

BREVE BIOGRAFIA PROFESSIONALE

Kristian Piscicchia è Ricercatore del Centro Ricerche Enrico Fermi (CREF)

E' un esperto nello sviluppo di modelli teorico/fenomenologici per l'interpretazione di dati di spettroscopia di precisione di raggi X in Meccanica Quantistica e Fisica Nucleare.

E' responsabile Nazionale INFN dell'esperimento Violation of the Pauli exclusion principle (VIP) che ha stabilito i più forti limiti sperimentali sui modelli di violazione di spin-statistica per elettroni, e sui modelli di collasso dinamico della funzione d'onda.

E' responsabile dell'analisi dati dell'esperimento AMADEUS e membro delle collaborazioni SIDDHARTA-2 presso l'acceleratore DAΦNE in Italia, E15, E17, E45, E57, E72 presso il J-PARC in Giappone. Si occupa di modelli di "pionizzazione" per lo studio della struttura della superficie nucleare, nonché della meccanica statistica dei sistemi autogravitanti, investigando il ruolo della "stranezza" negli aloni di materia oscura.

Nella sua carriera ha pubblicato più di 180 articoli su riviste peer-reviewed, ha tenuto più di 40 fra invited talks, seminars, lectures o colloquia ed ha organizzato 15 conferenze o workshops internazionali. E' editor di due special issues per le riviste Symmetry e J ed è molto attivo nella divulgazione scientifica.

Attualmente è responsabile del progetto CREF "Problemi Aperti in Meccanica Quantistica".

CURRICULUM VITAE

NAME: Kristian Piscicchia

PLACE OF BIRTH: Narni (TR) - Italy

DATE OF BIRTH: 19th July 1982

CITIZENSHIP: Italian

WORK ADDRESS: Centro Ricerche Enrico Fermi - Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi", Via Panisperna 89A, 00184 Rome – Italy
and

Laboratori Nazionali di Frascati dell'INFN (LNF-INFN), Via E. Fermi 40, 00044 Frascati (Roma) - Italy

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Studies and qualifications

2009-2013 PhD, XXV doctoral formation cycle in Mathematical and Physical sciences – Physics section, at the Department of Physics of Università degli Studi Roma TRE, PhD thesis titled:

"Lambda(1405) measurement through the decay to Sigma0pi0, resulting from K- meson absorption on 4He and 12C, with the KLOE detector". Title obtained on 20/02/2013.

2006 - 2009 Master Degree in Astronomy and Astrophysics at the Università degli Studi di Roma "La Sapienza", grade 110/110 Magna cum Laude, Master Degree thesis titled "Statistical mechanics for selfgravitating systems: gravothermal instability for King models", obtained on 26/06/2009

2001 – 2006 Bachelor Degree in Physics and Astrophysics at the Università degli Studi di Roma "La Sapienza", grade 110/110, Bachelor Degree thesis titled "Violent relaxation of stellar systems", obtained on 30/05/2006

1996 – 2001 High School "Liceo scientifico R. Donatelli" of Terni.

High school diploma 100 / 100.

Research activity and work experience

2019 – present Researcher, permanent staff at Centro Ricerche Enrico Fermi – Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi" (Italy); PI for the project "Open Problems in QuantumMechanics"

2016 – 2018 I won a research grant for three years, after a concourse, to perform research activity at Centro Fermi and at LNF-INFN on the project: "Open problems in quantum mechanics, new theoretical developments, innovative experimental researches dedicated to the Dynamical Reduction Models".

2013 – 2015: I won a research grant for three years in 2013, after a concourse, to perform research activity at Centro Fermi and at LNF-INFN on the project: "Development of SDD detectors systems and of Dynamical Reduction Models for the experimental investigation of open problems in quantum mechanics". Theoretical activity and development of statistical models and numerical simulations connected with the project.

2009 – 2013: PhD fellowship (after a concourse) at the "Laboratori Nazionali di Frascati" of INFN. Research activity on: upgrade of the VIP experiment and development of a Bayesian method dedicated to the VIP data analysis, KLOE data analysis, investigation of the reconstruction capability of the KLOE detector for the

AMADEUS experiment, development of a trigger system (based on SiPM and scintillating fibers) for the AMADEUS experiment.

