Universität Basel

Research Project

Critical and Super-Critical Half-Wave Maps

Third-party funded project

Project title Critical and Super-Critical Half-Wave Maps
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Organisation / Research unit
Departement Mathematik und Informatik / Analysis (Lenzmann)
Department
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This proposal presents a research program for the half-wave maps equation, which is a novel class of geometric evolution equations with nonlocal dispersion. The half-wave maps equation arises as a universal model for the effective dynamics of systems describing spin chains with critical long-range interactions. In one space dimension (which is stronlgy relevant to physical applications), the half-wave maps equation possesses ăsimultaneously ăthe remarkable features of energy-criticality, conformal invariance of the energy, and explicitly known (static and traveling) solitary waves indexed by a topological degree. The present proposal sets forth work concerning well-posedness of the Cauchy problem, stability of solitary waves, possible singularity formation (blowup), as well as the rigorous derivation of the half-wave maps equation from microscopic models. Furthermore, possible connections of the energy-critical half-wave maps equation to the completely integrable spin chain systems of Haldane-Shastry and Calogero-Moser-Sutherland are planned to be explored.

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In recent years, the area of geometric dispersive PDEs has seen fundamental breakthroughs concerning optimal well-posedness and the analytic insight into singularity formation. Compared to the landmark models, i.e. the wave maps and Schrödinger maps equations, the half-wave maps equation exhibits new intriguing phenomena, which come with strong motivations from physics (completely integrable spin chains) and differential geometry (conformal invariance). In view of this, the study of half-wave maps offers a natural field for future contributions to state-of-the-art research ăof geometric PDEs. The work proposed below is planned for a total duration of 36 months. More specifically, the proposed project is supposed to involve the funding of one PhD position (Lars Bugiera) for 24 months (in the first two years of the project), as well as one post-doctoral position for 24 months (in the last two years of the project). Moreover, the applicant plans to collaborate with a list of internationally established researchers named below. In recent years, the area of geometric dispersive PDEs has seen fundamental breakthroughs concerning optimal well-posedness and the analytic insight into singularity formation. Compared to the landmark models, i.e. the wave maps and Schrödinger maps equations, the half-wave maps equation exhibits new intriguing phenomena, which come with strong motivations from physics (completely integrable spin chains) and differential geometry (conformal invariance). In view of this, the study of half-wave maps offers a natural field for future contributions to state-of-the-art research ăof geometric PDEs. The work proposed below is planned for a total duration of 36 months. More specifically, the proposed project is supposed to involve the funding of one PhD position (Lars Bugiera) for 24 months (in the first two years of the project), as well as one post-doctoral position for 24 months (in the last two years of the project). Moreover, the applicant plans to collaborate with a list of internationally established researchers named below.

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