

**Part A. PERSONAL INFORMATION**

<b>CV date</b>	07/10/2019
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First and Family name	Pedro Pérez Fernández		
Social Security, Passport, ID number	47507084D	Age	36
Researcher codes	WoS Researcher ID (*)	L-1206-2014	
	SCOPUS Author ID(*)	25927481600	
	Open Researcher and Contributor ID (ORCID) **	0000-0002-4706-7080	

(\*) At least one of these is mandatory

(\*\*) Mandatory

**A.1. Current position**

Name of University/Institution	University of Seville		
Department	Física Aplicada III		
Address and Country	Escuela Técnica Superior de Ingeniería, Sevilla, Andalucía, Spain		
Phone number	954488149	E-mail	<a href="mailto:pedropf@us.es">pedropf@us.es</a>
Current position	Profesor Contratado Doctor	From	28/01/2019
Key words	Nuclear Physics, Algebraic Models, Quantum Phase Transitions		

**A.2. Education**

PhD	University	Year
Licenciatura en Matemáticas	Universidad de Sevilla	2017
Doctorado en Física Nuclear (PhD)	Universidad de Sevilla	2011
Licenciatura en Física	Universidad de Sevilla	2006

**A.3. JCR articles, h Index, thesis supervised...**

Six-year periods of research awarded by the CNEAI: I have not applied them yet.

Web of Science (WoS): 23 papers, 241 total times cited, h index = 7.

WoS, number of papers in first quartile (Q1): 12 papers

WoS, average number of times cited last five years: 4.73 citations/year

Supervisor of one PhD thesis in Mathematical Physics: Nuevas herramientas en el marco de la Teoría de Lie con aplicaciones a la Física. Student: José María Escobar Rica. Date of dissertation: 8th April 2019.

**Part B. CV SUMMARY (max. 3500 characters, including spaces)**

My research focuses mainly on the study of Quantum Phase Transitions (QPTs) in nuclear models. Since this type of transitions can be found in very different physical systems, I have carried out works in the field of Nuclear Physics with the Lipkin model, Molecular Physics with the Vibron model and Quantum Optics with the Dicke model. All these models share the common feature that they can be described as two-level systems, as the Interacting Boson Model (IBM) in Nuclear Physics. Indeed, I belong to a research group that has an extensive experience in the aforementioned model. In addition to the QPTs that can be found in these models, I recently became interested in exploring Excited State Quantum Phase Transitions (ESQPTs) and what dynamic consequences has on the phenomenon of decoherence when a qubit is coupled to the system. In addition, I have also studied the relationship between the precursors of ESQPTs and the onset of quantum chaos in the system. Another common aspect to these models is their relationship with the physical symmetries, which makes them excellent to apply algebraic tools based on Lie algebras.

Because in general, the size of physical systems under study is not infinite, I have also explored finite-size corrections of the system to characterize critical exponents of different observables at the critical point of the QPT. This way, it is possible to know how observables scale with the size of the system.



Furthermore, together with Professor T. Brandes' research group of the Technische Universität Berlin, I have extended the concept of ESQPT to dynamic systems in which there is an explicit time dependence and we have proposed a measurement protocol to experimentally observe ESQPTs.

I am currently studying the relationship between ESQPTs and thermal phase transitions, since it is known that certain models exhibit both types of phase transitions. As a result of this line of research, I have recently published a paper in Physical Review E whose results are promising. Furthermore, I keep a collaboration with a research group in the Department of Geometry and Topology of the Faculty of Mathematics of the University of Seville. As result of this collaboration, I have supervised a Ph.D. thesis in the field of Mathematical Physics.

I have attended approximately 20 international meetings, communicating my research results, with 2 invited talks. Also I have written a couple of popular science books.

Last but not least, to carry out my research I have performed several short stays and visits among which I highlight the ones to the Instituto de Estructura de la Materia (IEM), which is a research center in Madrid belonging to the CSIC, the Charles University in Prague and the Technische Universität Berlin in Berlin. All these contributions have led to publications in high impact journals.

## **Part C. RELEVANT MERITS**

### **C.1. Publications (including books)**

Publication in Journal. Dukelsky, Jorge; García-Ramos, José Enrique; Arias Carrasco, José Miguel; Pérez-Fernández, Pedro; Schuck, Peter. 2019. Number conserving particle-hole RPA for superfluid nuclei. Physics Letters B **795**: 537-541.

Publication in Journal. Pérez-Fernández, Pedro; Relaño, Armando. 2017. From thermal to excited-state quantum phase transition: the Dicke model. Physical Review E **96**: 012121-1-012121-14.

Publication in Journal. García-Ramos, José Enrique; Pérez-Fernández, Pedro; Arias Carrasco, José Miguel; Freire-Macias, Emilio. 2016. Phase diagram of the two-fluid Lipkin model: A "butterfly" catastrophe. Physical Review C **93**: 034336-1-034336-10.

Publication in Journal. Bastidas, Victor Manuel; Pérez-Fernández, Pedro; Vogl, Malte; Brandes, Tobias. 2014. Quantum Criticality and Dynamical Instability in the Kicked-Top Model. Physical Review Letters **112**: 140408-1-140408-5.

Publication in Journal. Bastidas, Victor Manuel; Engelhardt, Georg; Pérez-Fernández, Pedro; Brandes, Tobias. 2014. Critical quasienergy states in driven many-body systems. Physical Review A **90**: 063628-1-063628-9.

Publication in Journal. Relaño, Armando; Dukelsky, Jorge; Pérez-Fernández, Pedro; Arias Carrasco, José Miguel. 2014. Quantum phase transitions of atom-molecule Bose mixtures in a double-well potential. Physical Review E **90**: 042139-1-042139-1.

