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Curriculum

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Current Affiliation : Università degli Studi dell'Insubria, via Valleggio 11, 22100, Como, Italy

Place and Date of Birth : Premosello-Chiovenda (VB), April 16th, 1972

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Education :

1997-1999 : **Ph.D.** in Theoretical Physics at the Università degli Studi di Milano, Milan, Italy.
Date: February 7, 2000.
Title of Ph.D. Thesis : Non perturbative methods in string theory.
Supervisor : Prof. D. Zanon.

1991-1996 : **Laurea Degree** in Theoretical Physics at the Università degli Studi di Milano, Milan, Italy.
Date: July 10, 1996.
Final mark: 110/110 cum laude.
Title of Laurea Thesis: Quantum fluctuations around a wormhole.
Supervisor: Prof. G. Preparata.

1986-1991 : **Maturità Scientifica Degree**.
Institute: Technical-Industrial Institute "Guglielmo Marconi", Domodossola, Italy.
Specialisation: Electronics.
Final mark: 58/60.

Scientific career :

2000-2001 : postdoc position with title "Topological aspects in Field Theories", under the guidance of professor R. Ferrari, at the Physics department of the "Università degli Studi di Milano," Milan (Italy).

2001-2005 : postdoc position, under the guidance of professor G. Galgani, at the Mathematics department of the "Università degli Studi di Milano," Milan (Italy).

2006-2017 : researcher at the department of Science and High Technology of the "Università dell'Insubria," Como (Italy).

2017-present : associate professor at the department of Science and High Technology of the "Università dell'Insubria," Como (Italy).

Scientific Visiting Periods :

2006-2016 (`several visiting periods`) : Mathematics Dept. and Physics Dept., Università degli Studi di Milano, Milan, Italy.

2009-2016 (`several visiting periods`) : Mathematics Dept., Politecnico di Milano, Milan, Italy.

2007- 2013 (`6 visiting periods`) : IPhT - CEA, Saclay (Paris), France.

2013 (`1 visiting period`) : Institute for Theoretical Physics, ETH, Zurich, Switzerland.

2012 (`1 visiting period`) : School of Engineering and Physical Sciences, SUPA, Heriot-Watt University, Edinburgh, Scotland, UK.

2011 (`several visiting periods`) : INO-CNR BEC Center and Physics Dept., Università di Trento, Trento, Italy;
Institute of Theoretical Physics, K.U. Leuven, Belgium;
Physics and Astronomy Dept., Università degli Studi di Firenze, Sesto Fiorentino (Florence), Italy;
Theoretical Physics Dept., Università degli Studi di Torino, Turin, Italy.

2010 (`1 visiting period`) : Physics Dept., Universidad de los Andes, Bogotà, Colombia.

2009 (`1 visiting period`) : ICFO, The Institute of Photonic Science, Castelldefels (Barcelona), Spain.

2008 (`2 visiting period`) : Scuola Normale Superiore di Pisa, Pisa, Italy;
Perimeter Institute of Theoretical Physics, Waterloo, Canada.

Research interests

My research is mainly devoted to mathematical Physics and theoretical Physics and can be resumed in the following points:

1. Analogue Gravity in Dielectric Media.

Analogue gravity consists in all those approaches whose aim is to reproduce in laboratory, as faithfully as possible, some classical or quantum realisation of nontrivial phenomena involving gravity and that usually cannot tested in the real gravitational situation. Its origin can be identified with a paper by W. Unruh, who in 1981 proved that the linear perturbations of the steady flow of a perfect barotropic fluid are perfectly described by the relativistic wave equation of scalar field on a nontrivial curved spacetime background, whose precise geometry is determined by the exact unperturbed configuration. In particular, event horizons can be generated by allowing the fluid to pass from subluminal to superluminal regimes. Quantising the linearised perturbation one thus expects the analogue of the Hawking radiation phenomenon in presence of horizons. Indeed, Hawking effect is the prototype of object of study in analogue gravity, since it has no hope of being detected in astrophysical observations. This is not however the only one, and a plethora of other possible effects can be considered, including classical and quantum effects in cosmological models. Moreover, from 1981 up to now, several different analogue system have been introduced, for example in BEC, in condensed matter systems, and so on. The main reason my group and me are working with non linear dielectrics is that we think this is the only possible analogue that would allow for a direct measurement of the Hawking photons, the other methods giving only indirected signals.
In this field, together with my colleagues (mainly in collaboration with Daniele Faccio (Herriot-Watt, Edinburg) and Francesco Belgiorno (Politecnico di Milano)), I have obtained a number of important results among which more than one deserve to be mentioned:

- in [**43**] it has been discovered that a perturbation of the refractive index moving faster than light in a transparent medium produces photon emission in a way similar to the Cerenkov effect for a charged particle;

- in [**39**] we have studied a theoretical model describing the realisation of horizons in a Kerr dielectric medium (a medium where an intense laser pulse produces a local perturbation of the refractive index which depends linearly from the intensity of the pulse), where dispersion relations have been introduced phenomenologically, as well as quantisation. In particular, we predicted that in presence of a horizon Hawking modes are expected to be thermally excited at a temperature proportional to the gradient of the refractive index at the horizon, but only in a window of frequencies characterised by the speed and the hight of the pulse, and by the dispersion law (the window law);

- in [**31**], [**30**] and [**25**] we reported the detailed description including numerical and theoretical analysis of an experiment projected and performed by our group at the laboratories of the University of Insubria in Como (Italy), where the window law has been verified with success;

- in [**13**], [**12**] and [**9**] we have developed a covariant model of a transparent dielectric medium where the correct dispersion relations are obtained by first principles and whose quantisation is performed exactly in the Heisenberg picture. Thus, it provides a robust mathematical model for the rigorous study of quantum effects in a dispersive dielectric medium.

