

Angelo Esposito

CURRICULUM VITAE

Institute for Advanced Study, 1 Einstein Drive, Princeton, NJ 08540, United States



General Information

Full name: Angelo Esposito

Date and place of birth: 14/04/1989, Rome, Italy

Citizenship: Italian

Education

Columbia University

PH.D. IN THEORETICAL PHYSICS

New York, USA

2013 – 2018

Thesis title: Low Energy Physics for the High Energy Physicist; Advisor: Prof. A. Nicolis

Sapienza University

LAUREA SPECIALISTICA IN THEORETICAL PHYSICS, *Cum Laude*

Rome, Italy

2011 – 2013

Thesis title: A Mechanism for Hadron Molecule Production in $pp(\bar{p})$ Collisions; Advisor: Prof. A. D. Polosa

Sapienza University

LAUREA IN PHYSICS, *Cum Laude*

Rome, Italy

2008 – 2011

Thesis title: Group Theory and Symmetries in Physics; Advisor: Prof. M. Testa

Professional Experience

As of May 22nd 2020, I hold the Italian national scientific habilitation for associate professor (abilitazione scientifica nazionale per professore di seconda fascia).

Institute for Advanced Study

MEMBER, SCHOOL OF NATURAL SCIENCES

Princeton, USA

Fall 2021 – Present

École Polytechnique Fédérale de Lausanne

POSTDOCTORAL RESEARCH ASSOCIATE, THEORETICAL PARTICLE PHYSICS LABORATORY

Lausanne, Switzerland

Fall 2018 – Summer 2021

Sapienza University

VISITING SCIENTIST, HIGH ENERGY THEORY GROUP

Rome, Italy

Summer 2018

Columbia University

INSTRUCTOR, TEACHING/RESEARCH ASSISTANT

New York, United States

2013 – 2018

Grants & Awards

2021 **Marie Skłodowska-Curie Global Fellowship**, total amount of 250k €

Horizon 2020

2017 **“Allan M. Sachs” Teaching Award**, Physics Department at Columbia University

New York, USA

2016 **“Giuliano Preparata” prize for young graduates**, Italian Physical Society

Padova, Italy

2014 **“Nicola Cabibbo” diploma for new talents**, International School of Subnuclear Physics

Erice, Italy

2013 **ARAP prize for Astroparticle physics**, Roman Society for Astroparticles

Rome, Italy

27/9/2021 Angelo Esposito

Research

QUANTUM FIELD THEORY AND EFFECTIVE FIELD THEORIES

I study different aspects of **quantum field theory and effective field theories** (EFTs), especially in relation to different **phases of matter**. In particular, my collaborators and I have employed EFT techniques for the description of vortices in ultra-cold atom gases, of sound waves in different media, of pseudo-acoustic phonons in 2D materials and of the so-called gapped Goldstones arising, for example, in magnetic materials. I have also studied the connection between the holographic descriptions of superfluids and solids and the corresponding EFTs.

Main collaborators: T. Melia (Tokyo IPMU), A. Nicolis (Columbia), R. Penco (Carnegie Mellon), R. Rattazzi (EPFL).

LIGHT DARK MATTER

I recently devoted a large share of my time in applying the above EFT techniques to the study of **light dark matter and its detectability**. Together with my collaborators, I considered the possibility of detecting such particles using collective excitations in superfluid He-4, and developed a treatment in terms of the EFT for superfluids. I have also recently started investigating the so-called **oscillon profiles of ultra-light dark matter**, which might have been abundant in the early stages of the Universe. In particular, I am developing a nonrelativistic EFT to understand the unusual longevity of such configurations.

Main collaborators: A. Caputo (Tel Aviv U.), T. Melia (Tokyo IPMU), F. Piccinini (INFN Pavia), A. D. Polosa (Sapienza), S. Sibiryakov (Perimeter & McMaster).

