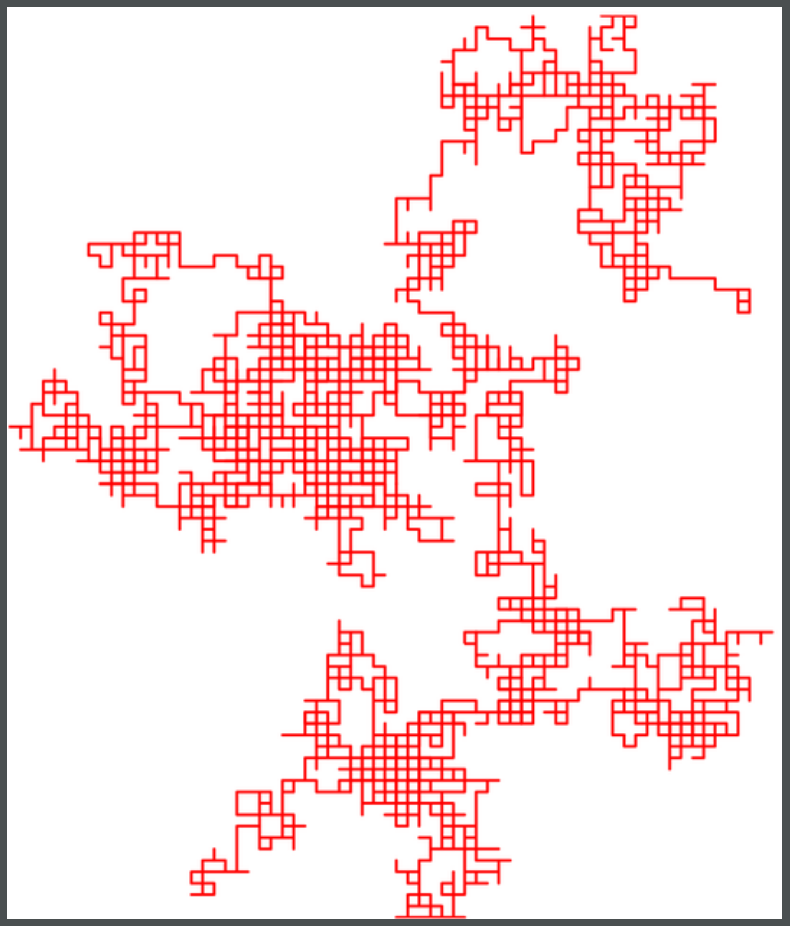
AN EE'S JOURNEY

LESA
Lighting Enabled Systems & Applications

Kenneth Connor
ECSE Dept
LESA ERC



A Random Walk Thru Technologies, Opportunities and Tinkering

- Background
- Events
- Programs
- Influences
- People
- Lessons
- Choices
- Research
- Leveraging Opportunities
- ??

OUTLINE

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Question: What Can You Learn from My Experiences as You Plan Your Careers?

Very Early Years

1957-58 – International Science

The Chosen

1963 – I Chose My Future

UW: Research, Internship, Professional Citizenship

UW: Grad School #1 & Poly: Grad School #2

RPI

& Tinkering

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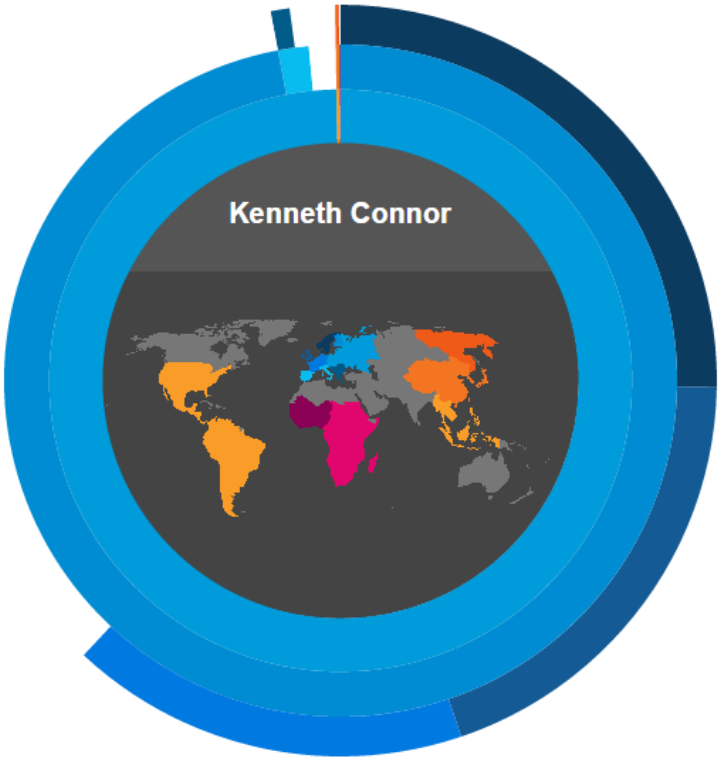
My Name is Ken Connor

I have been an ECSE Professor since 1974

Originally from Madison, Wisconsin
My family were dairy farmers until my parents' generation.
My father Steve ran a gray iron foundry for a medium size machine tool company.
He was ¼ Irish and ¾ German.
My mother Marie was a nurse. She was ¾ Norwegian and ¼ Danish.

23ANDME



99.8%	European	
	Northwestern European	
25.3%		Scandinavian
19.5%		British & Irish
17.2%		French & German
35.1%		Broadly Northwestern European
	Southern European	
0.8%		Balkan
0.7%		Broadly Southern European
1.3%	Broadly European	
0.2%	East Asian & Native American	
	East Asian	
0.2%		Yakut
0.1%	Sub-Saharan African	
0.1%		West African
< 0.1%	Unassigned	
100%	**Kenneth Connor**	

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I Was Born as Soon as My Parents Could Manage after my Dad Returned from WWII

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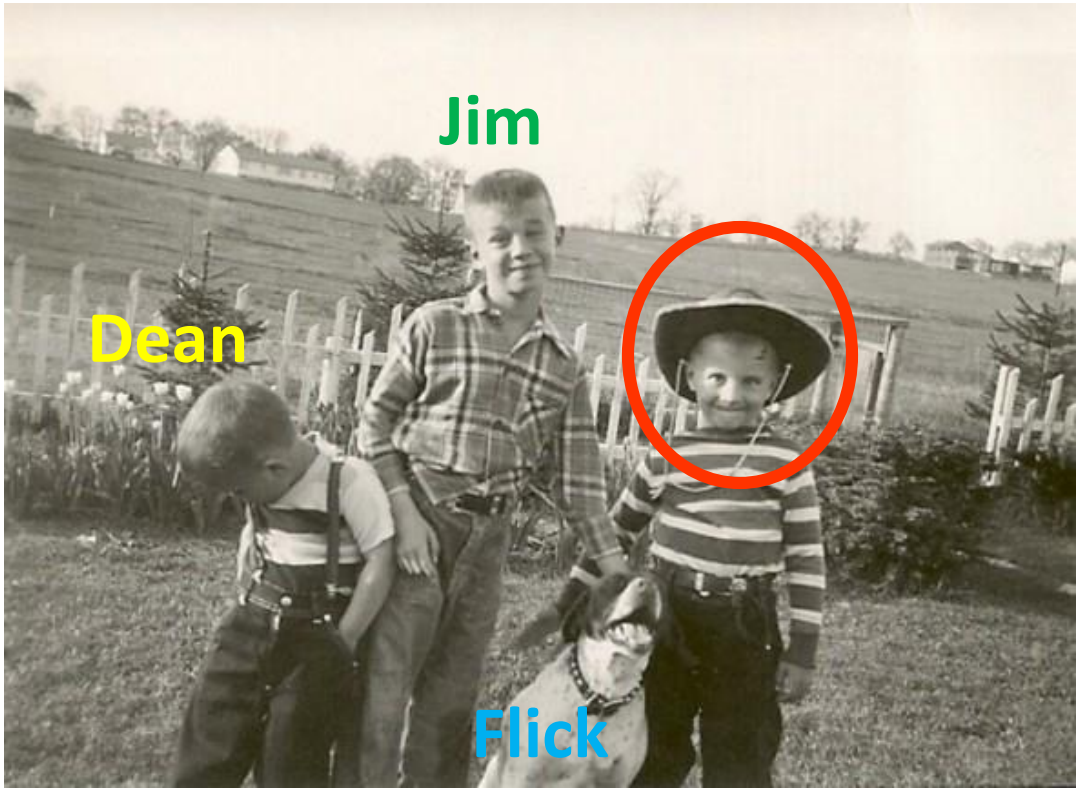
I Have Two Brothers



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I Attended Mendota School from 1952-1958

WHY AM I AN ENGINEER?

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- 4 October 1957 – Sputnik 1 **(Спутник-1)**
- 6th Grade Class – 4 students selected for advanced studies **Be Ready for Opportunities!**
- 7th & 8th Grade Math & Science Combined
- Began HS Math & Science in 8th Grade

Diameter = 58.5 cm

Inside

Sounds

http://www.nytimes.com/interactive/2007/09/24/science/space/20070924_SPUTNIK_GRAPHIC.html#tab1
http://www.mentallandscape.com/Sputnik1_WashingtonDC.mp3

4 Oct – Between games 2&3 of Series

SPUTNIK IMPACT ON EDUCATION

The students in Mr. Smoot's science class in 1957 in the Lewis School in Birmingham, Ala., might not have seen Sputnik or heard its beeping, but they felt its presence.

"We stopped having throwaway science and started having real science," recalled Shirley Malcolm, one of the students. "Here I was, a black kid in a segregated school that was under-resourced — Sputnik kind of crossed the barrier. All of a sudden everybody was talking about it, and science was above the fold in the newspaper, and my teachers went to institutes and really got us all engaged. It was just a time of incredible intensity and attention to science."

Little Rock, Arkansas 1957

A Russian guide-engineer at a Moscow exhibition displays a replica of the Soviet satellite Sputnik 1, November 1957. *Bettman/Corbis*

Broadcast at
20.007 MHz and 40.002 MHz

https://www.nytsyn.com/archives/photos/751637.html

http://www.nytimes.com/2007/09/25/science/space/25educ.html

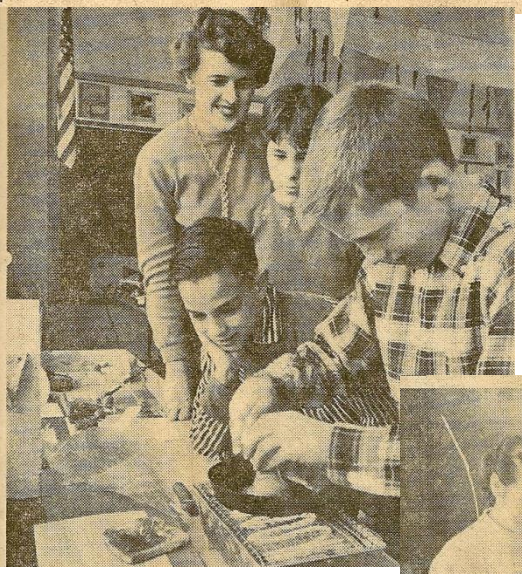
http://www.npr.org/templates/story/story.php?storyId=14829195

In Mendota School 6th Grade

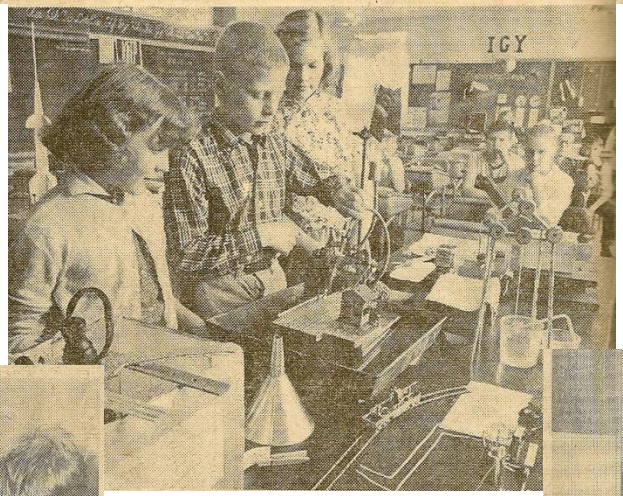
Hold Science Fair

What's Doing In Madison Schools

WEEKLY REPORT CARD



What is significant in these pictures?



