

ALLEGATO A

UNIVERSITÀ DEGLI STUDI DI MILANO

Procedura di selezione per la chiamata a professore di II fascia da ricoprire ai sensi dell'art. 18, commi 1 e 4, della Legge n. 240/2010 per il settore concorsuale 02/A2 - Fisica Teorica delle Interazioni Fondamentali, (settore scientifico-disciplinare FIS/02 - Fisica Teorica Modelli e Metodi Matematici) presso il Dipartimento di Fisica (Aldo Pontremoli), (avviso bando pubblicato sulla G.U. n. 68 del 01/09/2020) - Codice concorso 4415

Angelo Esposito CURRICULUM VITAE

INFORMAZIONI PERSONALI (NON INSERIRE INDIRIZZO PRIVATO E TELEFONO FISSO O CELLULARE)

COGNOME	ESPOSITO
NOME	ANGELO
DATA DI NASCITA	14/04/1989

**INSERIRE IL PROPRIO CURRICULUM
(non eccedente le 30 pagine)**

Data

06/09/2020

Luogo

Ecublens, Svizzera

Angelo Esposito

CURRICULUM VITAE

Theoretical Particle Physics Laboratory, EPFL, Route de la Sorge, 1015 Lausanne, Switzerland

☎ +41 (0)78 945 01 70 or +39 347 27 28 535 | ✉ angelo.esposito@epfl.ch | 📧 ang.esposito89

Education

Columbia University

New York, United States

PH.D.

2013 – 2018

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

Sapienza University

Rome, Italy

LAUREA SPECIALISTICA IN THEORETICAL PHYSICS, *Cum Laude*

2011 – 2013

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

Sapienza University

Rome, Italy

LAUREA IN PHYSICS, *Cum Laude*

2008 – 2011

Thesis: 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).

École Polytechnique Fédérale de Lausanne — LPTP

Lausanne, Switzerland

POSTDOCTORAL RESEARCH ASSOCIATE

Fall 2018 – Present

Sapienza University — High Energy Theory Group

Rome, Italy

VISITING SCIENTIST

Summer 2018

Columbia University

New York, United States

INSTRUCTOR, TEACHING/RESEARCH ASSISTANT

2013 – 2018

Awards & Recognitions

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

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 developed EFTs for the description of vortices in ultra-cold atom gases, of sound waves in different media, of 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: S. Garcia-Saenz (Imperial), A. Khmelnitsky (Imperial), T. Melia (Tokyo IPMU), A. Monin (EPFL), 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.

I am co-author of two Letters of Interest for the Snowmass2021 program, aimed at putting forth proposals for sub-GeV dark matter detection, and for the introduction of the EFTs for phases of matter among the key theoretical tools employed by the community.

Main collaborators: A. Caputo (Valencia U.), 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.

I am co-author of two Letters of Interest for the Snowmass2021 program in favor of the in depth theoretical and experimental study of diquarks, as well as the search for exotic states in a photoproduction factories.

Main collaborators: L. Maiani (Sapienza), F. Piccinini (INFN Pavia), A. Pilloni (ECT*), 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.

I am co-author of a Letter of Interest for the Snowmass2021 program proposing the initiation of a program to study the applicability of consistency relations to better constrain primordial non-gaussianities.

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

Publications and preprints

- [1] A. Esposito, E. G. Ferreira, A. Pilloni, A. D. Polosa and C. A. Salgado, “The nature of $X(3872)$ from high-multiplicity pp collisions,” [arXiv:2006.15044 [hep-ph]].
- [2] A. Esposito, E. Geoffray and T. Melia, “An Effective Field Theory for Acoustic and Pseudo-Acoustic Phonons in Solids,” [arXiv:2006.05429 [hep-th]].
- [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,” [arXiv:2005.12924 [hep-th]].
- [4] A. Esposito, R. Krichevsky and A. Nicolis, “Solidity without inhomogeneity: Perfectly homogeneous, weakly coupled, UV-complete solids,” [arXiv:2004.11386 [hep-th]].
- [5] A. Caputo, A. Esposito, E. Geoffray, A. D. Polosa and S. Sun, “Dark Matter, Dark Photon and Superfluid He-4 from Effective Field Theory,” Phys. Lett. B **802** (2020), 135258 doi:10.1016/j.physletb.2020.135258 [arXiv:1911.04511 [hep-ph]].
- [6] A. Caputo, A. Esposito and A. D. Polosa, “Sub-MeV Dark Matter and the Goldstone Modes of Superfluid Helium,” Phys. Rev. D **100** (2019) no.11, 116007 doi:10.1103/PhysRevD.100.116007 [arXiv:1907.10635 [hep-ph]].
- [7] A. Esposito, L. Hui and R. Scoccimarro, “Nonperturbative test of consistency relations and their violation,” Phys. Rev. D **100**, no. 4, 043536 (2019) doi:10.1103/PhysRevD.100.043536 [arXiv:1905.11423 [astro-ph.CO]]. Selected as **Physical Review D Editor's suggestion**.
- [8] 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 doi:10.1140/epjc/s10052-019-7057-0 [arXiv:1902.02361 [hep-ph]].
- [9] A. Cerri et al., “Report from Working Group 4: Opportunities in Flavour Physics at the HL-LHC and HE-LHC,” CERN Yellow Rep. Monogr. **7** (2019), 867-1158 doi:10.23731/CYRM-2019-007.867 [arXiv:1812.07638 [hep-ph]].
- [10] A. Esposito, R. Krichevsky and A. Nicolis, “Gravitational Mass Carried by Sound Waves,” Phys. Rev. Lett. **122**, no. 8, 084501 (2019) doi:10.1103/PhysRevLett.122.084501 [arXiv:1807.08771 [hep-th]]. Selected as **Physical Review Letters Editor's suggestion** and **Physics Focus**. Also featured in popular science articles in **Nature Review Physics**, **New Scientist** and **Scientific American**.
- [11] 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]].
- [12] A. Esposito, B. Grinstein, L. Maiani, F. Piccinini, A. Pilloni, A. D. Polosa and V. Riquer, “Comment on ‘Note on $X(3872)$ production at hadron colliders and its molecular structure’,” Chin. Phys. C **42**, no. 11, 114107 (2018) [arXiv:1709.09631 [hep-ph]].

