

# Curriculum Vitae

## INFORMAZIONI PERSONALI

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## FORMAZIONE TITOLI

### Academic record

- April 2002: Graduated *summa cum laude* in Nuclear Engineering at the University of Palermo. Graduation thesis titled “*Study of the WCLL-TBM nuclear response in ITER*”, carried out in collaboration with the Commissariat à l’Energie Atomique - Saclay Research Centre.
- July 2002: Chartered Engineer Habilitation.
- February 2006: Ph.D. in “*Innovative and fusion nuclear reactor engineering*” at Department of Nuclear Engineering of the University of Palermo. Doctoral dissertation titled “*Study of the nuclear response of the Helium - Cooled Lithium - Lead test blanket module*”.

### Fellowships

- September 2005 – July 2006: University research fellowships carried out at the Department of Nuclear Engineering of the University of Palermo on the subjects: “[Assessment of the Possible Lay-Out Influence on the HCLL-TBM Nuclear Response](#)”; “[Study of the potential influence of frame coolant on HCLL-TBM nuclear response](#)”; “*Study of the HCLL-TBM covers coolant distribution effect on its nuclear response*”.
- August 2006 – July 2010: Post doctoral research fellowship funded by the Italian Ministry for Education, University and Research and carried out at the Department of Nuclear Engineering of the University of Palermo on the subject “*Technological issues in the design of the Helium – cooled liquid metal breeding blanket of a fusion reactor*”.

### Employment record

- From September 2010: Assistant Professor of Nuclear Engineering (Scientific Area ING-IND/19 – “Impianti Nucleari”) at the Faculty of Engineering of the University of Palermo. Member of the Department of Energy, formerly known as Department of Nuclear Engineering.

## ATTIVITA' DIDATTICA

- From Academic Year 2006-07: subject *Nuclear Fusion Reactor Engineering* for the students of the second level (Master) degree courses in “Safety and Nuclear Technology Engineering” and “Energy and Nuclear Engineering”.
- From Academic Year 2010-11 to 2011-12: subject *Monte Carlo Methods in Engineering* for the students of the second level (Master) degree courses in “Energy Engineering”.
- From Academic Year 2012-13 to 2013-14: subject *Theory of nuclear reactor and Monte Carlo Methods* for the students of the second level (Master) degree courses in “Energy Engineering”.

The undersigned has taken part in the examination committees for several subjects including:

- *Nuclear Engineering I, Nuclear Engineering II, Nuclear Reactor Heat and Mass Transfer, Thermal-hydraulics* (“Nuclear Engineering” old 5-year degree course).
- *Principles of Nuclear Engineering, Nuclear Engineering* (first level degree course in “Energy Engineering”).
- *Nuclear Engineering, Nuclear Fusion Reactor Engineering*, (second level, or Master, degree courses in “Safety and Nuclear Technology Engineering” and “Energy and Nuclear Engineering”).

He has taken part in the Graduation Committees in “Energy Engineering” and “Energy and Nuclear Engineering” degree courses.

He has been also the supervisor of 3 graduation theses in “Energy and Nuclear Engineering” degree courses.

## PUBBLICAZIONE

The research activity has been reported in 29 publications including:

- 13 articles in international refereed journals and presented in international conferences;

- 4 papers presented at international conferences;
- 6 papers presented at national conferences;
- 1 departmental research memoranda;
- 2 international research reports.
- 3 national research reports.

