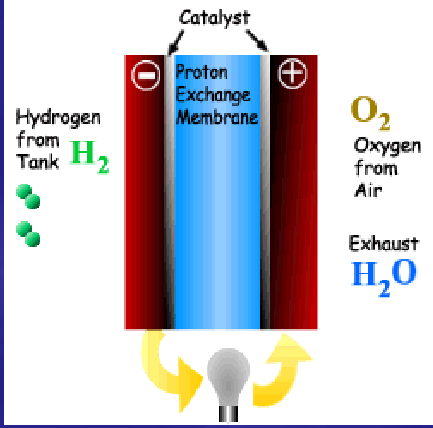
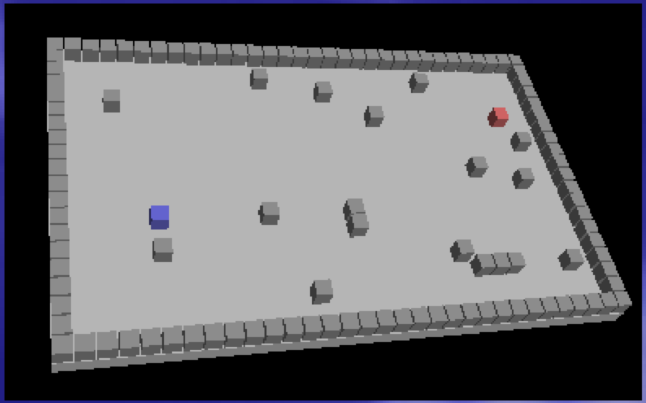
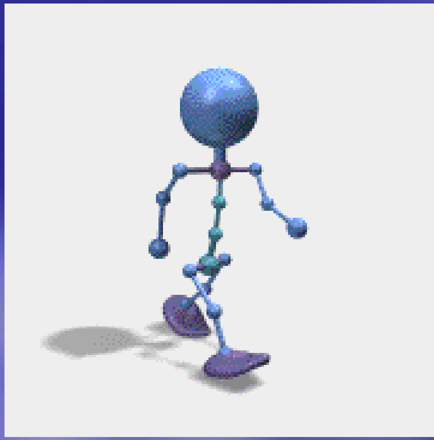
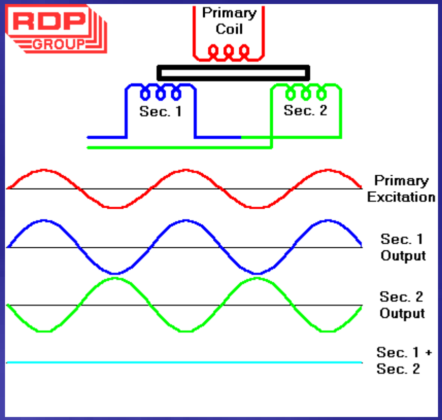


The frequency dependent potential distribution in a ground plane







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Electrical, Computer, and Systems Engineering Degree Programs

- Electric Power Engineering
- Electrical Engineering
- Computer and Systems Engineering

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Prof. Kenneth Connor
Chair, ECSE

- Office – JEC 6010
- Phone – 8552
- Email – connor@rpi.edu
- URL – http://www.rpi.edu/~connor
  - Copies of these slides can be found on this webpage
- See also – http://www.ecse.rpi.edu

What Is?

- Electrical Engineering – the application of the laws of physics governing electricity, magnetism, and light to develop products and services for the benefit of humankind.
- Computer Engineering – the design, construction, implementation, and maintenance of computers and computer controlled equipment for the benefit of humankind.
- Power Engineering – the design, construction, implementation and maintenance of devices, materials and systems for the safe, reliable and economic generation, transmission, distribution, conversion, measurement and control of electric energy for the benefit of humankind.

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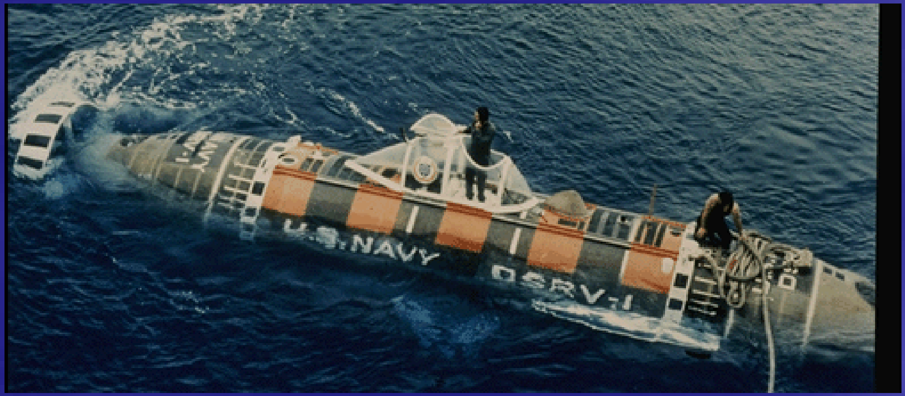
Example Job Description: EE



- Candidate will participate in the design of analog, digital, and power circuits, instrumentation, video, navigation, sonar, electro-hydraulic control systems, embedded controllers, Printed Circuit Board design, computer, network, fiber optic communications, and cable & harness design for underwater vehicle systems in a design team environment. Candidate will also support the drafting, fabrication, test, and evaluation of prototype and production hardware.

- Candidate required to be familiar with C++, Matlab & PSpice simulation tools, and OrCad & AutoCAD documentation tools. Candidate required to be familiar with printed circuit board (PCB) design process. Candidate must be capable of operating standard office software packages. Candidate required to be familiar with operation of Oscilloscopes, DMMS, network analyzers, spectrum analyzers, and other test & measurement equipment.

