Advancements in Power

Fission - Fusion

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Fusion News

1. **French scientists recently achieved a groundbreaking milestone in nuclear fusion research**
2. Using the WEST tokamak reactor, **they sustained hydrogen plasma for over 22 minutes**—a record-breaking duration.
3. This experiment involved
   - A. maintaining plasma at extreme temperatures
   - B. Two megawatts of heating power
   - C. Showcasing advancements in fusion
   - D. stability Technology achievement is a significant step toward practical fusion energy, as it demonstrates the ability to control and sustain plasma for extended periods.
4. The data collected will contribute to the development of the International Thermonuclear Experimental Reactor (ITER), a global fusion project being built in France.
5. Fusion energy holds the promise of clean, nearly unlimited power, and this milestone brings us closer to realizing that vision.

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Fission vs Fusion

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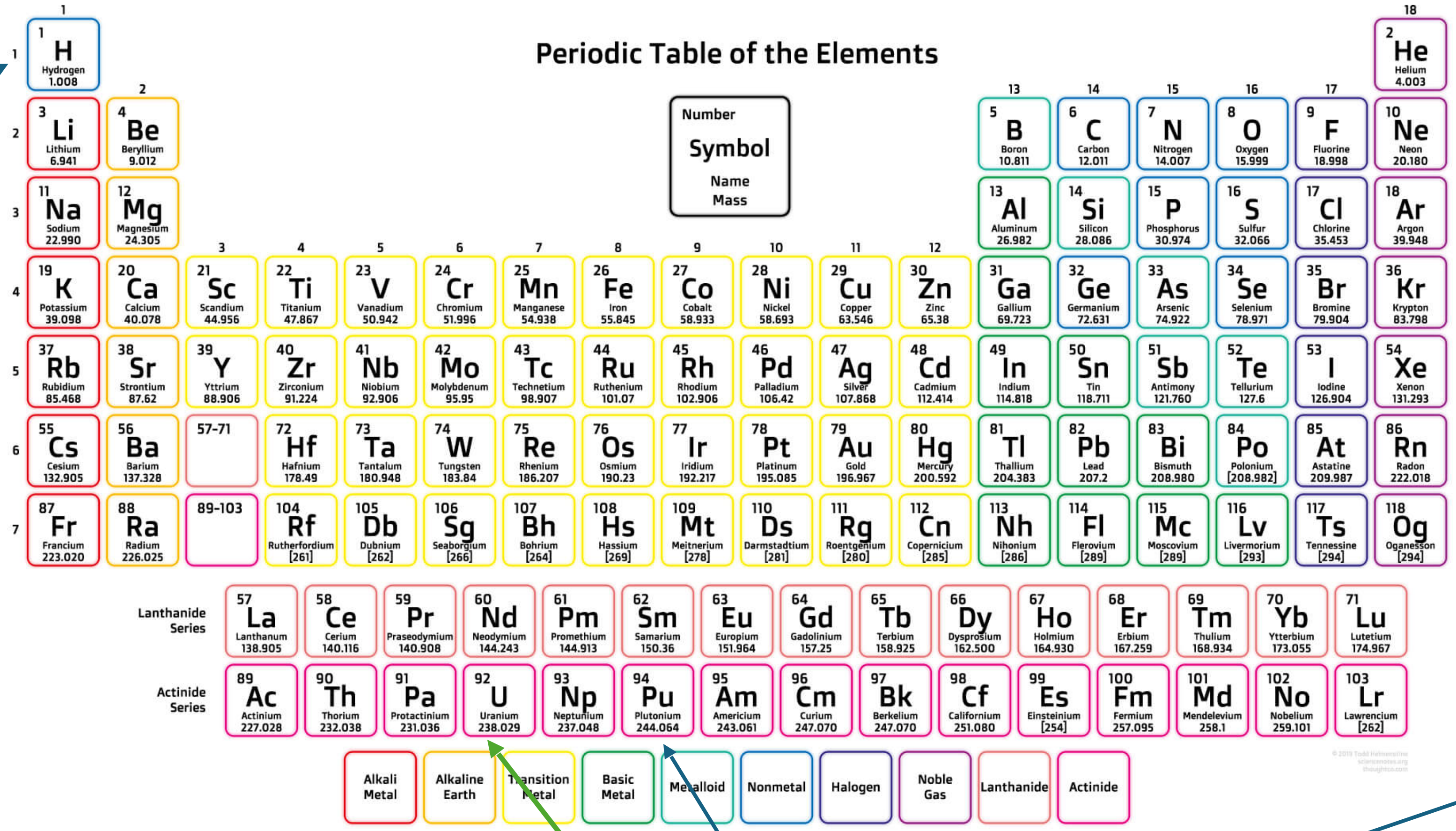
- Nuclear fission and fusion are two processes that release energy by altering atomic nuclei, but they operate differently.
- **Fission** splits heavy nuclei (like uranium or plutonium) into smaller ones, releasing energy, neutrons, and **radioactive byproducts**. It's used in nuclear power plants and atomic bombs.
- **Fusion**, on the other hand, combines light nuclei (like hydrogen isotopes) to form a heavier nucleus, **releasing massive energy** with **minimal radioactive waste**. Fusion powers stars, including the Sun.
- While fission is currently more practical for energy generation, fusion promises cleaner and virtually limitless energy, though it's still in experimental stages due to the high energy input required.

