

# Life is Bigger than Particle Accelerators and Magnetically-Confined Plasma Fusion Reactors

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... and yes, SOME of us are like Sheldon

**Common Call  
Greenville 2017  
Making An Impact**

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**cave<sup>3</sup>**

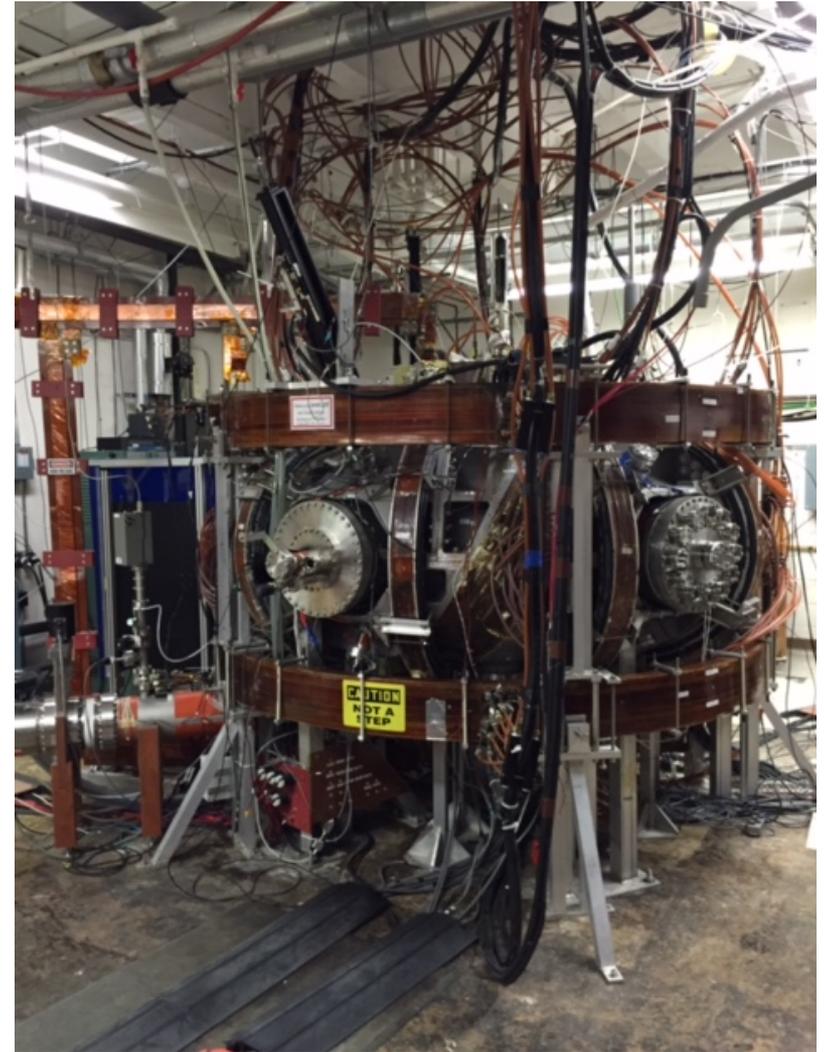
NSF Center for Advanced Vehicle and Extreme Environment Electronics



# Welcome to My World . . .



**AU 2 MeV Linear Particle Accelerator**



**AU Magnetically-Confined Plasma Fusion Reactor**

# The Main Thing

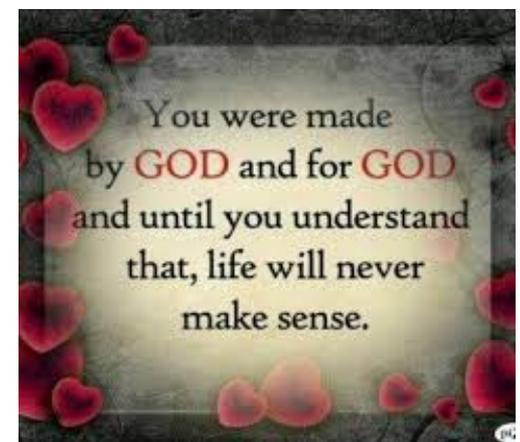
Philosophers have long strived to answer the question “why am I here?” and “what is life all about?” The Bible provides a clear answer...

**The Chief Aim of Man: To love and bring glory to God as an ambassador for Christ. It is more of Him expressed through less of me. John the Baptist said “He must increase, but I must decrease” (Jn 3:30)**

Paul says “so whether you eat or drink or whatever you do, do it all for the glory of God” (1 Cor. 10:31) and “therefore, we are ambassadors for Christ, God making his appeal through us” (2 Cor. 5:20).

An ambassador is a diplomatic official of the highest rank, sent by one sovereign or state to another as its representative.

We are called in these passages to evaluate everything we do in the light of whether it promotes the glory of God.

