PERSONAL INFORMATION

GALTIER Sébastien
24 February 1971, French
Professor at Université Paris-Saclay
Laboratoire de Physique des Plasmas, École polytechnique, 91128 Palaiseau Cedex, France
http://hebergement.universite-paris-saclay.fr/sebastien.s.galtier/

• EDUCATION

2003	Habilitation à Diriger des Recherches (HDR), Université Paris-Sud
1998	PhD on '*Turbulence and intermittency in magnetohydrodynamics*' Honours: '*Très honorable avec les félicitations du jury*' Observatoire de la Côte d'Azur, Nice, France
1995	Military Service with alpine troops
1994	Master in Astrophysics & Magistère Physique École Normale Supérieure & Université Grenoble

• CURRENT POSITION

2018 – Now	Professor (Exceptional Class) – National promotion Laboratoire de Physique des Plasmas, Université Paris-Saclay, France

• PREVIOUS POSITIONS

2014 – 2017	Professor (1st class) – National promotion Laboratoire de Physique des Plasmas, Université Paris-Sud
2012 – 2013	Professor (2nd class) Institut d'Astrophysique Spatiale, Université Paris-Sud
2001 – 2010	Assistant Professor Institut d'Astrophysique Spatiale, Université Paris-Sud
1999 – 2000	Research Assistant (European contract; coordinator: P. Tabeling, ENS Paris) Mathematics Institute, University of Warwick, UK

• FELLOWSHIPS AND AWARDS

2023 – Now	Honorary fellow of Institut Universitaire de France (IUF)
2018 – 2023	Senior fellow of Institut Universitaire de France (IUF)
2008 – 2013	Junior fellow of Institut Universitaire de France (IUF)

• TEACHING ACTIVITIES

2012 – Now	Full Professor – Physics (192h/year on average) – Université Paris-Saclay, France I teach plasma physics (in French and English) in Master 1 & 2 and mathematics
2001 – 2011	Assistant Professor – Physics (192h/year on average) – Université Paris-Sud, France I taught physics (Lectures, tutorials and experimental physics) in Licence/Master
1999 – 2000	Research Assistant – Numerical methods (in English) – University of Warwick, UK
1996 – 1998	PhD student – Experimental physics – University of Nice, France
1995 – 1997	PhD Student – Physics – Higher School Preparatory Classes, Nice, France

• ORGANISATION OF SCIENTIFIC MEETINGS (only recent)

Sept. 2024	Workshop on *Wave Turbulence* in Les Houches, France, 70 participants expected
Dec. 2018	International conference at École polytechnique, France, 85 participants
July 2016	International summer school of 2 weeks in Cargèse, France, 57 participants

- **SUPERVISION OF PHD STUDENTS AND POSTDOCTORAL FELLOWS**

PhD students:

- Eric Buchlin (2001-12/2004, ENS) on "Heating of the solar corona and turbulence". Supervising at 30%. Currently CNRS position at IAS-Orsay.
- Barbara Bigot (2005-04/2008, EDOM) on "Waves and turbulence in anisotropic MHD". Supervising at 100%. Currently in industry.
- Romain Meyrand (2009-03/2013, EDOM) on "Turbulence at high frequencies in the solar wind". Supervising at 100%. Currently: researcher at University of Otago, New-Zealand.
- Supratik Banerjee (2011-2014, X) on "Compressible turbulence in space and astrophysical plasmas". Supervising at 100%. Currently: Assistant Professor in Kanpur (India).
- Mélissa Menu (2016-12/2019, Labex) on "Magnetic field generated by dynamo effect in astrophysical objects under rotation". Supervising at 50%. Currently: permanent position at CEA-DAM in France.
- Renaud Ferrand (2018-10/2021, X) on "Multiscale compressible turbulence in astrophysical plasmas". Supervising at 50%. Currently: permanent position at CEA-DAM in France.
- Vincent David (2020-09/23, EDOM) on "Multiscale solar wind turbulence". Supervising at 70%. Currently: postdoc position at University of New Hampshire.
- Pauline Simon (2020-09/23, DIM-ACAV) on "Compressible turbulence in the solar wind". Supervising at 30%. Currently: postdoc position at Queen Mary University of London.
- Benoit Gay (10/2022-, ENS) on "Gravitational wave turbulence". Supervising at 100%.

Postdoctoral fellows:

- S. Parenti (2004-2006, ERC). Supervising at 30%. Currently position at IAS-Orsay.
- A. Canou (2012-2013, CNES). Supervising at 30%. Engineer at Ecole Polytechnique.
- K. Kiyani (2015-2016, ANR). Supervising at 30%. Position in industry in UK.
- N. Andrés (2016-2018, X). Supervising at 50%. CNR position in Buenos Aeres.

- **(SOME) INSTITUTIONAL RESPONSIBILITIES**

2023 – Now	Director of the Master M2 'Plasma Physics and Fusion'(Université Paris-Saclay, Institut Polytechnique de Paris, Sorbonne-Université)
2015 – 2023	Member of the steering committee of the Master M2 'Plasma Physics and Fusion'
2011 – 2015	Director of the Master M2 "Plasma Physics", Université Paris-Sud
2020 – Now	Member of the council of a doctoral school, Université Paris-Saclay. This council selects graduate students for a PhD thesis
2009 – 2014	President of a national (PNST) program (involving ~200 researchers) in astrophysics at CNRS/INSU. Member of the council in 2006-2009.
2008 – 2011	Elected member of the national council of universities (CNU), France
2010 – 2014	Member of the "Sun-Heliosphere-Magnetosphere" group at CNES (Assessment committee on space research at the French space agency)
2011 – 2014	Member of the scientific council on the solar telescope THEMIS