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Technical & Personal Interests: Examples

- Music
  - Recording: Signal compression
  - Instruments: MIDI or specific instruments
  - Listening: Audio electronics
- History
  - Electrical science: Telephony, broadcasting
  - Businesses: GE, IBM, Intel, Microsoft, Palm
  - Military: Weapons, intelligence
- Sports
  - Playing: Organizing software (team sport) or controls and feedback (auto racing)
  - Watching: Image processing
  - Training: Equipment

An Example of an Application That Can Tie Together Your Education

- Involves material from many different courses
- Involves many types of career choices
- Historically relevant for technology
- Historically relevant for international politics
- Involves music

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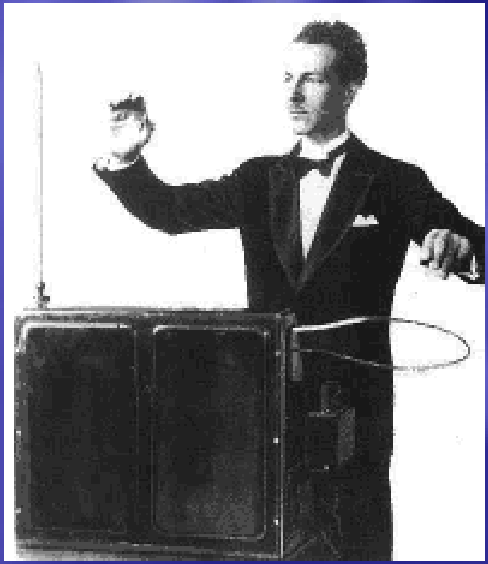
The Theremin



Clara Rockmore (1911-1998)

- The theremin was invented in 1919 by a Russian physicist named Lev Termen (his name was later changed to Leon Theremin).
- Besides looking like no other instrument, the theremin is unique in that it is played without being touched. Two antennas protrude from the theremin – one controlling pitch, and the other controlling volume. As a hand approaches the vertical antenna, the pitch gets higher. Approaching the horizontal antenna makes the volume softer. Because there is no physical contact with the instrument, playing the theremin requires precise skill and perfect pitch.

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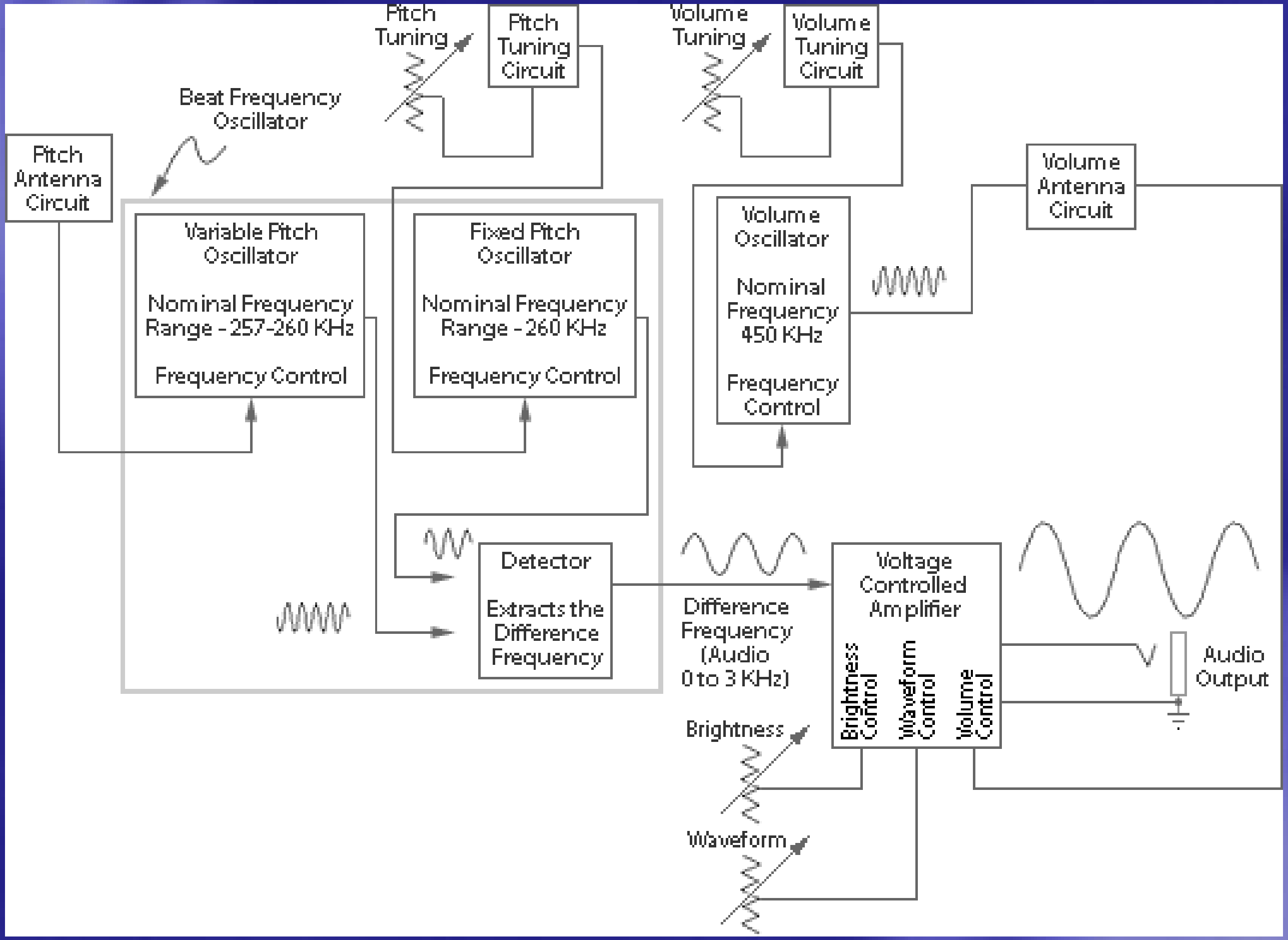
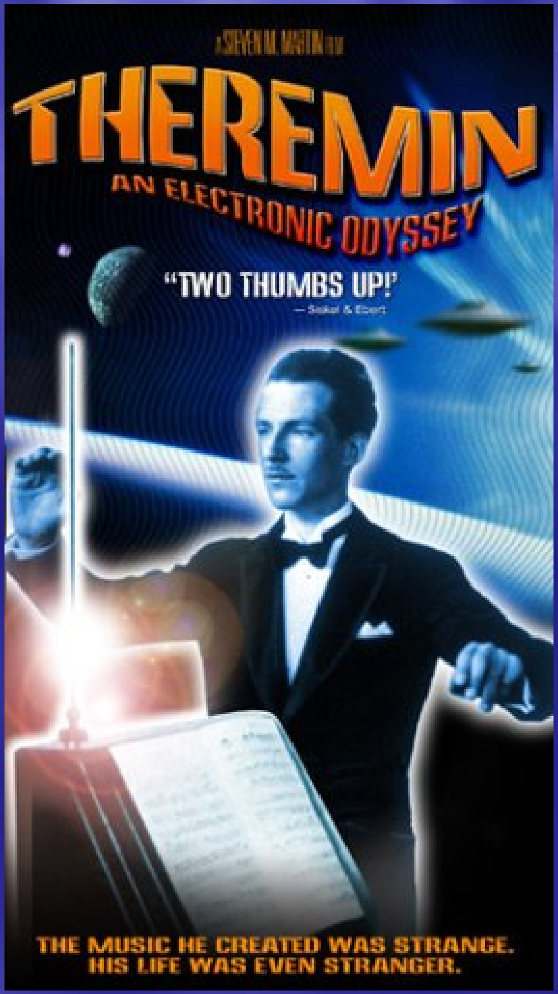
Theremin: How It Works