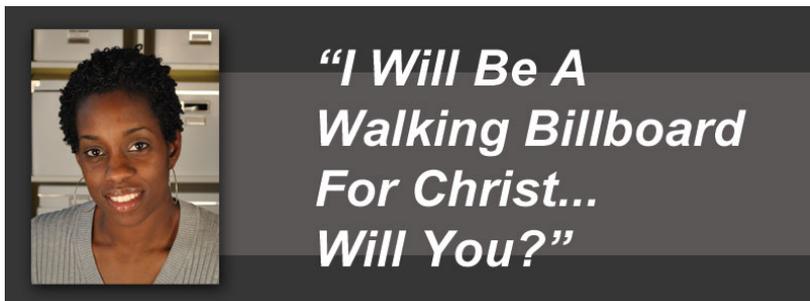


# What Does "Glory" Mean?

1 Cor. 10:31; Jn. 13:31-32

10:31	So	whether	you	eat	or	drink	or	whatever	you do
	<sup>4</sup> οὐν	<sup>3</sup> εἴτε		<sup>5</sup> ἐσθίετε	<sup>6</sup> εἴτε	<sup>7</sup> πίνετε	<sup>9</sup> εἴτε	<sup>10</sup> τι	<sup>11</sup> ποιεῖτε
	3767	1535		2068	1535	4095	1535	5100	4160
	do	all	for	the glory	of	God			
	<sup>17</sup> ποιεῖτε	<sup>13</sup> πάντα	<sup>14</sup> εἰς	<sup>15</sup> δόξαν	<sup>16</sup> θεοῦ				
	4160	3956A	1519	1301	2316				

**"Glory" is the Greek doxan (δοξαν) and refers to advertising, to "put something on display, as on a billboard . . . to show it off." God wants to be seen and appreciated.**



# The Importance of Calling

Christians should NOT be satisfied just to get a check from a job. Calling is God's special occupation for you—what He wants you to be.

**Definition:** Calling refers to the customized life purpose that God has ordained and equipped for you in order to expand His kingdom and to bring Him greater glory. It is how we “advertise” Christ.

Every believer has a calling. Eph. 2:8-10 says that

“For it is by grace you have been saved, through faith—and this is not from yourselves, it is the gift of God— not by works, so that no one can boast. For we are His workmanship, created in Christ Jesus to do good works, which God prepared in advance for us to do.”



This passage says that as part of your salvation package, there was provided for you a life plan and a life purpose. Jeremiah 29:11 adds

“For I know the plans I have for you,” declares the Lord, “plans to prosper you and not to harm you, plans to give you hope and a future.”

*Keep me running  
in the lane you  
have created just  
for me*

# Family Situation

## Broken Neighborhood

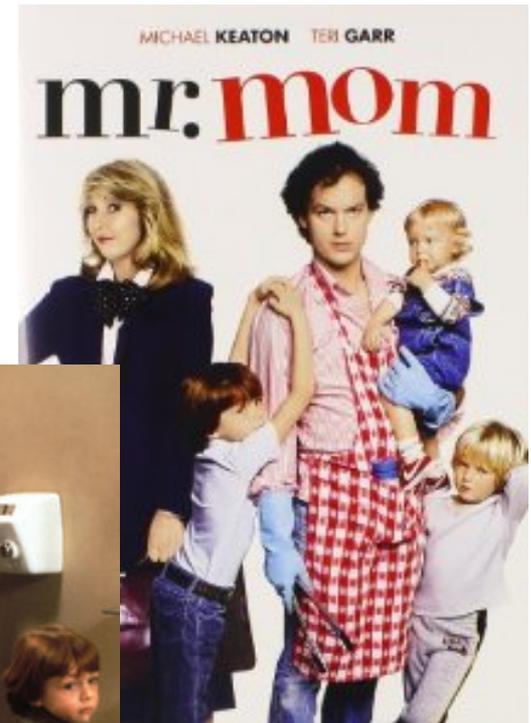
- **Average home value: \$15K**  
**Average annual salary: \$15K**
- **Our house was located in a steel foundry parking lot on a busy street. It was never quiet.**
- **The furnace burned coal.**
- **There was ice on the inside BR walls on some cold winter nights. I slept with my brother and our dog to keep warm.**
- **Summers weren't much better; you woke up in your sweaty bedclothes.**
- **Think recent pictures of Detroit blight.**



# Family Situation

## Broken Home

- Folks divorced when I was 12 years old. It was ugly. Mom had cheated. Dad was bitter.
- Custody battle dragged on for 2 years. Courts gave all children to dad, not mom.
- I ended up raising little sisters (5 and 6 years old) as a 12 year-old while dad worked swing shift. Older kids were "out of there."
- Turned into "Mr Mom"
- No-win situation. "Stuck"
- Pounded by dad and mom whenever "mistake" was made. All criticism, no encouragement . . . for years.
- Robbed of a childhood.
- Had to grow up fast.