Fusion Vs. Fission

Fusion
Combining
Light
elements
H
Isotopes
2H
3H



Periodic Table of the Elements

Number
Symbol
Name
Mass

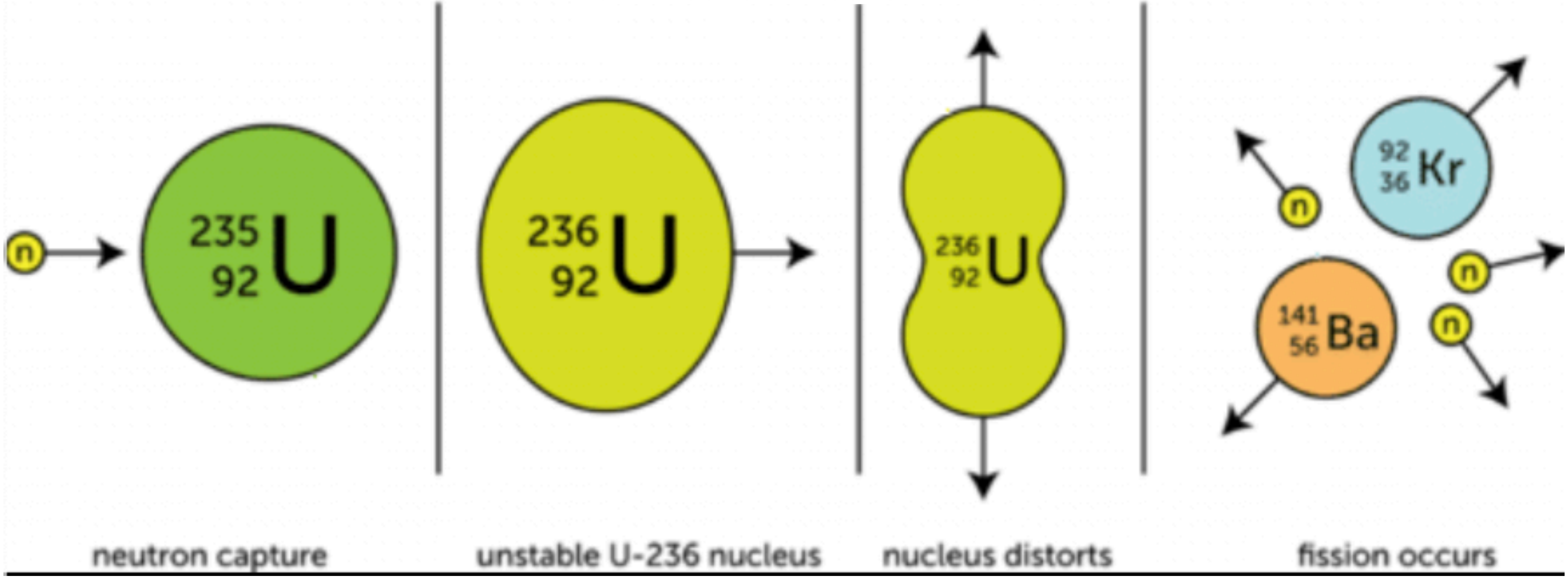
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.008																	2 He Helium 4.003
2	3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.798
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.293
6	55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
7	87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]

