David Preti

Curriculum Vitae

INFN - Sezione di Torino,
Via Pietro Giuria, 1
I-10125 Turin, Italy
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LinkedIn

Research Interests

- Lattice Field Theories, especially Lattice QCD
- Beyond Standard Model physics on the Lattice
- Non-perturbative aspects of Gauge Theories and Renormalization
- Computational Physics and Monte Carlo Algorithms
- Statistical Learning & Artificial Neural Networks, especially Generative Models

Professional Experience

12/2017-current **Research Fellow**, *INFN-Sezione di Torino*, Turin, Italy.

09–12/2016 **Short term visitor**, *Higgs Centre for Theoretical Physics/University of Edinburgh*, Edinburgh,UK.
Collaborators: Prof. L. Del Debbio, Dr. G. Cossu

Education

2014–2017 **PhD in Theoretical Physics**, *Instituto de Física Teórica CSIC/UAM*, Madrid, Spain.
Thesis project: Determination of Fundamental Parameters in the Hadron Sector of the Standard Model
Supervisor: Prof. C. Pena

2010–2013 **Master of Science in Physics**, *Sapienza Universitá di Roma*, Rome, Italy.
Thesis Title: Non-Perturbative Renormalization of $\Delta F = 2$ Four-fermion Operators
Supervisor: Dr. M. Papinutto

2007–2010 **Bachelor in Physics**, *Sapienza Universitá di Roma*, Rome, Italy.
Thesis Title: Bose-Einstein Condensation in Trapped Gases
Supervisor: Prof. S. Caprara

International Schools

2019 **15th Advanced School Of Parallel Computing**, *CINECA*, Casalecchio di Reno (BO), Italy.
Introduction to massively parallel architectures (Cavazzoni/Emerson, CINECA)
Software Engineering for HPC (Ciancarini, CINI)
Cineca HPC systems (Marani, CINECA)
Introduction to GPU Programming (Bonfá, CINECA)
Accelerated programming models: CUDA, OpenACC, CUDAFortran (E4/Arm)
ARM architecture and Ecosystem (Arm)
Compilers and Tools + Optimisation and Performance (Arm)
Python for HPC (Spallanzani, CINECA)

2016 **Lectures on the Theory of Fundamental Interactions**, *GGI*, Florence, Italy.
Early Universe (P. Creminelli, ICTP)
QFT beyond perturbation theory (L. Giusti, Milano Bicocca U. and INFN)
Effective Field Theories (D. B. Kaplan, U. of Washington and INT, Seattle)
Flavor Physics (Y. Nir, Weizmann Inst.)
Dark Matter (S. Profumo, UC, Santa Cruz)
QCD and Collider Physics (M. Schwartz, Harvard U.)

2015 **Lattice Practices 2015**, *Forschungszentrum Jülich Supercomputing Centre*, Jülich, Germany.
Data analysis (C. Hölbling, Wuppertal U.)
Solvers (A. Frommer and K. Kahl, Wuppertal U.)
Performance Optimization (G. Koutsou, Cyprus Institute)
Computer Architectures (D.Pleiter, JSC/Regensburg U.)
Valence techniques (A. Vaquero, INFN)
Finite temperature QCD (K. Szabo, JSC/Wuppertal U.)

2014 **Lectures on Lattice**, *VII Parma International School of Theoretical Physics*, Parma, Italy.
Introduction to lattice field theories (L. Del Debbio, Edinburgh)
Numerical Methods for lattice QCD (S. Schaefer, DESY NIC)
Lattice Heavy Flavor Physics and Standard Model (M. Della Morte, Odense)
QCD thermodynamics (O. Philipsen, Frankfurt)
Graphene, Topological Insulators and Weyl Semi-metals (P. Buividovich, Regensburg)

PhD Courses

2016 **Advanced topics on Renormalization**, *by A. Vladikas*.

2015 **Anomalies**, *by M.A. Vasquez Mozo*.

2015 **Introduction to String Theory**, *by A. Uranga*.

2015 **Application of Conformal Field Theory**, *by G. Sierra*.

2015 **Introduction to Supersymmetry**, *by L. Fogliani*.

Professional Courses

2019-ongoing **AWS Cloud Practitioner Essentials (Second Edition)**, *AWS training and certification*.

2019-ongoing **Spark and Python for BigData with PySpark**, *by J. Portilla*, Udemy.

2019-ongoing **Python for Data Science and Machine Learning complete Bootcamp**, *by J. Portilla*, Udemy.

