**Introduction:** This paper describes the design and the characterization of an eight key holes resonant cavities X-Band Magnetron, operating in $\pi$ mode, which undergoes the thermal-structural effects due to the cathode heating.

![Figure 1. Magnetron geometry and materials.](image)

**Computational Methods:** Thermal Stress (TS), Eigen-frequency (EF) and Particle Tracing (PT) analysis are coupled by Moving Mesh (MM) interface and by storing temperature information.

![Figure 2. Computation Logical Diagram.](image)

Critical field of the designed device can be described by (1) and (2) with $r_m=\left(\frac{r_c^2 \cdot r_k^2}{2r_a}\right)$, where $r_k$ and $r_a$ are respectively the cathode and anode radii, $B$ is the Magnetic induction field applied along the axial direction, $d$ the anode cathode distance and $f$ the operative frequency. A charge release discretization is given by (3), where $I$ is the cathode current and $\Delta t$ the time interval between releases.

$$B_C = \sqrt{\frac{2mV}{ed^2}} \quad (1), \quad V_C = \frac{1}{2} \pi B r_m df \quad (2), \quad N = \frac{I \Delta t}{e} \quad (3)$$

In order to decrease computational cost, the number of particle per release $N$ has been reduced and a charge multiplication factor $n$ has been introduced.

**Results:** Electromagnetic behavior and particle motion have been computed in Thermo mechanical operative conditions. By the superposition of resonant field and electron trajectories, operating working points have been individuated.

![Figure 3. Cathode heating effects.](image)

**Conclusions:** By applying the design condition: $V=60KV, B=1330G$ in order to have $I=110A$; this device, with a typical efficiency of 40%, can produce a pulsed microwave peak power of 2.64 MW.

**References:**
5. COMSOL Particle Tracing Module User’s Guide, Ver. 4.3.