

Gruppo IV

Preventivi 2020

CdS – 10 luglio 2019

Gruppo IV PD

- Staff (semi)permanente (**dipendenti INFN (7) e associati**): 46
 - Post Docs e assegnisti: 20
 - Dottorandi: 15
- TOTALE: > 80**

Progetti di ricerca internazionali

- EC Training Network Elusives (2016/20, Local PI S. Rigolin)
- EC RISE Network Invisibles+ (2016/20, Local PI S. Rigolin)
- ERC Consolidator Grant “Demography of black hole binaries in the era of gravitational wave astronomy” DEMOBLACK (2017/22 M. Mapelli INAF)
- MAECI Mobility Project with Slovenia (Stefan Institute di Lubiana)
"The flavore of the invisible Universe" (2018/20, PI F. D'Eramo)
- Australian Research Council Discovery Project "Advances in Higher Spin Gauge Theory" (2016/19, Local PI D. Sorokin)

Progetti Nazionali

- National PRIN (2019/22)
 - "Supersymmetry Breaking with Fields, Strings and Branes" (Local PI G. Dall'Agata)
 - "The Dark Universe: A Synergic Multimessenger Approach" (Local PI F. D'Eramo);
 - "New Avenues in Strong Dynamics: from the Early Universe to the Lab" (Local PI A. Wulzer)
- ASI/COSMOS Project – fisica della CMB (Local PI S. Matarrese)

Attività principali in sede

Ospiti per collaborazione (x breve-medio periodo)

Seminari

- High-Energy Theory Seminars
Pheno: P. Mastrolia e P. Paradisi, **Teoria di base:** S. Giusto e L. Martucci
- Seminari di fisica statistica e teoria della materia condensata
F. Baldovin
- **Cicli di incontri informali:**
 - Pheno Coffee, F. D'Eramo
 - Theory Lunch, D. Cassani
 - Cosmology Journal Club, D. Bertacca, A. Ricciardone
 - Nuclear Cookies, L. Fortunato

9 Iniziative Specifiche del Gruppo IV PD

- **Linea 1 - FIELD AND STRING THEORY**
 - Gauge Theories, Strings and Supergravity, GSS (RL D. Cassani) – 9 FTE
 - String Theory and Fundamental Interactions, ST&FI (RL D. Sorokin) - 5 FTE
- **Linea 2 - PHENOMENOLOGY OF ELEMENTARY PARTICLES**
 - Open problems in the Standard Model, HEPCUBE (RN P. Paradisi) - 14 FTE
- **Linea 3 - NUCLEAR AND HADRONIC PHYSICS**
 - Structure and Reactions of Nuclei: towards a global Theory, STRENGTH (RL L. Fortunato) – 3 FTE
 - Few Body Systems, FBS (RL L. Canton) – 1 FTE
- (Linea 4 – Mathematical methods – non è presentata formalmente)
- **Linea 5 – ASTROPARTICLE PHYSICS**
 - Theoretical Astroparticle Physics , TASP (RL F. D’Eramo) - 3.9 FTE
 - Inflation, Dark Matter and the Large-Scale Structure of the Universe, InDark (RN N. Bartolo) – 11.3 FTE
 - TEoria delle ONde GRAVitazionali, TEONGRAV (RL M. Mapelli) – dal settembre 2018 – 10,6 FTE
- **Linea 6 – STATISTICAL AND APPLIED FIELD THEORY**
 - Statistics and Dynamics on Complex Networks, PlexNet (RL E. Orlandini) – 5.3 FTE

G S S

Gauge Theories, Strings and Supergravity



- Permanent

Davide Cassani (R.L.), Gianguido Dall'Agata,
Stefano Giusto, Luca Martucci

- PhD students and postdocs

Alessio Marrani, Alexander Tyukov
Lorenzo Papini, Dario Partipilo,

Alessandro Bombini, Stefano Lanza,

→ defending PhD between Dec 2019 and Mar 2020

+ 1 perspective PhD student

- **Holography as a tool to understand black holes in quantum gravity**

- ◆ **asymptotically flat black holes**: construction of microstates in supergravity and analysis of correlators in dual CFT's
- ◆ **asymptotically Anti de Sitter black holes** : microscopic origin of the entropy and computation of dual CFT partition functions