2. Black Holes in Supergravity, Attractors and AdS/CFT.

Black holes in supergravity and in quantum gravity theories represent more than simply particular solutions of the (classical) equations of motion, since, at least as a residual supersymmetry is left unbroken, they provide perturbatively stable solutions around which testing quantum and/or stringy corrections, verifying the AdS/CFT correspondence, holography and so on.
In this context, I have devoted my efforts in more than one direction:

- looking for complete classifications of BPS solutions in $N = 2$, $D = 4$ supergravity theories. The most relevant result I have obtained together with collaborators of the Università degli Studi di Milano is presented in [**55**], where we have classified all timelike supersymmetric solutions of $N = 2$, $D = 4$ gauged supergravity coupled to abelian vector multiplets;

- studying the attractor mechanism for black holes in supersgravity theories, including exceptional (magic) supergravities and gauged supergravities. In collaboration with Dietmar Klemm (Università degli Studi di Milano) I have obtained a particularly relevant result in [**42**]. There, we have determined the first examples of genuine supersymmetric black holes in AdS_4, with nonconstant scalar fields, for various choices of the scalar potential. This allowed us to determine the attractor equations in gauged supergravity. We thus proved the presence of flat directions in the black hole potential so that, differently from the ungauged case, the moduli on the horizon are not completely specified by the charges. Still, the entropy remains fixed by the charges. This important results have made of [**42**] a basic reference in the literature on the subject;

- inspired by the AdS/CFT correspondence, I am interested in investigating the conformal properties of black hole solutions. In this direction I have already obtained more than one relevant result. In [**79**] we have shown that (super) particles near the event horizon of a BPS black hole satisfy a generalised (super-) Calogero-Moser conformal dynamics manifesting a (super-)W_∞ algebra (including the Virasoro algebra as a proper subalgebra) of symmetries. We also computed the corresponding central charge, providing an explicit realisation of the AdS_2/CFT_1 correspondence. It is worth mentioning that our results are to be considered universal in the sense that they can be applied to all black hole configurations whose near horizon geometry is of the type $AdS_2 \times \Sigma_2$, where Σ_2 is a surface with constant curvature. However, what I consider the most important result I have obtained in this direction up to now, is described in [**27**], where we have discovered the existence of an hidden conformal symmetry near the horizon of the Schwarzschild black hole. These represent a very important step, since the Schwarzschild black hole, the simplest of black holes, being far from any BPS solution, resists to any microscopical approach aimed to explain its entropy.

3. Perturbative and non perturbative Aspects of Quantum Gravity.

My main activity on quantum gravity regards topics in super string theory, but not exclusively. An important result I've obtained in a quantum gravity framework different from the stringy one is in [**74**], where we discovered that the construction of the invariant measure in noncommutative general theories realised previously in literature was not indeed invariant under diffeomorphisms, and we showed how this problem can be circumvented in the two dimensional case (or in three

dimensions in [**73**]). In what regards the string theory approach, my main efforts are devoted to four directions of research:

- a formulation of super string theory based on first principles is still lacking. In particular, after several years of intensive effort, perturbative calculations in string theory have been systematically realised only up to genus two. An important breakthrough is represented by paper [**56**], where, with the help of professor van Geemen and my PhD student, we have proved that few geometric constraints representing the basic physical properties expected for the vacuum-to-vacuum amplitude, would univocally fix the form of such amplitude and the integration measure for the case of genus g. Next, in [**53**] we proved the same at genus four. These results aroused the attention of the community giving rise of an increasing number of new papers on the subject and deeper investigations showed that our results are not the ones one should expect for superstring theory, despite our uniqueness theorems. The reason is that we assumed the super geometry of the moduli space of super Riemann surfaces (underlying the stringy geometry) can be projected down to the underlying bosonic geometry. A recent result due to Ron Donagi and Edward Witten has finally shown that such a projection is not holomorphic and then is not allowed. This has originated new ferment in studying super geometry from a rigorous viewpoint;

- the second direction, not unrelated to the first one, regards homological mirror symmetry. In particular, my main intent here is to make the abstract formulations, developed in the mathematical literature, simple enough to be manageable for physicist also. My main result in this sense is described in [**18**] where we provided a very explicit realisation of the homological mirror symmetry applied to the local Calabi-Yau threefold obtained from the total space of the anti canonical bundle over the complex projective space $\mathbb{P}^2$. As a byproduct of our work, we have shown that the abstract mathematical construction does not automatically provide the exact physical equivalence (which should respect brane charges), but only up to quasi-autoequivalence of categories. Thus, a more precise characterisation of the homological mirror symmetry needs to be worked out in order to select the physical mirror map along all the mathematically equivalent ones. A second byproduct has been the proof of a conjecture due to S. Hosono, at least for this particular case;