- **REVIEWING ACTIVITIES**

2001 – Now	Referee of more than 100 papers for more than 20 different international journals
2001 – Now	Member of 7 HDR (Habilitation) committees
2001 – Now	Member of 22 PhD thesis committees

- **PUBLICATIONS AND COMMUNICATIONS** (see list below)

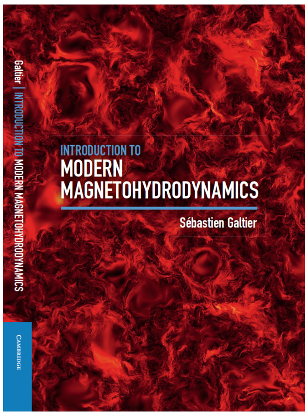
Author ORCID: https://orcid.org/0000-0001-8685-9497

- ✓ ***104*** *refereed articles (< **3** authors/article; **46** as 1st author); **11** Physical Review Letters*
- ✓ ***22*** *proceedings of international conferences*
- ✓ ***14*** *proceedings of national conferences*
- ✓ ***57*** *invited talks in international conferences*
- ✓ ***16*** *talks in international conferences*
- ✓ ***7*** *invited talks in national conferences*
- ✓ ***12*** *talks in national conferences*
- ✓ ***35*** *invited seminars*
- ✓ ***27*** *other seminars*
- ✓ *Citations > **4000** and h-index = **35** (sources: google scholar)* *https://scholar.google.fr/citations?user=JeDgazYAAAAJ&hl=fr*

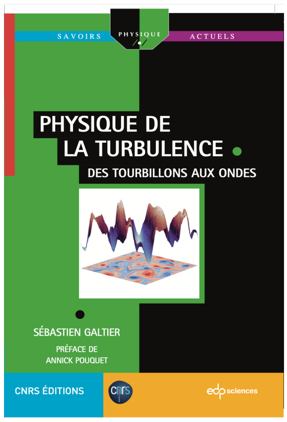
*4 books (2 in English & 2 in French) + participation to **1** book*

2013

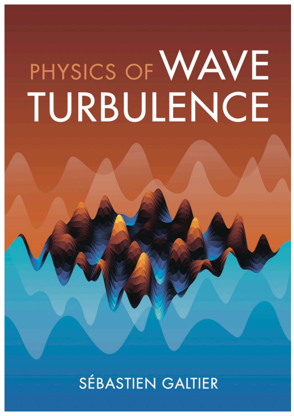
2016



2021



2023



- **OTHER QUALIFICATIONS**

1998: Qualification for the French National Championship of marathon (2h38'58")

SOME IMPORTANT PUBLICATIONS (see list below)

Nature of Alfvén wave turbulence

Magnetohydrodynamics (MHD) is the basic model to describe the large-scale dynamics of the visible matter in the universe, which is essentially in the form of plasma (Galtier, 2016 [A71]). As shown by the observations of the close (heliosphere) and farther (interstellar medium) environments, space and astrophysical plasmas are generally turbulent. Since the seminal papers by Iroshnikov (1964) and Kraichnan (1965), MHD turbulence is thought to have its origin in the stochastic collisions of counter propagating Alfvén (incompressible MHD) waves. The phenomenological model based on this idea predicts an isotropic energy spectrum different from that of hydrodynamics based on the interaction of vortices. However, in the 1980s it was realized that in the presence of a large-scale magnetic field $\mathbf{B_0}$ – a necessary condition for the generation of Alfvén waves – the energy redistribution mechanism is non-isotropic with a weakening of the turbulent cascade along the $\mathbf{B_0}$ direction (Montgomery & Turner, 1981; Shebalin et al., 1983). A first unsuccessful attempt to develop a theory for Alfvén wave turbulence (Sridhar & Goldreich, 1994) led to some confusion about the elementary bricks of MHD turbulence (Ng & Bhattacharjee, 1996).

We published (Galtier et al., 2000 [A8]) a rigorous theory called *Wave Turbulence (see eg.* Nazarenko, 2011) which is based on an asymptotic (and uniform) development of statistical quantities (two-point correlations) in Fourier space. We explained why three-wave resonant interactions are dominant at main order in the nonlinear transfer of energy from large to small scales, and how these transfers become non-isotropic with a cascade frozen along $\mathbf{B_0}$. The subtle point is that three-wave interactions always involve the slow mode ($k_{//}=0$, $k_{//}$ being the component of $\mathbf{k}$ along the $\mathbf{B_0}$ direction). We found the exact stationary solution (called Kolmogorov-Zakharov spectrum) which scales in the simplest case as $k_\perp^{-2}$. We showed that Alfvén wave turbulence becomes strong at small scales. The numerical simuation of the wave turbulence equations (called kinetic equations) revealed the existence during the non-stationary phase of an energy spectrum not compatible with the stationary solution. This is the first time that this spectral anomalous was detected in turbulence. It is now widely found in weak and strong turbulence and is understood as a self-similar solution of the second kind (Thalabard et al., 2015 [A66]). By solving this major problem of plasma physics, the Alfvén wave turbulence theory has become a reference (third most cited paper of J. Plasma Physics created in 1968) as it clarifies the foundation of MHD turbulence. Since then, Alfvén wave turbulence has been mentioned to explain measurements in the Jovian magnetosphere (Saur et al., 2002) and to describe the solar coronal loops (Rappazzo et al., 2007). Over the last ten years, I have returned to this fundamental problem to demonstrate the feasibility of such a regime using 3D direct numerical simulations. This is a non-trivial task as it requires the use of massive numerical resources and the development of specific tools dedicated to wave turbulence. With young researchers, we have succeeded in reproducing this regime. The very detailed study also allowed us to reveal new properties, including the transition from weak to strong wave turbulence described by the critical balance phenomenology (Meyrand, Kiyani & Galtier, 2015 [A65]; Meyrand, Galtier & Kyiani, 2016 [A67]).

