

LEONARDO PISANI

lpisani2@gmail.com

SUMMARY OF COMPETENCIES AND KEY SKILLS

Condensed Matter Field Theory, Superconductivity & Ultracold Atomic Gases

- Many-body diagrammatic approaches to Fermi and Bose superfluids
- BCS-BEC crossover within and beyond gaussian fluctuations
- Ultracold atomic gases: Josephson critical current, stability of persistent currents, radio frequency spectra, density profiles and superfluid transition temperature
- Tunnelling spectra of strong coupling unconventional superconductors (granular Aluminium)
- Single- and two-particle dynamical correlators of the homogenous strongly interacting Fermi gas
- Magnetism in carbon-based and metal-organic systems with application in Spintronics
- Phase diagram and long-range order in strongly correlated low dimensional systems

Density Functional Theory (DFT)

- expertise in DFT within the LAPW (linearised augmented plane wave) basis set and related software WIEN2k (Vienna) and within the Gaussian basis set and related software CRYSTAL (Turin-Daresbury Lab.)
- familiarity with a wide range of exchange-correlation functional (local density (LDA), generalised gradient (GGA, PBE), Hubbard correlation (LDA+U, GGA+U), Hartree-Fock hybrid (B3LYP))
- calculation of several material properties using DFT: electronic (band) structure, structural optimisation, dynamical forces, magnetic long range order, charge and spin density (Wannier decomposition), phonons (group theory analysis, mode assignment and atomic displacements), spin polarised transport

Materials Science & Spintronics

- Strongly correlated low dimensional transition metal oxides and anomalous spin-Peierls transition
- Interpretation of ARPES, infrared and Raman spectra in collaboration with experimental groups.
- Design of spintronics devices: dilute magnetic semiconductors with high Curie temperature and metal-organic compounds.
- Ferromagnetic long-range order and spin polarised transport in graphene ribbons
- Room temperature ferromagnetism in defective graphene

Financial Engineering

- Probability theory, Random walk, Markov chain, Brownian motion, stochastic differential equations and Ito's calculus, local and stochastic volatility models
- Theory of arbitrage pricing, hedging and risk management of standard and exotic derivatives
- Finite difference methods for partial differential equations and Monte-Carlo simulation
- Knowledge of the financial markets and their regulations, particularly foreign exchange

Banking Business

- Work under pressure for long hours in a fast-paced environment
- Ability to multitask and provide real-time support to the live trading desks
- Efficient collaboration with the information technology (I.T.) and other departments
- Management and coordination of I.T. outsourcing
- Clear, timely reporting and documentation skills
- Team building spirit, openness to constructive criticism from colleagues, strong individual drive, clarity in communication and customer service attitude

Programming & Numerical Methods

- Development of a multiple-programmer library in C++
- Expertise in object oriented programming (encapsulation, polymorphism, overloading, templating) and memory management
- Knowledge of the principles of software engineering: coding standards, extreme programming, code review, testing, debugging and deployment; automated code revision systems
- Extensive usage of modules and derived data types with Fortran 90/95
- Proficiency in numerical techniques for integration, interpolation, minimisation, sorting, root finding

ORCID: ORCID.ORG/0000-0001-6865-3372
SCOPUS: SCOPUS Author ID: 7004077663
RESEARCHERID:RESEARCHERID: N-4658-2018

H-INDEX: 14

CAREER HISTORY

University of Camerino, Camerino and LENS, University of Florence **Sep.'21-Sep'23**

Collaboration (Prof. P. Pieri, Prof. G. C. Strinati, Dr. G. Roati, Prof. G. Deutscher)

- Josephson critical current and stability of persistent currents in ultracold Fermi gases throughout the BCS-BEC crossover
- Tunnelling spectra and pseudo-gap in unconventional superconductors (granular Aluminium)

University of Camerino, Camerino, Italy

Sep.'19-Sep'21

Research Fellowship (Prof. P. Pieri and Prof. G. C. Strinati)

- Off-Diagonal long-range order and coherence lengths in the BCS-BEC crossover
- Radio Frequency Spectroscopy and Bragg Spectroscopy in ultracold Fermi gases

University of Camerino, Camerino, Italy

Mar.'17-Mar'19

Collaboration (Prof. P. Pieri and Prof. G. C. Strinati)

- Gorkov-Melik-Barkhudarov corrections to the critical temperature and order parameter of a neutral superfluid Fermi system

Sabbatical period

Mar.'13-Sep'16

- After years of metropolitan living and intense work schedule I decided to retreat to the beautiful landscape of the Nature Reserve of Mount San Vicino, where my late mother came from.
- Collaboration (Jul.'13-Apr.'14) with Prof. T. Maitra (Indian Institute of Technology, Roorkee) on geometrically frustrated magnetic systems with competing orbital degrees of freedom.