- Pitch & Volume Control Using Oscillators

What Ever Happened to Leon Theremin?

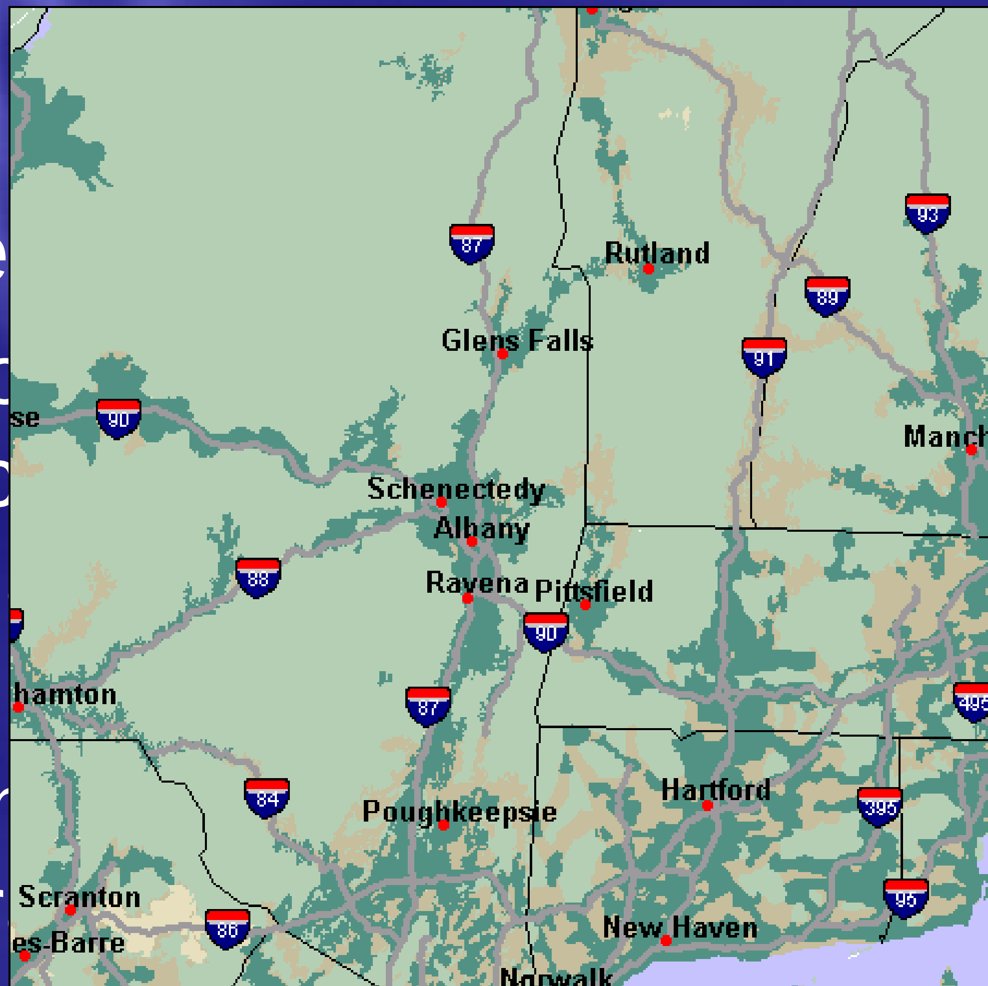
- Theremin: An Electronic Odyssey



  - Leon Theremin was the secret link between sci-fi films, the Beach Boys, and Carnegie Hall. His self-named electronic musical instrument--the first of its kind--took the world by storm in the 1920s and '30s. *Theremin: An Electronic Odyssey* , winner of Sundance's Filmmakers Trophy, explores the inventor's strange life and times, including his mysterious 50-year disappearance beginning in the 1940s. Interviews with theremin virtuoso Clara Rockmore, synthesizer pioneer Robert Moog, and Theremin's contemporaries, as well as clips from movies such as *The Day the Earth Stood Still*, featuring the unworldly sounds of his creation, show an eccentric genius working toward success until his sudden vanishing in the Soviet Union. Footage of Theremin at 94 years old, finally rediscovered and rewarded for his achievements, brings a celebratory ending to what could be a grim or at least uncertain story, but instead is a fascinating documentary.

The Future?
Iridium – An Entertaining Failure or Now on the Road to Success?

