Virtual Prototype of a Dielectric Window For High Power Microwave Tubes

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Introduction: The Virtual Prototype of a Dielectric Window (DW) for High Power Microwave Vacuum Tubes has been implemented. Electric Fields and S-parameters in working conditions have been computed, by considering the Thermo-mechanical alteration due to the joule effect and the Thermal contact with the Tube.

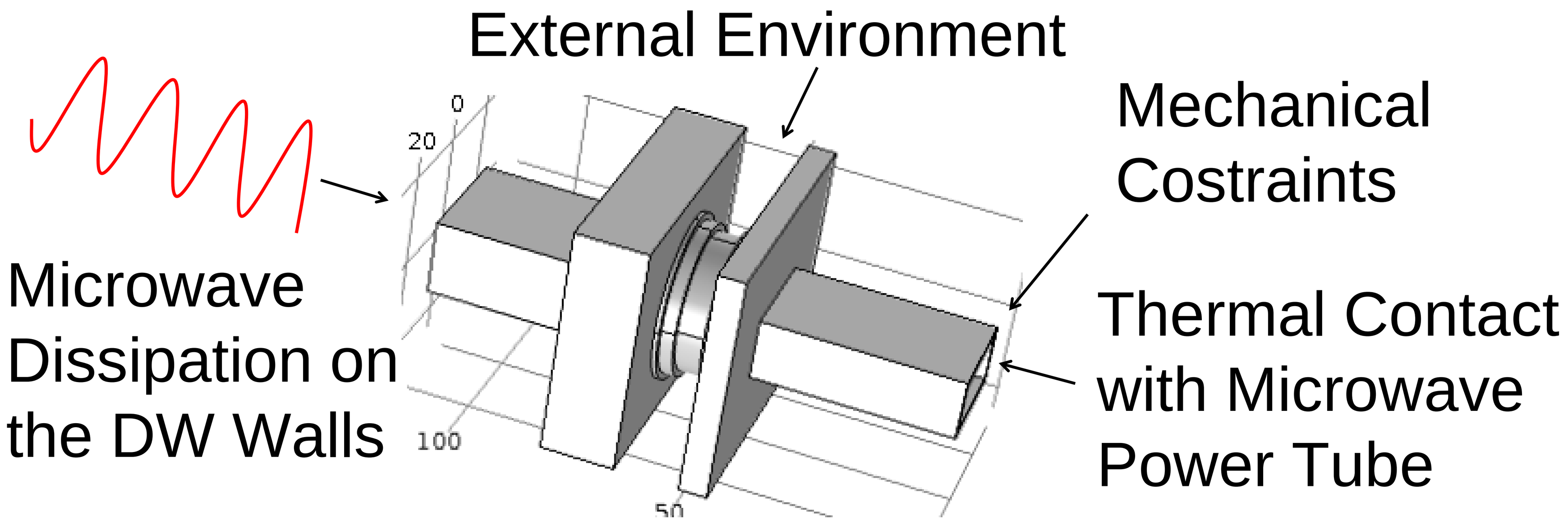

Figure 1. Multiple Physics influencing factors on the DW

Computational Methods: Joule Effect and Thermal Expansion (JHTE) and EM Waves (EMW) analysis are coupled by Moving Mesh (MM) interface and by storing temperature information.

