

Marco Falconi — Curriculum Vitæ

CONTACTS	Institut für Analysis, Dynamik und Modellierung Universität Stuttgart Pfaffenwaldring 57 70569 Stuttgart Deutschland	Tél : +49 (0)711 685 69768 Bureau : 8-528 Mail : marco.falconi@mathematik.uni-stuttgart.de Page Web : http://www.mathematik.uni-stuttgart.de/~falconnm/
DATE DE NAISSANCE	Le 5 octobre 1983 à Faenza, Italie.	
NATIONALITÉ	Italienne	
EMPLOI	<ul style="list-style-type: none">• Institut für Dynamik, Analysis und Modellierung — Universität Stuttgart ATER. depuis octobre 2015• Centre Henri Lebesgue — Université de Rennes I Postdoc. janvier 2014 - septembre 2015• Dipartimento di Matematica — Università di Bologna Postdoc. juin 2012 - décembre 2013• Dipartimento di Matematica — Università di Bologna Doctorant. janvier 2009 - mai 2012	
FORMATION UNIVERSITAIRE	Alma Mater Studiorum - Università di Bologna, Bologna (Italie) <i>Dottorato (Doctorat) en Mathématiques.</i> janvier 2009 - mai 2012 <ul style="list-style-type: none">• Soutenance : 8 juin, 2012• Thèse : Classical limit of the Nelson model• Directeur : Prof. Giorgio Velo• Jury : Prof. Piero D'Ancona, Prof. Alberto Parmeggiani, Prof. Marco Peloso <i>Laurea Specialistica (Master), Physique théorique</i> 2005 - 2007 <ul style="list-style-type: none">• Summa cum Laude• Thèse : On the regularization of phase-space path integral in curved manifolds• Directeur : Prof. Fiorenzo Bastianelli <i>Laurea Triennale (Licence), Physique</i> 2002 - 2005 <ul style="list-style-type: none">• Summa cum Laude• Thèse : Sulla nozione di distinguibilità e degenerazione (en italien)• Directeur : Prof. Loris Ferrari	
DOMAINES D'INTÉRÊT	<i>Physique Mathématique, Équations aux Dérivées Partielles</i> <ul style="list-style-type: none">• Limite classique et limite du champ moyen des systèmes quantiques• Scattering theory pour les champs quantiques• Aspects mathématiques de l'électrodynamique quantique• Renormalisation des théories des champs quantiques• EDP dispersives• Intégration fonctionnelle.	
PUBLICATIONS	<i>Bohr's correspondence principle in quantum field theory and classical dressing renormalization : the Nelson model.</i> (en collaboration avec Z. Ammari) En cours de préparation Abstract : In this paper we prove that Bohr's principle of correspondence between quantum and classical formulations of a physical theory holds for a renormalized system of quantum fields in interaction. In particular, it is shown that the renormalized Nelson dynamics converges, in the limit of large quantum numbers, towards the solution of a Schrödinger and Klein-Gordon system with Yukawa-type interaction. The dressing transformation is classically implemented by a symplectomorphism of the phase space. In virtue of this classical dressing, we can develop a new perspective on the renormalization procedure, that is founded exclusively on manipulations at the classical level.	

On the rate of convergence for the mean field approximation of many-body quantum dynamics (en collaboration avec Z. Ammari and B. Pawilowski) **Soumis à Comm. Math. Sci. (2015)**

[arXiv:1411.6284](#)

Abstract : We consider the time evolution of quantum states by many-body Schrödinger dynamics and study the rate of convergence of their reduced density matrices in the mean field limit. If the prepared state at initial time is of coherent or factorized type and the number of particles n is large enough then it is known that $1/n$ is the correct rate of convergence at any time. We show in the simple case of bounded pair potentials that the previous rate of convergence holds in more general situations with possibly correlated prepared states. In particular, it turns that the coherent structure at initial time is unessential and the important fact is rather the speed of convergence of all reduced density matrices of the prepared states. We illustrate our result with several numerical simulations and examples of multi-partite entangled quantum states borrowed from quantum information.

Self-Adjointness criterion for operators in Fock spaces

Math. Phys. Anal. Geom. 18, No.1 (2015)

[arXiv:1405.6570](#)

[doi:10.1007/s11040-015-9173-x](#)

Abstract : In this paper we provide a criterion of essential self-adjointness for operators in the tensor product of a separable Hilbert space and a Fock space. The class of operators we consider may contain a self-adjoint part, a part that preserves the number of Fock space particles and a non-diagonal part that is at most quadratic with respect to the creation and annihilation operators. The hypotheses of the criterion are satisfied in several interesting applications.

