PERSONAL INFORMATION CIURLUINI CRISTIANO

## WORK EXPERIENCE

Feb.-Oct. 2018 **Sapienza University of Rome** **Rome**

Term contract as researcher with Department of Astronautic, Electrical and Energy Engineering (DIAEE) of Sapienza University of Rome. Research activity focused on the preparation, validation and documentation of the thermal-hydraulic model of PHENIX reactor for the best estimate system code RELAP5 3-D.

Nov. 2021 - today **Sapienza University of Rome** **Rome**

Research fellowship with DIAEE of Sapienza University of Rome. Research activity mainly focuses on thermal-hydraulic analyses to support the design of advanced fission (GEN IV Liquid Metal Fast Reactors) and fusion (ITER, DEMO, ARC) reactors. Operative conditions, as well as accidental scenarios, are considered.

## EDUCATION AND TRAINING

Nov. 2018 – Oct. 2021 **Sapienza University of Rome** **Rome**

PhD in ''Energy and Environment''. Research activity focuses on the design and thermal-hydraulic transient analysis of fission and fusion nuclear reactors of new generation. In particular, sodium and lead fast reactors, Fast Flux Test Facility (FFTF) and Advanced Lead Fast Reactor European. Demonstrator (ALFRED), and nuclear fusion reactors, International Thermonuclear Experimental Reactor (ITER) and European DEMOnstration Power Plant (EU-DEMO).

Oct. 2012 – Jan. 2018 **Sapienza University of Rome** **Rome**

- Bachelor's degree in Energy Engineering with the academic record of 110/110 cum laude, discussing the thesis "Confronto tra i principali modelli di simulazione del fenomeno di esplosione di gas";

- Master's degree in Energy and Nuclear Engineering with the academic record of 110/110 cum laude, discussing the thesis "DEMO Primary Heat Transfer System and Balance of Plant: thermal hydraulic design and simulations using Relap-5 code".

Sept. 2012 - Jul. 2017 **Collegio Universitario Lamaro Pozzani (Federazione Nazionale Cavalieri del Lavoro)** **Rome**

This College, funded and financed by Federazione Nazionale Cavalieri del Lavoro, hosts excellent students selected with strict criteria. During the university career, they must additionally attend lectures on business, economics and corporate law. There are ten modules of lectures, each one followed by an exam. The entire course is named 'Corso di cultura per l'impresa Gaetano Marzotto'. English lectures are foreseen each year. Students can give also their contribution to the review 'Panorama per i giovani' writing articles about science, economics, education and university, politics, literature and philosophy.

- 'Corso di cultura per l'impresa Gaetano Marzotto: 'Ottimo cum Laude'.
- Article '*Start-up: la scelta vincente*' published on Panorama per i giovani (vol. 3, Sept. - Dec. 2014).

Sept. 2007 - Jul. 2012 **Liceo Scientifico Galileo Galilei** **Tarquinia (VT)**

Graduated with the record of 100/100 cum laude.

## LANGUAGE SKILLS

Mother tongue: Italian

Other languages

| | UNDERSTANDING | | SPEAKING | | WRITING |
|---|---|---|---|---|---|
| | Listening | Reading | Spoken interaction | Spoken production | |
| English | B2 | C1 | B2 | B2 | C1 |
| French | B2 | B2 | B2 | B2 | B2 |

## DIGITAL SKILLS

- Microsoft Office suite proficient user (word processor, spread sheet, presentation software)
- Proficient user of the best-estimate system thermal-hydraulic RELAP5 code series (RELAP5 Mod3.3 and RELAP5-3D). Six years of experience.
- MATLAB© proficient user. Six years of experience.
- Python starter user.

## INTERNSHIPS

Jul. 2017 **Research Center of ENEA Brasimone** **Camugnano (BO)**

Internship in Fusion reactor design and simulation with RELAP5 code

PUBLISHED PEER REVIEWED PAPERS

**h-index: 5, (SCOPUS, Elsevier)**


1. E. Martelli et al., Thermal-hydraulic modeling and analyses of the water-cooled EU DEMO using RELAP5 system code, Fusion Eng. Des., 146, 2019, 1121-1125. https://doi.org/10.1016/j.fusengdes.2019.02.021.

2. C. Ciurluini et al., Thermal-hydraulic modeling and analysis of the Water Cooling System for the ITER Test Blanket Module. Fusion Eng. Des. 158, 2020, 111709. https://doi.org/10.1016/j.fusengdes.2020.111709.

