

Gruppo IV

Preventivi di spesa per il 2017

CdS - 29 giugno 2016

Gli “esperimenti” del Gruppo 4 Padovano

IS	Responsabile	FTE
ST&FI	Sorokin	5.5
GSS	Giusto	8
HEPCUBE	Wulzer → Paradisi	14.6
FBS	Canton	1
STRENGTH	Lenzi	5.5
TASP	Masiero	2.2
INDARK	Bartolo	10.5
PleXNet	Orlandini	8
Totale		55.3

} L1: teoria dei campi e stringhe

L2: Fenomenologia

} L3: Fisica nucleare e adronica

} L5: Fisica astroparticellare

L6: Fisica Statistica

String Theory and Fundamental Interactions (STEFI)

K. Lechner, P. Marchetti, M. Matone, D. Sorokin
R. Volpato (RUB-Montalcini from July 1 2016)

INFN Post Doc: Praxitelis Ntokos
(expected from October 2016 in collaboration with GSS)

- Dynamics of strings and branes
- Spontaneous supersymmetry breaking in supergravity
- Mathematical structures in string theory
- Problems of interactions of higher spin fields
- Fundamental aspects of quantum field theory
- Application of QFT methods to statistical and condensed matter physics

The GSS Padua group

Permanent members: G. Dall'Agata, S. Giusto (RL), L. Martucci

Ph.D. students and Postdocs : S. Bansal, N. Cribiori, F. Farakos,
A. Galliani, A. Marrani, P. Ntokos (50%)

MAIN AREAS OF RESEARCH:

- **Black Holes in String Theory and Supergravity:** construction and holographic analysis of black hole microstates; susy black holes in extended supergravities
- **Supersymmetry breaking and Inflation:** non-linear realisations of supersymmetry as a tool to construct effective theories for strings and models for inflation; brane-induced susy breaking
- **Flux Compactifications and Holography:** backreaction and non-perturbative effects in four-dimensional compactifications; holographic effective theories for strongly coupled CFTs

HEPCube-Padova

Members:

• Staff

- Andrea Brignole
- Ferruccio Feruglio
- Antonio Masiero
- Pierpaolo Mastrolia
- Paride Paradisi
- Massimo Passera
- Massimo Pietroni
- Stefano Rigolin
- Andrea Wulzer
- Fabio Zwirner

• Students

- Ignacio Hierro
- Kirill Kanshin
- Andrea Patteri
- Amedeo Primo
- Javier Torres

• Postdocs

- Francesco Capozzi
- Alexandra Carvalho
- Eugenio del Nobile
- Luca Vecchi
- One more (cofin.)

HEPCube-Padova

Aim: learning about fund. int. from all sources

- **Energy Frontier**

- Direct searches: will run-2 have the final word on Naturalness?
- Indirect searches: what to learn from run-2 (and HL-LHC)?

- **Intensity Frontier**

- Muon $g-2$ at < 0.14 ppm: reducing hadronic uncertainty
- Flavour: universality violation in B; lepton sector discrete symm.

- **Cosmic Frontier**

- Neutrino mass in Large Scale Structure (semi-analytical approach)
- Dark Matter: improved cosmic rays propagation codes

STRENGTH

A. Vitturi, L. Fortunato, E. Maglione, S.M. Lenzi (resp.),
P. Lotti, J.A. Lay, J. Bonnard, L. Moschini

Nuclear structure and reaction dynamics

Studies characterized by the correlation between phenomenological aspects and fundamental microscopic approaches

Highlights 2015-2016

- Construction of charge-dependent effective interaction from the bare chiral interaction for the study of isospin symmetry and nuclear skins:
J. Bonnard, S.M. Lenzi and A. Zuker, Phys. Rev. Lett. 116 (2016) 212501
- Exotic excitations of low-lying isoscalar dipole modes:
F. Cappuzzello, ..., L. Fortunato, A. Vitturi et al., Nature Comm. (2015) 6743
- A model for low-energy fusion of light nuclei for astrophysical applications:
C. Spitaleri, C.A. Bertulani, L. Fortunato, A. Vitturi, Phys. Lett. B 755 (2016) 275.
- Exotic excitations of low-lying isoscalar dipole modes:
E.G.Lanza, A.Vitturi, M.V.Andres, Phys. Rev. C 91, 054607 (2015)
- Nuclear structure of very neutron-rich nuclei far from stability:
C. Babcock, ..., S.M. Lenzi et al., Phys. Lett. B 750, 176 (2015)

Theoretical Astroparticle Physics (TASP)

- F. Capozzi (postdoc)
- M. Laveder
- A. Masiero
- P. Paradisi
- Lepton Flavor Violation
- LHC SUSY searches
- Sterile Neutrinos

Theory of Few Body Systems (FBS)

- L. Canton
- Hadronic and nuclear physics

Linea 5

InDark (Inflation, Dark Matter and the Large-Scale Structure of the Universe)

➤ Line 5, **Astroparticle Physics**

➤ **Present composition**

Staff members: Nicola Bartolo (national coordinator), Michele Liguori, Sabino Matarrese, Massimo Pietroni, Emiliano Sefusatti

Postdocs: **Andrei Lazanu (INFN postdoc coming in September 2016)**; Karmakar Purnendu (grant PRIN-MIUR from 1/7/2016)

PhD Students: Karagiannis Dionysios, Maria Chiara Guzzetti, Filippo Opizzi, Andrea Provenzano, Andrea Ravenni

➤ In the last four years an average of 9 members, with **two INFN post-docs (Bin Hu and Frederico Arroja)**

