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Gyrotrons Collector Power Distribution Analysis HUMBERTO TORREBLANCA, YURI GORELOV, JOHN LOHR, General Atomics — Gyrotrons are typically used in tokamaks to launch EC waves in the 90-170 GHz frequency range. At DIII-D, the individual gyrotrons can deliver up to 1 MW of RF power for up to 5 seconds. In order to launch these waves, a cathode generates a cylindrically symmetrical electron beam that is then accelerated by a potential difference in the order of 80-100 kV. These electrons, guided by the field from a superconducting magnet, generate an rf beam while passing through a microwave cavity, losing about 30% of their kinetic energy to the generated rf, and impact on the water-cooled collector surface at ground potential. Ideally, the electron distribution over the collector wall is uniform, as the beam is swept by an externally applied magnetic field. But in practice there are regions on the collector where the current density is not uniform, turning these areas into hot spots which can be diagnosed by an array of RTDs on the outer surface of the collector. The presence of these hot spots can decrease the collector fatigue lifetime at the hottest locations, making the collector more prone to failure, and reducing the lifetime of the gyrotrons. Using COMSOL Multiphysics, a commercial finite element software, we have identified that the non-uniformity on the cathode emitted electron beam, the misalignment of the magnets, and the asymmetry of the electric field can contribute to this non-uniform power deposition.

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