Hamiltonian dynamics and applications
Dynamique hamiltonienne et applications

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LENNARD BAKKER, Brigham Young University

A Model for the Binary Asteroid 2017 YE5

The Asteroid 2017 YE5, first discovered in December 2017, was determined in June 2018 to be a rare binary pair of asteroids with an even more rare property of the two asteroids having nearly equal masses. We propose a model for the motion of a binary pair, with arbitrary but small masses, in the presence of two primaries, that is two bodies with much larger masses. The model is a time-dependent Hamiltonian for a three dimensional two-body problem build upon the Kepler 2-Body problem for two primaries. We numerically investigate this model for stable motions as well as for unstable motions, especially the situation where a tight binary pair, like 2017 YE5, will be torn apart by a passage too close to the two primaries. This is joint work with Skyler Simmons.

DAN OFFIN, Queen's University

Stability of periodic orbits by index methods

Roughly speaking, the Conley-Zehnder index measures the number of half windings of a fundamental solution for a periodic linear Hamiltonian system. This index, and its closely related cousin the Morse index for the equivariant action functional, can be used to give non perturbative arguments for linearized stability and instability for families of periodic orbits in Hamiltonian systems. We will give several examples of this from the setting of parametric resonance in parameterized families, to minimum distance lines in kinetic plus potential systems. Using a necessary and sufficient condition for elliptic stability of periodic orbits in two degree of freedom systems, we ouline the global argument for families of hyperbolic orbits in the Henon-Heiles system.

GEORGE PATRICK, University of Saskatchewan

The intrinsic linearization of equilibria of nonholonomic systems

For Hamiltonian systems, linearizations at an equilibrium are themselves Hamiltonian, and their spectrum is invariant under negation. By consequence, structurally either a Hamiltonian system departs an equilibrium or delicately oscillates about it with purely imaginary spectrum; asymptotic stability is precluded.

These structural restrictions do not persist to nonholonomic systems, such as are used to model rigid no-slip rolling. Yet, by following the underlying semi-symplectic geometry of nonholonomic systems to the linearized level (this geometry is universal for nonholonomic systems), one can derive the structure of the linearizations of their equilibria, and show for example that the linearization of the ground state of any nonholonomic system is fact naturally Hamiltonian.

MANUELE SANTOPRETE, Wilfrid Laurier University

On the Relationship between Two Notions of Compatibility for Bi-Hamiltonian Systems

Bi-Hamiltonian structures are of great importance in the theory of integrable Hamiltonian systems. The notion of compatibility of symplectic structures is a key aspect of bi-Hamiltonian systems. Because of this, a few different notions of compatibility have been introduced. In this talk we show that, under some additional assumptions, compatibility in the sense of Magri implies a notion of compatibility due to Fassò and Ratiu, that we dub bi-affine compatibility. There are at least two proofs of this fact. The first one uses the uniqueness of the connection parallelizing all the Hamiltonian vector fields tangent to the leaves of a Lagrangian foliation. The second proof uses Darboux-Nijenhuis coordinates and symplectic connections. In this talk we will attempt to outline both proofs.

TANYA SCHMAH, University of Ottawa
Controlling rigid body attitude via shape change

Satellite attitude control is typically achieved via reaction wheels (i.e. rotors) or magnets, which leave the moment of inertia fixed. We investigate an alternative control mechanism: sliding point masses, which change the moment of inertia and thus the angular velocity, while angular momentum remains fixed and nonzero.

Joint work with Cristina Stoica

COREY SHANBROM, Sacramento State University
A New Family of Solutions to the Kepler-Heisenberg Problem

The Kepler-Heisenberg problem is that of determining the motion of a planet around a sun in the Heisenberg group, thought of as a three-dimensional sub-Riemannian manifold. The sub-Riemannian Hamiltonian provides the kinetic energy, and the gravitational potential is given by the fundamental solution to the sub-Laplacian. The dynamics are at least partially integrable, possessing two first integrals as well as a dilational momentum which is conserved by orbits with zero energy. The system is known to admit closed orbits, which all lie within a fundamental integrable subsystem. Here, we present the numerical discovery of a new and beautiful family of solutions. This is joint work with Victor Dods.

CLAUDIO VIDAL, University of Bío-Bío

ZHIFU XIE, The University of Southern Mississippi
Central Configurations and Super Central Configurations in the Collinear 5-body Problem

In this talk, we present some interesting results of central configurations in collinear 5-body problem. The existence and classifications of super central configurations will be discussed too. Several necessary conditions of super central configurations are proved and they reduce the total 5!=120 permutations to 18 cases. These necessary conditions could be extended to general collinear n-body problem.