Wigner measures approach to the classical limit of the Nelson model : Convergence of dynamics and ground state energy (en collaboration avec Z. Ammari)

J. Stat. Phys. 157, No.2 330-364 (2014)

[arXiv:1403.2327](#)

[doi:10.1007/s10955-014-1079-7](#)

Abstract : We consider the classical limit of the Nelson model, a system of stable nucleons interacting with a meson field. We prove convergence of the quantum dynamics towards the evolution of the coupled Klein-Gordon-Schrödinger equation. Also, we show that the ground state energy level of N nucleons, when N is large and the meson field approaches its classical value, is given by the infimum of the classical energy functional at a fixed density of particles. Our study relies on a recently elaborated approach for mean field theory and uses Wigner measures.

Global Solution of the Electromagnetic Field-Particle System of Equations

J. Math. Phys. 55, 101502 (2014)

[arXiv:1311.1675](#)

[doi:10.1063/1.4897211](#)

Abstract : In this paper we discuss global existence of the solution of the Maxwell and Newton system of equations, describing the interaction of a rigid charge distribution with the electromagnetic field it generates. A unique solution is proved to exist (for regular charge distributions) on suitable homogeneous and non-homogeneous Sobolev spaces, for the electromagnetic field, and on coordinate and velocity space for the charge ; provided initial data belong to the subspace that satisfies the divergence part of Maxwell's equations.

Mean field limit of bosonic systems in partially factorized states and their linear combinations

arXiv e-Print (2013)

[arXiv:1305.5699](#)

Abstract : We study the mean field limit of one-particle reduced density matrices, for a bosonic system in an initial state with a fixed number of particles, only a fraction of which occupies the same state, and for linear combinations of such states. In the mean field limit, the time-evolved reduced density matrix is proved to converge : in trace norm, towards a rank one projection (on the state solution of Hartree equation) for a single state ; in Hilbert-Schmidt norm towards a mixed state, combination of projections on different solutions (corresponding to each initial datum), for states that are a linear superposition.

Classical limit of the Nelson model with cut off

J. Math. Phys. 54 012303 (2013)

[arXiv:1205.4367](#)

[doi:10.1063/1.4775716](#)

Abstract : In this paper we analyze the classical limit of the Nelson model with cut off, when both non-relativistic and relativistic particles number goes to infinity. We prove convergence of quantum observables to the solutions of classical equations, and find the evolution of quantum fluctuations around the classical solution. Furthermore we analyze the convergence of transition amplitudes of normal ordered products of creation and annihilation operators between different types of initial states. In particular the limit of normal ordered products between states with a fixed number of both relativistic and non-relativistic particles yields an unexpected quantum residue : instead of the product of classical solutions we obtain an average of the

product of solutions corresponding to varying initial conditions.

Mode Regularization for $N = 1, 2$ SUSY Sigma Model (en collaboration avec R. Bonezzi)

J. High Energy Phys. 10 (2008) 019

[arXiv:0807.2276](https://arxiv.org/abs/0807.2276)

[doi:10.1088/1126-6708/2008/10/019](https://doi.org/10.1088/1126-6708/2008/10/019)

Abstract : Worldline $N = 1$ and $N = 2$ supersymmetric sigma models in curved background are useful to describe spin one-half and spin one particles coupled to external gravity, respectively. It is well known that worldline path integrals in curved space require regularization : we present here the mode-regularization for these models, finding in particular the corresponding counterterms, both in the case of flat and curved indices for world- line fermions. For $N = 1$, using curved indices we find a contribution to the counterterm from the fermions that cancels the contribution of the bosons, leading to a vanishing total counterterm and thus preserving the covariance and supersymmetry of the classical action. Conversely in the case of $N = 2$ supersymmetries we obtain a non-covariant counterterm with both curved and flat indices. This work completes the analysis of the known regularization schemes for $N = 1, 2$ nonlinear sigma models in one dimension.

COMMUNICATIONS
ORALES

ANR SQFT, Île de Porquerolles (France)

- *Bohr's correspondence principle and classical dressing renormalization in the Nelson model*
ANR SQFT 3rd Meeting

11 Juin, 2015

Mathematik fakultät, Stuttgart (Germany)

- *Essential self-adjointness of operators in Fock space : a simple proof for "quadratic interactions"*
Graduiertenkolleg 1838 Guest Lecture

2 Juin, 2015

IRMAR, Rennes (France)

- *Auto-adjonction des opérateurs quadratiques dans les espaces de Fock*
Séminaire Landau

23 Mars, 2015

Institut Élie Cartan de Lorraine, Metz (France)

- *Vitesse de convergence vers la dynamique de Hartree pour des états généraux*
Séminaire EDP, Analyse et Applications

6 Mars, 2015

ANR LODIQUAS, Saint-Malo (France)

- *Bounds on the convergence towards mean field dynamics for systems of many bosons*
Rencontre LODIQUAS 2014

9 décembre, 2014

Università di Milano-Bicocca, Milan (Italie)