- a line unifying the previous two ones is the tentative of defining the super analogue of the Calabi-Yau manifolds and to extend the mirror symmetry tools to such new class of manifolds. Even though, together with the help of the algebraic geometry groups of the Università degli Studi di Catania and Università degli Studi di Milano, we already obtained the first results, succeeding in providing a generalised definition of super Calabi-Yau manifold and applications in the case of bosonic dimension one, still we have not yet published papers deserving particular attention;

- general computational aspects in string theory remain one of my main interests. A first important result, worth to be mentioned, is in [**26**] where we studied tadpole cancellation in the Sen limit of F theory. We there obtained a new case of universal tadpole cancellation, where the Sen limit may not exist. Moreover, we also found a new fibration with non-Kodaira type fibres.

The second important result is in [**28**], the last paper of a series devoted to the application of uniformization to higher genus string theory, an idea due to Dr. Matteo Cardella.

4. Lie Groups and their Applications to Physics.

Unavoidably, Lie algebra and Lie groups play fundamental roles essentially everywhere in physics. In most cases the properties of the algebra are sufficient to what concern the applications of interest. Nevertheless, there are cases where the knowledge of explicit realisations of the group is necessary, including a simple characterisation of the range of parameter for covering the group just once. I started my project on Lie groups as a commission required by people working on lattice QCD numerical simulations, who needed explicit parameterisations of exceptional Lie groups, but met the problem that fixing the correct range of parameters numerically was excessively time and memory consuming for computers, so slowing down the successive application. Together with collaborators I've introduced the concept of generalised Euler angles of a compact Lie group, with respect to a symmetrically embedded maximal compact subgroup. I have then constructed the generalised Euler parametrisation of all exceptional Lie groups and finally in [**4**] I ended up with a very general construction valid for all connected compact Lie groups. In the same paper, we have found a connection between generalised Euler parametrisation and a family of integrals generalising a Dyson conjecture. Our interpretation provides a new proof of the conjecture, based on geometrical arguments. It is worth mentioning that in [**66**] I have shown with an explicit example that the generalised Euler construction works also for non symmetrically embedded maximal subgroups. This shows that there must be more to understand about the generalised Euler construction, and it would be interesting to extend it to the more general case to get new information about the generalised Dyson conjecture.

5. Quantum Effects in Black Holes Physics.

There are a lot of quantum effects on a black hole background, beyond the Hawking effect, that deserve to be investigated, like, for example the discharge of black holes in presence of Dirac or Klein-Gordon fields, the lost of angular momentum and so on. I investigate this topics mainly in collaboration with Francesco Belgiorno (Politecnico di Milano). Among others, we obtained two results that deserve some attention. In [**51**], [**48**], we have carefully studied the self adjoined properties of the Dirac operator on a Kerr-Newmann black hole in presence of a cosmological constant. We have then proved the absence of bound state for Dirac fields on such background states. In [**45**] we have considered a charged Dirac field on a Nariai background, and employing the fact that the equations of motion for the field are exactly solvable, we have been able to provide a very detailed account of the discharge process (even for a non realistic background).

6. Foundations of Physics.

With this I simply mean the thus investigations which do not necessarily require the appealing to sophisticated technical tools, but are merely aimed to investigate what the minimal hypothesis (if there is a minimum) are necessary in order to define a unique universal physical model of the world. Assuming that I will never be able to construct a theory of all, in this direction I limit myself to investigate some basic problems, like the dark energy and dark matter questions, looking for

possible solutions that avoid additional assumptions not yet definitely confirmed by experiments. Two relevant example are **[54]** and **[36]**. In the first paper we have shown that assuming a nearly two dimensional fractal distribution of the galaxies in the universe (as suggested by Mandelbrot) the effects of the far Galaxies on a local cluster is not negligible and contribute to the local virial with an amount comparable to the one customarily attributed to some dark matter. In the second one we have provided an example of "empty" space-time where a test particle would appear to be the subject of some mysterious locally homogeneous dark matter, then reducing the appearance of dark matter as an illusion induced by a general relativistic effect.
In the same context I include the research of explicit and relatively simple examples illustrating well known facts but will could help students and beginners to keep more confidence with the subject. A relevant example which raised some interest is **[52]**, devoted to the centennial of the famous Minkowski's paper on spacetime geometry, where we have carefully studied the most general kinematical group for an homogeneous and spatially isotropic spacetime, showing that it consists on a two parameters family of groups: the isometry groups of a family of spacetime manifolds parameterised by a limit speed of light and a constant curvature. In this context, interpreting dark energy as a cosmological constant would be the most natural thing to do.