Me

Several weeks of scientific study and project work were climaxed recently when pupils of the sixth grade at Mendota School staged their second annual Science Fair. Various ingenious "gadgets" developed by each pupil were displayed and prizes were awarded for the best entries. An evening open house was held so parents could inspect the projects. The first-prize winner is in the picture at the upper left. The teacher, Carolyn Anderson is in the background. The others (rear to front) are Cheryl Moore, Eddy Gadzia, and Ronnie Trachte, who is dropping an egg into a pan, which is resting on an electric "stove" made by Ronnie. At the top, right, Steve Sprague (center) is demonstrating his water generator which won second prize. Watching are Polly Frihart (left) and Kim Klipstein. The group at the lower left includes Mary Joe Gross (left), who is watching closely as Leslie FaFard (center) and Ken Connor show off their respective electric eye and atomic generator devices. The three (lower right) include Mary Joe Gross (left); Jim Cron, pointing to simple machines made by him, and Janice Menge. **(Photos by Clarence E. Olson)**

29 March 1958

WHY AM I AN ENGINEER?

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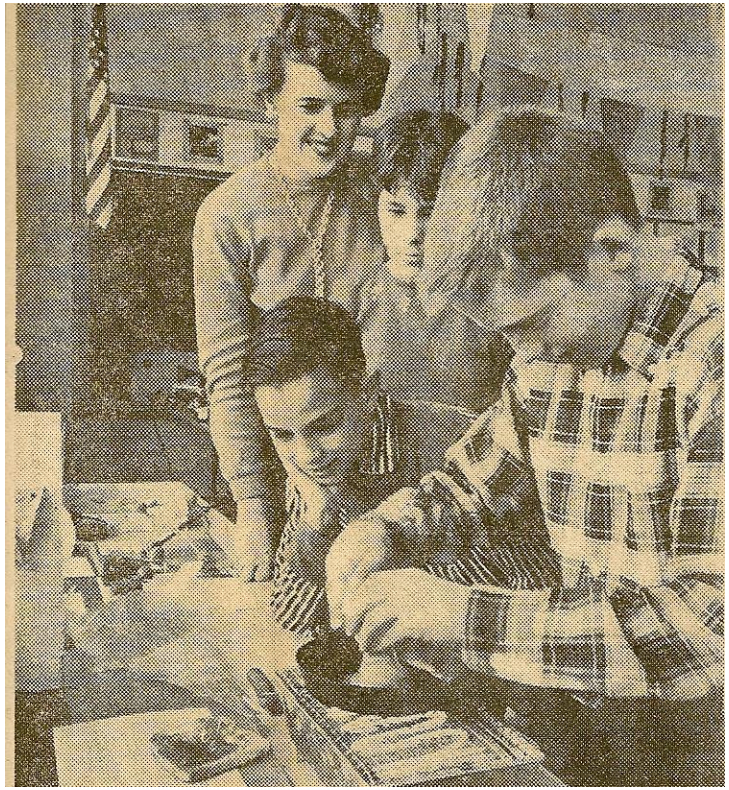
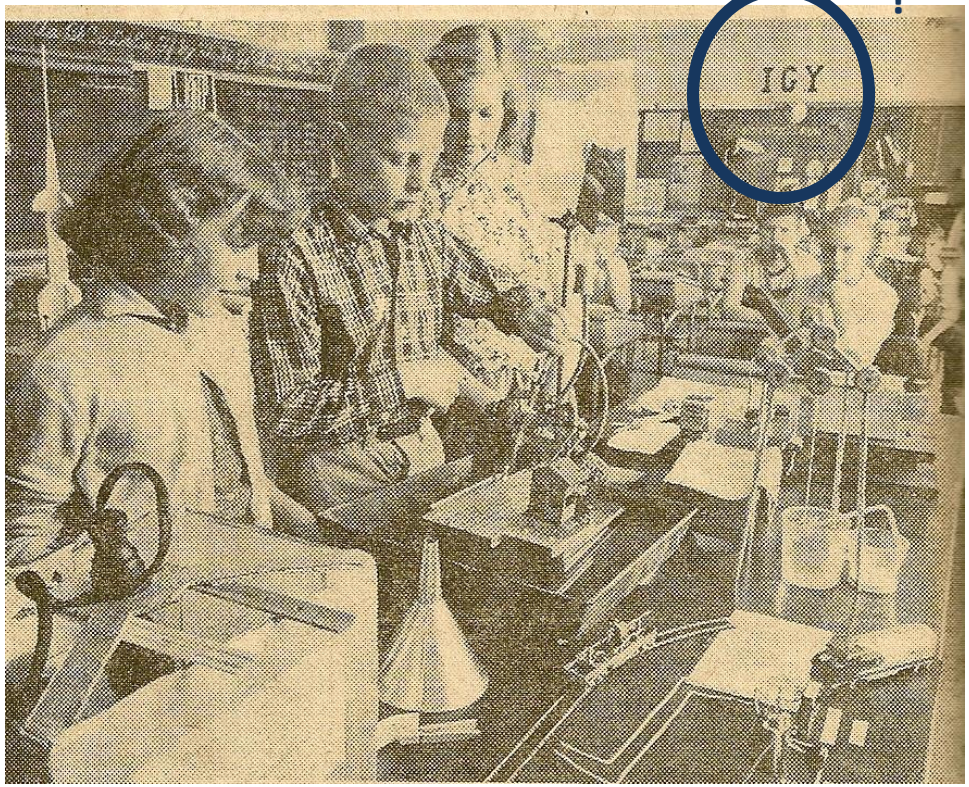
In Mendota School 6th Grade

Hold Science Fair

What's Doing In Madison Schools
WEEKLY REPORT CARD





?

IGY: INTERNATIONAL GEOPHYSICAL YEAR

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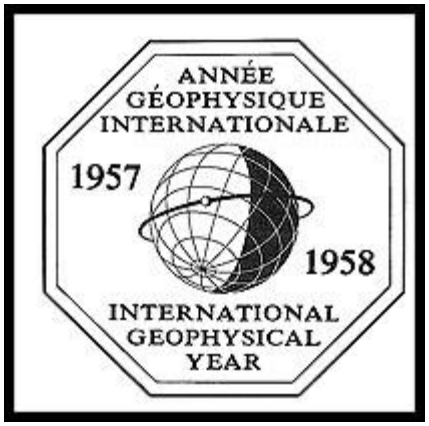
From Wikipedia:

- International scientific project that lasted from 7-1-57, to 12-31-58 (After Josef Stalin's death.)
- 67 Countries, 11 Earth sciences: aurora and airglow, cosmic rays, geomagnetism, gravity, ionospheric physics, longitude and latitude determinations, meteorology, oceanography, seismology, and solar activity.
- Soviet Union and the U.S. launched artificial satellites. Van Allen Belt discovered. Plate Tectonics confirmed.



Science & Engineering Were Highest Priorities

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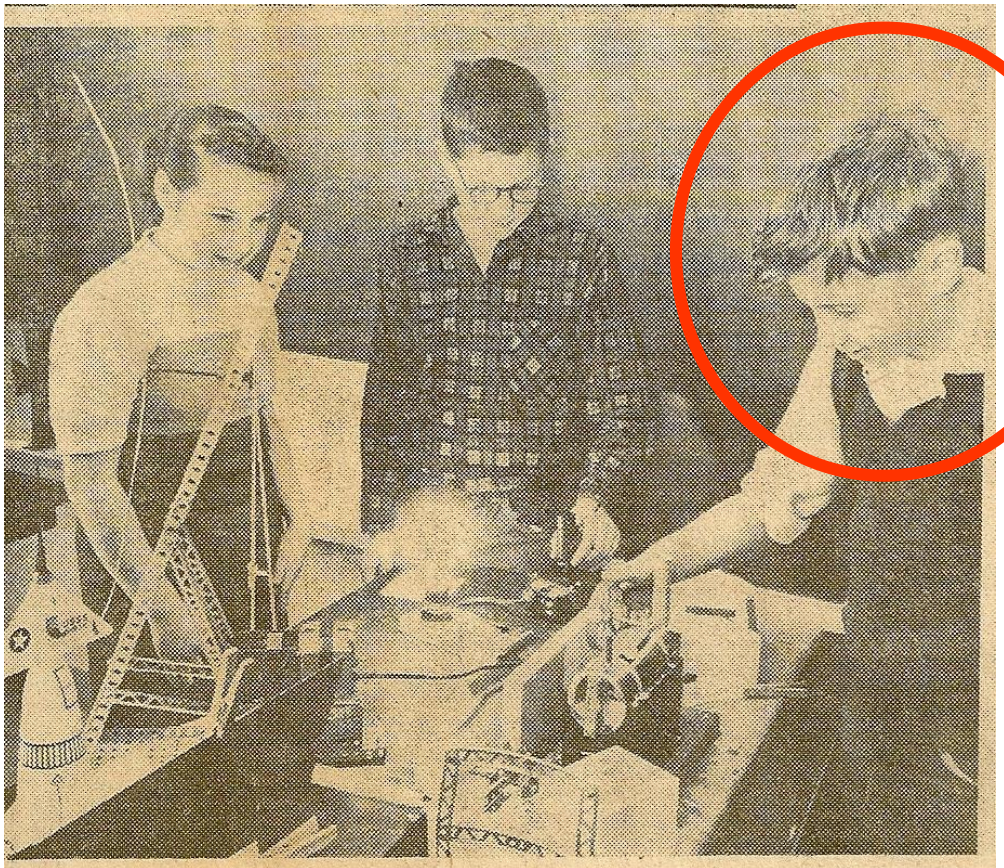

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Who was doing & who was watching?

WHY AM I AN ENGINEER?

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In 6th Grade, I decided to become an EE

- Good in math & science – become an engineer
- I began playing with electronics, especially radios – EE
- Why did I go to engineering school when none of the other three accelerated students from my elementary school did?
  - My theory – my dad was the 'go to' person for our extended family … if anyone had a problem they could not solve, they asked him to help. This made his sons problem solvers … it does not matter what the problem was, we do our best to find a solution.
  - Another theory – two were young women
  - Two became teachers … the other one???

WHO AM I?

I attended Sherman Junior High School from 1958 – 1961

I attended East High School from 1961 - 1964

Go East! Madison East High School
Go Purgolders!

WHY AM I AN ENGINEER?

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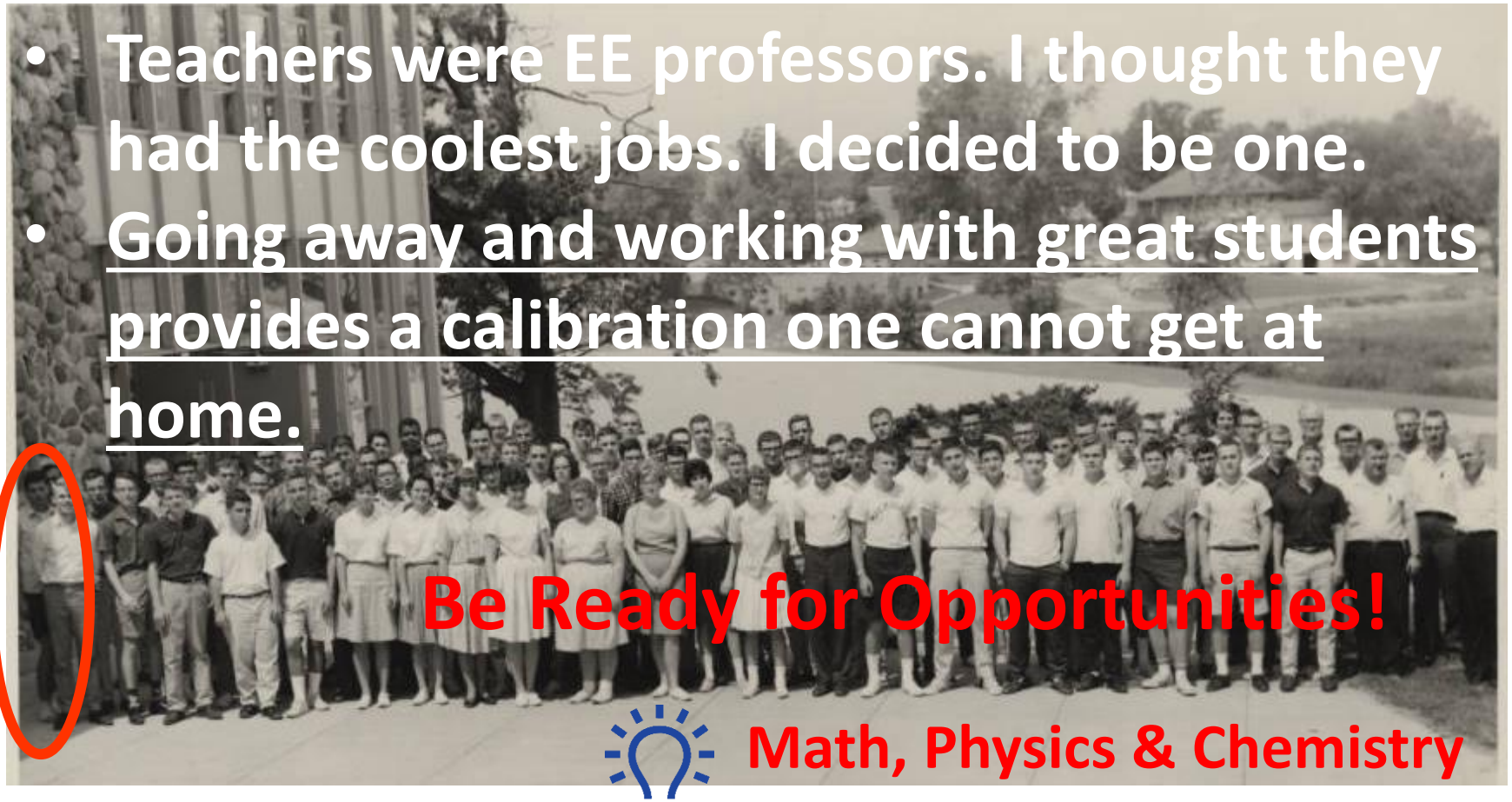
Honors Institute for Young Scientists: 8 Wks Summer 1963 (Grand Rapids & Ann Arbor)



- Teachers were EE professors. I thought they had the coolest jobs. I decided to be one.
- Going away and working with great students provides a calibration one cannot get at home.

