Multiphysics Design of a 130 GHz Klystron

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Introduction: Multiphysics design of a 130 GHz klystron is described in this paper. Thermomechanical effects due to the cathode heating and radiofrequency power dissipation are considered. In order to stabilize electromagnetic beahvior in thermo-mechanical operative conditions, the system is based on carbon nanotube cold cathode and use an opportune airflow. Frequency shift in operative condition is reduced by means of an anisotropic thermal expansion that compensates cavity radius dilation induced by heating phenomena.

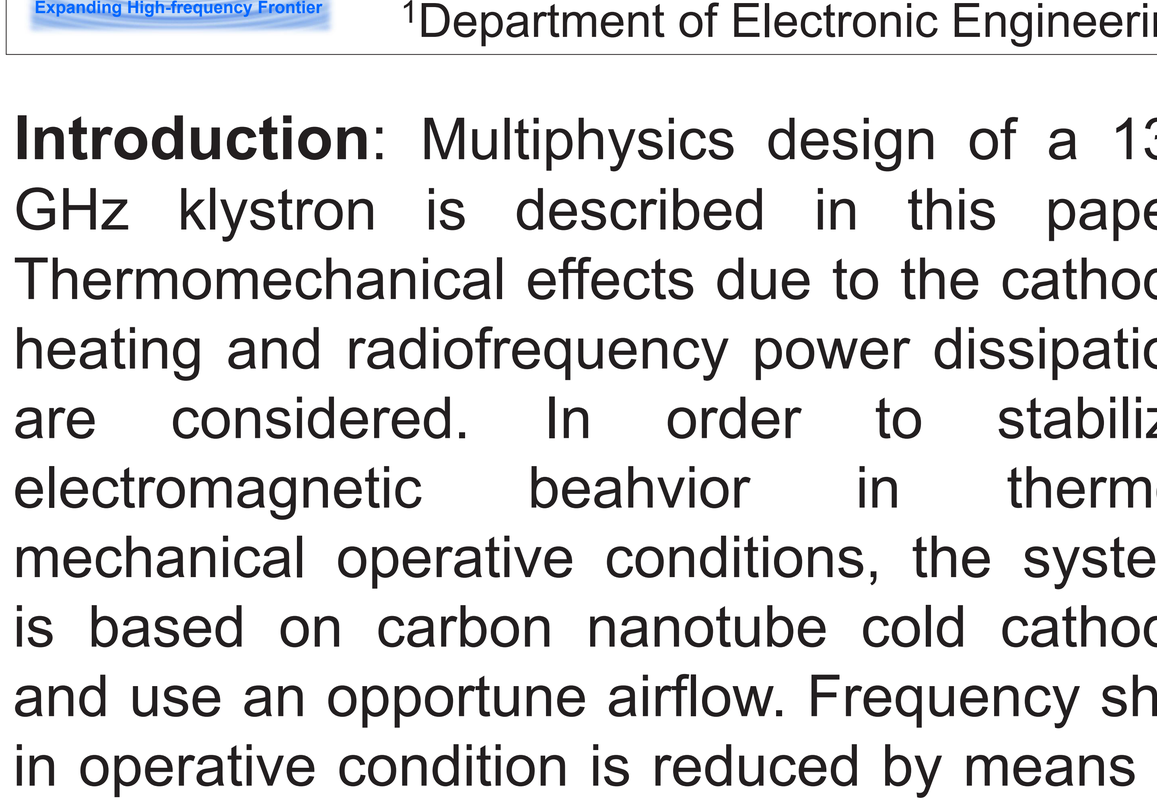

Figure 1. Simulated geometry and materials.

Computational Methods: Heat Transfer (HT), Solid Mechanics (SM), Laminar Flow (LF) and Electromagnetic Waves (EMW) analysis are coupled by Moving Mesh (MM) interface and by sharing temperature and power loss data.