7. Mathematics from Physics.

Finally I am also interested in problems in pure mathematics, especially when they have an origin from problems of physical nature. An example is **[11]**, where we proved that the existence of a Hurewicz fibration between certain spaces with the homotopy type of a CW-complex implies some topological restrictions on their universal coverings. In particular, in this paper, in collaboration with Professor Stefano Pigola, we obtained a surprisingly general result that can be roughly schematised as follows: Assume M is a smooth compact manifold whose universal covering is contractible, whereas N is a compact smooth manifold with compact universal covering. Choose an arbitrary Riemannian metric g on M and h on N. Finally, let $f : (M, g) \to (N, h)$ a smooth map such that for any $r > 0$ and $p \in M$, the image under f of a ball in M, centred in p with radius r, is contained in the ball in N, centred in $f(p)$ and with radius $e^{\epsilon}r$, but contains the concentric one of radius $e^{-\epsilon}r$. Then necessarily $\epsilon > \ln(1.02368)$.
It is worth mentioning that such a powerful result is a corollary of our extreme generalisation of a much more elementary result obtained for proving the unavoidable existence of stalling positions for robot's arms.

Organization of Workshops and Schools

I am in the scientific and organising committee of the following international schools:

- SIGRAV Graduated School in Contemporary Relativity and Gravitational Physics, IX edition: "Analogue Gravity", Villa Olmo, May 16-21, 2011, Como, Italy;
- SIGRAV Graduated School in Contemporary Relativity and Gravitational Physics, XI edition: "Gravity and the Quantum", Villa del Grumello, 1-6 June, 2014, Como, Italy;

- SIGRAV Graduated School in Contemporary Relativity and Gravitational Physics, XII edition: "Brave new Worlds", Villa del Grumello, 29 May-3 June, 2016, Como, Italy.

I have organised the workshop "Bridging the gap by building analogies," in the 2nd International Conference on Mathematical Modeling in Physical Science, 1–5 September 2013, Prague, Czech Republic.

Together with Gilberto Bini I have co-organised the Workshop "Interazioni fra Geometria Algebrica e Fisica Teorica" (Interactions between Algebraic Geometry and Theoretical Physics) held in Villa Grumello (Como, Italy) in January, 20-22, 2016.

I have co-organised (with prof. Daniele Cassani) the fifth RISM school, entitled "topological and algebraic aspects of QFT," to be held in Villa Toepliz (Varese, Italy) in July 31 - August 4, 2017.

I am co-founder, in the organising committee, and director of the scientific board of the DomoSummerSchool, an annual school in Mathematics and theoretical Physics, to be held in Domodossola, at Collegio Rosmini, sponsored by the municipality of Domodossola and the association ARS.UNI.VCO - Domodossola.

Selected invited talks and invitations to events

Among several talks and lectures given starting from the PhD period, I mention the following selected invited talks:

-Perimeter Institute of Theoretical Physics, Waterloo, Canada, October 09, 2008: *Problems in higher genus superstring amplitudes*

Università degli Studi di Milano, Department of Mathematics, Milan, Italy, November 30, 2009: *Calabi-Yau, Mirror Symmetry and rational curves: physical origins.*

-KU Leuven, October 27, 2010: *Hawking radiation from dielectric black holes;*

–Politecnico di Milano, Milan, Italy, February 17, 2011: *Hawking radiation in dielectric black holes;*

-Università degli Studi di Firenze, Florence, Italy, March 2, 2011: *Hawking radiation in nonlinear dielectrics;*

-Università degli Studi di Milano, Milan, Italy, April 15, 2010: *Analogue Hawking radiation in nonlinear optic media;*

-Università degli studi di Torino, Turin, Italy, May 27, 2011: *Hawking radiation in dielectric black holes;*

-ECT* Workshop on New trends in the physics of the quantum vacuum: from condensed matter, to gravitation and cosmology Trento, Italy, June 27-July 1, 2011: *Theory of analogue Hawking radiation in nonlinear optics;*

-Institut für Theoretische Physics, ETH, Zurich, Switzerland, January 17, 2013: *Hawking radiation in nonlinear dielectrics;*

-Politecnico di Milano, Milan, Italy, April 22, 2016: *Gravitational waves 100 years later;*

Among several others, I have participated to the following special events:

-I've been invited by prof. Gregory Sankaran to participate to the Workshop "Algebraic geometry, modular forms and applications to physics," held in November 26, 2012- November 30, 2012 at the International Center of Mathematical Sciences of Edinburgh;

-I've been invited by professors S. Grushevsky, R. Donagi, S. Katz and E. Witten to participate to the Simons Center's Workshop: Supermoduli held from 2015-05-18 to 2015-05-22 at the Simons Center for Geometry and Physics, Stonybrook, NY.

Articles, Proceedings and Books

Preprints

[1] S. L. Cacciatori and S. Noja, *Projective Superspaces in Practice,* arXiv:1708.02820 [math.AG].

[2] F. Belgiorno, S. L. Cacciatori, F. Dalla Piazza and M. Doronzo, *The Hopfield-Kerr model and analogue black hole radiation in dielectrics,* arXiv:1707.01663 [hep-th].

[3] S. L. Cacciatori, S. Noja and R. Re, *Non Projected Calabi-Yau Supermanifolds over* $\mathbb{P}^2$*,* arXiv:1706.01354 [math.AG].

[4] F. Belgiorno, S. L. Cacciatori and F. D. Piazza, "Tunneling approach and thermality in dispersive models of analogue gravity," arXiv:1411.7871 [gr-qc].

