Final Report to DOE, July 12, 2000

Project Title: Bifurcation, Geometric Phases and Control in Hamiltonian Systems and Fluid Dynamics

Project FG03-95-ER25251

Dates: July 1, 1995-June 30, 1999

1 Principal Investigators

Edgar Knobloch
Department of Physics, University of California
Berkeley, CA 94720; 510-642-3395

Jerrold E. Marsden
Department of Mathematics, University of California
Berkeley, CA 94720; 510-642-5229
and
Control and Dynamical Systems
Caltech 107-81
Pasadena, California 91125; 626-395-4176

2 Principal Project Personnel

Jerrold E. Marsden
A. Role in the project. Principal Investigator/Researcher

B. Principal Areas of Research and Expertise. Mechanics, dynamics, bifurcation theory and control theory.

C. Percentage of time. Approximately 15%.

D. Education. BSc, Toronto, 1965, PhD Princeton, 1968


Edgar Knobloch
A. Role in the project. Principal Investigator/Researcher
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B. Principal Areas of Research and Expertise. Applied Dynamics, Fluid Dynamics, Bifurcation Theory.

C. Percentage of time. Approximately 15%.

D. Education. BA, Cambridge, 1974, PhD, Harvard, 1978


3 Additional Project Personnel

Project personnel during the duration of the grant were described in the annual progress reports. During the final year no additional personnel were supported due to lack of funds.

Collaborators at other Universities were not supported by these funds, but include Anthony Bloch, Gerhard Dangelmayr, J. Hettel, Darryl Holm, Keith Julien, Vivien Kirk, P.S. Krishnaprasad, Hans-Peter Kruse, Adam Landsberg, Jeff Moehlis, Robert Piercc, Michael Proctor, Tudor Ratiu, Genevieve Raugel, Jürgen Scheurle, Mary Silber, Steve Tobias and Juri Toomre.

4 Project Overview

The following papers (in addition to those appearing in the annual progress reports) wrapped up the project:


3. Marsden, Ratiu and Raugel continue their work on shallow water approximations of the Euler equations, especially those on the two sphere. Some of the results were announced in the paper of Marsden, Ratiu, and Raugel [1995], "Équations d'Euler dans une coque sphérique mince (Euler equations on a
thin spherical shell)*, C.R. Acad. Sci. Paris 321, 1201-1206. Considerable progress has been made on the longer version of this paper during a visit of Marsden and Ratiu to Paris in 1999.


Significance and Relevance. We studied stability, bifurcation and dynamics problems in fluid mechanics which are topics of fundamental scientific importance. Considerable progress on these topics was made during the duration of the grant with numerous publications produced. In addition, the topic of variational integrators was begun which has led (after the grant closed) to significant breakthroughs in integration algorithms of a multisymplectic nature for elasticity, fluid mechanics and satellite dynamics. Application of these algorithms to the simulation of atmospheric, oceanographic and turbulent flows is currently underway. Support of DOE during the formative stage of these algorithms was an important part of this development.