- [13] A. Esposito, S. Garcia-Saenz, A. Nicolis and R. Penco, “Conformal solids and holography,” JHEP **1712**, 113 (2017) [arXiv:1708.09391 [hep-th]].
- [14] 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]].
- [15] A. Esposito, A. Pilloni and A. D. Polosa, “Multiquark Resonances,” Phys. Rept. **668**, 1 (2016) [arXiv:1611.07920 [hep-ph]].
- [16] A. Esposito, S. Garcia-Saenz and R. Penco, “First sound in holographic superfluids at zero temperature,” JHEP **1612**, 136 (2016) [arXiv:1606.03104 [hep-th]].
- [17] A. Esposito, A. Pilloni and A. D. Polosa, “Hybridized Tetraquarks,” Phys. Lett. B **758**, 292 (2016) [arXiv:1603.07667 [hep-ph]].
- [18] 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]].
- [19] A. Esposito and M. Gyulassy, “Hadronization scheme dependence of long-range azimuthal harmonics in high energy $p + A$ reactions,” Phys. Lett. B **747**, 433 (2015) [arXiv:1505.03734 [hep-ph]].
- [20] A. Esposito, A. L. Guerrieri, F. Piccinini, A. Pilloni and A. D. Polosa, “Four-Quark Hadrons: an Updated Review,” Int. J. Mod. Phys. A **30**, 1530002 (2015) [arXiv:1411.5997 [hep-ph]].
- [21] 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]].
- [22] A. Esposito, M. Papinutto, A. Pilloni, A. D. Polosa and N. Tantalo, “Doubly charmed tetraquarks in B_c and Ξ_{bc} decays,” Phys. Rev. D **88**, no. 5, 054029 (2013) [arXiv:1307.2873 [hep-ph]].
- [23] A. Esposito, F. Piccinini, A. Pilloni and A. D. Polosa, “A Mechanism for Hadron Molecule Production in $p\bar{p}(p)$ Collisions,” J. Mod. Phys. **4**, 1569 (2013) [arXiv:1305.0527 [hep-ph]].

Working Projects

Primordial non-gaussianities from consistency relations for galaxy density.

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

Dark matter and three-phonon emission in superfluid He-4.

with A. Caputo, F. Piccinini, A. D. Polosa and G. Rossi.

An analytic understanding of oscillon lifetime.

with S. Sirbiryakov.

Expected bounds from the High Luminosity LHC for composite Higgs models.

with R. Rattazzi and L. Vecchi.

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, 2021

LOW ENERGY CHALLENGES FOR HIGH ENERGY PHYSICISTS 3 ([LINK](#))

Perimeter Institute, 2017

Co-organizer

EPFL HIGH ENERGY THEORY SEMINAR

Columbia University

2019 – present

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

Columbia University

GRADUATE STUDENT COUNCIL

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.

Teaching experience

Co-supervisor of Master thesis

F. ACANFORA (SAPIENZA), E. GEOFFRAY (EPFL), A. FARQUET (EPFL), G. ROSSI (SAPIENZA)

Fall 2018 – present

Travaux Pratique IV

EPFL

QUANTUM FIELD THEORY

Fall 2019 – present

Instructor

Columbia University

INTRODUCTION TO EXPERIMENTAL PHYSICS LAB

2015 – 2016

Teaching Assistant

Columbia University

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

2013 – 2018

Teaching Assistant

Barnard College

MECHANICS, QUANTUM PHYSICS

2014 – 2015

Outreach

Co-organizer and teacher

Reading Team, New York

READING TEAM MATH PROGRAM

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

Columbia University, New York

PHYSICS SHOW

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

Columbia University, New York

GIRLS' SCIENCE DAY

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

Accessing and Understanding the QCD Spectra, Institute of Nuclear Theory at U. Washington 2020