2006 – 2008: Scientific stage at the Physics Institute for the Interplanetary Space (IFSI) Italy. Research activity based on data analysis and reduction of Spitzer-spectra of Seyfert galaxies.

Main research interests and scientific achievements

1) FOUNDATIONS OF QUANTUM MECHANICS

Wave Function Collapse models tests

My study is devoted to the theoretical and experimental investigation of the spontaneous radiation emission process, predicted by the Dynamical Reduction Models (Entropy 2017, 19(7), 319, International Journal of Quantum Information Vol. 17, No. 8 (2019) 1941011). In recent years my investigation concentrated on the experimental tests of the models initially developed by L. Diosi ed R. Penrose (DP). DP proposes a gravity related collapse mechanism, allowing the collapse strength to be the Newton constant G of gravity, and being characterized by a single free parameter R_0 . In collaboration with Diosi, Donadi and Derakhshani I calculated the expected rate of spontaneous X-rays emission in the context of the DP model. I developed a Bayesian model which lead to the extraction, from the data sets measured at the Laboratori Nazionali del Gran Sasso (LNGS) of INFN, of the probability distribution function of the parameter R_0 , from which the DP model (in its present formulation) is ruled out (Donadi S., Piscicchia K. et al., Nature Physics volume 17, pages 74–78 (2021)). An analogous analysis for the CSL collapse model was performed in S. Donadi, K. Piscicchia et al., Eur. Phys. J. C (2021) 81: 773. The implications of these results on the Orch OR model were investigated in Physics of Life Reviews Volume 42, September 2022, Pages 8-14.

This work was presented by me in 24 international conferences, one Invited Lecture one Invited Seminar and one Invited Colloquium.

I am the Italian national INFN responsible and coordinator of the data analyses for these experimental activities.

PI for the CREF project “Open Problems in Quantum Mechanics”

I was organizer of 9 international conferences and workshops on these items.

Test of the Pauli exclusion principle with the VIP experiment

The VIP experiment, operated at LNGS, aims to perform high precision tests of the Pauli Exclusion Principle (PEP) for electrons, and look for a possible small violation.

VIP-Open Systems - The experiment aims at testing local quantum field theories - e.g. the Quon Model - of PEP violation, which are subject to the Messiah-Greenberg superselection rule. The method consists in circulating a current in a copper strip, searching for the X radiation emission due to a prohibited transition (from the 2p level to the 1s level when this is already occupied by two electrons). The energy of the transition would differ from the standard $K\alpha$ (2p to 1s) of about 300 eV. The phenomenological analyses of the VIP-2 data lead to the strongest existing limits on the models (see in particular: K. Piscicchia et al., Eur. Phys. J. C (2020) 80: 508; H. Shi et al., Eur. Phys. J. C (2018) 78: 319; K. Piscicchia et al., Entropy 2020, 22(11), 1195; K. Piscicchia et al., Condens. Matter 2019; Entropy 2018, 20(7), 515; Entropy 2017, 19(7), 300; Symmetry 2021, 13(1), 6, Symmetry 2022, 14(5), 893).

VIP-Closed Systems - The experiment tests Non Commutative Quantum Gravity models, which predict PEP violation at an energy scale close to the non-commutativity scale. The method consists in the first survey of the spectral shape predicted for the whole K complex, by exploiting extreme radio-purity Roman lead targets and High Purity Germanium detectors. The study allowed to constraint the non-commutativity scale well above the Planck scale for θ -Poincaré and $\theta_{0i} \neq 0$.

VIP was presented by me in 8 international conferences and one Invited Lecture.

I organized 1 workshop on this item

I am the Italian national INFN responsible of the VIP experiment and coordinator of the data analyses.

2) HADRONIC NUCLEAR PHYSICS IN THE STRANGENESS SECTOR

My study is focused on the low energy hadronic antikaon($K_{\bar{a}}$)-nucleon interaction within the AMADEUS Collaboration. I led the collaboration among AMADEUS and KLOE2 for the realization of a joint experiment. From July 2015 I was appointed coordinator of the AMADEUS data analyses. In the context of the low-energy QCD studies I am member of the SIDDHARTA-2 collaboration at DAFNE, for which I contributed to the experiment development characterizing the SDD detectors. I am also part of the E15, E17, E45, E57, E72 collaborations at J-PARC, in which I collaborate to the data analysis and interpretation.

