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Nonlinear Wave Equations

Walter A. Strauss



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Nonlinear Wave Equations Cbms Regional Conference Series In Mathematics

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Nonlinear Wave Equations Cbms Regional Conference Series In Mathematics:

Nonlinear Wave Equations Walter A. Strauss, 1990-01-12 The theory of nonlinear wave equations in the absence of shocks began in the 1960s Despite a great deal of recent activity in this area some major issues remain unsolved such as sharp conditions for the global existence of solutions with arbitrary initial data and the global phase portrait in the presence of periodic solutions and traveling waves This book based on lectures presented by the author at George Mason University in January 1989 seeks to present the sharpest results to date in this area The author surveys the fundamental qualitative properties of the solutions of nonlinear wave equations in the absence of boundaries and shocks These properties include the existence and regularity of global solutions strong and weak singularities asymptotic properties scattering theory and stability of solitary waves Wave equations of hyperbolic Schrodinger and KdV type are discussed as well as the Yang Mills and the Vlasov Maxwell equations The book offers readers a broad overview of the field and an understanding of the most recent developments as well as the status of some important unsolved problems Intended for mathematicians and physicists interested in nonlinear waves this book would be suitable as the basis for an advanced graduate level course *Lectures on the Energy Critical Nonlinear Wave Equation* Carlos E. Kenig, 2015

Harmonic Analysis and Partial Differential Equations Michael Ruzhansky, Jens Wirth, 2023-03-06 This book collects papers related to the session Harmonic Analysis and Partial Differential Equations held at the 13th International ISAAC Congress in Ghent and provides an overview on recent trends and advances in the interplay between harmonic analysis and partial differential equations The book can serve as a useful source of information for mathematicians scientists and engineers The volume contains contributions of authors from a variety of countries on a wide range of active research areas covering different aspects of partial differential equations interacting with harmonic analysis and provides a state of the art overview over ongoing research in the field It shows original research in full detail allowing researchers as well as students to grasp new aspects and broaden their understanding of the area

Invariant Manifolds and Dispersive Hamiltonian Evolution Equations Kenji Nakanishi, Wilhelm Schlag, 2011 The notion of an invariant manifold arises naturally in the asymptotic stability analysis of stationary or standing wave solutions of unstable dispersive Hamiltonian evolution equations such as the focusing semilinear Klein Gordon and Schrodinger equations This is due to the fact that the linearized operators about such special solutions typically exhibit negative eigenvalues a single one for the ground state which lead to exponential instability of the linearized flow and allows for ideas from hyperbolic dynamics to enter One of the main results proved here for energy subcritical equations is that the center stable manifold associated with the ground state appears as a hyper surface which separates a region of finite time blowup in forward time from one which exhibits global existence and scattering to zero in forward time The authors entire analysis takes place in the energy topology and the conserved energy can exceed the ground state energy only by a small amount This monograph is based on recent research by the authors The proofs rely on an interplay between

the variational structure of the ground states and the nonlinear hyperbolic dynamics near these states A key element in the proof is a virial type argument excluding almost homoclinic orbits originating near the ground states and returning to them possibly after a long excursion These lectures are suitable for graduate students and researchers in partial differential equations and mathematical physics For the cubic Klein Gordon equation in three dimensions all details are provided including the derivation of Strichartz estimates for the free equation and the concentration compactness argument leading to scattering due to Kenig and Merle

Nonlinear Dirac Equation: Spectral Stability of Solitary Waves Nabile Boussaïd, Andrew Comech, 2019-11-21 This monograph gives a comprehensive treatment of spectral linear stability of weakly relativistic solitary waves in the nonlinear Dirac equation It turns out that the instability is not an intrinsic property of the Dirac equation that is only resolved in the framework of the second quantization with the Dirac sea hypothesis Whereas general results about the Dirac Maxwell and similar equations are not yet available we can consider the Dirac equation with scalar self interaction the model first introduced in 1938 In this book we show that in particular cases solitary waves in this model may be spectrally stable no linear instability This result is the first step towards proving asymptotic stability of solitary waves The book presents the necessary overview of the functional analysis spectral theory and the existence and linear stability of solitary waves of the nonlinear Schrödinger equation It also presents the necessary tools such as the limiting absorption principle and the Carleman estimates in the form applicable to the Dirac operator and proves the general form of the Dirac Pauli theorem All of these results are used to prove the spectral stability of weakly relativistic solitary wave solutions of the nonlinear Dirac equation

New Trends in the Theory of Hyperbolic Equations Michael Reissig, Bert-Wolfgang Schulze, 2006-03-21 Presenting several developments in the theory of hyperbolic equations this book's contributions deal with questions of low regularity critical growth ill posedness decay estimates for solutions of different nonlinear hyperbolic models and introduce new approaches based on microlocal methods

Lectures on Non-linear Wave Equations Christopher Donald Sogge, 2008 Presents an account of the basic facts concerning the linear wave equation and the methods from harmonic analysis that are necessary when studying nonlinear hyperbolic differential equations This book examines quasilinear equations with small data where the Klainerman Sobolev inequalities and weighted space time estimates are introduced

Hamiltonian Dynamical Systems and Applications Walter Craig, 2008-02-17 This volume is the collected and extended notes from the lectures on Hamiltonian dynamical systems and their applications that were given at the NATO Advanced Study Institute in Montreal in 2007 Many aspects of the modern theory of the subject were covered at this event including low dimensional problems Applications are also presented to several important areas of research including problems in classical mechanics continuum mechanics and partial differential equations

Nonlinear Dispersive Equations Terence Tao, 2006 Starting only with a basic knowledge of graduate real analysis and Fourier analysis the text first presents basic nonlinear tools such as the bootstrap method and perturbation theory in the simpler context of nonlinear ODE

then introduces the harmonic analysis and geometric tools used to control linear dispersive PDE. These methods are then combined to study four model nonlinear dispersive equations. Through extensive exercises, diagrams and informal discussion, the book gives a rigorous theoretical treatment of the material, the real world intuition and heuristics that underlie the subject, as well as mentioning connections with other areas of PDE, harmonic analysis and dynamical systems. **CBMS-NSF Regional Conference Series in Applied Mathematics**, 1977. *Notices of the American Mathematical Society*, American Mathematical Society, 1994. **Boletim da Sociedade Paranaense de Matemática**, 2004. **Bulletin of the Belgian Mathematical Society, Simon Stevin**, 1996. **Indiana University Mathematics Journal**, Indiana University Department of Mathematics, 2001. **Proceedings**, 2006. *Proceedings A* publishes refereed research papers in the mathematical, physical and engineering sciences. The emphasis is on new emerging areas of interdisciplinary and multidisciplinary research. *Continues Proceedings Mathematical and physical sciences*. **Dispersive Nonlinear Problems in Mathematical Physics**, Piero D'Ancona, Vladimir Georgev, 2005. **Bulletin (new Series) of the American Mathematical Society**, 2008. **Nonlinearity**, 2008-05. *Discrete and Continuous Dynamical Systems*, 2008. **Mathematical Reviews**, 2008.

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