High Energy Physics Seminar, California Institute of Technology 2020

Pheno Journal Club, Tel Aviv University 2020

Theory Seminar, Carnegie Mellon University 2020

Theory Seminar, Imperial College London 2020

Theory Seminar, International Center for Theoretical Physics (ICTP) 2020

Theory Seminar, European Center for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) 2020

IFAE Theory Seminar, Universitat Autònoma de Barcelona 2019

Theory Seminar , Geneva University	2019
Cygnus 2019 – 7th workshop on directional dark matter searches , Sapienza University	2019
Exotic Hadrons: Theory and Experiment at Lepton and Hadron Colliders , T. D. Lee Institute	2019
Joint Rome Seminar , Sapienza University	2017
Low Energy Challenges for High Energy Physicists 2 Conference , Perimeter Institute	2016
Implications of LHCb Measurements and Future Prospects Workshop , CERN	2016
Hadron 2015 Conference , Jefferson Lab	2015

Talks

QFC 2019 – Quantum gases, fundamental interactions and cosmology , Pisa University	2019
TAUP 2019 – Topics in Astroparticle and Underground Physics , Toyama	2019
Effective Theories of Quantum Phases of Matter Workshop , Nordita	2019
Theory Seminar , Carnegie Mellon University	2019
High Energy Theory Group Informal Seminar , Columbia University	2019
High Energy Theory Seminar , Sapienza University	2019
Informal Journal Club Talk , Columbia University	2017
Columbia-NYU-Penn Joint Particle Physics & Cosmology Meeting , University of Pennsylvania	2017
ISCAP Seminar , Columbia University	2016
Informal Journal Club Talk , Columbia University	2015
CHARM 2015 Conference , Wayne State University	2015
Collectivity in Small Colliding Systems with High Multiplicity Workshop , RIKEN BNL	2015
Seminar for new talents , 52 nd International School of Subnuclear Physics	2014
Seminar for new talents , 51 st International School of Subnuclear Physics	2013

Workshops, Conferences & Schools Attended

Heavy-flavour hadronization in pp and heavy ion collisions at the LHC , CERN	2020
QFC 2019 – Quantum gases, fundamental interactions and cosmology , Pisa University	2019
Next Frontiers in the Search for Dark Matter , Galileo Galilei Institute	2019
TAUP 2019 – Topics in Astroparticle and Underground Physics , Toyama	2019
Cygnus 2019 – 7th workshop on directional dark matter searches , Sapienza University	2019
Exotic Hadrons: Theory and Experiment at Lepton and Hadron Colliders , T. D. Lee Institute	2019
24th Rencontres Itzykson – EFT in Cosmology, Gravitation and Particle Physics , Saclay	2019
Effective Theories of Quantum Phases of Matter Workshop , Nordita	2019
Avogadro Meeting on Strings, Supergravity and Gauge Theories , Tor Vergata University	2018
Low Energy Challenges for High Energy Physicists 3 Conference , Perimeter Institute	2018
Field Theory Dualities and Strongly Correlated Matter , Aspen Center for Physics	2018
Joint Rome Seminar , Sapienza University	2017
GRC String Theory & Cosmology Conference , Barga, Italy	2017

Columbia-NYU-Penn Joint Particle Physics & Cosmology Meeting , University of Pennsylvania	2017
Avogadro Meeting on Strings, Supergravity and Gauge Theories , University of Perugia	2016
Implications of LHCb Measurements and Future Prospects Workshop , CERN	2016
Low Energy Challenges for High Energy Physicists 2 Conference , Perimeter Institute	2016
Hadron 2015 Conference , Jefferson Lab	2015
CHARM 2015 Conference , Wayne State University	2015
Collectivity in Small Colliding Systems with High Multiplicity Workshop , RIKEN BNL	2015
52nd International School of Subnuclear Physics , Erice, Italy	2014
51st International School of Subnuclear Physics , Erice, Italy	2013

References

Prof. Alberto Nicolis

Department of Physics
Columbia University
538 West 120th Street
New York, NY 10027
Email: a.nicolis@columbia.edu

Prof. Antonio D. Polosa

Dipartimento di Fisica
“Sapienza” Università di Roma
P.le Aldo Moro 2
00185 Rome, Italy
Email: antonio.polosa@roma1.infn.it

Prof. Riccardo Rattazzi

Theoretical Particle Physics Laboratory
École Polytechnique Fédérale de Lausanne
Route de la Sorge
1015 Lausanne, Switzerland
Email: riccardo.rattazzi@epfl.ch

Prof. Sergey Sibiryakov

Department of Physics & Astronomy
McMaster University
1280 Main Street West
Hamilton, Ontario, L8S 4M1, Canada
Email: sibiryas@mcmaster.ca

Prof. Lam Hui

Department of Physics
Columbia University
538 West 120th Street
New York, NY 10027
Email: lh399@columbia.edu

Prof. Roman Scoccimarro

Department of Physics
New York University
4 Washington Place
New York, NY 10003
Email: rs123@nyu.edu

Prof. Riccardo Penco

Department of Physics
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213
Email: rpenco@cmu.edu