EXOTIC HADRON SPECTROSCOPY

I also study several different aspects of the so-called **exotic hadrons**, which are observed resonances that do not fit the standard quarkonium models. My work has been mostly focused on the two main models proposed to explain their nature: the compact tetraquark and the hadron molecule. I have studied different aspects of both of them, ranging from the mechanism explaining their production, to selection rules for their spectrum and possible observables able to decipher their structure.

Main collaborators: L. Maiani (Sapienza), F. Piccinini (INFN Pavia), A. Pilloni (Messina U.), A. D. Polosa (Sapienza).

LARGE SCALE STRUCTURES

I am also interested in the connection between the **large scale structures of the Universe and primordial nongaussianities**. My collaborators and I have shown with numerical N -body simulations that it is possible to determine whether the initial inflationary expansion of the Universe was driven by one or more light fields by applying the so-called consistency relations (identities between different statistical correlators) to the distribution of matter in the sky.

Main collaborators: L. Hui (Columbia), R. Scoccimarro (NYU).

Working Projects

Primordial non-gaussianities from consistency relations for galaxy density.

with M. Abitbol, L. Hui and R. Scoccimarro.

An analytic understanding of oscillon lifetime.

with S. Sibiryakov.

An EFT viewpoint on superconductivity.

with I. Kourkoulou and A. Nicolis.

Soft limits in fluids and solids.

with T. Brauner and R. Penco.

Light dark matter detection with magnons from EFT.

with S. Pavaskar, R. Penco and I. Z. Rothstein.

Updates on the nonrelativistic EFT for tetraquarks.

with A. Glioti and R. Rattazzi.

Theory updates on the PTOLEMY project.

with A. Boyarsky, G. Cavoto, V. Cheianov, Y. Cheipesh, G. Menichetti, M. Polini, A. D. Polosa, V. Tozzini.

List of Selected Publications

- [1] A. Caputo, A. Esposito, F. Piccinini, A. D. Polosa and G. Rossi, “*Directional detection of light dark matter from three-phonon events in superfluid ^4He* ,” Phys. Rev. D **103**, no.5, 055017 (2021) [arXiv:2012.01432 [hep-ph]].
- [2] A. Esposito, E. G. Ferreira, A. Pilloni, A. D. Polosa and C. A. Salgado, “*The nature of $X(3872)$ from high-multiplicity pp collisions*,” Eur. Phys. J. C **81** (2021), 669 [arXiv:2006.15044 [hep-ph]].

Angelo Esposito
27/9/2021

- [3] G. Cuomo, A. Esposito, E. Gendy, A. Khmel'nitsky, A. Monin and R. Rattazzi, "Gapped Goldstones at the cut-off scale: a non-relativistic EFT," JHEP **21**, 068 (2020) [arXiv:2005.12924 [hep-th]].
- [4] A. Esposito, L. Hui and R. Scoccimarro, "Nonperturbative test of consistency relations and their violation," Phys. Rev. D **100**, no. 4, 043536 (2019) [arXiv:1905.11423 [astro-ph.CO]]. Selected as **Physical Review D Editor's suggestion**.
- [5] F. Acanfora, A. Esposito and A. D. Polosa, "Sub-GeV Dark Matter in Superfluid He-4: an Effective Theory Approach," Eur. Phys. J. C **79** (2019) no.7, 549 [arXiv:1902.02361 [hep-ph]].
- [6] A. Esposito, R. Krichevsky and A. Nicolis, "Gravitational Mass Carried by Sound Waves," Phys. Rev. Lett. **122**, no. 8, 084501 (2019) [arXiv:1807.08771 [hep-th]]. Selected as **Physical Review Letters Editor's suggestion** and **Physics Focus** (link). Also featured in popular science articles in **Nature Review Physics** (link), **New Scientist** (link) and **Scientific American** (link).
- [7] A. Esposito and A. D. Polosa, "A $b\bar{b}b\bar{b}$ di-bottomonium at the LHC?," Eur. Phys. J. C **78**, no. 9, 782 (2018) [arXiv:1807.06040 [hep-ph]].
- [8] A. Esposito, S. Garcia-Saenz, A. Nicolis and R. Penco, "Conformal solids and holography," JHEP **1712**, 113 (2017) [arXiv:1708.09391 [hep-th]].
- [9] A. Esposito, R. Krichevsky and A. Nicolis, "Vortex precession in trapped superfluids from effective field theory," Phys. Rev. A **96**, no. 3, 033615 (2017) [arXiv:1704.08267 [hep-th]].
- [10] A. Esposito, A. Pilloni and A. D. Polosa, "Multiquark Resonances," Phys. Rept. **668**, 1 (2016) [arXiv:1611.07920 [hep-ph]].
- [11] A. Esposito, A. L. Guerrieri, L. Maiani, F. Piccinini, A. Pilloni, A. D. Polosa and V. Riquer, "Observation of light nuclei at ALICE and the $X(3872)$ conundrum," Phys. Rev. D **92**, no. 3, 034028 (2015) [arXiv:1508.00295 [hep-ph]].
- [12] A. Esposito, A. L. Guerrieri and A. Pilloni, "Probing the nature of $Z_c^{(\prime)}$ states via the $\eta_{c\rho}$ decay," Phys. Lett. B **746**, 194 (2015) [arXiv:1409.3551 [hep-ph]].