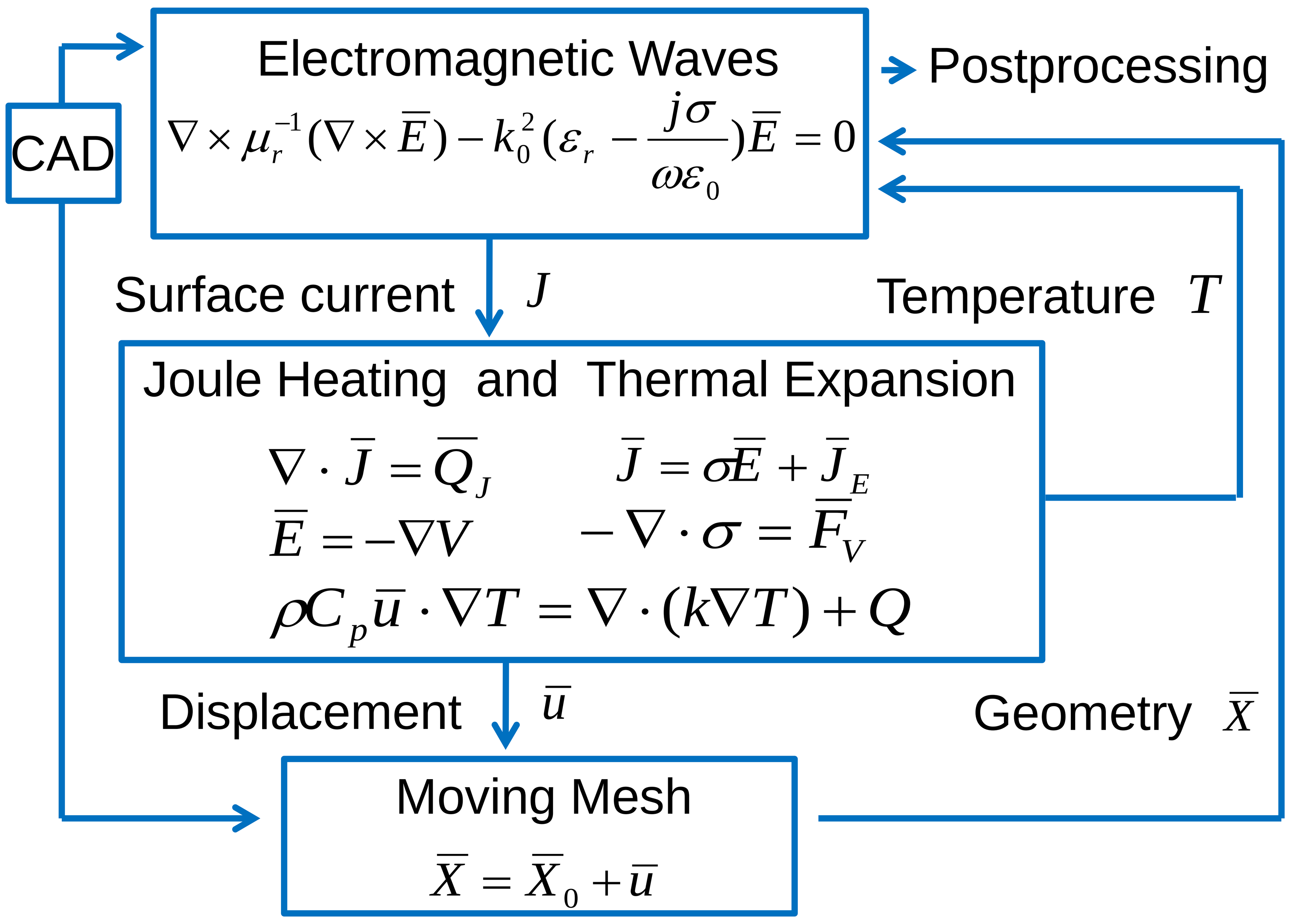

Figure 2. Computation Logical Diagram.

Results: This study has allowed to mitigate the degradation of the performances, induced by the thermal losses, by choosing opportune device shape and materials which, when deformed by the thermal expansion, modify constructively the EM fields to re-increase performances.

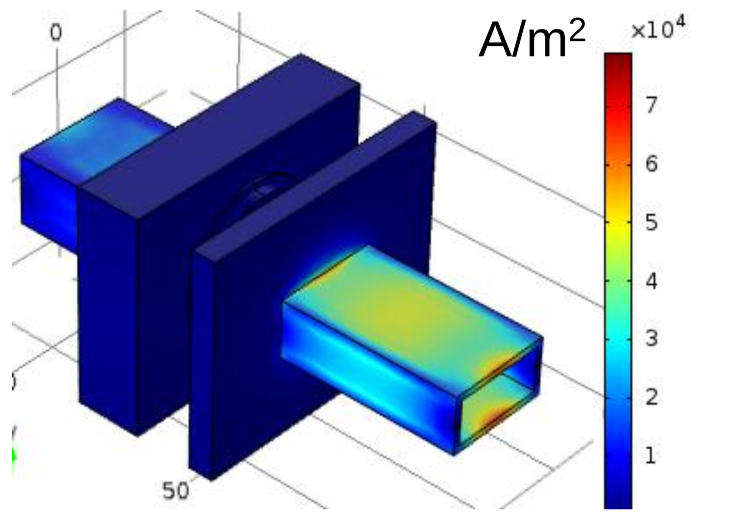

Figure 4. Surface Current Densisty.

