



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Mariano Pascale

XXXIII Cycle

Training and Research Activities Report – First Year

Tutor: Carlo Forestiere



1. Information

- Mariano Pascale, MSc in Electronic Engineering – University of Naples Federico II
- XXXIII Cycle- ITEE – University of Naples Federico II
- Athenaeum Fellowship
- Tutor: Prof. Carlo Forestiere

2. Study and Training activities

■ Courses (credits in brackets)

Attended

- **Meccanica Statistica** - MSc course of Physics
- **Geometria Differenziale** - MSc course of Mathematics
- **Solit State Physics** - MSc course of Mathematical Engineering
- **Ottica Quantistica** - MSc course of Physics
- **Elettromagnetismo e relatività** - Ad hoc course (5* : acquired in January 2019)

Attended with certification

- **Approssimazione di problemi alle derivate parziali e applicazioni** - Alfio Quarteroni, MSc external course of Mathematical Engineering (1)
- **Plasmonics and Metamaterials** - Ad hoc course (4)
- **Ciberconflitti sicurezza informatica, difesa, stabilità internazionale e diritto umanitario** - Ad hoc course (0.8)
- **Mathematical and Numerical Models for Multi-physics Applications** - Alfio Quarteroni, MSc external course of Mathematical Engineering (1.5)

■ External courses (credits in brackets)

- **International School of Plasmonics and Nano-Optics** - PhD school, Cetraro 15-18/06/2018 (3)

■ Seminars (credits in brackets)

- **IBM Q: building the first universal quantum computers for business and science** - Federico Mattei and Najla Said (0.4).
- **The Power of Trefftz Approximations: Applications in Electromagnetics** - Igor Tsukerman (0.2).
- **Non-Asymptotic and Nonlocal Homogenization of Periodic Electromagnetic Structures** - Igor Tsukerman (0.2).
- **Tailoring waves at the extreme with metamaterials** - Nader Engheta (0.5).
- **Near-zero-index photonics** - Nader Engheta (0.5).
- **F. Gasparini school, XXII stage** - Napoli, 15-19/10/2018 (3)
- **Tomografia e Imaging: Principi, Algoritmi e Metodi Numerici** - Pasquale Memmolo (0.4).

3. Credits Summary

	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	20	0	0	8	0	0	2,3	10,3	20							0								0	10,3	30-70
Seminars	5	0	0	1,8	0	3,4	0,4	5,6	5							0								0	5,6	10-30
Research	35	7	7,5	7	7	8,6	7	44,1	35							0								0	44,1	80-140
	60	7	7,5	16,8	7	12	9,7	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	180

4. Research activity

■ Title

Modal analysis of electromagnetic scattering from nanostructures.

■ Study

Nanophotonics.

■ Research description

I'm involved in all the activities of the research group. In general, we study the electromagnetic scattering from plasmonic and dielectric nanoparticles and two dimensional bodies. My research activity is centered on the development of spectral techniques for the analysis of the electromagnetic behavior of plasmonic and photonic nanostructures. Specifically, following the work I did for my master thesis [1], I'm developing the Material-Independent Modes decomposition, introduced in 2016 [2] as a powerful tool to analyze and design photonic nanostructures in the full-wave regime.

References

- [1] Pascale, Mariano & Miano, Giovanni & Forestiere, Carlo. (2017). **Spectral theory of electromagnetic scattering by a coated sphere**. Journal of the Optical Society of America B. 34. 1524. 10.1364/JOSAB.34.001524.
- [2] Forestiere C and Miano G 2016. **Material-independent modes for electromagnetic scattering**. Phys. Rev. B, 94 201406.

■ Collaborations

We collaborate with the Electrical Engineering group from the University of Cassino (Prof. Tamburrino), but we also collaborate with groups from physics (Profs. d'Ambrosio, Tagliacozzo, Pepe, Tafuri).

5. Products

■ Publications

- Forestiere C., Miano G., Pascale M., Tricarico R. (2018) **A Full-Retarded Spectral Technique for the Analysis of Fano Resonances in a Dielectric Nanosphere**. In: Kamenetskii E., Sadreev A., Miroshnichenko A. (eds) *Fano Resonances in Optics and Microwaves*. Springer Series in Optical Sciences, vol 219. Springer, Cham. DOI: 10.1007/978-3-319-99731-5_8.

■ Publications under review

- C. Forestiere, G. Miano, M. Pascale, R. Tricarico, **Electromagnetic modes and resonances of two-dimensional bodies**, Physical Review B.
- C. Forestiere, G. Miano, M. Pascale, R. Tricarico **Quasi-one-dimensional electromagnetic resonators**, IEEE Transactions on Antennas and Propagation.
- C. Forestiere, G. Miano, M. Pascale, R. Tricarico, **Directional Scattering Cancellation for an Electrically Large Dielectric Sphere**, Optics Letters.
- C. Forestiere, G. Miano, M. Pascale, R. Tricarico, book chapter: **Material Independent Modes for the design of electromagnetic scattering**, World Scientific Publishing book: Compendium on Electromagnetic Analysis.

■ Publications in preparation

- M. Pascale, G. Miano, R. Tricarico, C. Forestiere, **Full-wave electromagnetic modes and hybridization in nanoparticle dimers**.
- R. Tricarico, G. Miano, M. Pascale, C. Forestiere, **Quantum theory of arbitrary shaped plasmon nanoparticles: radiative lifetime and energy shift**.
- C. Forestiere, G. Miano, M. Pascale, R. Tricarico, **Non-Rayleigh scattering of light from small particles**.

6. Conferences and Seminars

■ Details

- **International school of Plasmonics and Nano-optics**, Cetraro (CS), 08-15/06/2018
- **Plasmonica 2018**, Firenze, 4-6/07/2018.

■ Presentations made

- **Plasmon Hybridization in the Full-Wave Regime** (poster), Cetraro (CS), 08-15/06/2018.
- **Plasmon Hybridization in the Full-Wave Regime**, Firenze, 4-6/07/2018.

7. Tutorship

- **Analisi Matematica 1 (BIO/AUT/ELN/INF/TLC CIS-FER), Fisica Generale 1 (BIO/AUT/ELN/INF/TLC RON-Z)** - Tutorship for the courses held by G. Lazzaroni and L. Valore, respectively. 11/2018 – 10/2019 (14 hours as far).