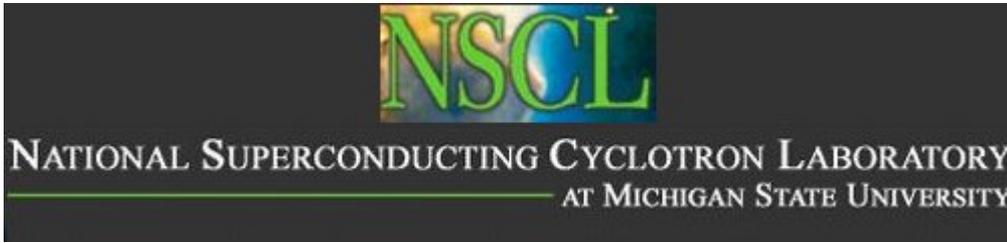
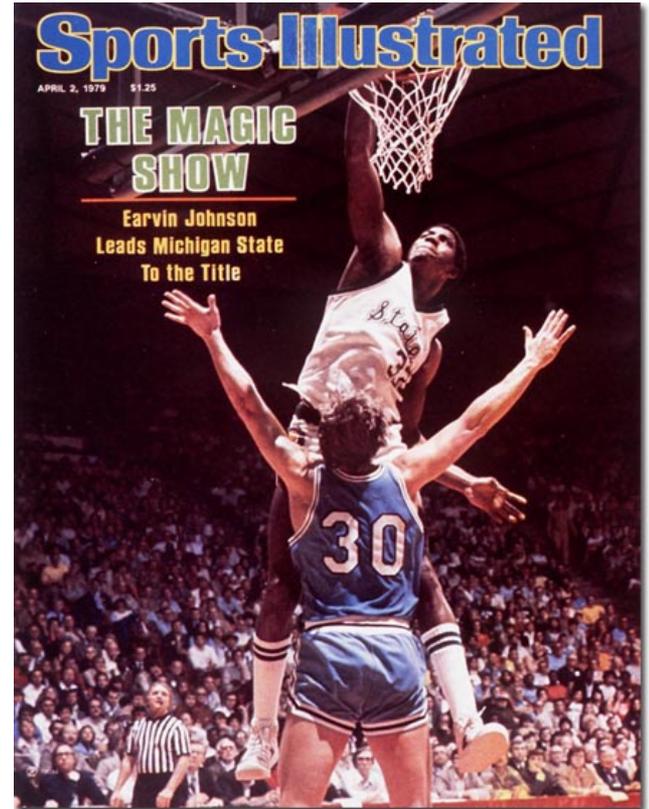


# Family Situation

Broken Dreams

But Some Escaped . . .

Talent . . . Sports . . . Education . . . God



LOOKING AT  
**GRAD SCHOOLS?**  
#1 NUCLEAR PHYSICS  
PROGRAM IN THE US



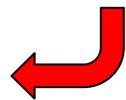
# A Unique, God-Ordained Career Path



12 years in the academic salt mines

- B.S. Physics, Michigan State
- M.S. Physics, Michigan State (NSCL)
- M.A. Theology, Western Conservative Baptist Seminary
- Ph.D. Applied Physics, Oregon
- Postdoc, Surface Chemistry, Carnegie-Mellon/Pitt
- Chief Surface Scientist, Intel Corporation

Accepted Jesus



Deliverance

Development

Destiny

Summers: LANL, Tektronix, MIT

Hybrid Background HUGE Advantage: Degrees in physics; postdoc in chemistry, headed a materials group in an electronics Fortune 500 firm.

# Teaching and Faith

Sprinkling Lectures with Useful, Christ-Announcing Analogies

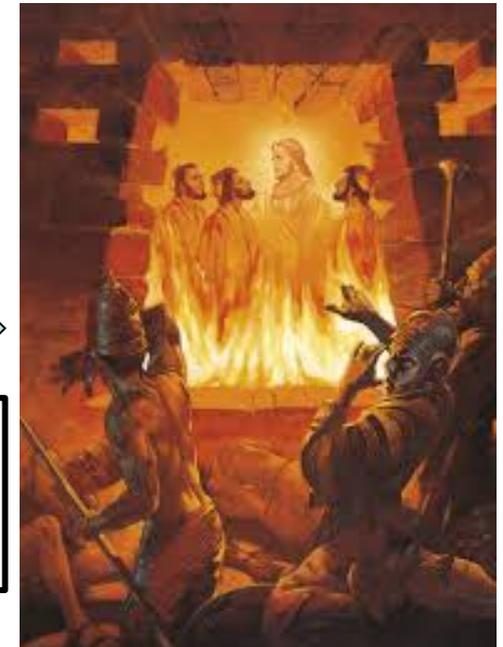
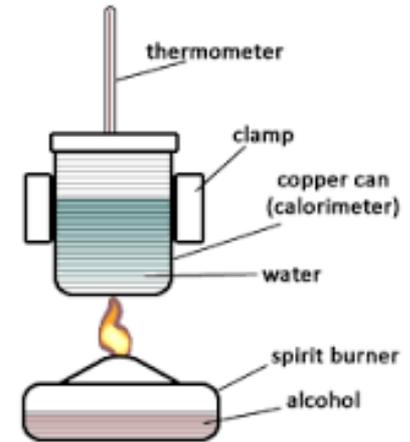
**Specific Heat:** The amount of heat energy required to raise the temperature of a substance by one degree,

$$c = Q/m\Delta T$$

where  $c$  = specific heat,  $Q$  = heat,  $m$  = mass of substance,  $\Delta T$  = change in temperature.

