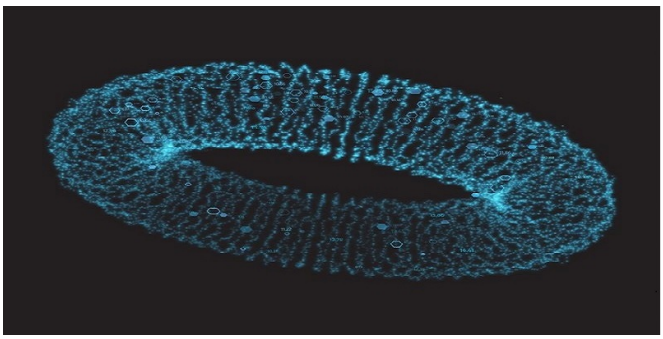
Charge clusters

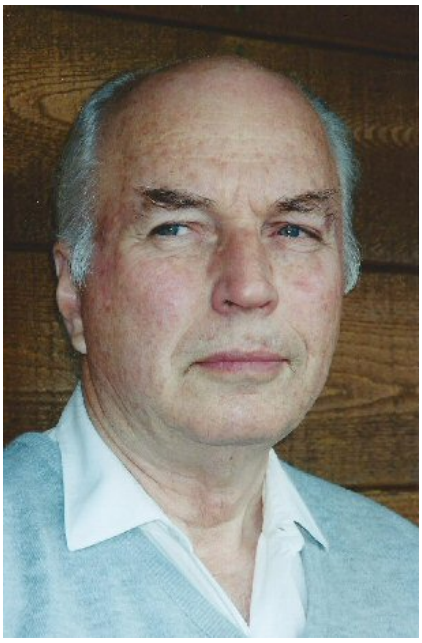
Round the end of the 20th century, US scientist Ken Shoulders created a very original electronic device, on which he conducted experiments by sending ultra-short high-voltage impulses. He observed the creation of uncommon localized charges (spherical form and hollow, with a diameter typically between 5 and 15 µm), made of an accumulation of 10^8 - 10^{11} electrons. Ken Shoulders called these charge accumulations « Electrum Validum » (« strong electron »), while their contemporary name is « Charge clusters » (or “Condensed Plasmoids”). He studied their behavior, lifetime, interactions with various metals, etc.



To our opinion, Ken Shoulders made a great discovery in the field of high-voltage electrophysics, while several other authors developed theories and wrote various publications about these exotic objects.

This section is providing a selection of publications by Ken Shoulders, by our Chief scientific advisor Vladimir Sapogin, and some other publications, describing the Charges Clusters, so our readers can better understand those physical objects, which are deeply involved in FREEL TECH’s innovative energy storage technology.

Publications by K. Shoulders



Kenneth Radford SHOULDERS

Kenneth Radford Shoulders (March 7, 1927 – June 7, 2013) was a experimental physicist.
He is known for various work related to the field of energy and has also been credited as an early pioneer of electron beam lithography, which has become a key mask-making technology for modern microelectronics.
He has additionally been attributed the title, 'Father of Vacuum of Microelectronics' and been known as a founder of microelectronic field emission devices.
He graduated from North Dallas High School in 1944, then worked at Maganavox Company, Texas Instruments Inc., and Collins Radio Company.
In 1955 – 1958, he worked as Research Staff Member at the MIT.
He joined the Stanford Research Institute (SRI) in Menlo, CA in 1958 as Senior Research Engineer.
In 1968, Ken Shoulders incepted Vertitek Inc., with the intention of building experimental aircraft ; during 20 years, he designed several aircraft and aircraft components, but never managed to successfully commercialize products.

K. Shoulders has conducted extensive research on the charge clusters (EV or EVO) phenomena between the 1980s and 2010s. He was awarded a number of patents over the course of his career.

We recommend also to read the very good biographical article published in Autumn 2016 in the Journal "Distilllations".

