

NEW DESIGN OF THE GYROTRON USED FOR ECRH EXPERIMENTS ON TORE SUPRA

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ECRH SYSTEM FOR TORE SUPRA AND LONG PULSE TESTING

Generator

- Sources 6 Gyrotrons
- Frequency 118 GHz
- Total Power 2.4 MW (3 MW)
- Pulse Length up to 600 s (5 s)

Typical vacuum behaviour for a 90 s pulse

Spectrum analyser on a 5 s pulse shows spurious oscillations measured in the MOU, with no frequency shift (waves not created in the cavity)

The maximal duration obtained so far is 110 s with an RF power of 300 kW, corresponding to an energy of 30 MJ, limited by the vacuum security

10 kW deposited on the mirror tank has been determined by calorimetry, with a large time constant

NEW DESIGN OF THE GYROTRON

PREVENTION OF HEATING IN THE TUBE

- Copper coating of all the internal stainless steel parts around the mirror box where the cooling is not efficient.
- Modification of the cooling of the internal mirror tank : creation of a separate cooling circuit based on a double wall structure with water flowing between.
- Moving of the inner ionic pumps outside the mirror box with RF shielding in the conducts.

PREVENTION OF SPURIOUS OSCILLATIONS

➢ Modification of the original cylindrical geometry of the launcher with a very small conical angle.

No spurious oscillation if $\alpha \geq 0.02^\circ$

$R = 20 + 0.002z + 0.05\cos(\theta - 0.144z) + 0.05\cos(\theta - 0.007z)$

Azimuthal Bunching
Longitudinal Bunching

FIRST RESULTS : TESTS IN FACTORY UP TO 500 kW AND 5 s

Conditioning of the gyrotron much faster than the previous tubes, with a better vacuum level even with a duty cycle of 10%.

A power of 7 kW measured by calorimetry in the mirror box cooling circuit with a small time constant shows the efficiency of the modification.
Reduced power deposited in the cavity-launcher (25 kW instead of 45 kW before).

No spurious frequency measured at the output of the gyrotron in the band 118 GHz +/- 10 GHz at a level higher than -20dB.

BUT the output beam is not gaussian (with 2 peaks), probably due to the launcher

Modification of the curvature of the third mirror of the MOU (the 2 others are used for the polarizer) to refocus the beam at the entrance of the waveguide to allow a better coupling with the HE11 mode.