Hamiltonian Dynamics and Celestial Mechanics: A Conference in Honor of Ken Meyer in his 75th Year

By H.S. Dumas
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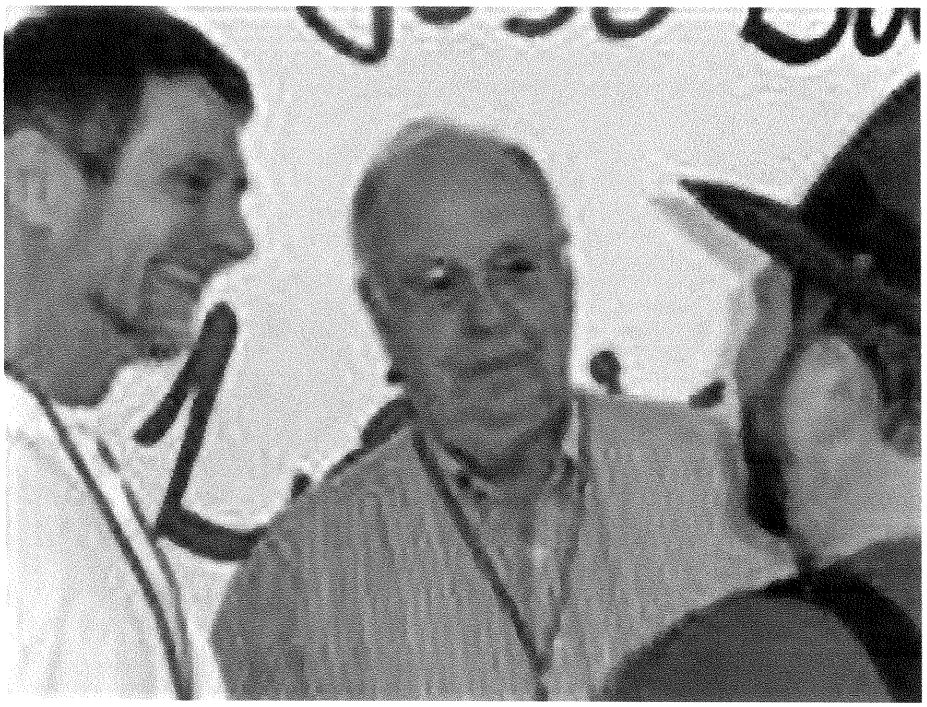
From May 30 to June 3, 2011 a special conference on Hamiltonian dynamics and celestial mechanics was held in Castro Urdiales, Spain, in honor of Professor Kenneth R. Meyer. Ken began his 75th year a few days before the conference, and is still going strong, as evidenced by the lecture he gave to conclude the meeting. In that lecture, he reported on recent joint work with Jesús Palacián and Patricia Yanguas 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 N body problem in celestial mechanics: stability, periodic orbits, collisions, hip-hop solutions, 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.

Lectures were held on the top floor of the International Center for Mathematical Meetings (every nice city should have one of these) overlooking the Bay of Biscay on the northern Spanish coast just west of Bilbao. Directly above the lecture hall was a clerestory, initially hidden by a movable screen in the roof. Through this screen came the occasional cries of seagulls and the sounds of late spring storms along the coast. On the fourth day of the meeting, the screen was unfurled, and we could see light streaming in the windows through which these sea-sounds had come to punctuate and enliven the talks.

With or without sea-sounds, the talks were very good. Most were PowerPoint presentations; a few were chalk-on-blackboard. 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 L_4L4 in the restricted three body problem, which permits the identification of long- and short-period periodic orbits.



Dan Offin, Ken Meyer, and Florin Diacu.

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. Ernesto Pérez-Chavela and Florin Diacu spoke on different aspects of N N body problems in spaces of constant curvature, while Esther Barrabés and Dan Offin explored so-called hip-hop solutions of special N 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 $N+1$ 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 Marion 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.

Since Ken Meyer attended all the lectures, I asked him if there were any that stood out. He said he thought they were all good, but that he was (surprise) most engaged by the ones that touched on topics he had worked on himself. He especially appreciated the presentations by Chris McCord and Alain

Albouy on integral manifolds of the N body problem; both of them have made significant advances since Alain, Chris, Ken, and Don Wang revived the subject in the 1990s (it originated with Poincaré and Birkhoff). Ken was also impressed with Heinz Hanßmann's chalkboard discussion of bifurcations in Hamiltonian systems with a reflecting symmetry, and with Don Wang's new results classifying the ways that homoclinic tangles appear in systems of periodically perturbed ordinary differential equations.