Rotating hydrodynamic turbulence

The Navier-Stokes equations are generally considered the archetypal model for studying turbulence. This is so commonly accepted that the word ‘turbulence’ is often used as a synonym for ‘incompressible hydrodynamic (eddy) turbulence’. It is true that the first experiments, concepts and results emerged from the study of water (Galtier, 2023 [A102]), however Navier-Stokes equations are somewhat singular since waves are not present while they are found in almost all physical system. Among the limited results of eddy turbulence, the exact law of Kolmogorov (1941) is certainly the best known. However, such a law gives only a superficial description of turbulence because it does not inform us about the nature of nonlinear interactions, the degree of isotropy, or whether the cascade is direct or inverse.

A much deeper understanding of turbulence can be obtained by considering the presence of waves. The first theoretical breakthrough was made with the study of capillary wave turbulence (Zakharov & Filonenko, 1967). Although the system studied is based on Navier-Stokes, some manipulations have to be performed to obtain a system that describes surface waves, so it is a bit far from the original archetypal model. The very first example where wave turbulence was applied directly to Navier-Stokes (with only a mild modification) is rotating turbulence where the Coriolis force is added to the equations (stratified turbulence is another example but there is no local solution). Interestingly, it is the addition of complexity that allows us to reach a deep understanding of turbulence. I have developed such a theory for inertial wave turbulence with uniform rotation (Galtier, 2003 [A19]). Based on the resonance condition, I was able to show that this turbulence is anisotropic with an energy cascase mainly transverse to the rotation axis, however contrary to MHD, a weak cascade along the parallel direction is still possible. I derived the wave turbulence equations for energy and helicity that describe the three-wave interactions between inertial waves. The exact solution corresponds to an energy spectrum in $k_\perp^{-5/2} k_{//}^{-1/2}$ with a positive energy flux, which means that the cascade is direct. We can also show that the solution is local and find the Kolmogorov constant (David & Galtier, 2023 [A103]). Interestingly, in the limit of super-local interactions, the integro-differential equation reduces to a nonlinear diffusion equation that is easy to simulate numerically. It reveals an anomalous scaling during the non-stationary phase with a steep energy spectrum in $k_\perp^{-8/3}$. This solution is understood as a self-similar solution of the second kind. Later, we discovered that the same diffusion equation is also present in a plasma physics model that describes solar wind turbulence (Galtier & David, 2020 [A87]). This finding offers the opportunity to learn more about space plasmas through laboratory experiments. Today, several experiments have been developed to produce inertial wave turbulence and the main properties found analytically have been measured (Yarom & Sharon, 2014; Monsalves et al., 2020).

Multi-scale solar wind turbulence

The solar wind is a turbulent plasma with magnetic field fluctuations that extend, in the frequency domain, over more than 8 decades. At 1 astronomical unit, for frequencies $f \in [10^{-4}, 10^{-1}]$Hz the spectrum in $f^{-5/3}$ is generally attributed to MHD turbulence (with Taylor's hypothesis f is a proxy of the wavenumber k). Another power law close to $f^{-8/3}$ is found for $f \in [1,100]$ Hz. This corresponds to sub-MHD scales where the decoupling between ions and electrons is felt and thus where MHD is no longer valid. Dispersive waves (kinetic Alfvén and whistler waves) are also detected. The possibility of interpreting this second frequency interval as a new turbulence regime was rarely mentioned before 2000 because space probes were not precise enough to make a clear distinction between an exponential law and a power law, the former being interpreted as the manifestation of dissipation. It is mainly thanks to the Cluster/ESA mission that the presence of a second power law was firmly established (Bale et al., 2005), allowing to seriously consider a theory of turbulence at sub-MHD scales.

In Galtier (2006; [A27]), I proposed a wave turbulence theory based on Hall MHD in order to include in a simple way (fluid model) the decoupling mentioned above. It is a theory of multi-wave and multi-scale turbulence covering the MHD and Hall-MHD scales, and where Alfvén, whistler and ion-cyclotron waves are present. I found the exact solutions to the problem (anisotropic spectra) and recovered the known results in the large scale limit (Alfvén wave turbulence). The analytical study revealed a modulated spectral anisotropy at all scales, and the spectral solutions showed a transition – as in the solar wind – at the scale where the dynamics of ions and electrons begins to decouple with an energy spectrum that stiffens at sub-MHD scales. Today, it is widely recognized that turbulence can explain the fluctuations at sub-MHD scales and that Hall MHD is a relevant first (fluid) model to understand solar wind turbulence. To completement this theory, I derived an exact relation *à la Kolmogorov* to express the two-point fluctuations (increment) in terms of the magnetic fluctuations (Galtier, 2008 [A37]). This exact law reveals also a change of scaling at the ion inertial length where ions and electrons begin to decouple. Over the last ten years, with young researchers, we have studied this multiscale and multi-wave problem using 3D direct numerical simulations (Meyrand & Galtier, 2013 [A60]; Meyrand, Kiyani, Gurcan & Galtier, 2018 [A79]). The nonlinear interaction between different types of waves was identified, as well as the coexistence of weak and strong wave turbulence on the same scale.

Foundation of compressible sub/super-sonic turbulence

A fundamental understanding of compressible turbulence requires going back to the basic concepts and researching the universal laws governing the dynamics. The importance of compressible effects is widely recognized in astrophysics. For example, interstellar turbulence is supersonic with turbulent Mach numbers well above 10 (Hennebelle et al., 2012). This turbulence is undoubtedly at the origin of the low rate of star formation by acting against gravitational collapse in the manner of a turbulent pressure. In the solar wind, where the turbulent Mach number is less than unity, it is recognized (Bandyopadhyay at al., 2020) that compressible turbulence can provide an additional source of heating and help us to understand why the (ion) temperature decreases so slowly with heliocentric distance. This is a long-standing problem that I have been working on for 15 years (Galtier, 2018 [A77]).

