



中央研究院數學研究所
Institute of Mathematics
Academia Sinica

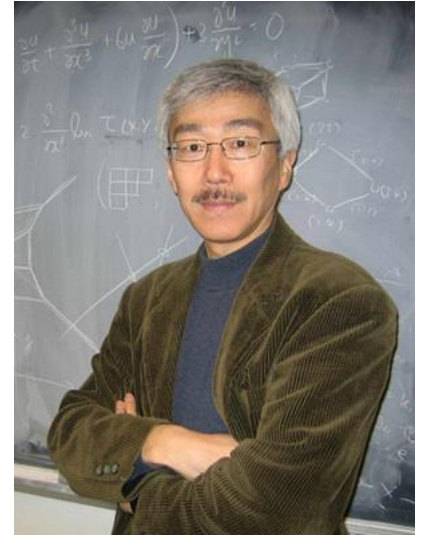
國立台灣大學數學系
Department of Mathematics
National Taiwan University



Lakeside Lectures

Speaker: Prof. Yuji Kodama
(Ohio State University)

Title: Combinatorics and geometry of KP solitons
and applications to tsunami



Abstract: Let $Gr(N, M)$ be the real Grassmann variety defined by the set of all N -dimensional subspaces of R^M . Each point on $Gr(N, M)$ can be represented by an $N \times M$ matrix A of rank N . If all the $N \times N$ minors of A are nonnegative, the set of all points associated with those matrices forms the totally nonnegative part of the Grassmannian, denoted by $Gr(N, M)^{+}$. In this talk, I start to give a realization of $Gr(N, M)^{+}$ in terms of the (regular) soliton solutions of the KP (Kadomtsev-Petviashvili) equation which is a two-dimensional extension of the KdV equation. The KP equation describes small amplitude and long waves on a surface of shallow water. I then construct a cellular decomposition of $Gr(N, M)^{+}$ with the asymptotic form of the soliton solutions. This leads to a classification theorem of all solitons solutions of the KP equation, showing that each soliton solution is uniquely parametrized by a derangement of the symmetric group S_M . Each derangement defines a combinatorial object called the Le-diagram (a Young diagram with zeros in particular boxes). Then I show that the Le-diagram provides a complete classification of the "entire" spatial patterns of the soliton solutions coming from the $Gr(N, M)^{+}$ for asymptotic values of the time. I will also present some movies of real experiments of shallow water waves which represent some of those solutions obtained in the classification problem. Finally I will discuss an application of those results to analyze the Tohoku-tsunami on March 2011. The talk is elementary, and shows interesting connections among combinatorics, geometry and integrable systems.

Date: Mar 16th, 2015

Time: 14:00-15:00

Venue: Room 202, Astro-Math Building

Refreshment: 13:30-14:00

Organizers: Chin-Yu Hsiao, Mao-Pei Tsu, Fu-Tsun Wei, Jeng-Daw Yu

