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PROJECT OF A NATURAL URANIUM MOLTEN-SALT REACTOR WITH AN EXTERNAL SOURCE OF THERMONUCLEAR NEUTRONS FROM A PLASMA COMPACT TORUS COLLIDER ^{*)}

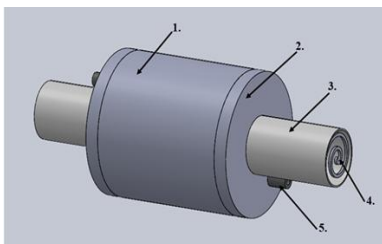
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The operation of conventional nuclear reactors is based on the ability to chain react when uranium 235 is fissioned by slow neutrons, which has sometimes led to well-known disasters. Natural uranium 238 is fissioned by fast neutrons (more than 1 MeV) produced by thermonuclear fusion with the release of another 200 MeV of energy, without a chain, self-sustaining reaction. To obtain 10 MJ in a single pulse from the fission of U 238, 100 kJ or $2.5 \cdot 10^{17}$ fast neutrons are needed (excluding secondary neutrons from fission). The thermonuclear reaction itself has a gain of the order of hundreds - 10 keV deuterium nuclei during fusion give from 2.45 MeV. In the USA, magnetic confinement is no longer the most promising path to large-scale thermonuclear energy [1]. The most promising direction is compact torus colliders (CT) or FRC-field Reversed Configuration - a plasmoid with a closed current loop with the required composition and mass (micrograms) is accelerated by external magnetic fields and collides with another one flying towards the opposite direction. With the same current directions, CTs are attracted and all kinetic energy goes to heating the plasma with the implementation of a thermonuclear reaction.

American companies Helion Energy and Tri Alpha Energy attracted about \$ 2 billion, (including 50 million from Rusnano). Helion has even signed contracts with Microsoft and America's largest steel company Nucor to supply 500 (!) MW reactors in 2028.

The "Know How Ltd " firm at the Lebedev Physical Institute is conducting experiments that have confirmed the possibility of achieving "breakeven" at compact torus colliders: - two plasmoids accelerated towards each other produced a plasma temperature of over 1 keV at the collision site and a soft X-ray duration of about one microsecond, which is similar to the duration of a nuclear explosion.



1 - the molten salt reactor body, 2 - its covers, 3 - a compact torus collider with a neutron yield of 10^{16} per pulse, 4 - an inductive storage unit of the compact torus formation section, 5 - inlet and outlet pipes for uranium-238 molten salts. In a molten salt reactor, the fuel is also the coolant.

It is necessary to create a consortium of Rosatom, the Ministry of Education and Science, Roscosmos, Rostec, Skolkovo, private investors and friendly countries for the fastest possible implementation of the technology and with the prospect of subsequently submitting a joint application to VEB RF or the Direct Investment Fund. A similar association has been created in the USA. Private companies engaged in thermonuclear research have already attracted more than \$ 7 billion. <https://www.fusionindustryassociation.org/>

References

- [1]. [The Current U.S. Approach to Fusion, <https://scsp222.substack.com/p/the-current-us-approach-to-fusion> , SEP 19, 2024

^{*)} [abstracts of this report in Russian](#)