



**PhD in Information Technology and Electrical Engineering**

**Università degli Studi di Napoli Federico II**

**PhD Student: Valentino Scalera**

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**XXXII Cycle**

**Training and Research Activities Report – Third Year**

**Tutor: Claudio Serpico – co-Tutor: Massimiliano d’Aquino**



## Information

### Name and MS Degree

Valentino Scalera, Master of Science in Electrical Engineering - Università di Napoli Federico II

### PhD cycle and University

XXXII Cycle - ITEE – Università di Napoli Federico II

### Tutor

Prof. Claudio Serpico

## Study and Training activities

### Courses

#### Courses attended with certification

- “*Elettromagnetismo e Relatività*” – ad Hoc Module
- “*Fisica Statistica*” – M.S. Course of Physics

### Seminars

#### Seminars attended

- “*Computational and Machine Learning Methods for Complex Ecosystems*”
- “*Chaos in Magnetization Dynamics*”
- “*In & Out Chip Signal and Power Integrity*”
- “*Applications of Fuzzy Cognitive Maps to Renewable Energy Networks*”
- “*Programming Intelligent Robots that Cares for Humans*”
- “*In-network Machine Learning for Networks*”

## Research activity

**Title:** Micromagnetics and Spintronics

### Study:

Micromagnetics is a field of physics dealing with the prediction of magnetic behaviors at sub-micrometer length scales. The length scales considered are large enough for the atomic structure of the material to be ignored (the continuum approximation), yet small enough to resolve magnetic structures such as domain walls or vortices.

Spintronics is the study of the intrinsic spins of the electron and its associated magnetic moments in solid-state devices.

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Spintronics fundamentally differs from traditional electronics because, in addition to charge state, electron spins are exploited as a further degree of freedom, with implications in the efficiency of data storage and transfer.

### **Research description:**

My research mainly focuses on the fast and ultrafast nonlinear magnetization dynamics in magnetic storage technologies. Fast dynamics include all the phenomena that occur in the timescale of nanoseconds, whereas ultrafast phenomena take place in the timescale of picoseconds or less.

I have been working on the implementation of a numeric algorithm for the computation of magnetostatic field and on analytical modelling and numerical simulation of spin waves.

I developed a spin waves model with inertia. The results of the research on ultrafast dynamics are of interest for a better understanding of the fundamental mechanisms of ultrafast demagnetization and reversal, with implications for the realization of faster and more efficient magnetic data storage.

I also devoted part of my research activity to plasma physics and I presented the poster “Energy Balance During Disruptions” at the 46th EPS Conference on Plasma Physics in Milan 8<sup>th</sup>-12<sup>th</sup> July 2019.

Moreover, I have been working on the simulation of Plasma evolutionary equilibrium. The outcome of this activity is in the poster “Poloidal currents in COMPASS vacuum vessel during disruptions: diamagnetic measurements and comparison with CarMa0NL modeling” presented at the 61st Annual Meeting of the APS Division of Plasma Physics, October 21–25, 2019; Fort Lauderdale, Florida (USA)

## **Products**

### **Conference Proceeding**

Isernia N., Scalera V., Serpico C., Villone F., (2019) “Energy Balance During Disruptions” Proceedings of the 46th EPS Conference on Plasma Physics, P4.1053  
<http://ocs.ciemat.es/EPS2019PAP/pdf/P4.1053.pdf>

### **Preprints**

Neeraj K., Awari N., Kovalev S., Polley D., Hagström N.Z., Arekapudi S., Semisalova A., Lenz K., Green B., Deinert J.C., Ilyakov I., Chen M., Bawatna M., Scalera V., d'Aquino M., Serpico C., Hellwig O., Wegrowe J.E., Gensch M., Bonetti S. (2019), “Experimental evidence of inertial dynamics in ferromagnets”, <https://arxiv.org/pdf/1910.11284.pdf>, under revision for Nature Physics

## Conferences and Seminars

Poster presentation “Energy Balance During Disruptions” at the 46th EPS Conference on Plasma Physics in Milan 8<sup>th</sup>-12<sup>th</sup> July 2019.

Seminar on “CREATE Tools for COMPASS and COMPASS UPGRADE” at the Institute of Plasma Physics in Prague (Czech Republic) on 23<sup>rd</sup> September 2019.

## Activity abroad

Visiting fellow at Institute of Plasma Physics in Prague (Czech Republic) from September 9<sup>th</sup> to October 5<sup>th</sup> 2019 where I provided computational support in the simulation of plasma evolutionary equilibrium in devices for the nuclear fusions.

Contact person: Vadim Yanovski