- What … s of prese…
- One c … that servic … gher popul…
- If you … spite of the ar … e cover…



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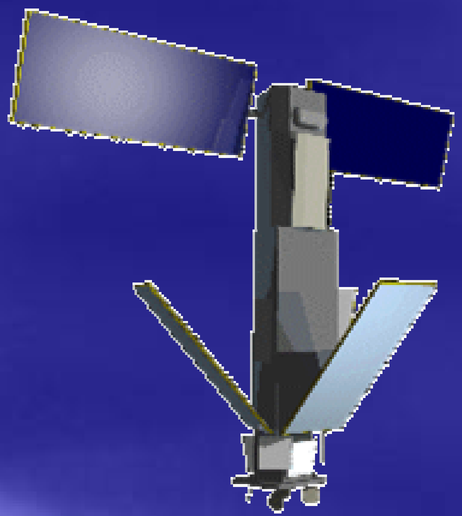
Iridium

- 1987: Two Motorola engineers envision a constellation of low orbiting satellites.
- 1990: The Iridium System is announced.
- 1995: FCC License granted
- 1998: Constellation of 66 satellites successfully launched.
- 1999: Chapter 11
- 2002: Licenses, etc. assigned to New Iridium

Note: Financing was several billion dollars

Iridium Flares – Fun With Satellites



- The Iridium satellites are relatively small telecommunications satellites in a low Earth orbit.
- Each satellite has three main mission antennas (MMAs), which are flat, highly reflective surfaces, that can reflect the Sun's rays to an observer on the ground when the geometry is correct.

Iridium Flares – Fun With Satellites

- The satellite's attitude is controlled so that the long axis remains vertical, with one MMA always pointing forwards. Given this knowledge of the attitude, together with the orbital position of the satellite and the Sun and observer's location, it is possible to calculate the angle between the direction to the observer from the satellite and the line of a perfect reflection of the Sun. This is the so-called "mirror angle" and determines the magnitude of the flare.

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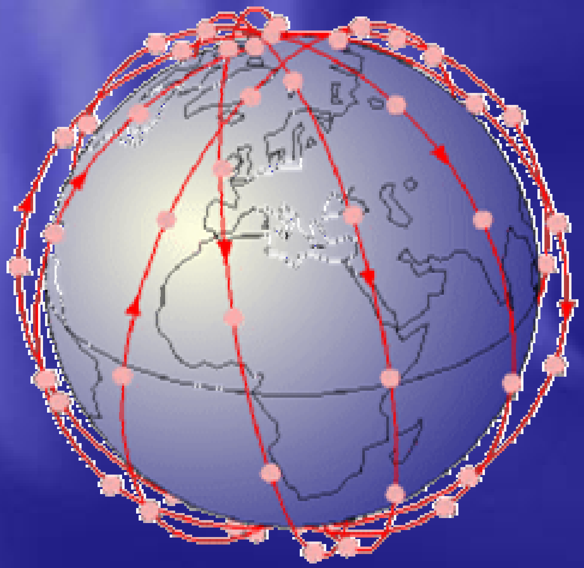
Iridium Flares



- Heavens Above is an extensive website with information on tracking objects in space, notably including Iridium Satellites.

Iridium Flares

- In the main Heavens Above webpage, select your location either exactly by longitude and latitude or from their extensive database.
- Choose United States, then Sycaway (where I live) Latitude: 42.742, Longitude:73.653, Elevation: 121 m
- Select Iridium Flares for the Next 7 Days.

Iridium Flares

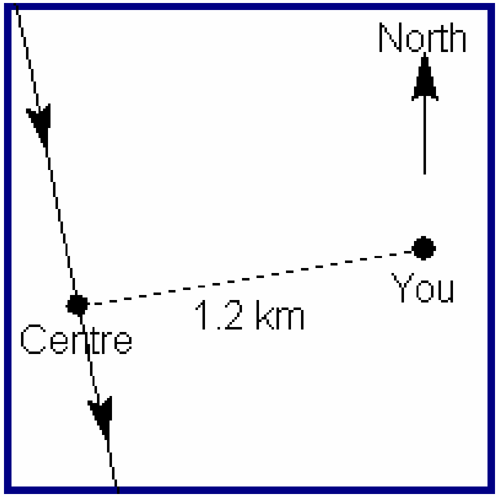
Clicking on the time of the flare will load another page with more details, including a map showing the track of the flare along the ground, and the location of the nearest point of maximum intensity.

Search Period Start:	21:24, Sunday, 10 November, 2002
Search Period End:	22:24, Sunday, 17 November, 2002
Observer's Location:	Sycaway (42.7420°N, 73.6530°W)
Local Time:	Eastern Standard Time (GMT - 5:00)

Date	Local Time	Intensity (Mag)	Alt.	Azimuth	Distance to flare centre	Intensity at flare centre (Mag.)	Satellite
13 Nov	05:31:13	-2	26°	162° (SSE)	27.0 km (W)	-7	Iridium 11
14 Nov	05:25:17	-2	25°	162° (SSE)	21.5 km (E)	-7	Iridium 3
15 Nov	06:42:50	-1	29°	76° (ENE)	39.7 km (E)	-7	Iridium 28
16 Nov	06:36:44	-7	28°	74° (ENE)	1.2 km (W)	-7	Iridium 30
17 Nov	05:16:14	-1	26°	170° (S)	35.0 km (W)	-7	Iridium 26
17 Nov	06:30:35	-1	28°	73° (ENE)	45.9 km (W)	-6	Iridium 57
17 Nov	17:34:52	-1	60°	34° (NE)	30.1 km (W)	-8	Iridium 46

Iridium Flare Details

| Home | Help |



Map showing path of flare centre over Earth's surface

Date: Saturday, 16 November, 2002
Your Location: Sycaway (42.742°N, 73.653°W)
Time Zone: Eastern Standard Time (GMT - 5:00)
Satellite: Iridium 30
Antenna (MMA): Front
Flare centre is at: 42.740°N, 73.668°W
Distance to centre: 1.2 km (0.8 miles)

	At your location	At flare centre
Time:	06:36:44	06:36:44
Magnitude:	-7	-7
Altitude:	28°	28°
Azimuth:	74° (ENE)	74° (ENE)
Mirror angle:	0.0°	0.0°