If something has a high  $c$ , it means you are pouring the heat to it but the  $T$  doesn't change much → Defies intuition !

**The Message: Shadrach, Meshach and Abednego could have suddenly acquired a very high specific heat to survive the fiery pit.**



# Teaching and Faith

Community Service Component in All Courses

If you need a special favor . . .

Examples:

- Excused absence
- Getting married
- Mommy is crying every night  
`cause you're not home
- No clean clothes for days
- Embarrassing frat hazing  
incident

. . . try bringing Snicker's Bars

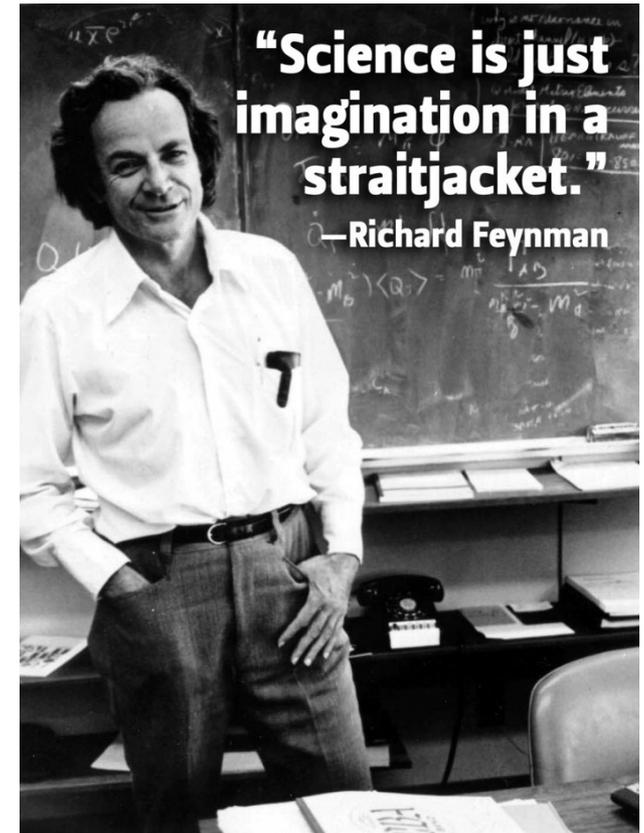
**Last semester, I collected Snickers Bars to give to community service organizations, such as the Auburn Food Bank or the Lee Country Department of Social Services.**



**. . . YOUR Best Friend in Time of Need**

# Teaching and Faith

A Professor Who Cares



**At universities such as Clemson and Auburn, there is considerable “word of mouth” among students about which professors genuinely care about students.**

# Research and Faith

## Excellence in Physics Research

**cave<sup>3</sup>** at Auburn University  
NSF Center for Advanced Vehicle and Extreme Environment Electronics

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CAVE3  
What is NSF-CAVE3  
Research Thrusts  
Component Reliability  
Connector Reliability  
Flip Chip and Underfills  
Harsh Electronics Systems and Manufacturing  
Lead free Soldering  
Research Highlights  
Lead Free  
Prognostics  
Shock & Vibration  
Tin Whiskers  
Publications  
Reviews  
Workshops  
Newsletters  
Facilities  
Software

The Center for Advanced Vehicle and Extreme Environment Electronics (CAVE<sup>3</sup>) at Auburn University is dedicated to working with industry in developing and implementing new technologies for the packaging and manufacturing of electronics with special emphasis on the cost, harsh environment and reliability requirements of the vehicle industry.

**cave<sup>3</sup>**

NSF Center for Advanced Vehicle and Extreme Environment Electronics

# Research and Faith

## Excellence in Physics Research

### Research Sponsors



**CAVE<sup>3</sup> By the Numbers**

- ~ 40 science/engineering research projects going on in a given year.
- Support of ~ 35 M.S. and Ph.D. students.
- Funding level ~ \$4M annually with \$\$\$M more in independent contracts and grants.



