Contribution ID: **30** Type: **20 Min Talk**

The role of radiation in Toda chain hydrodynamics

From a many-body perspective, classical integrable systems fall into two broad categories: fluids and chains. The former are particle-based and their hydrodynamics closely mirrors that of quantum models. Chain systems, on the other hand, behave like integrable wave equations, with their long-time dynamics separating into solitons and dispersive radiation. While soliton gases are relatively well understood, they generally don' t represent thermodynamic ensembles, and the role of radiation in GGEs remains an open question.

We focus on the Toda chain, whose inverse scattering spectrum includes both a solitonic mode and radiation. Using tools from random matrix theory, we compute average scattering data for random initial conditions. Radiation appears in generic GGEs, paving the way toward a coupled soliton–radiation hydrodynamic description.

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Session Classification: Participants Talks