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R&T Number: 4123033---04

Contract/Grant Number: N00014-89-J-1202

Contract/Grant Title: Large Motions of the Magnetization in Magnetically
Ordered Media

Principal Investigator: Harry Suhl

Mailing Address: University of California, San Diego
                         IPAPS - 0075
                         9500 Gilman Drive
                         La Jolla, CA 92093-0075
Phone Number: (with Area Code) (619) 534-4748

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E-Mail Address: (not checked on a regualr basis)

a. Number of Papers Submitted to Refereed Journal but not yet
        published: __0__

b. Number of Papers Published in Refereed Jounals: __3__
        (list attached)

c. Number of Books or Chapters Submitted but not yet Published:
        __0__

d. Number of Books or Chapters Published: __0__ (list attached)

e. Number of Printed Technical Reports & Non-Refereed Papers: __0__
        (list attached)

f. Number of Patents Filed: __0__

g. Number of Patents Granted: __0__   (list attached)

h. Number of Invited Presentations at Workshops or Prof. Society
        Meetings: __3__

i. Number of Presentations at Workshops or Prof. Society Meetings:
        __0__

j. Honors/Awards/Prizes for Contract/Grant Employees:
        (list attached, this might include Scientific Soc
        Awards/Offices, Promotions, Faculty Awards/Offices etc)

k. Total number of Graduate Students and Post-Docs Supported at least
        25% this year on this contract/grant:

        Grad Students __2__ and Post-Docs __0__ including

        Grad Student Female __0__ and Post-Docs Female __0__

        Grad Student Minority __0__ and Post-Doc Minority __0__

Minorities include Blacks, Aleuts, AmIndians, Hispanics etc. NB:
Asians are not considered an under-represented or minority group in
science and engineering.

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b. Papers Published in Refereed Journals:

Bouzidi, Djemoudi, and Harry Suhl, "Motion of a Bloch Domain Wall." Phys. Rev. Lett., **65**, 1990. (pp. 2587-2590)

Che, Xiaodong, and Harry Suhl, "Analysis of Correlation of Magnetization and Noise after AC Erasing." J. Appl. Phys., **69**, 1990. (pp. 2440-2443)

Che, Xiaodong, and Harry Suhl, "Scaling of Critical Self-Organized Megnetic Domain Formation." Phys. Rev. B, **44**, 1991. (pp. 155-158)

Statement A per telecon
Dr. Michael Shlesinger
ONR/Code 1112
Arlington, VA 22217-5000
NWW 1/08/92

1991 Annual Report to the Office of Naval Research

Two topics were studied during the year:

1. Interaction of domain wall motion with elementary
   excitations, and the resulting damping and instability
   mechanisms.

2. Self-organized criticality. Some further consolidation of
   this concept for large magnetic systems was achieved.
   Then, studies were begun to establish the minimum
   complexity a physical system must have if S.O.C. behavior
   is to result.

Under heading 1, we had previously used the theory of kink motion in
interaction with elementary excitations to establish that the velocity
of a ferromagnetic domain wall would be limited by emission and/or
amplification of spin wave excitations. The limiting wall velocity is
very nearly equal to the speed of the particular spin wave whose group
and phase velocities are equal. When the driving field is large enough
to induce this limiting velocity, the system achieves a "fixed point",
a state in which a group of non-synchronous spin-waves is excited to a
high, non-thermal level. When the driving field is further increased
beyond a certain threshold, this fixed point goes unstable. A new fixed
point is reached, at which the wall velocity has an oscillatory
component added to its mean value. This work constituted the thesis
subject of a student (Djemoui Bouzidi), who received his Ph.D. degree
during the past year. The part dealing with velocity saturation was
published in Phys. Rev. Letters in November, 1990. The more recent
results on wall oscillations have been submitted to Phys. Rev. B.

Under heading 2, we are trying to determine what physical aspects
of a system can lead to self-organized criticality (S.O.C.). Even
though the concept appears to be very successful in at least two well-
defined areas (earthquake statistics, and large, magnetically ordered
systems) the reasons are unclear. The simplest algorithms used in their
description assume that the systems get stuck in "only just" metastable
states, but do not explain why. During the latter half of the past year
we have been attempting to answer this question by studying the
coalescence of domain walls in an applied magnetic field. Such
coalescences occur in experiment by Westervelt, and they appear to
terminate in states displaying S.O.C.

Up to now, we have treated only a one-dimensional version:
reduction of winding number of a spiral sequence of Block-walls. So
far, we find that, starting from an unstable initial state, the final
stable is not "only just" stable, although it is far from the ground
state. This could be due to the low dimensionality of this model. In
any case, our next task is to determine what further complexity must be
introduced to result in S.O.C.