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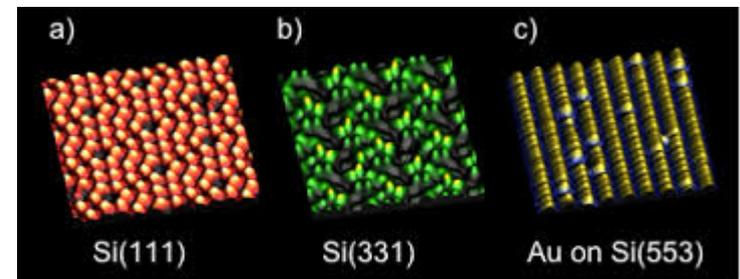
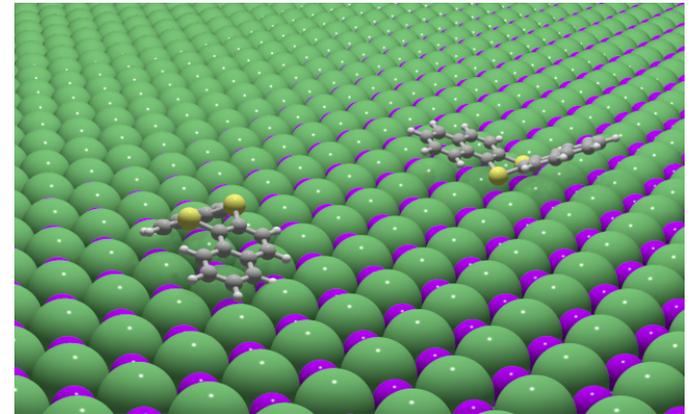
# What is Surface Physics?

Surface science arose out of the needs of the microelectronics industry in the 1970's.

As the size dimensions of electronic circuitry decreased, it became necessary not only to view the small features by electron microscopy, but to understand the thin films and interfaces involved in microprocessor processing.

A surface is defined as the top 5-10 atomic layers of a material.

Experimental surface science involves the use of a variety of novel instrumentation capable of measuring the physical, chemical, electronic, and material properties of surfaces.



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# Our Niche

**Our research focus is harsh environment electronics. A harsh environment is one with either . . .**

- 1) extreme temperatures**
- 2) high radiation**
- 3) high vibration**
- 4) high stress and strain**
- 5) corrosive surroundings**

**Conventional silicon electronics used in consumer electronics will not survive the rigors of most harsh environments and new materials and manufacturing approaches are necessary.**

**General Dynamics F-16  
Fighting Falcon  
Our Early Generation Tactical Fighter**



## **The F-16: Up Close and Personal**

- **A chair for the pilot**
- **Sitting on a HOT jet engine**
- **SURROUNDED by advanced electronics**
- **RECIPE FOR DISASTER!**

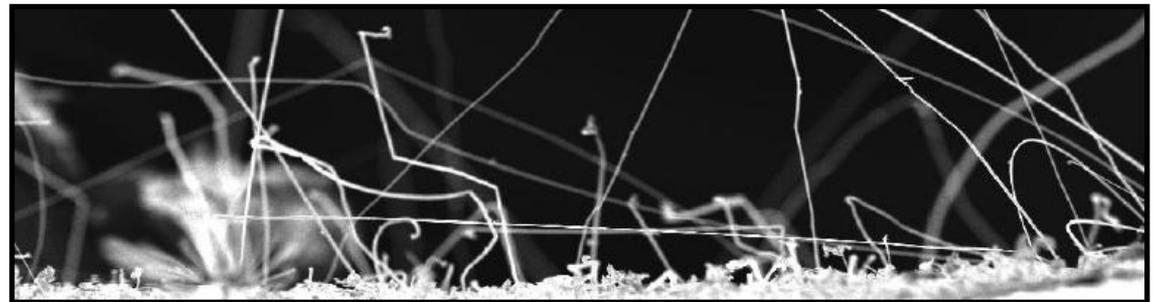


## Tin Whisker Research Thrust

### Texas Instruments Visit

February 15, 2012

**Michael J. Bozack**  
**Department of Physics**  
**Auburn University**  
**Auburn, AL 36849**



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<http://aussl.auburn.edu>

<http://cave.auburn.edu>

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# What are Sn Whiskers?

**Sn whiskers are nano-dimensional "hair-like" crystalline eruptions that grow from Sn finished surfaces.**



## Human Hair vs. Metal Whisker

**Metal Whiskers are commonly 1/10 to < 1/100 times thinner than a human hair!!!**

- They are electrically conductive with lengths varying from microns to millimeters and thicknesses from 0.5-10 $\mu\text{m}$
- Whisker densities (whiskers/cm<sup>2</sup>) vary from a few to thousands
- Unpredictable incubation period (hours, days, years)



November 30, 2010

Metal Whiskers

(courtesy, Dr. Jay Brusse, NASA) 4

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# Tin Whisker Failure Modes

Whiskers Pose a Number of Threats for Electronics Reliability

## Electrical Short Circuits

- If current  $\leq 10$  mA, Permanent Short
- If current  $\geq 10$  mA, Intermittent Short **WHISKER MELTS**



## Debris/Contamination

- Shorts *FAR* from Whisker Origins
- Whiskers Interfere with Sensitive Optics/MEMS Devices



## Metal Vapor Arcing

- Whisker Shorts Can Vaporize into Conductive PLASMA of Metal Ions
- Plasma Forms Arc Capable of Transmitting HUNDREDS OF AMPS ! With Resulting **CATASTROPHIC FAILURE**