Ken Shoulders
EV: A TALE OF DISCOVERY
(Jupiter Technology, Austin TX, 1987)

This is the main monography of K. Shoulders, where he describes how he registered the discovery of charge clusters (which he called « Electrum Validum »), their physical properties, the devices and numerous experimental equipment he developed in order to measure the EV's parameters: quantity of charges in one cluster, lifetime, geometrical form and sizes of craters when they hit titan foils, etc..

Ken and Steve Shoulders
CHARGE CLUSTERS IN ACTION
(Bodega, CA, 1999. p.12)

New energy transformations have been found using highly organized, micron-sized clusters of electrons, or EVs, having soliton behavior, with electron populations on the order of Avogadro's number. When interacted with solid material, these charge clusters perform a low-energy phase transformation type of atomic disruption that liquefies the lattice and propels the material to a high velocity without apparent signs of conventional heating. Evidence will be introduced for the underlying energy production process stemming from the equivalence of an electron-annihilation energy release based on the manipulation of fractional electronic charge. Evidence will also be shown of a low energy nuclear reaction that has produced nuclear transmutations by using a nuclear cluster reaction process.

Ken Shoulders
PERMITTIVITY TRANSITIONS
(Bodega, CA, 2000. p.18)

Highly organized, micron-sized clusters of electrons, or EVs, having soliton behavior, with electron populations on the order of Avogadro's number are represented as the necessary function for modifying the permittivity of space in a downward direction. The state of existence for this entity reduces its expressed charge by many orders of magnitude below that calculated for the same number and volume of uncontained electrons. The EV is shown to exist in at least two distinct modes of charge masking, with one of them, the black EV, being virtually undetectable using sensitive methods.

A form of inertial propulsion will be discussed that arises from the inertial rectification affects available by modulating the state of the EV, thereby the permittivity of space and concomitant inertia or effective mass of material moving through space. It will be shown that the same type of permittivity change through EV modulation can achieve a unidirectional current flow and that this gives rise to methods for generating monopole affects and vector potentials useful for communication outside the usual current loop generating them.

Complex organisms are discussed composed entirely of EV structures that are self-formed at electronic rates without using either mechanical or chemical methods. Some speculations will be made on the benefits of operating such complex entities in regions of greatly reduced permittivity.

A condensed matter dissolution technique will be shown that is capable of cold dissociation of refractory material into a low viscosity fluid. The root process for energy conversion methods resembling “cold fusion” are reviewed and shown to likely spring from the same EV technology capable of producing a modified space permittivity. Consideration will be given to experimental methods for testing affects on time at greatly reduced levels of permittivity.

Ken Shoulders
WHAT'S AN EVO ?

An EVO (exotic vacuum object) is just another name in a long line of names for a new electronic effect. In the past, it has been called an EV (Electromagnetic Vortex or Electrum Validum for strong electron), charge cluster (this could be just a piece of dirt with no net charge) and CCT for charge cluster technology. Whatever it is called, the effect can best be characterized by how it is measured using instruments capable of interpenetration in terms of somewhat similar phenomenon. We will assemble a series of observations characterizing the observable entity properties that are most pertinent to new energy and propulsion uses. This note by Ken Shoulders is an attempt to analyze the actions and basic characteristics of the entity while being as free as possible of preconceived notions about its structure.

Ken Shoulders
EVO LIFE CYCLE
(2006)

An EVO, or Exotic Vacuum Object, begins its life by accreting electrons extracted from gaseous or solid atoms. It then self-transforms into a coherent structure behaving as an entity functioning at greatly reduced expressed charge compared to the number of electrons either put into it or extracted from it at this stage in its life.
This note will present main features about EVOs’ behavior.

Ken Shoulders
BASIC EVO QUESTIONS
(2008)

Very interesting and straight-forward answers by K. Shoulders about natural questions which may be asked about the EVOs.