As of September 27th 2021, the Scopus database lists 24 of my works, with a H-index of 10. The total number of citations is 812, corresponding to an average per paper of 33.8. The sum of the cite scores (calculated relatively to the publication year, or the closest available on the database) is 229, corresponding to an average per paper of 9.5.

Academic and Organizational Services

Referee

PHYSICAL REVIEW LETTERS, PHYSICAL REVIEW D, JOURNAL OF HIGH ENERGY PHYSICS, EUROPEAN PHYSICAL JOURNAL A, C and PLUS

Conferences and workshops organized

HIGH ENERGY PHYSICS MEETS LOW ENERGY PHENOMENA (LINK)

Pollica Summer Workshop, 2022

LOW ENERGY CHALLENGES FOR HIGH ENERGY PHYSICISTS 3 (LINK)

Perimeter Institute, 2017

Co-organizer

EPFL HIGH ENERGY THEORY SEMINAR

EPFL

2019 – 2021

Founder and co-organizer

GRADUATE STUDENT TALK

Columbia University

2016 – 2017

This is a bi-weekly social event created with the idea of providing an environment where graduate students can learn about each other's research and socialize to build a stronger community. The events consist of a 30 minutes long talk given by a Ph.D. student to an audience of peers, followed by a happy hour funded by the Physics Department.

Co-founder

GRADUATE STUDENT COUNCIL

Columbia University

2016

Together with other fellow Ph.D. students I helped creating a Graduate Students Council. The group is composed by a small number of graduate students and constitutes a more direct link with the department.

27/9/2021 Angelo Esposito

Teaching experience

Co-supervisor of Master thesis

G. P. FARINA (SAPIENZA), F. ACANFORA (SAPIENZA), E. GEOFFRAY (EPFL), A. FARQUET (EPFL),
G. ROSSI (SAPIENZA), O. ALSHEIKH (EPFL), F. SCIOTTI (SAPIENZA)

Fall 2018 – present

Travaux Pratique IV

GROUP THEORY AND QUANTUM FIELD THEORY

EPFL

Fall 2019 – present

Instructor

INTRODUCTION TO EXPERIMENTAL PHYSICS LAB

Columbia University

2015 – 2016

Teaching Assistant

QUANTUM FIELD THEORY 2 AND 3, GENERAL PHYSICS LAB, SUMMER HIGH SCHOOL PROGRAM

Columbia University

2013 – 2018

Teaching Assistant

MECHANICS, QUANTUM PHYSICS

Barnard College

2014 – 2015

Outreach

Co-organizer and teacher

READING TEAM MATH PROGRAM

Reading Team, New York

2017 – 2018

Together with Prof. L. Hui and L. Havener, I have helped creating, designing and organizing the Reading Team Math Program ([link](#)). The program aims at helping Kindergarten, 1st and 2nd Grade students from low-income families in the Harlem area (New York), who are experiencing early difficulties in math. Thanks to several volunteers the program provides help with a ratio of almost one student per tutor. Preliminary data show that our program is statistically successful in improving the students' math skills.