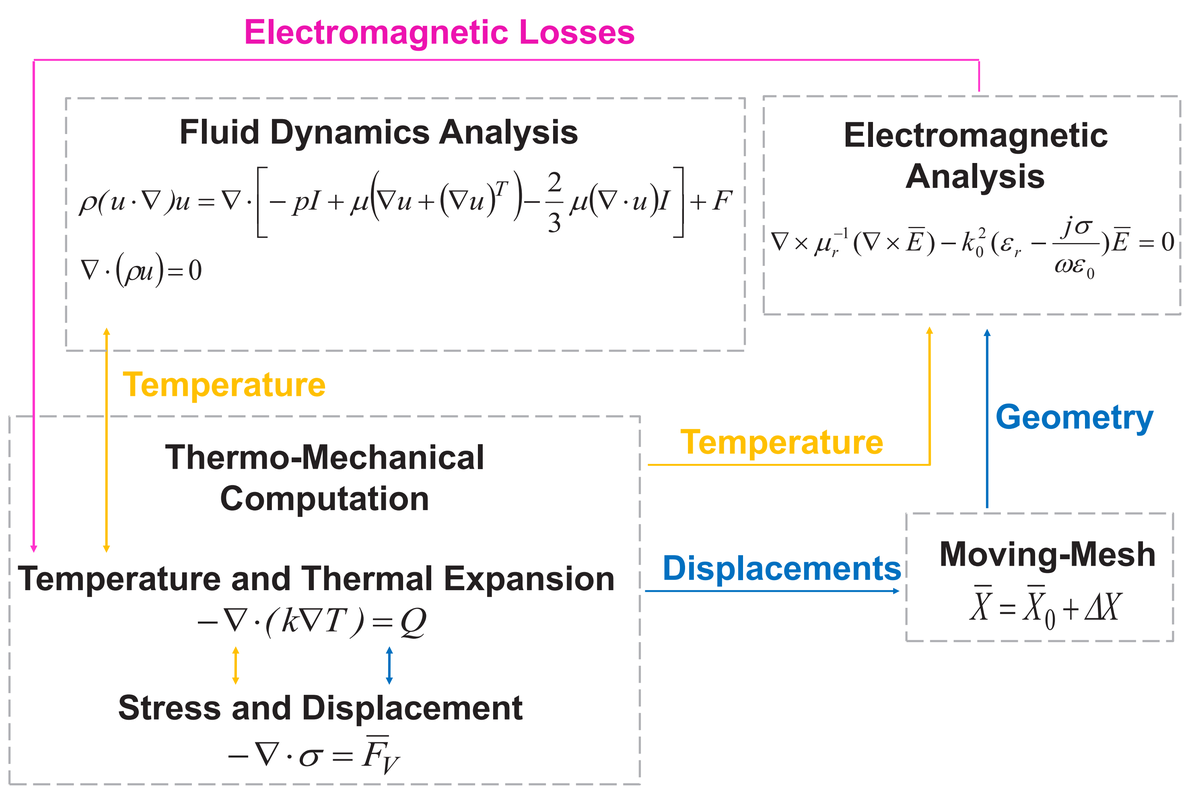

Figure 2. Computation Logical Diagram.

Results: Electromagnetic behavior has been computed in Thermo-mechanical operative conditions.

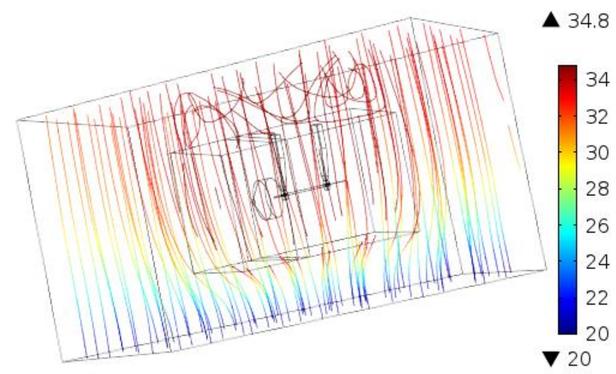

Figure 3. Cooling Airflow with Temperature (°C).

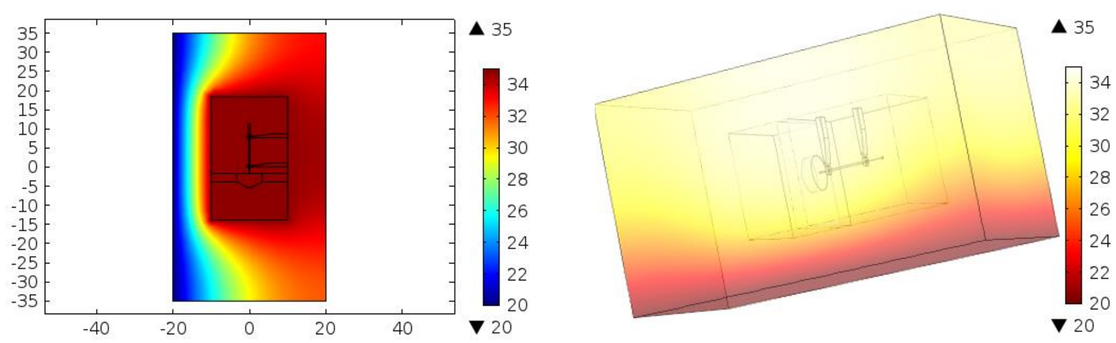

Figure 4. Temperature distribution (°C).

