

## CURRICULUM VITAE

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6 avenue Victor Le Gorgeu, 29200 Brest, France.  
**Date of birth :** 2<sup>nd</sup> April 1967.

### Diplomae

- **PhD :** 10<sup>th</sup> January 1994, Bordeaux 1 university, *suma cum laude*. Specialty : applied mathematics. Supervisor : A. Bachelot. Referees : C. Bardos, J. Ginibre, G. Métivier. Jury members : Y. Choquet-Bruhat (President), A. Bachelot, J. Ginibre, B. Hanouzet, J.-L. Joly, G. Métivier, V. Petkov. *Title of dissertation : Non linear Klein-Gordon equation and linear Dirac system on Schwarzschild-type metrics.*
- **Habilitation thesis :** 26<sup>th</sup> January 1999, Bordeaux 1 university. Specialty : mathematics. Supervisor : A. Bachelot. Referees : C. Gérard, V. Petkov, D. Robert. Jury members : J.-M. Bony (President), A. Bachelot, C. Gérard, V. Petkov, D. Robert. *Title of dissertation : A study of scalar and spinorial fields on some space-times of general relativity.*

### Career history

- **Teaching position during the preparation of the PhD :** 10/1991 – 09/1993.
- **Post-doctoral position :** 01/1994 – 12/1994. Under the supervision of R. Penrose. Mathematical Institute, Oxford University, England. Lavoisier fellowship of the french Ministry of Foreign Affairs and european Human Capital and Mobility fellowship.
- **Appointment as Maître de conférences, applied mathematics :** (permanent position, equivalent to lecturer) 1st january 1995, Bordeaux 1 university.
- **CNRS delegation :** (temporary pure research position) 09/1998 – 08/2000, CMAT (Centre de Mathématiques), Ecole Polytechnique, Palaiseau, France.
- **Appointment as Professor, pure mathematics, differential geometry :** 09/2007, University of Brest.
- **CNRS delegation :** 09/2011 – 01/2012, University of Brest.
- **Promotion to the first class of University Professors :** 09/2015.
- **CNRS delegation :** 09/2017 – 01/2018.
- **Sabatical :** 09/2019 – 01/2020.
- **CNRS delegation :** 09/2024 – 01/2025.

### Scholarships and grants

- **Post-doctoral training :** Lavoisier fellowship of the french Ministry of Foreign Affairs and Human Capital and Mobility european fellowship, for the post-doctoral training in Oxford in 1994.
- **Grant for research and doctoral supervision (PEDR) :** awarded for 4 years in september 1999, 2003 and 2007.
- **ANR project AARG, ANR-12-BS01-0012-01 :** projet bearer. 119 000 € granted for

4 years for the project “Asymptotic analysis in general relativity”, 01/2013–12/2016. Extended until June 2017.

- **Grant for scientific achievements (PES, equivalent to the PEDR) : 09/2012 – 08/2016.**

### **Supervision of PhD theses**

- Thierry Daudé, “scattering for the massive charged Dirac equation on flat space-time and outside rotating or non rotating black holes”, 12/2004, he is now a lecturer at Université Cergy-Pontoise, France.
- Y. Stadnicki, “scattering of Maxwell and Dirac fields by extreme black-holes”, 02/2008.
- J. Joudioux, “asymptotic behaviour of spinor fields in General Relativity : a conformal approach”, 06/2010.
- Jan-Hendrik Treude, “decay in Outgoing Null Directions of Solutions of the Massive Dirac Equation in Certain Asymptotically Flat, Static Spacetimes”, in co-supervision with Felix Finster, Regensburg University, Germany, 04/2016.
- Mokdad Mokdad, “decay of Maxwell fields and conformal scattering on the De Sitter-Reissner-Nordstrom spacetime”, 09/2016.
- Pham Truong Xuan, “Peeling and conformal scattering in the spacetimes of general relativity”, 04/2017.
- Jack Borthwick, “Geometric and analytic scattering for massive equations and extremal black holes”, 06/2021.
- Armand Coudray, “Conformal scattering and peeling for non linear equations on radiative black hole spacetimes”, 05/2024.

### **Supervision of post-docs**

- 10/2015–09/2016, Callum Sleight, postdoctoral position on the ANR contract ANR-12-BS01-0012-01.

