1 Introduction

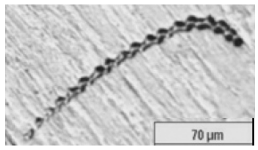
by Lutz Jaitner, October 2015

A plasmoid is a coherent (i.e. self-consistent) structure of a current-carrying plasma and magnetic fields. Plasmoids tend to self-organize their shape and current flow to minimize their energy.

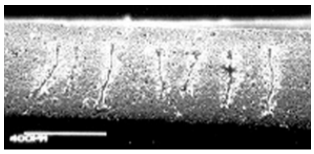
Condensed plasmoids (CP) represent mesoscopic objects of matter. “Mesoscopic” means “in between quantum-mechanical and macroscopic”.

The plasma inside CP…

- Maintains its ionic character quantum-mechanically even at low temperatures, which is leading to a remarkable stability of the CP.
- Is extremely dense along one spatial dimension (much denser than ordinary matter), whereby the wave functions of the electrons and the ions are delocalized along this dimension (*“breakdown of the Born-Oppenheimer approximation”*)
- Carries an *extremely high intrinsic current density of counter-moving electrons and ions*. The current is stabilized via the quantum-mechanical state of the CP (i.e. *electronic relaxation*) and by self-induction
- Is magnetically (Z-pinch) and electrostatically confined, i.e. it is maintaining a self-consistent equilibrium between electromagnetic pressure and thermodynamic pressure
- Is a quasi-one-dimensional conductor with a very low specific resistance
- Self-organizes its shape via its extremely high magneto-static field, electrostatic field and its bidirectional charge transport
- Carries a very large negative total charge due to its *abnormal chemical potential*. The large negative charge polarizes matter surrounding the CP. Attraction by induced charges is responsible for the effect, that the CP tend to move along the surface when slowly coming in contact with a solid body, sometimes leaving tracks like a “crawling caterpillar”



- Can dig tiny bore holes through solid matter by ionizing the matter at the head end and transporting the ionized matter to the other end (outside the hole)



As if these properties were not strange enough, the *CP can cause nuclear fusion* between ions, caused *by lowering the Coulomb barrier* of the ions *via highly effective screening by the electrons.*

The CP has another interesting property: *CP function as a “coolant” to carry away the energy of excited state nuclei without emitting energetic gamma rays*. This works as following: After nuclear fusion occurred, the baryon wave functions of the excited nuclei become time dependent, resulting in oscillating electric and magnetic dipole moments. The electromagnetic near-field of these oscillations couples with the dense charge of the surrounding electron current (velocity modulation). This dampens the baryon oscillations before gamma radiation can occur.

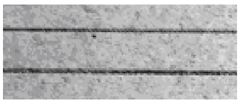
The nuclear energy is thus transformed to charge density fluctuations/oscillations of the electron current (much like in a traveling wave tube). The electron density oscillations couple to the ion current, which after some flight time leads to ion density oscillations and phonon emission. The electron density oscillations also leads to electromagnetic radiations at much lower frequencies (x-ray, etc.) than the frequency of the baryon oscillations (*“quantum down-conversion”*).

When CP catalyze nuclear reactions, some of the energy is released in form of kinetic energy of fission products, such as alpha particles and protons. These particles and the electromagnetic emissions ionize the matter surrounding the CP. With some probability the resulting ions of the matter enter the CP, which increases the current density and size of the CP. In other words, the *CP via nuclear reactions feed themselves in a self-sustainable fashion (“chain reaction”).*

Luckily, the very nature of these plasmoids stops the energy release, when it becomes too rapid. Therefore, this new energy source is impractical for building bombs. When the fusion rate and fusion density is high, the plasma of the CP becomes hot, the plasma pressure increases, leading to a decreased plasma density and plasma instabilities, which tend to destroy the CP.

Forming a CP is endothermic, requiring only small amounts of energy. We are very fortunate (on a small margin, though), that CP don’t represent the ground state of matter, otherwise mother earth would ionize itself.

