ABSTACT

March 13 (Monday): *plasma physics*

R. L. Dewar, *Plasma physics for fusion --- finding our way on the green side of the nuclear valley*
Negotiating the path to fusion power requires understanding and controlling a very complex system: a plasma sustaining an enormous thermal gradient that drives many emergent nonlinear phenomena through a variety of self-organization mechanisms. After a very brief overview of the magnetic confinement approach to plasma confinement, some theoretical approaches to understanding and modelling these phenomena will be reviewed.

H. Yamada, *Remarks on pronounced non-linear characteristics of transport in fusion plasmas*
The goal of study on fusion plasma is to harness fusion energy. In this regard, reliable prediction of a number is demanded, however, non-linearity in fusion plasmas with the temperature beyond 100 million degrees makes this very challenging. This talk highlights non-linear characteristics of transport identified in experiments and discusses perspective towards prediction from post-diction.

Y. Todo, *Energetic particles in plasmas*
Plasmas, both laboratory fusion plasmas and space/astrophysical plasmas, often contain energetic (=suprathermal) particles in addition to thermal ions and electrons. A short overview of energetic particles is presented in this seminar to explain why energetic particles are important and scientifically interesting from the viewpoint of wave-particle interaction.

Z. Yoshida, *Topological constraints generating structures*
Topological constraints are the key to an understanding of how a macrosystem can be different from the simple sum of microelements. The emergence of a macrostructure is a reflection of reduced degrees of freedom, because the realization of all degrees of freedom, on an equal footing, maximizes the entropy and eliminates any inhomogeneity. Here, we formulate topological constraints as foliation of the phase space. A macrohierarchy is, then, a leaf (submanifold) embedded in the total phase space.

March 14 (Tuesday): *fluid mechanics*

M. Hieber, *Mathematical analysis of various geophysical flow*
In this talk, we discuss various models arising in geophysical fluid dynamics, such as the primitive equations of ocean or atmospheric dynamics or the Navier-Stokes-Coriolis equations. We develop a framework, which, in the case of the primitive equations, allows us to deduce global well-posedness results for arbitrary large data belonging to certain classes of function spaces. In addition, we discuss the long-time behavior of strong solutions, as well as the situation of periodic solutions subject to large forces.

M. Hirota, *Hydrodynamic stability analysis in terms of action-angle variables*
In this talk, the concept of action-angle variables in the classical mechanics is revisited and generalized to hydrodynamic waves, where the continuous spectrum in shear flow requires a Laplace-transform analysis. The signs of action variables (called Krein signatures) are informative for predicting onsets of instabilities and deriving new stability criteria.

K. Nakayama, *Local flow geometry of a vortex and associated physical features and quantities*
Local flow geometry derived from the velocity gradient tensor and associated physical feature such as pressure minimum and vortex stretching are discussed. Swirlity, sourcity and flow symmetry quantities specify the detail flow geometry and these features, and they are important quantities for development of a vortex. The local geometry also derives a new definition of a vortical axis.

T. Yoneda, *Mathematical analysis of pulsatile flow and vortex breakdown*
Trip-Kuik-Westerweel-Poelma (2012) investigated the transition of pulsatile flow from the laminar to the turbulent. On the other hand, Brons-Voigt-Sorensen (1999) studied possible flow topologies of the steady vortex breakdown in the axisymmetric flow. Our aim here is to analyze such physical phenomenon using elementary differential geometry.

March 22 (Wednesday): *mechanics*

P.J. Morrison, Integrability, *Chaos, and noncanonical Hamiltonian structure*

The first part is on integrability vs Chaos and the breaking of invariant tori, including sketching calculations regarding critical tori in twist and nontwist systems. The second part is noncanonical structure including the rattleback and maybe (time permitting) working into infinite-dimensional theories such as Vlasov, MHD etc. Both parts have material that is not considered in usual mechanics courses.

H. Fukagawa, *A variational principle for dissipative systems*

We formulate a variational principle for dissipative systems in terms of optimal control theory for nonholonomic systems. The equations of entropy in the dissipative systems are considered as nonholonomic constraints. We describe the detailed derivation of the equations for a damped harmonic oscillator, a Newtonian fluid, and a viscoelastic material.

H. Sugama, *Lie transform perturbation theory for Hamiltonian systems and its application to guiding center motion*

The Lie transform perturbation theory is a convenient method to find noncanonical coordinates in which the fundamental 1-form and Hamiltonian's canonical equations are transformed into simpler structures. As an example, derivation of the guiding center motion equation is considered.

Reference:http://www.jspf.or.jp/Journal/PDF_JSPF/jspf2015_01/jspf2015_01-51.pdf

Y. Giga, *On transport equations in thin moving domains*

We consider mass transport equations in thin moving domains as well as diffusion equations and derive limit equations which are equations on moving surfaces. Such equations are also derived by what is called energetic variational approach.