INFN - Sezione di Lecce
Preventivi 2022
Gruppo 4

L. Martina

Sezione INFN, Lecce, Italy

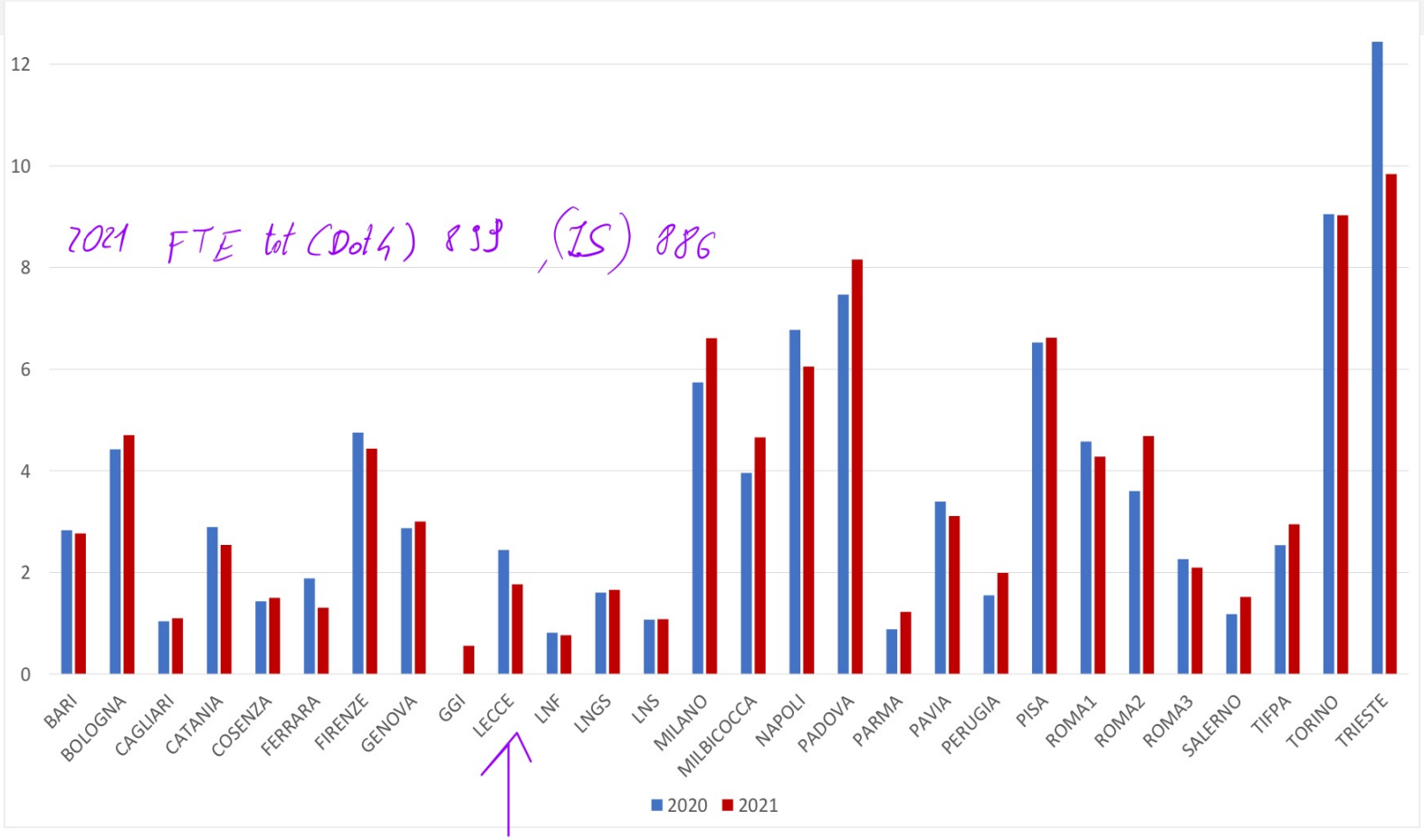
Lecce 5-7/7/2021

Outline

Quadro Generale su CSN4

1. CSN4 coordina la ricerca di fisica teorica, che si occupa di sviluppare ipotesi, modelli e teorie fisiche per spiegare i risultati degli esperimenti e aprire nuovi scenari per la fisica.
2. Presidente: Fulvio Piccinini (Pavia)
    1. origine della massa delle particelle fondamentali
    2. natura e le caratteristiche della materia oscura
    3. asimmetria materia-antimateria nell'universo
    4. unificazione quantistica fondamentale di tutte le interazioni, comprese gravità
    5. natura e la struttura intrinseca dello spazio-tempo
    6. la fisica del nucleo e delle particelle costituenti
    7. i processi avvenuti all'epoca del Big-Bang e la successiva evoluzione dell'universo.
    a) studi teorici sui risultati agli acceleratori di particelle e astroparticellari
    b) metodi matematici e tecniche formali e numeriche.
3. Nuovo Sito : https://web.infn.it/CSN4/index.php/it/home

Quadro Generale su CSN4: FTE



Quadro Generale su CSN4: IS

Nuove Iniziative Specifiche 2021/23 (processo di valutazione completato a Ottobre '20)

	L1 T. Campi Stringhe	L2 Fenomen. Part. Elem	L3 Fis . Nucl. Adron.	L4 Metodi Matem.	L5 Astropart. e Grav.	L6 Appl. t. C. e F. Stat.
%	27	18	8	13	25	12
IS	8	8	4	5	5	5
Ref.	F. Morales	G. De Grassi	U. D'Alesio	L. Griguolo	P. Natoli	D. Giuliano
Int.	D. Sorokin	L. Silvestrini	E. Lanza	L. Martina	E. Nardi	M. Nicodemi
b20	2	2	2	1	2	1
b21	4	4	1	2	4	1

The Galileo Galilei Institute (GGI) for Theoretical Physics (https://www.ggi.infn.it/): Workshops, Schools, GGI Tea Breaks' Seminars, Theory Lectures by Young Researchers, GGI Post-Docs, Simons Visiting Scientists, GGI Visiting Program, Galileo Galilei Medal Award: (2019) J. M. Maldacena, (2021) A. Buonanno, T. Damour and F. Pretorius

1. Premio "Fubini" 2020 (Tesi di dottorato discussa tra 01/06/2019 e 31/05/2020)
   Pervenute 26/61: L1 - 9 L2 - 4 L3 - 8 L4 - 3 L5 - 2

   - Francesco Galvagno (TO) *Wilson loops as defects in N=2 conformal field theories*
   - Davide Giusti (RM3) *Isospin Breaking Corrections to Masses and Hadronic Processes on the Lattice*
   - Paola Ruggiero (SISSA) *Entanglement and correlations in one-dimensional quantum many body systems*

   Menzione: Matteo Buzzegoli (FI), Alberto Fachechi (LE), Andrea Mitridate (SNS-PI)

2. Premio "Baldo Ceolin" per 10 laureate 2020 (Tesi magistrale discussa tra 1/11/2019 e 31/10/2020

Quadro Generale a oggi

La casellina "Eti¿½" evidenziata in arancione indica che la persona compirï¿½ 70 o pïi¿½ anni nell'anno di preventivo
La dicitura [P] prima del profilo indica che la persona ï¿½ in quiescenza

