PhD in Information Technology and Electrical Engineering
Università degli Studi di Napoli Federico II

PhD Student: Andrea Antonione

Cycle: XXXIX

Training and Research Activities Report

Academic year: 2024-25 - PhD Year: Second

Andrea Antonione

Tutor: prof. G. De Tommasi

Co-Tutor: G. Carannante

Co-Tutor: M. Giordano

Date: October 29, 2025

1. Information:

- **PhD student:** **Andrea Antonione** **PhD Cycle:** **XXXIX**
- **DR number:** **997756**
- **Date of birth:** **12/07/1998**
- **Master Science degree:** **Physics** **University: Università degli Studi di Torino**
- **Scholarship type:** **no scholarship**
- **Tutor:** **G. De Tommasi**
- **Co-tutor:** **G. Carannante**
- **Co-tutor:** **M. Giordano**
- **Period abroad:** ***Iter site***

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
AC1- Plasma Physics	Course	30	5	11/2024	UniPd	Y
Controlli Automatici (exam)	Course	72	3	14/11/2024	UniPd	Y
RF System Design Using MathWorks Tools	Course	14	3	24-25/ 02/2025	MathWorks Trainer L. Garth	Y
Nuclear Fusion: the promising potentials and ethical challenges	Seminar	1.5	0.3	09/01/2025	Prof. L. Piron and Prof. P. Martin (Università di Padova)	Y
ECRH Worskshop (IPP Geifswald)	Seminar	20	4	04-06/ 02/2025	ECRH network (run jointly by Fusion for Energy and EUROfusion)	Y
Artificial Intelligence for Engineering	Seminar	2	0.4	18/02/2025	Fusion For Energy	Y
Waves Propagation in Corrugated Waveguides	Seminar	4	0.8	30/04/2025 07/05/2025	ITER staff A. Danisi	Y
ECRH Network Seminar	Seminar	2.5	0.5	14/05/2025	F4E-EUROfusion	Y
Accelerating Fusion via Machine Learning: Advancements in Disruption Prevention	Seminar	1.5	0.3	26/05/2025	F4E	Y
SOFE 2025	Doctoral	32	6.4	23-26/ 06/2025	MIT (Boston)	Y
Joint IFAC Conference – SSSC – TDS – COSY 2025	Doctoral	24	4.8	30/06/2025 02/07/2025	Paris-Saclay University campus (Gif-sur-Yvette)	Y
Final Design Review meeting (FDR) of the EU EC Gyrotrons	Seminar	16	3.2	08-10/ 07/2025	Fusion For Energy	Y
Energy in Europe - An overview of the current scenario and Europe future objectives	Seminar	4	0.8	23/09/2025	Fusion For Energy	Y

1) Courses, Seminar, Doctoral School, Research, Tutorship
2) Choose: Y or N

2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	**6**		**4**		**10**
Bimonth 2	**5**	**4.7**	**4**		**13.7**
Bimonth 3		**0.4**	**8**		**8.4**
Bimonth 4		**8.9**	**6**		**14.9**
Bimonth 5		**6.4**	**2**		**8.4**
Bimonth 6		**0.8**	**6**		
Total	**11**	**21.2**	**30**	**0**	**62.2**
Expected	**30 - 70**	**10 - 30**	**80 - 140**	**0 – 4.8**	

3. Research activity:

Topics:

- Development of a thermal lumped model for the magnetron injection gun of ITER gyrotrons
- Model-based controller synthesis studies for the ITER gyrotron operational phases
- Data-driven mode loss detection to complement safeties

Methodologies:

- Data-driven optimization of a black box thermal model to perform system identification of the magnetron injection gun of ITER gyrotron with minimal assumptions on the system
- Development of a custom control logic for the ITER European gyrotron and control tests on the thermal model representing the machine
- Mode loss detection on the acquired gyrotron data (temperatures, currents, voltages) by applying machine learning-based prediction techniques and evaluation of the outliers

Results:

- Optimization and benchmark of a black-box thermal of the ITER European gyrotron
- Model performance improvement compared to the semi-physical model based on the MIG system
- Development and benchmarking of a custom control logic to control the gyrotron's on- and off-phases, tested on different type of experiments that can be performed (long single pulses, multiple long pulses in a row, multiple short pulses in a row)
- Development of two data-driven mode loss detection methods
    - One based on the anomalous temperature variations in the gyrotron collector
    - One based on the anomalous trend variations of the electron beam current emitted from the cathode of the gyrotron

4. Research products:

Article

A. Antonione, R. Bertazzoni, G. Carannante, K. Cindric, M. Ferrari, A. Leggieri, F. Sanchez, G. De Tommasi

Development and Benchmarking of a Thermal Lumped Model for the Magnetron Injection Gun of the MW-Power ITER European Gyrotron

Published on Nuclear Fusion (25 February 2025)

Article

A. Antonione, G. Carannante, K. Cindric, M. Ferrari, G. De Tommasi

Control system development and testing for the electron beam current of ITER European gyrotrons

Published on IFAC PapersOnLine (2025)

Article

A. Antonione, G. Carannante, M. Ferrari, F. Sanchez, G. De Tommasi

Data-driven mode loss detection for the emitted radiofrequency beam of ITER gyrotrons

Submitted to IEEE Transactions on Plasma Science (SOFE Proceedings)

5. Conferences and seminars attended

2025 IEEE Symposium on Fusion Engineering
SOFE2025, 23-26/06/2025, MIT's campus in Cambridge, MA.
Poster: *Data-driven mode loss detection for the emitted radiofrequency beam of ITER gyrotrons*
Paper under review

Joint IFAC Conference – SSSC – TDS – COSY 2025
30/06/2025-02/07/2025, Paris-Saclay University campus (Gif-sur-Yvette).
Presentation: *Control system development and testing for the electron beam current of ITER European gyrotrons*
Published paper

6. Periods abroad and/or in international research institutions

7. Tutorship

8. Plan for year three

- Optimization of the thermal lumped model on the different type of gyrotrons deployed in ITER
- RF mode loss detection by employing the body power supply current of the gyrotron
- Participation to the gyrotron commissioning in ITER

Andrea Antonione