Be Ready for Opportunities!

Math, Physics & Chemistry

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The Family Dairy Farm (Norway Grove, WI)

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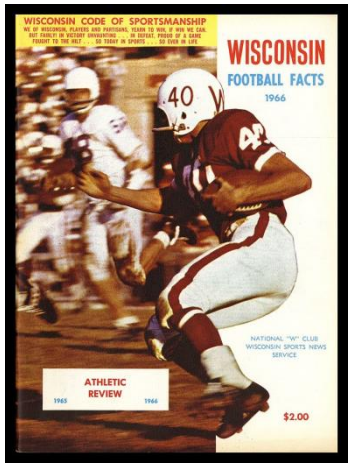
I Attended the University of Wisconsin from 1964-1970 Receiving 2 EE Degrees

Students
Kidnap
Dow
Recruiter

THE UNIVERSITY of WISCONSIN MADISON

Physics
Building
Bombed



UW Football 11-45-3 during these years

WHY AM I AN EE PROFESSOR?

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Key Events: **Be Ready for Opportunities!**

- Many Part-Time Jobs
- Professional Picket for Retail Clerks in 1965
- Gisholt: I worked for my Dad in 1966
- **Solid-State Lab:** I worked for 2+ years in a solid-state lab, assisting a grad student
- **John Deere:** Summer Internship in 1967
- **HKN:** I was very active in HKN leadership
  - Got to know many faculty
  - Identified the professor I wanted to do grad work with – Plasma Physics/Engineering

WHY AM I AN EE PROFESSOR?

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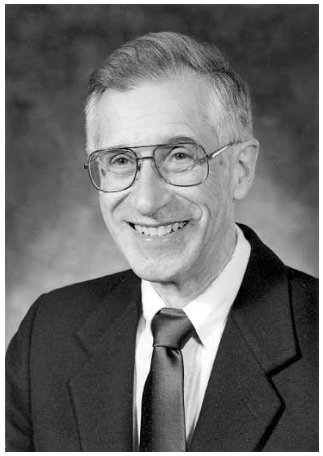
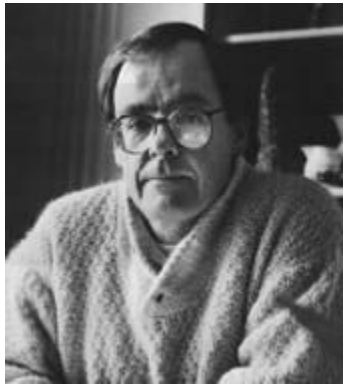
Solid-State Lab, ECE Dept, Wisconsin

- Prof. James Nordman
  - Semiconductors
  - Superconductivity
- Prof. Alwyn C. Scott
  - Helped pioneer the understanding of nonlinear waves, emergent mental patterns and human consciousness
  - UW, Arizona, DTU, LANL …





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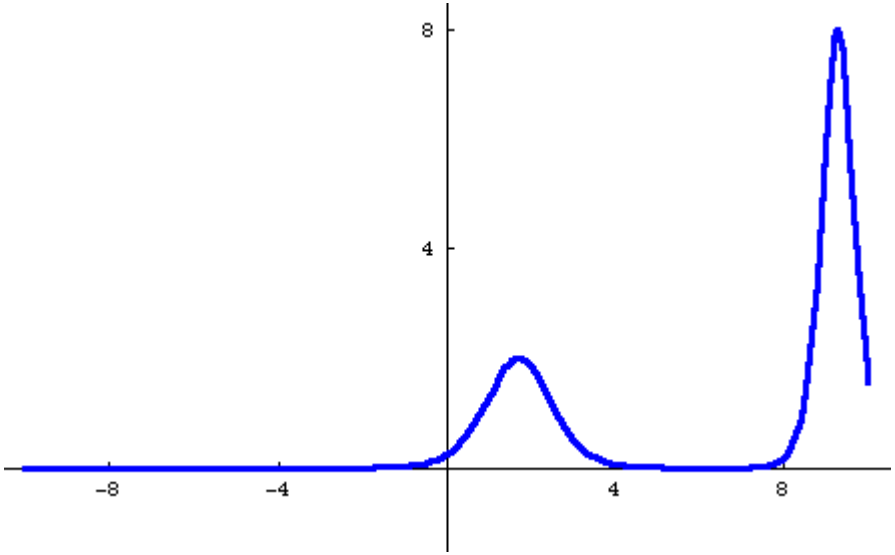
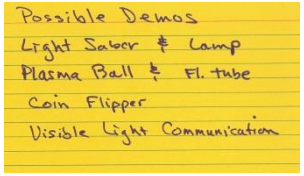
Al Scott

A remarkable surge in the interest in solitons in biology occurred in the early 1970s because of two people: Alwyn C. Scott, a powerful theoretical physicist with a strong interest in nonlinear phenomena and biology, and Alexander Davydov, an eminent theoretical solid state theorist.



In 1834, John Scott Russell made the discovery of the wave of translation that gave birth to the modern study of solitons.



http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2660402/

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Juris Afanasjevs

Juris Afanasjevs (S'62–M'75) was born in Kacene, Latvia, in 1941. He received the B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Wisconsin, Madison, in 1963, 1965, and 1969, respectively.

After working for three years in medical Electronics in private industry, he joined the Space Science and Engineering Center, University of Wisconsin, as a Staff Engineer. Presently he is a Program Manager at the Center.

From 1976 IEEE Paper: No publications after that.

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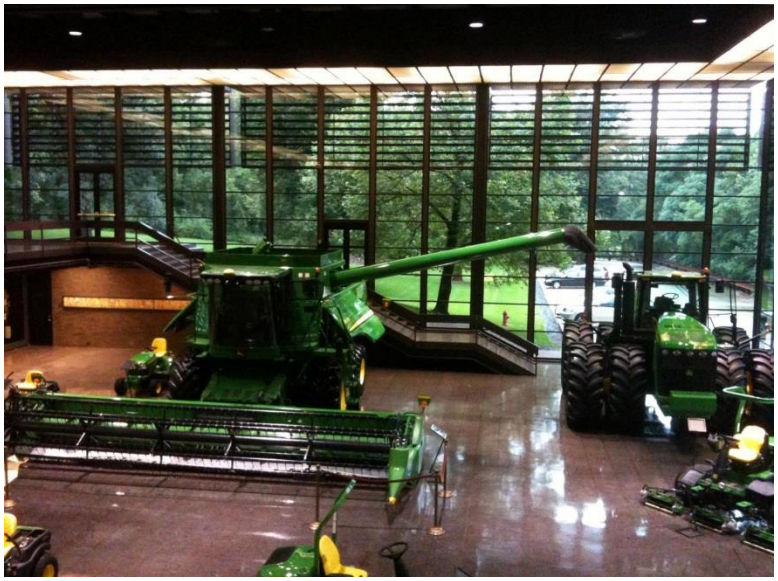
John Deere Dubuque Works Internship – 1967

- Goal: Experience the life of a BS engineer
  - What can one do with BSEE?
  - Being paid like an engineer.
- Plant Engineering – Document power and control systems throughout plant
- Mid-Summer Meeting – Report on summer
- Research & Development – Front end loaders connected to RV full of instrumentation

JOHN DEERE WORLD HEADQUARTERS



Eero Saarinen

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What Did I Learn?

- Engineer vs. Technician
- Industry goal is to make money, not the best product.
- Companies have cultures – AE & ME at JD
- Don't talk to management without preparation. **Be Ready for Opportunities!**
- Big companies have a lot of money and amazing facilities.
- I definitely wanted to go to grad school.

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HKN

- Joined as junior, leadership as senior
- Published Newsletter (**ICBS**)
  - Transient Controversy
  - Steady-State
- Lessons/Benefits
  - Being known is good, bad writing is be writing
  - We used HKN to learn what we neede about grad school
  - Honorary societies are not just resume fillers, they are what you make of them
  - Found my first grad advisor – Prof. Leon Shohet

P. Hernday M. Vidyasagar

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Off Resonant Microwave Heating of a Mirror-Confined Plasma

- With J. Clint Sprott & J. Leon Shohet
  - Clint filled in for Leon while he was on sabbatical in France
- Heating at 3GHz and 8.54GHz
- Supported work that became the Elmo Bumpy Torus fusion experiment at Oak Ridge
- Helped me decide that I was indeed an experimentalist, but I should have a solid theory background … decided to change schools.

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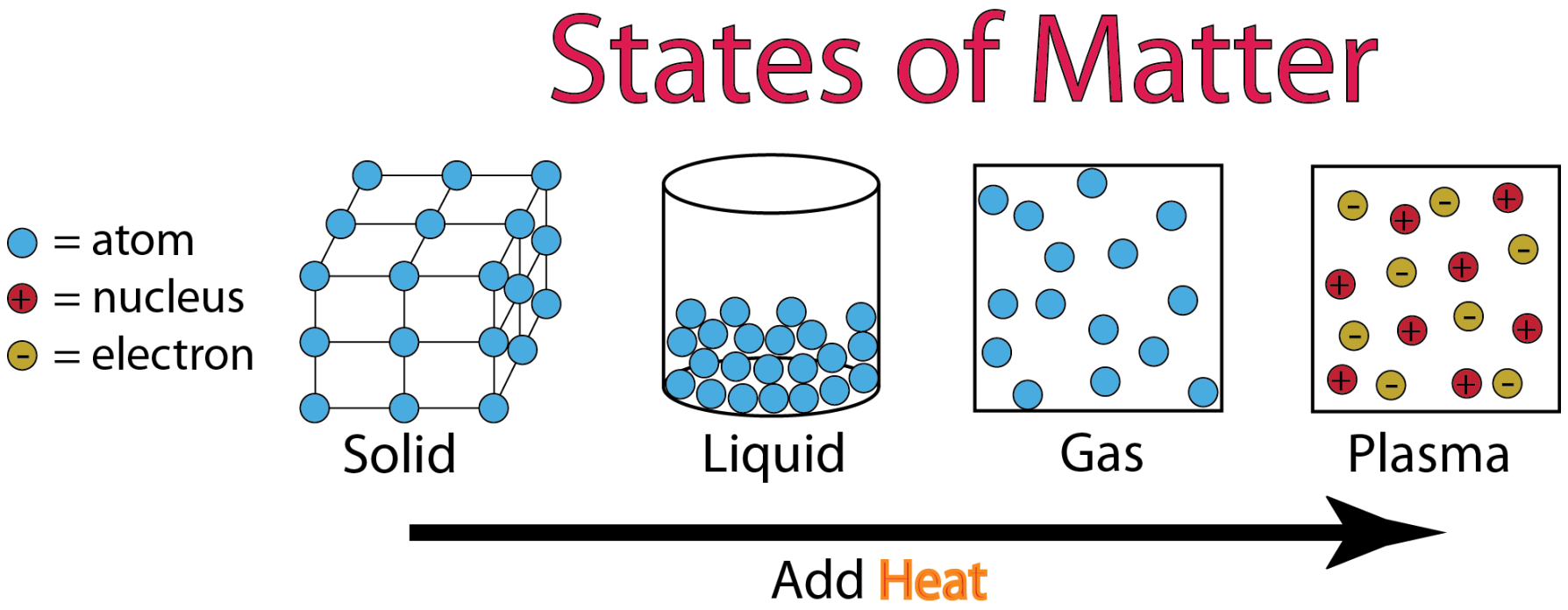
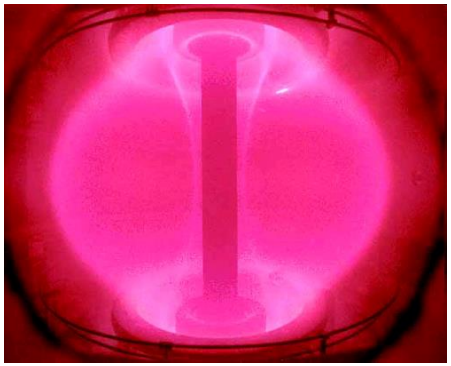
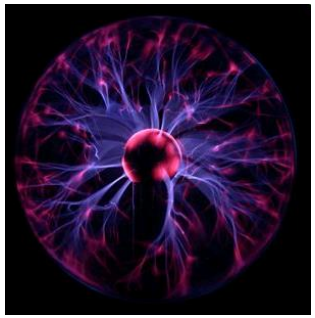
Plasma – Fourth State of Matter

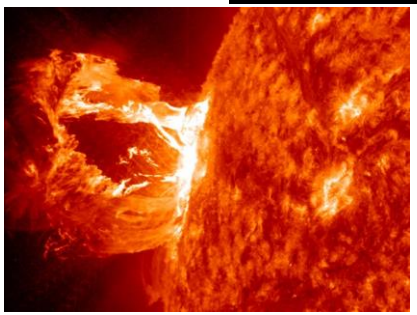


Examples?