3. C. Ciurluini et al., Preliminary neutron kinetic – thermal-hydraulic coupled analysis of the ALFRED reactor using PHISICS/RELAP5-3D. J. Phys. Conf. Ser. 1599, 2020, 012023. https://doi.org/10.1088/1742-6596/1599/1/012023.

4. C. Ciurluini et al., Analysis of the thermal-hydraulic behavior of the EU-DEMO WCLL Breeding Blanket cooling systems during a Loss Of Flow Accident. Fusion Eng. Des., 164, 2021, 112206. https://doi.org/10.1016/j.fusengdes.2020.112206.

5. A. Tincani et al., Conceptual design of the main Ancillary Systems of the ITER Water Cooled Lithium Lead Test Blanket System. Fusion Eng. Des. 167, 2021, 112345. https://doi.org/10.1016/j.fusengdes.2021.112345.

6. C. Ciurluini et al., Study of the EU-DEMO WCLL Breeding Blanket Primary Cooling Circuits Thermal-Hydraulic Performances during Transients Belonging to LOFA Category. Energies, 14(6), 2021, 1541. https://doi.org/10.3390/en14061541.

7. C. Ciurluini et al., Conceptual design overview of the ITER WCLL Water Cooling System and supporting thermal-hydraulic analysis. Fusion Eng. Des. 171, 2021, 112598. https://doi.org/10.1016/j.fusengdes.2021.112598.

8. V. Narcisi et al., Thermal-hydraulic transient analysis of the FFTF LOFWOS Test #13. Nucl. Eng. Des. 383, 2021, 111405. https://doi.org/10.1016/j.nucengdes.2021.111405.

9. L. Melchiorri et al., Preliminary MHD pressure drop analysis for the prototypical WCLL TBM with RELAP5/MOD3.3. Fusion Eng. Des. 176, 2022, 113048. https://doi.org/10.1016/j.fusengdes.2022.113048.

10. I. Moscato et al., Tokamak cooling systems and power conversion system options. Fusion Eng. Des. 178, 2022, 113093. https://doi.org/10.1016/j.fusengdes.2022.113093.

11. L. Barucca et al., Maturation of critical technologies for the DEMO balance of plant systems. Fusion Eng. Des. 179, 2022, 113096. https://doi.org/10.1016/j.fusengdes.2022.113096.

12. F. Galli et al., Evaluation of the thermal-hydraulic performances of a once-through steam generator in nuclear fusion applications. J. Phys. Conf. Ser. 2177, 2022, 012017. https://doi.org/10.1088/1742-6596/2177/1/012017.

13. M. Molinari et al., Transient analysis of OSU-MASLWR with RELAP5. J. Phys. Conf. Ser. 2177, 2022, 012018. https://doi.org/10.1088/1742-6596/2177/1/012018.

14. V. Narcisi et al., Analysis of EU-DEMO WCLL Power Conversion System in Two Relevant Balance of Plant Configurations: Direct Coupling with Auxiliary Boiler and Indirect Coupling. Sustainability 14(10), 2022, 5779. https://doi.org/10.3390/su14105779.

15. C. Ciurluini et al., Transient analysis of a locked rotor/shaft seizure accident involving the EU-DEMO WCLL Breeding Blanket primary cooling circuits, Fusion Eng. Des. 187, 2023, 113396. https://doi.org/10.1016/j.fusengdes.2022.113396.

16. P. Arena et al., Design and Integration of the EU-DEMO Water-Cooled Lead Lithium Breeding Blanket, Energies, 16(4), 2023, 2069. https://doi.org/10.3390/en16042069.

17. A. Tincani et al., Conceptual Design of the Steam Generators for the EU DEMO WCLL Reactor, Energies, 16(6), 2023, 2601. https://doi.org/10.3390/en16062601.

18. C. Ciurluini et al., Thermal-hydraulic assessment of Once-Through Steam Generators for EU-DEMO WCLL Breeding Blanket primary cooling system application, Fusion Eng. Des. 193, 2023, 113688. https://doi.org/10.1016/j.fusengdes.2023.113688.

19. C. Ciurluini et al., Subchannel modelling capabilities of RELAP5-3D© for wire-spaced fuel pin bundle, Nucl. Eng. Des. 409, 2023, 112353. https://doi.org/10.1016/j.nucengdes.2023.112353.

20. A. Vannoni et al., Development of a Steam Generator Mock-Up for EU DEMO Fusion Reactor: Conceptual Design and Code Assessment, Energies, 16(9), 2023, 3729. https://doi.org/10.3390/en16093729.