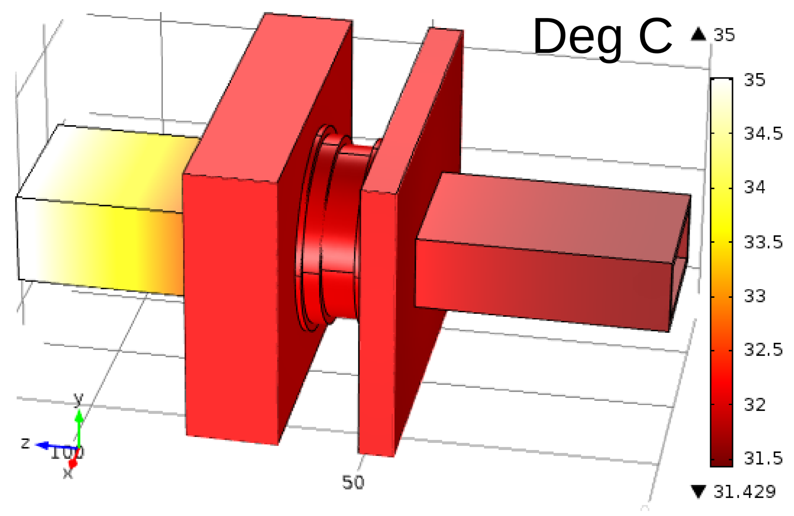

Figure 5. Temperature Distribution.

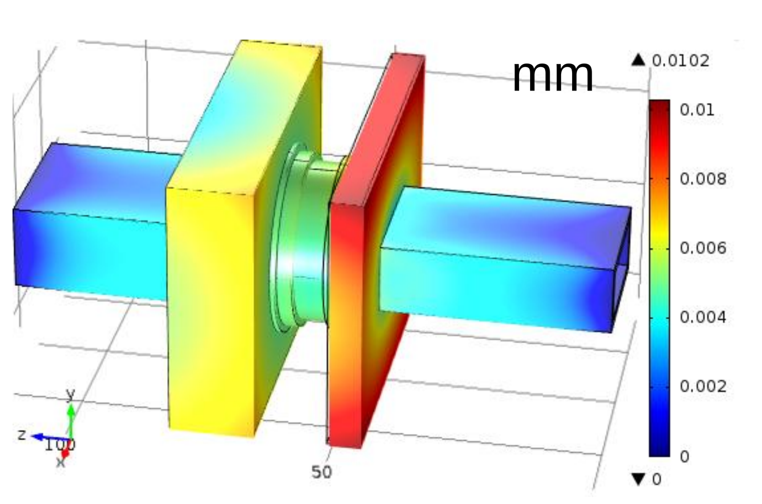

Figure 6. Displacement.

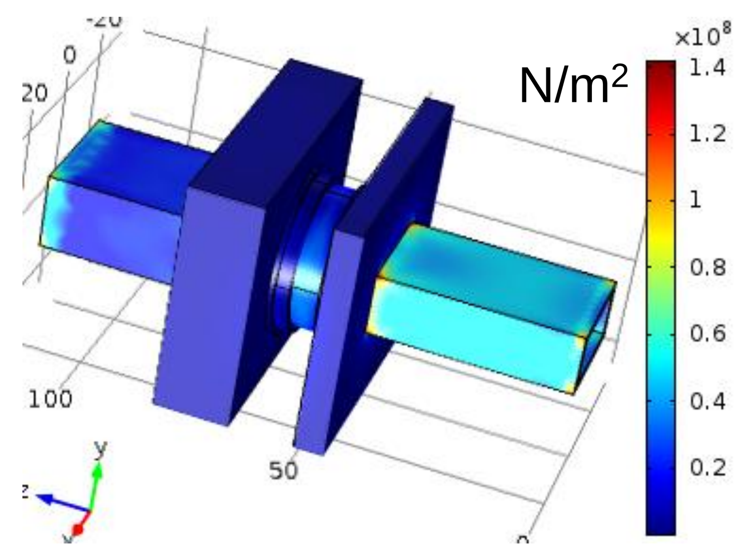

Figure 7. Stress.

