Initial studies on the morphology of the exploding wire plasma

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Exploding wire phenomenon consists initially in the transformation of a metallic wire matter from solid to plasma state by a very intense, at least kA, and short, maximum of ns, electrical current following through the wire in a controlled time.

Wire metal is initially heated by joule heating, which in turn transforms the wire into liquid, metallic gas and finally a plasma that can still absorb part of the electrical energy [1]. The final stage of the system, when the surrounding medium is atmospheric air, is a non expanded plasma which shows diverse morphological instabilities, depending on the material and initial energy, among other factors.

Electrical current distribution across the wire, that could be approximated by a cylindrical one, cannot be considered as constant, or uniform, with a large dependence on the skin depth of the material, a parameter that indicates the penetration deep of the electromagnetic fields inside the wire. In principle, it is tempting to consider that such parameter can be related with the final morphology of the plasma, as it sets up the initial condition for the plasma expansion. In this work we show that such relation is not observed at a charging voltage of 20 kV, based on measurements of the distance between observed peak and valleys, obtained with a fast frame camera synchronized with the exploding wire. They can be adjusted to exponential decay functions with very similar fitted values for the materials employed in these experiments. As fig. 1 shows, distribution of the distances between consecutive peaks and valleys is very similar for the three metals used.

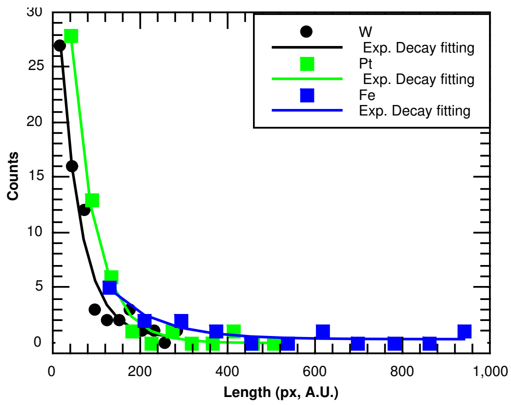

Figure 1: *Distance distribution for the peaks and valleys of exploding wire plasmas.*

References

[1] G. Rodríguez Prieto, L. Bilbao, M. Milanese, Laser and Particle Beams **34**, 263 – 269 (2016)