### **Participation to PhD thesis juries**

- Jury for the thesis of Fabrice Melnyk, Bordeaux 1 University, supervisor : Alain Bachelot, 12<sup>th</sup> 12/2002.
- Referee for Davide Catania’s thesis, University of Pisa, Italy, supervisor : Vladimir Georgiev, 01/2008.
- Referee for Julien Loizelet’s thesis, University of Tours, France, supervisor : Piotr Chrusciel, 24<sup>th</sup> 06/2008.
- Member of the jury for Dietrich Häfner’s habilitation, University of Bordeaux, 12/2008.
- Referee for Zakaria Hachemaoui’s thesis, University Paris 13, France, supervisor : Fabrice Planchon, 30<sup>th</sup> 01/2009.
- Member of the jury for Mohammad Webbe’s thesis, University of Brest, supervisor : Paul Baird, 11/2009.
- Referee for Calvin Tadmon’s thesis, University of Yaoundé, Cameroon, supervisor : Marcel Dossa, 10/2010.
- President of the jury for Mekki Houbad’s thesis, University of Rennes, supervisor : Christophe Cheverry, 11/2010.
- Referee for Roger Tagné Wafo’s thesis, University of Yaoundé, supervisors : Piotr Chrusciel and Marcel Dossa, 01/2011.
- Referee for Jean-Charles Ponsignon’s thesis, University of Reims, 06/2013, “Fuchsian methods

and asymptotic analysis”.

- President of the jury for Patrick Bouvier’s thesis, University of Paris 11 (Orsay), supervisor : Christian Gérard, 12/2013.
- President of the jury for Guillaume Idelon-Riton’s thesis, Joseph Fourier University, Grenoble, supervisor : Dietrich Häfner, 07/2016.
- Referee for Alexander Afriat’s habilitation thesis, Philosophy of sciences, Paris 7 University, 11/2018.
- Member of the jury for Carl Tipler’s habilitation thesis, University of Brest, 05/2019.
- Referee for Shijie Dong’s thesis, Paris Sorbonne University, 07/2019.
- Member of the jury for Jérémie Joudioux’s habilitation, University of Grenoble, 12/2019.
- Referee for Samuel Porath’s thesis, University of Auckland, New Zealand, 06/2023.
- Member of the jury for Jordan Nicoules’s thesis, Paris Observatory Meudon, 06/2023.
- Member of the jury for Pascal Millet’s thesis, University of Grenoble, 06/2023.

### **Administration**

- Correspondant for my laboratory at the Bordeaux research library committee from 1995 till 2007.
- Member of a committee for planning electronic subscriptions of the whole Bordeaux university in 2004. Correspondant of mathematics at the Common Documentation Service of the university 2005–2007.
- Member of the applied mathematics appointing committee at Bordeaux University, 1995–2007. From 1998 until 2001, I have held the position of vice-president B (i.e. at the level of lecturers) of this committee.
- Member of the governing body of my laboratory at Bordeaux University, 2003–2006.
- Member of the “Theses committee” of the Western Mathematical Doctoral Network since May 2008.
- Head of the mathematics research library at the University of Brest since May 2008.
- Member of the appointing committee for a lecturer position in “PDE analysis and applications”, University of Rennes, spring 2010.
- Mathematics correspondant at the Common Documentation Service of the University of Brest since May 2010.
- Head of the PMRC degree (Parcours Mathématiques Renforcées et Concours) at the University of Brest, 2010–2012.
- Local correspondant of the Quantum Dynamics CNRS Research Group, member of its scientific committee since 2012.
- Member of the appointing committee for a lecturer position in geometry, University of Brest, spring 2013.
- “Open access” correspondant for Couperin at the University of Brest since 2013.
- President of the jury for the first year of the Mathematics degree, “PMRC track” (preparation to competitions for “Grandes Ecoles”), 2020-2021.

### **Teaching activities**

- Classes in the theory of distributions, partial differential equations, spectral theory, complex analysis, to first year graduate students. Classes in analysis, differential calculus, topology, integration, commutative algebra and numerical analysis to third year undergraduates, in real and complex analysis, theory of probabilities, linear algebra, euclidean spaces and differential calculus, to first and second year undergraduates.