21. C. Ciurluini et al., Subchannel Analysis of LFR Wire-Wrapped Fuel Bundle with RELAP5-3D, Nucl. Technol. 2023. https://doi.org/10.1080/00295450.2023.2222248.

## ATTENDED CONFERENCES

2023, Aug. 20-25

20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-19), Washington DC (USA).

*Oral presentation*: “Analysis of Steady State and Operational Transients of the Versatile Loop Facility in support to Lead Fast Reactor development”.

2022, Sept. 26-30

IAEA Technical Meeting on State-of-the-art Thermal Hydraulics of Fast Reactors, Brasimone (BO), Italy.

*Oral presentation*: “Subchannel modelling capabilities of RELAP5-3D© for wire-spaced fuel pin bundle”.

2022, Sept. 18-23

32nd Symposium on Fusion Technology (SOFT), Dubrovnik (Croatia).

*Poster presentation*: “Thermal-hydraulic assessment of Once-Through Steam Generators for EU-DEMO WCLL Breeding Blanket primary cooling system application”.

2022, Mar. 06-11 — 19th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-19), Virtual Meeting.

*Oral presentation*: "Transient analysis of a locked rotor/shaft seizure accident involving the EU-DEMO WCLL breeding blanket primary cooling circuits".

2021, Jun. 21-22 — 38th UIT International Conference, 100% online.

*Oral presentation*: "Evaluation of the thermal-hydraulic performances of a once-through steam generator in nuclear fusion applications".

2020, Nov. 23-24 — FuseNet PhD Event, The Virtualternative.

2020, Sept. 20-25 — 31st Symposium on Fusion Technology (SOFT), Virtual Edition.

*Poster presentation*: "Analysis of the thermal-hydraulic behavior of the EU-DEMO WCLL Breeding Blanket systems during a Loss of Flow Accident".

2019, Sept. 22-27 — 14th International Symposium on Fusion Nuclear Technology, Budapest (Hungary).

*Poster presentation*: "Thermal-hydraulic modeling and analysis of the Water Cooling System for the ITER Test Blanket Module".

2019, Jun. 24-26 — 37th UIT Heat Transfer Conference, Padova (Italy).

*Oral presentation*: "Preliminary neutron kinetic – thermal hydraulic coupled analysis of the ALFRED reactor using PHISICS/RELAP5-3D©".

## GRANTS AND AWARDS

2023 — Poster Competition Award – Doctoral Category - Nuclear Days 2023, 14-15 September, Pilsen, Czech Republic.

ENEN PhD Award – European Nuclear Young Generation Forum 2023, 8-12 May, Krakow, Poland.

2021 — Sapienza University of Rome Starter Research Grant.

2020 — Sapienza University of Rome Starter Research Grant.

2019 — Sapienza University of Rome Starter Research Grant.

## INTERNATIONAL PROJECTS

**EUROfusion (Horizon 2020)**
**Early 2018 – 2020**

Within the framework of European (EU) Horizon 2020 programme, Euratom research activities focuses on the completion of the ITER fusion test facility followed by the construction of a demonstration fusion power plant (DEMO). European Commission has developed a partnership with a consortium of fusion laboratories from all EU Member States and Switzerland, named EUROfusion Consortium. The signatory for Italy is ENEA. Among the ENEA linked third parties there is the Nuclear Energy Research Group (NERG) of Sapienza University of Rome, where I worked since my MD thesis. EUROfusion research activities are articulated in different Working Packages (WP), each one addressing a specific technological issue emerging from the design of the overall fusion reactor. In particular, I gave my contribution in the following WPs:

- Work Package (WP) Plant Level System Engineering, Design Integration and Physics Integration.
- Work Package Balance of Plant.
- Work Package Breeding Blanket.

In the framework of these WPs, I performed sizing activities and thermal-hydraulic simulations to support the conceptual design of ITER Water-Cooled Lithium Lead (WCLL) Test Blanket System (TBS) and EU- DEMO WCLL Breeding Blanket and Balance of Plant.

**EUROfusion (Horizon Europe)**
**2021 – 2027**

Horizon Europe is the prosecution of Horizon 2020 programme. Currently, I am involved in the following WPs:

- Work Package Balance of Plant.
- Work Package Breeding Blanket.

