**Title and Subtitle**

Mathematical Analysis of Strong Fluid Mechanical Effects at High Mach Number in Reactive and Nonreactive Flow

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**Supplementary Notes**

The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

**Distribution/Availability Statement**

Approved for public release; distribution unlimited.

**Abstract**

The following topics have been studied during this three year period:

- Transition to instability for unstable one-dimensional detonations
- Development of the first asymptotic model to incorporate the self-stretching of vortex filaments in high Reynolds number fluid flows
- Development of the first rigorous model with exact renormalization for turbulent transport
Andrew J. Majda

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This report covers the period January 1, 1989 through December 31, 1991, the three year period of this grant. The research performed under this grant includes mathematical analysis of strong fluid mechanical effects at high Mach number in reactive flow. The principal investigator has published the following papers with at least partial support by this research grant:


9. (with M. Avellaneda) Homogenization and Renormalization of Multiple-Scattering
Expansions for Green Functions in Turbulent Transport. Published in *Composite
Media and Homogenization Theory*, Birkhauser, Boston, Edited by Dal Mao and
Dell'Antonio, pp. 13-37, 1990
10. (with A. Bourlioux and V. Roytburd), “Theoretical and numerical structure for unsta-
ble one-dimensional detonations”, *SIAM J. Appl. Math.*, Vol. 51, No. 2, pp. 303-343,
April 1991
11. (with M. Avellaneda) “An integral representation and bounds on the effective diffu-
12. (with R. Almgren and R. Rosales) “Asymptotic analysis of reacting materials with
275-313, 1991
13. (with R. Almgren and R. Rosales) “Asymptotic analysis of reacting materials with
saturated explosion. II. High-frequency waves”, *Studies in Applied Mathematics* 84,
pp. 315-360, 1991
14. (with R. Klein) “Self-stretching of a perturbed vortex filament I. The asymptotic
equation for deviations from a straight line”, *Physica D* 49, pp. 323-352, 1991
15. (with A. Bourlioux and V. Roytburd) “Nonlinear development of low frequency one-
dimensional instabilities for reacting shock waves”, *IMA Volumes in Mathematics and
16. (with K. Lamb) “Simplified equations for low mach number combustion with strong
heat release”, *IMA Volumes in Mathematics and its Applications*, Vol. 35, pp. 167-
211, 1991
17. (with M. Avellaned), “An integral representation and bounds on the effective diffu-
sivity in passive advection by Laminar and turbulent flows”, *Commun. Math. Phys.*, 
18. “The interaction of nonlinear analysis and modern applied mathematics”, *Proceedings
349-388, 1991
20. (with R. Klein), “Self-stretching of perturbed vortex filaments II. Structure of solu-

Submitted Papers of A. Majda


3. (with P. Embid), “An asymptotic theory for hot spot formation and transition to detonation for reactive granular materials”, accepted, Combustion and Flame


In addition, the following people have been partially or completely supported by this grant:

Andrea Bertozzi, graduate student, received Ph.D. 6/91
Anne Bourlioux, graduate student, received Ph.D. 6/91
David Horntrop, graduate student, Ph.D. expected 1/94
Richard McLaughlin, graduate student, Ph.D. expected 6/93
David Stuart, graudate student, received Ph.D. 6/90

Pedro Embid, visiting research scientist, 9/89 through 6/90