GT3 – Quelles sont les nouvelles frontières dans la description microscopique des noyaux ?

AG – 9-10 Dec 2020

T. Duguet, J.-P. Ebran, U. van Kolck

Contents

- Goals and spirit of WG3
- Past actions
- On-going scientific progress by members of WG3
- Planned actions
- Topics for discussion

Contents

Questions underlying the WG3

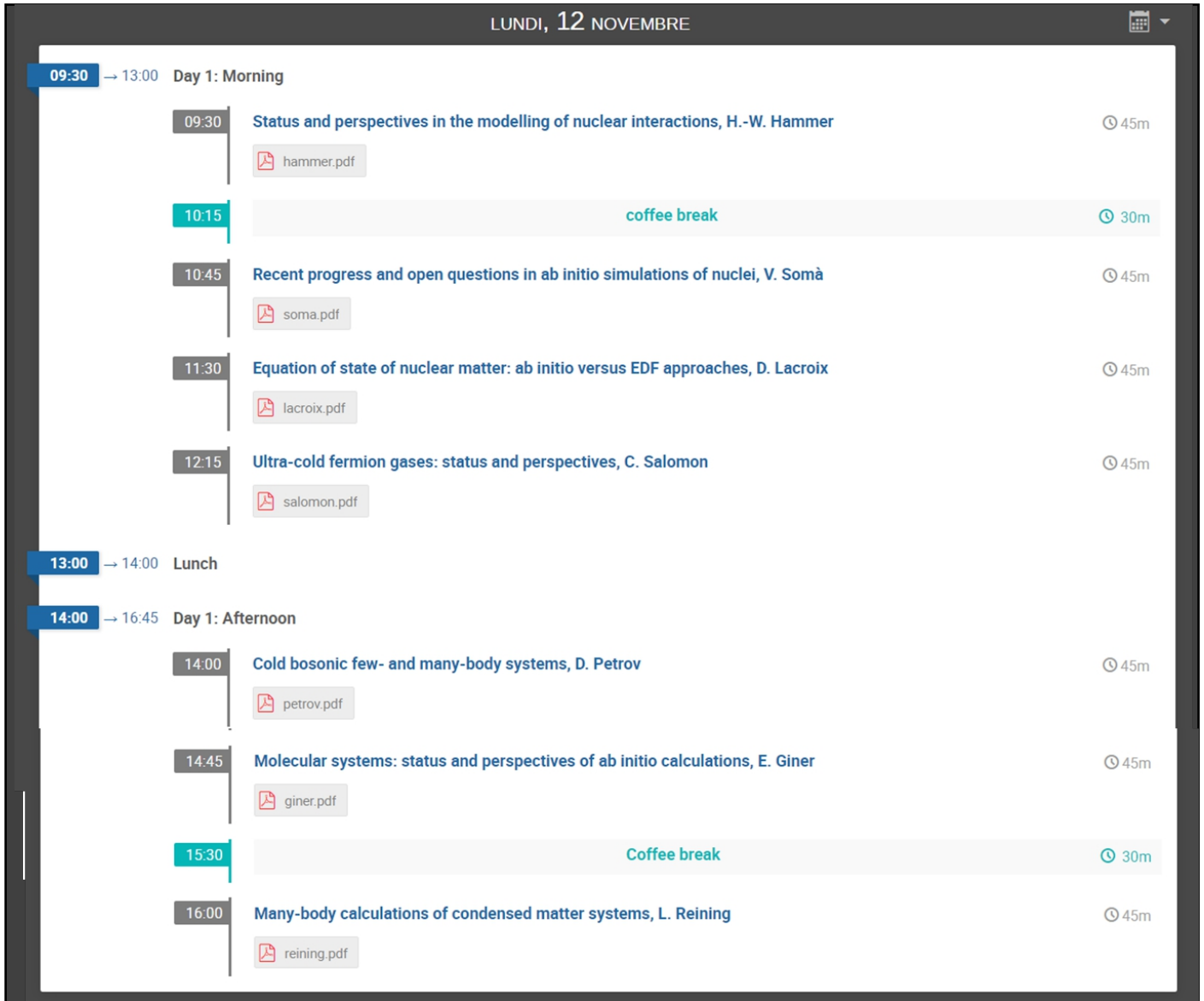
- ❑ **Anchor nuclear physics in QCD**
- ❑ **Exploit the unitarity limit and connection to atomic physics**
- ❑ **Extend the reach of the *ab initio* methods**
- ❑ **Extend the reach of the traditional shell model**
- ❑ **Covariant formulation of the nuclear many-body problem**
- ❑ **Improve the nuclear EDF method**
- ❑ **Understand neutron matter and neutron stars**

