

Lorenzo Giannini

Magneto-structural analyst

Research and Work Experience

Vocational

Jan 2019 – **Structural analyst**, *ICAS-Italian Consortium for Applied Superconductivity*,
Present Frascati, IT.

- Design study and magneto-structural analyses of the DTT central solenoid.
- Magnetic field evaluations for the operative plasma scenarios in normal and off-normal conditions.
- Static stress and fatigue life assessment under different electromagnetic and thermal loading conditions of all main and support structures, for metallic and non-metallic components.

Nov 2018 – **Structural Analyst**, *CREATE-Consorzio di Ricerca per l'Energia*,
Dec 2018 *l'Automazione e le Tecnologie dell'Elettromagnetismo*, Naples, IT.

- Magneto structural analyses of the DTT central solenoid.
- Definition and implementation of a parametric and multi-physical design optimization model for the CS layout.
- Static stress and fatigue life assessment under different electromagnetic and thermal loading conditions of all main and support structures, for metallic and non-metallic components.

Miscellaneous

Jun 2017 – **Structural Analyst**, *ICAS-Italian Consortium for Applied Superconductivity*,
Sept 2018 Frascati, IT.

- Magneto structural analyses of the DEMO poloidal coil system.
- PF1-6 non-linear fully parametric 3D FEM model, magnetic field calculation for the operative plasma scenarios and static mechanical assessment under electromagnetic load conditions.

Feb 2017 – **MSc undergraduate intern**, *ENEA-Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile*, Frascati, IT.

- Internship done in conjunction with university of Rome “La Sapienza”, oriented at developing Finite Element codes for structural analyses in tokamak applications.
- Bidimensional model for CICC steel jacket and monodimensional toroidal field coil model; derivation and validation of different equivalent loading conditions for a tokamak S/C cables.

Apr 2016 – **BSc undergraduate intern**, *ENEA-Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile*, Frascati, IT.

- In-depth study of the superconducting magnet system of a tokamak fusion reactor.
- Structural analysis of the DEMO toroidal magnet system via numerical simulations with thoroughly parametric 2D FEM models.
- Software employed: COMSOL Multi-physics, Ansys APDL, Ansys Workbench, Matlab, Solidworks.
- BSc thesis: “Analisi del sistema magnetico superconduttivo nei reattori a fusione nucleare di tipo tokamak” (Analysis of the superconducting magnet system of tokamak nuclear fusion reactors)

Link : <https://drive.google.com/open?id=1ln9LklTPwDAg01kJvNsduZTJU3aAC4an>

Education

Nov 2018 **MSc**, *University of Rome "La Sapienza"* , Rome, Industrial Engineering.

Specialization: Mechanical engineering

Background: Nuclear energy engineering

MSc thesis title: Magneto structural analyses and design study of the DTT central solenoid

List of curricular exams:

- Mechanical Vibrations
- Mechanics of Structures
- Advanced Technologies
- Mechanical Technologies
- Plant Operation Management
- Metallurgical Techniques and Methods
- Metallographic and Metallurgical Methodologies
- Machines Construction and Finite Element design
- Internal Combustion Engines
- Mechanical and Thermal Measurements
- Engineer Mathematical Methods
- Energy Conversion Plants
- Radioprotection
- Nuclear Power Plants
- Energy Systems

Nov 2016 **BSc**, *Università degli Studi Guglielmo Marconi*, Rome, Nuclear energy Engineering.

Honours and Awards

Nov 2017 **International CAE Conference**, *EnginSoft*, Vicenza, IT.

CAE poster award 2017 – Winner: “Mechanical Analysis of the Toroidal and Poloidal Field Coils for DEMOnstrating Nuclear Fusion Reactor”

Presentations and invited lectures

Mar 2019 Enginsoft Seminary, “Fusion power is a sun in a bottle”

Professional training

Apr 2018 **Advanced Ansys training**, *Enginsoft*, Frascati (IT).

• EMAG • Workbench • Maxwell • Dynamic/seismic • Advanced APDL

Gen 2019 **Compacting process of a superconducting cable**, *Criotec*, Torin (IT).

Apr 2019 **Work organization and economy**, *Informatica & lingue one way srl*, Rome (IT).

Professional Service

Peer reviewed Articles, *Fusion Engineering and Design*.