- *Global solution of the Newton-Maxwell equations by energy-type inequalities*
Seminari del Dipartimento di Matematica e Applicazioni

28 novembre, 2014

IRMAR, Rennes (France)

- *Limite classique et équations de Schrödinger-Klein-Gordon*
Séminaire d'équations aux dérivées partielles

23 octobre, 2014

Wolfgang Pauli Institute, Wien (Austria)

- *Schrödinger-Klein-Gordon system as the classical limit of a Quantum Field Theory dynamics*
Workshop on Dispersive equations with nonlocal dispersion - III

10 octobre, 2014

GDR DynQua, Roscoff (France)

- *Classical and mean field limit of field-particle systems*
2014 Annual Meeting

5 février, 2014

IRMAR, Rennes (France)

- *Global Solution of the Electromagnetic Field-Particle System of Equations*
Groupe de travail EDP

10 janvier, 2014

SÉJOURS
SCIENTIFIQUES

Séjours de courte durée

- *Stuttgart Universität (invité par Marcel Griesemer)*
- *Institut Élie Cartan de Lorraine (invité par Jérémy Faupin)*
- *Università di Milano-Bicocca (invité par Diego Noja)*

1-3 Juin, 2015

6-14 mars, 2015

24-28 novembre, 2014

ENSEIGNEMENT	Universität Stuttgart	
	Fachbereich Mathematik, Assistant d'enseignement	octobre 2015-mars 2015
	• Analysis I, Lehramtsstudiengang Mathematik.	
	IRMAR - Université de Rennes I	
	Cours doctoral	janvier-février 2015
	• <i>Relations de commutation canoniques : représentations en systèmes fini ou infini-dimensionnels</i>	
	Alma Mater Studiorum - Università di Bologna	
	École d'architecture, Assistant d'enseignement	2009-2013
	• Istituzioni di Matematica, CdL Architettura e Processo Edilizio	
	• Istituzioni di Matematiche I e II, CdL Architettura	
	École d'ingénieurs, Assistant d'enseignement	2010
	• Analisi Matematica per l'Ingegneria Informatica, CdL in Ingegneria Informatica	
QUALIFICATIONS	<i>Maître de Conférences</i>	
	Qualification aux fonctions de Maître de conférences Ministère de l'Enseignement supérieur et de la Recherche	2014-2018
AFFILIATIONS	<i>Graduiertenkolleg 1838 : Spectral Theory and Dynamics of Quantum Systems (GRK1838)</i>	2015
	<i>Société Mathématique de France (SMF)</i>	2014, 2015
	<i>European Mathematical Society (EMS)</i>	2015
	<i>International Association of Mathematical Physics ($M \cap \Phi$)</i>	2014, 2015
HONNEURS, PRIX ET BOURSES	<i>Contrat de Postdoc</i>	
	6 mois, Universität Stuttgart ATER	octobre 2015 - mars 2016
	12 mois, Centre Henri Lebesgue programme "Investissements d'avenir" --- ANR-11-LABX-0020-01	octobre 2014 - septembre 2015
	9 mois, Centre Henri Lebesgue programme "Investissements d'avenir" --- ANR-11-LABX-0020-01	janvier - septembre 2014
	<i>Bourse de doctorat</i>	
	3 ans, Università di Bologna	2009, 2010, 2011
CONFÉRENCES ET WORKSHOPS	<i>Meeting SQFT 2015</i>	11-13 Juin, 2015
	Île de Porquerolles, France	
	<i>Mathematical physics (GDR DynQua—ANR Nosevol)</i>	2-6 février, 2015
	Nantes, France	
	<i>Rencontre LODIQUAS 2014</i>	8-10 décembre, 2014
	Saint-Malo, France	
	<i>Dispersive equations with nonlocal dispersion - III</i>	6-10 octobre 2014
	Wolfgang Pauli Institute Vienna, Autriche	
	<i>Workshop SQFT 2014</i>	5-7 juin 2014
	Île de Porquerolles, France	
<i>Rencontre Nosevol #3</i>	7-9 avril 2014	
IRMAR Rennes, France		
<i>GDR DynQua annual meeting 2014</i>	5-7 février, 2014	
Roscoff, France		
<i>Perspectives in Phase Space Analysis of PDE's</i>	27-30 septembre, 2011	
Bertinoro, Italie		

Asymptotic Properties of Solutions to Hyperbolic Equations
Imperial College London, Royaume-Uni

21-25 mars, 2011

Fourth School and Workshop on Mathematical Methods in Quantum Mechanics
Bressanone, Italie

14-19 février, 2011

Seminal Interactions between Mathematics and Physics
Accademia Nazionale dei Lincei Roma, Italie

22-25 septembre, 2010

LANGUES

Italien

Langue maternelle

Anglais

Très bon niveau

Français

Bon niveau

Espagnol

Niveau scolaire