- Lecture courses in linear algebra, analysis, algebra, arithmetics, differential equations and integration to first and second year undergraduates, in differential calculus, integration, Fourier series to third year undergraduates, in spectral theory, complex analysis and functional analysis to first year graduate students.
- Advanced graduate lecture course in mathematics at the University of Rennes, “Black holes and geometrical methods in general relativity”, 2010 and 2011.
- Invited advanced graduate lecture course : “partial differential equations and conformal scattering” to second year graduates in mathematics, Vietnam National University in Hanoi, 2012.
- Supervision of first and second year graduate students research projects (these are pre-thesis research projects).
- Advanced graduate lecture courses : “geometry of Schwarzschild and Kerr metrics” Bordeaux 2001, “General Relativity : fundamental notions and asymptotic structures” Bordeaux 2007 and Brest 2009, “conformal asymptotic analysis” Brest 2014, “scattering theory” Brest 2021.

### Organisation of conferences

- Graduate students conference, 14 and 15 december 1992, Bordeaux, member of the scientific committee.
- “Scattering days”, Bordeaux, 28 and 29 january 1993, in collaboration with A. Bachelot, B. Hanouzet, J.-L. Joly and V. Petkov.
- “Scattering days II”, Bordeaux, 12 and 13 juin 1995, in collaboration with A. Bachelot, B. Hanouzet, J.-L. Joly and V. Petkov.
- “Hyperbolic equations in relativity”, Bordeaux, 16<sup>th</sup> june till 19<sup>th</sup> june 2008, in collaboration with Dietrich Häfner.
- “Black holes, general relativity and waves”, Roscoff 8–10 November 2010, in collaboration with Dietrich Häfner.
- “First AARG meeting”, June 2013, University of Cergy-Pontoise, in collaboration with Thierry Daudé and Dietrich Häfner.
- “Quantum dynamics research group meeting, 2014”, February 2014, Roscoff Station Biologique, in collaboration with Frédéric Hérau, Alain Joye and Stéphane Nonnenmacher.
- Summer school : “Asymptotic Analysis in General Relativity”, Grenoble, June-July 2014, in collaboration with Thierry Daudé and Dietrich Häfner.
- The Aber Wrac’H Autumn Schools : autumn schools in mathematical physics, two sessions in 2014 (quantum field theory, course given by Glenn Barnich, Brussels free University and International Solvay Institutes, Belgium) and 2015 (supersymmetry, course given by Luc Frappat, University of Savoie, Annecy, France), in collaboration with Johannes Huisman.
- Asymptotic analysis in General relativity, Roscoff, Biological Station, 3-7 October 2016, final conference of the AARG project, in collaboration with T. Daudé and D. Häfner.
- Hyperbolic Equations and Mathematical Physics, conference in honour of Alain Bachelot, University of Bordeaux May 29 - June 1<sup>st</sup> 2017. Member of the scientific committee.

## 1 Research orientations

My work concerns mostly the study of **asymptotic behaviour of solutions to hyperbolic partial differential equations in the framework of general relativity**. The techniques I use belong to two broad types :

- **functional analytic techniques** : Sobolev spaces, semi-group theory, Sobolev embeddings, time-dependent scattering theory (involving spectral analysis, trace-class perturbation

methods, Mourre theory, positive commutator methods), weak convergence and compactness methods ;

- **geometrical techniques** : conformal compactification,  $3 + 1$  decomposition, Newman-Penrose and Geroch-Held-Penrose formalisms, 2-spinor formalism, geometric energy estimates.

There has also been two incursions into numerical simulations, to develop some understanding of some aspects of superradiance and black hole bombs. I aim to prolong these studies by theoretical works based on Sturm-Liouville equations and resonances.

My past research as well as my projects are oriented along two main directions with non empty intersection :

- **Black hole spacetimes** The purpose is to get a precise understanding of the geometry of black hole spacetimes and its influence on the behaviour of fields. I am in particular interesting in the following aspects.
  - Time dependent scattering theory. The geometry of black hole spacetimes near horizons and at infinity is directly translated in the asymptotic behaviour of the coefficients of covariant partial differential equations on such backgrounds. This information can be extracted by means of spectral analysis in order to infer a precise description of the asymptotic behaviour of solutions to these equations.
  - The existence of ergoregions is related to the phenomenon of superradiance by which a field can extract energy from the black hole ; it exists for charged scalar fields outside a charged spherical black hole, and for fields of integral spin outside a rotating black hole. We now have a partial understanding of rotation-induced superradiance but when the driving mechanism is charge interaction, many questions remain open, including a rigorous theoretical estimate of the amount of energy that is possible to extract.
  - Our knowledge of the conformal structure of black hole spacetimes is incomplete, more precisely concerning the nature of the singularities of the conformal metric, both for asymptotically flat spacetimes and in the presence of a cosmological horizon. Spacelike infinity has been the object of intensive work by Helmut Friedrich in particular but timelike infinity is less well understood. To gain a precise understanding of timelike infinity, it appears necessary to resort to the tools of projective differential geometry rather than conformal geometry.
  - I have recently started to investigate the geometrical structure of some radiative black hole spacetimes known as the Vaidya metric, using the Newman-Penrose formalism and studying the ODEs defining the principal null congruences.
  - The behaviour of fields at internal horizons of black holes is a fascinating question related to the stability of such horizons and to the strong cosmic censorship conjecture. Analytic time-dependent scattering and spectral analysis a well adapted tools for studying such questions on explicit backgrounds such as Reissner-Nordström or Kerr.
  - Extremal horizons are remarkable geometrical objects, akin to conformally rescaled null infinities. This analogy is exact in the case of extreme Reissner-Nordström space-time but remains valid in a broader sense for a larger class of spacetimes. To which extent this property holds in general is a question I am keen to explore. Also, describing the geometry of extreme horizons in this manner provides tools to analyse the behaviour of fields in their neighbourhoods, such as their peeling properties for instance.

- **Conformal compactification and asymptotic analysis.** Penrose’s conformal compactification is a tool that gives a synthetic geometrical description of asymptotic informations. Combining this with precise analytic methods, we obtain results that are more general than through purely analytic methods, and more precise than what a purely geometrical approach allows. I am particularly interested in two different but related approaches.
  - The development of an alternative approach to scattering theory, allowing a natural extension to time-dependent geometries and to non linear problems.
  - The precise analysis of peeling properties in the sense of understanding the functions spaces of initial data that ensure a given (transverse) regularity of the conformal field at null infinity.

This is a programme that Lionel Mason and myself have been pursuing since 2004 and we are writing a monograph on the subject. Recent developments include investigations of the behaviour of fields near extremal horizons. Extension of our constructions to massive fields is a fascinating question that requires a radical change of approach, replacing conformal geometry with projective differential geometry. Already in the flat case, some fundamental questions are open such as the geometrical construction of an analogue to the Lax-Phillips theory.

## 2 Publications

### 2.1 Livres

- [I] T. Daudé, D. Häfner, J.-P. Nicolas éditeurs, *Asymptotic analysis in general relativity : lecture notes of the 2015 Grenoble Summer School*, London Mathematical Society Lecture Notes Vol. 443, Cambridge University Press, 2018.  
<https://doi.org/10.1017/9781108186612>
- [II] L.J. Mason, J.-P. Nicolas, *Conformal scattering theory*, in preparation, contract with Cambridge University Press.

### 2.2 Articles

- [1] A. Bachelot, J.-P. Nicolas, (1993) *Equation non linéaire de Klein-Gordon dans des métriques de type Schwarzschild*, C. R. Acad. Sci. Paris, t. 316, Série 1, p. 1047-1050.
- [2] J.-P. Nicolas, (1993) *Nonlinear Klein-Gordon equation on Schwarzschild-like metrics*, Proceedings of the conference : “Nonlinear hyperbolic problems : theoretical, applied, and computational aspects” (Taormina, 1992), p. 449-456, Notes Numer. Fluid Mech., 43, Vieweg, Braunschweig.
- [3] J.-P. Nicolas, (1994) *Opérateur de diffusion pour le système de Dirac en métrique de Schwarzschild*, C. R. Acad. Sci. Paris, t. 318, Série 1, p. 729-734.
- [4] J.-P. Nicolas, PhD thesis, Université Bordeaux 1, Mathématiques Appliquées, “L’équation non linéaire de Klein-Gordon et le système linéaire de Dirac en métrique de type Schwarzschild”, January 1994.
- [5] J.-P. Nicolas, (1995) *Non linear Klein-Gordon equation on Schwarzschild-like metrics*, J. Math. Pures Appl., 74, p. 35-58.

- [6] J.-P. Nicolas, (1995) *Scattering of linear Dirac fields by a spherically symmetric Black-Hole*, Ann. Inst. Henri Poincaré - Physique Théorique, 62, 2, p. 145-179.
- [7] J.-P. Nicolas, (1995) *Spin 3/2 zero rest-mass fields in the Schwarzschild space-time*, Twistor Newsletter 39, p. 6-10.
- [8] J.-P. Nicolas, (1997) *Problème de Cauchy global pour les équations linéaires sans masse de spin 3/2 en métrique de Schwarzschild*, C. R. Acad. Sci. Paris, t. 325, Série 1, p. 277-282.
- [9] J.-P. Nicolas, (1997) *Global exterior Cauchy problem for spin 3/2 zero rest-mass fields in the Schwarzschild space-time*, Commun. in PDE, 22, 3&4, p. 465-502.
- [10] L.J. Mason, J.-P. Nicolas, (1998) *Résultats globaux pour les équations de Rarita-Schwinger en espace-temps d'Einstein asymptotiquement plat*, C. R. Acad. Sci. Paris, t. 327, Série 1, p. 743-748.
- [11] J.-P. Nicolas, *Champs de spin 3/2 et relativité générale*, Partial Differential Equations Seminar, Ecole Polytechnique, Palaiseau, France, 17th November 1998.
- [12] J.-P. Nicolas, Habilitation thesis, *Une étude de champs scalaires et spinoriels dans des espaces-temps de la relativité générale*, Université Bordeaux 1, 26th January 1999.
- [13] L.J. Mason, J.-P. Nicolas, (1999) *Global results for the Rarita-Schwinger equations and Einstein vacuum equations*, Proc. London Math. Soc., 3, 79, p. 694–720.
- [14] J.-P. Nicolas, *Dirac fields on asymptotically flat space-times*, Dissertationes Mathematicae 408, 2002, 85 pages.
- [15] J.-P. Nicolas, *A non linear Klein-Gordon equation on Kerr metrics*, Journal de Mathématiques Pures et Appliquées, 81 (9) (2002) p. 885–914.
- [16] J.-P. Nicolas, *Dirac fields on asymptotically simple space-times*, Jean Leray '99 Conference Proceedings, Maurice de Gosson editor, May 2003.
- [17] D. Häfner, J.-P. Nicolas, *Théorie de la diffusion pour l'équation de Dirac sans masse dans la métrique de Kerr. (French) [Scattering theory for the massless Dirac equation in the Kerr metric]*, Partial Differential Equations Seminar, 2002–2003, Talk No. XXIII, 15 pp., Ecole Polytechnique, Palaiseau, 2003.
- [18] D. Häfner, J.-P. Nicolas, *Scattering of massless Dirac fields by a slow Kerr black hole*, Reviews in Mathematical Physics 16(1) (2004), p. 29–123.
- [19] L.J. Mason, J.-P. Nicolas, *Conformal scattering and the Goursat problem*, Journal of Hyperbolic Differential Equations, 1 (2) (2004), p. 197–233.
- [20] J.-P. Nicolas, *On Lars Hörmander's remark on the characteristic Cauchy problem*, Annales de l'Institut Fourier, 56 (2006), 3, p. 517–543.
- [21] J.-P. Nicolas, *On Lars Hörmander's remark on the characteristic Cauchy problem*, Note to the Comptes Rendus of the Academy of Sciences, Série 1, Comptes Rendus Mathématique, 344 (mai 2007), 10, p. 621-626.
- [22] L.J. Mason, J.-P. Nicolas, *Regularity at spacelike and null infinity*, J. Inst. Math. Jussieu, 8 (2009), 1, p. 179-208.  
<https://doi.org/10.1017/S1474748008000297>

- [23] D. Häfner, J.-P. Nicolas, *The characteristic Cauchy problem for Dirac Fields on curved backgrounds*, J. Hyperbolic Differ. Equ. **8** (2011), 3, 437–483.  
<https://doi.org/10.1142/S0219891611002469>
- [24] L. Andersson, P. Blue, J.-P. Nicolas, *A decay estimate for a wave equation with trapping and a complex potential*, I.M.R.N, 2013, 548–561.  
<https://doi.org/10.1093/imrn/rnr237>
- [25] L.J. Mason, J.-P. Nicolas, *Peeling of Dirac and Maxwell fields on a Schwarzschild background*, J. Geom. Phys. **62** (2012), 867–889.  
<https://doi.org/10.1016/j.geomphys.2012.01.005>
- [26] J.-P. Nicolas, *Conformal scattering on the Schwarzschild metric*, arXiv:1312.1386, Ann. Inst. Fourier (Grenoble) **66** (2016), 3, 1175–1216.  
[http://aif.cedram.org/item?id=AIF\\_2016\\_\\_66\\_3\\_1175\\_0](http://aif.cedram.org/item?id=AIF_2016__66_3_1175_0)
- [27] L. Di Menza, J.-P. Nicolas, *Superradiance on the Reissner-Nordström metric*, arXiv:1411.3988, Class. Quantum Grav. **32** (2015), 145013 (28pp).  
<https://doi.org/10.1088/0264-9381/32/14/145013>
- [28] J.-P. Nicolas, *The conformal approach to asymptotic analysis*, arXiv1508.02592, 2015, chapter in “From Riemann to differential geometry and relativity”, Lizhen Ji, Athanase Papadopoulos and Sumio Yamada Eds., Springer, 2017, <https://link.springer.com/book/10.1007%2F978-3-319-60039-0..>
- [29] C. Markakis, K. Uryū, E.ourgoulhon, J.-P. Nicolas, N. Andersson, A. Pouri, V. Witzany, *Conservation laws and evolution schemes in geodesic, hydrodynamic and magnetohydrodynamic flows*, arXiv:1612.09308, 2016, Phys. Rev. D **96** (2017), 064019.  
<https://doi.org/10.1103/PhysRevD.96.064019>
- [30] J.-P. Nicolas, Pham T. X., *Peeling for the wave equation on the Kerr metric*, 2018, arXiv:1801.08996, Annales Henri Poincaré **20** (2019), 10, 3419–3470.  
<https://doi.org/10.1007/s00023-019-00832-0>
- [31] L. Di Menza, J.-P. Nicolas, M. Pellen, *A new type of black hole bomb*, arXiv:1903.02941, 2019, Gen. Relativ. Gravit. **52** (2020), 8.  
<https://doi.org/10.1007/s10714-020-2656-5>
- [32] D. Häfner, M. Mokdad, J.-P. Nicolas, *Scattering theory for Dirac fields inside a Reissner-Nordström-type black hole*, 2020, arXiv:2007.16139, J. Math. Phys. **62** (2021), 8, 081503, 15 pp.  
<https://doi.org/10.1063/5.0055920>
- [33] A. Coudray, J.-P. Nicolas, *Geometry of Vaidya spacetimes*, arXiv:2101.06544, General Relativity and Gravitation **53** (2021), 8, article 73, 23 pp.  
<https://doi.org/10.1007/s10714-021-02839-7>.
- [34] J.-P. Nicolas, G. Taujanskas, *Conformal scattering of Maxwell potentials*, 2022, arXiv:2211.14579, to appear in Annales de l’Institut Fourier.
- [35] J. Borthwick, E.ourgoulhon, J.-P. Nicolas, *Peeling at extreme black hole horizons*, 2023, arXiv:2303.14574.



- [36] J.-P. Nicolas, *Analytic and conformal scattering in general relativity*, Philos. Trans. Roy. Soc. A **382** (2024), 2267, Paper No. 20230035, 25 pp.
- [37] J.-P. Nicolas, G. Taujanskas, *Finite energy well-posedness of the Maxwell-scalar field system on the Einstein cylinder*, in preparation.

