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Quodons in tokamak fusion reactors

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Abstract— Experiments have shown that alpha particles incident on different materials bring about the generation of *quodons*, that is packets of localized energy that can bind to an electric charge and transport it without the presence of an electric field, a phenomenon called *hyperconductivity*. Tokamak fusion reactors produce a huge amount of alpha particles, transporting energy and charge trough insulators and metals at much more speed that ohmic conduction and heat conductivity. The consequences are still unclear but should be studied and incorporated in reactor designs.

1. Introduction

Current design of fusion tokamak reactors are based in the reaction of deuterium (D or ${}^2_1$H) and tritium (T or ${}^3_1$H) according to the exothermic nuclear reaction:

$${}^2_1\mathrm{H} + {}^3_1\mathrm{H} \rightarrow {}^4_2\mathrm{He}\ (3.5\ \mathrm{MeV}) + {}^1_0\mathrm{n}\ (14\ \mathrm{MeV})$$

The energy carried out by the alpha particles (${}^4_2$He) and neutrons has to be transformed in heat and eventually into electric power, although ITER [1] will just produce heat that has to be evacuated by powerful cryogenic systems. However, both particles also have other intended uses.

Some part of the alpha particles are expected to thermalize producing a *burning* plasma, that is, they would give enough energy to keep the plasma at 150 millions of Kelvin so as the fusion reaction continues. However, a significative part of the alpha particles would escape the plasma and hit the walls of the container.

Most of he neutrons will escape the plasma confinement due to their absence of electric charge and will hit the walls of the plasma container. As tritium is not easy to obtain, these walls will be covered with lithium, either ^{6}Li of ^{7}Li, forming a *breeding blanket*, to breed tritium so it can be reused into the reactor by the nuclear reactions:

$${}^1_0\mathrm{n} + {}^6_3\mathrm{Li} \rightarrow {}^4_2\mathrm{He}\ (2.05\ \mathrm{MeV}) + {}^3_1\mathrm{H}\ (2.75\ \mathrm{MeV})$$

$${}^1_0\mathrm{n} + {}^7_3\mathrm{Li} \rightarrow {}^4_2\mathrm{He} + {}^3_1\mathrm{H} + {}^1_0\mathrm{n}\ (\mathrm{Endothermic})$$

Both ${}^6_3$Li and ${}^7_3$Li are naturally occurring isotopes, ${}^6_3$Li being between 2% and 8% and the rest being ${}^7_3$Li. The breeding blanket should be enriched with ${}^6_3$Li in order to keep the general process exothermic as intended in a nuclear reactor. It is essential that this process is achieved as tritium is not easy to obtain otherwise, so we can predict that many neutrons in the plasma will eventually lead to alpha particles.

2. Results

Recently 5.1 MeV alpha particles from ^{241}Am has been used in experiments of *hyperconductivity*, that is the transport of charge at room temperature in absence of an electric field [2]. The charge is transported by nonlinear excitations called *quodons* that also leave fossil tracks and may carry electric charge [3]. New experimental results [4] of irradiating samples of tantalum and tungsten with alpha particles suggest that each 3.5 MeV hitting a heavy metal would generate at least 10^4 quodons. Their speed of km/s was also measured with time-of-flight experiments.

The conclusion is that many quodons with the capacity of very fast transport energy and charge through metals and insulators will be created with possible unintended consequences for the reactor design as possibly the overwhelming of the cryogenic system. The effect of quodons should be taken into account with the necessary design modifications.

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