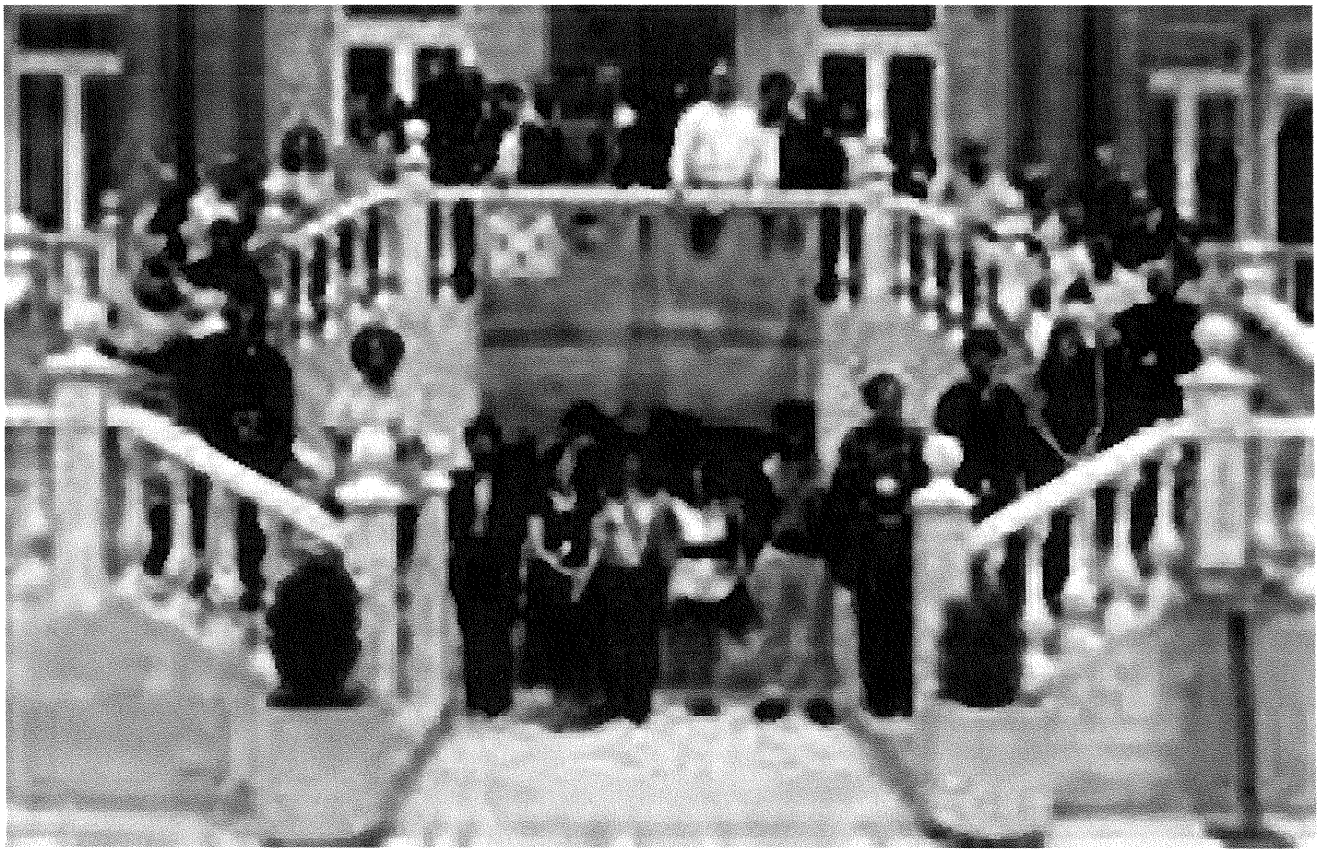
My own range of work being more limited than Ken's, I was drawn to presentations involving KAM theory, such as those by Henk Broer, Carles Simó, and the talk by Yingfei Yi on the regularity of viscosity solutions in certain Hamiltonian systems.

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.

Further details about the meeting, including a program, abstracts--even slides from the lectures and reproductions of the posters--may be found here: http://www1.unavarra.es/kenmeeting

After the talks, and after meals at which we were fed like kings, conference-goers were treated to several guided tours, most notably through Castro Urdiales and the medieval town of Santillana del Mar. But just walking from the hotels to the conference center took us along the beach, with striking views of the church and castle in Castro Urdiales, and eastward across the bay toward Bilbao.

The conference banquet was exceptionally good and became a little raucous once the speeches got underway. Chris McCord acted as MC, extemporizing a nice encomium for Ken and setting the stage for Clark Robinson's story about the infamous singing purple gorilla that interrupted a 1980s Midwest talk by John Guckenheimer, asking for Ken Meyer. (Rumors about the sender or even identity of the gorilla--Bob Devaney?--remain just that, of course.) Carl Simon's speech was in a class by itself, somehow combining mild ``celebrity roast" humor with a sincere peroration. Carl could easily do talk shows or professional stand-up routines if he chose to. Finally, Patricia Yanguas calmed things down with an eloquent and elegant account of her and Jesús Palacián's work with Ken, and with expressions of thanks to all who helped make the conference possible. But in fact, it was really Patricia and Jesús who worked more than anyone else in raising funds, in organizing and running the meeting and making sure everything went smoothly. Heartfelt thanks go to them from all of us who participated in this outstanding conference--*¡Gracias!*



Participants in front of the International Center (CIEM) in Castro Urdiales.

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