Lanthanide Series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

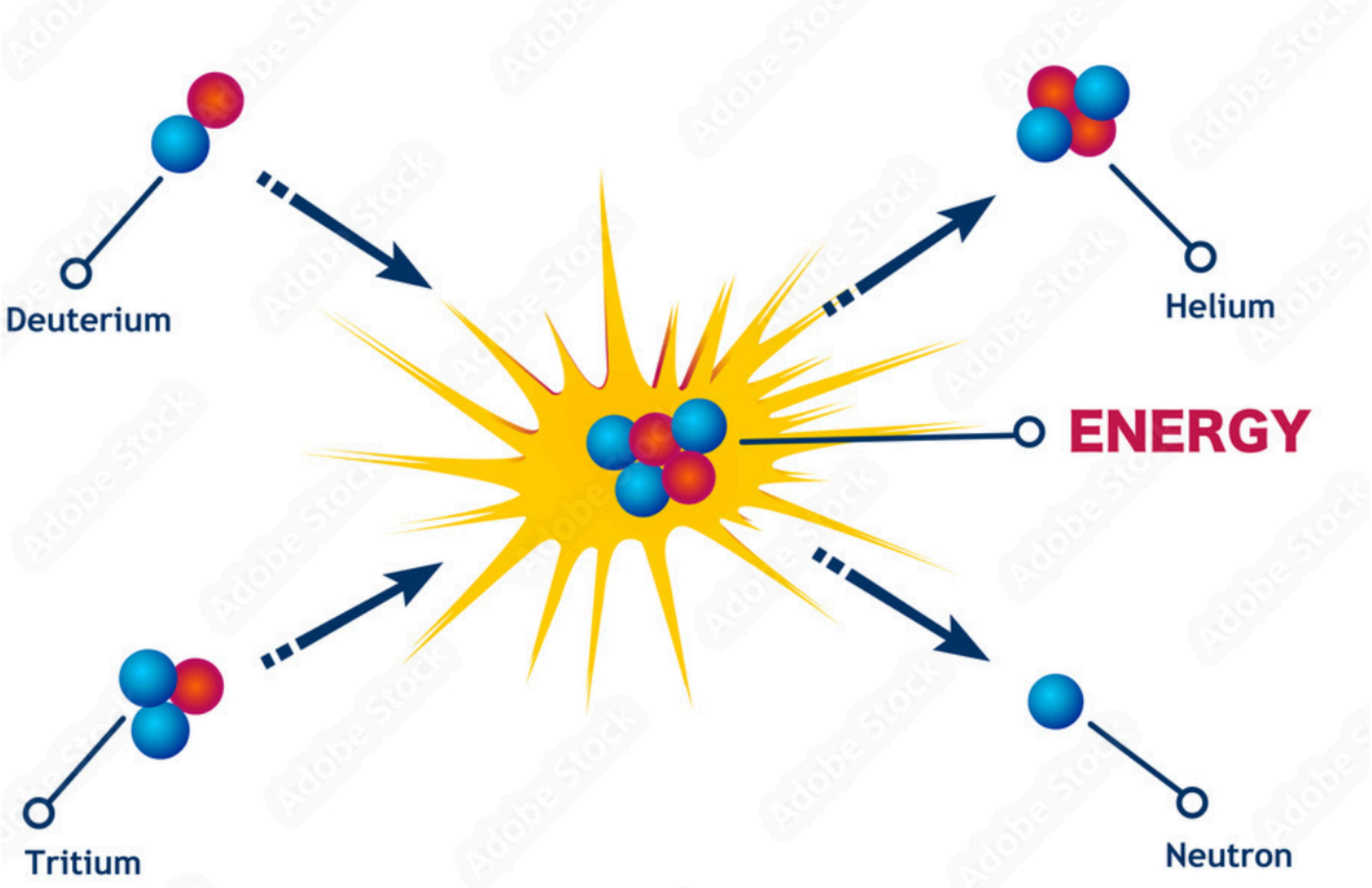
Alkali Metal | Alkaline Earth | Transition Metal | Basic Metal | Metalloid | Nonmetal | Halogen | Noble Gas | Lanthanide | Actinide