Commerzbank, London

Mar.'08-Mar'13

Financial Engineer

- Front office role within the foreign exchange (FX) financial engineering team aimed at the development of the pricing (C++) library and live support of structuring, trading and sales desks
- Complete knowledge of FX market conventions and FX volatility surface construction
- Familiar with models of Local Volatility, Local Stochastic Volatility, FX-IR Hybrid and numerical techniques like Monte-Carlo and Finite Difference Methods (generalised Crank-Nicholson)
- Theory of arbitrage pricing, stochastic differential equations and Ito's calculus
- Implemented risk engine for generation of greeks and bid ask prices (C++) across the full range of FX products: options, vanilla strategies, exotic and structured products
- Implemented a consistent framework for the estimation of non-hedgeable risk
- Developed structured and exotic (/// generation) products via the bank proprietary pay-out language, adopting single and multicurrency (local correlation model) frameworks
- Generated analytical solutions for very fast pricing of exotic products
- Validated and tested the FX risk management system
- Integrated risk engine with the parallel computation engine
- Developed interface utilities for the interconnection of the core library with the in-house pricers, volatility management system and e-Commerce
- Coordination of offshore outsourcing of IT development
- Liaised with the onshore IT departments on deployment and maintenance of pricing GUI
- Created a number of multitasking, flexible and user-friendly spreadsheets for the structuring desk via the use of Excel-VBA

Imperial College London**Nov.'05-Nov.'07***Post-doctoral Research Associate (Prof. N. M. Harrison and Dr. B. Montanari)*

- Investigation of possible routes to carbon-based magnetism through large scale simulations and *Density Functional Theory* within the project: European Consortium **FERROCARBON** (<http://www.ferrocarbon.eu>)
- Electronic structure, magnetic long range order and spin dependent transport in graphitic ribbons.
- Room temperature ferromagnetism and spin polarised transport in graphene by means of defects, vacancies and doping
- Room temperature ferromagnetism in metal-organic materials ($V(TCNE)_2$)

J. W. Goethe University, Frankfurt**Sep.'03-Nov.'05***Post-doctoral Research Associate (Prof. R. Valenti)*

- Structural, electronic, vibrational and magnetic properties of novel transition-metal oxyhalides via *Density Functional Theory* (relevant to high-temperature superconductivity)
- Anomalous spin-Peierls transition, Raman and infrared phonon spectra and interplay between orbital, lattice, spin degrees of freedom in low dimensional systems
- Interpretation of angle-resolved photoemission spectra in collaboration with Prof. R. Claessen (University of Wuerzburg)
- *First-principles* study of magnetically doped spinel semiconductors (Fe-doped $ZnGa_2O_4$) and their possible application to *Spintronics*

University of Camerino, Camerino, Italy**Feb.'03-Jul.'03***Post-doctoral Research Associate (Prof. G. C. Strinati, Prof. P. Pieri and Prof. A. Perali)*

- *BCS-BEC crossover* for a system of trapped Fermi atoms above and below the superfluid critical temperature.

Military Service, Rome**Jun.'99-Mar.'00***Army Corporal***EDUCATION****University of Camerino, Italy****Apr.'00-Jul.'03***PhD in Physics (Supervisors: Prof. G. C. Strinati and Prof. P. Pieri)*

- Pairing fluctuation effects on the single-particle photoemission spectra below the superconducting transition temperature across the *BCS-BEC crossover*
- Built, tested and optimised two FORTRAN77 codes to generate the single-particle spectral function and thermodynamic parameters, respectively
- Developed analytical representations of the spectral function in the strong coupling limit as a benchmark for testing and as an aid for the interpretation of experimental spectra
- Comparison of spectral features with angle resolved photoemission spectra of high-temperature superconductors

University of Bologna, Italy**Oct.'92- Oct.'98***Laurea in Physics, final mark: 110/110 cum laude.*

Thesis: "Magnetic Properties of Strongly Correlated Electron Systems".

