Contribution ID: **41** Type: **Poster**

Progress in the Short-Pulse E×B Drift Two-Stage Depressed Collector Prototype for Gyrotrons

Thursday, 23 June 2022 14:00 (2h 30m)

The plug-in efficiency of Electron-Cyclotron-Resonance-Heating (ECRH) systems of nuclear fusion facilities is important for the performance of existing devices and will become a vital performance parameter of future facilities that will have installed multiple tens of megawatts of microwave power. Gyrotrons are the sources of any ECRH system. Today, a gyrotron provides 1-2 MW output power at maximum 50 % total gyrotron efficiency with a single stage depressed collector. It is limited, on the one hand, by the efficiency of the interaction between the electron beam and the electromagnetic wave and, on the other hand, by the maximum depression voltage that can be applied to the spent electron beam. To target the latter limitation, Multistage Depressed Collectors (MDC) incorporates multiple depression voltages so that the total gyrotron efficiency can be significantly improved.
The E×B drift concept is considered as the most promising method for the spatial separation of the spent beam electrons with a large spread of rest-energy in a fusion gyrotron [1-2]. In recent years, various designs based on the E×B drift concept have been theoretically investigated at KIT [3-11]. The design approach described in [7, 8, 10, 11] is deemed to be the simplest and most promising concept of a first prototype. This first prototype is specified for short-pulse operation with a pulse length of < 3 ms and a maximum power of 4 MW in the spent electron beam to validate the physical principle of electron separation without the need to implement sophisticated cooling and beam sweeping systems.
Major targets of the mechanical design of the first MDC prototype are compactness and simplicity. The complexity of the collector is increased with the size of the electrodes, the size of ceramics used for high voltage insulation, the size of seals for the vacuum enclosure and the weight of the individual components. Taking all those factors into account, an MDC system is optimized to significantly reduce the manufacturing complexity of the prototype. The mechanical design and the progress in manufacturing of the two-stage depressed collector prototype for the KIT 2 MW 170 GHz coaxial-cavity gyrotron [12] are presented here.

Acknowledgements
Part of this work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.

References

[1] C. Wu, et al., EPJ Web Conf. 149, 04005 (2017).
[2] V. Manuilov, et al., Infrared Phys. Technol. 91, 46–54 (2018).
[3] I. Gr. Pagonakis, et al., IEEE Transactions on Plasma Science 36, 469 480 (2008).
[4] I. Gr. Pagonakis, et al., Physics of Plasmas 23, 043114 (2016).
[5] C. Wu, et al., German Microwave Conference (GeMiC), pp. 365–368 (2016).
[6] C. Wu, et al., Physics of Plasmas 24, 043102 (2017).
[7] C. Wu, et al., Physics of Plasmas 25, 033108 (2018).
[8] C. Wu, et al., Physics of Plasmas 26, 013108 (2019).
[9] B. Ell, et al., Physics of Plasmas 26, 113107 (2019).
[10] B. Ell, et al., 21st International Vacuum Electronics Conference (IVEC) (2020).
[11] B. Ell, et al., 22nd International Vacuum Electronics Conference (IVEC) (2021).
[12] S. Illy, et al., EPJ Web Conf., 203, 04005 (2019).

Primary author: Mr ELL, Benjamin (Karlsruhe Institute of Technology)

Co-authors: Dr WU, Chuanren (Karlsruhe Institute of Technology); Dr GANTENBEIN, Gerd (Karlsruhe Institute of Technology); Dr ILLY, Stefan (Karlsruhe Institute of Technology); Dr PAGONAKIS, Ioannis Gr. (Karlsruhe Institute of Technology); Dr RZESNICKI, Tomasz (Karlsruhe Institute of Technology); Dr STANCULOVIC, Sebastian (Karlsruhe Institute of Technology); Prof. THUMM, Manfred (Karlsruhe Institute of Technology); Mr

WEGGEN, Jörg (Karlsruhe Institute of Technology); Prof. JELONNEK, John (Karlsruhe Institute of Technology)

Presenter: Mr ELL, Benjamin (Karlsruhe Institute of Technology)

Session Classification: Poster Session 2