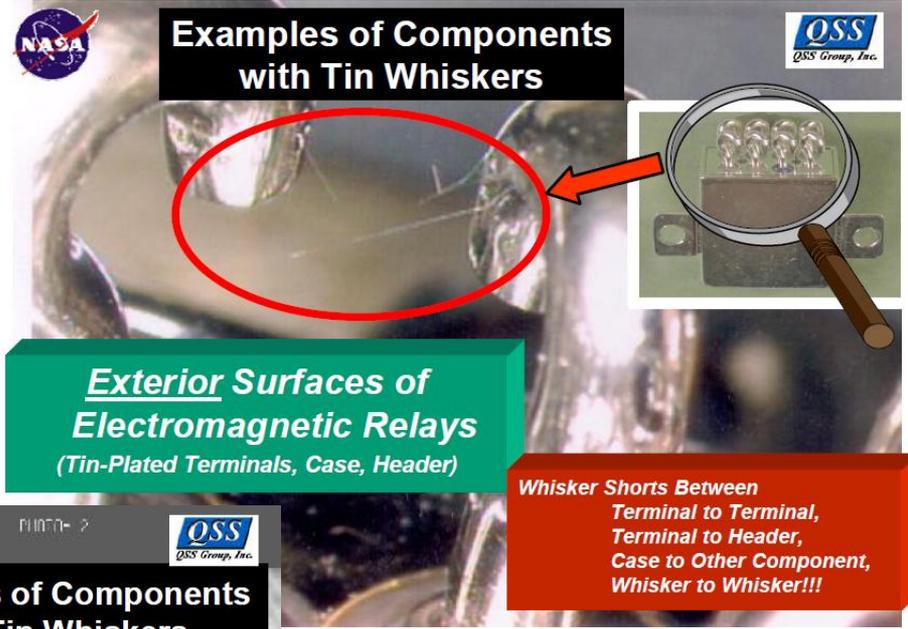


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# Where Have Whiskers Been Observed?

**Answer: Nearly Everywhere !**



(courtesy, Dr. Jay Brusse, NASA)

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# History of Documented Metal Whisker Failures: 2000s

Year**	Application	Industry	Failure Cause	Whiskers on?
2000	GALAXY VII (Side 2)	Space (Complete Loss)	Tin Whiskers	Relays
2000	Missile Program "D"	Military	Tin Whiskers	Terminals
2000	Power Mgmt Modules	Industrial	Tin Whiskers	Connectors
2000	SOLIDARIDAD I (Side 2)	Space (Complete Loss)	Tin Whiskers	Relays
2001	GALAXY IIIIR (Side 1)	Space	Tin Whiskers	Relays
2001	Hi-Rel	Hi-Rel	Tin Whiskers	Ceramic Chip Caps
2001	Nuclear Power Plant	Power	Tin Whiskers	Relays
2001	Space Ground Test Eqpt	Ground Support	Zinc Whiskers	Bus Rail
2002	DirecTV 3 (Side 1)	Space	Tin Whiskers	Relays
2002	Electric Power Plant	Power	Tin Whiskers	Microcircuit Leads
2002	GPS Receiver	Aeronautical	Tin Whiskers	RF Enclosure
2002	MIL Aerospace	MIL Aerospace	Tin Whiskers	Mounting Hardware (nuts)
2002	Military Aircraft	Military	Tin Whiskers	Relays
2002	Nuclear Power Plant	Power	Tin Whiskers	Potentiometer
2003	Commercial Electronics	Telecom	Tin Whiskers	RF Enclosure
2003	Missile Program "E"	Military	Tin Whiskers	Connectors
2003	Missile Program "F"	Military	Tin Whiskers	Relays
2003	Telecom Equipment	Telecom	Tin Whiskers	Ckt Breaker
2004	Military	Military	Tin Whiskers	Waveguide
2005	Communications	Radio (1960s vintage)	Tin Whiskers	Transistor TO Package
2005	Millstone Nuclear Power Plant	Power	Tin Whiskers	Diode (Axial Leads)
2005	OPTUS B1	Space	Tin Whiskers	Relays
2005	Telecom Equipment	Telecom	Tin Whiskers	RF Enclosure
2006	GALAXY IIIIR (Side 2)	Space	Tin Whiskers	Relays

