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Research article

Topology of nucleons.

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Abstract

The accepted quark structure of nucleons as composed of three quarks that cannot be extracted free can be interpreted in terms of fractal sets known as lakes of Wada. They are classified as indecomposable continua.

Keywords: Topology, Wada lakes, nucleons, quarks, fractal

1. Introduction

The word atom implies in Greek that it is indestructible. However, experiments showed that it is an aggregate of particles (electrons, protons and neutrons) that can be interpreted in terms of fractal physics [1]. Atomic nuclei,containing the heaviest part of the atom, were shown to be sets of protons and neutrons tightly packed. For a while they seemed to be elementary and structure less (like the electron).Concepts of SU3 and SU5 entered the interpretation of experimental particle physics results and introduced " quarks", (never observed free), three hypothetical subnucleon components with non integer electric charges.A topology bearing similarity to the tripartite and non decomposable characteristic of the quark picture of nucleons is given by the lakes of Wada, topological curiosities which have acquired relevance in connection with fractals and algorithms of chaotic systems.

2. Lakes of Wada.

They are three disjoint connected sets having the same boundary. They were published by Yoneyama [2] in 1917 and attributed to his mentor Takeo Wada. Brouwer [3] also constructed a undecomposable continuum of three sets having a common boundary. Fig.1 is an example constructed by Brouwer. A Wada basin, related to Wada lakes, appears in chaotic systems [4][5]: Every point of a basin of attraction which is also common on the boundary with another basin is also the

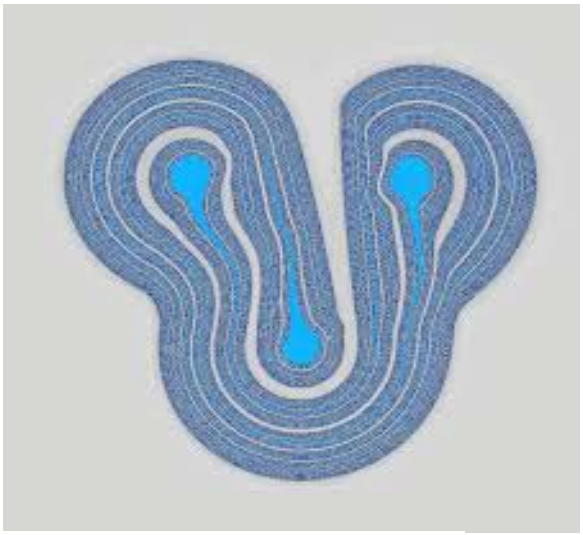

Fig. 1. A Brower's continuum starter set.

boundary of a third basin. A set of three Wada lakes may be obtained by digging contour iterations on a plane [2] carried to infinity. The result is an ensemble of three disjoint open sets with a common boundary. Each neighborhood of a point within the boundary has components of the three initial sets. A generalization starting from a disk and subsequently inducing a rotation of it (preserving the properties), yields a shape similar to nucleons. A proton or a neutron can thus be considered a set of three Wada lakes (quarks). Its reversal into constituent quarks is thus impossible.

3. Concluding remarks.

Often general topology [6] allows to grasp physical phenomena which seem beyond reason. Every neighborhood within a nucleon contains elements of its constituent quarks but they cannot be separated.

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