	Nome	Età	Posizione	Qualifica	Afferenza	FIELDTURB	GSS	MMNLP	MONSTRE	NUCSYS	QFT_HEP	TASP	ALTRO-UNIVERSE	DOT4	CSN I	CSN II	CSN III	CSN V	P.S.	CCR	Servizi	UE	PON	POR	FIRB	PRIN	ALTRO	PP	TT	CSN	Tot.	Note
1	Abenda Simonetta		Associato	Prof. Associato	CSN IV			50																							50	
2	Albanese Linda		Associato	Dottorando	CSN IV	100																									100	
3	Angelelli Mario		Assegn./Bors.	Assegnista	CSN IV			100																							100	
4	Barra Adriano		Associato	Prof. Associato	CSN IV	100																									100	
5	Beccaria Matteo		Inc. Ric.	Prof. Ordinario	CSN IV		100																								100	
6	Ciafaloni Paolo		Dipendente	Ricercatore	CSN IV									0																	0	
7	Co' Giampaolo		Inc. Ric.	Prof. Associato	CSN IV				95																						95	
8	Coriano' Claudio		Inc. Ric.	Prof. Associato	CSN IV						100																				100	
9	De Paolis Francesco		Inc. Ric.	Prof. Associato	CSN IV							50				50															100	
10	Girlanda Luca		Inc. Ric.	Ricercatore Universitario	CSN IV					100																					100	
11	Landolfi Giulio		Associato	Ricercatore Confermato (Ricercatore)	CSN IV		50	50																							100	
12	Lanotte Alessandra S.		Associato	I Ric.	CSN IV	100																									100	
13	Maiorano Michele		Associato	Dottorando	CSN IV							100																			100	
14	Martina Luigi		Inc. Ric.	Prof. Associato	CSN IV			80								20															100	
15	Montanino Daniele		Inc. Ric.	Ricercatore Universitario	CSN IV							70				30															100	
16	Orofino Vincenzo		Associato	Prof. Associato	CSN IV							50				50															100	
17	Pallara Diego		Associato	Prof. Ordinario	CSN IV		100																								100	
18	Panico Riccardo		Associato	Dottorando	CSN IV	100																									100	
19	Saccomandi Giuseppe		Associato	Prof. Ordinario	CSN IV			100																							100	
20	Sanvitto Daniele		Associato	Dir.Ric.	CSN IV	25																									25	
21	Strafella Francesco		Associato	Prof. Ordinario	CSN IV							50				50															100	
22	Theofilopoulos Dimosthenis		Associato	Dottorando	CSN IV						100																				100	
23	Vergallo Pierandrea		Associato	Dottorando	CSN IV			100																							100	
24	Vitolo Raffaele		Inc. Ric.	Prof. Associato	CSN IV			100																							100	

modo da correggerlo prima della fine del preventivo.

	Contratti con scadenza entro il 30-12-2021																																
25	De Matteis Giovanni		Assegn./Bors.	Assegnista	CSN IV			100																							100	
26	Ingrosso Gabriele		Inc. Ric.	Prof. Associato	CSN IV							0																			0	
27	Konopelchenco Boris		[P] Associato	Ass.Senior	CSN IV			0																							0	
28	Polimeno Laura		Associato	Dottorando	CSN IV	100																									100	
29	Tatullo Alessandro		Associato	Dottorando	CSN IV						100																				100	

	Nominativi la cui posizione contrattuale non ï¿½ stata (ancora) inserita nei sistemi INFN																																
30	Hasan Azeem		*Inserire manualmente la qualifica !*		CSN IV		100																								100	
					FTE Totali	5.25	3.5	6.8	0.95	1	3	3.2																							

Totale: 23.7 FTE

Sintesi

	2020	2021	2022
Dipendenti	1	1	1
Incarico Ric.	9	8	8
Associati	7	6	5
Ass. su IS	0	0	2
Altri Enti	2	2	2
Senior	1	2	1
Post doc	2	1	0
Assegnisti	4	2	2
Ass. Dott.	4	5	5
Tot	30	27	24/26

Quadro delle IS 2021/2023 - LE

Linea	*IS*	*fte* − 21	*fte* − 22	*Loc.R.*
*L*6	*FIELDTURB*	5.25	5.25	*A.Lanotte*
*L*1	*GSS*	4.5	2.5	*M.Beccaria*
*L*4	*MMNLP*	3.3	6.8	*R.Vitolo*
*L*3	*MONSTRE*	0.95	0.95	*G.P.Co′*
*L*3	*NUCSYS*	1	1	*L.Girlanda*
*L*2	*QFT_HEP*	4	3	*C.Coriano′*
*L*5	*TASP*	2.7	3.2	*F.De Paolis*
		23.7	20.25	