2019-ongoing **Learning Python for Data Analysis and Data Visualization**, *by J. Portilla*, Udemy.

2019 **Machine Learning**, *by A. Ng*, Stanford University - Cursera.

2019 **Complete Guide to TensorFlow for Deep Learning with Python**, *by J. Portilla*, Udemy.

2019 **Introduction to TensorFlow for Artificial Intelligence, Machine Learning and Deep Learning**, *by A. Ng*, Coursera.

2019 **Neural Networks and Deep Learning**, *by A. Ng*, Cursera.

2019 **Improving Deep Neural Networks**, *by A. Ng*, Cursera.

2019 **Structuring Machine Learning Projects**, *by A. Ng*, Cursera.

2019 **Convolutional Neural Networks**, *by A. Ng*, Cursera.

2019 **Sequence Models**, *by A. Ng*, Cursera.

Workshop and Conferences

2017 **SM&FT 2017**, *Centro Polifunzionale UniBA*, Bari, IT.
The 17th Workshop on Statistical Mechanics and Non-Perturbative Field Theory

2016 **Lattice 2016**, *University of Southampton*, Southampton, UK.
The 34th International Symposium on Lattice Field Theory

2015 **IV Postgraduate Meeting on Theoretical Physics**, *IFT-CSIC/UAM*, Madrid, Spain.

2015 **Lattice 2015**, *Kobe International Conference Center*, Kobe, Japan.
The 33rd International Symposium of Lattice Field Theory

2015 **eNLarge Horizons**, *IFT-CSIC/UAM*, Madrid, Spain.

Invited Talks

18/06/2018 **Lattice Seminar**, *NIC-DESY Zeuthen/Humboldt University of Berlin*, Berlin, DE.
Non-perturbative renormalization and running of composite operators in the SF schemes

15/11/2017 **Theory Seminar**, *University of Turin*, Turin, IT.
Renormalization of Composite operators in the Schrödinger Functional scheme

26/10/2017 **Theory Seminar**, *Higgs Centre for Theoretical Physics/University of Edinburgh*, Edinburgh, UK.
Running of Composite operators in the Schrödinger Functional scheme

Master Thesis Co-advised

2018 **"Non-Perturbative Renormalization of Tensor Currents"**, *Leonardo Chimirri*, UniTo, University of Turin, Italy.

Publications

G. Cossu, L. Del Debbio, M. Panero, **D. Preti**,
Strong dynamics with matter in multiple representations: $SU(4)$ gauge theory with fundamental and sextet fermions,
Submitted to Eur.Phys.J C, arXiv:1904.08885 [hep-lat]

M. Bruno, I. Campos, P. Fritzsch, J. Koponen, C. Pena, **D. Preti**, A. Ramos, and A. Vladikas,
Light and strange quark masses from $N_f = 2 + 1$ simulations with Wilson fermions,
PoS (LATTICE2018), arXiv:1903.04094 [hep-lat]

A. Bussone, I. Herdoíza, C. Pena, **D. Preti**, J.A. Romero, A. Ugarrio
Matching of $N_f = 2 + 1$ CLS ensembles to a tmQCD valence sector ,
PoS (LATTICE2018), arXiv:1903.00286 [hep-lat]

A. Bussone, I. Herdoíza, C. Pena, **D. Preti**, J.A. Romero, A. Ugarrio
First results for charm physics with a tmQCD valence action,
PoS (LATTICE2018), arXiv:1812.05458 [hep-lat]

A. Bussone, S. Chaves, I. Herdoíza, C. Pena, **D. Preti**, J.A. Romero, A. Ugarrio
Heavy-quark physics with a tmQCD valence action,
PoS (LATTICE2018), arXiv:1812.01474 [hep-lat]

I. Campos, P. Fritzsch, C. Pena, **D. Preti**, A. Ramos and A. Vladikas,
Non-perturbative quark mass renormalisation and running in $N_f = 3$ QCD ,
Eur.Phys.J. C78 (2018) no.5, 387.

P. Dimopoulos, G. Herdoíza, M. Papinutto, C. Pena, **D. Preti** and A. Vladikas
Non-Perturbative Renormalisation and
Running of BSM Four-Quark Operators in $N_f = 2$ QCD ,
Eur.Phys.J. C78 (2018) no.7, 579.