- **String Theory Compactifications and Supergravity**

- ◆ Constraints on effective field theories from quantum gravity
- ◆ String theory compactifications leading to supergravity with three-forms
- ◆ Uplifting supergravity vacua on non-geometric backgrounds
- ◆ String theory dimensional reductions using Generalized Geometry

String Theory and Fundamental Interactions (STEFI)

K. Lechner, P. Marchetti, M. Matone, D. Sorokin (RL), R. Volpato 5 FTE

- Dynamics of strings and branes (in collaborazione con GSS PD)
- Supergravity and spontaneous breaking of supersymmetry (con GSS PD)
- Mathematical structures in string theory
- Problems of interactions of higher spin fields
- Modified theories of gravity (in collaborazione con InDark PD)
- Fundamental aspects of quantum field theory
- Application of QFT methods to statistical and condensed matter physics and quantum information (collaborazione con Linea 6)

- ① **Staff:** Andrea Brignole, Francesco D'Eramo, Ferruccio Feruglio, Antonio Masiero, Pierpaolo Mastrolia, **Paride Paradisi (RN)**, Massimo Passera, Massimo Pietroni, Stefano Rigolin, Fabio Zwirner, Ramona Grober
- ② **Postdocs:** Hjalte Frellesvig, Sergio Gonzalez, Simon King, Mandal Manoj, Arsenii Titov
- ③ **Students:** Claudia Cornella, Federico Pobbe, Federico Gasparotto

FTE HEPCube-Padova: 14

Richieste alla CSN IV: 28 Keuro (missioni)

Learning about fundamental interactions

① Energy Frontier

- ▶ Direct searches: what to learn from run-2 and HL-LHC?

② Intensity Frontier

- ▶ Indirect searches: what to learn from LHCb, BelleII, ...?

③ Cosmic Frontier

- ▶ Dark Matter, Dark Energy, Inflation, ...

STRENGTH : Fisica Nucleare Teorica a Padova

Personale (3 FTE):

Silvia **LENZI** (50%)

Lorenzo **FORTUNATO**

Jesús **CASAL**

Paolo **LOTTI** (50%)

Richiesta:

6 kE per missioni

- Fenomenologia alle basse energie
 $0.1 < E_n < 20 \text{ MeV}$
- Struttura nucleare
- Reazioni nucleari
- Nuclei lontani dalla valle di stabilità

Few-Body System (FBS)

Luciano Canton (+1 assegno di ricerca da settembre)

Metodi a canali accoppiati applicati alla fisica con fasci radioattivi:

Collisioni nucleone-nucleo alle basse energie.

Collisioni cluster-nucleo alle basse energie.

Calcoli di reazioni nucleari di interesse medico:

Produzione di radiofarmaci a SPES/Laramed-LNL

Produzione di radionuclidi teranostici e per l'imaging multimodale
(in esperimenti PASTA e METRICS di CSN5)

Theoretical Astroparticle Physics (TAsP)

Staff: F. D'Eramo, M. Laveder, A. Masiero, P. Paradisi, M. Peloso, M. Pietroni

Postdoc: R. Nagai

Dark Matter Particle Candidates

- WIMPs
- Axions
- Sub-GeV dark matter candidates

Early Universe

- Inflation
- Baryogenesis
- Large Scale Structure

Weakly-coupled light particles

- Light pseudo-scalars
- Sterile neutrinos

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

➤ Line 5, Astroparticle Physics.

