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FUTURE SUCCESS IN FUSION LIES WITH FRCS COLLIDERS (REVIEW OF TECHNOLOGIES AND COMPANIES) ^{*)}

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The axisymmetric configuration of a closed loop with a current in the plasma is called a compact torus or FRC - Field Reversed Configuration. Tori can be accelerated and compressed by magnetic fields. Currently, a new experimental platform for FRC research is being created at the US National Laboratory at Los Alamos. Well-known private American companies are Tri Alpha Energy (more than \$1.2 billion has been raised, of which 50 million from Rusnano) and Helion Energy - the latter even announced in 2024 that it will supply energy to the network from its new Polaris thermonuclear collider (invested in 2021). \$570 million, with an additional \$1.2 billion committed, lead investor Sam Altman, Elon Musk's Open AI partner, contracted with Microsoft to deliver first reactor in 2028). America's largest steel company Nucor also signed a contract with Helion Energy for \$35 million. Private companies in the world engaged in thermonuclear research have already raised more than \$6 billion. China, Japan, England, and Germany are also conducting research in this area. The Russian Rosatom RTTN program "Development of equipment, technologies and scientific research in the field of use of atomic energy in the Russian Federation" (33.375 billion rubles) provides for the construction of a second plasma accelerator at TRINITY to create a collider of two plasmoids. Work is also carried out at the Lebedev Physical Institute together with I Know How Ltd. A new method for forming compact tori in inductive energy storage devices was proposed and patented [1]. This method showed high efficiency in converting the magnetic energy of the storage device - up to 70 percent of the stored energy is transferred to the plasmoid, the current reached several tens of kiloamperes with a plasmoid diameter of 30 cm, and its speed was 40 km/sec. Two plasmoids accelerated towards each other produced a plasma temperature of more than 1 keV at the collision site and a duration of soft X-ray radiation of about one microsecond, which is three orders of magnitude longer than the duration of such radiation in installations with a Z, X-pinch and a plasma focus [2]. This shows the real possibility of inertial thermonuclear fusion. Multiple acceleration of toroids is also a new type of electric rocket thruster for space. We propose to create a collaboration to carry out research on this topic with the involvement of leading scientific organizations in Russia and friendly countries, as well as investment companies to submit a joint application to the VEB of the Russian Federation (the necessary criterion is 10% of the applicants for the requested funding from 3 billion and for a period of up to 30 years) and/or to the Direct Investment Fund. Rapid modernization of installations can be implemented at VNIIEF, NRC Kurchatov Institute, Novosibirsk Institute of Nuclear Physics, TRINITY, NIIP, FIAN, Tomsk ISE, where there are already experimental installations with quasi-megajoule energy.

References

- [1]. RF Patent No. RU 2523427 Method for forming a compact plasmoid
- [2]. <https://efre2022.hcei.tsc.ru/publication/proceedings.html> (S2-O-043801- FRC collider)

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