Microwave Effects & Chaos in 21st Century Analog & Digital Electronics

University of Maryland, College Park (UMCP)

and

Boise State University (BSU)

AFOSR MURI 2001 Kickoff Meeting 6/14/01

Microwave Effects & Chaos (UMCP/BSU)

Goals

- **Understand failure mechanisms in electronics, esp. as voltage & detail size decrease (e.g. to 0.5V, 50nm)**
- **Discover Chaos effects that would result in upset or damage at reduced levels of microwave power density**
- **Specify innovations to reduce vulnerability (e.g. new computer architecture, error correcting codes, or electronic packaging)**

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Methodology

- Custom design and fabrication of ICs with on-chip diagnostics and ability to modify connections with focused ion beams
- Statistical description of fields in complex topologies (hot spots on circuits in boxes)
- Testing over an extensive frequency range (100MHz to 100 GHz), single or repetitive pulsing, variable pulse duration & power
- Balanced efforts in theory, computer simulation and experiment

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Three Interrelated Parts of Study

- **A. Studies of semiconductor devices, circuits and systems**
- **B. Studies of Chaos at microwave frequencies**
- **C. Microwave testing of electronics identified as candidates for intensive study in parts A and B**

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Personnel

- Principal Investigator: Victor Granatstein

- Co - PIs:

Part A: Neil Goldsman, Agis Iliadis, Bruce Jacob, John Melngailis

Part B: Steven Anlage, Thomas Antonsen, Jr., Edward Ott

Part C: Yuval Carmel, Patrick O'Shea, Omar Ramahi, John Rodgers

- PI on BSU Subcontract: R. Jacob Baker (Part A)

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Presentations

A. 1. Overview of vulnerabilities in analog & digital electronics
------- N. Goldsman

2. On-chip measurement of electromagnetic pulses
---------- R. J. Baker

3. Microwave radiation effects in digital data processors
---------- B. Jacob

4. Numerical modeling & analysis of nanoscale devices
------- N. Goldsman

5. Experimental studies of interference & upset in devices & gates
---------- A. Iliadis

6. Diagnostics of upset & damage using focused ion beams and other advanced techniques ---------- J. Melngailis

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Presentations (continued)

B. 1. Theory and modeling of wave chaos

-------- E. Ott and T.M. Antonsen Jr.

2. Chaos experiments at microwave frequencies

---------- S. Anlage

C. 1. Microwave experimental design and methodology

--- J. Rodgers, Y. Carmel & P. O'Shea

2. Computational electromagnetics & coupling into enclosures

---------- O. Ramahi