Fission
Splits
Uranium
Plutonium

Nuclear Fission

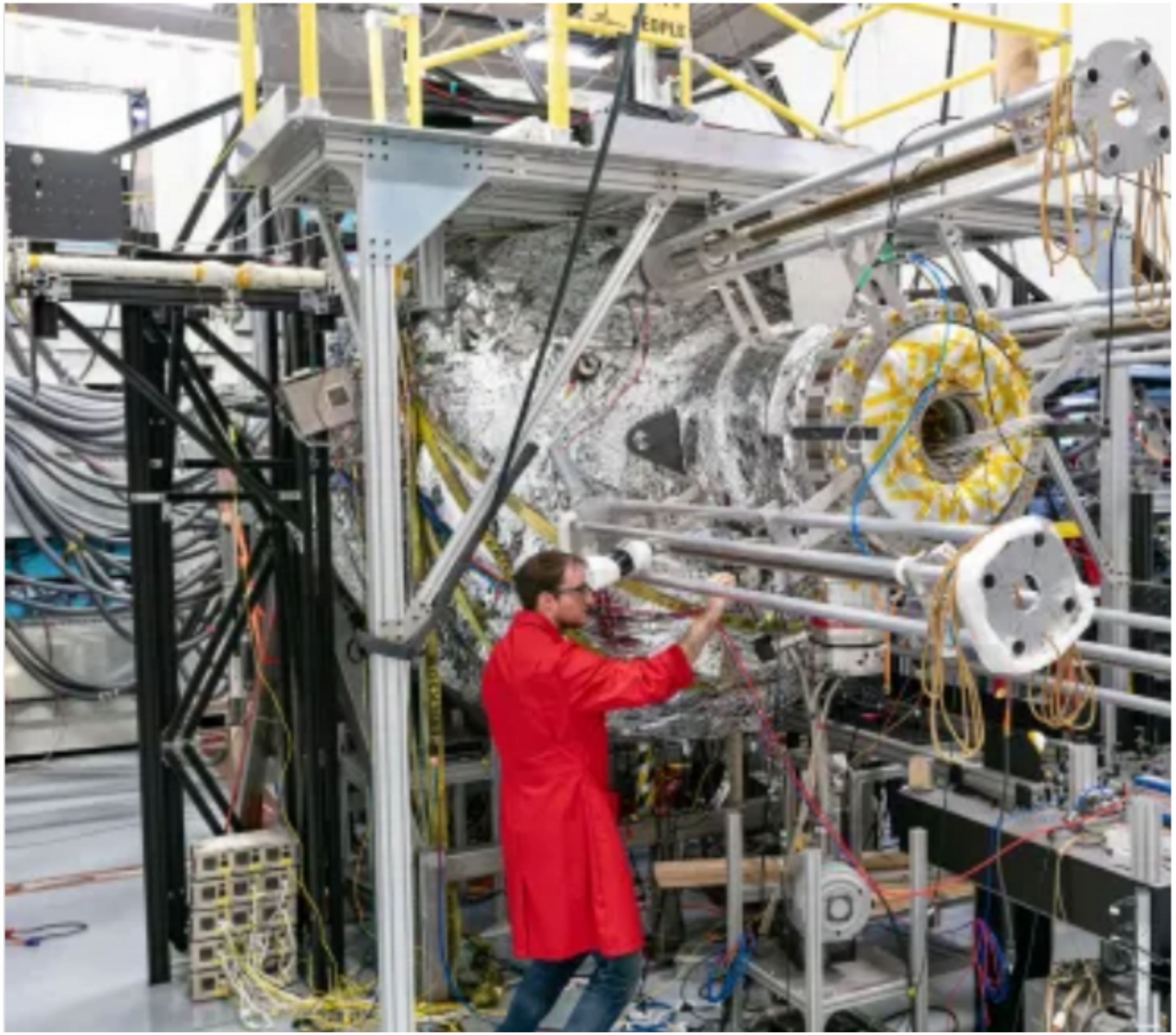


Nuclear Fusion



Fusion

You need all this equipment to pull the energy from water



Sustaining a fusion reaction for 22 minutes is a remarkable scientific achievement, as it requires overcoming numerous challenges. Here's an explanation of how this is accomplished:

1. **High Temperatures:** Fusion reactions occur when atomic nuclei collide and fuse, releasing energy. To achieve this, plasma—the hot, charged gas where fusion occurs—must reach temperatures of millions of degrees Celsius, mimicking the conditions at the core of stars.
2. **Magnetic Confinement:** The plasma must be contained and prevented from touching the walls of the reactor, as contact would cool the plasma and damage the reactor. Powerful magnetic fields, created using devices like tokamaks or stellarators, confine and stabilize the plasma in a toroidal (doughnut-shaped) configuration.
3. **Plasma Stability:** Maintaining plasma stability is crucial to keep the reaction running. Scientists use advanced control systems and techniques to minimize instabilities and turbulence that could disrupt the plasma.
4. **Fuel Supply:** Fusion typically involves isotopes of hydrogen, such as deuterium and tritium. These fuels must be steadily injected into the reactor to sustain the reaction while maintaining the right balance to optimize energy output.
5. **Heat Management:** Fusion produces immense heat, and systems must be in place to manage and utilize this heat effectively. Divertors and cooling systems help remove excess heat without disrupting the plasma.
6. **Energy Input vs. Output:** To keep the fusion reaction running, the energy input must support the conditions for fusion without exceeding the energy generated. Recent advancements have brought researchers closer to achieving "net energy gain," where the reaction produces more energy than it consumes.

The achievement of sustaining a fusion reaction for 22 minutes marks significant progress toward making fusion a viable energy source.

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