Curriculum vitae Giacomo Roati

PERSONAL INFORMATION

Roati Giacomo - ID ORCID: orcid.org/0000-0001-8749-5621

Date of birth: 1/11/1974 - Nationality: Italian

URL for web site: http://quantumgases.lens.unifi.it/exp/li

EDUCATION

2003 PhD in Physics (*cum laude*), Department of Physics University of Trento, Italy
1999 Master in Physics (*cum laude*), Department of Physics University of Milan, Italy

CURRENT POSITION(S)

2018 – Director of Research at CNR-INO, Italy
2020 – Visiting scientist at Yale, New Haven USA (Prof. N. Navon)
2018 – Visiting scientist at UNAM, Mexico City (Prof. J. H. Seman)
2005 – Visiting scientist at University of Sao Carlos, Brazil (Prof. V. Bagnato)

PREVIOUS POSITIONS

2010 – 2018 Senior Researcher at CNR-INO
2005 – 2010 Fixed-term Researcher, University of Florence and Centro INFM- BEC of Trento, Italy
2010 Visiting research fellow (February-June), MIT, Cambridge USA (Prof. M. Zwierlein)
2006 Visiting scientist (January-March), JILA, Boulder USA (Prof. E. Cornell)
2003 – 2005 Post-Doc at the European Laboratory for Non-Linear Spectroscopy (LENS), Florence, Italy

FELLOWSHIPS AND AWARDS

2010 – Associated Fellow to LENS, University of Florence, Italy
2014 – National Scientific Qualification for Full Professor position (Condensed Matter Physics)
2012 – 2017 ERC-Consolidator Grant QuFerm2D, Quantum Simulation of Two-Dimensional Fermionic Systems (ERC-2012-StG)
2002 Award as best oral contribution at the SIF (Italian Physics Society) Conference
2000 Award as young researcher at Italian National Institute of Physics of Matter Meeting

SCIENTIFIC INTEREST

My scientific interests regard quantum simulation with strongly-correlated atomic Fermi systems. As Research Director, I have however the ambition of fostering the cooperation of the different scientific areas of CNR-INO, supporting and conducting cross-fertilisation actions and projects.

During my **ERC Consolidator Grant** (2012-2017), I have set up a new experimental machine that produces ultracold Fermi gases of 6-Lithium atoms. I have developed new cooling techniques that allow an efficient production of Fermi superfluids and ultracold Fermi spin mixtures (Phys. Rev. A 90, 043408 (2014)), and this scheme is now replicated in many experiments worldwide. Our machine exploits the most advanced optical diagnostic and manipulation tools. In particular it features a large optical access to detect the atomic cloud with high resolution (below 1 μm). We can measure not only global but also local quantities and we can extract the properties of the many-body wave functions. At the same time, we have the possibility to image topological defects and their dynamics even in-situ (see Nature 600, 64, (2021)), which is a fundamental diagnostic tool for this proposal. My group is pioneering, first in Italy and among the first in Europe, the **manipulation of ultracold matter through arbitrarily tailored optical potentials**. These are created using dynamical devices such as digital micromirror devices (DMD) and they are imprinted with similar sub-micron resolution through the microscope objective. We can produce ordered and disordered structures, mesoscopic channels, barriers, with sizes comparable with the correlation lengths of our atomic gases (~500 nm). This feature allows for

studying the onset of quantum dynamics in the transport of superfluids or spin. In the last years my research activity has been indeed focussed on the study of quantum transport phenomena in such strongly-correlated Fermi systems. In particular, with my group I have investigated the Josephson dynamics both in the AC (Science, 350, 1505, (2015)) and DC regimes (Science 369, 84 (2020)), disclosing the **effects of dissipation in the superfluid dynamics** (Phys. Rev. Lett. 120, 025302 (2018) and Phys. Rev. Lett. 126, 055301 (2021)). At the same time, we have investigated **spin transport in repulsive Fermi gases**, attacking with new approaches the long-sought and still debated Stoner ferromagnetic instability (Nature Physics 13, 704709 (2017), Phys. Rev. Lett. 118, 083602 (2017), Phys. Rev. Lett. 121, 253602 (2018)).