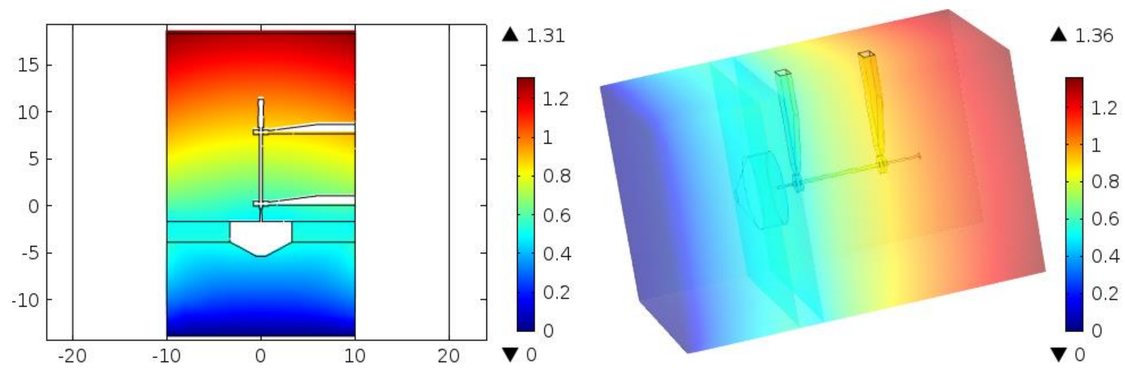

Figure 5. Thermomechanical Displacement (μm).

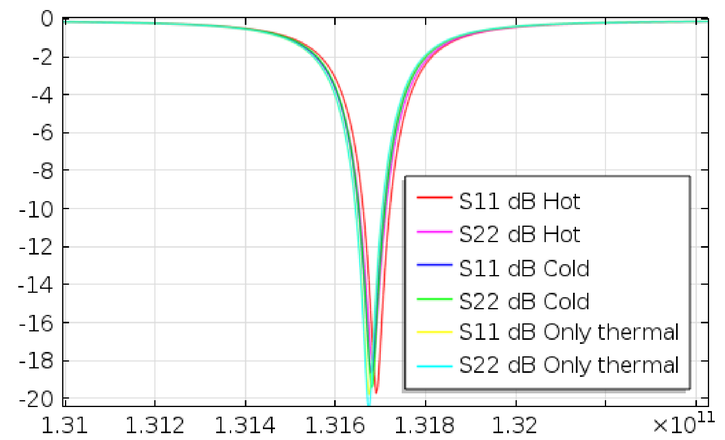

Figure 6. Reflection parameters vs Frequency (Hz).

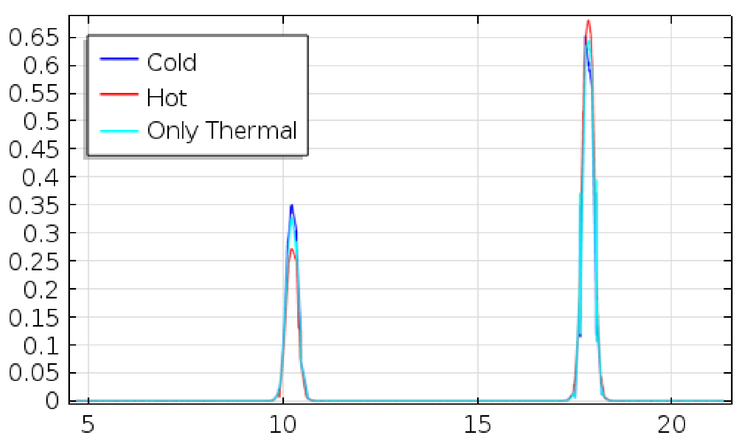

Figure 7. Axial Electric Field (MV/m) vs space (mm).

Conclusions: Advantage of using cold cathode and cooling airflow in millimetric klystron is shown. Appropriate materials and geometries have been chosen.

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