#### Articles in international refereed journals and presented in international conferences

1. G. Vella, P. Chiovaro, P. A. Di Maio, A. Li Puma, E. Oliveri, *Neutronic and photonic analysis of the water-cooled Pb-17Li test blanket module for ITER-FEAT*. Fusion Engineering and Design, 61-62, pp. 439-447, 2002. Presented at the 6<sup>th</sup> International Symposium On Fusion Nuclear Technology ISFNT, April 7 - 12, 2002, San Diego, California, USA.
2. P. Chiovaro, P. A. Di Maio, E. Oliveri, G. Vella, *On the nuclear response of the water-cooled Pb-17Li Test Blanket Module for ITER-FEAT*. Fusion Engineering and Design, 69, n. 1-4, pp. 469-477, 2003. Presented at the 22<sup>nd</sup> Symposium On Fusion Technology SOFT, September 9 - 13, 2002, Helsinki, Finland.
3. P. Chiovaro, P. A. Di Maio, G. Vella, *On the nuclear response of the Helium-Cooled Lithium Lead Test Blanket Module in ITER*. Fusion Engineering and Design, 75-79, pp. 725-730, 2005. Presented at the 23<sup>rd</sup> Symposium On Fusion Technology SOFT, September 20 - 24, 2004, Venezia, Italy
4. P. Chiovaro, P. A. Di Maio, E. Oliveri, G. Vella, *On the influence of the supporting frame on the nuclear response of the Helium-Cooled Lithium Lead Test Blanket Module for ITER*. Fusion Engineering and Design, 81, pp. 677-686, 2006. Presented at the 7<sup>th</sup> International Symposium on Fusion Nuclear Technology ISFNT, May 22-27, 2005, Tokyo, Japan.
5. P. Chiovaro, P. A. Di Maio, E. Oliveri, G. Vella, *On the effects of the supporting frame on the radiation-induced damage of HCLL-TBM structural material*. Journal of Nuclear Materials, 367-370, pp. 1344-1349, 2007. Presented at the 12<sup>th</sup> International Conference on Fusion Reactor Materials, December 4-9, 2005, Santa Barbara, California, USA.
6. P. Chiovaro, P. A. Di Maio, E. Oliveri, G. Vella, *A study of the potential influence of frame coolant on HCLL-TBM nuclear response*. Fusion Engineering and Design, 82, pp. 2359-2365, 2007. Presented at the 24<sup>th</sup> Symposium On Fusion Technology SOFT, September 11 - 15, 2006, Warsaw, Poland.
7. P. Chiovaro, P. A. Di Maio, E. Oliveri, G. Vella, *A study of the potential influence of frame coolant distribution on the radiation-induced damage of HCLL-TBM structural material*. Fusion Engineering and Design, 83, pp. 1273-1276, 2008. Presented at the 8<sup>th</sup> International Symposium on Fusion Nuclear Technology ISFNT, September 30 – October 5, 2007, Heidelberg, Germany.
8. P. Chiovaro, P. A. Di Maio, G. Vella, *Study of the helium-cooled lithium lead test blanket module nuclear behaviour under irradiation in ITER*. Fusion Engineering and Design, 84, pp. 2178-2186, 2009.
9. P. Chiovaro, P. A. Di Maio, G. Vella, *Assessment of the possible lay-out influence in the HCLL-TBM nuclear response*. Journal of Fusion Energy, 28, pp. 335-341, 2009. Presented at the 25<sup>th</sup> Symposium On Fusion Technology SOFT, September 15 - 19, 2008, Rostok, Germany.
10. P. Chiovaro, P. A. Di Maio, R. Giannusso, Q. Lupo, G. Vella, *Thermal-Mechanical and Thermal-Hydraulic Integrated Study of the Helium-Cooled Lithium Lead Test Blanket Module*. Fusion Engineering and Design, 85, pp. 1147-1153, 2010. Presented at the 9<sup>th</sup> International Symposium on Fusion Nuclear Technology ISFNT, October 11 – 16, 2009, Dalian, China.
11. P. Chiovaro, P. A. Di Maio, G. Vella, [A neutron point kinetic model for fusion relevant calculations](#). Fusion Engineering and Design, 87, pp. 1147-1153, 2012.
12. P. Chiovaro, P. A. Di Maio, V. Parrinello, [Nuclear analysis of an ITER blanket module](#). Journal of Fusion Energy, 32, pp. 600-606, 2013.
13. P. Chiovaro, P. A. Di Maio, [On the adoption of the Monte Carlo method to solve one-dimensional steady state thermal diffusion problems for non-uniform solids](#). *Applied Mathematical Modelling*, 37, 9707-9721, 2013.