Last year courses: Quantum Field Theory, Quantum Electrodynamics, General Relativity, Nuclear Physics, Statistical Mechanics, Non-Linear Mechanics

TECHNICAL SKILLS**Modern languages:** highest-level qualification within Cambridge English Assessment (CEFR C2), Certificate n. 0053370400. Can read German.**Operating Systems:** Linux and Windows.**Development/Productivity Tools:** Mathematica, Microsoft Office applications, Xmgrace, Gnuplot, Latex.

TEACHING AND SUPERVISING EXPERIENCE

- coordinated project on Josephson critical current and stability of persistent currents involving at first a PhD student then junior post-doctoral researcher (Verdiana Piselli) at the University of Camerino and at LENS in Florence (2021-current)
- contributed to supervise a PhD student (Michele Pini) at the University of Camerino on the study of radio frequency spectra (2019) and of the polaronic limit of the polarized Fermi gas (2022)
- supervision of a PhD student at Imperial College (2006-2007) within the project: "Room temperature ferromagnetism in organic and metal-organic materials"
- supervision of a 3rd year undergraduate student for the Literature B.Sc. projects on Intercalated graphite (March-June 2007) at Imperial College.
- supervision of 3rd year undergraduate student for the Literature B.Sc. projects on Spintronics (January-March 2007).
- Research Masters and 4th year students - Autumn Term 2006, Chemistry Dept. - Lecture on Magnetism and Spin-Density Functional Theory.
- 2nd year Undergraduate - Autumn Term 2006, Chemistry Dept. - Problem Class -Theoretical methods in chemistry: LCAO Theory of Ethene and Butadiene.
- 2nd year Undergraduate - Spring Term 2005, Chemistry Dept. - Computational Laboratory, Module: "The Free Energy and Thermal Expansion of MgO"
- 2nd year Undergraduate - Spring Term 2005, Chemistry Dept. - Problem Class: theoretical methods in chemistry: sequences, series, Morse potential, harmonic approximation, vibrational modes.
- Problems in quantum mechanics at the Institute for Theoretical Physics, Frankfurt am Main (3 rd year Undergraduate, Winter Term 2004)

SCIENTIFIC VISITS

- CNR-INO and LENS, June 2023, Florence. Discussion over theory and experiment on "*Persistent currents and Landau critical velocity in the BCS-BEC crossover*" in the group of Dr. G. Roati
- CNR-INO and LENS, 21 Oct. 2022, Florence. Invited Talk: "*Spatial emergence of off-diagonal long-range order throughout the BCS-BEC crossover*", hosted by Dr. G. Roati and by CNR-INO Executive Director Prof. Francesco Saverio Cataliotti
- CNR-INO and LENS, June 2022, Florence. Discussion over theory and experiment on the "*Josephson effect in the BCS-BEC crossover*" in the group of Dr. G. Roati

CONFERENCES and WORKSHOPS

- **Quantum Simulation with Ultracold atoms (WE-Heraeus-Seminar)**, 30 Sep.- 2 Oct. 2024, Galileo Galilei Institute, Florence. Poster: "*Critical Current throughout BCS-BEC crossover: Landau Critical Velocity and Persistent Currents*"
- **CMD31 2024**, 1-6 September 2024, Forum Braga, Portugal. Invited Talk: "*Critical Current in the BCS-BEC crossover and Collective Excitations in Bose-Fermi Mixtures*"
- **ICQSIM 2023**, 13-17 November 2023, Ecole Polytechnique, Palaiseau (Paris). Poster: "*Josephson effect and Landau critical velocity throughout the BCS-BEC crossover in ultracold atomic gases*"
- **Multi-Super 2023**, 8-10 September 2023, University of Camerino. Invited Talk: "*Josephson effect and Landau Critical Velocity throughout the BCS-BEC crossover*"
- **Super-Fluctuations 2017**, 6-8 September 2017, University of Camerino
- **Condensed Matter and Materials Physics (CMMP07)**, 12 - 13 April 2007, University of Leicester, UK. Poster: "*Ferromagnetism in graphitic ribbons*"
- **Korrelationstage 2007**, 26 Feb.-2 March 2007, Max-Planck-Institut fuer Physik komplexer Systeme, Dresden, Germany. Invited Talk: "*Ab-initio phonons in the Spin-Peierls phase of TiOCl*"