Seventy years after Kolmogorov (1941), I derived the first compressible exact law for isothermal hydrodynamic turbulence (Galtier & Banerjee, 2011 [A54]). This statistical law introduces a new type of term (a source) which is purely compressible and can be interpreted as a global effect: in an expansion phase, it contributes to decrease the energy transfer rate (the intensity of the cascade), while in a contraction phase it increases the transfer rate. The exact law has been well verified numerically in 3D at turbulent Mach number 6 (Kritsuk et al., 2013). This publication paved the way for further theoretical work on plasmas (MHD) with applications to space plasmas (solar wind and Earth's magnetosphere) to better estimate the plasma heating (Banerjee & Galtier, 2013 [A58]; Hadid et al., 2018 [A75]). The most recent 3D direct numerical simulation of isothermal hydrodynamic turbulence performed at an extremely high spatial resolution of 10048^3 (Ferrand et al., 2020 [A90]), confirms that the exact law of compressible turbulence provides a relevant model to explain the observed physics. In particular, it is shown that the sonic scale separates two turbulence regimes: supersonic and sub-sonic. In the first case, we have shown that the source term of the exact law dominates, while it is the flux term in the second case. Moreover, the scaling found is dimensionally compatible with the exact law.

Gravitational wave turbulence and the primordial Universe

The first direct detection in 2015 of a gravitational wave (GW) by the LIGO-Virgo collaboration (Abbott et al., 2016), a century after their prediction by A. Einstein (1916), is certainly one of the most important events in astronomy of the last decades. This observation opens a new window onto the Universe called GW astronomy. Unlike photons, GW are expected to be unaffected by the opacity of the early Universe, therefore they have the potential to provide a wealth of observational data about this primordial phase. In modern Universe, shortly after being excited by a source like the merger of two black holes, GW become quickly linear because their amplitude decreases with the distance of propagation. The situation was probably different in the early Universe (first second) because GW were presumably significantly more nonlinear as they had much larger energy packed in a much tighter space. The nonlinear nature of the GW was pointed out in the past and the possibility to get a turbulent energy cascade of primordial GW was also mentioned but, until our work, no theory had been developed.

In Galtier & Nazarenko (2017; [A74]), we derived for the first time a turbulence theory in general relativity for an empty universe and without introducing the cosmological constant. It is a wave turbulence theory that describes a sea of weak GW interacting nonlinearly. We first proved that three-wave interactions do not contribute to the nonlinear dynamics and that the theory must therefore be developed at the level of four-wave interactions. Using the Hadad-Zakharov (diagonal) metric, we derived the kinetic equations of weak GW turbulence. These equations conserve energy and wave action for which we have a direct and an inverse cascade, respectively. We derived the exact solutions (Kolmogorov-Zakharov spectra) and showed that the inverse cascade is explosive with an anomalous scaling for the wave action spectrum during the non-stationary phase (Galtier et al., 2019 [A81]). Recently, we published the first direct evidence of a dual cascade in GW turbulence (Galtier et al., 2021 [A96]). This result is based on a direct numerical simulation of Einstein's equations. A dual cascade of energy and wave action is reported with – as expected – a timescale corresponding to four-wave interactions. We show that wave turbulence becomes strong at large scales with a selective amplification of the space-time metric components during the inverse cascade. Strong/weak GW turbulence can potentially completely change the commonly accepted picture of the early Universe and the cause of cosmological inflation (currently considered as the result of the existence of a hypothetical field called inflaton). Indeed, without introducing a new ad-hoc physics, it can be shown phenomenologically that strong wave turbulence could provide a nonlinear inflation mechanism by producing a fast condensation phenomenon eventually leaving a fossile spectrum (Harrison-Zeldovich spectrum) compatible with the Planck data (Galtier et al., 2020 [A89]). This theoretical scenario can be verified by direct numerical simulations.

Origin of the anomalous dissipation in turbulence

The anomalous dissipation is defined as the non-vanishing of the mean energy dissipation at infinite-Reynolds number. This property of the turbulence theory is so fundamental that it is often called the zeroth law of turbulence (Frisch, 1995). Number of experimental or numerical results have confirmed the zeroth law (Ravelet et al., 2008). The origin of the anomalous dissipation is, however, not rigorously understood and very often semi-phenomenological argument are used like the one proposed by Taylor (1935). In the theory of Kolmogorov (1941), the anomalous dissipation is used to derive the so-called 4/5 law for incompressible hydrodynamics. This law can be generalized to other incompressible fluids as discussed above in the context of MHD (Politano & Pouquet, 1998; Galtier, 2008 [A37]). It was Onsager (1949) who actually mentioned for the first time the possible origin of an anomalous dissipation in the loss of smoothness of the velocity field in hydrodynamics. A major breakthrough was achieved by the mathematicians Duchon & Robert (2000) who derived an exact local form of the energy dissipation created by a loss of regularity in the velocity field. In particular, they derived the Onsager anomalous dissipation in terms of velocity increments. Remarkably, the expression found is closely related to the exact 4/3 law for Navier-Stokes turbulence (Antonia et al., 1997).