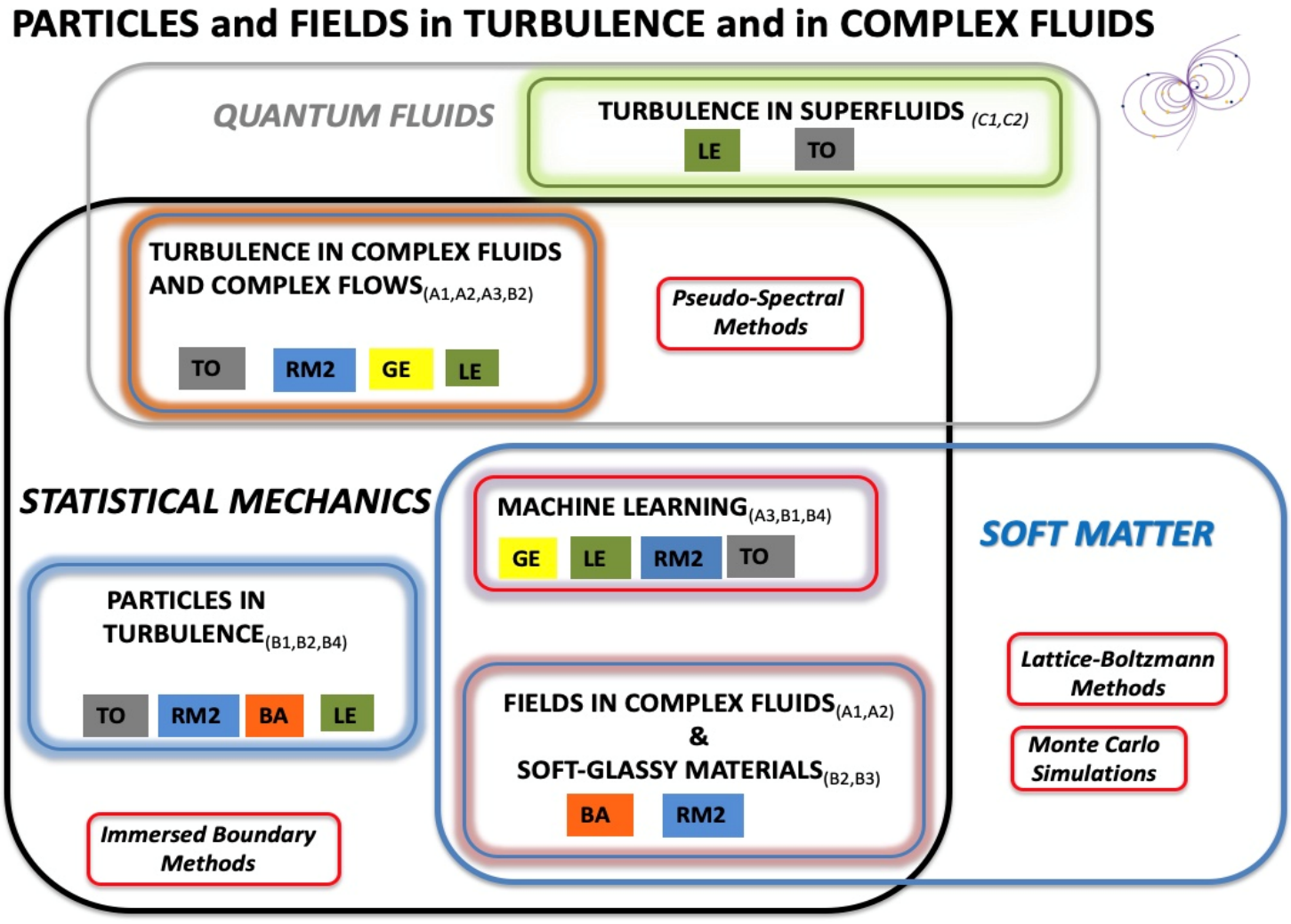
Fuori CSN4 : 2 FTE in CSN2

Contabilità Dot4 2021

Descrizione	Stanziato	Variato	ubjudice e Conç	Preimpegno	Impegni	Disponib.	roposta in cors	Disp. Teori
Pubblicazioni	1.500,00	0	0	0	0	1.500,00	0	1.500,00
Materiale informatico	1.500,00	-500	0	870,01	41,48	88,51	0	88,51
Rimborso per viaggio e trasloco	5.000,00	2.500,00	0	0	0	7.500,00	0	7.500,00
Indennità di missione e di trasferta	7.000,00	-1.500,00	0	0	0	5.500,00	0	5.500,00
Organizzazione e partecipazione a	2.500,00	0	0	0	150	2.350,00	0	2.350,00
Licenze d'uso per software	1.500,00	-500	0	0	0	1.000,00	0	1.000,00
Manutenzione ordinaria e riparazio	500	500	0	0	0	1.000,00	0	1.000,00
Spese per commissioni e comitati c	0	1.500,00	0	0	0	1.500,00	0	1.500,00
Attrezzature scientifiche	6.000,00	5.000,00	0	0	8.889,41	2.110,59	0	2.110,59

FIELDTURB 2021 - 2024

National Coordinator: Guido Boffetta (Univ. Torino)



5 Units

Torino

Genova

RM2

Bari

Lecce

Research activity in Lecce

PEOPLE

Albanese Linda, dottoranda
Barra Adriano, Prof associato
Lanotte Alessandra Sabina, primo ricercatore CNR
Panico Riccardo, dottorando
Polimeno Laura, dottoranda
Sanvitto Daniele, Dirigente di ricerca CNR

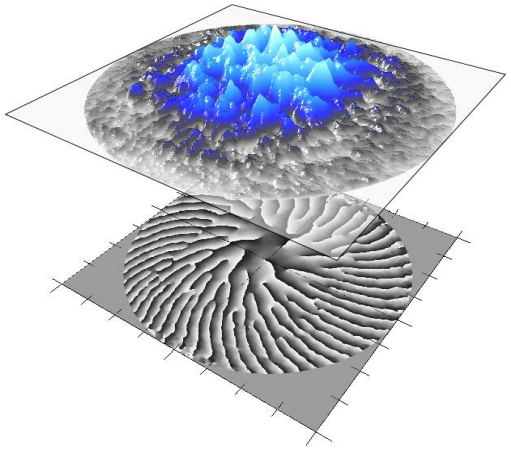


Figure: On the top, the polariton fluid density profile; on the bottom, its phase pattern: each black stripe corresponds to a phase defect, i.e. a vortex.

Vortices dynamics in exciton-polariton condensates

There is only one way a superfluid – a fluid with no friction- can rotate, and it is by forming topological defects, that we call quantum vortices. These are quantised objects and their number per unit area is fixed by the Feynman-Onsager relation, derived in the ’50s and first observed in superfluid helium in the '90s. We report [1] on the first experimental study of the Feynman-Onsager relation in a non-equilibrium two-dimensional polariton fluid, free to expand and rotate. In the absence of boundaries, the regular lattice of vortices expands, but not exactly as the theory would predict: in particular we observe an accelerated stretching of the lattice and an outward bending of the linear trajectories of the vortices, due to the repulsive non-linear polariton interactions. Remarkably, we are able to detect a small deviation from the Feynman-Onsager rule in terms of a transverse velocity component, alike a classical Magnus force, due to the density gradient of the fluid envelope acting on the vortex lattice.

Our activity continues now by studying the dynamics of the interaction of waves and rapidly rotating Bose-Einstein condensates, realized in exciton-polariton quantum fluids, see [2].

[1] R Panico, G. Macorini, L. Dominici, A. Gianfrate, A. Fieramosca, M. De Giorgi, G. Gigli, D. Sanvitto, A. S. Lanotte, and D. Ballarini, “Dynamics of a vortex lattice in an expanding polariton quantum fluid”, accepted on PRL 2021.

[2] A. Geelmuyden et al,” The sound-ring radiation of expanding vortex clusters” arXiv: 2105.11509v1 (2021)

Research activity in Lecce (continued)

Machine Learning and Statistical Mechanics

As for the first topic, we plan to deepen our understanding about how dense neural networks (namely networks whose neurons interact in "p-plets", rather than just in couples) are able to perform pattern recognition at vanishing signal-to-noise ratios and we aim to use this skill spontaneously shown by these machines for early cancer detection in automatized image-screening procedures.

The mathematical backbone of this investigation lies in the statistical mechanics of spin glasses, the latter playing as a natural theoretical framework for the modern (re)-formulation of Artificial Intelligence that is under construction: focusing on the latter, we aim to also study formal aspects of the theory. In particular, despite the knowledge of Parisi theory for the Sherrington-Kirkpatrick model (and, thus, barely for the Hopfield model and multi-species spin glasses), in general, replica symmetry breaking in associative memories, neural networks and learning machines is still an open problem. We plan to inspect in depth such a phenomenon in these systems.

LIST OF PUBLICATIONS (2020- 2021)

[1] E. Agliari, et al. "Neural Networks with a Redundant Representation: Detecting the Undetectable", PRL 124 (2), 028301 (2020).

[2] D. Alberici, et al., "Annealing and Replica-Symmetry in Deep Boltzmann Machines" J STAT PHYS 1-13 (2020)

[3] E. Agliari, et al., "Detecting cardiac pathologies via machine learning on heart-rate variability time series and related markers" SCI REP. 10, (1) 1-182020

[4] E. Agliari, E et al., "Generalized Guerra's interpolation schemes for dense associative neural networks", NEURAL NETWORKS 128, 254 (2020).

[5] E Agliari, A Barra, P Sollich, L Zdeborova, "Machine learning and statistical physics: preface" Journal of Physics A: Mathematical and Theoretical 53 (50), 500401 (2020).

[6] E Agliari, F Alemanno, A Barra, OA Barra, A Fachechi, LF Vento, L Moretti,"Analysis of temporal correlation in heart rate variability through maximum entropy principle in a minimal pairwise glassy model", Scientific Reports 10 (1), 1-14 (2020).

[7] E Agliari, L Albanese, A Barra, G Ottaviani, "Replica symmetry breaking in neural networks: a few steps toward rigorous results", Journal of Physics A: Mathematical and Theoretical 53 (41), 415005 (2020).

[8] A. Gianfrate, L. Dominici, D. Ballarini, D. Sanvitto, M. Leonetti "Transverse localization of light in laser written designed disorder", APPL PHYS LETT Volume 116 Issue 7 (2020).