[5] S. L. Cacciatori and S. A. Filippini, "The $E^3/Z3$ orbifold, mirror symmetry, and Hodge structures of Calabi-Yau type," arXiv:1201.5057 [hep-th].

[6] S. L. Cacciatori, M. A. Cardella, "Uniformization, Unipotent Flows and the Riemann Hypothesis," [arXiv:1102.1201 [math.NT]].

Published Articles

[1] F. Belgiorno, S. L. Cacciatori and F. Dalla Piazza, "Tunneling method for Hawking radiation in the Nariai case," Gen. Rel. Grav. **49** (2017) no.8, 109.

[2] F. Belgiorno, S. L. Cacciatori and A. Viganò, *Spectral boundary conditions and solitonic solutions in a classical Sellmeier dielectric,* Eur. Phys. J. C (2017), no. 6, 404.

[3] S. L. Cacciatori, F. Dalla Piazza, A. Marrani, S. Noja, R. Re, *One-Dimensional Super Calabi-Yau Manifolds and their Mirrors,* JHEP 1704 (2017) 094

[4] S. L. Cacciatori, F. Dalla Piazza, A. Scotti, "Compact Lie groups: Euler constructions and generalized Dyson conjecture," Trans. Am. Math. Soc. 369 (2017), no. 7, 4709-4724

[5] S. L. Cacciatori, D. Klemm and M. Rabbiosi, *Duality invariance in Fayet-Iliopoulos gauged supergravity,* JHEP1609(2016)088.

[6] M. Tettamanti, S. L. Cacciatori, A. Parola and I. Carusotto, *Numerical study of a recent black hole lasing experiment,* Europhys. Lett. **114** (2016) no.6, 60011.

[7] F. Belgiorno and S. L. Cacciatori, *Stimulated emission and Hawking radiation in black hole analogues,* Gen. Relativ. Gravit. (2016) 48:145.

[8] F. Belgiorno, S. L. Cacciatori, F. Dalla Piazza and M. Doronzo, *Path integral quantisation of the relativistic Hopfield model,* Phys. Rev. D **93** (2016) no.6, 065020.

[9] F. Belgiorno, S. L. Cacciatori, F. Dalla Piazza and M. Doronzo, *Exact quantisation of the relativistic Hopfield model,* Annals of Physics 374 (2016) 338-365.

[10] F. Belgiorno, S. L. Cacciatori, F. Dalla Piazza and M. Doronzo, "$\mathbf{\Phi - \Psi}$ model for Electrodynamics in dielectric media: exact quantisation in the Heisenberg representation," Eur. Phys. J. C (2016) 76:308.

[11] S. L. Cacciatori and S. Pigola, "Hurewicz fibrations, almost submetries and critical points of smooth maps," to appear on Forum Mathematicum: ISSN (Online) 1435-5337, ISSN (Print) 0933-7741, DOI: 10.1515/forum-2016-0009, September 2016.

[12] F. Belgiorno, S. L. Cacciatori and F. Dalla Piazza, "The Hopfield model revisited: Covariance and Quantization," Phys. Scripta **91** (2016) 1, 015001.

[13] F. Belgiorno, S. L. Cacciatori and F. Dalla Piazza, "Hawking effect in dielectric media and the Hopfield model," Phys. Rev. D **91** (2015) 12, 124063.

[14] N. Westerberg, S. Cacciatori, F. Belgiorno, F. Dalla Piazza and D. Faccio, "Experimental quantum cosmology in time-dependent optical media," New J. Phys. **16** (2014) 075003.

[15] S. L. Cacciatori, B. L. Cerchiai, S. Ferrara and A. Marrani, "Iwasawa nilpotency degree of non compact symmetric cosets in N-extended Supergravity," Fortsch. Phys. **62** (2014) 350.

[16] F. Belgiorno, S. L. Cacciatori and F. Dalla Piazza, "Perturbative photon production in a dispersive medium," Eur. Phys. J. D **68** (2014) 134.

[17] M. Petev, N. Westerberg, D. Moss, E. Rubino, C. Rimoldi, S. L. Cacciatori, F. Belgiorno and D. Faccio, "Blackbody emission from light interacting with an effective moving dispersive medium," Phys. Rev. Lett, vol. 111, **043902** (2013).

[18] S. L. Cacciatori, M. Compagnoni and S. Guerra, "The Physical Mirror Equivalence for the Local P^2," Commun.Math.Phys. **333** (2015) 1, 367-388.

[19] S. L. Cacciatori, A. Marrani and B. van Geemen, "Multi-Centered Invariants, Plethysm and Grassmannians," JHEP **1302** (2013) 049.

[20] S.L. Cacciatori, B.L. Cerchiai, and A. Marrani, "Squaring the Magic," Adv. Theor. Math. Phys. **19** (2015) 923.

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[24] F. Belgiorno and S. L. Cacciatori, "General Symmetries: From Homogeneous Thermodynamics to Black Holes," Eur. Phys. J. Plus **126** (2011) 86.

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[28] S. L. Cacciatori, M. A. Cardella, "Eluding SUSY at every genus on stable closed string vacua," JHEP **1105** (2011) 124.