Some representative publications: Nucl. Instrum. Meth. A671 (2012) 125-128; JINST 8 (2013) T05006; Nucl.Phys. A914 (2013) 251-259; Nucl. Phys. A954 (2016) 75-93; Physics Letters B 758 (2016) 134–139; Phys.Lett. B782 (2018) 339-345, Eur.Phys.J. C79 (2019) no.3, 190, Phys.Rev.Lett. 123 (2019) no.2, 022002, Phys.Lett. B789 (2019) 620-625, Phys.Scripta 95 (2020) 8, 084012, *Measur.Sci.Tech.* 32 (2021) 9, 095501, *Phys.Rev.Lett.* 128 (2022) 11, 112503.

The studies in this sector were presented by me in more than 30 international conferences.

I organized of 4 international workshops on the described items.

I am coordinator of the AMADEUS data analyses.

3) STATISTICAL MECHANICS OF LONG RANGE INTERACTION SYSTEMS

Period 2008-2009 Master Degree thesis. I developed a statistical mechanics model describing the evolution of a self-gravitating system immersed in an external tidal field. The gravothermal stability limit of the Globular Clusters was obtained with impact on generic systems of long range interacting particles. The predicted gravothermal stability limit recently received observational evidence (The Fourteenth Marcel Grossmann Meeting, 2509-2514, The Fourteenth Marcel Grossmann Meeting, 2515-2522). Self-gravitating strange dark matter halos were investigated in Phys. Rev. D **102**, 083015, (2020).

These studies were presented by me in 2 conferences.

4) ANALYSIS OF THE SPITZER-SPECTRA OF SEYFERT GALAXIES

During the period 2006-2008 I performed a research stage at the Italian Physics Institute for the Interplanetary Space (IFSI). The research work was devoted to the analysis of infrared spectra of Seyfert galaxies.

5) STUDY OF THE RELAXATION TIMES OF SELF-GRAVITATING SYSTEMS

In the period 2005-2006 Bachelor Thesis, I studied the relaxation mechanisms to which stellar systems (like stellar clusters and galaxies) are subject, with particular regard to the violent relaxation mechanism.

Responsibilities

- PI for the CREF project “Open Problems in Quantum Mechanics”
- Italian national INFN responsible of the VIP experiment,
- Coordinator of the AMADEUS experiment data analyses,
- Editor of the Special Issue: Symmetries and the Pauli Exclusion Principle, for the journal Symmetry
- Editor of the Special Issue: Dark Matter and Cosmic Rays, for the journal J

Projects/Grants

- 1 October 2021 – ongoing: co-PI for the QUBO (Quantum Boundaries) project financed by John Templeton Foundation.
- 22 July 2021 – ongoing: co-PI for MITIQO Research Project financed by Regione Lazio

I gave more than 70 presentations at Conferences and Workshops (more than 40 among invited talks, seminars, lectures or colloquia);

Organizer of more than 15 International Workshops and Conferences, with latest 5:

- 1) Is Quantum Theory exact? From quantum foundations to quantum applications, 23-27 September 2019, Frascati,
- 2) Is Quantum Theory exact? Exploring Quantum Boundaries, online, 10-11 December 2020
- 3) STRANU: Hot Topics in STRANgeness Nuclear and Atomic Physics, 24-28 May 2021, ECT*
- 4) Nuclear and Atomic Transitions as Laboratories for High Precision Tests of Quantum Gravity inspired Models, 27-29 July 2021, ECT*
- 5) Mini Symposium Quantum Boundaries: Gravity Related Collapse Models, LNF (INFN), 22 December 2021

DISSEMINATION ACTIVITY

- In 2019 Scientific Responsible for the CREF museum outfitting.
- from 2012 I am part of SIS-Educational at (LNF-INFN), performing dissemination activities in schools, universities and public events like:
 - “International MasterClass”
 - “Seminars in high schools”
 - “Open Labs” and “Researchers Night”
 - “INSPYRE – INternational School on modern PhYsics and REsearch”
 - “Summer Stages”
- Outreach activity in the EEE collaboration.