



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Nicola Isernia

XXXIV Cycle

Training and Research Activities Report – First Year

Tutor: Prof. Fabio Villone



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

1. Information

- a. Nicola Isernia, M.Sc. in Electrical Engineering, Università degli Studi di Napoli Federico II
- b. XXXIV Cycle - ITEE Doctoral School, Università degli Studi di Napoli Federico II
- c. Athenaeum fellowship
- d. Tutor: Prof. Fabio Villone

2. Study and Training activities (Credits in brackets)

a) Modules and Courses

- I. Mathematical Physics Models – Prof. Maurizio Gentile - Master Degree in Mathematical Engineering (9)
- II. Elettromagnetismo e Relatività – Prof. Amedeo Capozzoli – ITEE ad hoc Course (5)
- III. Meccanica Statistica – Prof. Fulvio Peruggi – Master Degree in Physics (9)
- IV. MHD Equilibrium and Stability – Prof. Vladimir Pustovitov (Kurchatov Institute) – ad hoc Module (2.4)
- V. A leap into Functional Data Analysis – Simone Vantini and Alessandra Menafoglio – ad hoc Module for Departments of *Industrial Engineering* and *Mathematics and Applications* (2)

b) Seminars

- I. Computational and Machine Learning Methods for Complex Ecosystems – Edoardo Pasolli (0.2)
- II. Chaos in Magnetization Dynamics – Prof. Claudio Serpico (0.4)
- III. Spin-orbit optical phenomena – Prof. Lorenzo Marrucci (0.2)
- IV. IEEEExplore Training and Authorship Workshop (0.5)
- V. Medical Thermal Therapy and Monitoring using Microwave Inverse Scattering – Prof. Mahta Moghaddam (0.2)
- VI. Modeling, simulation and optimization of circuits and systems for photovoltaic applications – Prof. Giovanni Spagnuolo – Scuola Nazionale Dottorandi di Elettrotecnica F. Gasparini, Viterbo, 19 Giugno 2019 (0.8)
- VII. Micromagnetismo – Prof. Claudio Serpico – 23th Stage Scuola Nazionale Dottorandi F. Gasparini, 14-18 Ottobre 2019 (1)
- VIII. Circuiti dinamici non lineari: oscillatori – Prof. Marco Storace - 23th Stage Scuola Nazionale Dottorandi F. Gasparini, 14-18 Ottobre 2019 (1)
- IX. Minimizzazione senza derivate: sintesi di campi in elettricità e magnetismo – Prof. Paolo di Barba - 23th Stage Scuola Nazionale Dottorandi F. Gasparini, 14-18 Ottobre 2019 (1)

3. Research activity

a) Title

Plasma – Structures Electromagnetic Interaction

b) Study

Magneto-Hydro-Dynamic plasma models and MQS models.

c) Research description

The PhD research topic deals with the coupling of plasma fluid models with electromagnetic models of surrounding structures and devices. During the first year of activities, the main focus has been the comparison of numerical and analytical models of plasma-structures inductive interaction, in simple idealised geometries. This included the analysis of electromagnetic forces in solid structures and energy fluxes studies. I was involved moreover in the comparison of numerical results with Joint European Torus (JET) experiments. In next years the focus will be on modelling the interface between plasma and structures, in particular on the interface conditions for the electric current.

d) Collaborations

- Prof. Claudio Serpico and ITEE PhD student Valentino Scalera – Energy Balances in multi-physics problems, with application to fusion plasmas
- Prof. V. D. Pustovitov (National Research Centre *Kurchatov Institute*) and PhD Vadim Yanovskiy (Postdoctoral researcher at *IPP Prague*) - Analytical modelling of *disruption forces*.
- PhD Vadim Yanovskiy – Design of COMPASS-U and modelling of COMPASS experiments.
- Joint European Torus (JET) Work Package T17-13 “*Disruption and runaways*” – Coupled plasma-structure models for JET experiments.
- Joint European Torus (JET) Work Package M18-33 “*Mitigation of Disruption electromagnetic load with SPI*” – analysis of experimental data.