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Contributions to Proceedings and Reviews

[1] S. L. Cacciatori, B. L. Cerchiai and A. Marrani, "Adams-Iwasawa N=8 Black Holes," International Journal of Modern Physics: Conference Series, Volume: 13 (2012) 44.

[2] S. L. Cacciatori, B. L. Cerchiai and A. Marrani, "On the Scalar Manifold of Exceptional Supergravity," Fortsch. Phys. **60** (2012) 952.

[3] S. L. Cacciatori, "Conserved quantities for the Sitter particles*," arXiv:0909.1074 [gr-qc].

[4] A. Carati, S. L. Cacciatori, L. Galgani, "Far fields, from electrodynamics to gravitation, and the dark matter problem," Book Series Astrophysics and Space Science Proceedings, Book Chaos in Astronomy, p. 1-11, (Springer Berlin Heidelberg 2009), Subject Collection Physics and Astronomy.

I have published more than 180 reviews for the American Mathematical Society.

Contributions in Books and Encyclopedias

[1] El. Rubino, F. Belgiorno, S. L. Cacciatori, and D. Faccio, "Laser Pulse Analogues for Gravity," chapter 11 in "Analogue Gravity Phenomenology," Lect. Notes Phys. **870** (2013).

[2] F. Belgiorno, S. L. Cacciatori, F. Dalla Piazza, "Quantum Instability for Charged Particles on Charged Nariai Black Hole Manifold: Exact 4D Results for Black Hole Discharge Phenomenon," chapter 8 in "Classical and Quantum Gravity: Theory, Analysis and Applications," V. Frignanni editor, Novapublisher (2012), ISBN: 978-1-61122-957-8.

[3] S. L. Cacciatori and M. Compagnoni, "Supersymmetric Standard Model, Branes and Del Pezzo Surfaces," chapter 4 (pp. 131-184) in "New Developments in the Standard Model," R. J. Larsen editor, Novapublisher (2012) ISBN: 978-1-61209-989-7.

[4] S.L. Cacciatori, F. Dalla Piazza, "Modular forms and superstrings amplitudes," in " Superstring Theory", edited by. Frank Columbus (Nova Science Publisher, 2010), ISBN: 978-1-61668-385-6.

[5] S.L. Cacciatori, B.L. Cerchiai, "Exceptional groups, symmetric spaces and applications to supergravity," in " Group Theory: Classes, Representations and Connections, and Applications", Charles Danelling editor (Nova Science Publisher, 2009), (2010) ISBN: 978-1-60876-175-3.

[6] F. Belgiorno, S.L. Cacciatori, "Quantum loss of charge by non-rotating black holes with cosmological constant," in "Black Holes and Galaxy Formation," edited by. Frank Columbus (Nova Science Publisher, 2009), ISBN: 978-1-60741-703-3.

[7] S. L. Cacciatori, "Brane construction of gauge theories " Encyclopedia of Mathematical Physics, eds. J.-P. Franoise, G.L. Naber and Tsou S.T. Oxford: Elsevier, 2006 (ISBN 978-0-1251-2666-3), volume 1 page p.360.

Books

[1] M. Bertini, S. L. Cacciatori, M. Falchi Perna "Introduzione alla Fisica matematica," edizioni Aracne, collana scientifica EUREKA, serie Basic, Aspetti matematici della Fisica teorica, ISBN 978-88-255-0592-4

[2] F. Belgiorno, S.L. Cacciatori, D. Faccio, "Hawking Radiation: From Astrophysical Black Holes To Analogous Systems In Lab," World Scientific, to appear 30 Apr 2018

[3] S.L. Cacciatori, A. Scotti, "Compact Lie Groups and Dyson Integrals," OmniScriptum Publishing Group, to appear 2018

Unpublished Papers

[1] S. L. Cacciatori, F. Dalla Piazza, A. Scotti, "A simple E_8 construction," arXiv:1207.3623 .

[2] S. L. Cacciatori, "On a polynomial zeta function," e-Print: arxiv:0902.3190 [math-ph].

[3] S. L. Cacciatori and A. Celi, "New constraint for Black Holes in N = 2, D = 5 supergravity with matter," e-print:hep-th/0405284

Editorial Activity

I am in the editorial board of the scientific journal: Universe.
I am director of the editorial series EUREKA, *aspetti matematici della fisica teorica*, divided into two subseries: Basic and Advanced, published by the Aracne edition, Roma.

Edited Books

[1] D. Faccio, F. Belgiorno, S. Cacciatori, V. Gorini, S. Liberati and U. Moschella, "Analogue Gravity Phenomenology," Lect. Notes Phys. **870**, Springer (2013).