#### Papers presented at international conferences

1. P. Chiovaro, P. A. Di Maio, E. Oliveri, E. Tomarchio, G. Vella, *On the AGN - 201 "COSTANZA" Research Reactor at the Department of Nuclear Engineering of the University of Palermo*. Proceedings of the International Symposium on Research Reactor and Neutron Science – HANARO 2005, April 11-13, 2005, Daejeon, KOREA.
2. P. Chiovaro, F. D'Aleo, P. A. Di Maio, E. Oliveri, E. Tomarchio, G. Vella, *Studies on the AGN - 201 "COSTANZA" Research Reactor*. Proceedings of the First International Conference on Physics and Technology of Reactors and Applications - PHYTRA1 GMTR (2007), March 14 - 16, 2007, Marrakech, MOROCCO, pp.171-179, ISBN 978-9954-9000-0-0.
3. E. Tomarchio, M. Casamirra, P. Chiovaro, F. D'Aleo, P. A. Di Maio, M. Giardina, G. Vella, *A training experience of operators with the AGN-201 "Costanza" research reactor of Palermo university*. Proceedings of the RRFM 2011 - European Research Reactor Conference 2011, March 20-24, 2011, Rome, ITALY.
4. P. Chiovaro, P. A. Di Maio, G. Vella, *A neutron point kinetic model for fusion relevant calculations*. 10<sup>th</sup> International Symposium on Fusion Nuclear Technology (ISFNT), September 11 - 16, 2011, Portland, Oregon, USA.

#### Papers presented at national conferences

1. P. Chiovaro, E. Oliveri, *Probabilità di fuga di "particelle" nucleari da corpi a simmetria sferica*, Atti della Accademia di Scienze, Lettere ed Arti, Palermo, Serie quinta Volume XXIV Anni Accademici 2004-2008, Tomo I.
2. P. Chiovaro, P. A. Di Maio, R. Giannusso, Q. Lupo, G. Vella, *Thermal analysis of the Helium-Cooled Lithium Lead Test Blanket Module to be irradiated in ITER*. Atti del XXVII Congresso Nazionale sulla Trasmissione del Calore, Reggio Emilia, 22-24 Giugno 2009, pp. 371-376, ISBN 978-88-7488-312-7.
3. P. Chiovaro, E. Oliveri, *Una variante del problema dell'ago di Buffon e verifica con il metodo Monte Carlo*, Atti della Accademia di Scienze, Lettere ed Arti, Palermo, Serie quinta Volume XXIV Anno Accademico 2009, Tomo I.

4. P. Chiovaro, F. D'Aleo, P. A. Di Maio, E. Oliveri, G. Vella, *On the improved current pulse method for the dynamic assesment of thermal diffusive properties*, Atti della Accademia di Scienze, Lettere ed Arti, Palermo, Serie quinta Volume XXIV Anno Accademico 2009, Tomo I.
5. P. Chiovaro, P. A. Di Maio, G. Vella, *Applicazione del metodo Monte Carlo a problemi monodimensionali di conduzione termica stazionaria in sistemi con conducibilità dipendente dalla posizione*. Atti dell'Accademia Nazionale di Scienze, Lettere ed Arti di Palermo, Serie VI, I, pp. 85-102, 2010.
6. P. Chiovaro, P. A. Di Maio, F. Mascari, G. Vella, *Analysis of the SPES-3 direct vessel injection line break by using TRACE code*. Atti del XXIX Congresso Nazionale sulla Trasmissione del Calore, Torino, 20-22 Giugno 2011, pp. 347-352, ISBN 978-88467-3072-5.

#### Departmental research memorandum

1. P. Chiovaro, P. A. Di Maio, G. Vella, *Studio della risposta nucleare del Water-Cooled Lithium Lead Test Blanket Module nel reattore ITER-FEAT*. Quaderni del Dipartimento di Ingegneria Nucleare, 8/2002.

#### International research reports

1. P. Chiovaro, P. A. Di Maio, G. Vella, *On the nuclear response of the HCLL-TBM in ITER-FEAT*. Report for the Commissariat à l'Energie Atomique - Saclay, September, 2003.
2. P. Chiovaro, P. A. Di Maio, G. Vella, *On the nuclear impact of different coolants in the HCLL-TBM in ITER-FEAT*. Report for the Commissariat à l'Energie Atomique - Saclay, October, 2003.