[9] D. Ballarini, D. Caputo, G. Dagvadorj, R. Juggins, M. De Giorgi, L. Dominici, K. West, N. Pfeiffer, G. Gigli, M.H. Szymanska, D. Sanvitto, "Directional Goldstone waves in polariton condensates close to equilibrium" NAT COMMUN Volume 11 Issue 1 (2020).

[10] R. Panico, G. Macorini, L. Dominici, A. Gianfrate, A. Fieramosca, M. De Giorgi, G. Gigli, D. Sanvitto, A. S. Lanotte, and D. Ballarini "Dynamics of a vortex lattice in an expanding polariton superfluid", accepted on PRL 2021.

[11] D. G. Suarez-Forero, F. Riminucci, V. Ardizzone, N. Karpowicz, E. Maggiolini, G. Macorini, G. Lerario, F. Todisco, M. De Giorgi, L. Dominici, D. Ballarini, K. West, L. Pfeiffer, G. Gigli, A. S Lanotte, D. Sanvitto, "Enhancement of Parametric Effects in Polariton Waveguides Induced by Dipolar Interactions", PRL 126, (13), 137401 (2021).

GSS: gauge theories, supergravity and string theory

Struttura "amministrativa"

Responsabile nazionale: Anna Ceresole (TO)

Responsabili locali:

Torino - Anna Ceresole

Milano S. - Alberto Santambrogio

Padova - Davide Cassani

Genova - Camillo Imbimbo

Pisa SNS - Augusto Sagnotti

Milano B. - Alberto Zaffaroni

Lecce - MB

Associazioni **Lecce**: Matteo Beccaria (PO), Diego Pallara (PO, MATH), 50% Giulio Landolfi (RTI), Azeem Hasan (INFN PhD)

GSS: gauge theories, supergravity and string theory

Preventivo attività scientifica: l'iniziativa GSS è un'iniziativa che continua. I temi di ricerca saranno schematicamente:

A) Compattificazione di stringa e vuoti di stringa: classificazione delle geometrie della compattificazione di stringa con brane e flussi, descrizione di bassa energia in termini di supergravità**.**

B) Rottura della supersimmetria dovuta a brane: studio della stabilità di classi di vuoti non-supersimmetrici con applicazioni alla cosmologia e all'inflazione.

C) Teorie di gauge supersimmetriche, olografia e dualità: studio di teorie di campo che possono essere realizzate in teoria di stringa e descritte olograficamente da supergravity in spazi di anti De Sitter in varie dimensioni. Higher spin gauge theories, integrability delle ampiezze di scattering etc.

D) Buchi Neri e supergravità: descrizione microscopica di buchi neri e derivazione oleografica dell'entropia di buchi neri supersimmetrici in AdS.

E) **Metodi Matematici:** utilizzo (e sviluppo) di metodi matematici per lo studio di problemi legati ai temi indicati. In particolare, tecniche di localizzazione, supergravità di Chern-Simons.

Principali pubblicazioni 2021

Strong coupling expansion of free energy and BPS Wilson loop in $\mathcal{N} = 2$ superconformal models with fundamental hypermultiplets #1

Matteo Beccaria (INFN, Lecce and Salento U.), Gerald V Dunne (Connecticut U.), Arkady A Tseytlin (Imperial Coll., London and ITMP, Moscow and Lebedev Inst.) (May 31, 2021)

e-Print: 2105.14729 [hep-th]

pdf cite 0 citations

Exact results in a $N = 2$ superconformal gauge theory at strong coupling #2

M. Beccaria (INFN, Lecce and Salento U.), M. Billò (Turin U. and INFN, Turin), M. Frau (Turin U. and INFN, Turin), A. Lerda (INFN, Turin and Piemonte Orientale U., Alessandria), A. Pini (INFN, Turin) (May 31, 2021)

e-Print: 2105.15113 [hep-th]

pdf cite 1 citation

BPS Wilson loop in $\mathcal{N} = 2$ superconformal $SU(N)$ "orientifold" gauge theory and weak-strong coupling interpolation #3

Matteo Beccaria (Salento U. and INFN, Lecce), Gerald V. Dunne (Connecticut U.), Arkady A. Tseytlin (Imperial Coll., London and ITMP, Moscow and Lebedev Inst.) (Apr 26, 2021)

e-Print: 2104.12625 [hep-th]

pdf cite 3 citations

On topological recursion for Wilson loops in $\mathcal{N}$ = 4 SYM at strong coupling #4

Matteo Beccaria (Salento U. and INFN, Lecce), Azeem Hasan (Salento U. and INFN, Lecce) (Feb 24, 2021)

Published in: *JHEP* 04 (2021) 194 • e-Print: 2102.12322 [hep-th]

pdf DOI cite 2 citations

$1/N$ expansion of circular Wilson loop in $\mathcal{N} = 2$ superconformal $SU(N) \times SU(N)$ quiver #5

Matteo Beccaria (INFN, Lecce and U. Salento, Lecce (main)), Arkady A Tseytlin (Imperial Coll., London and ITMP, Moscow and Lebedev Inst.) (Feb 15, 2021)

Published in: *JHEP* 04 (2021) 265 • e-Print: 2102.07696 [hep-th]

pdf DOI cite 6 citations

On the structure of non-planar strong coupling corrections to correlators of BPS Wilson loops and chiral primary operators #6

Matteo Beccaria (INFN, Lecce and Salento U.), Arkady A Tseytlin (Imperial Coll., London and ITMP, Moscow and Lebedev Inst.) (Nov 5, 2020)

Published in: *JHEP* 01 (2021) 149 • e-Print: 2011.02885 [hep-th]

pdf DOI cite 9 citations

MMNLP: Mathematical methods of nonlinear Physics

3 units: **Lecce, Milano-Bicocca, Roma.**
Team members:

- **Lecce**: Mario Angelelli, Giovanni De Matteis, Giulio Landolfi, Luigi Martina, Pierandrea Vergallo (PhD), Raffaele Vitolo (national coordinator).
- **Milano-Bicocca**: Gregorio Falqui, Paolo Lorenzoni (local coordinator), Giovanni Ortenzi, Marco Pedroni, Sara Perletti (Phd) Andrea Raimondo.
- **Roma**: Francesco Calogero, Sandra Carillo, Francesco Coppini (PhD), Matteo Valerio Falessi, Paolo Maria Santini (local coordinator), Federico Zullo.

- KdV as infinite dimensional integrable system:
  V. E. Zakharov, L. D. Faddeev, *Korteweg-de Vries equation: A completely integrable Hamiltonian system*, Functional Analysis and Its Applications, 1971, 5:4, 280-287.

$$u_t = \{u(x), H[u]\}$$

where

$$H[u] = -\frac{1}{2}\int_{-\infty}^{+\infty} (u_x^2 + 2u^3)\, dx$$

and

$$\{u(x), u(y)\} = \delta'(x-y).$$

Moreover there exists an infinite sequence of integrals of motion in involution:

$$\{H[u], I_i[u]\} = 0, \qquad \{I_i[u], I_j[u]\} = 0$$

Hamiltonian methods in PDEs

(P. Vergallo, R. Vitolo) Hamiltonian equations:

$$u^i = f^i(u^j, u^j_x, u^j_{xx}, \ldots) = A^{ij} \frac{\delta H}{\delta u^j},$$

where A^{ij} is a *Hamiltonian operator* (e.g., in the KdV example, $\delta'(x-y)$ corresponds to ∂_x). A bi-Hamiltonian equation is *integrable*.
Results (2021):

- WDVV equations are bi-Hamiltonian (JHEP, J. Vasicek and RV)
- New integrable systems from 'isometric' bi-Hamiltonian pairs (Proc. Royal Soc. A, M.V. Pavlov, P. Vergallo, R.V.)
- New symbolic software for calculations with nonlocal Hamiltonian operators (preprint, with M. Casati, P. Lorenzoni (Milano Bicocca unit), D. Valeri).