Doctoral faculty

I've been member of the following PhD cycles:

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXII;
  Period: 2006–2009;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXIII;
  Period: 2007–2010;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXIV;
  Period: 2008–2011;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physical and Mathematical Sciences;
  Cycle: XXV;
  Period: 2009–2012;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXVI;
  Period: 2010–2013;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXVII;
  Period: 2011–2014;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics;
  Cycle: XXVIII;
  Period: 2012–2015;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics and Astrophysics;
  Cycle: XXIX;
  Period: 2013–2016;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics and Astrophysics;
  Cycle: XXX;
  Period: 2014–2017;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics and Astrophysics;
  Cycle: XXXI;
  Period: 2015–2018;

- Place: Università degli Studi INSUBRIA Varese-Como;
  Title: Physics and Astrophysics;
  Cycle: XXXII;
  Period: 2016–2019;

Teaching activity

Teaching courses

- *Exercises in Physics I* for the faculty of Geology, at the department of Geology of the Università degli Studi di Milano, Milan: 2000–2002.

- *Complements in Group Theory*, as part of the course in "Physical applications of the group theory" with Prof. Renzo Cirelli, at the department of Physics, Università degli Studi di Milano, Milan: 2003–2009.

- *Geometrical methods in Physics*, together with professor B. van Geemen, for degree in Mathematics and/or in Physics, at the department of Physics, Università degli Studi di Milano, Milan: 2007–2009.

- *Geometrical methods in Physics I*, for degree in Mathematics and/or in Physics, at the department of Mathematical and Physical sciences, Università dell'Insubria, Como: 2006–2012.

- *Geometrical methods in Physics II*, for degree in Mathematics and/or in Physics, at the department of Mathematical and Physical sciences, Università dell'Insubria, Como: 2007–2011.

- *Physics I*, for degree in Chemic and/or in Mathematics, at the department of Mathematical and Physical sciences, Università dell'Insubria, Como: 2007–2008.

- *Physics I*, for mathematichans, at the department of Mathematical and Physical sciences, Università dell'Insubria, Como: 2009–2012.

- *Physics I*, for mathematichans, at the department of Science and High Technology, Università dell'Insubria, Como: 2012–2015.

- *Theoretical Physics*, for physicists, at the department of Science and High Technology, Università dell'Insubria, Como: 2013–present.

- *Analytic Mechanics with exercises*, for physicists and mathematichans, at the department of Science and High Technology, Università dell'Insubria, Como: 2013–present.

- *Selfadjointness properties of the Dirac operator on black hole backgrounds,* in "Escuela de Física Matemática 2010: Functional analytic methods in general relativity and quantum mechanics," Mathematics Department of Universidad de los Andes, Bogotá, May–June 2010.
- *Mathematical Methods in Physics*, for degree in Physics, at the department of Science and High Technology, Como: 2016.

Degree students

1. Elias Arawi Sol Megier, "Yang-Mills theory of gravity," degree in Physics (Como, 2017)
2. Enea Riva, "Super particles on super $\mathbb{P}^{1|2}$," degree in Physics (Como, 2017)
3. Federico Re, "Yang-Mills dynamics from local symmetries," degree in Mathematics (Milano, 2017)
4. Davide Astesiano, "Stationary BPS solutions in $N = 2$ $D = 4$ gauged supergravity," degree in Physics (Milano, 2017)
5. Gianluca Molteni, "Black holes in diamond-like materials," degree in Physics (Milano, 2017)
6. Adriano Viganò, "Dielectric Black Holes in an optic fiber," degree in Physics (Milano, 2017)
7. Marco Rampazzo, "D-branes and homological mirror symmetry for thr canonical bundle $\mathbb{B}^2 \times \mathbb{P}^1$," degree in Physics (Milano, 2016)
8. Giulio Salvatori, "Grassmannian formulation of $N = 4$ super Yang-Mills theory," degree in Physics (Milano, 2016)
9. Manuele Tettamanti, "Flowing Bose condensate as a model of black hole laser: a numerical study," degree in physics (Como, 2015)
10. Fabrizio Angaroni, "Study of Klein-Gordon operator in Black Hole background, with Krein spaces," degree in Physics (Como, 2014)
11. Matteo Foresti, "Equivalence of gravity in $2 + 1$ dimensions with Chern-Simons theory," bachelor in Physics (Milano, 2013)
12. Matteo Sordelli, "Lace coefficients and applications," bachelor in Physics (Como, 2013)
13. Eros Martinelli, "Clifford Algebras, Spin Groups and physical applications," bachelor in Physics (Milano, 2012)
14. Simone Panozzo, "Fiber bundles and gauge theories," bachelor in Physics (Milano, 2012)
15. Giulia Colombelli, "Maxwell equations, conservation laws and uniqueness theorems," bachelor in Mathematics (Como, 2012)
16. Cristina Rimoldi, "Study of thermality for the stimulated Hawking effect," bachelor in Physics (Como, 2011)

17. Aurora Boscato, "Differential forms, Maxwell equations, and gauge symmetries," bachelor in Mathematics (Como, 2011)

18. Silvia Marelli, "Differential forms, Maxwell equations, charges and topological invariants," bachelor in Mathematics (Como, 2011)

19. Luca Rizzi, "Analogue Gravity In Nonlinear Dielctrics: theretical predictions," degree in Physics (Como, 2010)

20. Amanda Ranaudo, "Inertail motions on surfaces in $\mathbb{R}^3$," bachelor in Mathematics (Como, 2010)

21. Vera Giulia Sala, "Analogue Gravity In Nonlinear Dielctrics: experimental measurements," degree in Physics (Como, 2010)

