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Qualitative Theory of Dynamical Systems

Preface

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Professor Kenneth R. Meyer has been a guiding influence in celestial mechanics and Hamiltonian systems for more than 40 years, and has produced a voluminous and celebrated body of work in dynamical systems in general and celestial mechanics in particular. Ken loves mathematics, research, and teaching, and he loves being with friends and colleagues. We thought that the best way to celebrate his birthday would be to combine all these things in a nice location for a lively event spread over several days. So from May 30 to June 3, 2011, a special conference on Hamiltonian dynamics and celestial mechanics was held in Ken's honor in Castro Urdiales, Spain, at the CIEM (International Centre for Mathematical Meetings of the University of Cantabria and the City Council of Castro Urdiales). Ken began his 75th year a few days before the conference, and is still going strong, as evidenced by the lecture he gave to conclude the meeting. In that lecture, he reported on recent joint work with two of us (JFP and PY) concerning the concept of normally stable Hamiltonian systems.

The major themes of the meeting were those pioneered or further developed by Ken throughout his career: bifurcations, normal forms and averaging, reduction of Hamiltonian systems with symmetry, and the following topics related to the N body problem in celestial mechanics: stability, periodic orbits, collisions, hip-hop solutions,

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central configurations and integral manifolds. Further topics at the meeting included symplectic geometry, celestial mechanics in curved spaces, variational methods, and invariant manifolds, homoclinic tangles and quasiperiodic solutions in Hamiltonian systems.

Dieter Schmidt opened the first session by presenting Ken Meyer's mathematical genealogy, tracing it back through Gauss and ultimately to the late middle ages. Of course, he was also tracing his own genealogy, since he was Ken's first PhD student, and probably also the researcher who has worked most closely with Ken during his long career. Dieter devoted the second part of his talk to normalization of the Hamiltonian near $\mathcal{L}_4$ in the restricted three body problem, which permits the identification of long- and short-period periodic orbits.

Later, Tudor Ratiu wowed us as always with his mastery of geometric mechanics, Henk Broer discussed the role of fractal geometry in resonant phenomena, and Carles Simó presented both rigorous and non-rigorous methods for checking the nondegeneracy conditions of KAM theory. Jeff Xia showed the utility of symplectic geometry in the theory of invariant manifolds for Hamiltonian systems, and Hildeberto Cabral explained the mechanics of nearly co-orbital satellites (such as Saturn's moons Janus and Epimetheus) that swap orbits as they approach each other. Alain Albouy and Chris McCord presented separate results on the integral manifolds of the N body problem, partially generalizing previous results of McCord, Ken Meyer and Qiudong Wang for the three body problem. Ernesto Pérez-Chavela and Florin Diacu spoke on different aspects of N body problems in spaces of constant curvature, while Esther Barrabés and Dan Offin explored so-called hip-hop solutions of special N body problems. Cristina Stoica spoke about generalizing a result of Ken and Dieter Schmidt ("From the restricted to the full three body problem") to the case of $N + 1$ bodies when one body is small, and Clark Robinson revisited a problem of his own concerning partially parabolic orbits in the planar three body problem, using ideas from the classical linearization theorems of dynamical systems. We also heard from Marian Gidea about the role of invariant manifolds in locating weak stability boundaries in certain three body problems (such boundaries are important in applications to fuel efficient space flight). Sebastián Ferrer discussed the use of the bidimensional Duffing oscillator in the study of elliptic functions, presenting it as an alternative to more traditional methods based on the pendulum or rigid body motions. Roughly speaking, Hamiltonian systems in which equilibrium stability cannot be established by normalization to finite order are called "transcendental"; Boris Bardin explained how transcendental systems occur, and showed that they are Liapunov unstable. Yan Ning Fu described joint work with X. B. Xu in which they find special symmetric solutions of the restricted three body problem—the infinitesimal moving in a nearly circular orbit with a line of symmetry joining the primaries. Jaume Llibre traced some of the modern criteria for integrability (due to Morales, Ramis, Ziglin, and others) back to their origins in Poincaré and showed how the original methods are still applicable. Heinz Hanßmann spoke about bifurcations in Hamiltonian systems in one degree of freedom with a reflecting symmetry. Qiudong Wang dealt with a theory on the dynamics of homoclinic tangles in periodically perturbed second order equations. Finally, Yingfei Yi spoke on viscous stability of quasi-periodic Lagrangian tori and applications to viscosity solutions near KAM tori in nearly integrable Hamiltonian systems.

There was also a poster session during which younger researchers presented their ongoing and latest results. Poster subjects ranged from comet orbits, new numerical methods, aspects of three and four body problems, to Lie transforms, satellite tracking, solution stability, variational methods, and more. The session was a lively event and lasted longer than planned, as presenters explained details of their work to other participants through the afternoon and into the early evening.

The meeting was a token of gratitude from the mathematics community for Ken Meyer's outstanding contributions. But it was also a way of recognizing Ken's exceptional qualities as a person and a very good teacher. He is generous, modest, and sincere, always ready to teach, discuss a problem, or have a beer with you. He tries—and is often able—to bring out the best in people. We thank him for all we were able to learn from him.

This special issue dedicated to Ken Meyer presents fifteen articles which give the reader an appreciation for the importance of Ken's many contributions to the fields of Hamiltonian systems and celestial mechanics that are at the core of this journal.