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Closed and exact functions in interacting particle systems

Statistical physics has developed a whole variety of interacting particle systems to explain the transition from microscopic to macroscopic scale. One of the main difficulties in finding the scaling limit of a nongradient particle system is to make rigorous sense of the fluctuation-dissipation equations. As has been shown by Varadhan, the fluctuation-dissipation equation is equivalent to a certain direct sum decomposition of a Hilbert space. For a general vector field we exhibit two Hilbert spaces, namely the space of so called "closed functions" and the space of "exact functions" and we calculate the codimension of the space of "exact functions" inside the space of "closed functions". In particular we provide a new approach based on Fourier analysis for the two known cases, the Glauber field and the second-order Ginzburg–Landau field, and we provide a solution for a new case, the fourth-order Ginzburg–Landau field.

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