Teacher

PHYSICS SHOW

Columbia University, New York

2013 – 2017

Once per year, the Physics Department at Columbia University organizes a physics show for young students from public elementary schools in the neighborhood (Harlem and Morningside). The volunteers perform simple but entertaining experiments in front of the students, who are then free to ask as many questions as they wish.

Teacher

GIRLS' SCIENCE DAY

Columbia University, New York

2017

Once per year, Columbia University hosts the Girls' Science Day ([link](#)), a free day-long program for hands-on experiments for middle school girls. Faculty members, postdocs and graduate students participate to the organization and teaching of the activities, which cover many different sciences all over the university campus.

Skills

Programming Mathematica (expert), Fortran (expert), C/C++ (intermediate), ROOT (intermediate), Python (beginner)
Languages Italian (native language), English (excellent), French (intermediate)

Invited Talks

Institute of Physics of 2 Infinities of Lyon , Double Charm Tetraquark and Other Exotics	2021
University of Bristol , International Workshop on Partial Wave Analyses and Advanced Tools for Hadron Spectroscopy	2021
Universidad Nacional Autónoma de México , HADRON 2021	2021
Weizmann Institute of Science , Physics Seminar	2021
SISSA , Theoretical Particle Physics Seminar	2021
Stavanger University , Theory Seminar	2021
Perimeter Institute , Theory Seminar	2021
Oxford University , Cosmology Seminar	2021
Heidelberg University , Kirchhoff-Institute for Physics Seminar	2020
CERN , ALICE 3: First workshop on physics and detector	2020
Institute of Nuclear Theory at U. Washington , Accessing and Understanding the QCD Spectra Workshop	2020

27/9/2021 Angelo Esposito

California Institute of Technology , High Energy Physics Seminar	2020
Tel Aviv University , Pheno Journal Club	2020
Carnegie Mellon University , Theory Seminar	2020
Imperial College London , Theory Seminar	2020
International Center for Theoretical Physics (ICTP) , Theory Seminar	2020
European Center for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) , Theory Seminar	2020
Universitat Autònoma de Barcelona , IFAE Theory Seminar	2019
Geneva University , Theory Seminar	2019
Sapienza University , Cygnus 2019 — 7 th workshop on directional dark matter searches	2019
T. D. Lee Institute , Exotic Hadrons: Theory and Experiment at Lepton and Hadron Colliders	2019
Sapienza University , Joint Rome Seminar	2017
Perimeter Institute , Low Energy Challenges for High Energy Physicists 2 Conference	2016
CERN , Implications of LHCb Measurements and Future Prospects Workshop	2016
Jefferson Lab , Hadron 2015 Conference	2015

References

Prof. Alberto Nicolis

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Prof. Antonio D. Polosa

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P.le Aldo Moro 2
00185 Rome, Italy
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Prof. Riccardo Rattazzi

Theoretical Particle Physics Laboratory
École Polytechnique Fédérale de Lausanne
Route de la Sorge
1015 Lausanne, Switzerland
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Prof. Lam Hui

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Columbia University
538 West 120th Street
New York, NY 10027
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Prof. Roman Scoccimarro

Department of Physics
New York University
4 Washington Place
New York, NY 10003
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Prof. Riccardo Penco

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Carnegie Mellon University
5000 Forbes Avenue
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17/9/2021 Angelo Esposito