### 3 Seminars and invitations

1. Fourth International Conference on Hyperbolic Problems, Taormina, Sicily, from the 3rd to the 8th April 1992.
2. University of Bonn, Germany, Applied Mathematics Seminar, May 1992. On a personal invitation by Vladimir Georgiev and Pedro Schirmer.
3. Sixth International Workshop on General Relativity, Gregynog, Wales, from the 23rd to the 26th August 1993.
4. Max Planck Institut für Astrophysik, München, Germany, General Relativity Seminar, November 1993, on a personal invitation by Bernd Schmidt.
5. Mathematical Institute, Oxford, England, Mathematical Physics Seminar, February 1994.
6. Mathematical Institute, Oxford, England, Quantum Fields Theory Seminar, November 1994.
7. Edinburgh University, Scotland, Geometry Seminar, December 1994, on a personal invitation by Toby Bailey.
8. University of Nantes, France, Scattering Theory Seminar, 28th April 1995.
9. 14th International Conference on General Relativity (GR14), Florence, Italy, from the 6th to the 12th August 1995, Workshop “Twistors, new variables and complex methods” (Chairman : Lionel Mason).
10. 14th International Conference on General Relativity (GR14), Florence, Italy, from the 6th to the 12th August 1995, Workshop “Mathematical studies of relativistic fields” (Chairman : Jim Isenberg).
11. International Workshop on Microlocal Analysis and the General Theory of Partial Differential Equations, International Centre for Theoretical Physics, Trieste, Italy, first two weeks of september 1995, Session “Partial Differential Equations and Applications”.
12. Invitation to participate for two weeks in the Workshop “Spaces of Geodesics and Complex Structures in General Relativity and Differential Geometry”, Vienna, Austria, Erwin Schrödinger Institut. From the 21st June to the 6th July 1997.
13. Mathematical Institute, Oxford, England, Mathematical Physics Seminar, 27th january 1998, During a two weeks stay on a personal invitation by Lionel Mason.
14. Partial Differential Equations Seminar, Ecole Polytechnique, 17th november 1998.
15. Invited Speaker at the Semi-Classical Days, Nantes, France, february 1999.

16. Partial Differential Equations Seminar, University of Rennes, France, 25th march 1999.
17. Invited speaker at the Conference in Honour of Jean Leray, from the 29th august to the 4th september 1999, University of Blekinge, Karlskrona, Sweden.
18. Mathematical Institute, Oxford, England, Mathematical Physics Seminar, 12th november 1999, during a 10 days stay on a personal invitation by Lionel Mason.
19. Mathematical Institute, Oxford, England, Mathematical Physics Seminar, 24th november 2000, during a one week stay on a personal invitation by Lionel Mason.
20. Invitation to take part in the programme “Scattering theory” organised by V. Petkov, A. Vasy and M. Zworski. Erwin Schrödinger International Institute for Mathematical Physics, Vienna, Austria. One week in june 2001.
21. Partial Differential Equations and Mathematical Physics Seminar, university of Reims, 31st january 2002.
22. Rotating Seminar on Spectral Problems in Physics, CEA Saclay, 11th february 2002.
23. Mathematical Physics and Geometry Seminar, University of Lille, 12th march 2002.
24. Numerical Analysis Seminar, CMAP, Ecole Polytechnique, personal invitation by Philippe Le Floch, 13th january 2004.
25. Analysis seminar, university of Nantes, personal invitation by Wang Xue Ping, 2nd april 2004.
26. Workshop on Geometry and General Relativity, Regensburg, Germany, July 19-21 2004.
27. Relativity seminar, Mathematical Institute, Oxford, England, personal invitation by Lionel Mason, 2nd november 2004.
28. Geometry and Analysis seminar, University of Bath, England, 4th february 2005.
29. Analysis seminar, University of Cergy-Pontoise, 23<sup>rd</sup> may 2005.
30. Mathematics colloquium, University of Regensburg, Germany, 17th june 2005, during a one week stay on a personal invitation by Felix Finster.
31. invitation to stay for 3 weeks at the Newton Institute, Cambridge, England, from the 22nd August to the 11th september, on the occasion of the semestre “Global problems in Mathematical Relativity”.
32. Partial Differential Equations and Mathematical Physics Seminar, university of Reims, october 2005.
33. Mathematical physics seminar, Regensburg, 30<sup>th</sup> june 2006, personal invitation for a week by Felix Finster.
34. Mathematics seminar, Cambridge University UK, november 2006, personal invitation for a week by Mihalis Dafermos.
35. Mathematics seminar, University of Pisa, february 2007, personal invitation for a week by Vladimir Georgiev.