The immediate question for our concern is: can we also find an expression for the anomalous dissipation in incompressible MHD which shares this remarkable property. I have proved that the answer is yes (Galtier, 2018 [A78]). The mathematical developed was performed on the 3D Hall MHD equations. I was able to recover the exat law of MHD and Hall MHD (Politano & Pouquet, 1998; Galtier, 2008 [A37]) as the kernel of the anomalous expression. This result is particularly important for space plasmas because it opens the possibility to study the question of local dissipation since the expression of the anomalous dissipation does not imply an ensemble average: it is valid for individual realization and locally in space-time in the sense of distribution (Eyink, 2008). Recently, we have studied this question using data from the Parker Solar Probe which travels very close to the Sun where discontinuities are often present. Our study (David et al., 2022 [A99]) reveals that the local heating evaluated with the expression of the anomalous dissipation can be much higher that the mean heating obtained with the classical 4/3 law of MHD. We also have studied the heating of the solar wind near Jupiter where strong shocks have been measured by Voyager. Using a reduced model that generalizes the Burgers equation to MHD, it was possible to derive an exact solution and to show that the anomalous dissipation is compatible with the small viscosity/resistivity limit (David & Galtier, 2021 [A94]). In other words, we proved the zeroth law of turbulence in a reduced MHD model.

PUBLICATIONS (with referees)

[A1] Galtier S., Politano H. & Pouquet A.,
Self-Similar Energy Decay in Magnetohydrodynamic Turbulence, Phys. Rev. Lett. **79**, pp 2807-2810 (1997).

[A2] Galtier S. & Pouquet A.,
Solar Flares Statistics With a One-Dimensional MHD Model, Solar Phys. **179**, pp 141-165 (1998).

[A3] Galtier S., Gomez T., Politano H. & Pouquet A.,
Intermittency in MHD Flows, Advances in Turbulence VII **46**, pp 453-456 (1998).

[A4] Galtier S.,
A 1-D MHD Model of Solar Flares: Emergence of a Population of Weak Events, and a Possible Road Towards Nano-Flares, Astrophys. J. **521**, pp 483-489 (1999).

[A5] Galtier S., Nazarenko S.V., Newell A.C. & Pouquet A.,
A Weak Turbulence Theory for Incompressible MHD, Lecture Notes in Phys. **536**, pp 291-330 (1999).

[A6] Galtier S., Zienicke Z., Politano H. & Pouquet A.,
Parametric Investigation of Self-Similar Decay Laws in MHD Turbulent Flows, J. Plasma Phys. **61**, pp 507-541 (1999).

[A7] Pouquet A., **Galtier S.** & Politano H.,
Mechanisms of Injection and Dissipation of Energy and their Relation to the Dynamics of the Interstellar Medium, Astron. Soc. Pac. Conf. Series **168**, pp 417-426 (1999).

[A8] Galtier S., Nazarenko S.V., Newell A.C. & Pouquet A.,
A Weak Turbulence Theory for Incompressible MHD, J. Plasma Phys. **63(5)**, pp 447-488 (2000).

[A9] Walsh R.W. & **Galtier S.,**
Intermittent Heating in a Model of Solar Coronal Loops, Solar Physics. **197(1),** pp 57-73 (2000).

[A10] Nazarenko S.V., Falkovich G.E. & **Galtier S.**,
Feedback of Small-Scale Magnetic Dynamo, Phys. Rev. E **63(1),** p 016408 (2001).

[A11] Nazarenko S.V., Newell A.C. & **Galtier S.,**
Non-Local MHD Turbulence, Physica D **152-153**, pp 646-652 (2001).

[A12] Galtier S., Nazarenko S.V. & Newell A.C.,
On Wave Turbulence in MHD, Nonl. Proc. Geophys. **8(3),** pp 141-150 (2001).

[A13] Galtier S.,
Statistical Study of Short Quiescent Times Between Solar Flares in a 1D MHD Model, Solar Phys. **201**, pp 133-136 (2001).

[A14] Fournier J.-D. & **Galtier S.**,
Meromorphy and Topology of Localized Solutions in the Thomas-MHD Model, J. Plasma Phys. **65(5),** pp 365-406 (2001).

[A15] Galtier S., Nazarenko S.V., Newell A.C. & Pouquet A.,
Anisotropic Turbulence of Shear-Alfvén Waves, Astrophys. J. 564, pp L49-L52 (2002).

[A16] Ng C.S., Bhattacharjee A., Germaschewski K. & **Galtier S.,**
Anisotropic Fluid Turbulence in the Interstellar Medium and Solar Wind, Phys. Plasmas **10(5),** pp 1954-1962 (2003).

[A17] Buchlin E., Aletti V., **Galtier S.,** Velli M., Einaudi G. & Vial J.-C.,
A Solar Cellular Automata Model Based on Reduced MHD, Astron. & Astrophys. **406**, pp 1061-1070 (2003).

[A18] Galtier S. & Bhattacharjee A.,
Anisotropic Weak Whistler Wave Turbulence in Electron MHD, Phys. Plasmas **10(8),** pp 3065-3076 (2003).

[A19] Galtier S.,
Weak Inertial Wave Turbulence Theory, Phys. Rev. E **68**, pp 015301(R) (2003).

[A20] Galtier S., Nazarenko S.V., Newell, A.C. & Pouquet, A.,
Weak Turbulence of Anisotropic Shear-Alfvén Waves, Solar Wind X, AIP Conf. Proc. **679**, pp 518-521 (2003).

[A21] Buchlin E., Aletti V., **Galtier S.,** Velli M. & Vial J.-C.,
A Solar Cellular Automata Model Issued from Reduced MHD, Solar Wind X, AIP Conference Proc. **679**, pp 335-338 (2003).

[A22] West R.J., Nazarenko S.V., Laval J.-P. & **Galtier S**.,
Kinetic Turbulent Dynamo in the Large Prandtl Number Regime, Astron. & Astrophys. **414**, pp 807-824 (2004).

[A23] Buchlin E., **Galtier S.** & Velli M.,
Influence of the Definition of Dissipative Events on their Statistics, Astron. & Astrophys. **436**, pp 355-362 (2005).

[A24] Galtier S., Pouquet A. & Mangeney A.,
On Spectral Scaling Laws for Incompressible Anisotropic MHD Turbulence, Phys. Plasmas **12**, pp 092310-1-5 (2005).

[A25] Galtier S. & Bhattacharjee, A.,
Anisotropic Wave Turbulence in Electron MHD, Plasma Phys. Control. Fusion **47**, pp 1-11 (2005).

[A26] Parenti S., Buchlin E., **Galtier S.** & Vial J.-C.,
Radiative Signature of Coronal Loops Submitted to Turbulent Heating, Connecting Sun and Heliosphere, ESA **SP-592**, pp 523-525 (2005).

[A27] Galtier S.,
Wave Turbulence in Incompressible Hall MHD, J. Plasma Phys. **72**, pp 721-769 (2006).

[A28] Parenti S., Buchlin E., Cargill P., **Galtier S.** & Vial J.-C.,
Modelling the Radiative Signatures of Turbulent Heating in Coronal Loops, Astrophys. J. **651**, pp 1219-1228 (2006).

[A29] Galtier S. & Chandran B.,
Extended Spectral Scaling Laws for Shear-Alfvén Wave Turbulence, Phys. Plasmas **13**, pp 114505-1-4 (2006).

[A30] Galtier S.,
Multi-Scale Turbulence in the Inner Solar Wind, J. Low Temp. Phys. **145**, pp 59-74, (2006).

[A31] Galtier S. & Buchlin, E.,
Multi-Scale Hall-MHD Turbulence in the Solar Wind, Astrophys. J. **656**, pp 560-566 (2007).

[A32] Sahraoui F., **Galtier S.** & Belmont G.,
On Waves in Incompressible Hall MHD, J. Plasma Physics **73**, pp 723-730 (2007).

[A33] Alexakis A., Bigot B., Politano H. & **Galtier S.,**
Anisotropic Fluxes and Nonlocal Interactions in MHD Turbulence, Phys. Rev. E **76**, pp 056313-1-8 (2007).

[A34] Galtier S. & Buchlin E.,
Hall-MHD Turbulence in the Solar Wind, Advances in Turbulence XI, Springer Proc. in Physics **117**, pp 70-72 (2007).

[A35] Bigot B., **Galtier S.** & Politano H.,
Anisotropy in Three-Dimensional MHD Turbulence, Advances in Turbulence XI, Springer Proc. in physics **117**, pp 26-28 (2007).

[A36] Galtier S.,
Exact Scaling Laws for 3D Electron MHD Turbulence, J. Geophys. Res. **113**, p A01102 (2008).

[A37] Galtier S.,
von Karman-Howarth Equations for Hall Magnetohydrodynamic Flows, Phys. Rev. E **77**, p 015302(R) (2008).

[A38] Bigot B., **Galtier S.** & Politano H.,
Energy Decay Laws in Strongly Anisotropic MHD Turbulence, Phys. Rev. Lett. **100**, p 074502 (2008).

[A39] Galtier S.,
Hall Effect in Solar Wind Turbulence, Astron. Soc. Pac. Conf. Series **385**, pp 25-30 (2008).

[A40] Bigot B., **Galtier S.** & Politano H.,
Anisotropic Turbulent Model for Solar Coronal Heating, Astrophys. & Astron. **490**, pp 325-337 (2008).

[A41] Galtier S. & Nazarenko S.,
Large-Scale Magnetic Field Sustainment by Forced MHD Wave Turbulence, J. Turbulence **9(40),** pp 1-10 (2008).

[A42] Bigot B., **Galtier S.** & Politano H.,
Development of Anisotropy in Incompressible Magnetohydrodynamic Turbulence, Phys. Rev. E. **78**, pp 066301-1-22 (2008).

[A43] Galtier S.,
Wave Turbulence in Magnetized Plasmas, Nonlin. Proc. Geophys. **16**, pp 83-98 (2009).

[A44] Galtier S.,
Exact Vectorial Law for Axisymmetric MHD Turbulence, Astrophys. J. **704**, pp 1371-1384 (2009).

[A45] Galtier S.,
Exact Vectorial Law for Homogeneous Rotating Turbulence, Phys. Rev. E **80**, pp 046301-1-9 (2009).

[A46] Galtier S.,
Consequence of Space Correlation Foliation for EMHD Turbulence, Phys. Plasmas **16**, pp 112310-1-6 (2009).

[A47] Galtier S.,
Solar Wind Turbulence: New Questions and Possible Solutions, Solar Wind 12, AIP Conference Proc. **1216**, pp 109-114 (2010).

[A48] Bigot B., **Galtier S.** & Politano H.,
An Anisotropic Turbulent Model for Solar Coronal Heating, Solar Wind XII, AIP Conference Proc. **1216**, pp 48-51 (2010).

[A49] Meyrand R. & **Galtier S.**,
A Universal *Law for Solar-Wind Turbulence at Electron Scales,* Astrophys. J. **721**, pp 1421-1424 (2010).

[A50] Galtier S. & Buchlin E,
Nonlinear Diffusion Equations for Anisotropic MHD Turbulence with Cross-helicity, Astrophys. J. **722**, pp 1977-1983 (2010).

[A51] Bigot B. & **Galtier S.,**
Two-Dimensional State in Driven Magnetohydrodynamic Turbulence, Phys. Rev. E **83**, pp 026405-1-9 (2011).

[A52] Galtier S.,
Universal Law in Terms of Elsasser fields for Axisymmetric MHD Turbulence, Comptes Rendus de Physique de l'Académie des Sciences **12**, 151-159 (2011).

[A53] Meyrand R. & **Galtier S.**,
Three-Dimensional Hall MHD Turbulence, Astron. Soc. Pac. Conf. Series **459**, 28-34 (2011).

[A54] Galtier S. & Banerjee S.,
Exact Relation for Correlation Functions in Compressible Isothermal Turbulence, Phys. Rev. Lett. **107**, 134501 (2011).

[A55] Galtier S.,
Kolmogorov Vectorial Law for Solar Wind Turbulence, Astrophys. J. **746**, 184-1-4 (2012).

[A56] Augier P., **Galtier S.** & Billant P.,
Kolmogorov Laws for Stratified Turbulence, J. Fluid Mech. **709**, 659-670 (2012).

[A57] Meyrand R. & **Galtier S.,**
Spontaneous Chiral Symmetry Breaking of Hall MHD Turbulence, Phys. Rev. Lett. **109**, 194501 (2012).

[A58] Banerjee S. & **Galtier S.,**
Exact Relation with Two-point Correlation Functions and Phenomenological Approach for Compressible MHD Turbulence, Phys. Rev. E **87(1)**, 013019 (2013).

[A59] Tronko N., **Galtier S.** & Nazarenko S.,
Wave Turbulence in 2D Magnetohydrodynamics, Phys. Rev. E **87(3)**, 033101 (2013).

[A60] Meyrand R. & **Galtier S.,**
Anomalous -8/3 Scaling Spectrum in Electron MHD, Phys. Rev. Lett. **111**, 264501 (2013).

[A61] Banerjee S. & **Galtier S.,**
A Kolmogorov-like Exact Relation for Compressible Polytropic Turbulence, J. Fluid Mech. **742**, 230-242 (2014).

[A62] Galtier S.,
Theory for Helical Turbulence under Fast Rotation, Phys. Rev. E(R) **89**, 041001 (2014).

[A63] Galtier S.,
A Weak Turbulence Theory for Rotating Magnetohydrodynamics and Planetary Flows, J. Fluid Mech. **757**, pp 114-154 (2014).

[A64] Galtier S. & Meyrand R.,
Entanglement of Magnetic Helicity and Energy in Kinetic-Alfvén / Whistler Turbulence, J. Plasma Phys. **81(01)**, 3206 (2015).

[A65] Meyrand R., Kyiani K. & **Galtier S.**,
Weak MHD Turbulence and Intermittency, J. Fluid Mech. Rapids **770**, R1, 11 pages (2015). **FRONT COVER.**

[A66] Thalabard S., Nazarenko S., **Galtier S**. & Medvedev S.,
Anomalous Scalings in the Differential Models of Turbulence, J. Physics A: Math. and Theoretical **48(28)**, 285501, 21 pages (2015).

[A67] Meyrand R., **Galtier S.** & Kiyani, K.,
Direct Evidence of the Transition from Weak to Strong MHD Turbulence, Phys. Rev. Lett. **116**, 105002 (2016).

[A68] Banerjee S. & **Galtier S**.,
Chiral Exact Relations for Helicities in Hall MHD Turbulence, Phys. Rev. E **93**, 033120, 6 pages (2016).

[A69] Banerjee S., Hadid L., Sahraoui F. & **Galtier S**.,
Scaling of Compressible MHD Turbulence in the Fast Solar Wind, Astrophys. J. **829**, L27-L31 (2016).

[A70] Andrés, N., Sahraoui, F. & **Galtier S**.,
Exact Scaling Laws for Helical Three-dimensional Two-Fluid Turbulent Plasmas, Phys. Rev. E **94**, 063206 (2016).

[A71] Galtier S.,
*Introduction to Modern Magnetohydrodynamics (**book**), Cambridge University Press, 290 pages (2016).*

[A72] Banerjee S. & **Galtier S**.,
An Alternative Formulation for Exact Scaling Relations in HD and MHD Turbulence, J. Phys. A: Math. Theor. **50**, 015501 (2017). **Highlights of 2017 collection.**

[A73] Hadid L.Z., Sahraoui F., & **Galtier S**.,
Energy Cascade Rate in Compressible Fast and Slow Solar Wind Turbulence, Astrophys. J. **838(9)**, 11 pages (2017).

[A74] Galtier S. & Nazarenko S.V.,
Turbulence of Weak Gravitational Waves in the Early Universe, Phys. Rev. Lett. **119**, 221101 (2017).

[A75] Hadid L.Z., Sahraoui F., **Galtier S**. & Huang S.Y.,
*Compressible MHD Turbulence in the Earth's Magnetosheath: Estimation of the Energy Cascade Rate Using in situ Spacecraft Data, Phys. Rev. Lett. **121***, (2018).

[A76] Andrés N., **Galtier S**. & Sahraoui F.,
Exact Law for Homogeneous Compressible Hall Magnetohydrodynamic Turbulence, Phys. Rev. E **97**, 013204 (2018).

[A77] Galtier S.,
*Turbulence in Space Plasmas and Beyond (**Invited Review**)*, J. Phys. A: Math. Theor. **51**, 293001, 39 pages (2018).

[A78] Galtier S.,
On the Origin of the Energy Dissipation Anomaly in Hall MHD, J. Phys. A: Math. Theor. **51**, 205501, 9 pages (2018).

[A79] Meyrand R., Kiyani K.H., Gürcan O. & **Galtier S**.,
Coexistence of Weak and Strong Wave Turbulence in Incompressible Hall MHD, Phys. Rev. X **8**, 031066, 19 pages (2018).

[A80] Andrés N., Sahraoui F., **Galtier S**., Hadid L.Z., Dmitruk P. & Mininni P.,
Energy Cascade Rate in 3D Compressible and Isothermal MHD Turbulence, J. Plasma Physics **84(4)**, 905840404 (2018).

[A81] Galtier S., Nazarenko S.V., Buchlin E. & Thalabard S.,
Nonlinear Diffusion Models for Gravitational Wave Turbulence, Physica D **390**, 84-88 (2019).

[A82] Nazarenko S.V., Grebenev V., Medvedev S. & **Galtier S**.,
The Focusing Problem for the Leith Model of Turbulence: a Self-similar Solution of the Third Kind, J. Phys. A: Math. Theor. **52**, 155501 (2019).