Contents

I. Kick-off workshop – 12-13 Nov. 2018 (T. Duguet, J.-P. Ebran, U. van Kolck)

Program – First day

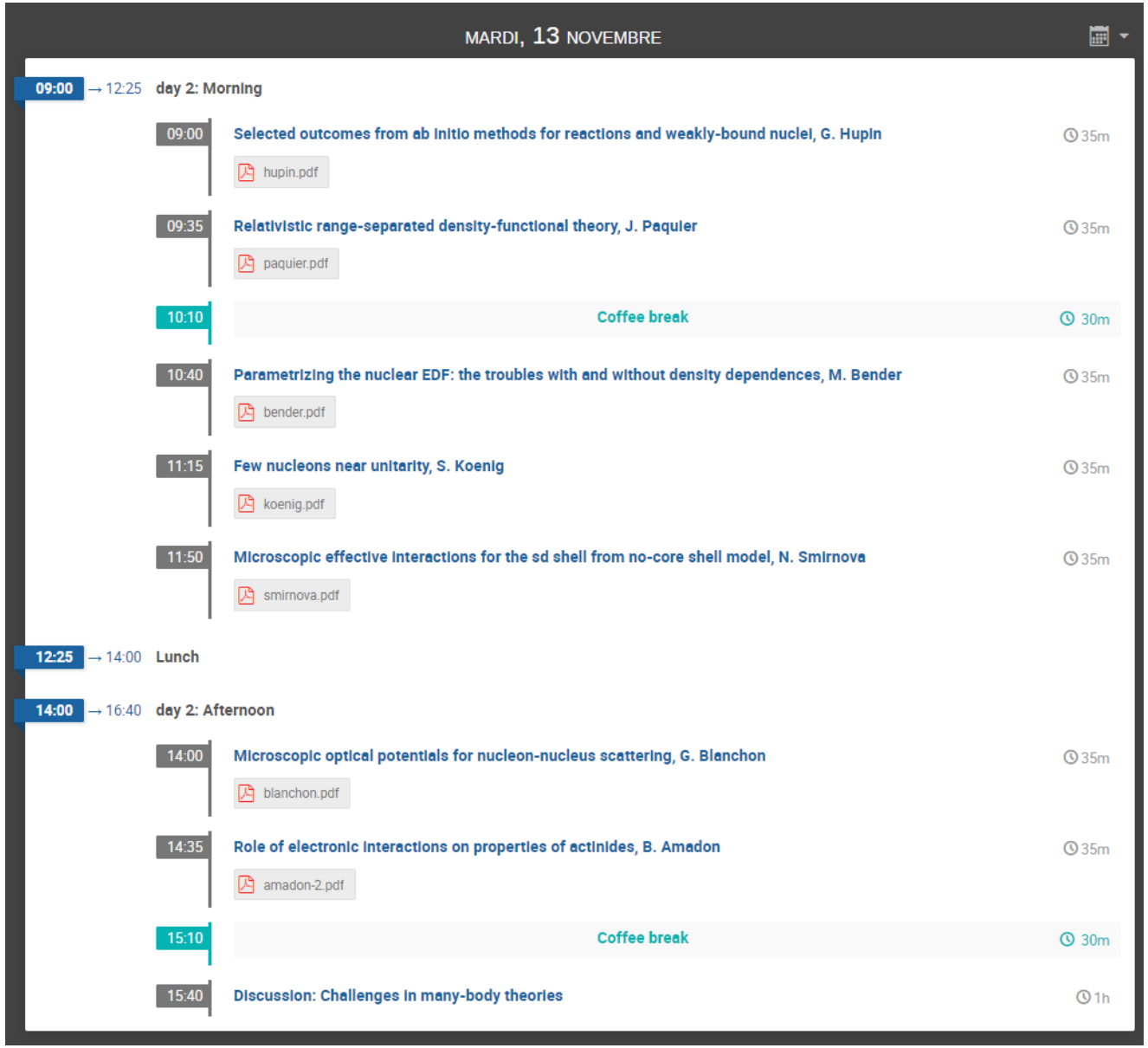
- **Interdisciplinary aspects of the many-body problem**
- **7 review talks**
  - 3 nuclear physics
  - 2 cold atoms
  - 1 quantum chemistry
  - 1 condensed matter



I. Kick-off workshop – 12-13 Nov. 2018 (T. Duguet, J.-P. Ebran, U. van Kolck)

Program – Second day

- **7 focused talks**
  - Ab initio reaction theory
  - Energy density functional
  - Effective field theory
  - Non-empirical shell model
  - Microscopic optical potential
  - Electronic structure DFT/DMFT
- **Discussion on challenges in many-body theories**



I. Kick-off workshop – 12-13 Nov. 2018 (T. Duguet, J.-P. Ebran, U. van Kolck)

Main points requiring efforts/of potential inter-disciplinary interest

1. **How to best solve the static A-body Schroedinger equation for doubly open-shell/heavier (A>100) nuclei?**
2. **How to go about improving inter-nucleon interactions?**
3. **How about pushing reaction theory**
4. **How to expand the nuclear EDF method to make it a systematically improvable method?**
5. **How/where to cross benefit from cold atoms/quantum chemistry/condensed matter?**

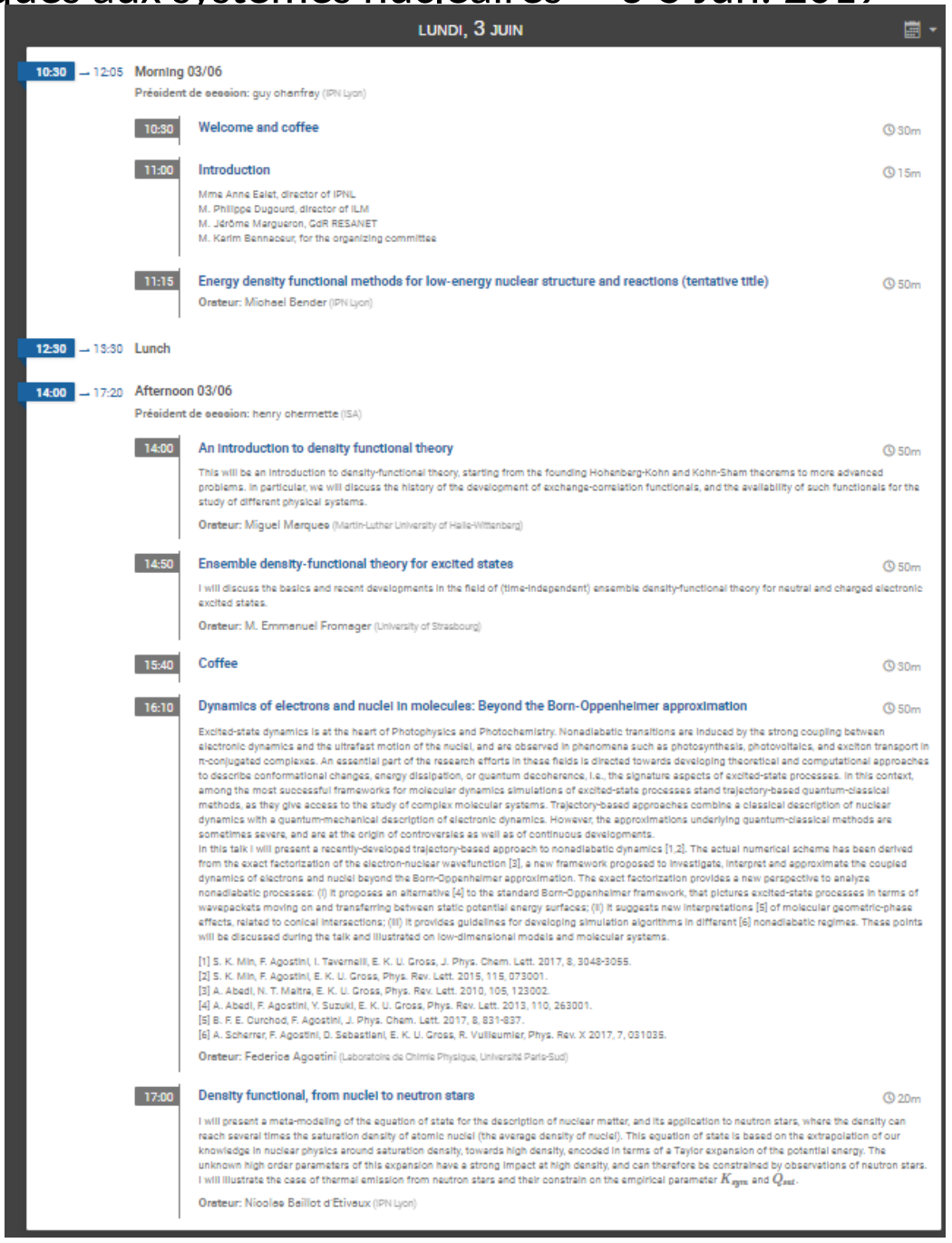
- **Excellent feedback from participants**
- **Interdisciplinary character particularly praised ► already leading to explicit future connections**

II. Workshop on Fonctionnelles de la densité: des systèmes atomiques aux systèmes nucléaires – 3-5 Jun. 2019

(K. Bennaceur, T. Albaret, L. Joly, J. Margueron)

Program – First day

- **Interdisciplinary aspects of DF-based approaches**
  - 2 nuclear physics
  - 3 quantum chemistry



LUNDI, 3 JUIN

10:30 – 12:05 Morning 03/06

Président de session: guy chanfray (IPN Lyon)

10:30 Welcome and coffee 30m

11:00 Introduction 15m

Mme Anne Ealet, director of IPNL
M. Philippe Dugourd, director of ILM
M. Jérôme Margueron, GdR RESANET
M. Karim Bennaceur, for the organizing committee

11:15 Energy density functional methods for low-energy nuclear structure and reactions (tentative title) 50m

Orateur: Michael Bender (IPN Lyon)

12:30 – 13:30 Lunch

14:00 – 17:20 Afternoon 03/06

Président de session: henry chermette (ISA)

14:00 An introduction to density functional theory 50m

This will be an introduction to density-functional theory, starting from the founding Hohenberg-Kohn and Kohn-Sham theorems to more advanced problems. In particular, we will discuss the history of the development of exchange-correlation functionals, and the availability of such functionals for the study of different physical systems.

Orateur: Miguel Marques (Martin-Luther University of Halle-Wittenberg)

14:50 Ensemble density-functional theory for excited states 50m

I will discuss the basics and recent developments in the field of (time-independent) ensemble density-functional theory for neutral and charged electronic excited states.

Orateur: M. Emmanuel Fromager (University of Strasbourg)

15:40 Coffee 30m

16:10 Dynamics of electrons and nuclei in molecules: Beyond the Born-Oppenheimer approximation 50m

Excited-state dynamics is at the heart of Photophysics and Photochemistry. Nonadiabatic transitions are induced by the strong coupling between electronic dynamics and the ultrafast motion of the nuclei, and are observed in phenomena such as photosynthesis, photovoltaics, and exciton transport in π-conjugated complexes. An essential part of the research efforts in these fields is directed towards developing theoretical and computational approaches to describe conformational changes, energy dissipation, or quantum decoherence, i.e., the signature aspects of excited-state processes. In this context, among the most successful frameworks for molecular dynamics simulations of excited-state processes stand trajectory-based quantum-classical methods, as they give access to the study of complex molecular systems. Trajectory-based approaches combine a classical description of nuclear dynamics with a quantum-mechanical description of electronic dynamics. However, the approximations underlying quantum-classical methods are sometimes severe, and are at the origin of controversies as well as of continuous developments.
In this talk I will present a recently-developed trajectory-based approach to nonadiabatic dynamics [1,2]. The actual numerical scheme has been derived from the exact factorization of the electron-nuclear wavefunction [3], a new framework proposed to investigate, interpret and approximate the coupled dynamics of electrons and nuclei beyond the Born-Oppenheimer approximation. The exact factorization provides a new perspective to analyze nonadiabatic processes: (i) it proposes an alternative [4] to the standard Born-Oppenheimer framework, that pictures excited-state processes in terms of wavepackets moving on and transferring between static potential energy surfaces; (ii) it suggests new interpretations [5] of molecular geometric-phase effects, related to conical intersections; (iii) it provides guidelines for developing simulation algorithms in different [6] nonadiabatic regimes. These points will be discussed during the talk and illustrated on low-dimensional models and molecular systems.

[1] S. K. Min, F. Agostini, I. Tavernelli, E. K. U. Gross, J. Phys. Chem. Lett. 2017, 8, 3048-3055.
[2] S. K. Min, F. Agostini, E. K. U. Gross, Phys. Rev. Lett. 2015, 115, 073001.
[3] A. Abedi, N. T. Maitra, E. K. U. Gross, Phys. Rev. Lett. 2010, 105, 123002.
[4] A. Abedi, F. Agostini, Y. Suzuki, E. K. U. Gross, Phys. Rev. Lett. 2013, 110, 263001.
[5] B. F. E. Curchod, F. Agostini, J. Phys. Chem. Lett. 2017, 8, 831-837.
[6] A. Scherrer, F. Agostini, D. Sebastiani, E. K. U. Gross, R. Vuilleumier, Phys. Rev. X 2017, 7, 031035.

Orateur: Federico Agostini (Laboratoire de Chimie Physique, Université Paris-Sud)

17:00 Density functional, from nuclei to neutron stars 20m

I will present a meta-modeling of the equation of state for the description of nuclear matter, and its application to neutron stars, where the density can reach several times the saturation density of atomic nuclei (the average density of nuclei). This equation of state is based on the extrapolation of our knowledge in nuclear physics around saturation density, towards high density, encoded in terms of a Taylor expansion of the potential energy. The unknown high order parameters of this expansion have a strong impact at high density, and can therefore be constrained by observations of neutron stars. I will illustrate the case of thermal emission from neutron stars and their constrain on the empirical parameter K_{sym} and Q_{sat}.

Orateur: Nicolas Baillot d'Etivaux (IPN Lyon)

II. Workshop on Fonctionnelles de la densité: des systèmes atomiques aux systèmes nucléaires – 3-5 Jun. 2019

(K. Bennaceur, T. Albaret, L. Joly, J. Margueron)

Program – Second day

- **Interdisciplinary aspects of DF-based approaches**
  - 5 nuclear physics
  - 1 quantum chemistry

MARDI, 4 JUIN

09:00 → 12:20 **Morning 04/06**

Président de session: Tristan Albaret (ILM, Université Lyon 1)

09:00 Time-dependent DFT: Foundations, Fruition and Failures — 50m

I attempt to review the present state of time-dependent density functional theory (TDDFT) [1,2] applied to electronic systems. After a brief view at the mathematical foundations, I discuss the numerical aspects of the method and provide some illustrative examples of its application. I will also show some of the difficulties that plague TDDFT and how they start to be addressed.