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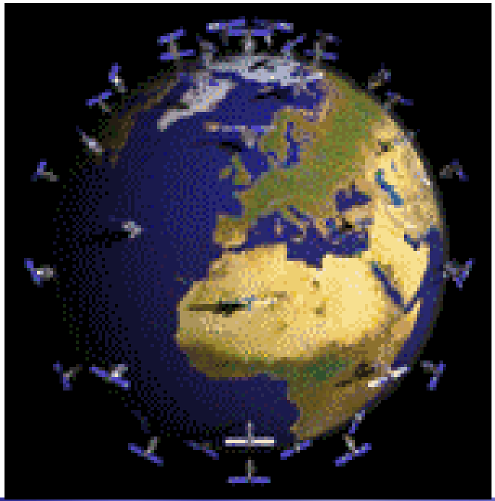
magnitude

This is a measure of the brightness of a celestial object. The lower the value, the brighter the object, so magnitude -4 is brighter than magnitude 0, which is in turn brighter than magnitude +4. The scale is logarithmic, and a difference of 5 magnitudes means a brightness difference of exactly 100 times. A difference of one magnitude corresponds to a brightness difference of around 2.51 (the fifth root of 100).

The system was started by the ancient Greeks, who divided the stars into one of six magnitude groups with stars of the first magnitude being the first ones to be visible after sunset. In modern times, the scale has been extended in both directions and more strictly defined.

Examples of magnitude values for well-known objects are;

Sun	-26.7 (about 400 000 times brighter than full Moon!)
Full Moon	-12.7
Brightest Iridium flares	-8
Venus (at brightest)	-4.4
International Space Station	-2
Sirius (brightest star)	-1.44
Limit of human eye	+6 to +7
Limit of 10x50 binoculars	+9
Pluto	+14
Limit of Hubble Space Telescope	+30



IEEE (366,000 Members)

- Aerospace and Electronic Systems Society
- Antennas and Propagation Society (9,000 Members)
- Broadcast Technology Society
- Circuits and Systems Society (16,000 Members)
- Communications Society (50,000 Members)
- Components Packaging, and Manufacturing Technology Society
- Computer Society (88,000 Members)
- Consumer Electronics Society
- Control Systems Society (10,000 Members)
- Council on Super Conductivity
- Dielectrics and Electrical Insulation Society
- Education Society

IEEE

- Electromagnetic Compatibility Society
- Electron Devices Society (13,000 Members)
- Engineering Management Society
- Engineering in Medicine and Biology Society
- Geoscience & Remote Sensing Society
- Industrial Electronics Society
- Industry Applications Society
- Information Theory Society
- Intelligent Transportation Systems Council
- Instrumentation and Measurement Society
- Lasers & Electro-Optics Society (9,000 Members)
- Magnetics Society
- Microwave Theory and Techniques Society (12,000 Members)
- Nuclear and Plasma Sciences Society
- Neural Networks Council

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IEEE

- Oceanic Engineering Society
- Power Electronics Society
- Power Engineering Society (22,000 Members)
- Professional Communication Society
- Reliability Society
- Robotics & Automation Society
- Sensors Council
- Signal Processing Society (18,000 Members)
- Society on Social Implications of Technology
- Solid-State Circuits Society (14,000 Members)
- Systems, Man, and Cybernetics Society
- Ultrasonics, Ferroelectrics, and Frequency Control Society
- Vehicular Technology Society

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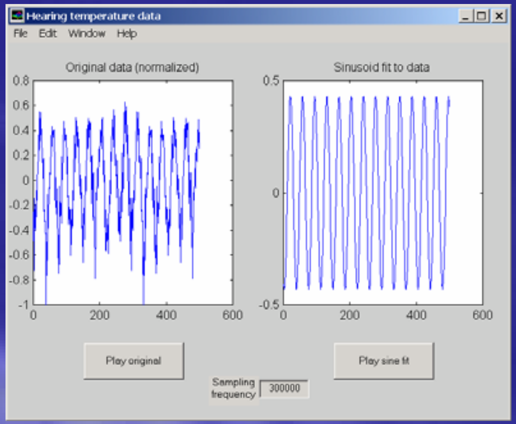
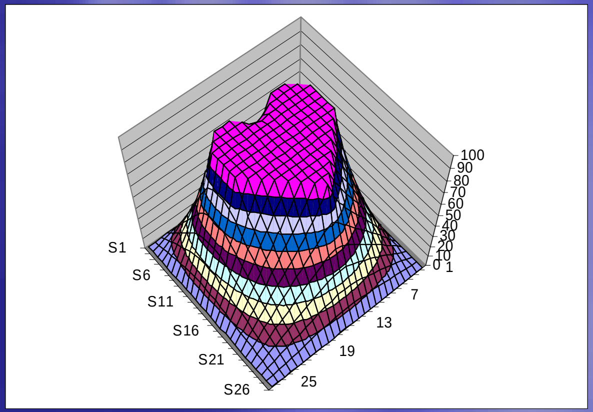
Some Exercises