Inverse Spectral Transform

Boris Konopelchenko

- Self-dual Einstein spaces in the coordinates being eigenfunctions of the corresponding linear problems (Lax pair) have been studied. The formalism introduced allows to link algorithmically a variety of known heavenly equations, in particular, first and second Plebanski heavenly equations, dispersionless Hirota equation, TED equation and others. As a particular application , it is proved that a large class of self-dual Einstein spaces governed by a compatible system of dispersionless Hirota equations is genuinely four-dimensional in that the generic metrics do not admit any conformal Killing vector.
- The hydrodynamical homogeneous Euler equation has been studied . It has been shown that it can be viewed as the master equation in a sense that it admits dimensional reductions to a number of well-known hydrodynamical type systems like the integrable one-dimensional systems in terms of Riemann invariants, shallow water equations, systems describing iso-enthalpic and polytropic motions of gas, multi-dimensional extensions of Jordan systems, Burgers and Korteweg-de Vries equations.

Publications

- B.G.Konopelchenko and G. Ortenzi, On the plane to plane mapping of hydrodynamic type. Parabolic case, Reviews in Mathematical Physics, vol. 32 (2020), 2050006 (27 pages).
- M. Angelelli and B. Konopelchenko, Entropy driven transformations of statistical surfaces, Reviews in Mathematical Physics, 33 (2021), 2150001 (22 pages)
- B. G. Konopelchenko, W.K. Schief and A. Szereszewski, Self-dual Einstein spaces and general heavenly equation. Eigenfunctions as coordinates, Classical and quantum gravity, 38 (2021) 045007 (30 pages), published 24 December 2020.
- B.G. Konopelchenko and G.Ortenzi, On the universality of homogeneous Euler equation, Journal of Physics A : Math. Theor., 54 (2021), 205701 (22 pages).

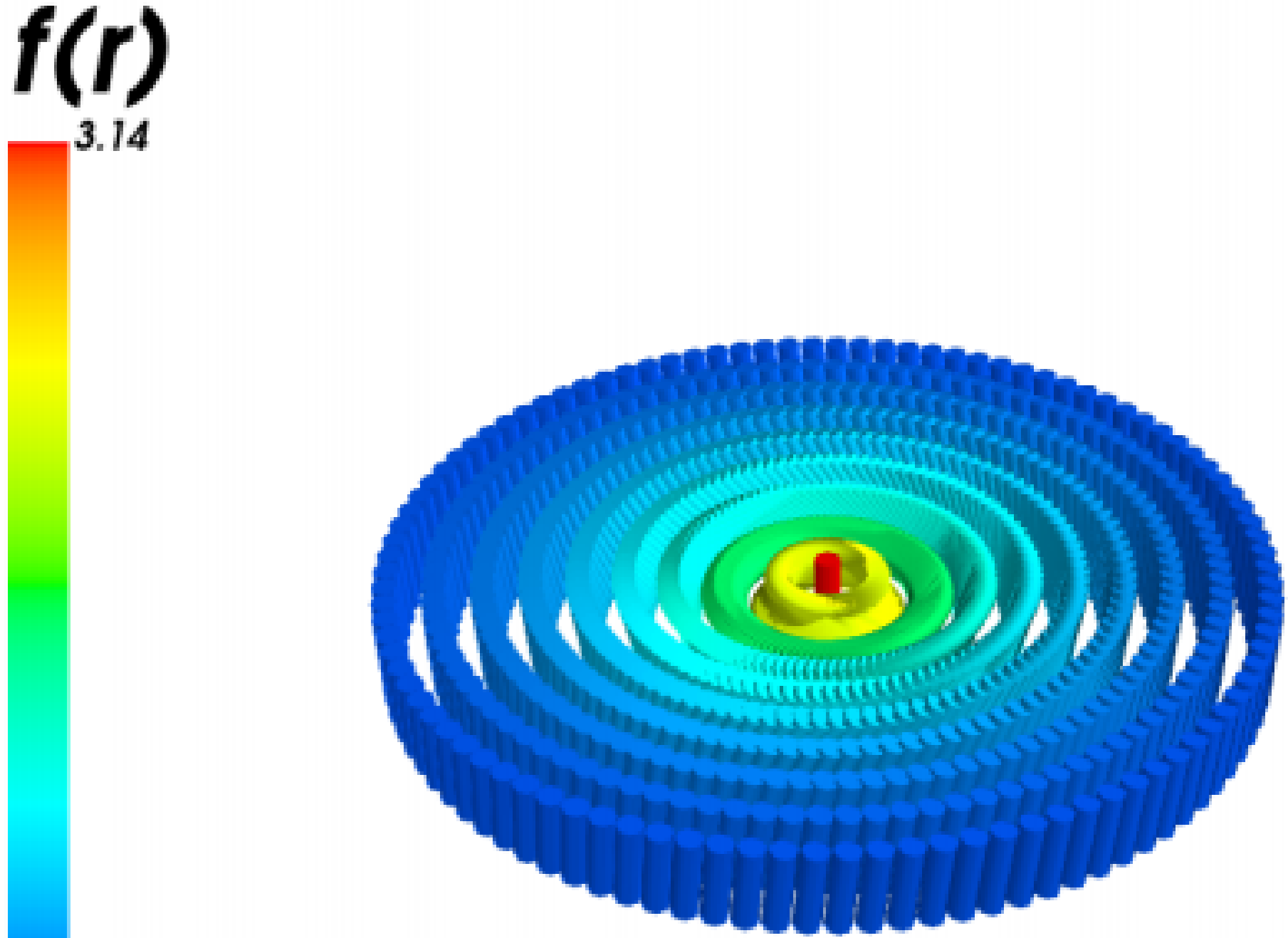
Nonlinear Quasi-integrable and Quantum System

Giulio Landolfi Features of non-stationary modes for non-autonomous systems subjected to drivings with distinguished characteristics. The manner the resulting changes for classical modes amplitudes do transfer to quantum correlations has been scrutinised in detail. Pubblicazioni

- M. Gianfreda and G. Landolfi,"Effects of quenching protocols based on parametric oscillators", (submitted 2021 Annals of Physicvs) F. Giglio, G. Landolfi, L. Martina, A. Moro, "Symmetries and criticality of generalised van Der Waals models", (submitted 2021 Phys. Lett. A), arXiv:2106.02456

G. De Matteis, L. Martina , C. Naya, V. Turco 1) New phases in liquid crystal configurations characterized by a localized pattern. Nonlinear clssical field theory characterized by topological charges, solitons in soft matter and skyrmions. 2) The relationship between the BMS and Conformal Carroll asymptotic group in General Relativity 3) Coupling spin-waves and E.M modes

- G. De Matteis, L. Martina, C. Naya, and V. Turco, Nonuniform localized distortions in generalized elasticity for liquid crystals, Phys. Rev. E 102, 042705 (2020).
- Leo, A et al. . Identification and time-resolved study of ferrimagnetic spin-wave modes in a microwave cavity in the strong-coupling regime. PhysRevB.101.014439. pp.014439 (2020).
- De Matteis, G.; Martina, L.; Turco, V., Waveguiding by helicoids in confined chiral nematics. J. Instr. - ISSN:1748-0221 vol. 15 (2021)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MONSTRE