Publications by V.G. Sapogin

Vladimir Georgievich SAPOGIN

Vladimir G. SAPOGIN (born in 1945 is PhD in Physics and Mathematics, as well as Professor at the Chair of Physics of the Taganrog Technological Institute (depends on the Southern Federal University of the Russian Federation).

He is also Professor at the Russian Academy of Natural Sciences, worked several years on the ball lighting phenomenon (another form of “charge cluster”) and knows also well Ken Shoulders’ works.

Vladimir Sapogin is the Scientific Senior Fellow of FREEL TECH’s team and has built various physical models with respect to the electron emission of cathodes in various conditions, and for the calculation of the storage potential of some of the Vacuum Capacitor’s prototypes developed by our team.

Personal website:
http://inep.sfedu.ru/chairs/physics/physics-staff/physics-sapogin/

Main articles of V.G. Sapogin that we would like to recommend are :

V.G. Sapogin
KEN SHOULDERS’ CHARGE CLUSTERS (Physical aspects of the phenomenon) - *In Russian*
(Taganrog Radio-Technical University, 2019)

In the note the physical aspect of experimental discovery of charge cluster of Ken Shoulders in 1987 and its influence at the process of break-through development of various fields of physical knowledge domains is discussed. There are following: 1) the technologies of creation of microscopic auto-electronic cathodes for vacuum diodes, triodes and tetrodes, and effective charge integrators of new generation; 2) the self-consistent theories, which explain the reasons of field’s holding of similar charges and distribution of their physical quantities in the cluster; 3) the researches of new class of cluster’s reactions, appearing under interaction of charge clusters with metal’s crystal lattice; 4) the effects of holding of charges at the surface of conductor in high-voltage electro-physics. The comments to the works of Shoulders, expanding the

terminology of new knowledge division by the name of “charge clusters” have been cited. The repercussions of the latest “revolutionary in physics” are discussed and the set of experiences, which have no adequate explanations, are adduced.

V.G. Sapogin
MONOGRAPH "MECHANISMS OF SUBSTANCE CONFINEMENT BY SELF-CONSISTENT FIELD" - *In Russian*
(Taganrog: edited by the Taganrog Radio-Technical University, 2000)

This work underlines the discovered ability of a self-consistent field to maintain identical particles accumulated in a limited volume of space. In these accumulations, Bernoulli force compensates the Newton attraction force, and in accumulations of identical charged particles it compensates the Coulomb repulsive force.
These spherical accumulations are usually hollow in their centers.
Hollow micrometric charge clusters have been discovered in experiments by the US scientist Ken Shoulders (Bodega, 1980).

ADDITIONAL PUBLICATIONS OF V.G. SAPOGIN

Vladimir SAPOGIN also published several works about the theory of charge clusters (mainly in Russian) :

- **COLLECTIVE INTERACTION OF CHARGES WITH SELF-CONSISTENT FIELD OF PLANE SYMMETRY**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1994, N° 3, pp. 49−59)
- **COLLECTIVE INTERACTION OF RELATIVISTIC CHARGES WITH A SELF-CONSISTENT FIELD OF PLANE SYMMETRY. PART I - CAPTURED STATES WITH POSITIVE TOTAL PRESURE.**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1995, N° 4, pp. 34−39).
- **COLLECTIVE INTERACTION OF RELATIVISTIC CHARGES WITH A SELF-CONSISTENT FIELD OF PLANE SYMMETRY. PART II. CAPTURED STATES WITH ZERO TOTAL PRESSURE.**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1996, N° 1, pp. 31−32).
- **COLLECTIVE INTERACTION OF RELATIVISTIC CHARGES WITH A SELF-CONSISTENT FIELD OF PLANE SYMMETRY. PART III - TRANSIT STATES WITH NEGATIVE TOTAL PRESSURE.**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1996, N° 2, pp. 25−29).
- **PLANE SYMMETRIC SELF-CONSISTENT HAMILTONIAN SYSTEMS OF SIMILAR CHARGES IN EQUILIBRIUM**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1996, N° 4, pp. 63−68).
- **INTEGRAL OF MOTION AND DUAL-FLUX STATES IN PLANE VIRTUAL CATHODE**
  (Taganrog Institute of Radio Engineering, 1992. 25 p. Deposited by All-Russian Institute of Scientific and Technical Information, N° 118-B92. 10.01.92)
- **PRESSURE INTEGRAL AND STATIONARY STATES OF PLANE SELF-CONSISTENT FIELDS OF MONO-ENERGETIC CATHODE WITH NONRELATIVISTIC CHARGES**