- Matlab representation of signals

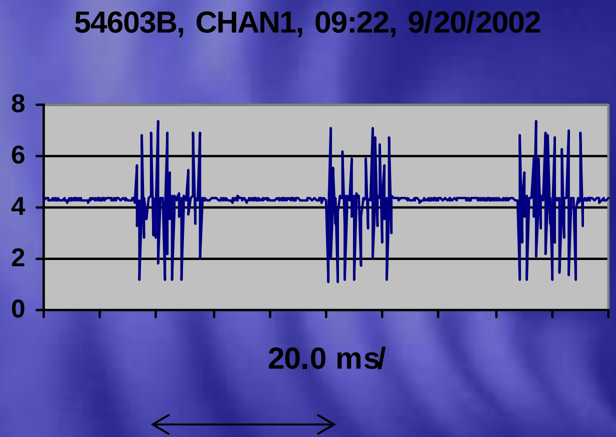


- Excel Analysis of Electrodes

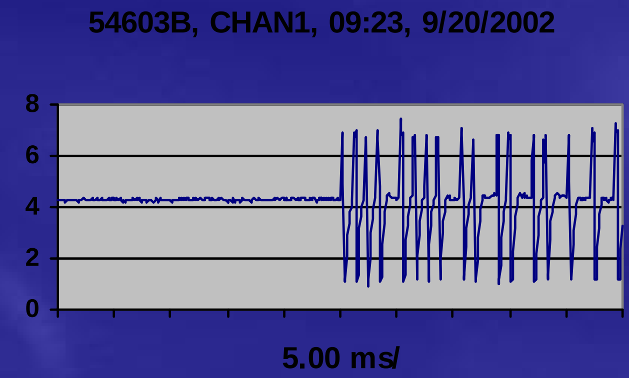


- Others

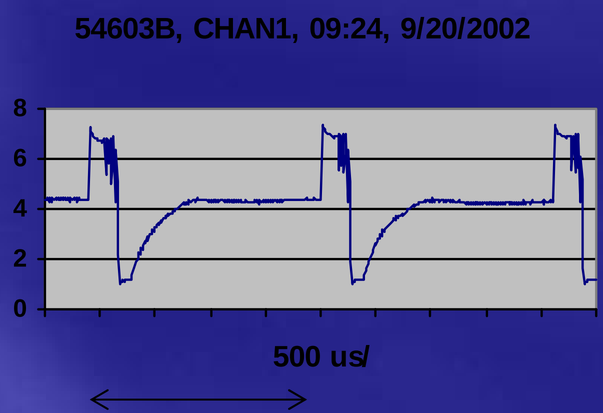
Signals from Audio Remote



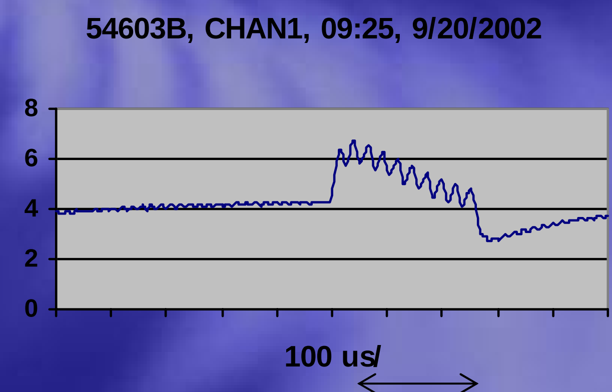
3.5 x 20 = 70ms or 14Hz



Mostly hear higher frequencies in pulses

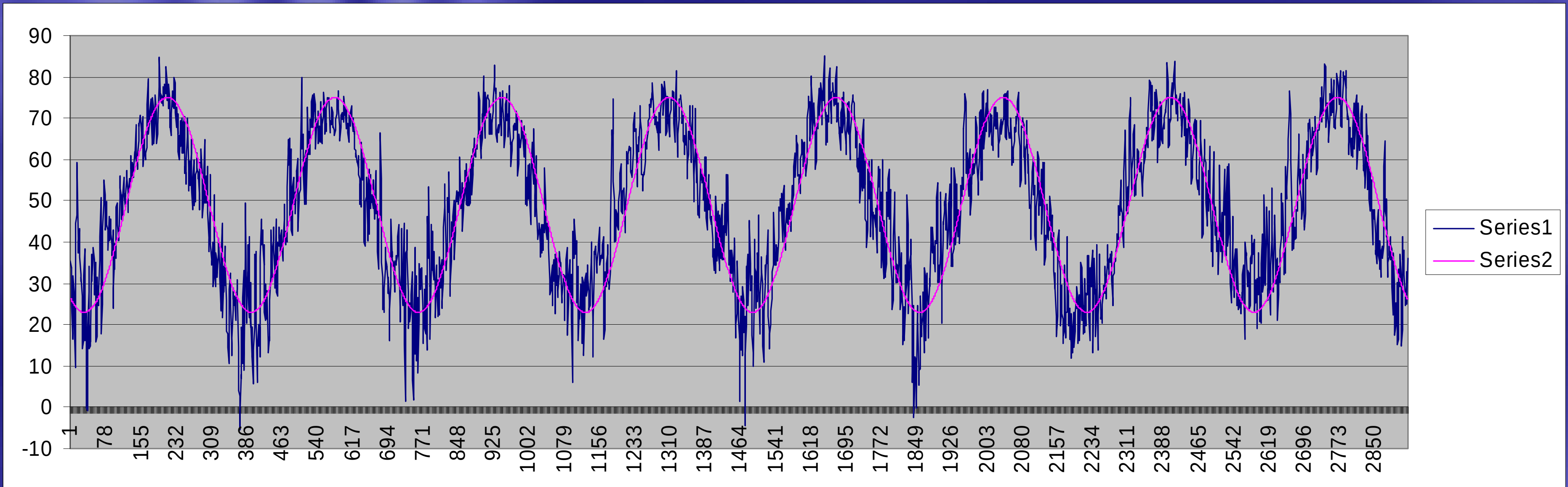


