GENERATION OF DENSE PLASMAS AT LOW AVERAGE POWER INPUT BY POWER PULSING

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One of the remarkable plasma effects experimentally discovered is the large increase in plasma density at the same average power input provided by pulsing the power input[1]. In our experiments, a density increase of over 100 has been observed. Although various experimenters have observed similar effects using different power input techniques, to my knowledge no one has provided a theoretical explanation as yet.

I attempt to provide a theoretical model for this effect. Since the power is obviously being deposited into the plasma, I assume that during the power input, an enhanced plasma loss occurs. This plasma loss occurs on a time scale T1. On turning off the power input, this plasma loss process disappears on a time scale T2. The resulting afterglow plasma disappears on a much slower time scale T3. I model this as a system driven by a power delta function repeating on a time period T4. The height of the delta function is proportional to T4, so the longer the time between pulses, the higher the delta function, but the average power input is preserved.

As a first approximation on a single pulse basis, we obtain,

$$\frac{Nl}{Ns} = E^{\frac{T2}{T1}} \frac{T4}{T5}$$

Where N l is the afterglow density during pulsing and Ns is the density during steady-state operation. In our experiments, T4 is about 1000 times T5 (the duration of the delta function). If we assume that the fast decay process T1 is of the same approximate length as the time in which this decay process disappears T2, the above calculation yields a density enhancement of about 300. This number agrees with our observed density enhancement. This calculation ignores plasma left over from the preceding pulse, but most of this is dumped by the effects of the pulse. In any case it can only improve plasma density.

1 Igor Alexeff, USA Patent 7274333, Issued Sept. 25, 2007..