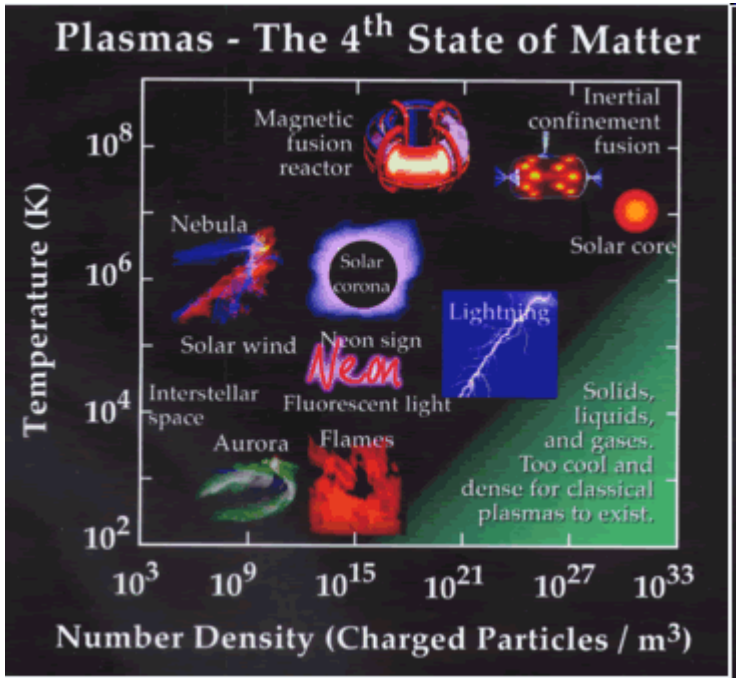
WHAT IS A PLASMA & WHY DO WE CARE?

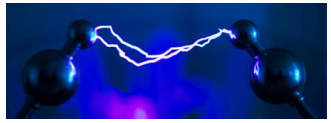






http://www.plasmas.org/





http://www.plasmas.com/

http://en.wikipedia.org/wiki/Plasma_physics

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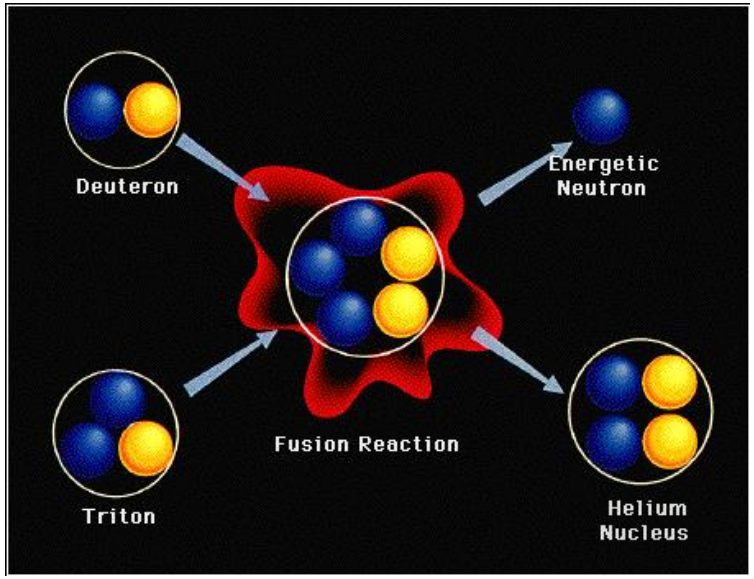
Fusion



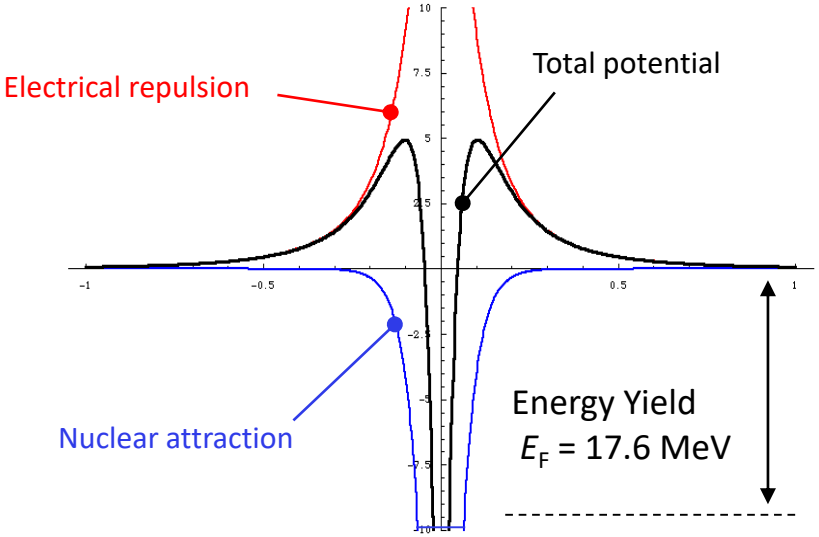
E_n = 14MeV

deposited in heat exchangers containing lithium for tritium breeding

E_α = 3.5 MeV

deposited in plasma, provides self heating

Potential energy



About 10 keV of kinetic energy is required to overcome the Coulomb barrier to obtain nuclear reaction

The nuclear interaction has short range whereas the Coulomb interaction is long range

The fusion reaction rate of an energetic T in a D target is much less than the energy loss rate due to Coulomb scattering

Plasma?

NUCLEAR FUSION – MAGNETIC CONFINEMENT

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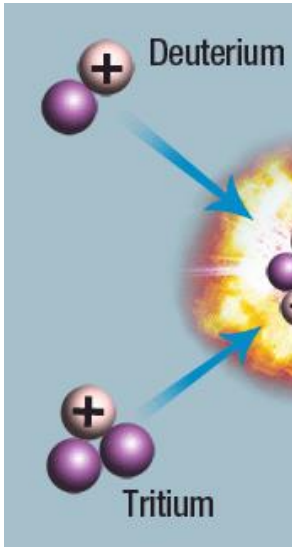

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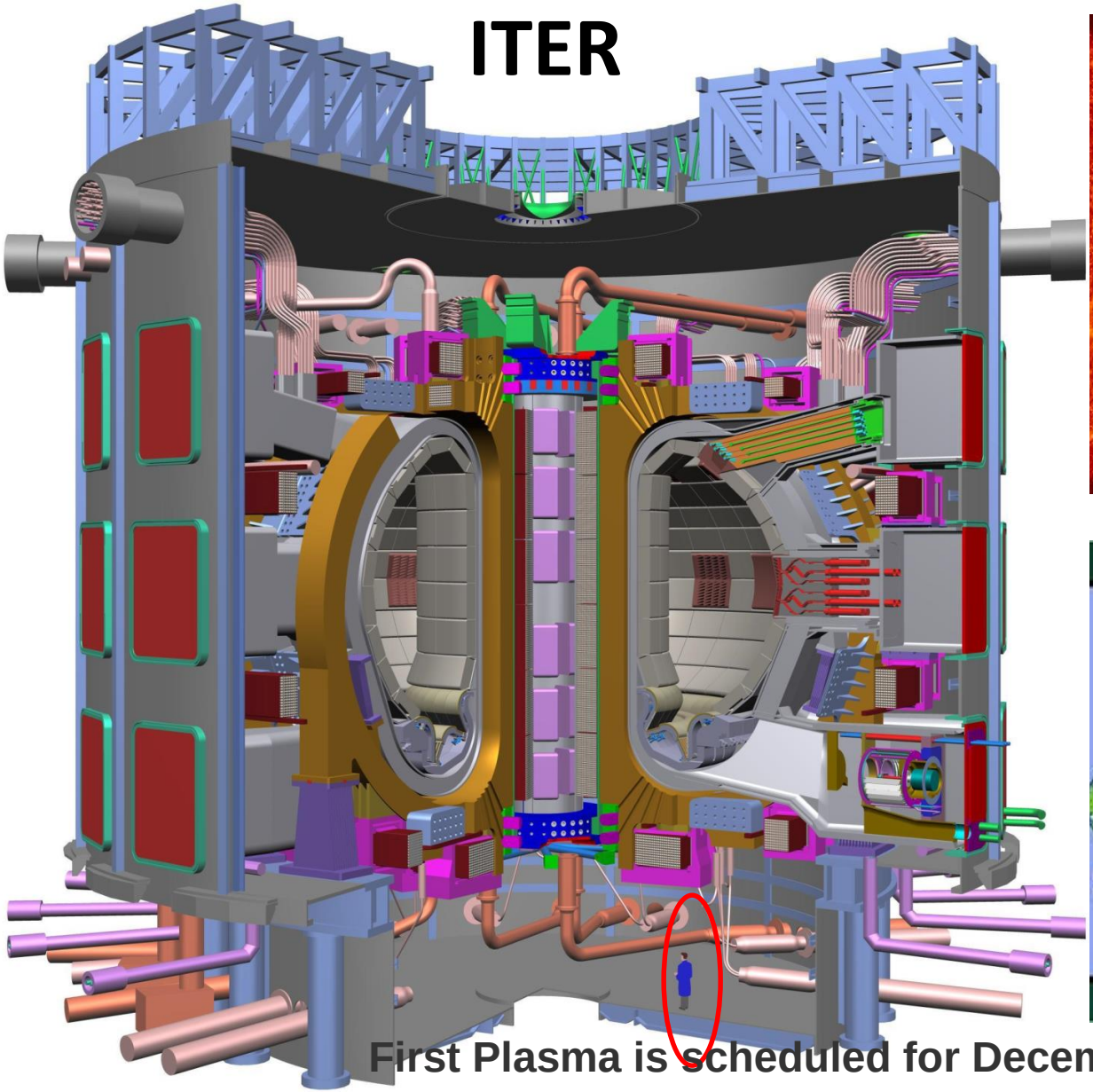

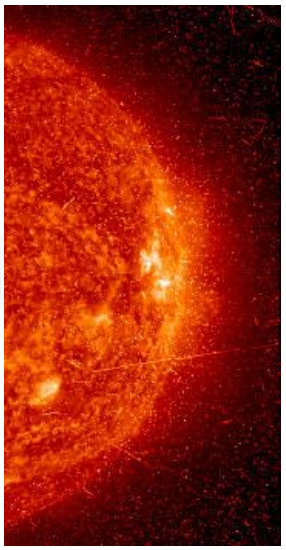

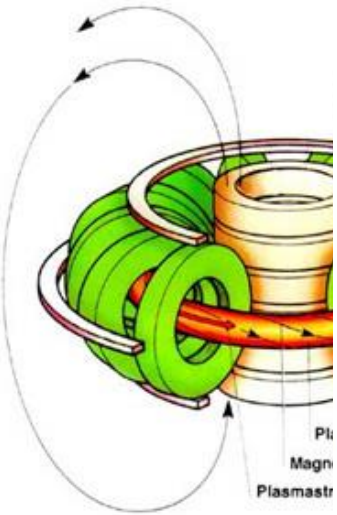

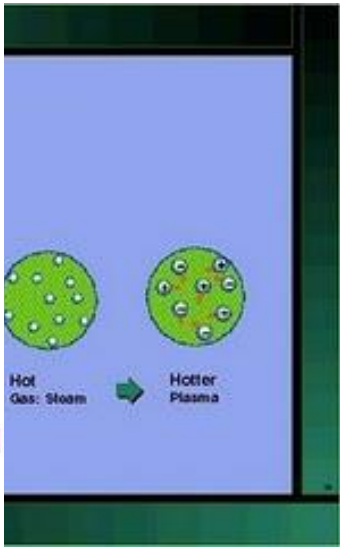

First Plasma is scheduled for December 2025

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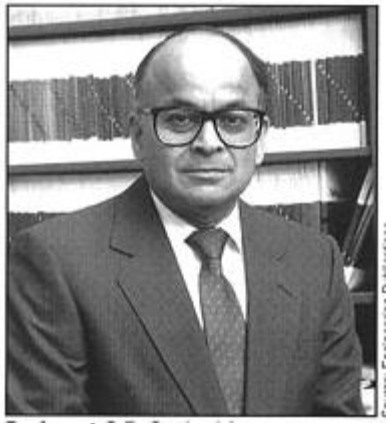
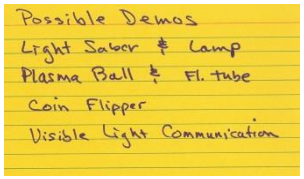
Courses/Building Blocks (Examples)

- Electromagnetic Theory
- Statistical Thermodynamics, Kinetic
- Power, Electronics, Communications
- Wave Phenomena (Linear & Nonline
- Instrumentation
- Classical Mechanics
- Numerical Methods
- Applied Mathematics



To pursue a career in plasmas, I decided to build a foundation in electromagnetic theory in my doctoral studies.
(Favorite Prof – S. R. Seshadri)



WHY AM I AN EE PROFESSOR?

