
ITER A New Tokomak Type Mini-Sun for Thermo -Nuclear –Plasma Energy

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Abstract:

Tokomak is a device to achieve fusion in a Toroidal chamber when under a heavy magnetic field. The scientists around the world are confident about its high success rate. The word is a brief Russian name of which the full meaning is Toroidal Magnetic Chamber, Russian physicist Lev Andreevich Artsimovich first of all discovered this device in 1968. Lev Andreevich Artsimovich is also called a father of Tokomak research.

With the development of human civilization the demand of energy is increasing at very rapid rate. Energy crisis is a major issue many countries are nowadays are facing. Tokomak is the man made artificial Sun.

With the multilateral collaboration, India with 10% of cost partner in ITER a new Tokomak working hard to construct a mini Sun at Cadarache, France. India hopes to earn large amount of energy out of it in very near future.

Keywords:

Tokomak, toroidal chamber

Theory and Discussion:

In a Tokomak say chamber, experimental gas is first brought to a very low pressure of the order of 10^{-4} torr and then introduced into a Toroidal chamber. The advantage of the Toroidal shape is that it is being endless, the problem of escape of the plasma through does not come into being. Tokomak provides very strong magnetic field to trap very hot Plasma. Very high currents are passed through heavy coils in the toroidal coils. The motion of the charged particle is impeded, thus particle performs helical motion, with magnetic lines of force as the axis. Due to gradient and curvature of magnetic field, positive and negative particles move in opposite directions thus charges separates. The Plasma is driven in the form of electric field.

Hon. Prime minister of India, Narendra Modi accompanied by French president Emmanuel Macron on Wednesday 12th February 2025 visited the international thermo nucleare xperimental

reactor ITER project in Southern France to witness the development of the earth's first mini Sun that aims to produce nuclear energy on an industrial scale through the nuclear fusion process.

Harnessing the powers of nuclear fusion which powers the Sun and stars is the goal of it as the process is a long term option for sustainable energy and non-carbon emitting energy.

India is a key partner in this Global program as it is providing not only 10% of the total cost of the project but also contributing the biggest components, the refrigerator or cryogenic engines that house this unique reactor, which is currently under construction at Cadarache, France and is expected to create its first Plasma in the coming few years.

When it becomes operational, the reactor will produce more energy than is used to initiate its fusion reaction. During the visit, Indian Prime Minister Mr. Modi and Macron appreciated the progress of ITER including the Assembly of the world's largest Tokamak, a machine fusion device where ultimately 5000 megawatt Fusion Power will be produced by creating, containing and controlling burning plasma. They also appreciated the dedication of ITER engineers and scientists working on the project. Press release stated this was the first visit by any heads of state to either

India or France. Nuclear reactor in the French collaboration on cutting edge nuclear Technology, two countries have agreed to jointly develop new generation of advanced nuclear reactor as one of the three nuclear agreements signed during PM Modi's visit to France.

The two countries have decided to partner on building advanced modular reactors and small modular reactor, for civil use. The three MOUs signed including a declaration of intent on establishment of partnership on Advanced modular reactor and small modular reactor renewable between Department of Atomic Energy DAE of India and CAE France, concerning Cooperation with the Global Centre for nuclear energy partnership GCNEP, and an agreement between GCNEP India and Institute for Nuclear Science and Technology, France.

Challenges that are being faced to store hot plasma

Storing a hot Plasma is really a big challenge the scientists of the globe are facing today. To the date, ITER scientists have discovered the plasma cage using plasma mirrors, plasma cavity, where large plasma can be stored, transferred and carried away for its conversion into other forms and for reusability purpose. India has supplied very significant cryogenic engines for this ITER project. Land T Company, based at Ahmedabad, has supplied these useful engines for large scale plasma production...

Result, Discussion and conclusion:

In near future, Plasma is going to play a prominent role in energy creation, energy storage and its supply to the world leaders which are participating in its generation, large scale production, energy storage, supply and transformation into other useful energy types. India would have faced an acute energy crises if India had not have been the part of ITER. Along with the nonconventional energy source like Solar and wind energy Plasma also as an indirect nonconventional energy source will fulfill the energy requirement of India in near future.

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