#### National research reports

1. A. Caronia, M Casamirra, F. Castiglia, P. Chiovaro, M. Ciofalo, P.A. Di Maio, I. Di Piazza, M. Giardina, C. Lombardo, E. Oliveri, S. Puleo e G. Vella, *Convezione naturale in fluidi a basso numero di Prandtl con generazione interna di potenza: risultati computazionali per diverse geometrie*, Rapporto CERSE-UNIPA RL-1200/2008 (lavoro svolto in esecuzione della linea progettuale LP3 – punto F dell'AdP ENEA MSE del 21/06/07, Tema 5.2.5.8 – “Nuovo Nucleare da Fissione”). Dipartimento di Ingegneria Nucleare, Università di Palermo, Novembre 2008. Pubblicato nell'Aprile 2010.
2. A. Caronia, M Casamirra, F. Castiglia, P. Chiovaro, M. Ciofalo, P.A. Di Maio, I. Di Piazza, M. Giardina, C. Lombardo, E. Oliveri, S. Puleo e G. Vella, *Studio con il codice RELAP5 dello scambio termico e delle perdite di carico in generatori di vapore a tubi elicoidali*, Rapporto CERSE-UNIPA RL-1201/2008 (lavoro svolto in esecuzione delle linee progettuali LP2 – punto P e LP3 – punto G dell'AdP ENEA MSE del 21/06/07, Tema 5.2.5.8 – “Nuovo Nucleare da Fissione”). Dipartimento di Ingegneria Nucleare, Università di Palermo, Dicembre 2008. Pubblicato nell'Aprile 2010.
3. A. Caronia, M Casamirra, F. Castiglia, P. Chiovaro, M. Ciofalo, P.A. Di Maio, I. Di Piazza, M. Giardina, C. Lombardo, E. Oliveri, S. Puleo e G. Vella, *Modellazione numerica del campo di moto e dello scambio termico in condotti elicoidali*, Rapporto CERSE-UNIPA RL-1202/2008 (lavoro svolto in esecuzione della linea progettuale LP2 – punto P dell'AdP ENEA MSE del 21/06/07, Tema 5.2.5.8 – “Nuovo Nucleare da Fissione”). Dipartimento di Ingegneria Nucleare, Università di Palermo, Novembre 2008. Pubblicato nell'Aprile 2010.

## ATTIVITA' SCIENTIFICHE

The research activity has been carried out in the field of nuclear engineering and has mainly regarded the study of nuclear issues and thermo-mechanical, relevant to the design and development of a TOKAMAK nuclear fusion reactor.

It has been performed following both an experimental and a theoretical approach. In the latter case both analytical and numerical techniques, based on the use of the Finite Element Method and the Monte Carlo Method, have been adopted.

The main research subjects are herewith reported.

- Investigation of the nuclear response of liquid metal Test Blanket Modules under irradiation in ITER by means of Monte Carlo neutronic and photonic analysis
- Experimental investigation of the thermal diffusive properties of non-coherent granular materials by the improved current pulse method.

The research activity has been carried out in close cooperation with researchers of ENEA-Brasimone and CEA-Saclay.

Moreover, the research activity has been focussed also on nuclear fission issues related both to thermal - hydraulic and neutronic features. Both the subjects have been developed by numerical analyses based on the use the Finite Volume Method and the Monte Carlo Method. The main research subjects are herewith reported.

- Investigation, by the RELAP code, of the heat transport and pressure drop in steam generator with helicoidal tubes to be used in III generation nuclear power plants. This research activity has been carried out in the framework of the project line “LP2 – punto P dell'AdP ENEA MSE del 21/06/07, Tema 5.2.5.8 – Nuovo Nucleare da Fissione”.
- Criticality and dosimetric calculations on the AGN 201 nuclear research reactor installed at the Department of Nuclear Engineering of the University of Palermo.

- The undersigned has been a referee for the international journal "*Fusion Engineering and Design*".

The undersigned is currently a member of the *Italian Union of Thermal-Fluid Dynamics*.

#### **AMBITI DI RICERCA**

The research activity has been carried out in the field of nuclear engineering and has mainly regarded the study of nuclear issues and thermo-mechanical, relevant to the design and development of a TOKAMAK nuclear fusion reactor.

It has been performed following both an experimental and a theoretical approach. In the latter case both analytical and numerical techniques, based on the use of the Finite Element Method and the Monte Carlo Method, have been adopted.