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THE UNIVERSITY of WISCONSIN MADISON

NYU·poly
POLYTECHNIC INSTITUTE OF NYU

Rensselaer

Be Ready for Opportunities!

- I attended the Polytechnic Institute of Brooklyn from 1970 – 1974 receiving a PhD in Electrophysics
- I have been a professor of Electrical Engineering at Rensselaer Polytechnic Institute in Troy, NY since 1974.

http://kenconnor.org

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Thesis: Complex Space-Time Rays and Their Application to Pulse Propagation in Lossy, Dispersive Media

- Geometrical Optics (Ray Theory) is a powerful analytic approach to studying wave propagation.
- Plasmas are lossy, dispersive media
- My advisor (Leopold Felsen) was a leading expert on the waves of the electromagnetic spectrum, waves in water and other media. NAE member and fellow of many orgs … poet. A goal was to work for someone who was the world's best.

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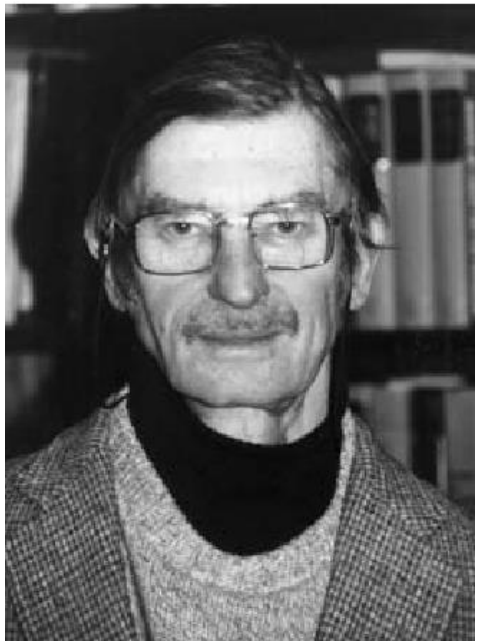
Poet's Corner

EVANESCENT PROFESSORS
Occasions like the present one
Remind those who have come of age
That surely there will be a time
When they will move from center stage.
Just how a person leaves the stage
Is often difficult to say.
Old soldiers, getting to that point,
They never die, they Fade Away.
Professors somehow do the same.
How it is done, you'll hardly guess.
For those of us who deal with Waves,
We do not fade, we Evanesce.



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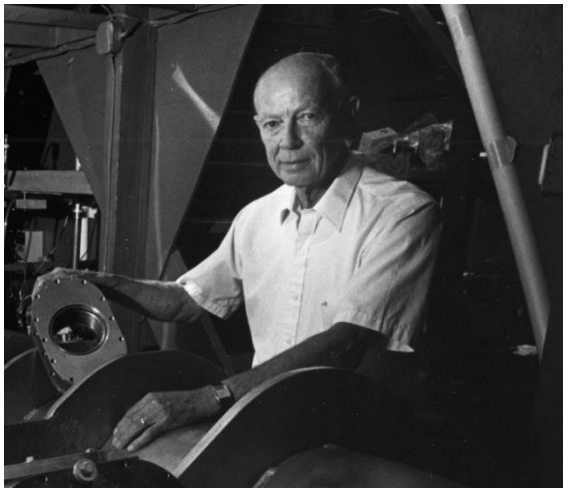
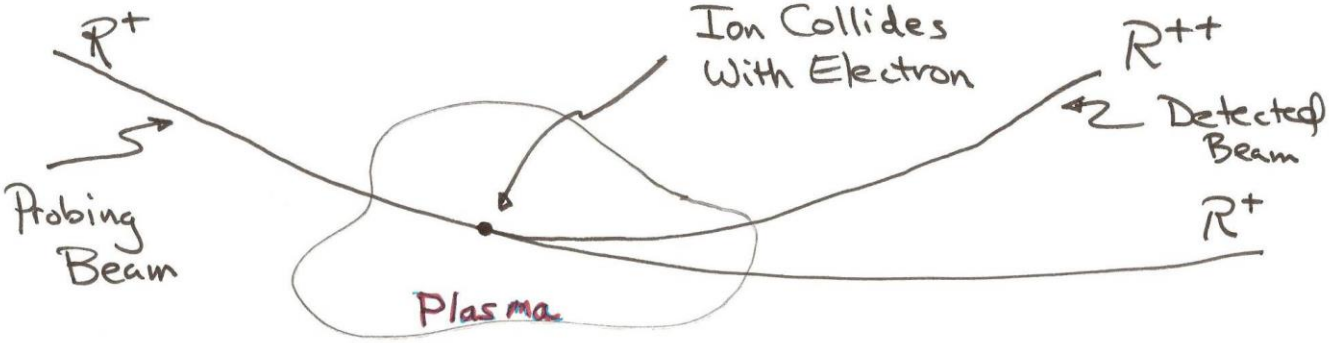
Heavy Ion Beam Probing

- Idea from Bob Hickok
- Measurements: Potential, Density, Fluctuations

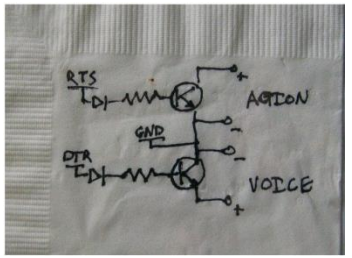




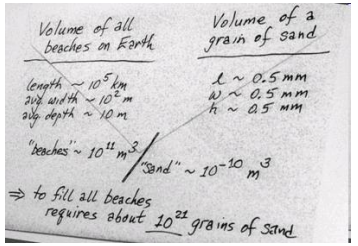
Ions Used: Na^+, K^+, Rb^+, Cs^+, Tl^+

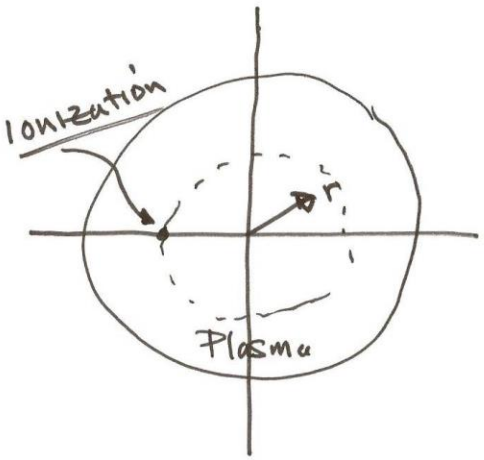
$$R^+ + e \rightarrow R^{++} + 2e$$

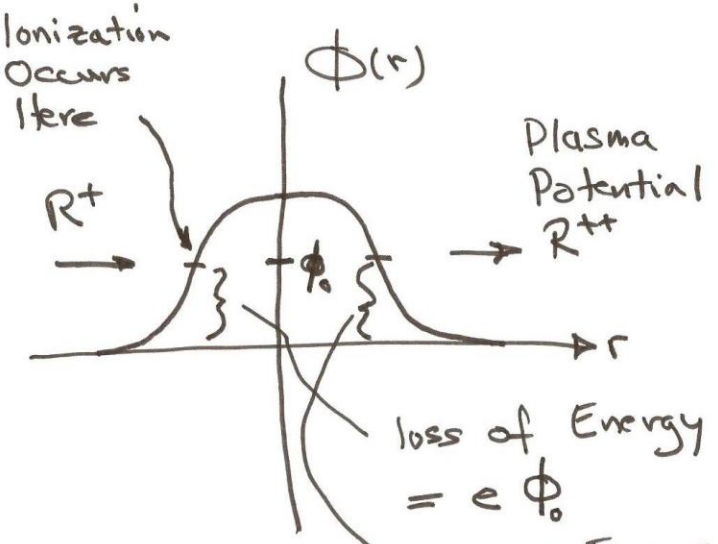
Ionization

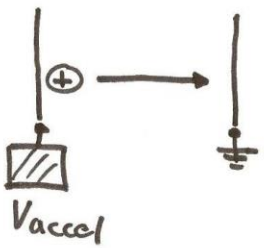


Napkin Science









As ion leaves the accelerator

$$\text{Energy} = \frac{1}{2} m_i v_i^2 = e V_{accel}$$

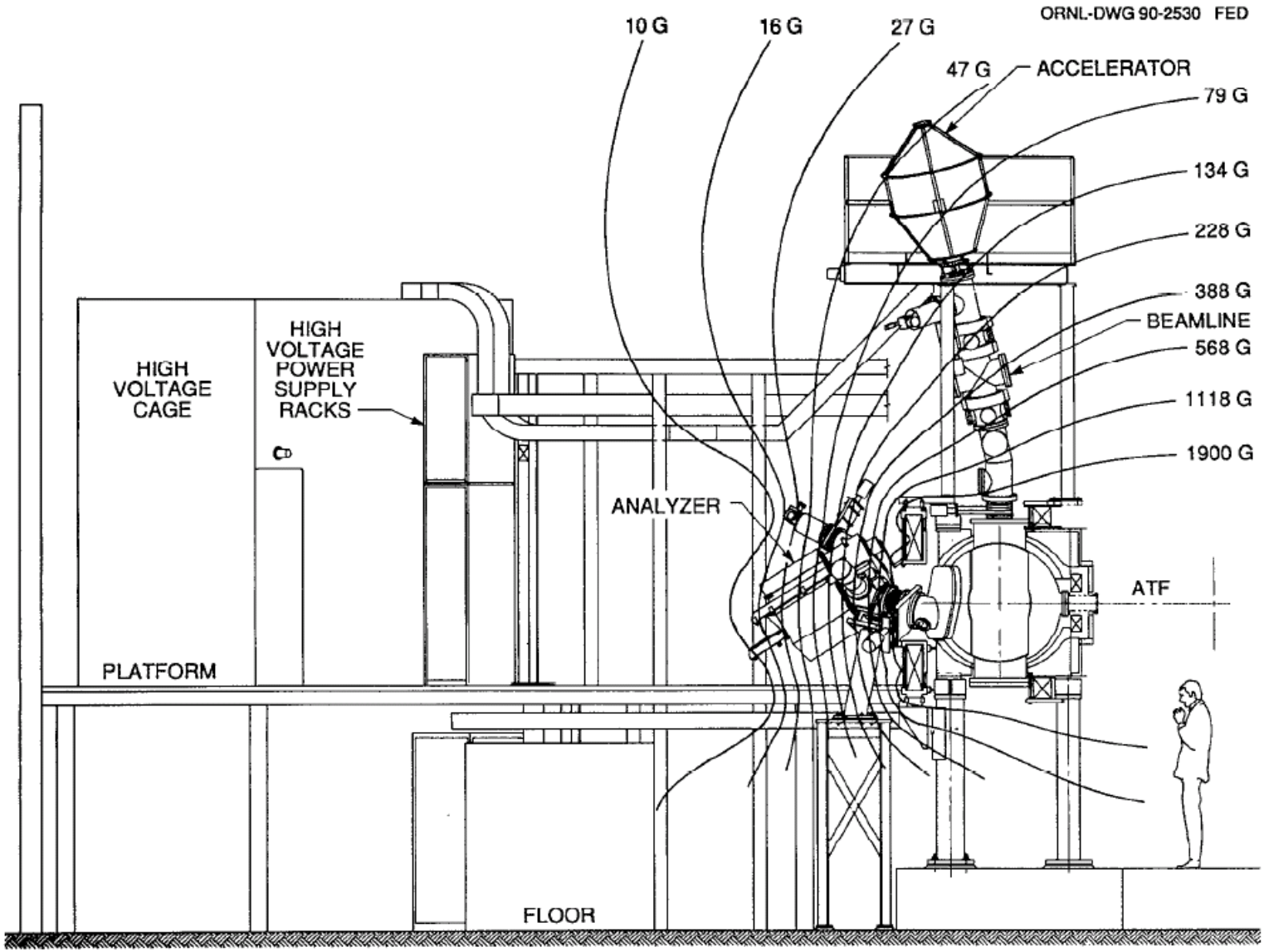
As ion moves from one potential to another $V_1 \rightarrow V_2$