- **Annual IoP Condensed Matter Theory group meeting**, 19 December 2006, University of Warwick. Poster: "*Ferromagnetism in graphitic ribbons*"
- **Computational Magnetism**, 13 December 2006, The Institute of Physics, London.
- **CRIM06: Current research in magnetism 2006**, 8 December 2006, London, Imperial College London.
- **Theoretical and Experimental Magnetism Meeting**, 3-4 August 2006, Cosener's House, Abingdon, UK. Poster: "*Ferromagnetism in only-carbon structures*".
- **14th European Conference on Mathematics for Industry**, 10-14 July 2006, Madrid. Invited Talk: "*Ferromagnetism in graphitic systems*".
- **Topics in Nano-Magnetism**, 30 November 2005, Daresbury, UK, organised by Prof. W. Temmerman, Dr W. Hofer, Dr A. Wander and Prof. N. Harrison.
- **Toward atomistic materials design**, Ψ -k Network Conference, 17-21 September, 2005, Schwaebisch Gmuend, Germany. Poster: "*Ab-initio phonons for the layered compound TiOCl*".
- **Spring Meeting of the Condensed Matter Division of the German Physical Society (DPG)**, 4-9 March, 2005, Berlin. Poster: "*Ab-initio phonons for the layered compound TiOCl*".
- **International workshop on Collective quantum states in low-dimensional transition metal oxides**, 22-25 Feb. 2005, Max Planck Institut fuer Physik Komplexer Systeme, Dresden (Germany)
- **Field Theory of Quantum Coherence, Correlations, and Mesoscopic Physics**, III Windsor Summer School, 9-22 August 2004, Windsor (Lancaster University, UK). Poster: "BCS-BEC crossover at finite temperature for superfluid trapped Fermi atoms".
- **XI National School of Physics of Condensed Matter "Stati elettronici in metalli superconduttori"**, Sep. 2000, I.S.I. Foundation (Institute for Scientific Interchange), Villa Gualino, Turin, (Italy).

PROFESSIONAL QUALIFICATIONS & MEMBERSHIPS

Mar.'99-Jun.'99	Qualification to teach Mathematics in Secondary School.
Nov.'05-Nov.'07	Referee of Physical Review B, Referee of Journal of Physics, Member of Institute of Physics, Member of American Physical Society

PUBLICATIONS

1. L. Pisani, P. Bovini, F. Pavan, P. Pieri: "***Boson-fermion pairing and condensation in two-dimensional Bose-Fermi mixtures***", arXiv:2405.05029
2. L. Pisani, A. G. Moshe, P. Pieri, G. Calvanese Strinati, G. Deutscher: "***Tunneling spectra of strong coupling unconventional superconductors***", Phys. Rev. B (Letter) **110**, L100506 (2024)
3. L. Pisani, V. Piselli, G. Calvanese Strinati, "***Critical current throughout the BCS-BEC crossover with the inclusion of pairing fluctuations***", Phys. Rev. A **109**, 033306 (2024)
4. V. Piselli, L. Pisani, G. Calvanese Strinati, "***Inclusion of pairing fluctuations in a semiclassical approach: The case of study of the Josephson effect***", Eur. Phys. J. A **60**, 49 (2024).
5. L. Pisani, M. Pini, P. Pieri, G. C. Strinati, "***Peaks and widths of radio-frequency spectra: An analysis of the phase diagram of ultra-cold Fermi gases***", Results in Physics **57**, 107358 (2024)
6. V. Piselli, L. Pisani, G. Calvanese Strinati, "***Josephson current flowing through a nontrivial geometry: The role of pairing fluctuations across the BCS-BEC crossover***", Phys. Rev. B **108**, 214504 (2023)
7. L. Pisani, V. Piselli, G. Calvanese Strinati, "***Inclusion of pairing fluctuations in the differential equation for the gap parameter for superfluid fermions in the presence of nontrivial spatial constraints***", Phys. Rev. B **108**, 214503 (2023)