22. Sara Angela Filippini, "Calabi-Yau manifolds and supergravity," degree in Physics (Milano, 2009)

23. Alessandro Santagata, "Supersymmetry and string amplitudes," degree in Physics (Milano, 2008)

24. Fabio Costa, "Causality and locality in quantum systems," degree in Physics (Milano, 2007)

25. Francesco dalla Piazza, "Conformal theories on complex curves: geometric aspects," degree in Physics (Milano, 2007)

26. Matteo Penegini, "Derived categories and Mirror Symmetry," degree in Physics (Milano, 2006)

27. Giovanni Tagliabue, "Gravity with torsion and Chern-Simons theories," degree in Physics (Milano, 2006)

28. Luca Rizzi, "Vacuum solutions with hyperbolic symmetry of the Einstein equations," bachelor in Physics (Como, 2006)
and "Analogue gravity in nonlinear dielectrics," degree in Physics (Como, 2009)

29. Mauro Mazzola, "Topological aspects in supersymmetric mechanics," bachelor in Physics (Como, 2006)

30. Fortunato Procopio, "Evolution of the concept of field in Physics," degree in Physics (Milano, 2006)

31. Stefano Bertini, "Topological and geometrical aspects of Lie groups in gauge theory," degree in Physics (Milano, 2005)

32. Lucio Mauri, "K-theory in Physics," degree in Physics (Milano, 2005)

33. Marco Rusconi, "Exact solutions in string theory," degree in Physics (Milano, 2005)

34. Antonucci Rossella, "The Erlangen program in Physics," degree in Physics (Milano, 2004)

PhD students

1. Elias Arawi Sol Megier, "Yang-Mills theory of gravity," 2017–2020, PhD in Mathematics
2. Carlo Alberto Cremonini "Quantum Gravity," 2017–2020, PhD in Physics
3. Federico Re, "Loop Chern Simons theory in Physics," 2017–2020, PhD in Physics
4. Matteo Azzola, "Mirror symmetry and heterotic string theories," 2016–2019, PhD in Physics (co-superadvisor)
5. Giulio Salvatori, "Geometric aspects of Amplitude equations," 2016–2019, PhD in Physics (co-superadvisor with Dietmar Klemm);
6. Manuele Tettamanti, "Analogue gravity in condensed matter," 2015–2018, PhD in Physics (co-superadvisor with Alberto Parola);
7. Michele Doronzo, "Quantum aspects in analogue gravity," 2014–2017, PhD in Physics;
8. Sara Angela Filippini, "Rigid Calabi-Yau manifolds and supergravity," 2009–2012, PhD in Mathematics;
9. Francesco Dalla Piazza, "Higher genera superstring amplitudes," 2007–2010, PhD in Physics;
10. Marco Compagnoni, "Geometric Aspects of D- Branes on Non compact Varieties," 2006–2009, PhD in Mathematics;

Referee Activity

I have referred articles for the following international journals:

1. Classical and Quantum Gravity;
2. International Journal of Geometric Methods in Mathematical Physics;
3. Physical Review Letters;
4. European Physical Journal C;
5. European Physical Journal Plus;
6. Galaxies;
7. International Journal of Modern Physics A;
8. SIGMA;
9. Canadian Journal of Physics;
10. Journal of Physics A: Mathematical and Theoretical;

11. Annali di Matematica Pura e Applicata;
12. Journal of Nonlinear Mathematical Physics;
13. Euro Physics Letter;
14. Foundation of Physics;
15. General Relativity and Gravitation;
16. Journal of Geometry and Physics;
17. Journal of Mathematical Physics;
18. Physics Letters A;
19. Physica Scripta;
20. Physical Review D;
21. Physics Letters B;
22. Entropy;
23. Quantum Studies: Mathematics and Foundations;
24. Universe;
25. Revista Mexicana de Fìsica.

Further Scientific Activity

- Europhysics Letters Highlights 2016: M. Tettamanti, S. L. Cacciatori, A. Parola and I. Carusotto, " Numerical study of a recent black hole lasing experiment," Europhys. Lett. **114** (2016) no.6, 60011;
- New Journal of Physics Highlights 2010: S. L. Cacciatori *et al.*, "Space-time geometries and light trapping in travelling refractive index perturbations," New J. Phys. **12** (2010) 095021, highlights in Optics and Imagings;
- New Journal of Physics Highlights 2011: S. L. Cacciatori *et al.*, "Experimental evidence of analogue Hawking radiation from ultrashort laser pulse filaments," New J. Phys. 13 (2011) 085005, highlights in Astrophysics, Cosmology and Gravitation;
- New Journal of Physics Highlights 2014: S. L. Cacciatori *et al.*, "Experimental quantum cosmology in time-dependent optical media," New J. Phys. **16** (2014) 075003, highlights in Gravitational Physics and Cosmology;
- Physical Review Letters Highlights 2010: S. L. Cacciatori *et al.*, "Hawking radiation from ultrashort laser pulse filaments," Phys. Rev. Lett. 105, 203901 (2010). This paper has received double mention as "Featured in Physics," and as "Editors' Suggestion".

- I have received from EPJ.org the diploma as "Distinguished Referee in 2013," including the following logo: