Mathematical Physics Seminar

Winter Semester 2021/2022. Fridays / Wednesdays.

- Zoom links for online talks will be sent by e-mail.
- Zoom links for online talks of the Cracow-Poznań-Warsaw talks are also available `https://www.fuw.edu.pl/~exact/`
  shortly before a talk.

15.10.2021

- 15:00. Abhishek Goswami (AMU) *Cluster expansions.*
  [On site group meeting, B1-7/8]

- 17:00. Błażej Ruba (UJ) *Holomorphic family of Dirac-Coulomb Hamiltonians.*
  [Online, joint talk with UW and UJ]

> It is a classic fact that the Dirac Hamiltonian with Coulomb potential is essentially self-adjoint only for atomic numbers Z up to 118. In the range 119< Z < 137 essential self-adjointness is lost, but physically distinguished self-adjoint extensions exist. I will discuss how these issues can be understood by constructing a holomorphic family of Dirac-Coulomb operators. These operators depend on charge and angular momentum parameters (both allowed to be complex) and a boundary condition at the origin. Their spectral properties will be described. Another perspective on the problem of self-adjoint extensions is offered by the analysis of scaling action. With mass parameter put to zero, one obtains formally homogeneous differential operators, whose domains of self-adjointness are acted upon by the scaling group. Distinguished extensions are the infrared attractive fixed points, while for Z above 137 the scaling action becomes periodic. If time permits, I will also review separation of variables for Dirac Hamiltonian in any dimension.

22.10.2021 15:00 Group meeting cancelled.

29.10.2021 15:00

- 14:00 Nick Manton, (DAMTP, Cambridge) *Skyrmions, Topology and Instantons*
  [Online, joint talk with UW and UJ]

> Skyrmions are solitons in three space dimensions, constructed from a nonlinear pion field. I will discuss their basic properties, including their topological stability, and show examples. Instantons are solitons in four space dimensions, constructed from an SU(2) gauge field. I will show how Skyrmions can be approximated in terms of exact instantons, and instantons can be approximated in terms of exact Skyrmions.

- 15:30 Azam Jahandideh (AMU) *Diagrams of* Φ_3^4.
  [On site group meeting, B1-7/8]

05.11.2021 15:00 Janik Kruse (AMU) *Haag-Ruelle scattering theory.*
[On site group meeting, B1-7/8]

12.11.2021 15:00 Bartosz Biadasiewicz (AMU) *Infravacuum.*
[On site group meeting, B1-7/8]

17.11.2021 (Wed) 16:00 Krzysztof Pawałowski (AMU) *Smooth structures on n-dimensional spheres. Part I.* [**Online** group meeting]

19.11.2021 (Fri) 17:00 Yoh Tanimoto (Rome "Tor Vergata") *Unitary modules and conformal nets associated with the W_3-algebra with $c \geq 2$.*
[Online, joint talk with UW and UJ]

> The W_3-algebra is a higher spin extension of the Virasoro algebra. We construct a conformal net associated with each of the vacuum modules of the W_3 algebra. We show the strong locality of fields by a new technique involving local energy bounds.

(Based on `https://arxiv.org/abs/2103.16475`).

24.11.2021 (Wed) 15:00 Krzysztof Pawałowski (AMU) *Smooth structures on n-dimensional spheres. Part II.* [**Online** group meeting.]

26.11.2021 (Fri) 14:15 Bogdan Damski (IFT UJ) *Angular momentum of the electron in covariantly quantized electrodynamics.* [Online, joint talk with UW and UJ.]

> I will start the talk with a brief discussion of not-so-intuitive expressions for angular momentum operators of the covariantly quantized electromagnetic field. I will then discuss radiative corrections to various components of angular momentum of the electron (e.g. spin and orbital components associated with fermionic and electromagnetic degrees of freedom). The reported results come from one-loop calculations performed in the general covariant gauge. Technical aspects of these studies, such as a not-so-obvious Pauli-Villars-like regularization of the calculations, will be commented upon.