36. Analysis seminar, University of Rennes, France, November 2007.
37. Algebra and geometry seminar, University of Brest, France, October 2008.
38. Mathematical Physics seminar, Mathematical Institute Oxford, UK, October 2008.
39. Invitation for a month at the Mittag-Leffler institute, Stockholm, Sweden, for a relativity programme, November 2008.
40. Mathematical Relativity day at the Meudon Observatory, France, 14 January 2009, invited speaker.
41. Geometry seminar, University of Avignon, France, June 2009.
42. Séminaire de mathématiques, University of Reims, June 2009.
43. GDR Quantum Dynamics, Lyon, September 2009, invited speaker.
44. Spectral problems seminar, IHP Paris, December 2009.
45. Geometric Scattering Theory and Applications conference, Banff International Research Station, Banff, Canada, 14-19 March 2010, invited participant.
46. “Analysis, Geometry and Dynamics in Lorentzian Geometry”, ENS Lyon, May 2010, invited speaker.
47. Mathematical physics seminar, Grenoble, May 2010 (one week invitation).
48. “General Relativity and its Geometrical Aspects” conference, Nancy June 2010, invited speaker.
49. One week invitation to the Albert Einstein Institut Golm, Germany, November 2010.
50. Mathematical Physics seminar, Bordeaux, May 2011.
51. “The geometry of differential equations” conference, Canberra, Australia, September 2011, invited speaker.
52. One week invitation to Reims, November 2011.
53. One week invitation to Grenoble, December 2011.
54. One week invitation to the Albert Einstein Institut Golm, Germany, February 2012.
55. Mathematical general relativity seminar, Paris 6 University, June 2012.
56. Mathematics seminar, Reims University, November 2012.
57. Géométrie, PDE and mathematical physics seminar, Cergy-Pontoise University, November 2012.
58. Partial differential equations seminar, University of Rennes, March 2013.
59. Mathematical physics seminar, University of Bordeaux, June 2013.
60. One week invitation to Regensburg, Germany, November 2013.

61. Geometry seminar, University of Tours, November 2013.
62. Partial differential equations seminar, The Mathematical Institute, Oxford, UK, May 2014.
63. 94<sup>th</sup> meeting between mathematicians and theoretical physicists : Riemann, Einstein and geometry, September 2014, Strasbourg. Invited speaker.
64. Mathematical physics work session, Paris 11 University, May 2015.
65. “Recent advances in general relativity” conference, IHP, Paris, September 2015, invited speaker.
66. Brussels Free University, May 2017, one week invitation by Glenn Barnich.
67. Invites speaker at the “Cinq minutes Lebesgue”, Rennes University, May 2017.
68. Conference in honour of Alain Bachelot, Bordeaux June 2017, invited speaker.
69. “Quantum fields, scattering and spacetime horizons: mathematical challenges” conference, Les Houches May 2018, invited speaker.
70. General relativity seminar, Paris Sorbonne University, September 2018.
71. General relativity seminar, The Mathematical Institute Oxford, UK, November 2018.
72. OxPDE CDT seminar, The Mathematical Institute Oxford, UK, November 2018.
73. Mathematical relativity seminar, Albert Einstein Institut, Golm, Germany, April 2019, 10 days invitation.
74. “Resonances, inverse problems and seismic waves” conference, invited speaker, November 2021, University of Reims.
75. On-line conference “Asymptotic and Harmonic Analysis, Evolution Equations, and Applications”, Vietnam Institute for Advanced Studies, January 2022, invited speaker.
76. 5 months stay at The Mathematical Institute, Oxford, UK, 26/01/2022 – 26/06/2022.
77. Relativity and quantum field theory, The Mathematical Institute, Oxford, UK, May 2022.
78. Workshop on hyperbolic equations and related topics, Queen Mary University of London, Royaume Uni, invited speaker, May 2022.
79. “Second Carrollian workshop”, Mons, Belgium, invited speaker, September 2022.
80. “Mathematical aspects of black hole theory” workshop, Meudon, France, December 2022, invited speaker.
81. “At the Interface of Asymptotics, Conformal Methods, and Analysis in General Relativity” conference, Royal Society, London, May 2023, invited speaker.
82. Two-week stay at ICMS Edinburgh, June-July 2023.
83. Geometry seminar, Tours, France, December 2023.
84. Conference “Advances in black hole mathematics”, Grenoble, France, 6-8 février 2024, invited speaker.