$$\Delta E = eV_1 - eV_2$$

$$\text{Energy Out} = e V_{accel} + e\phi_0$$

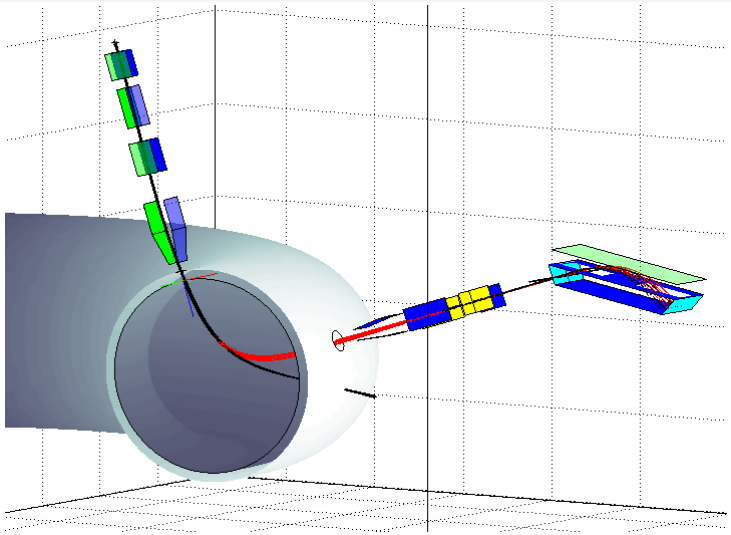
Really Big Voltmeter

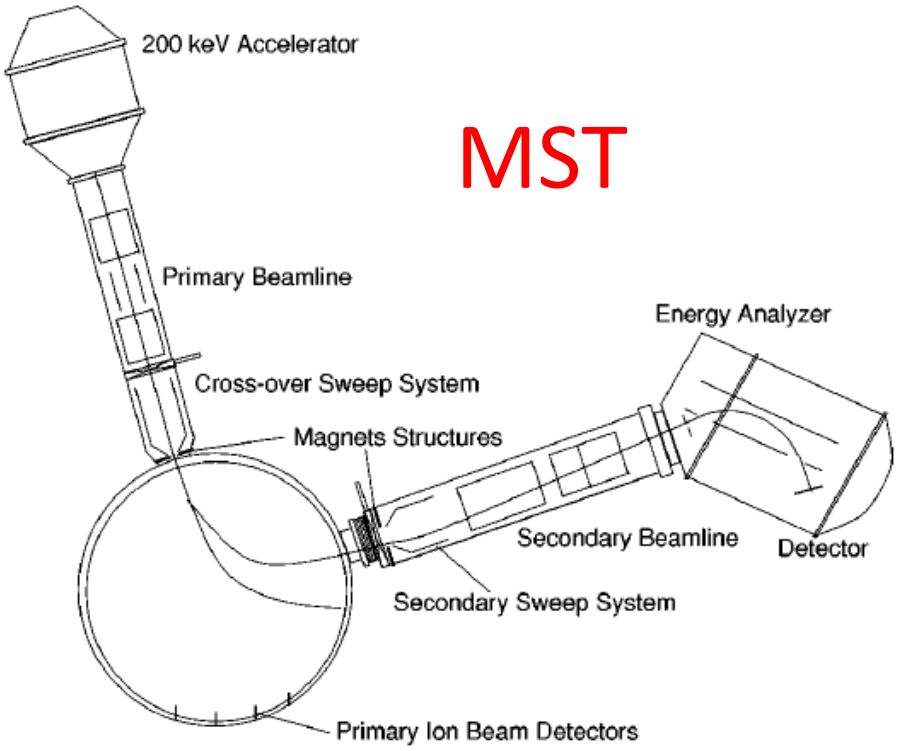
HIBP


ORNL-DWG 90-2530 FED
10 G
16 G
27 G
47 G
ACCELERATOR
79 G
134 G
228 G
388 G
BEAMLINE
568 G
1118 G
1900 G
HIGH VOLTAGE CAGE
HIGH VOLTAGE POWER SUPPLY RACKS
ANALYZER
ATF
PLATFORM
FLOOR