Peer reviewed Articles, *MT-25*.

Peer reviewed Articles, *IEEE*.

Languages

Italian Native language

English Advanced Reading and Writing, Intermediate Listener and Speaker

Computer skills

FEM Ansys Workbench, Ansys CAD/CAE SolidWorks, CATIA
APDL, COMSOL, Abaqus

Application Matlab, LaTeX, Office Programming FORTRAN, C++, Python

Platforms Windows, iOS, Linux

Other Work Experiences

Feb **Athlete** , *Circolo Canottieri Aniene* , Rome (IT) .

2010–Jun Kayaker of international interest
2015

2010 – 2016 National Team

2009, 2010, Italian champion

2013, 2014,
2015

2012 World Championship, Kazan (RU)

2013 European Championship, Poznan (PO)

2013 27th summer Universiade, Kazan (RU)

2014 European Championship, Paris (FR)

2015 World Championship, Montemor-o-velho (PT)

2019 IDBF World Championship, Pattaya (T)

Scientific Publications

Books(as co-author)

- 2015 **Blue Book-DTT Divertor Tokamak Test Facility**, *ENEA*, Frascati, IT.
Interim Design Report
- 2019 **Green Book-DTT Divertor Tokamak Test Facility**, *ENEA*, Frascati, IT.
Interim Design Report

Journal Publications

- 2018 **Progress in the design of the superconducting magnets for the EU DEMO**, *V. Corato, T. Bagni, M.E. Biancolini, R. Bonifetto, P. Bruzzone, N. Bykovsky, D. Ciazynski, M. Coleman, A. della Corte, A. Dembkowska, A. Di Zenobio, L. Giannini, et al.*, *Fusion Engineering and Design*, vol.136, Part B, 2018, pp.1597-1604.
- 2019 **Design of DEMO PF coils based on cable-in-conduit conductor**, *M. Kumar, K. Sedlak, X. Sarasola, P. Bruzzone, A. della Corte, L. Giannini, L. Muzzi, V. Corato*, *IEEE Transactions on Applied Superconductivity*, vol.29, Issue 5, 2019, DOI:10.1109/TASC.2019.2892112.
- 2019 **Fusion power is a sun in a bottle**, *L. Giannini, L. Zoboli*, *ANSYS Advantage*.
- 2019 **Magnetostructural Calculations and Design Study of the DTT Central Solenoid**, *L. Giannini, L. Muzzi, A. Di Zenobio, A. Anemona, A. della Corte, G. Romanelli, L. Zoboli, S. Turtù*, *IEEE Transactions on Applied Superconductivity*, vol.30, Issue 4, June 2020, Date of Publication:27 December 2019, DOI: 10.1109/TASC.2019.2962487.
- 2019 **Structural Assessment Procedure of the Toroidal Field Magnet System for the Divertor Tokamak Test**, *Gherardo Romanelli, Aldo Di Zenobio, Alessandro Anemona, Lorenzo Zoboli, Lorenzo Giannini, Simonetta Turtù, Luigi Muzzi, Riccardo Righetti, Antonio della Corte*, *IEEE Transactions on Applied Superconductivity*, vol.30, Issue 4, June 2020, Date of Publication:27 December 2019, DOI:10.1109/TASC.2019.2962411.
- 2019 **Structural Assessment Procedure of the Toroidal Field Magnet System for the Divertor Tokamak Test**, *Lorenzo Zoboli, Gherardo Romanelli, Aldo Di Zenobio, Alessandro Anemona, Lorenzo Giannini, Simonetta Turtù, Luigi Muzzi, Riccardo Righetti, Antonio della Corte*, *IEEE Transactions on Applied Superconductivity*, vol.30, Issue 4, June 2020, Date of Publication:24 December 2019, DOI:10.1109/TASC.2019.2961894.

Conference proceedings

- Sep 2019 **MT 26-International conference of magnet technology**, Vancouver (CA).
- **Magneto-structural calculations and design study of the DTT central solenoid**, *L. Giannini, A. Di Zenobio, L. Muzzi, S. Turtù, A. Anemona, G. Romanelli, C. Fiamozzi Zignani, L. Zoboli, A. della Corte*
 - **The Conceptual design of the DTT superconducting magnet system**, *A. Di Zenobio, L. Muzzi, S. Turtù, L. Affinito, A. Anemona, R. Bonifetto, L. Giannini, V. Corato, C. Fiamozzi Zignani, G. Messina, L. Morici, G. Romanelli, L. Savoldi, A. Zappatore, R. Zanino, L. Zoboli, A. della Corte*

- **Conceptual design and analysis of the DDT PF coil system**, *S. Turtù, A. Di Zenobio, L. Muzzi, L. Affinito, A. Anemona, R. Bonifetto, V. Corato, C. Fiamozzi Zignani, L. Giannini, G. Messina, L. Morici, G. Romanelli, L. Savoldi, A. Zappatore, R. Zanino, L. Zoboli, A. della Cortea*
 - **Design of the inter-coil structures and supports of the DTT magnet system**, *A. Anemona, A. Di Zenobio, L. Muzzi, S. Turtù, L. Giannini, G. Romanelli, L. Zoboli, A. della Corte*
 - **Structural analyses of the Toroidal Field magnet system of the DTT**, *G. Romanelli, A. Di Zenobio, A. Anemona, L. Giannini, L. Zoboli, S. Turtù, L. Muzzi, R. Righetti*
 - **Structural optimization methodology of the 2-D inner-leg cross-section for the TF Coils of fusion reactors**, *G. Tomassetti, L. Giannini, L. Zoboli, S. Turtù, V. Corato, A. della Corte*
- Sep 2019 **EUCAS- European Conference on Applied Superconductivity**, Glasgow (UK).
- **Overview of the magnet system of the European DEMO fusion reactor**, *K. Sedlak, L. Giannini*
- Sep 2019 **AIMETA**, Rome (IT).
- **Multi-scale and multi-physics computational analyses of the DTT magnet system**, *L. Zoboli, A. Anemona, A. della Corte, A. Di Zenobio, L. Giannini, L. Muzzi, G. Romanelli, S. Turtù, G. Vairo*
- Apr 2019 **Back to the Future Workshop**, Erice (IT).
- **The Superconducting Magnet System of the Divertor Tokamak Test (DTT) Facility fusion project**, *L. Muzzi, A. Di Zenobio, S. Turtù, L. Affinito, A. Anemona, V. Corato, C. Fiamozzi Zignani, L. Giannini, G. Messina, R. Righetti, G. Romanelli, L. Zoboli, A. della Corte, R. Bonifetto, L. Savoldi, A. Zappatore, R. Zanino*
- Feb 2019 **LTSW-International conference of magnet technology**, Charleston (SC).
- **The Superconducting Magnet System of the Divertor Tokamak Test (DTT) Facility fusion project**, *L. Muzzi, A. Di Zenobio, S. Turtù, A. Anemona, V. Corato, C. Fiamozzi Zignani, L. Giannini, G. Messina, R. Righetti, G. Romanelli, G. Tomassetti, L. Zoboli, A. della Corte, R. Bonifetto, L. Savoldi, A. Zappatore, R. Zanino*
- Oct 2018 **ASC-Applied Superconductivity Conference**, Seattle (WA).
- **Magneto-Structural Optimization of the Central Solenoid of the DTT magnet system**, *G. Tomassetti, L. Giannini, S. Turtù, L. Muzzi, A. Di Zenobio, A. della Corte*
 - **The DTT magnet system: status of design and procurement strategy**, *A. Di Zenobio, A. Anemona, M. Arabi, F. Crisanti, V. Corato, A. della Corte, C. Fiamozzi Zignani, L. Giannini, G. Messina, L. Muzzi, G. M. Polli, G. Ramogida, G. Romanelli, E. Tamburo de Bella, G. Tomassetti, S. Turtù, R. Villari, L. Zoboli, R. Bonifetto, L. Savoldi, R. Zanino, R. Albanese*
- Sep 2018 **SOFT-30th Symposium on fusion technology**, Taormina (IT).

- **Mechanical Analysis of the DTT central solenoid**, *L. Giannini, A. Di Zenobio, L. Muzzi, S. Turtù, A. Anemona, G. Romanelli, C. Fiamozzi Zignani, L. Zoboli, A. della Corte*
- **Design of the support structures of the DTT magnet system**, *A. Anemona, L. Giannini, L. Zoboli, A. Di Zenobio, A. della Corte, L. Muzzi, G. Romanelli, S. Turtù*
- **Mechanical analysis of the updated DTT TF coil system**, *G. Romanelli, A. Anemona, L. Giannini, L. Zoboli, A. Di Zenobio, A. della Corte, L. Muzzi, S. Turtù*

Nov 2017 **International CAE Conference**, Vicenza (IT).

- **Mechanical Analysis of the Toroidal and Poloidal Field Coils for DEMOnstrating Nuclear Fusion Reactor**, *L. Giannini, L. Zoboli, G. Tomassetti, A. della Corte, A. Anemona*

Sep 2016 **ASC-Applied Superconductivity Conference**, Denver (CO).

- **2D structural analysis and optimization of the inner-leg cross-section for the Toroidal Field Coils of the DEMO fusion reactor**, *G. Tomassetti, F. Giorgetti, L. Giannini, A. Chiappa, M.E. Biancolini, S. Turtù, F. Nunio, L. Muzzi, C. Brutti, A. della Corte*

[Design review meeting reports](#)

Jun 2019 DTT design review meeting-003, Frascati (IT)
 Mar 2019 DTT design review meeting-002, Frascati (IT)
 Jan 2019 DTT design review meeting-001, Frascati (IT)
 Feb 2019 DEMO WPMAG Final Progress Meeting, Garching (DE)
 Oct 2018 DEMO WPMAG Interim Progress Meeting
 Feb 2018 DEMO WPMAG Final Progress Meeting, Torino (IT)
 Sep 2017 DEMO WPMAG Interim Progress Meeting
 Jan 2017 DEMO WPMAG Final Progress Meeting
 Sep 2016 DEMO WPMAG Interim Progress MeetingFrascati (IT)

[Official Reports](#)

Final Report on Deliverable - Structural analyses of PFC system, *L. Giannini*, EUROfusion power plant physics & technology department, MAG-3.1-T014-D002.

Final Report on Deliverable - Mechanical analysis of PF5 and PF6, *L. Giannini, F. Giorgetti, G. Tomassetti, M. E. Biancolini*, EUROfusion power plant physics & technology department, MAG-MCD-3.1-T012-D001.

Final Report on Deliverable - Mechanical analysis of PF5 and PF6, *L. Giannini, F. Giorgetti, G. Tomassetti, M. E. Biancolini*, EUROfusion power plant physics & technology department, MAG-MCD-3.1-T012-D002.

Master Thesis

Title

Magneto structural analyses and design study of the DTT central solenoid

Supervisor

Prof. Giuseppe Ruta

Abstract

The “Divertor Tokamak Test” facility, DTT, is a project of an experimental tokamak reactor developed in Italy, in the framework of the European Fusion Roadmap. This work presents the magnetic and the structural assessment of the performance of the DTT central solenoid. The CS is the core magnet of the poloidal system and generates the magnetic flux needed to induce the plasma current. This magnet is composed of a stack of six layer-wound independently energized modules, comprised of Nb3Sn Cable-in-Conduit Conductors. To optimize the amount of superconducting material, each module is divided into two submodules. The innermost submodule operates in a range of 10/14 T, while the outer one at 6/10 T. The objective of the design process is to obtain a coil capable of providing the required magnetic performance while being structurally compliant. To address this problem, an analytical assessment has been carried out and a thoroughly parametric FEM model has been implemented.

Thesis Purpose

This thesis had as its objective the coding of a multi-physics parametric finite element model, for the design and optimization of the central solenoid of the tokamak machine DTT- "Divertor Tokamak Test Facility", magnetic confinement experimental reactor.

Structure

The thesis is subdivided in two main parts: the first is focused on the definition and the explanation of the basic notions:

- The nuclear fusion reaction as viable, no-impact source of energy;
- The thermo-nuclear fusion reactor (tokamak) magnetic confinement;
- The mechanical behaviour of the central solenoid system;

the second part focuses on DTT and the work done in this context, with an in-depth description of the model and the analyses implemented:

- The EUROfusion Road Map for the fusion and the DTT project;
- The definition of the operative conditions and data for the magneto-structural analyses;
- Objectives and advantages of the Finite Element Modelling;
- Numerical model architecture, parametrisation and engineering;
- Magnetostatic and thermo-mechanical calculations;
- Results and conclusions;

Link

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Roma, 31/05/2020