G. Herdoíza, C. Pena, **D. Preti**, J.A. Romero, J. Ugarrio,
A tmQCD mixed-action approach to flavour physics
EPJ Web Conf. 175 (2018) 13018

C. Pena and **D. Preti**,
Non-perturbative renormalization of tensor currents:
strategy and results for $N_f = 0$ and $N_f = 2$ QCD,
Eur.Phys.J. C78 (2018) no.7, 575 .

M. Papinutto, C. Pena and **D. Preti**,
On the perturbative renormalisation of four-quark operators for new physics,
Eur.Phys.J. C77 (2017) no.6, 376.

I. Campos, P. Fritzsch, C. Pena, **D. Preti**, A. Ramos and T. Vladikas,
Controlling quark mass determinations non-perturbatively in three-flavour QCD,
EPJ Web Conf. 137 (2017) 08006.

I. Campos, P. Fritzsch, C. Pena, **D. Preti**, A. Ramos and A. Vladikas,
Non-perturbative running of quark masses in three-flavour QCD ,
PoS (LATTICE2016) 201, arXiv:1611.09711 [hep-lat].

P. Fritzsch, C. Pena and **D. Preti**,
Non-perturbative renormalization of tensor bilinears in Schrödinger Functional schemes,
PoS (LATTICE2015) 250, arXiv:1511.05024 [hep-lat].

I. Campos, P. Fritzsch, C. Pena, **D. Preti**, A. Ramos and A. Vladikas,
Prospects and status of quark mass renormalization in three-flavour QCD,
PoS (LATTICE2015) 249, arXiv:1508.06939 [hep-lat].

M. Papinutto, C. Pena and **D. Preti**,
Non-perturbative renormalization and
running of Delta F=2 four-fermion operators in the SF scheme,
PoS (LATTICE2014) 281, arXiv:1412.1742 [hep-lat].

Research Activity

My research activity concerns the study of strongly interacting theories in the Standard Model (SM) and beyond (BSM). In particular I have been studying field theories regularised on a space-time lattice, the only known approach which allow for first-principle computations through numerical Monte Carlo techniques. During the beginning of my career I mainly focused on aspects of QCD relevant for the phenomenology of flavour physics and CP-violating processes within the SM and Beyond. Starting with my master thesis and during the PhD I mainly contributed in non-perturbative (high-precision) renormalization of fundamental parameters of the SM and renormalization of composite operators appearing in the effective weak Hamiltonian approach of processes relevant for improving constraints on CKM and new physics. The setup employed for the above calculations is the Schrödinger Functional (SF) renormalization scheme, which allows through a finite volume recursive procedure to compute the non-perturbative renormalization and running over several order of magnitude in energy and even address directly the calculation of the non-perturbative anomalous dimension. More specifically I worked on the renormalization of the tensor current ($N_f = 0, 2$), the BSM 4-fermion operators ($N_f = 2$) and the quark masses ($N_f = 3$). All these projects are part of the ALPHA collaboration renormalization program. Currently I branched out my interests to several different aspects of gauge theories, focusing in particular on the numerical implementation and exploration of a UV complete partial composite Higgs scenario based on an SU(4) gauge group and fermions in multiple representation. Given the UV completion of the model under investigation, it constitutes a perfect candidate to be studied on the lattice. Strictly related to this project, I am also contributing to the advancement of *GRID*: a new generation C++ library for lattice simulation mainly developed by the Edinburgh Lattice group. In parallel with the latter project I am active in the development of a new algorithm inspired by the "multi-level" applied to precision spectroscopy of both fundamental and excited bound states on the lattice. I am also recently fascinated by the possibility of numerical simulations of quantum gravity on the lattice. While this problem is notoriously very intricate, a lattice exploration can be fundamental to establish non-perturbatively the existence of a possible "asymptotic-safety" scenario, without resort to any perturbative approximation.

Teaching

2015-2016 **Assistant Professor**, *"Física - grado en Biología"* , (Physics for Biology).

Language Skills

Italian Native
English Fluent

Spanish	Intermediate
Russian	Elementary

Technical Skills

OS	Windows, Linux, Mac OS
HPC experience	Galileo (CINECA), Marconi (CINECA), Altamira (IFCA), FinisTerrae2 (CESGA), Marenostrum4 (BSC)
Coding Languages	C/C++, Python, Bash, Perl, MatLab, Mathematica
Utility Programs	LaTeX, Git, Docker, Jupyter Notebooks, VisualStudio Code, CI systems, GooglePresentation/Keynote/PowerPoint