4 x 500 = 2000us or 500Hz



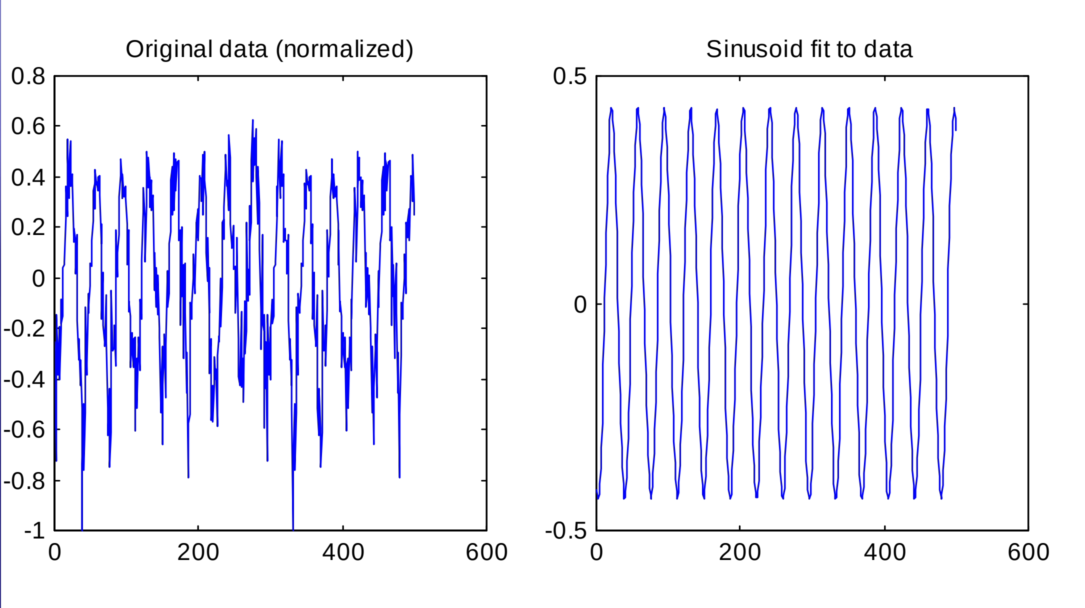
2 x 100 / 9 = 23us or 43kHz

Daily Average Temperature
Albany-Troy-Schenectady



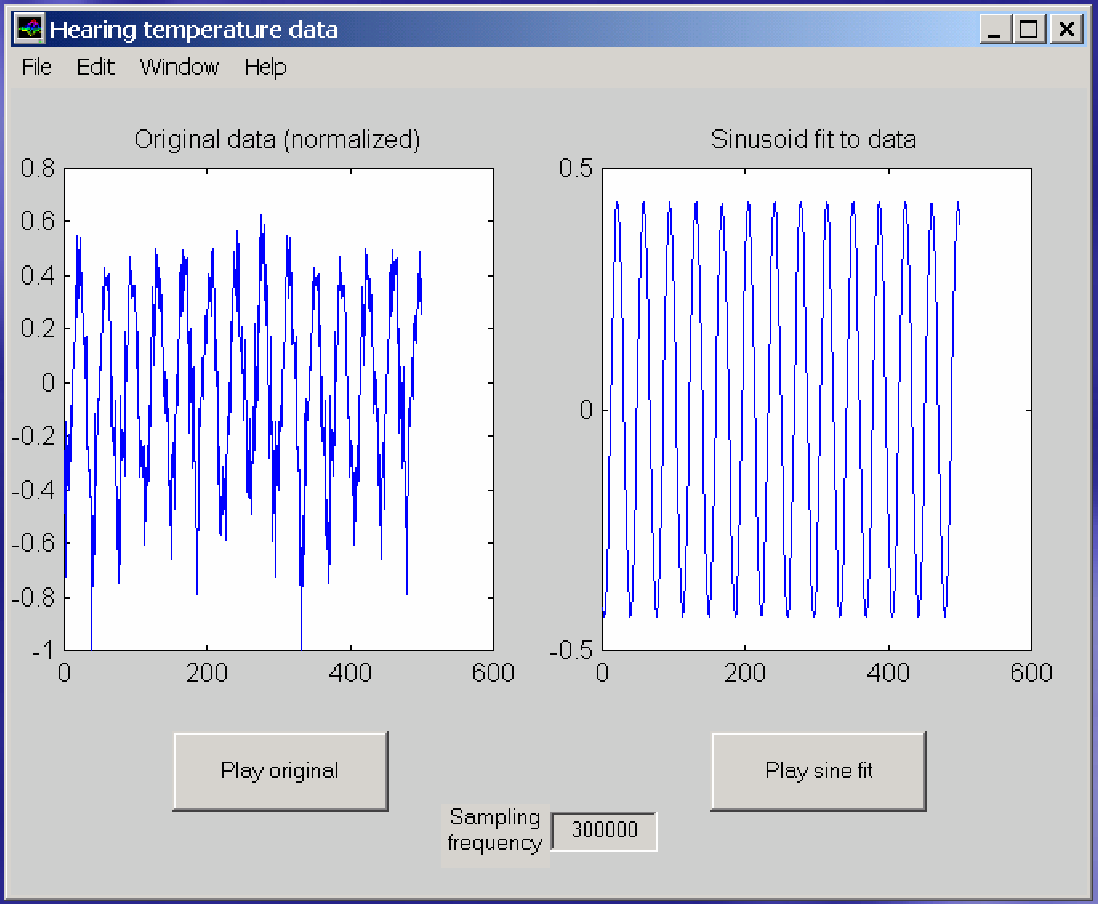
- Data (blue) covers 1995-2002
- Note the sinusoid (pink) fit to the data

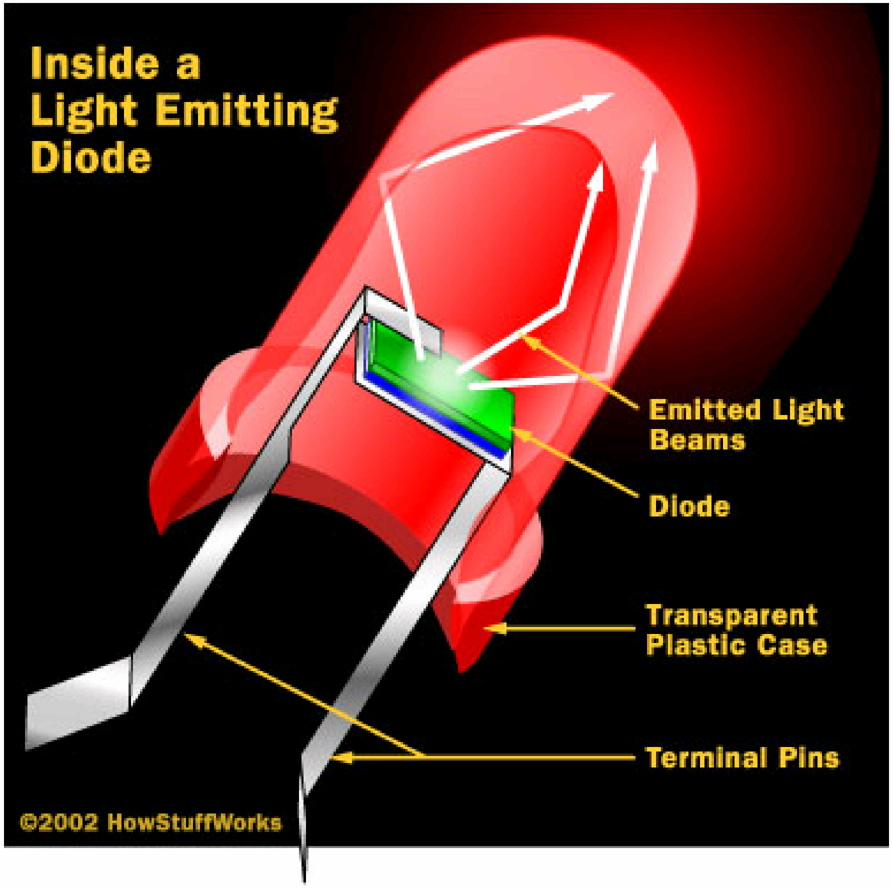
Using Matlab to Produce Audio Signal from Daily Average Temps



