

Seminar Partial Differential Equations
by dr hab. Anna Ochal & prof. dr hab. Piotr Zgliczynski
winter semester 2021-2022, Tuesday, 12:15-13:45

October 5, 2021

Jarosław Duda, Exploring resemblance between liquid crystals topological defects and particle physics

Abstract: There are experimentally observed long-range e.g. Coulomb-like interactions for topological defects in liquid crystals, suggesting investigation how far can we take this resemblance with particle physics. I will discuss postulating skyrmion-like Lagrangian to get electromagnetism for their effective dynamics, interpreting filed curvature as electric field - making Gauss law count (quantized) topological charge. For biaxial nematic - with 3 distinguished axes, hedgehogs of one of 3 axes are different mass realizations of the same topological charge - resembling 3 leptons. Further baryon-like topological structures require charge, which has to be compensated for neutron - suggesting why it is heavier than proton.

Slajdy:

<https://www.dropbox.com/s/9dl2g9lypzqu5hp/liquid%20crystal%20particles.pdf>

October 12, 19, 26, Decemmmber 14, 2021

Robert Szczelina, Instablility of Turing Patterns in Reaction-Diffusion-ODE Systems

Based on the paper of the same title: Marciniak-Czochra, A., Karch, G. & Suzuki, K. J. Math. Biol. 74, 583–618 (2017).

<https://doi.org/10.1007/s00285-016-1035-z>

November 2, 2021

Anna Gierzkiewicz-Pieniazek, O spektralnych kryteriach niestabilnosci

November 9, 16, 23, 30, December 7, 2021

Piotr Zgliczynski, Kryterium niestabilnosci oparte na spektrum linearyzacji

Abstract: Niech $u' = Lu + F(u)$ bedzie taki ze $F(0)=0$ i L jest liniowe definiujace silnie ciagla podgrupe. Jesli spectrum L przecina $\Re\lambda > 0$ to przy pewnych zalozeniach o F , 0 jest niestabilne.

Na podstawie pracy: J. Shatah and W. Strauss, Sectral condition for instability, Contemporary Mathematics, vol. 255 (2000), 189–198.

December 21, 2021, January 4, 2022

Nikodem Szyszka, Nieciągła metoda Galerkina

Abstract: W trakcie referatu przedstawiona zostanie idea nieciągłej metody Galerkina, działanie metody oraz aproksymacja błędu na przykładzie równania $u_t + \operatorname{div} F(u) = g$

Na podstawie:

- Feistauer, M., Kučera, V., Najzar, K., & Prokopová, J. (2011). Analysis of space–time discontinuous Galerkin method for nonlinear convection–diffusion problems. *Numerische Mathematik*, 117(2), 251–288.
- Cockburn, B., Karniadakis, G. E., & Shu, C. W. (Eds.). (2012). Discontinuous Galerkin methods: theory, computation and applications (Vol. 11). Springer Science & Business Media.

January 11, 18, 25, 2022

Jacek Kubica, Stability in partial differential equations

Abstract: We will discuss various methods of proving stability and instability in partial differential equations of the form $u' = Lu + F(u)$, where L is linear and F is formally $O(u^2)$. Examples will include the orbital stability of peakons in Kamassa-Holmes equation, Rayleigh's and Arnold criteria for the Euler incompressible equations and an application of the spectral methods to the Boussinesq equation.

Talk will be based on W. Strauss tutorial notes on nonlinear stability:
http://depts.washington.edu/bdecon/workshop2012/g_stability.pdf