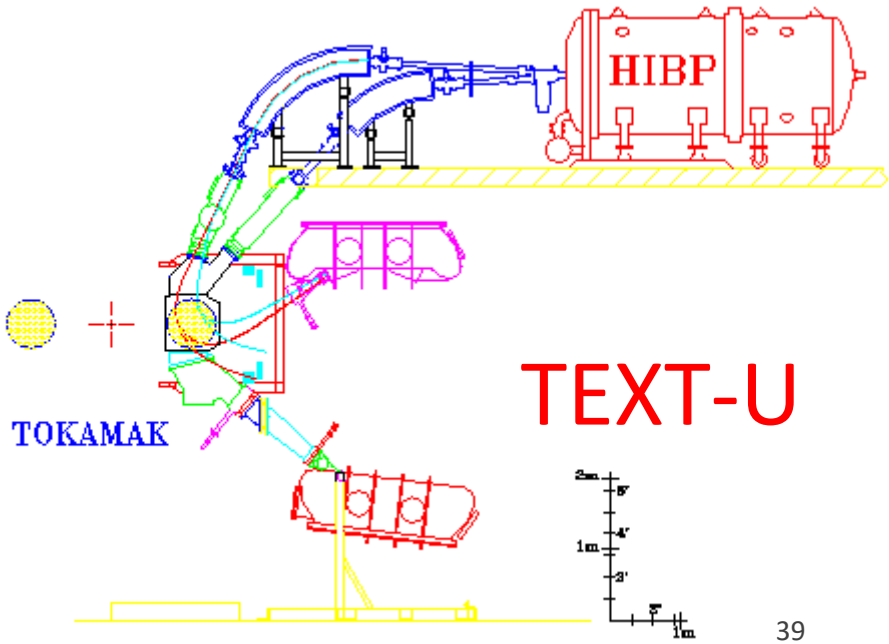
HIBP

ORNL: HIBP, ISX-B, ATF
Texas: TEXT, TEST-U
Wisconsin: MST
LLNL: TMX



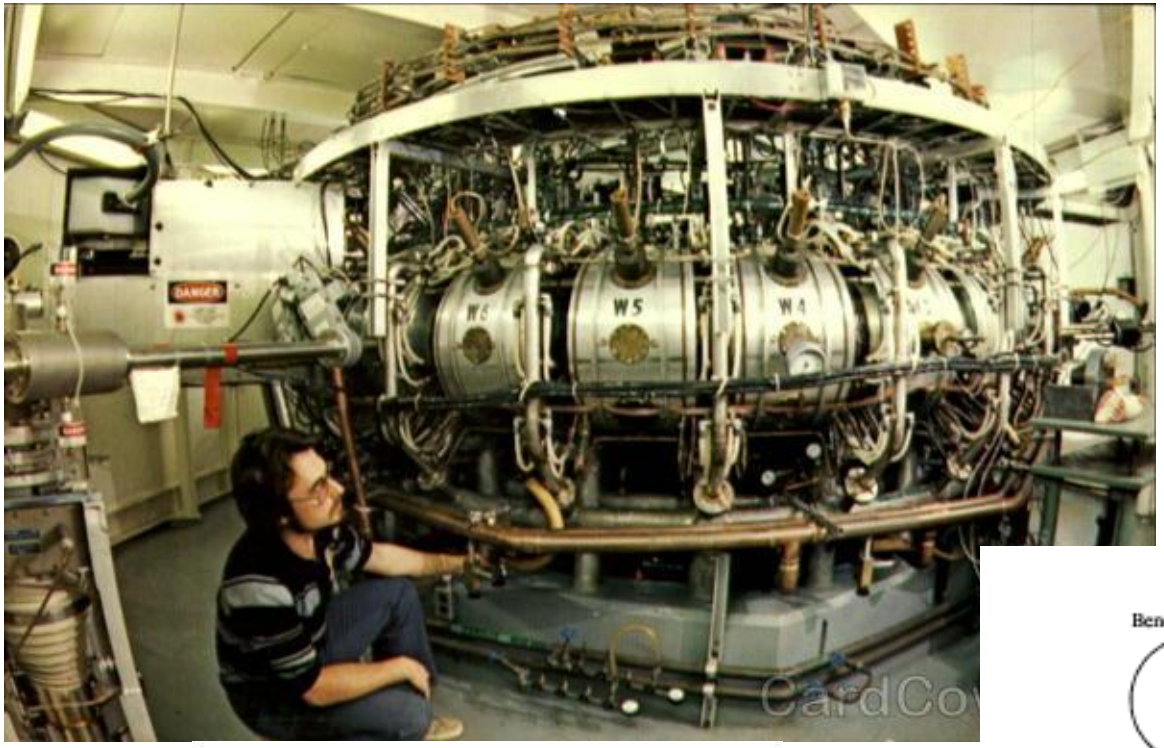


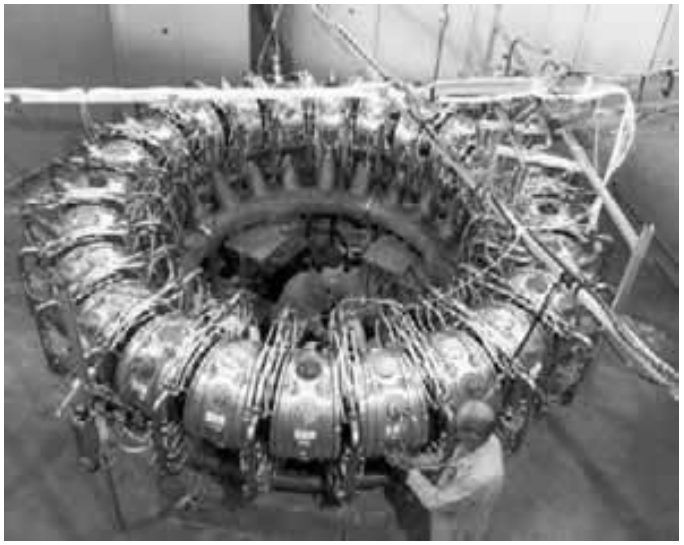
MST



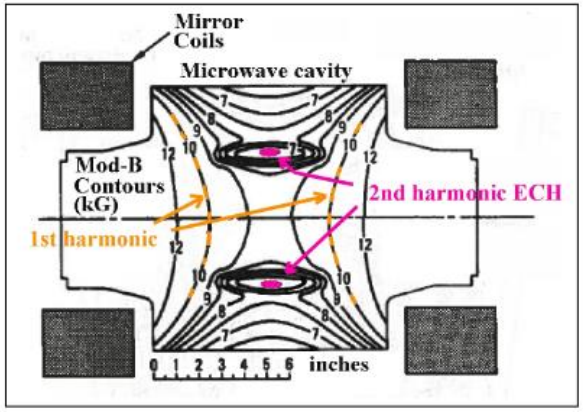
TEXT-U

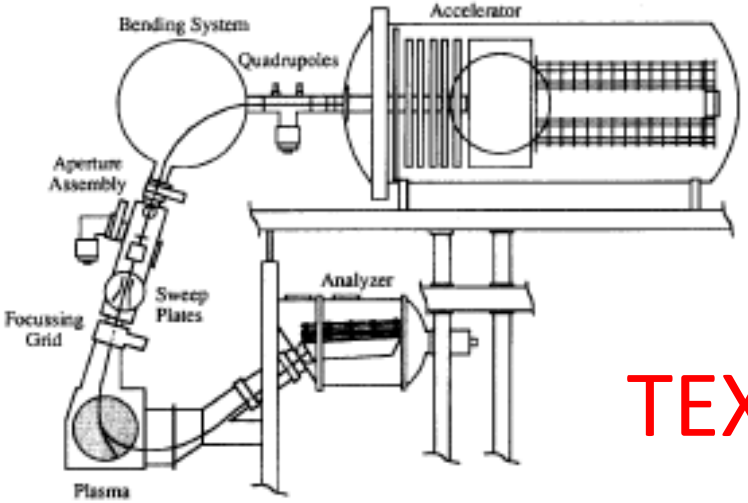
EBT & TEXT HIBP





EBT

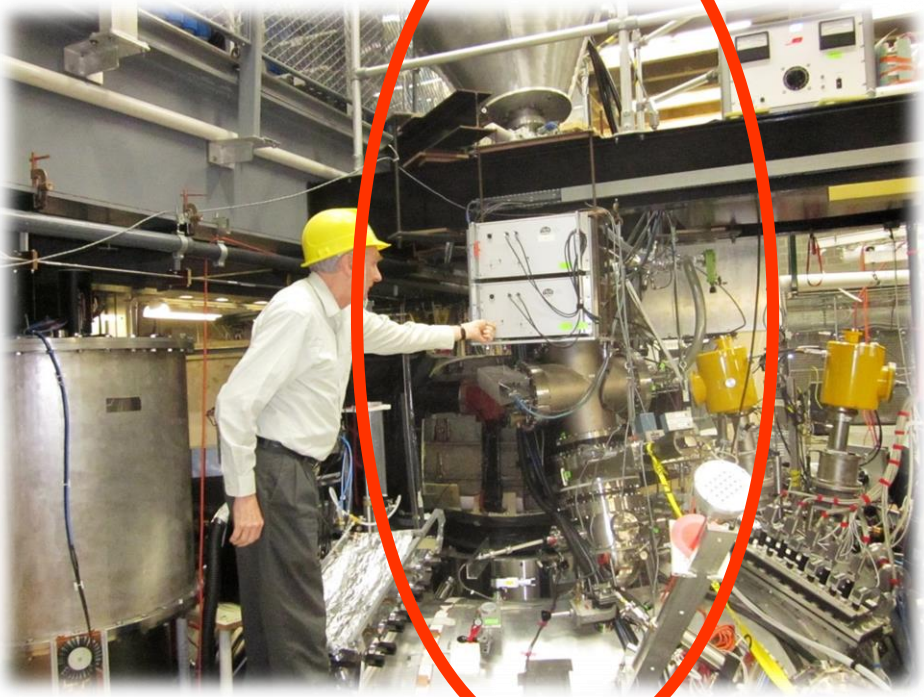




TEXT

MST HIBP

HIBP



Field Reversed Toroidal Pinch

HIBP AT WISCONSIN

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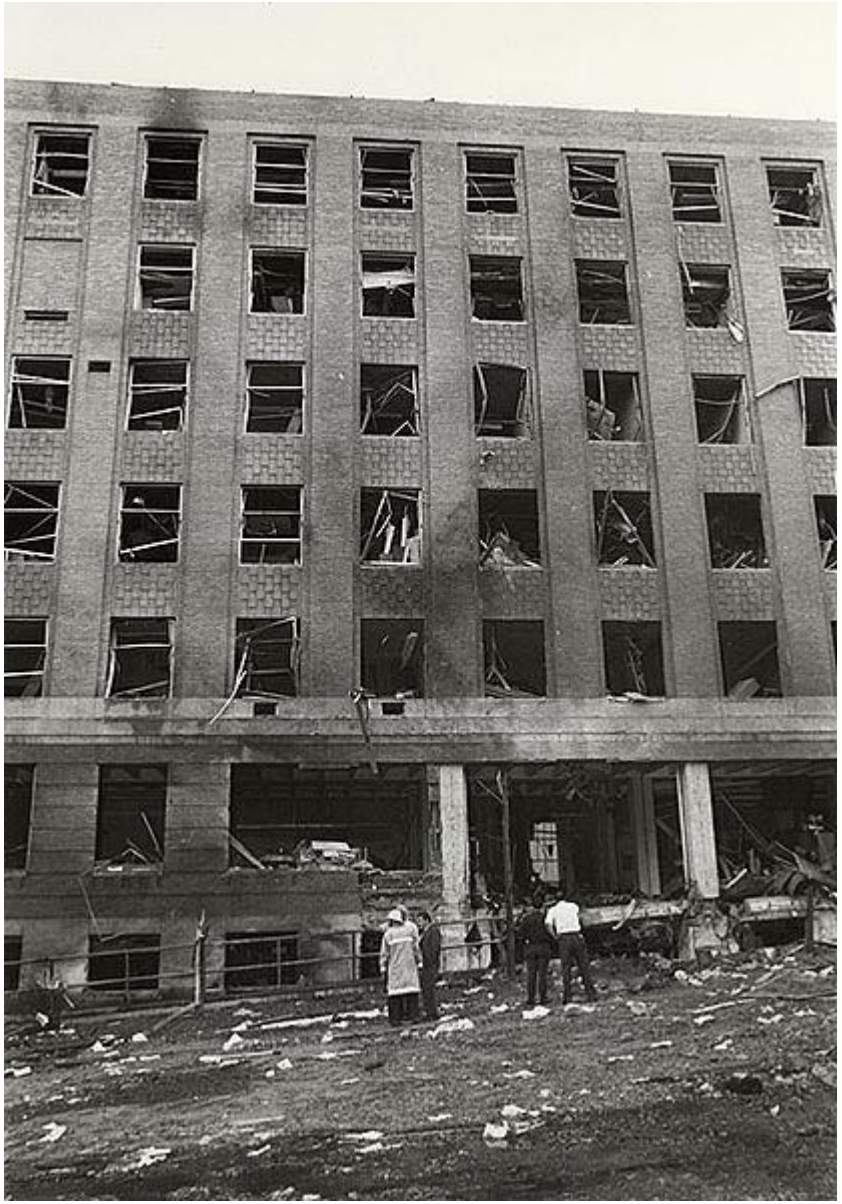
Sterling & Chamberlin Halls



OTHER RESEARCH AT RPI (EXAMPLES)

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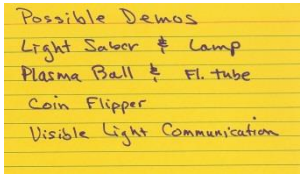
Electromagnetics



- Magnetic Bearings (Tichy)
- High Power Microwave Launchers (Salon)
- Advanced Power Systems (Salon)
- Force Sensors (Ledet)

Education

- Project Links (Cast of 1000s)
- Studio Instruction (Carlson, Maby, Schoch …)
- Mobile Studio (Millard)
- Flipped Classrooms (ERC, Newman et al)
- Mobile Hands-On STEM (Meehan, Ferri, …)
- Virtual Community of Practice (Huettel, …)
- HBCU ECP (13 HBCU ECE Programs) … Also in Puerto Rico

WHERE HAS THIS WORK TAKEN ME?

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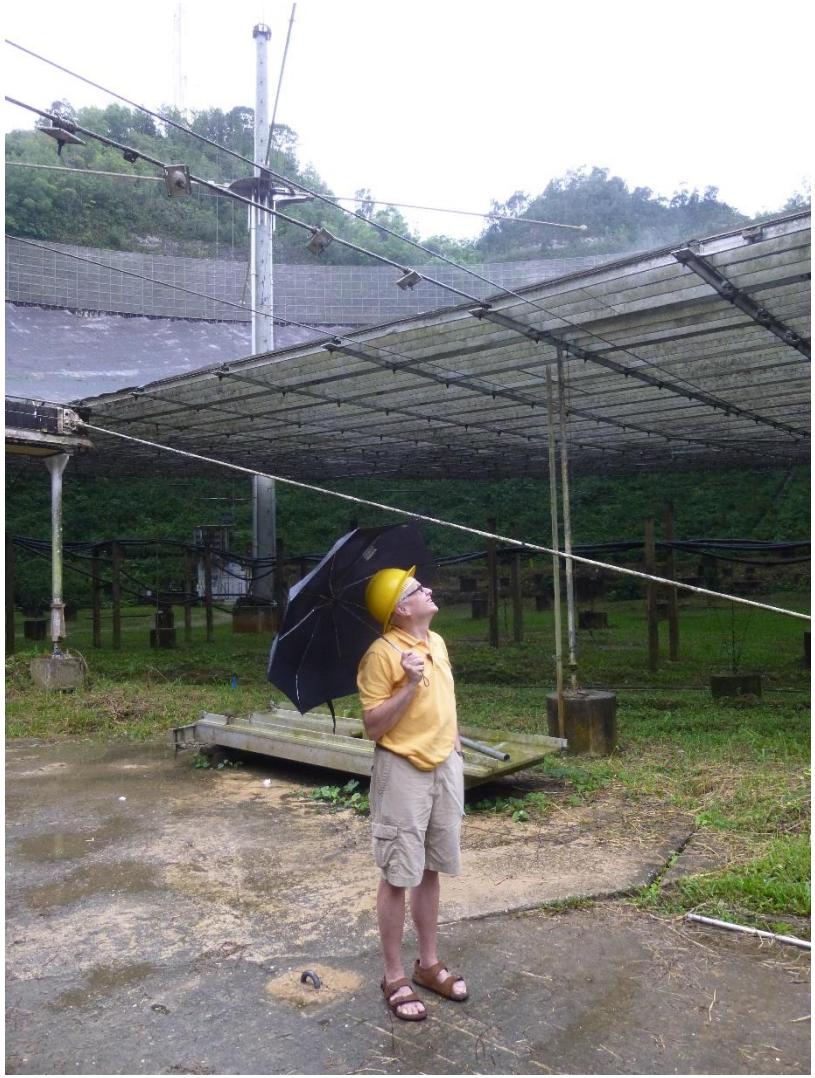

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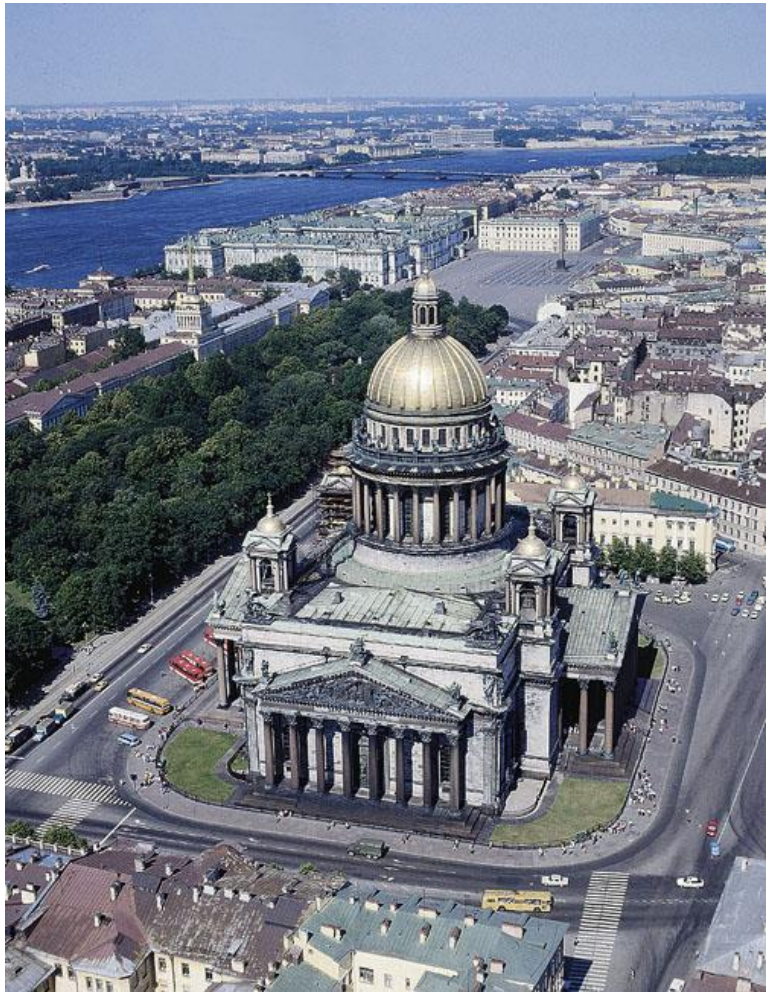
Where are these buildings?