Since the last year, my group is exploring **the dynamics of topological defects** quasi-two dimensional homogenous Fermi gases, to study new and exciting phenomena in disparate systems in nature. In particular, in such layered Fermi superfluids, we have very recently realised a programmable quantum vortex collider platform (Nature 600, 64 (2021)). This experimental scheme is unique. It will allow the study of vortex dynamics with an unprecedented degree of controllability, giving the possibility of addressing collisions, trajectories and annihilation processes and vortex-sound interactions, comparing directly them with numeric.

Since 2005, I actively collaborate with **Prof. V. S. Bagnato** of the University of Sao Carlos (Brazil) in **studies of quantum turbulent regime** in atomic BEC. I have participated in the setting up of the experimental apparatus achieving the first Bose-Einstein condensate of Latin America. We have reported out the first observations of quantum turbulence phenomena in atomic Bose-Einstein condensates, which is considered a milestone in our field, followed by other publications in this topic.

I collaborate with Prof. Jorge Seman at the UNAM University in Mexico City. We have recently completed the realisation of the experimental apparatus, observing the first superfluid Fermi gas of Latin America. More recently, I have started a long-term collaboration with Prof. N. Navon at Yale University, USA, on the study of the out-of-equilibrium dynamics of homogeneous strongly-correlated Fermi systems.

I currently conduct individual research and lead an experimental group at CNR-INO laboratory at LENS, Florence. One of my main principles of team management is the development of the researchers' talents and the maximum valorisation of their contribution in the group's results. This has attracted in the past 10 years 2 Marie Skłodowska-Curie Fellows (F. Scazza, W.J. Kwon) and has lead three team members to obtain an ERC Starting Grant (W. Kwon, F. Scazza, M. Zaccanti).

Bibliometrics indices at 20/01/2023:

ISI WoS: h-index 34, number of citations 6100 w/o self-citations
Google Scholar: h-index 43, number of citations 10500
Scopus: h-index 35, 6700 citations (**https://www.scopus.com/authid/detail.uri?authorId=6701442264)**

I am co-author of more than 62 publications on peer-reviewed journals (excluding the Conference Proceedings), among which 19 Phys. Rev. Lett., 1 Phys. Rev. X, 4 Science, 3 Nature and 3 Nature Physics.

Five selected publications:

1) G. Del Pace, K. Xhani, A. Muzi Falconi, M. Fedrizzi, N. Grani, D. Hernandez Rajkov, M. Inguscio, F. Scazza, W. J. Kwon, **G. Roati**, Phys. Rev. X 12, 041037 (2022), *Imprinting persistent currents in tunable fermionic rings*

2) W. J. Kwon, G. Del Pace, K. Xhani, L. Galantucci, A. Muzi Falconi, M. Inguscio, F. Scazza and **G. Roati**, Nature 600, 64 (2021)*, Sound emission and annihilations in a programmable quantum vortex collider*

3) G. Del Pace, W.J. Kwon, M. Zaccanti, **G. Roati**, and F. Scazza, Phys. Rev. Lett. 126, 055301 (2021), *Tunneling Transport of Unitary Fermions across the Superfluid Transition*

4) W. J. Kwon, G. Del Pace, R. Panza, M. Inguscio, W. Zwerger, M. Zaccanti, F. Scazza and **G. Roati**, Science 369, 84 (2020), *Strongly correlated superfluid order parameters from dc Josephson supercurrents*

5) K. Xhani, E. Neri, L. Galantucci, F. Scazza, A. Burchianti, K.L. Lee, C. F. Barenghi, A. Trombettoni, M. Inguscio, M. Zaccanti, **G. Roati**, N. P. Proukakis, Phys. Rev. Lett. 124, 045301 (2020), *Critical transport and vortex dynamics in a thin atomic Josephson junction*