[1] Time-dependent Density-Functional Theory, Carsten A. Ullrich, Oxford University Press,2012.
[2] Time-dependent Density-Functional Theory, MAL Marques and EKU Gross, Annu. Rev. Phys. Chem. 55, 427, (2004)

Orateur: Thomas NIEHAUS (Institut Lumière Matière, Lyon)

09:50 What can we learn from ultracold atoms about dilute neutron matter? — 50m

Orateur: Michael Urban (IPN Orsay)

10:40 Coffee — 30m

11:10 Applications of EDF for astrophysics — 50m

Orateur: Francesca Gulminelli (LPC/Ensicaen)

12:00 General predictions for the neutron star crustal moment of inertia — 20m

The neutron star crustal EoS and transition point properties are computed within a unified meta-modeling approach. A Bayesian approach is employed including two types of filters: bulk nuclear properties are controlled from low density effective field theory (EFT) predictions as well as the present knowledge from nuclear experiments, while the surface energy is adjusted on experimental nuclear masses. Considering these constraints, a quantitative prediction of crustal properties can be reached with controlled confidence intervals and increased precision with respect to previous calculations: $\approx 11\%$ dispersion on the crustal width and $\approx 27\%$ dispersion on the fractional moment of inertia. The crust moment of inertia is also evaluated as a function of the neutron star mass, and predictions for mass and radii are given for different pulsars. The possible crustal origin of Vela pulsar glitches is discussed within the present estimations of crustal entrainment, disfavoring a large entrainment phenomenon if the Vela mass is above $1.4M_{\odot}$. Further refinement of the present predictions requires a better estimation of the high order isovector empirical parameters, e.g. K_{sym} and Q_{sym}, and a better control of the surface properties of extremely neutron rich nuclei.

Orateur: Thomas Carreau (LPC Caen)

12:30 → 13:30 **Lunch**

14:30 → 17:00 **Afternoon 04/06**

Président de session: Prof. Caracas Razvan (ENS Lyon)

14:30 TBA — 50m

Orateur: Andreas Savin (Laboratoire de Chimie Theorique, CNRS at Sorbonne Universite)

15:20 TBA — 20m — Compte-rendu

Orateur: Swagata Mallik Mallik (LPC Caen)

15:40 Coffee — 30m

16:10 Breaking and restoring symmetries in ab initio many-body formalisms — 50m

Orateur: Thomas Duguet (CEA/Saclay/SPhN)

20:00 → 23:00 **Conference diner**

II. Workshop on Fonctionnelles de la densité: des systèmes atomiques aux systèmes nucléaires – 3-5 Jun. 2019

(K. Bennaceur, T. Albaret, L. Joly, J. Margueron)

Program – Third day

- **Interdisciplinary aspects of DF-based approaches**
  - 1 nuclear physics
  - 1 quantum chemistry
  - 1 summary talk

MERCREDI, 5 JUIN

09:00 → 12:10 **Morning 05/06**

Président de session: Jacques MEYER (Institut de Physique Nucléaire de Lyon)

09:00 **Modeling reactivity at the solid-liquid interface** 50m

To describe reactions occurring at the solid/water interface is currently one of the major challenges in modeling in Heterogeneous Catalysis. It requires a proper depiction of the water solvent together with an adequate description of the surface state. Several approaches are available nowadays in the literature, from continuum models to a full explicit description of the liquid water [1]. We have recently shown that continuum models are key to a proper description of reactions occurring at the electrochemical interface on the formic acid oxidation into CO2 [2]. They also open the door to a proper inclusion of the effect of co-adsorbed anions in thermal heterogeneous catalysis [3]. In both cases, charges are involved and the electrostatic contribution in the major one. When H-bonding between the liquid water and the reactant or intermediate is crucial, continuum models are not sufficient and an explicit inclusion of water molecule is a necessity. As a first step, micro-solvation can be an effective approach that allowed us to interpret solvent effect in the conversion of levulinic acid into γ-valerolactone [4]. Moving to a full description of reactivity the water/metal interface is still beyond a full complete DFT approach provided the minimal size of the periodic cell that is necessary and the minimal sampling required. A combined QM/MM approach could be a promising strategy [5], but necessitates a new generation of metal/water force field [6]. Nevertheless, being less demanding, inspecting transformations occurring at oxide/water interface is now reachable, as illustrated by our recent work on the stability of γ-alumina in water [7].