[A83] Menu M., **Galtier S**. & Petitdemange L.,
Inverse Cascade of Hybrid Helicity in Rotating MHD Turbulence, Phys. Rev. Fluids 4, 073701 (2019).

[A84] David V. & **Galtier S**.,
-8/3 Spectrum in Kinetic Alfvén Wave Turbulence: Implications for the Solar Wind, Astrophys. J. **880**, L10 (2019).

[A85] Ferrand R., **Galtier S**., Sahraoui F., Meyrand R., Andrés N. & Banerjee S.,
On Exact Laws in Incompressible Hall MHD Turbulence, Astrophys. J. **881**, 50 (2019).

[A86] Andrés N., Sahraoui F., **Galtier S**., Hadid L.Z., Ferrand R. & Huang S.Y.,
Energy Cascade Rate Measured in a Collisionless Space Plasma with MMS Data and Compressible Hall MHD Turbulence Theory, Phys. Rev. Lett. **123**, 245101 (2019).

[A87] Galtier S. & David V.,
Inertial/Kinetic Alfvén-Wave Turbulence: A Twin Problem in the Limit of Local Interactions, Phys. Rev. Fluids **5**, 44603, 1-14 (2020).

[A88] Menu M., Petitdemange L. & **Galtier S.**,
Magnetic Effects on Fields Morphologies and Reversals in Geodynamo Simulations, Physics of the Earth and Planetary Interiors **307**, 106542 (2020).

[A89] Galtier S., Laurie J. & Nazarenko S.V.,
A Plausible Model of Inflation Driven by Strong Gravitational Wave Turbulence, Universe **6(7)**, 16 pages (2020).

[A90] Ferrand R, **Galtier S**., Sahraoui F. & Federrath C.,
Compressible Turbulence in the Interstellar Medium: New Insights from a Hight-Resolution Supersonic Turbulence Simulation, Astrophys. J. **904**, 160, 7 pages (2020).

[A91] Galtier S.,
Wave Turbulence: the Case of Capillary Waves (A Review), Geophys. & Astro. Fluid Dyn. **115**, 234-257 (2021).

[A92] Huang S.Y. et al.,
The Ion Transition Range of Solar Wind Turbulence in the Inner Heliosphere: Parker Solar Probe Observations, Astrophys. J. Lett. **909(1)**, L7 (2021).

[A93] Ferrand R, **Galtier S**. & Sahraoui F.,
A Compact Exact Law for Compressible Isothermal Hall MHD Turbulence, J. Plasma Phys. **87(2)**, 905870220 (2021).

[A94] David V. & **Galtier S.**,
Proof of the Zeroth Law of Turbulence in 1D Compressible MHD and Shock Heating, Phys. Rev. E. **103**, 063215 (2021).

[A95] Andres N., Sahraoui F., Hadid L.Z., Huang S.Y., Romanellu N., **Galtier S**., DiBraccio G. & Halekas J.,
The Evolution of Compressible Solar Wind Turbulence in the Inner Heliosphere: PSP, THEMIS and MAVEN Observations, Astrophys. J. **919**, 19 (2021).

[A96] Galtier S. & Nazarenko S.,
Direct Evidence of a Dual Cascade in Gravitational Wave Turbulence, Phys. Rev. Lett. **127**, 131101 (2021). **EDITORS' SUGGESTION.**

[A97] Ferrand R, Sahraoui F., Laveder D., Passot T., Sulem P.-L. & **Galtier S.**,
Fluid Energy Cascade Rate and Kinetic Landau Damping: 3D Landau-Fluid Simulation, Astrophys. J. **923(3)**, 122 (2021).

[A98] Ferrand R, Sahraoui F., **Galtier S**., Andrés N., Mininni P. & Dmitruk P.,
In-depth Numerical Study of Exact Laws for Compressible Hall MHD Turbulence, Astrophys. J. **927**, 205 (2022).

[A99] David V., **Galtier S**., Sahraoui F. & Hadid L.,
Energy Transfer, Discontinuities and Heating in the Inner Heliosphere Measured with a Weak and Local Formulation of the Politano-Pouquet Law, Astrophys. J. **927**, 200 (2022).

[A100] Andrés N., Sahraoui F., Huang S.Y., Hadid L. & **Galtier S.**,
About the Incompressible Energy Cascade Rate in Anisotropic Solar Wind Turbulence, Astron. & Astrophys. **661**, A116 (2022).

[A101] David V. & **Galtier S.**,
Wave Turbulence in Inertial Electron MHD, J. Plasma Phys. **88**, 905880509, 32 pages (2022).

[A102] Galtier S.,
*Physics of Wave Turbulence (**book**)*, Cambridge University Press, 280 pages, (2023).

[A103] David V. & **Galtier S.**,
*Locality of Triad Interaction and Kolmogorov Constant in Inertial Wave Turbulence, J. Fluid Mech. Rapids **955**, R2* (2023).

[A104] Galtier S.,
Fast Magneto-Acoustic Wave Turbulence and the Iroshnikov-Kraichnan Spectrum, J. Plasma Physics ***89****, 905890205, 28 pages* (2023).

[A105] Galtier S.,
A Multiple Time-scale Approach for Anisotropic Inertial Wave Turbulence, J. Fluid Mech. ***974****, A24, 17 pages* (2023).

[A106] David V., **Galtier S**. & Meyrand R.,
Monofractality in the Solar Wind at Electron Scales: Insights from KAW Turbulence, Phys. Rev. Lett. ***132****, 085201* (2024).

[A107] Gay B., **Galtier S**.,
Gravitational Wave Turbulence: A Multiple Time Scale Approach for Quartic Wave Interactions, Phys. Rev. D, 38 pages, accepted (2024).