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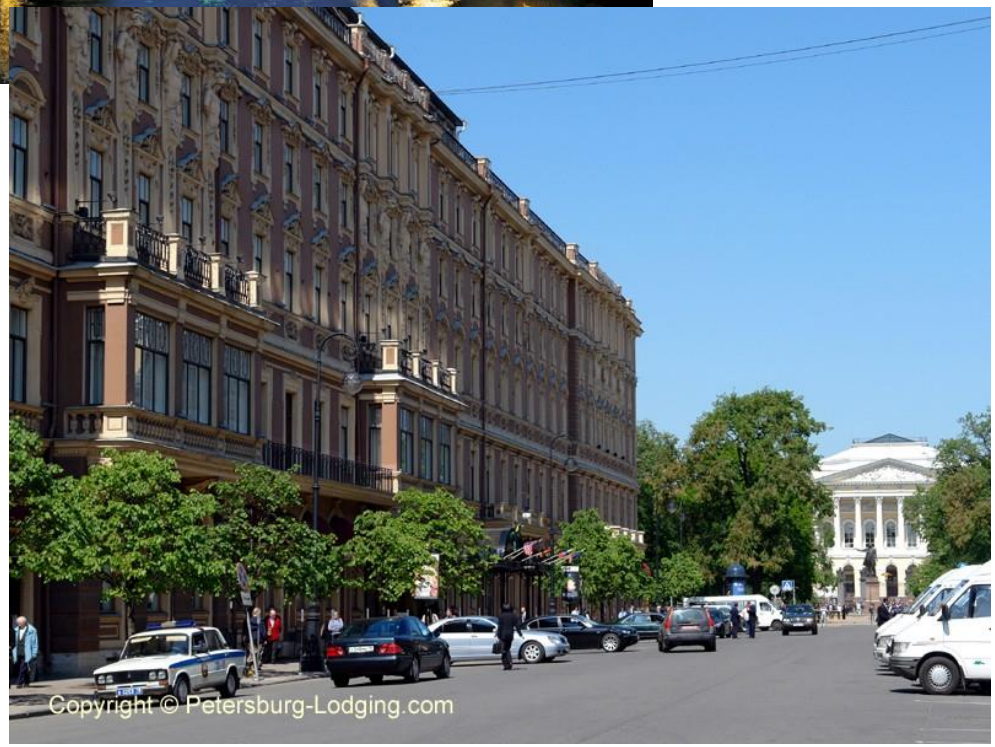

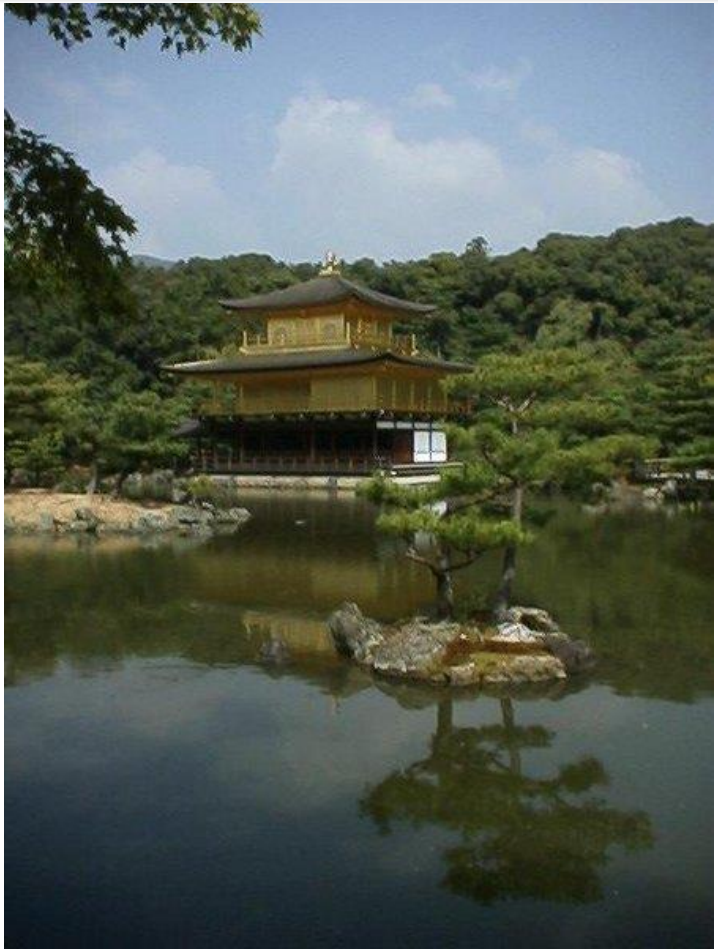

ST. PETERSBURG

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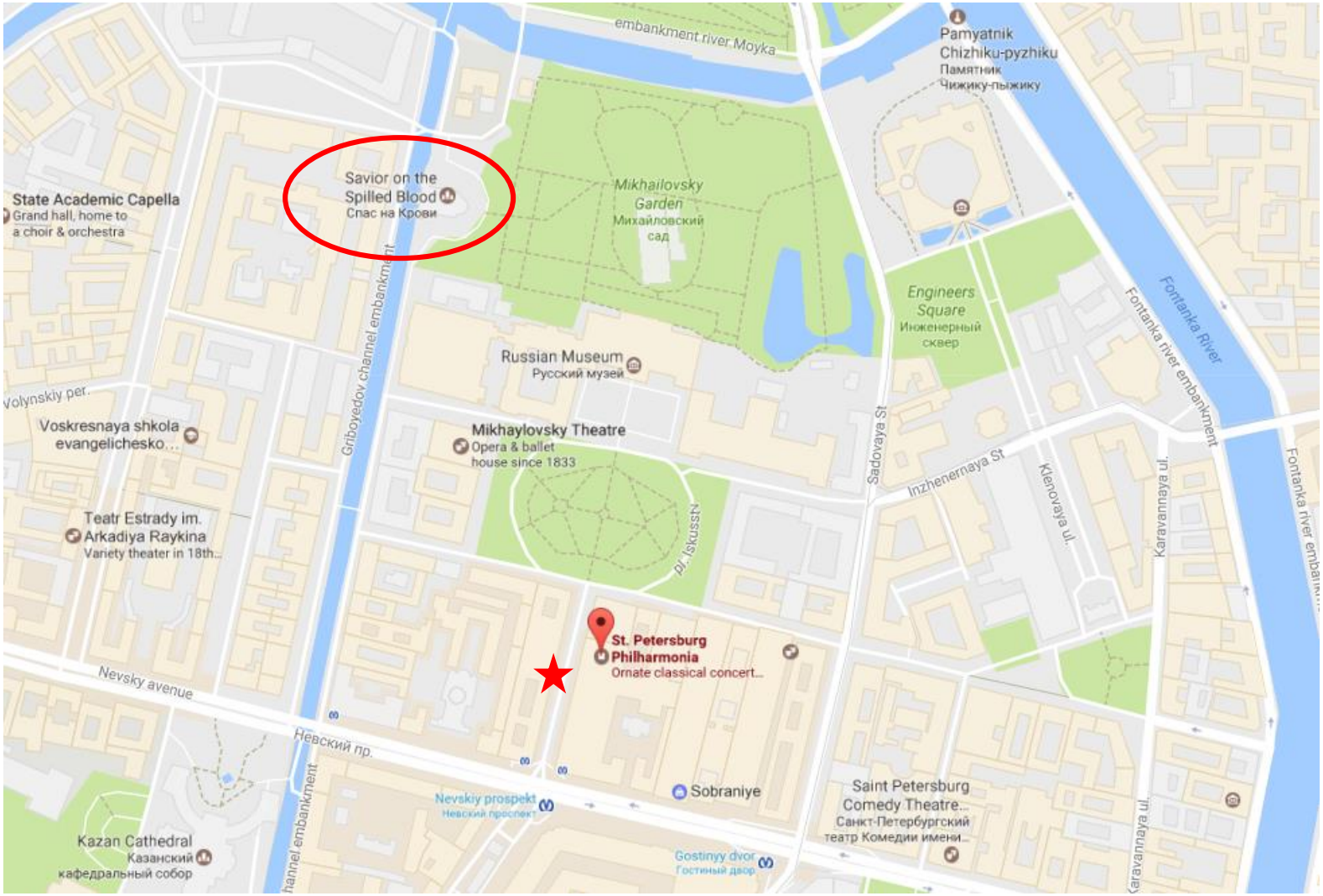

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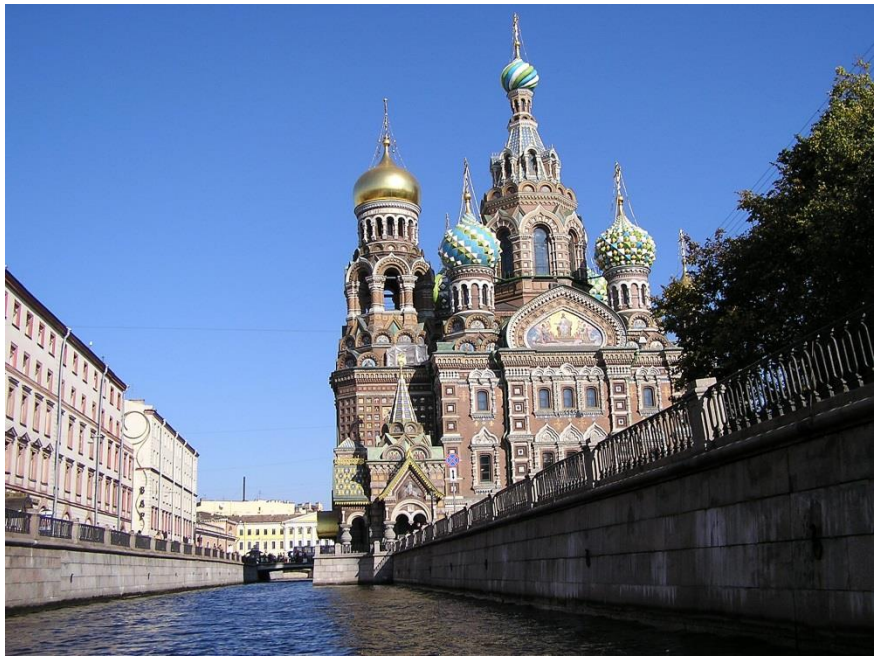

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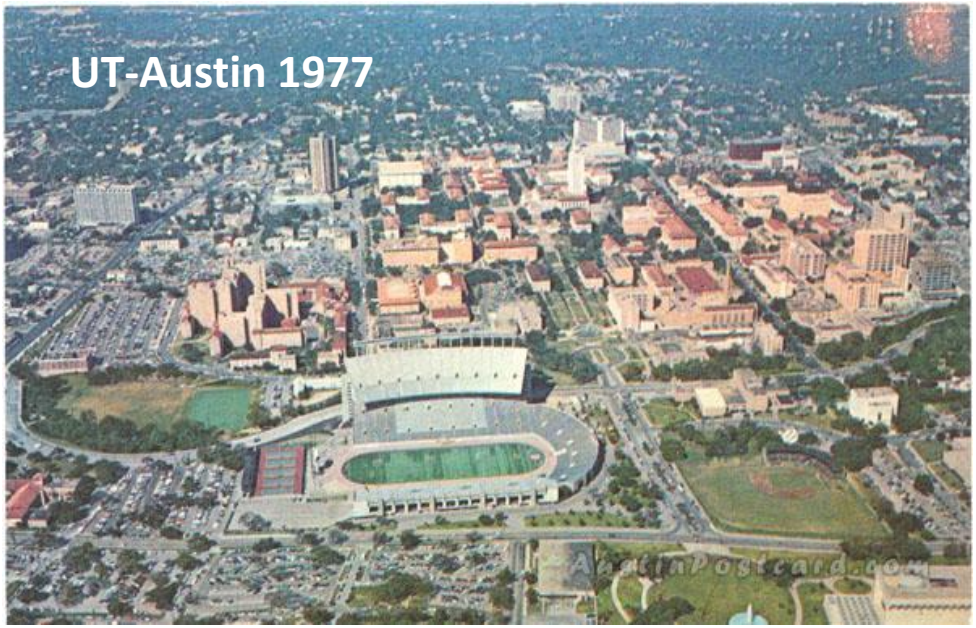

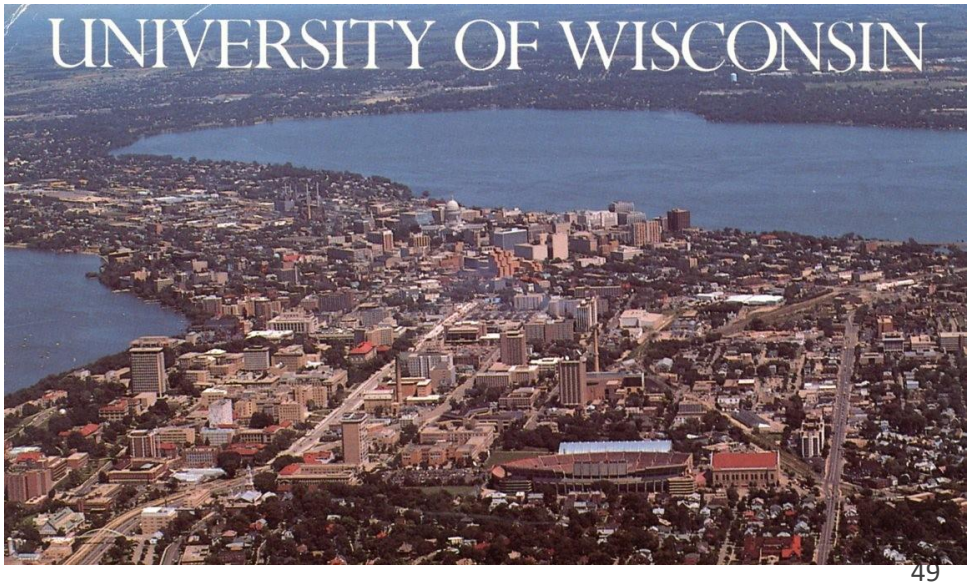

MY BROTHERS TODAY

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Tinkerers!

Metso Minerals Industries, Inc.

Mining Services North America

OPPORTUNITIES SUMMARY

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- New Programs
- Coop/Summer Internship/Job
- Undergrad Research – Academic & Summer
- Technical/Professional Activities
- Design Courses
- Access to Tools
- Access to Information from Instructors
- Travel – Be Ready

Leverage Everything! Work with Others. Plan for the Future (Build Network/Relationships)

QUESTIONS?

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