4. Products

a) Publications (Journal Papers)

- V.V. Yanovskiy, N. Isernia, V.D. Pustovitov, F. Villone, D. Abate, P. Bettini, S.L. Chen, J. Havlicek, A. Herrmann, J. Hromadka, M. Hron, M. Imrisek, M. Komm, R. Paccagnella, R. Panek, G. Pautasso, S. Peruzzo, D. Sestak, M. Teschke, I. Zammuto, “*Comparison of approaches to the electromagnetic analysis of COMPASS-U vacuum vessel during fast transients*”, *Fusion Engineering and Design*, Volume 146, Part B, 2019.
- N. Isernia, V. D. Pustovitov, F. Villone, V. Yanovskiy, Cross-validation of analytical models for computation of disruption forces in tokamaks, *Plasma Physics and Controlled Fusion*, Volume 61, Number 11, 2019.

b) Publications (Conference Proceedings)

- N. Isernia, V. Scalera, C. Serpico, F. Villone, “*Energy balance during disruptions*”, 46th Plasma Physics Conference of the European Physical Society, Milan, 2019.
- S. Chen, F. Villone, Y. Sun, B. Xiao, N. Isernia, G. Rubinacci, S. Ventre, “*Simulation of disruptions in EAST tokamak*”, 46th Plasma Physics Conference of the European Physical Society, Milan, 2019
- S. Jardin, F. Villone, C. Clauser, N. Ferraro, N. Isernia, G. Rubinacci, S. Ventre, “*ITER disruption simulations with realistic plasma and conductors modelling*”, 46th Plasma Physics Conference of the European Physical Society, Milan, 2019
- V. Yanovskiy, N. Isernia, V.D. Pustovitov, F. Villone, J. Havlicek, A. Havranek, J. Hromadka, M. Hron, F. Jaulmes, M. Komm, O. Kovanda, K. Kovarik, J. Krbec, T. Markovic, E. Matveeva, R. Panek, J. Seidl, D. Tskhakaya, V. Weinzettl, “*Poloidal currents in COMPASS vacuum vessel during symmetrical disruptions: measurements using diamagnetic loop and comparison with CarMa0NL modelling*”, 46th Plasma Physics Conference of the European Physical Society, Milan, 2019

c) Under review or in preparation

- N. Isernia, F. Villone, “*Statistical Analysis of the effect of 3D Conducting Structures on the Axisymmetric Evolution of Fusion Plasmas*”, *IEEE Transactions on Magnetics* – Conferences (under review, following the poster presentation at the 22nd International Conference on the Computation of Electromagnetic Fields, Paris, 2019)
- N. Isernia, V. Scalera, C. Serpico, F. Villone, “*Energy Balance during plasma transient events*” (in preparation)

5. Conferences and Seminars

- *XXXV Riunione Annuale dei Ricercatori di Elettrotecnica e Scuola Nazionale Dottorandi di Elettrotecnica F. Gasparini*, Viterbo, 19/06/19 – 21/06/19
- 46th Plasma Physics Conference of the European Physical Society, Milan, 08/07/19 – 12/07/19 (See Section 4a for related Conference Proceedings)
- 22nd International Conference on the Computation of Electromagnetic Fields, Paris 15/07/19 – 19/07/19 (See Section 4b for manuscript under review in a special issue of IEEE Transactions on Magnetics)

6. Activity Abroad

- Participation to the modelling campaign T17-13 “*Disruption and Runaways*” at Culham Science Centre for Fusion Energy (JET-UKAEA), Culham, UK, 11/03/19 – 22/03/19. Contact person: PhD Emmanuel Joffrin. Reference Scientific Coordinator: G. Pautasso
- Participation to the experimental campaign M18-33 “*Mitigation of Disruption electromagnetic load with SPI*” at Culham Science Centre for Fusion Energy (JET-UKAEA), Culham, UK, 2/09/19-13/09/19. Reference Scientific Coordinator: S. Gerasimov

31/10/19

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Cycle XXXIV

	Credits year 1							Credits year 2							Credits year 3							Total	Check			
	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4			5	6	Summary
Modules	23	9	9.4		9			27	15							0	20							0	27	30-70
Seminars	7	0	0.6	0.7	1	0	3	5.3	3							0	5							0	5.3	10-30
Research	34	2	1	6.3	5	8	6	28	42							0	34							0	28	80-140
	64	11	11	7	15	8	9	61	60	0	0	0	0	0	0	0	59	0	0	0	0	0	0	0	61	180

Year	Lecture/Activity	Type	Credits	Certification	Notes
1	Elettromagnetismo e Relatività	Ad hoc module	5	x	
1	Mathematical Physics Model	MS module	9	x	
1	A leap into functional data analysis	Ad hoc module	2	x	
1	MHD Equilibrium and Stability	Ad hoc module	2.4	x	
1	Meccanica Statistica	MS module	9	x	
1	Computational And Machine Learning for Complex Ecosystems	Seminar	0.2	x	
1	Chaos in Magnetization Dynamics	Seminar	0.4	x	
1	Spin-orbit optical phenomena	Seminar	0.2	x	
1	IEEEExplore Training and Authorship Workshop	Seminar	0.5	x	
1	Medical Thermal Therapy and Monitoring using Microwave Inverse Scattering	Seminar	0.2	x	
1	Scuola F. Gasparini - Viterbo	PhD School	0.8	x	
1	Scuola F. Gasparini - Napoli	PhD School	3	x	