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Particles charge dissipation in Ku-band relativistic HPM source

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When designing relativistic high power microwave sources operating at high frequency one must combine high power handling with small structures in order to prevent from mode competition. This consequently leads to high power density levels with the risk of power breakdown inside of the microwave source. The triaxial configuration offers a solution to this tradeoff where the electronic beam is surrounded by both an inner and an outer conductor. Low power density levels can be achieved with wide structures and transverse electromagnetic mode propagation is ensured thanks to the coaxial design. However, electric potential and currents of the inner conductor rise up during a pulse and need to be dissipated. Metallic plots acting as short-circuits can be consequently positioned between outer and inner conductors to discharge the currents but specific attention has to be paid to the electromagnetic propagation. Moreover, Particle-In-Cell simulations revealed that surface currents on these plots can reach dramatically high values.
A novel approach is proposed to solve these drawbacks: The design of a Transit Time Oscillator (TTO) with an inverted output is firstly exposed. In this configuration, the electronic beam is collected directly by the Anode and not by the inner conductor resulting very low current level on the metallic plots. On the second solution, an antenna (with a design containing short-circuits) is connected at the output of a TTO (with no inverted output and no metallic plots). Electromagnetic simulations show that when the antenna is fed with transverse electromagnetic mode input signal combined with the continuous signal component coming from the electric potential of the inner conductor, the antenna operates conveniently with good radiation patterns and low input reflection coefficient.

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