April 2006

A History of Tin Whiskers

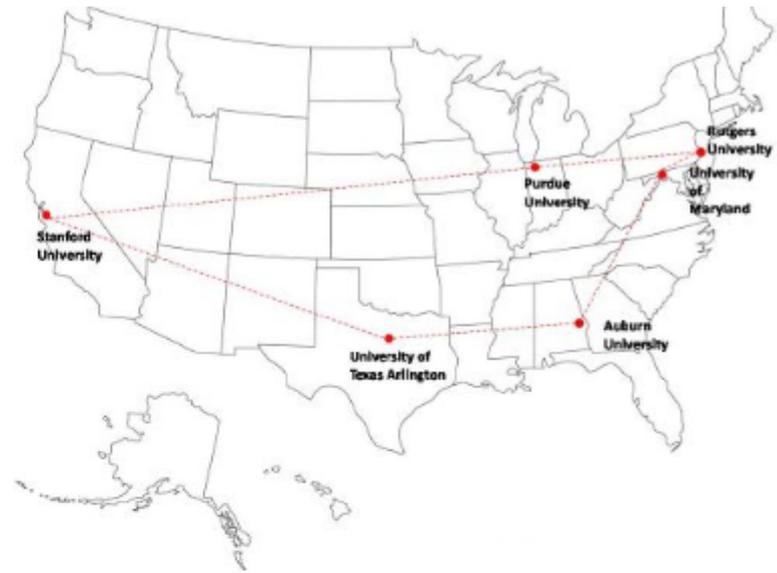
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# National Manufacturing Institute on Flexible Electronics



**Comprises 96 companies, 11 laboratories and non-profits, 43 universities and 15 state and regional organizations. The Institute will be awarded \$171 million in federal funding over a five-year period.**

The team led by Auburn University includes the following members (in alphabetic order). The main point of contact at each university has also been listed in each case:

- Auburn University (*Pradeep Lall, Walter Professor and Director*); Team-Lead
- Rutgers University (*Jaeseok Jeon, Professor*)
- Purdue University (*Ganesh Subbarayan, Professor*)
- Stanford University (*Ken Goodson, Bosch Chair and Davies Family Professor*)
- University of Maryland (*Michael Pecht, Chair Professor and Director*)
- University of Texas at Arlington (*Dereje Agonafer, Professor and Director*)

# Outreach and Faith

Itinerant SS Teacher and Friend of Pastors



**Gauging Your Spiritual Growth**  
Cascade Hills Church, Winter 2015  
Michael J. Bozack  
Leach Science Center, Department of Physics, Auburn University  
Email: [bozack@physics.auburn.edu](mailto:bozack@physics.auburn.edu)  
Website: <http://aussl.auburn.edu/>

## Introduction

One of the most misunderstood aspects of our Christian life is the subject of spiritual growth. Are you spiritually growing? What factors does spiritual growth depend on? Can you work at it? Does it happen by time or osmosis? Does it require a curriculum, a ten-step program, or by saying no to what you want in life? A proper Biblical understanding of spiritual growth will free us to serve the Lord with power and gladness. We seek to throw off common misconceptions about the subject of spiritual growth and cover the basic Biblical facts.

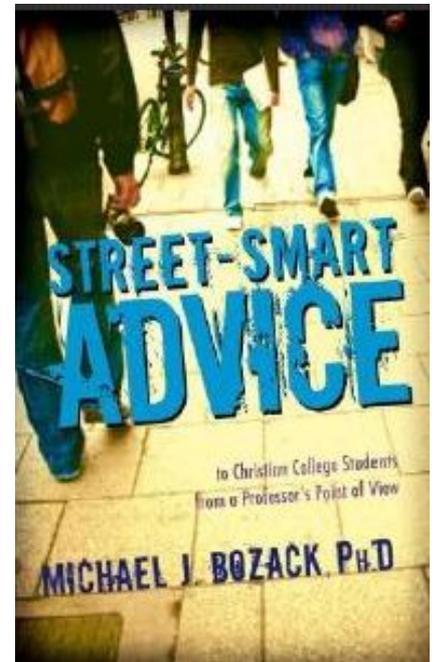
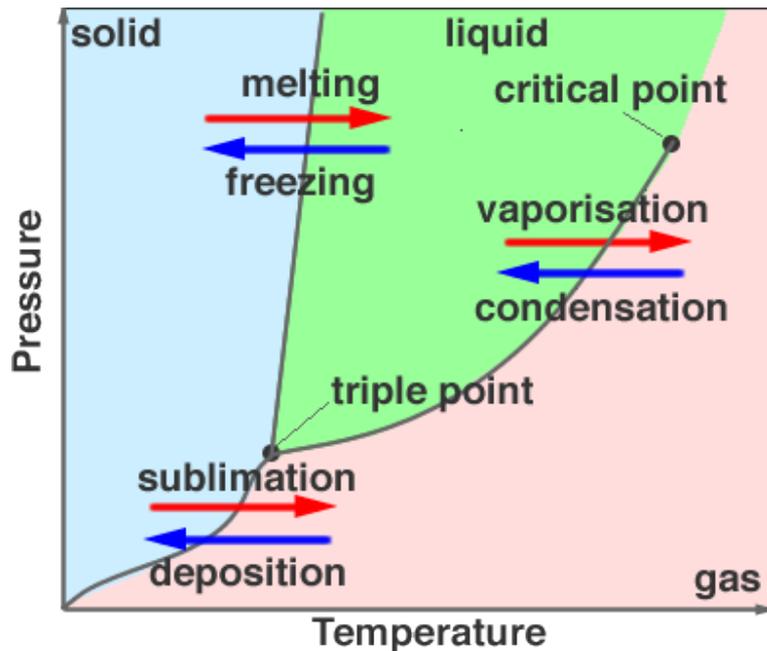