References:

[1] M. Saleheen, A. Heyden, ACS Catal. 8, (2018), pp. 2188-2194
[2] S. N. Steinmann, C. Michel, R. Schwiedernoch, J.-S. Filhol, P. Sautet, Chemphyschem, 16 (2015), pp. 2307-2311
[3] P. Wang, S. N. Steinmann, G. Fu, C. Michel, and P. Sautet, ACS Catalysis, 7, (2017), pp. 1955−1959
[4] C. Michel, J. Zaffran, A. M. Ruppert, J. Matras-Michalska, M. Jedrzejczyk, J. Grams, P. Sautet, Chem. Comm. 50 (2014), pp. 12450−12453
[5] S. N. Steinmann, P. Sautet, and C. Michel, Phys Chem Cheml Phys, 18, (2016), pp. 31850−31861
[6] S.N. Steinmann, R. Ferreira De Morais, A. W. Götz, P. Fleurat-Lessard, M. Iannuzzi, P. Sautet, C. Michel, J Comp Theo Chem, submitted, (2018)
[7] R. Réocreux, "Biomass derivatives in heterogeneous catalysis: adsorption, reactivity and support from first principles", PhD thesis, (2017)

Orateur: Carine Michel (Laboratoire de Chimie, Ecole Normale Supérieure de Lyon)

09:50 **Selected interdisciplinary aspects of static and time-dependent nuclear DFT** 50m

Orateur: Denis LACROIX (Institut de Physique Nucléaire)

10:40 **Coffee** 30m

11:10 **Summary talk: On DFT and EDF in finite fermion systems** 1h

Examples in various systems. Statics and dynamics.

Orateur: Eric Suraud (Université Paul Sabatier)

12:30 → 13:30 **Lunch**

II. Workshop on Fonctionnelles de la densité: des systèmes atomiques aux systèmes nucléaires – 3-5 Jun. 2019

(K. Bennaceur, T. Albaret, L. Joly, J. Margueron)

Main points requiring efforts/of potential inter-disciplinary interest

1. **How to best extend DF-based methods to open-shell systems?**

2. **How to expand the nuclear EDF method to make it a systematically improvable method?**

3. **Time-dependent aspects**

4. **How/where to cross benefit from cold atoms/quantum chemistry/condensed matter?**

- ❑ **Excellent feedback from participants**
- ❑ **Interdisciplinary character particularly praised**

Contents

On-going progress in WG3-related topics
– Anchor Nuclear Physics in QCD –

- **Chiral/pionless EFT**
  - **Nuclear effective field theory: Status and perspectives**, *H.-W. Hammer, S. Koenig, U. van Kolck, RMP92 (2020) 025004* (IJCLab)
  - **Baryon-Number Violation by Two Units and the Deuteron Lifetime**, *F. Oosterhof et al., PRL122 (2019) 172501* (IJCLab)
  - **Renormalized approach to neutrinoless double-β decay**, *V. Cirigliano et al.* , *PRC 100 (2019) 055504* (IJCLab)
  - **Renormalization of pionless effective field theory in the A-body sector**, *M. Drissi, T. Duguet, V. Somà, EPJA56 (2020) 119* (DPhN)

- **Cluster/Halo EFT**
  - **Nuclear effective field theory: Status and perspectives**, *H.-W. Hammer, S. Koenig, U. van Kolck, RMP92 (2020) 025004* (IJCLab)
  - **Finite-size effects in heavy halo nuclei from effective field theory**, *E. Ryberg et al., EPJA 56 (2020) 7* (IJCLab)

On-going progress in WG3-related topics
– Exploit the unitarity limit and connection to atomic physics –

- **Fate of the neutron–deuteron virtual state as an Efimov level**, *G.Rupak, A.Vaghani, R.Higa, U. van Kolck PLB 791 (2019) 414* (IJCLab)
- **Four-Body Scale in Universal Few-Boson Systems**, *B. Bazak et al., PRL122 (2019) 143001* (IJCLab)
- **Clustering of Four-Component Unitary Fermions**, *W.G. Dawkins et al., PRL124 (2020) 143402* (IJCLab)
- **Approximate self-energy for Fermi systems with large s-wave scattering length: a step towards density functional theory**, *A. Boulet, D. Lacroix JPG 46 (2019) 105104* (IJCLab)
- **Modeling ^{19}B as a three-body ^{17}B-n-n system in the unitary limit,** *E. Hiyama et al., PRC 100.1 (2019) 011603* (IPHC, IJCLab)

On-going progress in WG3-related topics
– Extend the reach of the *ab initio* methods –

- **Few-body systems**
  - ✪ **Comment on "Is a Trineutron Resonance Lower in Energy than a Tetraneutron Resonance?",** *A. Deltuva, R. Lazauskas, PR123 (2019) 069201* (IPHC)
  - ✪ **Ab initio calculations of ^{5}H resonant states ,** *R. Lazauskas, E. Hiyama, J. Carbonell, PLB 791 (2019) 335*, (IPHC, IJCLab)
  - ✪ **Improved description of light nuclei through chiral effective field theory at leading order** , *M. Sanchez Sanchez et al., PRC102, 024324 (2020)* (CENBG)
  - ✪ **Entanglement Rearrangement in Self-Consistent Nuclear Structure Calculations**, *C. Robin, M. J. Savage and N. Pillet, arXiv:2007.09157* (2020) (DAM)

