The list below contains several papers on topics of relevance to our course. In consultation with me if you wish, please choose a paper from this list (or find another relevant paper — this list is by no means exhaustive). Each of you will have the opportunity to give a 35-minute mini-lecture to our class on the subject of the paper you choose to read. We will have these mini-lectures on Thursday, April 6 (2 presentations), Tuesday, April 11 (2 presentations), Thursday, April 13 (2 presentations), and Tuesday, April 18 (1 presentation). Note: if you choose a paper that we have talked about in class, you should be prepared to present to the class aspects of the paper that were not already discussed.

Don’t be afraid to select a lengthy paper, or another textbook on the subject: you can concentrate on just a small part of the paper/book for your presentation.

Classic papers.


Specific applications.


- Water waves. Here there are many, many papers. The integrable equations that describe water waves in various limits are many: Korteweg-de Vries equation, Boussinesq equation, Camassa-Holm equation, Kadomtsev-Petviashvili equation, nonlinear Schrödinger equation, Davey-Stewartson equation, Benjamin-Ono equation, intermediate long-wave equation, etc. A paper on any of these equations would be appropriate. Also, consider the following provocatively-titled paper: A. I. Dyachenko and V. E. Zakharov, “Is free-surface hydrodynamics an integrable system?”, *Phys. Lett. A*, 190, pp. 144–148, 1994.


- An integrable equation arising in the theory of general relativity is the Ernst equation. As a start, see C. Klein and O. Richter, “Riemann-Hilbert problems for the Ernst equation and fibre bundles”, *J. Geom. Phys.*, 30, pp. 331–342, 1999. References therein may also be useful.
• Applications of the sine-Gordon equation:

**Mathematical aspects.**

• Scattering and inverse-scattering theory.


• Algebraic geometry.

• Asymptotics for integrable nonlinear waves.

• Orthogonal polynomials.

• Random matrix theory.


Other integrable systems.


• Toda lattice. Many interesting papers.


• Intermediate long-wave equation.

• Benjamin-Ono equation.

• Davey-Stewartson equation (a two-dimensional version of NLS).

• Camassa-Holm equation.

• Boussinesq equation.


• 3-wave interaction system. See the text by Ablowitz and Clarkson, or E. V. Doktorov, “Spectral transform and solitons for the three-wave coupling model with nontrivial boundary conditions”, *J. Math. Phys.*, 38, pp. 1–13, 1997.

**Survey papers.**

  – J. D. Gibbon, “A survey of the origins and physical importance of soliton equations”.
  – J. B. Keller, “Soliton generation and nonlinear wave propagation”.
  – P. van Moerbeke, “Algebraic geometrical methods in Hamiltonian mechanics”.
  – G. Wilson, “Infinite-dimensional Lie groups and algebraic geometry in soliton theory”.
  – N. M. Ercolani and H. Flaschka, “The geometry of the Hill equation and of the Neumann system”.
  – A. C. Scott, “Davydov solitons in polypeptides”.
  – L. F. Mollenauer, “Solitons in optical fibers and the soliton laser”.
  – R. S. Ward, “Integrable and solvable systems, and relations among them”.
  – M. Atiyah and N. J. Hitchin, “Low-energy scattering of non-Abelian magnetic monopoles”.

**Textbooks.**