08.12.2021 (Wed) 10:30 Krzysztof Pawałowski (AMU) *Smooth structures on the 4-dimensional Euclidean space. Part I.*
[**Online** group meeting.]

08.12.2021 (Wed) 15:00 Paweł Duch (AMU) *Existence of solutions of singular stochastic differential equations.*
[**Online** group meeting.]

15.12.2021 (Wed) 10:30 Krzysztof Pawałowski (AMU) *Smooth structures on the 4-dimensional Euclidean space. Part II.*
[**Online** group meeting.]

15.12.2021 (Wed) 15:00 Abhishek Goswami (AMU) *Balaban's renormalization group approach to Non-Linear Sigma models - I.*
[On site group meeting, **room B1-38**.]

22.12.2021 (Wed) 10:30 Krzysztof Pawałowski (AMU) *Smooth structures on non-compact 4-dimensional manifolds.*
[**Online** group meeting.]

22.12.2021 (Wed) 15:00 Azam Jahandideh (AMU) *Stochastic quantization.*
[**Online** group meeting.]

12.01.2022 (Wed) 15:00 Janik Kruse (AMU) *Haag-Ruelle scattering theory II.*
[**Online** group meeting.]

19.01.2022 (Wed) 15:00 Bartosz Biadasiewicz (AMU) *Infravacuum II.*
[**Online** group meeting.]

21.01.2022 (Fri) 14:15 Alexander Stottmeister (Univ. Hannover) *Towards the quantum scaling limit of the Ising model.* [Online, joint talk with UJ and UW]

> I will discuss how the scaling limit of the two-dimensional Ising model in its 1+1-dimensional incarnation, the transverse-field Ising chain, can be constructed by operator-algebraic renormalization. In this respect, I will point out some open questions concerning the convergence of the order parameter. As an application, I will explain out how this construction entails a quantum simulation algorithm for the Ising CFT.

26.01.2022 (Wed) 15:00 Wojciech Dybalski (AMU) *Chatterjee approach to non-linear sigma models.*
[**Online** group meeting.]

For the above talk cf. S. Chatterjee, *The leading term of the Yang-Mills free energy* J. Funct. Anal. 15, 2944–3005 (2016) `https://arxiv.org/pdf/1602.01222.pdf`.

28.01.2022 (Fri) 17:00 Jonathan Stanfill (Baylor University) *Spectral zeta functions and zeta regularized functional determinants for singular Sturm-Liouville operators.* [Online, joint talk with UJ and UW]

02.02.2022 (Wed) 10:30 Abhishek Goswami (AMU) *Variational problem in renormalization group method for non-linear sigma models I.*
[**Hybrid** group meeting. (Transmitted blackboard talk).]

02.02.2022 (Wed) 15:00 Abhishek Goswami (AMU) *Variational problem in renormalization group method for non-linear sigma models II.*
[**Hybrid** group meeting.]

For the above two talks cf. T. Bałaban, *The Variational Problem and Background Fields in Renormalization Group Method for Lattice Gauge Theories* Commun. Math. Phys. 102, 277–309 (1985) https://deepblue.lib.umich.edu/bitstream/handle/2027.42/46461/220_2005_Article_BF01229381.pdf?sequence=1

04.02.2022 (Fri) Joint Online Colloquium with Dirk Deckert (LMU), Felix Finster (Univ. Regensburg) and Peter Pickl (Univ. Tübingen). Program: https://www.mathematik.uni-muenchen.de/~deckert/events/ws2122_colloquium_mfqm.php.

09.02.2022 (Wed) 10:30 Abhishek Goswami (AMU) *Variational problem in renormalization group method for non-linear sigma models III.*
[**Online** group meeting.]

09.02.2022 (Wed) 15:00 Abhishek Goswami (AMU) *Variational problem in renormalization group method for non-linear sigma models IV.*
[**Online** group meeting.]