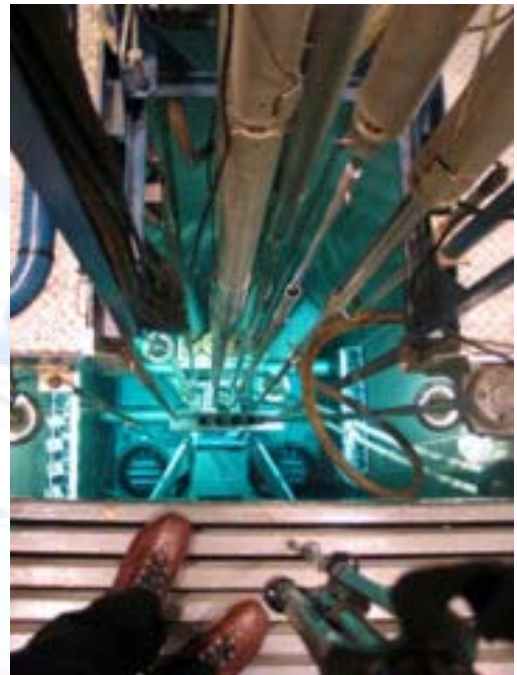
400

448

Three Miles

Island





(Pu-239 U-235)  
( Pu-240 U-236 )





غواصة نووية

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- إنتاج نيوترونات حرة و نظائر مشعة للإستعمال في البحث.