(Taganrog Institute of Radio Engineering, 1993. 19 p. Deposited by All-Russian Institute of Scientific and Technical Information, N° 2622-B93. 20.10.93)

- **POLYTROPIC EQUILIBRIUM OF SELF-CONSISTENT HAMILTONIAN SYSTEMS OF SIMILAR CHARGES**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 2000, N° 2, pp.46−51)
- **POLYTROPIC EQUILIBRIUM OF SELF-CONSISTENT HAMILTONIAN SYSTEMS OF SIMILAR CHARGES. STATES WITH NON-POSIVE TOTAL PRESSURE.**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 2000, N° 4, pp.53−56)
- **ABOUT MODEL OF SIMILAR CHARGES' BALL LIGHTNING**
  (Izvestiya Vuzov, Severo-Kavkazskii Region, Natural Science, 1999, N° 3, pp.67−70)
- **ISOTHERMAL MODEL OF SIMILAR CHARGES' BALL LIGHTNING**
  (Publication by Taganrog State University of Radio Engineering, 2000, N° 1. pp. 186−191)
- **SPHERICAL CLUSTER OF SIMILAR CHARGES WITH HOMOGENEOUS TEMPERATURE DISTRIBUTION**
  (International Conference « Current problems of solid-state electronics and micro-electronics », Divnomorsk, Russia, September 17−22, 2000)
- **SIMULATION OF SIMILAR CHARGES' DISTRIBUTION IN A SPHERICAL CLUSTER WITH HOMOGENEOUS TEMPERATURE**
  (All-Russian scientific conference “Mathematical modeling in scientific research”, Stavropol, Stavropol State University, Russia, September 27-30, 2000)

Publications by other authors

We highly recommend the article of Lutz Jaitner, who gathered several observations and theories about charge clusters into a single article (the charge clusters are here called “Condensed Plasmoids”) :

Here is an interesting theoretical article about charge clusters :

The Russian Academician Gennady A. Mesyats has developed numerous experiments leading to the observation and characterization of charge clusters in parallel of Ken R. Shoulders.

Other interesting observations of charge clusters and plasmoids, long-living luminous objects in liquid and atmosphere :

Lutz Jaitner
THE PHYSICS OF CONDENSED PLASMOIDS (CPs) AND LOW-ENERGY NUCLEAR REACTIONS (LENR)
(2015 - 2019)

LENR research was puzzled for a long time by the basic questions. To answer them, the author has built a quantum-mechanical model of the nuclear active environment in LENR.

This environment is an ultra-dense plasmoid, i.e. a “condensed plasmoid”. The computed properties of CPs are so exotic, that CPs qualify as a previously unknown aggregation state of matter.
This document is first in describing the properties of CPs, the microscopic evidence of CPs in LENR experiments, how the properties of CPs help explaining a wealth of remarkable findings in LENR experiments, examples of nuclear reaction routes possibly enabled by CPs, the quantum-mechanical model of CPs, the computational results derived from this model, verifiable predictions derived from the theory on CPs and a technology assessment on potential dangers of LENR.