➤ **Main lines of research:** Physics of the early universe (inflation), Dark Matter, Cosmic Microwave Background (CMB) physics, Large-Scale Structure (LSS) of the Universe, Dark energy/modified gravity

➤ **Highlights of some of the main scientific results achieved in the last 4 years**

- Most precise constraints on primordial non-Gaussianity from inflation (one of the most efficient tools to discriminate among competing inflation models for the early universe) and on inflation models achieved within *Planck* collaboration
- For the first time we pointed out severe theoretical constraints naturally arising in inflation models where U(1) gauge fields are dynamically relevant
- Investigations of new observational probes, new statistical estimators, and forecasts to constrain non-Gaussianity via CMB and LSS surveys (e.g. CMB spectral distortions and the so-called "scale-dependent halo bias")
- Investigations of new classes of modified gravity models
- Renormalization group techniques to study non-linear evolution of cosmological dark matter perturbations

➤ **Publications in the last four years:** 94 publications present in the INFN database.

➤ **Participation to International collaborations:** most of us are *Planck* scientists and Core Team members of the *Planck* satellite collaboration, members of the *Euclid* satellite collaboration, of the "cosmology" and "tests of fundamental physics" WG of *eLISA*, and of the Science Case WG for the proposal of a future M5 ESA space mission (**CORE+**) to measure inflationary gravitational waves via CMB polarization

Statistics and Dynamics on Complex Networks (PlexNet)

M. Baiesi, F. Baldovin, A. Maritan, E. Orlandini, S. Samir, F. Seno, A. Stella, A. Trovato

Statistical mechanics
In cognitive science
Neural networks activity

In strict collaboration with neuro scientists we will study the spontaneous and induced activity of neural network in vivo as well as develop a prediction algorithm in the context of protein aggregation related to neurodegenerative diseases.

Econophysics:
Economic growth at the
global scale

Introduce long-memory effects in the underlying dynamics of a network of assets to study how the problem of derivative pricing is influenced by such effects.

Non equilibrium statistical mechanics:
Self-propelled particles
in nano- channels

Study of the **collective dynamics of mixtures of self-propelled particles** with different sizes confined into nano-channels. Look at the phenomenon of **negative differential mobility** for particles forced to move within complex fluids.

(Molti) Seminari

- **High-energy theory seminars & Theory Colloquia**
PH: Paradisi, TH: Giusto e Martucci, TC:
Dall'Agata e Wulzer. 26 nella stagione in corso.
- **Seminari di fisica statistica e teoria della materia condensata.** Baldovin
- **Cicli di incontri Informali:**
 - **Pheno Coffee Del Nobile**
 - **Theory Lunch Martucci**
 - **Cosmology Journal Club.** Liguori
 - **Nuclear Cookies.** Fortunato, Mazzocco, Mengoni, Valiente-Dobón (LNL)

Welcome to the **Theoretical Physics Group** in Padova

The Theoretical Physics Group in Padova is active in several different branches of research on fundamental physics. Our activities range from string theory and cosmology at the highest energies, down through unification and beyond-the-standard-model physics, through the standard model, to nuclear physics at the low energy scale, also covering statistical and biological physics.

Members of our group are involved in various national and international research networks linked here:

- EC Training Networks:
 - [Invisibles](#) (FP7 Initial Training Network, 2012/16, Local PI: S. Rigolin);
 - [Elusives](#) (FP7 Innovative Training Network, 2016/20, Local PI: S. Rigolin);
- ERC Advanced Grants:
 - [DaMESyFla](#) (2011/16);
- RISE Network:
 - [Invisibles+](#) (2016/20, Local PI: S. Rigolin);
- COST Network:
 - [The String Theory Universe](#); (2013/17)
- Russian Science Foundation International Project
 - Quantum theory of higher-spin gravity, string theory and associated dualities (2014-2016, Local PI: D. Sorokin)
- Australian Research Council Discovery Project
 - [Advances in Higher Spin Gauge Theory](#) (2016-2018, Local PI: D. Sorokin)
- National PRIN:
 - "Simmetrie, Masse e Misteri: Rottura della simmetria elettrodebole, Mescolamento dei sapori e violazione di CP e Materia oscura nell'era di LHC" ; (2012/16, Unit Leader: F. Feruglio)
 - "Statistical Physics of Active Matter: Disentangling Complexity Patterns in Biological Systems ", (2012/15, PI: A. Maritan)
 - "", (2012/16, PI: A. Masiero).
- FIRB:
 - "A new strong force, the origin of masses, and the LHC" (2013/17)
 - "[String Theory and Fundamental Interactions](#)"; (2012/16, PI: G. Dall'Agata)
- University Projects:
 - "New approaches to Quantum Gravity" (2015-2017, PI: S. Giusto)

Richieste alla CSN IV

Sigla	A carico dell'I.N.F.N.										
	missioni	inviti	consumo	altri_cons	seminari	pubblicazioni	manutenzione	inventario	licenze-SW	spservizi	TOTALI
FBS											
GSS	17.00										17.00
HEPCUBE											
INDARK	14.00										14.00
PLEXNET											
STEFI	12.00										12.00
STRENGTH											
TASP	3.50										3.50
PRIN - SIMAMI											
UE - ELUSIVES											
UE - INVISIBLESPLUS											
Tot.Sigle	46.50										46.50
Dotazioni di CSN IV	20.00	20.00	3.00		10.00			10.00	2.00		65.00
Totale CSN IV Padova	66.50	20.00	3.00		10.00			10.00	2.00		111.50