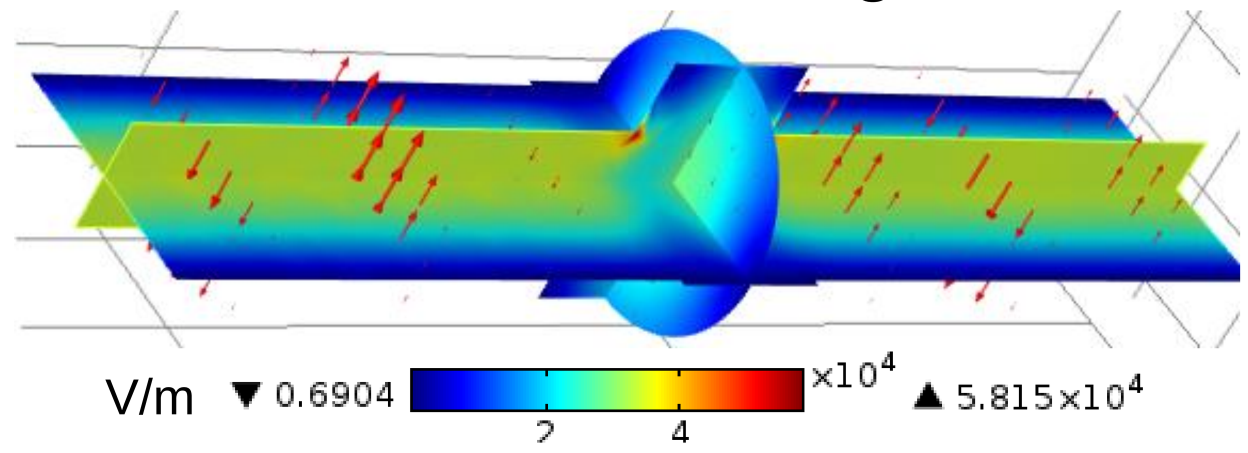

Figure 6. Electric Field Distributuion.

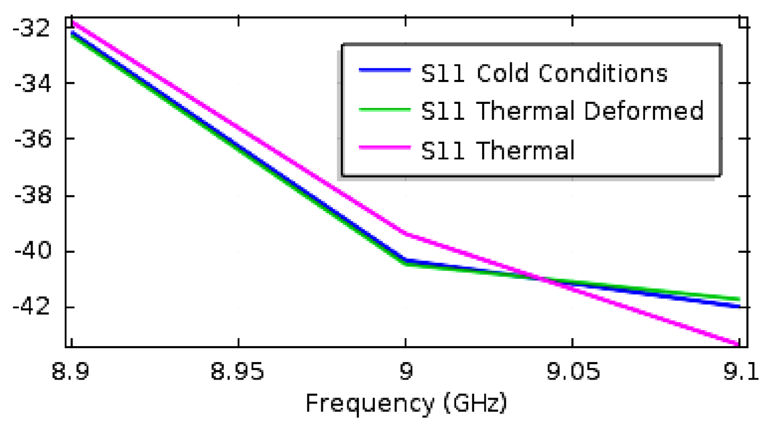

Figure 8. Reflection.

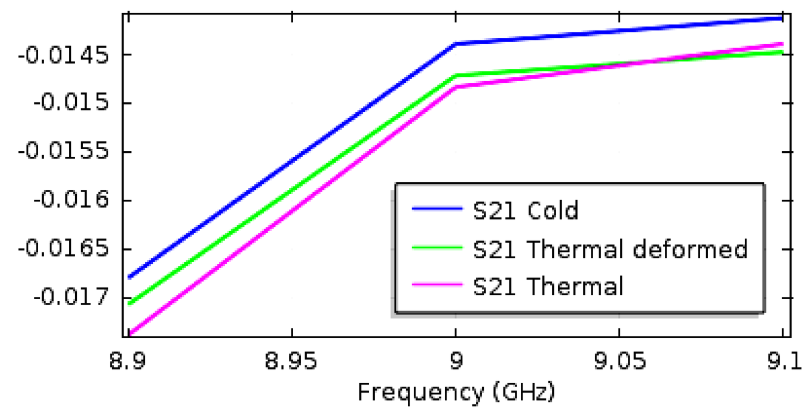

Figure 9. Transmission.

Conclusions: The proposed device operates at the f=9 GHz with 200 MHz of Bandwidth, where it can ensure a minimum return loss of RL=32 dB and a maximum Insertion Loss IL=0.017 dB when it is carrying a pulsed power of P_{peak}=3MW with a Duty Cycle of δ=0.004%. provided by an X-Band Magnetron or Klystron.

References:

1. Alberto Leggieri, Alessia Ciccotelli, Giuseppe Felici, Davide Passi and Franco Di Paolo: "Tuned Window for Standing Wave Linear Accelerators", Progress In Electromagnetic Research Symposium, Guangzhou, China, August 2014.

2. *COMSOL RF Module User's Guide* Version: November 2013 COMSOL 4.4.

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