In the framework of these WPs, I am performing sizing activities and thermal-hydraulic simulations to support the conceptual design of EU-DEMO WCLL Breeding Blanket and Balance of Plant and related components, with a special focus on the Once-Through Steam generator. To deeply investigate the water and lithium-lead technologies a new multipurpose experimental infrastructure, called W-HYDRA, is planned to be built at the ENEA Brasimone Research Centre. It will include: *i)* STEAM: a water facility designed to experimentally investigate the DEMO balance of plant, focusing the study on the steam generator of the breeding blanket primary heat transfer system; *ii)* Water Loop: a water facility conceived to study the thermal-hydraulic behavior of the ITER WCLLTBS water cooling system (here reproduced 1:1) and to test a full scale TBM mock-up. I'm currently involved in the design process of both these experimental facilities.

**ARC**
**2021 – ongoing**

The Affordable, Robust and Compact (ARC) fusion reactor is a project developed by Massachusetts Institute of Technology (MIT) e its spin-out Commonwealth Fusion Systems (CFS). The latter has been recently acquired by Ente Nazionale Idrocarburi (ENI) S.p.A. From 2021, the NERG of Sapienza University of Rome has started a collaboration with the nuclear fusion division of ENI S.p.A. with the aim of supporting the design of the ARC reactor. My contribution to this project consists in the supervision of two PhD students. The former is involved in the design of the reactor Balance of Plant system. The second is focusing his research efforts on the tritium related design issues.

IAEA CRP I32011 (Benchmark Analysis of FFTF Loss of Flow Without Scram Test) Nov. 2018 – Nov. 2022

An International Atomic Energy Agency (IAEA) Coordinate Research Project is a network of national research institutions which collaborate within an operational framework for research with a similar and well defined global or regional problem focus which is relevant to nuclear technology. As a part of the DIAEE research team I participated to the CRP I32011. It deals with a benchmark analysis involving the simulation of a Loss of Flow Without Scram test (LOFWOS test #13) performed at the American Fast Flux Test Facility reactor. FFTF was a loop-type sodium fast reactor prototype. Twenty-five research institutions from thirteen countries participated to this benchmark exercise. The main goal of this research activity is the coupling between neutron-kinetic (NK) and thermal-hydraulic (TH) codes for the developing of a full-integrated tool to investigate safety-relevant accidental scenarios characterizing these fission reactors of new generation. Within this framework, me and my colleagues have performed NK/TH simulations of the FFTF selected test by using PHISICS/RELAP5-3D© coupled codes.

IAEA CRP I31038 (Benchmark of Transition from Forced to Natural Circulation Experiment with Heavy Liquid Metal Loop) 2022 – 2025

This IAEA CRP involves twenty-two research institutions from ten member states. It deals with the simulation at a subchannel level of the thermal-hydraulic performances of a fuel pin bundle simulator installed at the NACIE-up facility hosted at ENEA Brasimone Research center. This experimental infrastructure has been conceived to investigate the transient behavior of Lead Fast Reactors with a special focus on the scenarios characterized by the transition to natural circulation. Several tests have been selected to be studied. During the next years I will carry out the numerical simulations required by the benchmark exercise.

ANSELMUS 2022 – 2026

The Advanced Nuclear Safety Evaluation of Liquid Metal Using Systems (ANSELMUS) project is part of the Horizon Europe Euratom research activities. Its final purpose is contributing to the safety risk assessment for GEN IV Liquid Metal Fast Reactors (LMFR). Both sodium and lead technologies are investigated, by considering MYRRHA and ALFRED reactors, respectively. I am currently involved in the Work Package 1, related to the development of a Phenomena Identification and Ranking Technique (PIRT) methodology to be applied during the LMFR design process. I will support the project by performing thermal-hydraulic transient simulations of ALFRED reactor during selected accidental scenarios.

SASPAM-SA 2022 – 2026

The technical activity is mainly focused on the In Vessel Melt Retention (IVMR) strategy developed for Light Water Reactors (LWR). It is an appealing solution for the mitigation of many Severe Accident (SA) scenarios. This approach is typical of innovative reactors (AP1000, Hualong One, both GW-size Pressurized Water Reactors, PWR). Within the framework of SASPAM-SA project the application of IVMR for integral PWR (iPWR) is investigated. These kinds of reactors are characterized by an electrical power output generally lower than 300 MWe, an integral layout and the use of passive safety systems. The purpose of task WP 4.1 is to develop a 0D model for the steady-state analysis of idealized cases in an iPWR. It is part of the preliminary activities which examine the evaluation of the safety margin for several existing iPWR designs, considering available data and plausible assumptions for the unknown parameters.