

Commissioning of the Gyrotron Test Facility FULGOR - First Results

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Since the mid 80's of the last century KIT is consequently pursuing the goal to develop high power gyrotrons which are widely used as RF source for ECRH and ECCD in fusion devices. KIT is currently establishing a new teststand for gyrotron development. FULGOR (FUision Long Pulse Gyrotron LabORatory) will allow to test gyrotrons with a performance which is well beyond the state-of-the-art. The HVDCPS (High Voltage Direct Current Power Supply) was manufactured by Ampegon AG, CH, it takes advantage of the Enhanced Pulse Step Modulator technology which allows intermediate tapping points for highly efficient operation of gyrotrons with multi-staged depressed collectors and very low noise levels. The power supply is designed for 10 MW CW operation at 90 kV and 120 A, for short pulse operation (< 5 ms) 130 kV at 120 A is possible. Specific modular units make sure that in case of an arc in the gyrotron the energy is limited to 10 J. The rise time of the pulse is < 50 ns, the modulation frequency is up to 5 kHz. An additional body power supply (BPS) for operation of conventional single-stage depressed collector gyrotrons has been installed. This power supply will deliver an output voltage of up to 50 kV at 100 mA. Future gyrotrons which will be developed for fusion applications will require higher operating frequencies compared to state-of-the-art. This will call superconducting magnets which allow for operation well above 200 GHz. The FULGOR test facility will be equipped with a flexible and extensive diagnostic system which allows the full characterisation of gyrotrons in short pulse and long pulse operation. A new frequency diagnostic system will be built up in the range 170 – 260 GHz, it will include a 18 GHz bandwidth filterbank system with 2 GHz sub-channels and a pulse spectrum analysis system. The cooling system of the facility is capable of handling a power of 10 MW, each secondary cooling channel is equipped with temperature sensors and flow meters to allow calorimetric measurement. Precise temperature sensors and flow meters are installed in the primary cooling circuits to offer exact measurement of the power loading of the different cooling channels in the gyrotron.

First results of gyrotron operation with FULGOR will be reported. In order to verify proper operation of the complete FULGOR teststand a 140 GHz pre-prototype short pulse gyrotron has been used. The basic performance of this gyrotron has been investigated in previous experiments and is reported in [1].

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[1] Z. Ioannidis, et.al., Generation of 1.5MW-140GHz pulses with the modular pre-prototype gyrotron for W7-X, IEEE Electron Device Letters, 42, 6, June 2021, DOI: 10.1109/LED.2021.3073221

Primary author: Dr GANTENBEIN, Gerd (Karlsruhe Institute of Technology)

Co-authors: ILLY, Stefan (Karlsruhe Institute of Technology); Prof. JELONNEK, John (Karlsruhe Institute of Technology); Mr RUESS, Tobias (Karlsruhe Institute of Technology); Dr RZESNICKI, Tomasz (Karlsruhe Institute of Technology); Mr SCHMID, Martin (KIT); Dr STANCULOVIC, Sebastian (KIT)

Presenter: Dr GANTENBEIN, Gerd (Karlsruhe Institute of Technology)

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