- **Open-shell systems**
  - ✪ **(P)BMBPT : PhD (2016-2019) Julien Ripoche**, T. Duguet, JP Ebran (DPhN, DAM) **; PhD (2018-2021) Mikael Frosini**, T. Duguet, V.Somà, JP Ebran (DPhN, DAM) ; *A. Tichai et al., PLB 786 (2018) 195 (DPhN); A Tichai, R. Roth, T. Duguet, FP8 164 (2020) (DPhN); P. Demol et al., AP424 168358 (2021) (DPhN); P. Demol et al., PRC 101, 041302 (2020) (DPhN)*
  - ✪ **Particle-number projected Bogoliubov coupled cluster theory. Application to the pairing Hamiltonian** , *Y. Qiu et al., PRC99 (2019) 044301* (DPhN)
  - ✪ **GSCGF :** PhD proposal **Pushing ab initio calculations of atomic nuclei to higher precision**
  - ✪ **HFB (broken parity & SU(2)) + Projection + GCM : PhD (2018-2021) Mikael Frosini**, T.Duguet, V.Somà, JP Ebran (DPhN, DAM)
  - ✪ **QRPA FAM: PhD (2018-2021) Yann Beaujeault-Taudière**, D. Lacroix, T. Duguet, JP Ebran (DAM, DPhN)
  - ✪ **B-IMSRG:** *A. Tichai et al., (in prep.) (DPhN)*
  - ✪ **Equation of Motion Method to strongly correlated Fermi system and extended RPA approaches,** *P. Schuck et. al., under review at Phys. Rept. (IJCLab)*

- **Cost-efficiency**
  - ✪ **Automation of the many-body workflow : ADG (BMBPT)**, *P. Arthuis et al., CPC. 240 (2019) 202* (DPhN, DAM); **ADG (PBMBPT)** *P. Arthuis et al., accepted in CPC.* (DPhN); **Automated symbolic evaluation of SU(2) algebra**, *A. Tichai et al., EPJA56 (2020) 272* (DPhN)
  - ✪ **Importance-Truncation techniques** : A. Tichai, J. Ripoche, T. Duguet, EPJA 55 (2019) 90 (DPhN); **Master Thesis A. Porro**, V. Somà, T. Duguet, A. Tichai (DPhN)
  - ✪ **Symmetry assisted preparation of entangled many-body states on a quantum computer** , *D. Lacroix, PRL125, 230502 (2020)* **+ PhD** (IJCLab)

On-going progress in WG3-related topics

– Extend the reach of the standard shell model –

- **Radial overlap correction to superallowed 0+→0+ β decay reexamined**, *L. Xayavon, N.A. Smirnova, PRC97,024324 (2018)* **PhD (2016) L. Xayavong**, N.A. Smirnova (CENBG)
- **Effective interactions in the sd shell,** *N. A. Smirnova et al., PRC100, 054329 (2019)* (CENBG)

– Understand neutron matter and neutron stars –

- **Soft breathing modes in neutron-rich nuclei with the subtracted second random--phase approximation,** *D. Gambacurta, M. Grasso, O. Sorlin*, PRC 100, 014317 (2019) (IJCLab, GANIL)
- **Beyond-mean-field effects on the symmetry energy and its slope from the low-lying dipole response of 68Ni,** *M. Grasso, D. Gambacurta, PRC 101, 064314 (2020)* (IJCLab)
- **EoS : Constraints on the nuclear symmetry energy from asymmetric-matter calculations with chiral NN and 3N interactions,** *R. Somasundaram, C. Drischler, I. Tews, J. Margueron, arXiv: 2009.04737 (2020), sub. To PRC* (IP2I); **Multimessenger and multiphysics Bayesian inference for the GW170817 binary neutron star merger**, *H. Güven, K. Bozkurt, E. Khan, J. Margueron, ,PRC 102, 015805 (2020)* (IJCLab, IP2I); **New constraints on the nuclear equation of state from the thermal emission of neutron stars in quiescent low-mass X-ray binaries**, *N. Baillot d'Etivaux et al, Astrophys. J. 887, 48 (2019)* (IP2I); **Confronting gravitational-wave observations with modern nuclear physics constraints** , *I. Tews, J. Margueron, S. Reddy, Eur. Phys. J. A. 55, 97 (2019)* (IP2I); **Bayesian analysis of the crust-core transition with a compressible liquid-drop model**, *T. Carreau, F. Gulminelli, J. Margueron, Eur. Phys. J. A 55, 188 (2019)* (LPC, IP2I) …

– Covariant formulation of the nuclear many-body problem –

- **48Si : An atypical nucleus ?,** *J. J. Li, W. Long, J. Margueron, N. Van Giai*, PLB 788, 192 (2019) (IP2I, IJCLab)
- **Contribution of the rho meson and quark substructure to the nuclear spin-orbit potential**, *G. Chanfray, J. Margueron*, PRC 102, 024331 (2020) (IP2I)
- **Reduced spin-orbit splitting in 35Si: Weak binding or density-depletion effect?**, *O. Sorlin, F. de Oliveira Santos, JP Ebran, PLB 809, 135740 (2020)* (GANIL, DAM)
- **Nuclear Clustering: α-particle condensation: A nuclear quantum phase transition**, *JP Ebran et al, PRC 102 014305 (2020)* (DAM, IJCLab); **PhD (2019-2022) Florian Mercier,** E.Khan, JP Ebran : **Low-energy cluster vibrations** arXiv:2007.13358 (2020) under review at PRC; **Microscopic description of the self-conjugate 108Xe and 104Te α-decay chain** PRC **102** 011301(R)