8 nodes (Bologna, Ferrara, LNGS, **Padova**, Roma II, Roma III, Torino, Trieste)

see <https://web.infn.it/CSN4-new/IS/Linea5/InDark/InDark.html>

Evaluated as “excellent” in the last evaluation by the external Referees (October 2016)

➤ Present composition

Staff members: N. Bartolo (national coordinator), **D. Bertacca (new RTDA since March 2018)**,
M. Liguori, S. Matarrese, M. Peloso, M. Pietroni

Postdocs: **Angelo Ricciardone (new INFN postdoc since Sept. 2018)**;
K. Dionysios “**assegno di Ricerca**” since Sept. 2018, co-funded by INFN for
Euclid activities; J. Fonseca; G. Jung

PhD Students: Giampaolo Benevento, Alexander Ganz, Giorgio Orlando, Sarah Libanore

➤ Last 4 years average of 12 members, **2 INFN postdocs (A. Lazanu, A. Ricciardone)**

➤ Main lines of research: - **Cosmology**

- **Physics of the early universe (inflation)**

- **Cosmic Microwave Background (CMB) physics**

- **Modeling of Large-Scale Structure (LSS) of the Universe/Dark Matter**

- **Tests of fundamental physics via cosmological observables**

- **Dark energy/modified gravity models**

- **Cosmological inference from gravitational waves**

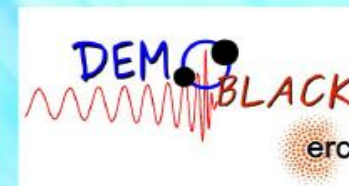
Request for 2020: 17 keuro. In line with previous years (Total FTE: 11.3)

The new Gravitational Wave Astrophysics TEONGRAV group

Staff: Michela Mapelli, Riccardo Ciolfi

Postdocs: Alessandro Ballone, Yann Bouffanais, Guglielmo Costa, Nicola Giacobbo, Giuliano Iorio, Mario Pasquato, Sara Rastello, Mario Spera (global MC fellow)

PhD students: Ugo N. Di Carlo, Jay Kalinani, Andrea Pavan, Filippo Santoliquido



TOPICS:

- * **CONSTRAINTS ON THE MASS SPECTRUM OF COMPACT OBJECTS**
- * **DEMOGRAPHY of GRAVITATIONAL – WAVE SOURCES**
- * **POPULATION SYNTHESIS AND N-BODY SIMULATIONS OF BINARY COMPACT OBJECTS**
- * **CONSTRAINTS ON THE MERGER RATE OF BINARY BLACK HOLES, BINARY NEUTRON STARS AND BLACK HOLE – NEUTRON STAR BINARIES**
- * **MAGNETO-HYDRODYNAMICS RELATIVISTIC SIMULATIONS OF BINARY NEUTRON STAR MERGERS**
- * **STUDY of SPINDOWN – POWERED TRANSIENTS**

Statistics and Dynamics on Complex Networks

(PlexNet)

People: M. Baiesi, F. Baldovin, A. Maritan, E. Orlandini, S. Samir, F. Seno, A. Stella, A. Trovato 5,3 FTE

Statistical mechanics
in cognitive science

Neural networks activity

Study the spontaneous and induced activity of neural network in vivo as well as apply ideas and methods of **renormalisation group theory** to data of spiking neurons in simulated and empirical **brain dynamics**.

Non equilibrium statistical mechanics:

Active matter under confinement.

Anomalous diffusion.

Study of the **collective dynamics of mixtures of self-propelled particles** confined into nano-channels or pores. Look at the phenomenon of **negative differential mobility** and **anomalous diffusion** for probes moving within complex fluids and active polymers.

Statistical mechanics in biophysics and polymer physics.

Physics of epigenetic and chromatin organisation.

Entanglement in fluctuating filaments.

Use **Landau-Ginzburg models** to study the interplay between chromosome organisation and **epigenetic dynamics**.

Look at the **entanglement** of proteins and polymer networks using topological concepts such as **knotting** and **linking**.

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	1.50										1.50
GSS	18.00										18.00
HEPCUBE											
INDARK	17.00										17.00
PLEXNET											
STEFI	11.00										11.00
STRENGTH	6.00										6.00
TASP	8.00										8.00
TEONGRAV											
UE - FELLINI											
Tot.Sigle	61.50										61.50
Dotazioni di CSN IV	20.00	20.00	3.00		10.00			10.00	2.00		65.00
Totale CSN IV Padova	81.50	20.00	3.00		10.00			10.00	2.00		126.50