Generation of quodons in tokamak fusion reactors

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The quodons are mobile, highly localized, nonlinear excitations created by swift particles colliding with atoms in condensed matter. They behave like very stable nano-scale atomic shock-waves that can propagate great distances in any material and are independent of temperature. They can bond with a positive or negative unit of charge, which enables them to be studied. They are created by energetic individual collisions of swift particles with atoms, as opposed to collective excitation. The ability of quodons to transport charge at near sonic speed over large distances at any temperature suggested use in a hyperconducting cable with an insulating sheath. Irradiation of samples of PTFE with He ions of 5 MeV energy showed hyperconductivity could occur in solid polymers. The near instantaneous drop of current and subsequent rise caused by interrupting irradiation shows the current is not due to progressive build-up of an emf in the sample. They can transport charge in absence of an applied emf in an electrical insulator of very high resistivity. This enabled separation of hyperconduction from conduction currents by use of the triple filter technique.[1] It enabled study of quodons in metals and other materials. New results on the creation of quodons by irradiation of different metals by the products of fusion in tokamak reactors is presented. Quodons will be created in any process involving collisions due to scattering of swift particles propagating through any material. Hence, they will be produced in both nuclear fission and fusion reactors. Their effect in fission reactors is to help anneal radiation damage. In tokamak fusion reactors they will present significant hurdles to achieving commercial electrical generation due to their rapid dispersal of heat throughout the apparatus.[2] This highlights the need to study how to control propagation of quodons.

[1] FM Russell; JFR Archilla; Low Temp. Phys. **48** 1009 (2022)
[2] FM Russell; JFR Archilla; R Witty; JL Más; 2303.07087v1 (2023)