On-going progress in WG3-related topics
– Improve the nuclear EDF method –

- **Functional**
  - **Generalized Gogny Interaction + Gaussian Fit of Chiral Potential PhD (2021-2024) G. Zietek** , N.Pillet , G.Hupin, C.Robin, R.Bernard (DAM, IJCLab)
  - **Interaction nucléaire effective à 3 corps semi-régularisée PhD (2019-2022) Philippe Da Costa** , K.Bennaceur, M. Bender, J. Meyer (IP2I Lyon)
  - **Construction d'une interaction nucléaire effective généralisée et applications à l'astrophysique et aux noyaux lourds PhD (2020-2023) Paul Proust** , M. Bender, D. Davesne (IP2I Lyon)
  - **New energy functional for heavy nuclei ANR Projet Blanc (2020-2023) (NEWFUN)** M. Bender (IP2I Lyon)
- **HFB Solver**
  - **Approximation de Hartree-Fock pour les noyaux déformés avec un potentiel général à 2-corps et corrélations d'appariement avec une interaction résiduelle cohérente, PhD (2016-2019) Dao Duy Duc**, L. Bonneau APPB Proc. Suppl. 13, 405 (2020) (CENBG)
  - **HFB3 : broken parity axial 2-center HO basis HFB solver**, N. Dubray, JP Ebran, A. Zdeb, N. Pillet (DAM)
- **Post-HFB**
  - **Gamow-Teller Strength in 48Ca and 78Ni with the Charge-Exchange Subtracted Second Random-Phase Approximation** , *D. Gambacurta, M. Grasso, and J. Engel, PRL125, 212501 (2020)* (IJCLab)
- **EFT-driven EDF**
  - **Towards a power counting in nuclear EDF theories through a perturbative analysis,** *S. Burrello, M. Grasso, C.J. Yang, PLB 811, 135938 (2020)* (IJCLab)
  - **Lee-Yang–inspired EDF including contributions from p-wave scattering** , *J.Bonnard, M.Grasso, D.Lacroix*, PRC 101 (2020) 064319 (IJCLab)
  - **Approximate self-energy for Fermi systems with large s-wave scattering length: a step towards density functional theory** , *A. Boulet, D. Lacroix JPG 46 (2019) 105104* (IJCLab)
  - **EDF from the Effective Action Formalism and the Functional Renormalization Group PhD (2018-2021) K. Fraboulet** , E. Khan, JP Ebran (DAM)

Contents

Interdisciplinary workshop GDR NBODY (QC) & GDR RESANET (NP)

T. Duguet, E. Giner, P.-F. Loos, J. Toulouse

Ab initio quantum computational methods

February 8th – 12th online (originally planned in 2020)

- **Scheme**
  - Two 1h30 talks per afternoon
  - Same topic
  - 1 QC talk + 1 NP talk
- **Discussion towards explicit collaborations**

Official announce very soon

- **Day 1 : General introduction and panorama**
- **Day 2 : Computational aspects specific to each domain**
- **Day 3 : Importance-selected wave-function methods**
- **Day 4 : Quantum Monte-Carlo methods**
- **Day 5 : Tensor factorisation approximation methods**

Two envisioned workshops

- **Workshop on nuclear reaction theory**
  - Guillaume Hupin, Guillaume Blanchon

- **Workshop on neutrino-less double-beta decay?**
  - Possible connection with the GDR DUP (Deep Underground Physics)
  - Frederic Nowacki (member of DUP), Bira van Kolck…

Other ideas, in particular for inter-WG activities, are welcome

Contents

Inputs from colleagues regarding topics of discussion

- **O. Sorlin**
  - French experimental community working on drip-line physics (cluster, halo, shell evolution, multi-nucleons…) strong and visible
  - Theoretical community working on this topic small (decreasing): is there a way to deal with it?
- **W. Korten**
  - State of the art data from French experimental on collectivity (70,72Kr, 110Ru, or 100,110Zr (to be coming))
  - Theoretical community working on this topic decreasing but strong need to advance GCM (Bohr H) to triaxial nuclei
- **P. Arthuis**
  - Strong connection between recent ab initio and empirical EDF/shell model: possible transfer back?
  - ab initio lacks visibility from experimental community whereas now highly competitive in many respects: need for better advertising?
  - French ab initio community small (compared to American or German groups): better mutualization of efforts/tools through meetings?
  - Connection between QC and NP fruitful at the international level: opportunity for such a connection at the national level?