University of Colorado Colorado Springs

Math Colloquium Series

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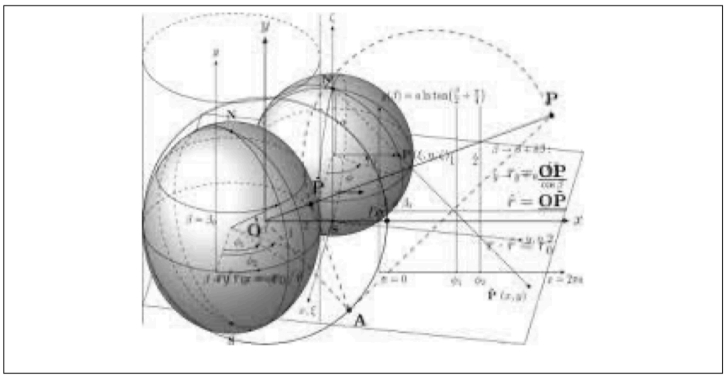

DATE:
NOVEMBER 4, 2021

TIME:
12:30PM-1:30PM

Conformal Mappings and Integrability of Surface Dynamics

Abstract:

A Hamiltonian formulation of the time dependent potential flow of ideal incompressible fluid with a free surface is considered in two dimensional geometry. It is well known that the dynamics of small to moderate amplitudes of surface perturbations can be reformulated in terms of the canonical Hamiltonian structure for the surface elevation and Dirichlet boundary condition of the velocity potential. Arbitrary large perturbations can be efficiently characterized through a time-dependent conformal mapping of a fluid domain into the lower complex half-plane. We reformulate the exact Eulerian dynamics through a non-canonical nonlocal Hamiltonian system for the pair of new conformal variables. The corresponding non-canonical Poisson bracket is non-degenerate, i.e. it does not have any Casimir invariant. Any two functionals of the conformal mapping commute with respect to the Poisson bracket. We also consider a generalized hydrodynamics for two components of superfluid Helium which has the same non-canonical Hamiltonian structure. In both cases the fluid dynamics is fully characterized by the complex singularities in the upper complex half-plane of the conformal map and the complex velocity. Analytical continuation through the branch cuts generically results in the Riemann surface with infinite number of sheets. An infinite family of solutions with moving poles are found on the Riemann surface. Residues of poles are the constants of motion. These constants commute with each other in the sense of underlying non-canonical Hamiltonian dynamics which provides an argument in support of the conjecture of complete Hamiltonian integrability of surface dynamics.

LOCATION:

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