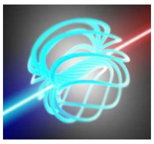
The linear form of CP is magnetically and electrically very unstable. Detached from the electrodes, the linear form of a CP would build up a strong electric dipole emitting electrons at one side and positive ions on the other side. However, the negative end and the positive end of CP attract each other, so that a the plasma wire tends to close itself to form a much more stable ring structure.



CP tend to aggregate with each other in parallel strands, leaving typical rail-like traces on surfaces. The electric currents in these strands flow in the same direction. Therefore the parallel CP are magnetically attracted to each other.

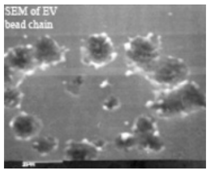
The electrostatic charge of the CP however, keep them at an equilibrium distance to each other: At longer distances the electrostatic fields are screen by ions in the surrounding matter. At shorter distances the negative charges of the CP repel each other.

Due to their magneto-hydrodynamic *kink instability*, a CP quickly forms a thin stretched helix. This helix can wind up in a secondary helix or in more complex patterns. This lowers the energy of the magnetic field a bit at the expense of increasing the electrical potential energy of the negatively charged CP.



The (helical) CP can wind up itself to a spheromaks, i.e. a toroidal filamented plasmoid. The diameter of these spheromaks is in the order of 1 to 10 micrometers. This lowers the energy of the magnetic field substantially by confining it in the plasma torus and squeezing the field lines into small circles. Again, this increases the electrical potential energy of the CP, because it assembles its large negative charge in a smaller area.

When the amount of ions in a CP increases, the spheromaks don't grow beyond a certain limit. Instead they decompose into several smaller spheromaks, which are connected via plasma wires (*"chain of beads"*). The decomposition is driven by the repelling forces of the CP's electrostatic field.



Very large CP are identical to *lightning balls* with all its witnessed attributes.

CP are attracted by magnets, i.e. they behave like ferromagnetic material. CP tend to increase the magnetic **B**-field of adjacent currents by arranging their intrinsic current largely in parallel to the external current (like ferromagnetic material does). CP can maintain their quasi-ferromagnetic behavior well above the Curie temperature of all known ferromagnetic materials.

The deeply penetrating effects of energetic CP can damage all sorts of materials and can be harmful to health. Devices creating CP need to be properly shielded e.g. with sheets of iron/steel. Beware, that plastics is doing just the opposite of shielding: It is easily penetrated by CP and can increase the energy of CP to the degree of hot plasma formation.

CP can both radiate and absorb electromagnetic waves over a broad spectrum, i.e. from radio frequencies to x-rays. The intensity of electromagnetic radiation and charged particle emission of CP can vary by a large scale, depending on the plasma temperature and other conditions. CP can be very luminous to almost dark.

For sustained existence CP must be continuously fed with energy and matter, otherwise they shrink by loosing matter and finally extinguish. There is a minimum size of CP, i.e. they cannot be created or sustained by just a few ions/electrons.

The phenomenon of *CP is ubiquitous*: Electrical discharges (e.g. sparks, arcs, glow discharges), cavitation, LENR devices and ball lightning involve CP.

In bitter irony one can say, that dozens of billion dollars could have been saved on nuclear fusion research, if the reactors had been optimized for low-temperature plasma instead of high temperatures. On the other hand, some of the knowledge of magneto-hydrodynamics gained through hot-fusion research will likely be useful for handling also the other end of the temperature scale.

Since the early days of Irving Langmuir (who discovered excess of heat production in hydrogen plasmas created between tungsten electrodes in 1909), Joseph John ("J.J.") Thomson together with William Ramsay (who created tritium and helium-3 via glow discharge in 1912) [5] and John Tandberg (who discovered Fleischmann/Pons-type cold fusion in 1927) the phenomenon of *CP has been observed a countless number of times*.

It is due to the *transient nature of CP*, that its physics has not been understood by its discoverers. It requires a good quantum-mechanical understanding of CP, to create, stabilize and hold CP experimentally/technically for extended amounts of time. It is the goal of the author to provide this theoretical knowledge in ways acceptable to the common understanding of physics.