MURI on "The Effects of RF Pulses on Electronic Circuits and Systems" (Administered by AFOSR)

Summary of Presentations by

University of Maryland, College Park (UMCP)

and Boise State University (BSU)

"Research Plans"

presented by Victor Granatstein

Second Annual Review 11/14/03

A. Wave Chaos : Research Plans

- **Extend theory and experimental work on Random Coupling Model (RCM) to include:**
  - **i) Cavities with more than 2 ports**
  - **ii) Three-dimensional cavities**
  - **iii) Cryogenically cooled cavity to test RCM in the low loss limit**
  - **iv) Rectangular cavities to see if RCM is applicable to integrable systems**
  - **v) Rectangular cavities containing rectangular scatterers (similar to enclosure containing ICs) to test RCM in pseudo-integrable systems**

B. EM Noise Mitigation: Research Plans

- **Development of ultra wideband High Impedance Surface (HIS) based noise suppression strategies**
- **Development of a robust mathematical theory for noise suppression in the parallel plate waveguide and highly resonant enclosures**
- **Development of analytical expressions for certain types of chaotic cavities**

C. Microwave Effects on Devices & Circuits Research Plans

- **Extend investigation of gate oxide breakdown in MOSFETs on ICs (comparison of code with exper.)**
- **Couple semiconductor device modeling codes with Maxwell equations solver (physics based description of effect of microwave pulses on ICs)**
- **Investigate distinction between thermal effects and high field effects by varying duty cycle**
- **Investigate possibility of shielding devices on-chip with nanocomposite polymer coatings**
- **For digital systems, complete study of vulner. of clock network & characterize data network etc.**

Microwave Effects & Chaos (UMCP/BSU)

D. Testing Chaos & Nonlinear Effects in Ckts.

Research Plans

- **Refine model of chaos in transmission-line/diode ckt. & experimentally test (2004 DURIP proposal)**
- **Investigate detrimental response of nonlin. ckt. elements to complex modulation waveforms**
- **Generalize modeling of RF effects to account for reduced process sizes & voltages, faster switching speed, parasitic resonances, etc.**
- **Incorporate Schottky-diode microwave sensors in real test chips (data for comparison with models)**
- **Fabricate Schottky-diodes by FIB to extend freq.**

Research Plans at Boise State University

- **Extend studies of effects of voltage pulses on gate oxide reliability (could provide opportunity for testing UMCP codes)**

- **Spin-off development of new memory technology using high frequency pulses with direct tunneling (present if oxide thickness < 20 angstroms). Similar to flash memory which uses Fowler-Nordheim tunneling**

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