MOdeling Nuclear STRucture and REaction

Coordinatore: Francesco Pederiva (TIPFA-Trento)

Composizione territoriale

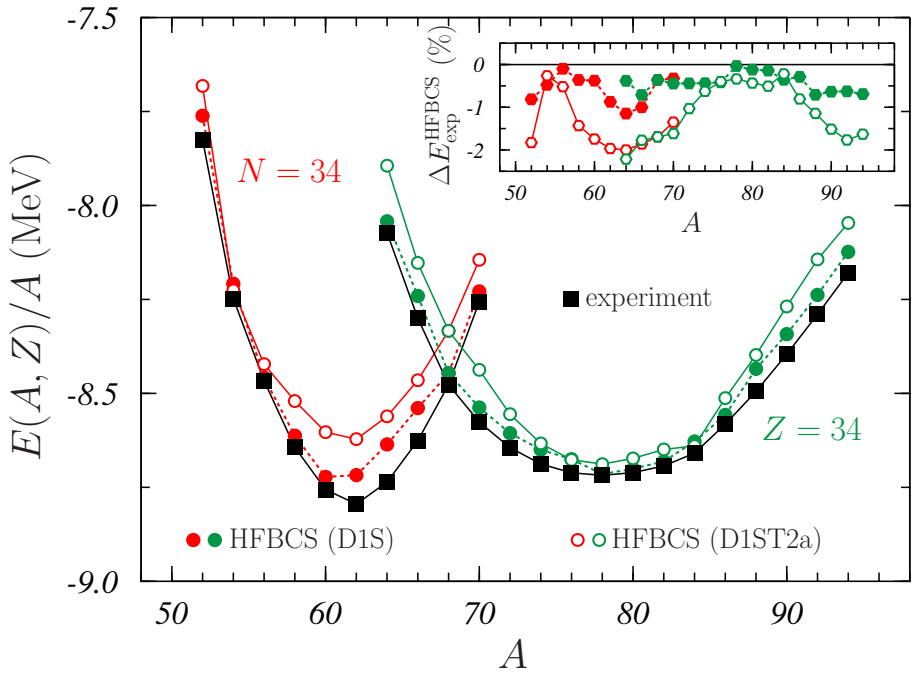
Bologna, Catania, Lecce, LNS, Milano, Napoli, Padova, Trento

Attività svolta a Lecce per il 2020-2021

In collaborazione con M. Anguiano e A.M. Lallena
Università di Granada, Spagna

Sviluppo di una teoria Hartree-Fock e Bardeen-Cooper-Schrieffer per nuclei deformati.
Possibilità di calcolare lo stato fondamentale di tutti i nuclei pari-pari.

G. Co', M. Anguiano, A. M. Lallena
Tensor force and deformation in even-even nuclei.
Accettato per la pubblicazione in Phys. Rev. C



Confronto tra energie di legame per nucleone sperimentali per isotoni con N=34 e isotopi con Z=34 con i risultati del nostro modello ottenuti con il tensore (D1ST2a) e senza (D1S).

NUCSYS

The strongly correlated nuclear system: effective interactions, models, reactions, fundamental symmetries and applications

Nuova IS, nata dalla fusione parziale di FBS (Few-Body Systems) e MANYBODY

Maggiore caratterizzazione verso la fisica fondamentale
e lo studio del nucleo con sonde elettrodeboli
(neutrino physics and beyond the standard model)

Composizione: Pisa (A. Kievsky) – Lecce – Trento – Padova – Pavia – Torino

Lecce: Luca Girlanda, 100 %

Contributo di Lecce:

-Applicazione delle tecniche della teoria di campo efficace al calcolo delle interazioni e degli operatori di corrente elettrodeboli nucleari

-Individuazione di proprieta' universali dei sistemi nucleari dovute alla grande lunghezza di scattering NN

-Studio di fisica al di la' del modello standard (dark matter, axion, X17) da esperimenti su nuclei leggeri.

Pubblicazioni 2021

1) R. Schiavilla et al. «Two- and three-nucleon contact interactions and ground-state energies of light- and medium-mass nuclei»,
Phys. Rev. C 103 (2021) 054003
2) A. Kievsky et al. «Efimov Physics and Connections to Nuclear Physics»,
Ann. Rev. Nucl. Part. Science 71 (2021) 465.
3) M. Viviani et al. «The X17 boson and the 3^33H(p,e+e−)4(p,e^+ e^-)^4(p,e+e−)4He and 3^33He(n,e+e−)4(n,e^+ e^-)^4(n,e+e−)4He processes: a theoretical analysis»,
arXiv: 2104.07808

Tesi 2021:

1) Irene Trenta, «Calcolo variazionale degli sfasamenti protone-protone in teoria effettiva pionless», Laurea triennale, Università del Salento, 15 Ottobre 2020
2) Antonio Mello, «Studio di sistemi quantistici bidimensionali basato sul gruppo di rinormalizzazione» Laurea triennale, Università del Salento, 22 Luglio 2021

Sviluppi e prospettive

-Studio dell'impatto di nuovi termini di interazioni di contatto a tre nucleoni individuati a N3LO e loro impatto nella diffusione nucleone deutone

(in collaborazione con Pisa)

-Studio di sistemi bosonici e fermionici vicino al limite unitario (infinite scattering length) agli ordini successivi della teoria effettiva pionless

(in collaborazione con Pisa e Universite de Nice [Paolo Recchia ->PhD])

-Studio delle proprieta' del bosone X17 da esperimenti di pair production nella diffusione protone-He3

(in collaborazione con Pisa, Trento e Frascati)

QFT_HEP

Standard Model and Beyond Standard Model Physics by QFT Methods

Physics Beyond the Standard Model, Flavour Physics, Vacuum Stability, Conformal, Symmetry Breaking in SM extensions, AdS/CFT methods, RG methods

Responsabile Nazionale: Fulvia De Fazio (BA)

Unità locali

Bari : F. De Fazio Catania: V. Brachina Lecce: C. Coriano'

Napoli: P. Santorelli

Main aim and topics

- Flavour physics in the Standard Model and Beyond, and vacuum stability
- Conformal and GUT extensions of the Standard Model and topological transitions
- Phenomenological applications of the AdS/CFT methods
- RG flows and their aoolications.

QFT HEP: Sviluppi e prospettive - Lecce

Lecce Unit

BSM PHYSICS

- **WP1:** In Grand Unified Theories the work will be focused on unification models based on SO(10), with a combined analysis of both their scalar and flavour sectors, discussing the structure of their effective actions resulting from the decoupling of a heavy right-handed neutrino. Phenomenological analyses will also be devoted to quiver models, extending recent work on quivers and gravitational waves. Attention will be paid to the investigation of the vacuum and thermal effects in the phase transitions for this class of models, and to the production of stochastic gravitational waves in the early universe, an activity started last year within the Unit.

CONFORMAL FIELD THEORY IN MOMENTUM SPACE

- **WP2:** In CFT in momentum space, the Unit will extend the analyses in momentum space in 3 and 4 dimensions of three-point functions to four-point correlators. These studies are relevant for determining the role of nonlocal anomaly actions in the description of the breaking of the conformal symmetry in conformal extensions of the Standard Model. The study in 3 dimensions is relevant for the analysis of non-gaussianities in the power spectrum associated to the cosmic background radiation of the early universe. In 4 dimensions, the analysis of conformal anomaly actions, both in non-supersymmetric and supersymmetric contexts will continue, also with the study of the impact in the production of gravitational waves. Implications of such actions in condensed matter theory will be further investigated, an activity recently started together with CNRS researchers.

QFT_HEP: Sviluppi e prospettive - Lecce

HOLOGRAPHIC COSMOLOGY

WP3: In holographic cosmology, studies of models describing a holographic phase of gravity using the AdS/CFT correspondence will continue, in collaboration with researchers in Florence and Southampton.

COLLABORATORS LECCE UNIT:
M. Chernodub CNRS, TOURS
P. Frampton, Oxford
K. Skenderis, Southampton
E. Mottola, Los Alamos
L. Delle Rose, Florence
E. Costantini, Bologna
V. Del Duca, ETH
P. Anastasopoulos, Vienna Tech. Univ.
M. Guzzi, KSU, Atlanta, Georgia.

QFT_HEP: Pubblicazioni

INFN Unit Lecce

1. *M. N. Chernodub, C. Corianò, M. M. Maglio,* Anomalous Gravitational TTT Vertex, Temperature Inhomogeneity, and Pressure Anisotropy, *Phys. Lett. B 802 (2020) 135236*
2. *C. Corianò, M. M. Maglio,* On some hypergeometrical solutions of the Conformal Ward Identities of the scalar 4-point functions in Momentum Space, *JHEP 09 (2019) 107*

Conformal Unificaton in a Quiver Theory and Gravitational Waves (with P.H. Frampton and A. Tatullo)

Conformal Field Theory in Momentum Space and Anomaly Actions in Gravity: The Analysis of 3- and 4-Point Functions (with M.M. Maglio)

Dark Matter with light and ultralight Stuckelberg axions with M.M. Maglio, A. Tatullo and D. Theofilopoulos (2020)

Four-Point Functions in Momentum Space: Conformal Ward Identities in the Scalar/Tensor case (with M.M. Maglio and D. Theofilopoulos) (to appear on Eur. Phys. J. C) (2020)

The Generalized Hypergeometric Structure of the Ward Identities of CFT's in Momentum Space in d > 2 (open access) (2020) (with M.M. Maglio)

An Axion-Like Particle from an *SO*(10) Seesaw with *U*(1) X (with P.H. Frampton, A. Tatullo, D. Theofilopoulos)

Anomalous Gravitational TTT Vertex, Temperature Inhomogeneity, and Pressure Anisotropy (with M. M Maglio and M. Chernodub)

TASP

Nome	Qualifica	% TAsP
De Paolis Francesco	Prof. Associato	**50**
Ingrosso Gabriele	Prof. Associato	**0**
Maiorano Michele	Dottorando	**100**
Montanino Daniele	Ricercatore Universitario	**70**
Orofino Vincenzo	Prof. Associato	**50**
Strafella Francesco	Prof. Ordinario	50

TASP

Scientific activities

- *Astrophysics:* Second-order effects in gravitational microlensing: polarization, astrometric microlensing, spin and orbital rotation; analysis of X-ray data of nearby dwarf galaxies; intermediate-mass black holes in the center of globular clusters and dwarf galaxies; use of Planck data to determine the rotation of the disk and halo of nearby galaxies; tidal disruption events in globular clusters;
- *Neutrinos and other particles:* improved bounds on neutrino parameters with new data coming from different sets of (solar, atmospheric, accelerator and reactor) experiments; Axion Like Particle (ALPs) oscillations in astrophysical magnetic fields; primordial Black Holes

TASP

Publications 2020-21

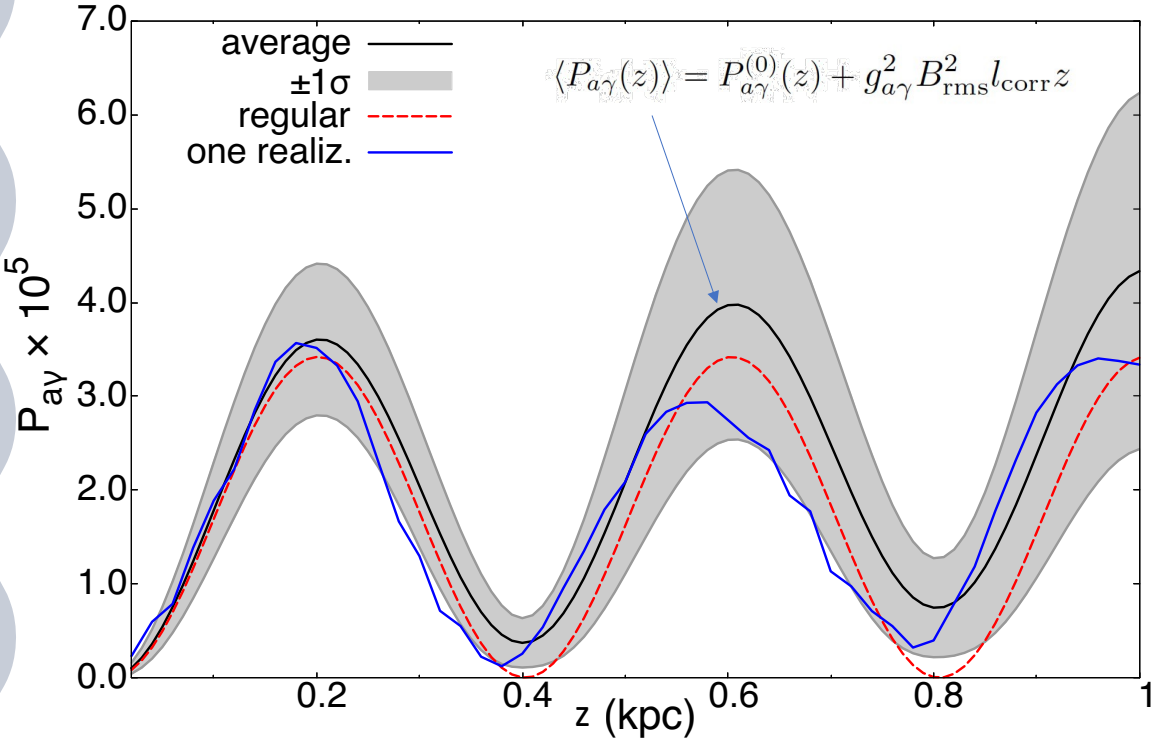
- ✓ L. Hamolli, M. Hafizi, F. De Paolis and A. A. Nucita, *Exploiting the IRT-THESEUS Capability to Observe Lensed Quasars*, Galaxies **9** (2021) no.2, 35 doi:10.3390/galaxies9020035 [arXiv:2105.05803 [astro-ph.HE]].
- ✓ A. A. Nucita, F. De Paolis, D. Licchelli, F. Strafella, G. Ingrosso and M. Maiorano, *VZ Sex: X-ray confirmation of its intermediate polar nature*,' Astrophys. J. **906** (2021) no.2, 134 doi:10.3847/1538-4357/abc7ca [arXiv:2012.14134 [astro-ph.HE]].
- ✓ F. De Paolis, A. A. Nucita, F. Strafella, D. Licchelli and G. Ingrosso, *A Quasar microlensing event towards J1249+3449?*, Mon. Not. Roy. Astron. Soc. **499** (2020) no.1, L87-L90 doi:10.1093/mnrasl/slaa140 [arXiv:2008.02692 [astro-ph.GA]].
- ✓ M. C. Orofino, A. Ferrara and S. Gallerani, *Massive black holes in high-redshift Lyman Break Galaxies*, Mon. Not. Roy. Astron. Soc. **502** (2021) no.2, 2757-2769 doi:10.1093/mnras/stab160 [arXiv:2101.05292 [astro-ph.CO]].
- ✓ P. Carenza, C. Evoli, M. Giannotti, A. Mirizzi and D. Montanino, *Turbulent axion-photon conversions in the Milky-Way*, [arXiv:2104.13935 [hep-ph]], to be published on PRD

TASP

Axion-like (ALPs) particles in stochastic magnetic field

- Axion-like particle can convert into photons (and vice versa) in galactic and extragalactic magnetic fields
- The stochastic component of the magnetic field induce fluctuations in the conversion probability
- The turbulent magnetic field can change the conversion probability by up to a factor of 2 and may lead to observable irregularities in the observable photon spectra from different astrophysical sources
- The average conversion probability grows linearly in the limit of δ-correlated gaussian fluctuations
- Under certain conditions the PDF of these fluctuations can be calculated analytically

m_a=10^{-10}eV, $g_{a\gamma}$=10^{-11}GeV^{-1}, E=50keV, B_{reg}=3μG, $\langle\delta B^2\rangle$=B^2_{rms}=1μG^2
Correlation length of fluctuations l_{corr}=10pc



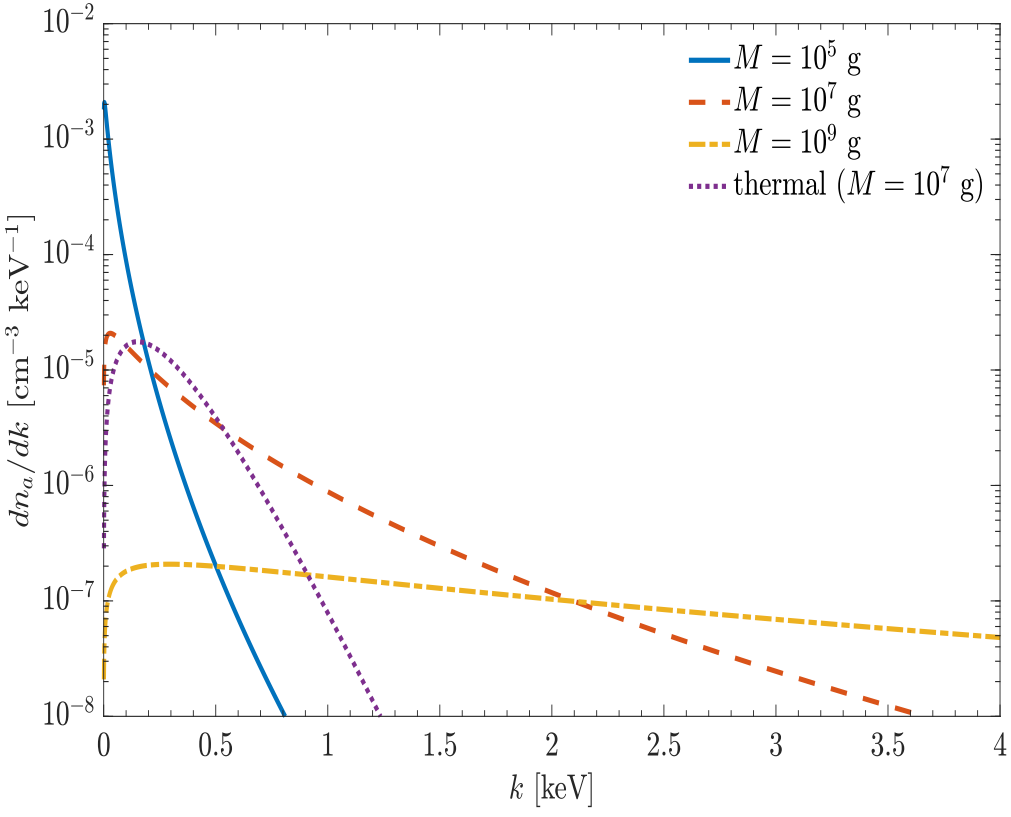
P. Carenza, C. Evoli, M. Giannotti, A. Mirizzi and D. Montanino, *Turbulent axion-photon conversions in the Milky-Way*, [arXiv:2104.13935 [hep-ph]], to be published in PRD

TASP

ALPs **produced** from evaporation of primordial Black Holes (PBHs)

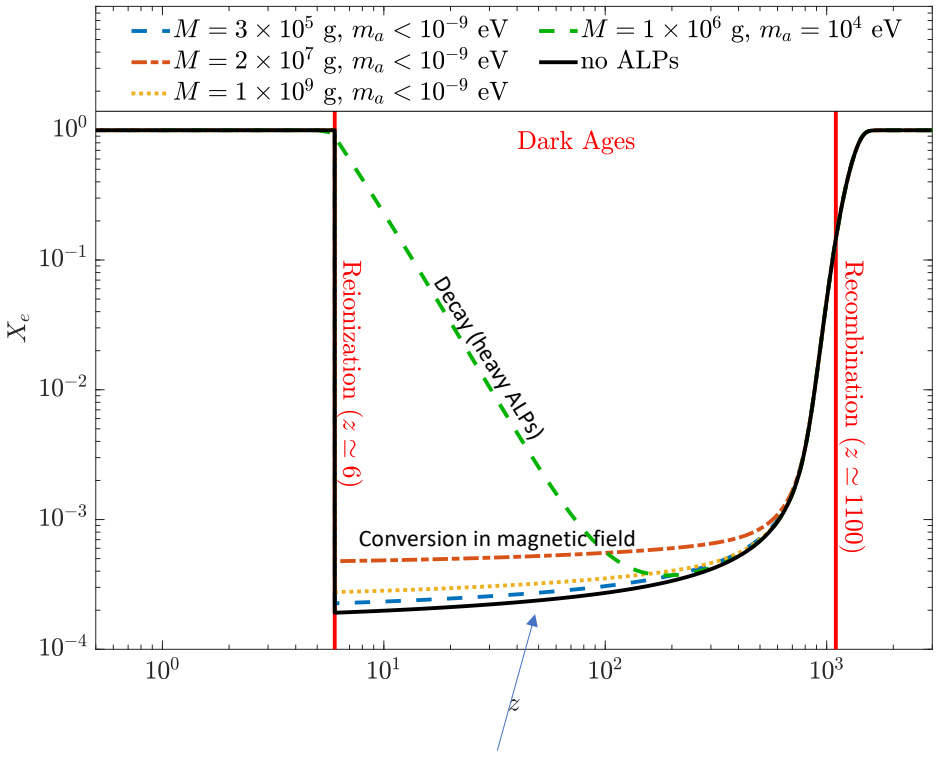
- Primordial Black Holes can be formed in early universe and undergo to Hawking evaporation before Big-bang nucleosynthesis
- PBHs can evaporate in all particles of the Standard Model and possibly in non-standard particles
- We consider a possible evaporation in Axion-like particles (ALPs)
- Unlike other standard model particles, ALPs do not enter in thermal equilibrium and can be observed at late time
- Light ALPs can convert into γ's into extragalactic magnetic fields
- Heavy ALPs can decay into γ's
- Photons can be directly detected or leave an imprint on the reionization during the era in which universe was transparent (reionization).

ALP spectrum at the end of evaporation



F. Schiavone, D. Montanino, A. Mirizzi and F. Capozzi, in preparation

TASP



Fraction of ionized hydrogen as function of the redshift during “dark ages”(6<z<1100)

”Optical depth” enhancement due to excess of free electrons caused by reionizations