Publication in Journal. Pérez-Fernández, Pedro; Jorge; Arias Carrasco, José Miguel; García-Ramos, José Enrique; Pérez-Bernal, Francisco. 2011. Finite-size corrections in the bosonic algebraic approach to two-dimensional systems. Physical Review A **83**: 062125-1-062125-15.

Publication in Journal. Pérez-Fernández, Pedro; Cejnar, Pavel; Arias Carrasco, José Miguel; Dukelsky, J; García-Ramos, José Enrique; Relaño, Armando. 2011. Quantum quench influenced by an excited-state phase transition. Physical Review A **83**: 033802-1-033802-14.

Publication in Journal. Pérez-Fernández, Pedro; Relaño, Armando; Arias Carrasco, José Miguel; Cejnar, Pavel; Dukelsky, J; García-Ramos, José Enrique; 2011. Excited-state phase



transition and the onset of chaos in quantum optical models. Physical Review E **83**: 046208-1-046208-4.

Publication in Journal. Pérez-Fernández, Pedro; Relaño, Armando; García-Ramos, José Enrique; Arias Carrasco, José Miguel; Dukelsky, J. Decoherence due to an excited state quantum phase transition in a two-level boson model. 2009. Physical Review A **80**: 032111-1-032111-10.

## **C.2. Research projects and grants**

Title: Estructura de Núcleos, Moléculas y Hadrones y su Dinámica en Procesos de Dispersión Fuerte y Electrodebil (FIS2014-53448-C2-1-P)

Funding Entity: Ministerio de Economía y Competitividad

Organizations involved: Universidad de Sevilla and Universidad de Huelva

Research leader: Antonio Matías Moro Muñoz and Juan Antonio Caballero Carretero

Start date: 01/01/2015

Completion date: 30/06/2018

Grant Amount: 72600.00 eur

Number of participants: 8

Type of participation: Researcher

Title: La Física Nuclear Fuera del Valle de Beta-Estabilidad: Sus Implicaciones en Astrofísica (P11-FQM-7632)

Funding Entity: Junta de Andalucía. Consejería de Innovación, Ciencia y Empresas.

Organizations involved: Universidad de Sevilla

Research leader: Lozano-Leyva, Manuel Luis

Start date: 26/03/2013

Completion date: 31/03/2018

Grant Amount: 176918.30 eur

Number of participants: 18

Type of participation: Researcher

Title: Física con Sistemas de Fermiones Correlacionados: Estudios en Física Nuclear y Extensión a Otros Campos (FIS2011-28738-C02-01)

Funding Entity: Ministerio de Economía y Competitividad

Organizations involved: Universidad de Sevilla and Universidad de Huelva

Research leader: Caballero-Carretero, Juan Antonio

Start date: 01/01/2012

Completion date: 31/12/2015

Grant Amount: 71390.00 eur

Number of participants: 12

Type of participation: Researcher

Title: Sistemas de Fermiones fuertemente correlacionados: Estructura, Dispersión y Aplicaciones (FIS2008-04189)

Funding Entity: Ministerio de Ciencia e Innovación

Organizations involved: Universidad de Sevilla

Research leader: Arias Carrasco, José Miguel

Start date: 01/01/2009

Completion date: 31/03/2012

Grant Amount: 107690.00 eur

Number of participants: 14

Type of participation: Researcher

Title: Núcleos en el límite de la estabilidad en el Centro Nacional de Aceleradores (P07-FQM-02894)

Funding Entity: Junta de Andalucía (Consejería de Innovación, Ciencia y Empresa)

Organizations involved: Universidad de Sevilla

Research leader: Lozano-Leyva, Manuel Luis

Start date: 31/01/2008

Completion date: 31/12/2012

Grant Amount: 306000.00 eur

Number of participants: 20



Type of participation: Researcher

### **C.3. Contracts**

No

### **C.4. Patents**

No

### **C.5, C.6, C.7... (e. g., Institutional responsibilities, memberships of scientific societies...)**

Referee of Nature Physics and Frontiers of Physics.

Supervisor of 6 final projects in the degree of Physics and supervisor of 2 final degree project in the degree in Industrial Technologies Engineering, both of the Universidad de Sevilla. I am currently supervising a Master thesis at the Faculty of Physics about the study of an anharmonic Lipkin.

I have the habilitation to Profesor Titular de Universidad since the beginning of 2019.

Author of the book about popular science entitled "*Las nubes y el polvo cósmicos*" belonging to the collection "*Un paseo por el cosmos*". Editorial RBA. ISBN: 978-84-473-9137-0. Year 2018.

Coauthor together with Marta Sabaté Gilarte of the book about popular science entitled "*Megaciencia. Los proyectos más grandes de la física*" belonging to the collection "*Los desafíos de la ciencia*". Editorial RBA jointly National Geographic. In press.

Award to the Best Scientific Article of the Trimester of the ETSI for the third quarter of 2017 by Escuela Técnica Superior de Ingeniería of Universidad de Sevilla. The paper awarded is: Pérez-Fernández, Pedro; Relaño, Armando. 2017. From thermal to excited-state quantum phase transition: the Dicke model. Physical Review E **96**: 012121-1 012121-14.

Collaborator of the Instituto de Matemáticas Universidad de Sevilla (IMUS).

Member of the Instituto Carlos I de Física Teórica y Computacional de la Universidad de Granada (iC1).

FPU predoctoral fellowship awarded by the Spanish "Ministerio de Ciencia e Innovación" (2007-2010).