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STABLE ATMOSPHERIC PLASMA OVERVIEW

Plasma stability in a gaseous environment is determined by the time during which its body is able to exist after the power source was disconnected and in the absence of strong external magnetic fields. Hence, the initiation phase, in particularly, the methods of initiation play the crucial role in the process. Among the existing technologies, the most popular is perhaps an electric arc, subjected to certain electromagnetic manipulations, aimed at creating favorable magneto dynamics. Other used techniques are foil explosion, capillary plasma injection, etc. Atmospheric pressure, however, alters the experiment significantly, and few descriptions of stable plasma configurations at pressures comparable to atmospheric pressure.

The magnetic component, which causes the plasma body formation, can be either external or produced by the arc itself. An example of the latter was described in [1] and was created in partial atmosphere of 0.1 to 10 Torr (0.013 to 1.31% of atmospheric pressure). A DC discharge was formed between two metal electrodes, and then the electric current was slowly increased, forming a strong Coulomb force, acting on the outer electrons of the arc.

$$F_{containment} = \frac{e^2}{\varepsilon_0 \, k_0 \, d_i^2}$$

where e is aparticle charge, ε_0 is the electric field permeability, k_0 is the spacing between orbits, d_i is the ion distance.

Formula, used in [1] to approximate the magnetic field, created by the arc:

$$B = \frac{\mu_0 e V}{k_0 {d_e}^2}$$

where V is the electron velocity, d_e is the electron distance, μ_0 is the magnetic permeability.

This effect causes the electron rotation around much slower ions, and the toroid is able to withstand the conditions of the gas medium for a considerable amount of time. The resulting form of the ionized gas was a spinning toroid of a 0.002 m radius, dissipating after a record time of 200 milliseconds. The preferable aspect ratio, according to the paper [1], is 3:1. The research team proposes this model as a potential explanation to the ball lightning phenomenon.

Capillary injection is another widespread plasma source. A coaxial plasma gun, described in [2], relies on a series of radially symmetrical plasma jets, located at the rear end of a coaxial accelerator. This setup also forms a toroid. It operates under the pressure of less than 10^{-5} Torr, and yet the main engineering challenge is the necessity of a sufficient insulation, which causes such deep vacuum. Nonetheless, the plasma density in the article [2] is 10^{17} cm^{-3}, which is considered high even for atmospheric conditions [3, p. 2]. Consequently, such calculations rely on the liquid plasma model, which covers the factor of neutral particles collisions. Exploding foils approached was also mentioned in [2] as equally effective, but it is much less practical. The optimal toroid ratio for the conditions, described in this paper, is no more than 2:1. High plasma stability is reached inside the accelerator by passing large currents through the plasma body. Apart from coaxial accelerators, there are other geometries in existence, for instance, two parallel plates that also hold a great charge and transport it through the plasma, providing its stability and acceleration.

According to [4], a sufficiently ionized and stable plasma (regardless of the medium) must be dominated by magneto dynamic equations, instead of aerodynamic ones, which exist in the atmosphere. The liquid plasma model is an accurate approximation for highly collisional plasmas, however, it is not always applicable, as shown in [1], where the effects of the liquid plasma theory were not significant enough, and a single particle approach was seen as an acceptable approximation.

Finally, there are many methods of improving the qualities of the DC arc, possibly the most notable one is the field emission theory. However, it is not accurate for large electrode areas; in this case, the predicted emission current is much smaller than experiments show [5, p. 31–32]. It is supposed that microscopic topology of the electrode surface (around 1 micron in height) is the reason for this effect, and it can multiply the average electric field by a factor of one hundred or more. Formulas for the field enhancement β for hemispherical electrode and electric field F are also provided in [5]:

$$\beta = \frac{H}{R} + 2$$

$$F = \beta \frac{V}{d}$$

where H is the hemisphere height, R is the hemisphere radius, V is the voltage, and d is the gap length.

The practical application of such geometrical protrusions remains a challenge though, due to their unstable form, subjected to the arc influence.

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USING NEURAL NETWORK MODELING FOR THE DIAGNOSIS OF EPILEPSY BASED ON ELECTROENCEPHALOGRAM RHYTHMS

Epilepsy affects about 50 million individuals worldwide and is characterized by sudden seizures caused by abnormal electrical activity in the brain. The electroencephalogram (EEG) technique [1] is used to quantify the increase in brain activity during epileptic seizures, and neurologists analyze EEG recordings to identify different stages of epilepsy. However, this approach can be time-consuming and laborious, necessitating an automated epileptic seizure prediction system.

To address this, a neural network model for epilepsy control using the Long Short-Term Memory (LSTM) method has been developed [2]. The goal of my project is to create an automated seizure prediction and control system that can assist patients and healthcare providers in managing the condition. To ensure the effectiveness and reliability of my model, I am training it on the real patient data, both with healthy EEG readings and those diagnosed with epilepsy.

LSTM is a type of Recurrent Neural Network architecture that has been successful in time-series data analysis. To compare the effectiveness of different LSTM implementations, including LSTM for Regression Using the Window Method, LSTM for Regression with Time Steps, and LSTM with Memory Between Batches, I conducted experiments using data from the Boston University dataset. My findings indicated that LSTM for Regression Using the Window Method achieved the lowest error rate, while LSTM with Memory Between Batches showed the highest