# Outreach and Faith

Producing Christian Books and Articles That Assist Faith

## THE THERMODYNAMICAL TRIPLE POINT. Implications for the Trinity

Michael J. Bozack  
Surface Science Center  
Department of Chemistry  
University of Pittsburgh  
Pittsburgh, PA 15260



## MY MINISTRY MINUTE

### Committing Academic Suicide

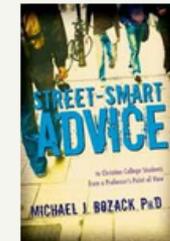
Oct 8, 2013

Michael J. Bozack  
Surface Science Laboratory  
Department of Physics  
Auburn University

It's rare for me to walk among the crepe myrtles at Auburn University and not remember that the Christian life is high adventure, filled with unexpected twists and turns crafted by the God who loves us. In my case, the fork in the road was a brush with academic suicide.

During my graduate studies in physics at Michigan State, a rare opportunity arose to go to seminary. As a young

### WORTH READING:



Michael's book provides a realistic glimpse of the hectic pace at major universities, exposes the academic and spiritual pitfalls which beset many students, and gives practical and spiritual advice for handling it all.

# The Book of Ecclesiastes In Pictures

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**5:10**

**He who loves money will not  
be satisfied with money;**

**Nor will he who loves riches  
be satisfied with what money  
can buy . . .**



**The more you have, the more you want and the less you're  
satisfied . . .**

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**5:11**

**As goods increase, so  
do those who  
consume them . . .**

**The more you have, the more  
people come after it . . .**



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**5:11**

**. . . and what advantage are great riches to their owner? Since he obviously cannot eat them, what good are they except to be looked at?**

**The more you have, the more you realize it doesn't meet your real needs . . .**



**Hope Diamond**

**Region of house actually occupied by people**



5:12

The laboring man's  
sleep is sweet  
regardless of how much  
he eats . . . but the rich  
man's wealth will not  
allow him to sleep



The more you have, the more you have to worry about . . .

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5:13-14

A painful misfortune I have seen under the sun is this—great wealth was protected by its owner to his hurt.

And when that wealth was lost through a bad mistake, he had nothing left of any value to pass along to his son . . .

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## Money

DJIA 10,557.39 ▲ 43.50 NASDAQ 2,144.11 ▲ 0.96 4:30P ET

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### Ebbers gets 25 years in fraud

By Erin McClam, Associated Press Writer

NEW YORK — Bernard Ebbers, the once-swaggering CEO of WorldCom who oversaw the largest corporate fraud in U.S. history, wept in court Wednesday after a judge sentenced him to 25 years in prison — the toughest sentence yet in the string of recent corporate scandals.

Bernard Ebbers and wife Kristie leave Manhattan federal court Wednesday.

Louis Lanzano, AP

**The more you have, the more you can hurt yourself by holding onto it and the more you have to lose.**

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**5:15**

**Naked a man comes from his mother's womb, and as he comes, so he departs. He takes nothing from his labor that he can carry in his hand . . .**



**The more you have, the more you'll leave behind . . .**

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**AUBURN**  
UNIVERSITY



## Wal-Mart heir John Walton dies in Wyoming plane crash

5:16

**Just think of the calamity! He will leave life exactly as he arrived—with nothing.**

**And what has he gained by all of his toiling for the wind in the meantime?**



**John Walton, 58, was listed as No. 11 among the world's richest people with a net worth of \$18.2 billion**

**Focus on what is important in life  
... not things and money**



**cave<sup>3</sup>**

# Outreach and Faith

## Seminars to Help Christian Students and Parents

### Surviving the High School-to-College Transition Are You Ready?

**Ministry to Students**  
Michael J. Bozack, Ph.D.  
Department of Physics  
Auburn University  
Auburn, AL 36849

- Home
- About Us
- Workshop
- Calendar
- Success Strategies
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#### Are You a Christian Student Who . . .

- Is anxious about attending college?
- Wants a high college GPA?
- Is undecided about what college to attend?
- Wonders whether you can cut it academically?
- Is clueless about what to do with your life?
- Is unsure about living in a secular college environment?
- Worries that you will abandon Christian values in college?
- Is already in college but barely making it?

#### Pastors and Youth Leaders . . .

- Do you have prospective college students in your church who would benefit from street-smart advice about how to navigate successfully through college?
- Would you like to help your Christian youth survive the difficult high school-to-college transition?
- Would you seek to insure a vital spiritual life in college so they don't get knocked off by secular culture?

#### Parents of Christian Students . . .

What would it be worth for you and your college-bound child to

#### Did You Know?

Craig Barrett, former CEO of Intel Corporation, says "if we could capture 1% of the hot air on this topic and turn it into results, it would be wonderful . . . the longer kids stay in the system, the worse they do compared to their international counterparts. In fourth grade, our kids are roughly comparable. By eighth grade, they are behind. By the 12th grade, they are substantially behind other industrialized nations."