8. L. Pisani, P. Pieri, G. Calvanese Strinati, "**Spatial emergence of off-diagonal long range order throughout the BCS-BEC crossover**", Phys. Rev. B **105**, 054505 (2022)
9. L. Pisani, P. Pieri, G. Calvanese Strinati, "**Gap equation with pairing correlations beyond mean field and its equivalence to a Hugenholtz-Pines condition for fermion pairs**", Phys. Rev. B **98**, 104507 (2018)
10. L. Pisani, A. Perali, P. Pieri, G. Calvanese Strinati, "**Entanglement between pairing and screening in the Gorkov-Melik-Barkhudarov correction to the critical temperature throughout the BCS-BEC crossover**", Phys. Rev. B **97**, 014528 (2018)
11. M. Dhariwal, L. Pisani, T. Maitra, "**Competing electronic states in high temperature phase of NaTiO(2)**", J. Phys.: Condensed Matter **26**, 205501 (2014)
12. L. Pisani, B. Montanari, N. H. Harrison, "**Stability of the ferromagnetic state in a mixed sp²-sp³ carbon system**", Phys. Rev. B **80**, 104415 (2009)
13. G. C. de Fusco, L. Pisani, B. Montanari, N. H. Harrison, "**Density functional study of the magnetic coupling in V(TCNE)-2**", Phys. Rev. B **79**, 8 (2009)
14. L. Pisani, B. Montanari, N. H. Harrison, "**A defective graphene phase predicted to be a room temperature ferromagnetic semiconductor**", New Journal of Physics **10**, 033002 (2008).
15. L. Pisani, R. Valenti, B. Montanari and N. M. Harrison, "**Density functional study of the electronic and vibrational properties of TiOCl**", Phys. Rev. B **76**, 235126 (2007)
16. M. Hoinkis, M. Sing, S. Glawion, L. Pisani, R. Valenti, S. van Smaalen, M. Klemm, S. Horn, and R. Claessen, "**One-dimensional versus two-dimensional correlation effects in the oxyhalides TiOCl and TiOBr**", Phys. Rev. B **75**, 245124 (2007)
17. L. Pisani, J. A. Chan, B. Montanari, N. H. Harrison, "**Electronic structure and magnetic properties of graphitic ribbons**", Phys. Rev. B **75**, 064418 (2007)
18. L. Pisani, T. Maitra, and R. Valenti: "**Effects of Fe substitution on the electronic, transport, and magnetic properties of ZnGa₂O₄: A systematic ab-initio study**", Phys. Rev. B **73**, 205204 (2006)
19. M. Sing, M. Hoinkis, J. Schaefer, M. Klemm, S. Horn, H. Benthien, E. Jeckelmann, L. Pisani, R. Valenti, and R. Claessen: "**Electronic structure and fluctuation effects in the spin-1/2 quantum magnet TiOCl**", J. de Physique IV **131**, 331 (2005)
20. M. Hoinkis, M. Sing, J. Schaefer, M. Klemm, S. Horn, H. Benthien, E. Jeckelmann, T. Saha-Dasgupta, L. Pisani, R. Valenti, and R. Claessen: "**Electronic structure of the spin-1/2 quantum magnet TiOCl**", Phys. Rev. B **72**, 125127 (2005)
21. P. Pieri, L. Pisani, and G. C. Strinati: "**Comparison between a diagrammatic theory for the BCS-BEC crossover and quantum Monte Carlo results**", Phys. Rev. B **73**, 0125127 (2005)
22. L. Pisani and R. Valenti: "**Ab initio phonon calculations for the layered compound TiOCl**", Phys. Rev. B **71**, 180409(R) (2005)
23. A. Perali, P. Pieri, L. Pisani, and G. C. Strinati: "**BCS-BEC Crossover at Finite Temperature for Superfluid Trapped Fermi Atoms**", Phys. Rev. Lett. **92**, 220404 (2004)
24. P. Pieri, L. Pisani, G. C. Strinati and A. Perali: "**Single-particle spectra and magnetic field effects within precursor superconductivity**", PHYSICA C **408**, 317 (2004)
25. P. Pieri, L. Pisani, and G. C. Strinati: "**Pairing Fluctuation Effects on the Single-Particle Spectra for the Superconducting State**", Phys. Rev. Lett. **92**, 110401 (2004)
26. P. Pieri, L. Pisani, and G. C. Strinati: "**BCS-BEC crossover at finite temperature in the broken-symmetry phase**", Phys. Rev. B **70**, 094508 (2004)
27. E. Ercolessi., G. Morandi, L. Pisani and M. Roncaglia: "**Mixed phases for the t-J model**", PHYSICA C **331**, 178 (2000)