Shang-Xian Jin & Hal Fox
CHARACTERISTICS OF HIGH-DENSITY CHARGE CLUSTER: A THEORETICAL MODEL
(Journal of New Energy. 1996. Vol. 1. No. 4. pp. 5-20)

The model, which could be able to explain the physical reasons of probable charges’ holding in bounded region of space by forces of electromagnetic origin, has been proposed in the work. The system of self-consistent equations for electron plasma, which consists of continuity equation and equation of charged fluid motion, is written. This system has been considered the forces, coupled with electromagnetic fields and pressure gradient. The equations have been supplemented with Maxwell equations. The obtained system of equations is not succeeded in solution. So, it’s supposed that the values of electric and magnetic fields, appearing inside the cluster, by order of values coincide with the values, giving by classic electrodynamics (?). In assumption of homogeneous density profile of electron liquid, rotating in toroid cluster, the equilibrium equation of forces passes into the radial criterion of equilibrium of such electron liquid. The estimations, made on results of experiments of Shoulders, point out on the availability of execution of such equilibrium criterion.

G. A. Mesyats
CATHODE PHENOMENA IN A VACUUM DISCHARGE: THE BREAKDOWN, THE SPARK, AND THE ARC
(Nauka, Moscow, 2000)

Flows of such objects appeared near uneven cathode at explosive thermionic emission.
The fast density of heat energy at cathode’s micro asperities has resulted in explosions of electrons’ flow, being escaped from asperity. These explosions, appeared in overheating area of cathode surface, are like to explosions, ejecting warmed-up material from volcano crater.
The separately formed “volcano micro explosions” and overheating area have been named as “ectons” (the ecton is electron avalanche from metal).
The estimations, followed from experiments, show that ectons eject by bounded portions (clusters), where the quantity of electrons is situated in the range, observed by K. Shoulders.

A. I. Egorov, S. I. Stepanov, G. D. Shabanov
DEMONSTRATION OF BALL LIGHTNING LABORATORY
(Progress in Physical Science, 2004. V. 174. № 1, pp. 107-109)

G.D.Shabanov, B.Yu. Sokolovskiy
Macroscopic separation of charges in a pulsed electric discharge
(Physics of Plasma. 2005. V. 31. №6. pp. 560-566)

The physical properties of high-voltage discharge of capacitor at conducting liquid have been investigated in various works.
At the expense of axial symmetry of electrodes, remote in water, electrical surface discharge with current's radial component at the liquid-air boundary is succeeded in creation of electrical surface discharge with current's radial component at the liquid-air boundary.
The electrons' cluster, holding the current near the surface of liquid, is heated more in areas with major current density.
At the moment of discharge completion, the heated film of charges floats more quickly near the axis of system than at system's periphery.
By virtue of this, a thin luminous film of charges, alike ball lightning, is created. The film comes up and forms thin-wall spherical cluster of electrons with thickness of 0,5 mm, charge value of 10 nano-coulomb, temperature of 103 K, de-excitation time of 0,5 sec and radius by order of 5 cm.

P.I. Golubnichiy , Yu.M. Krutov , S.A. Kamenev, A.N. Cymbalyuk, A.V. Alborov, A.N. Nadobnyh
EXPERIMENTAL RESEARCH OF DYNAMICS OF FORMATION OF LONG-LIVING LUMINOUS OBJECTS IN CONDITIONS, CLOSE TO ORIGINATION OF BALL LIGHTNING IN NATURE (observation) - *In Russian*

The experiments on flowing of high-power pulse of current in distilled water have been executed in the works. The class of long-living luminous objects (LLO), which temperature is in the range of 102 to 103 K, has been discovered. The estimations of density, heat diffusivity, glow power and density of particles in LLO have been made. The values obtained contradict to known data about oxygen, hydrogen and oxy-hydrogen associations. The hypothesis that LLO discovered is aerogel has been suggested. It explains the most of experimental and rated data about properties of luminous objects. However, the question of nature of aerogel's substance remains an open.