- Data is normalized to mimic sound
- Data is filtered to find fundamental

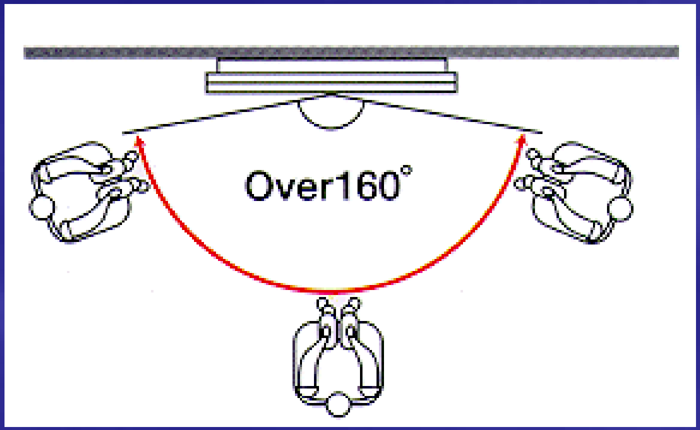
Matlab Window





LEDs have several advantages over conventional incandescent lamps. For one thing, they don't have a filament that will burn out, so they last much longer. Additionally, their small plastic bulb makes them a lot more durable. They also fit more easily into modern electronic circuits.

Plasma Displays



- Large, bright, flat panel display
- View from a wide angular range
- Designed for HDTV
- Available from many companies

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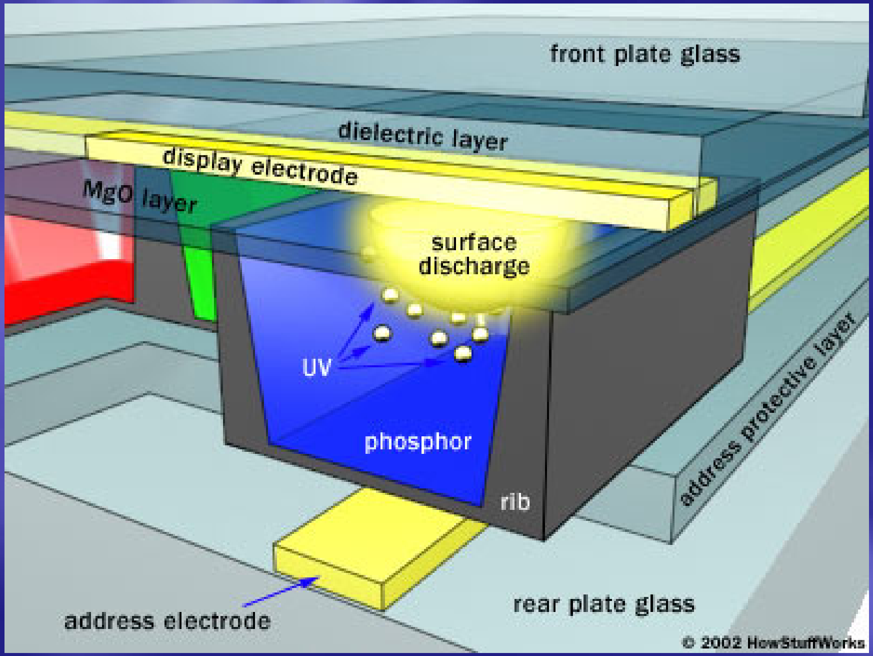
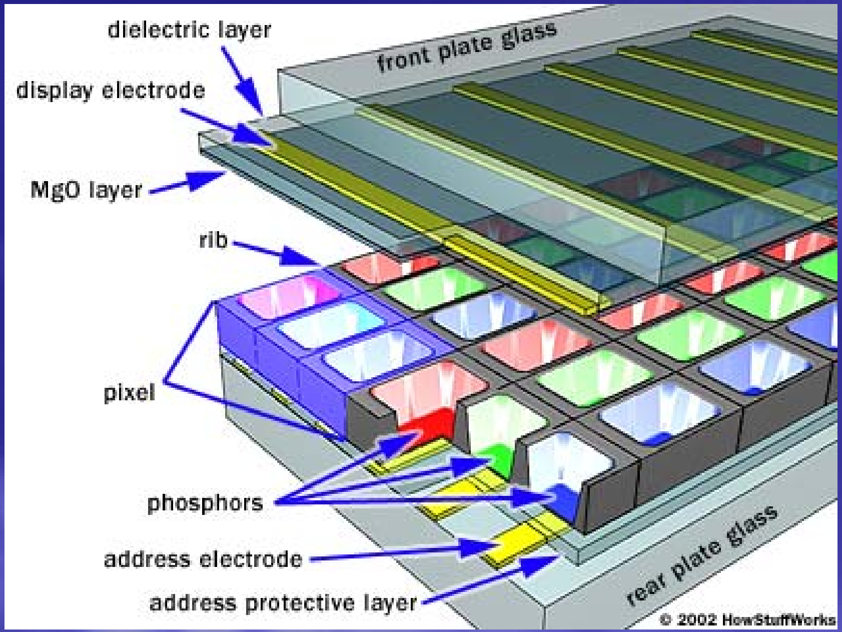
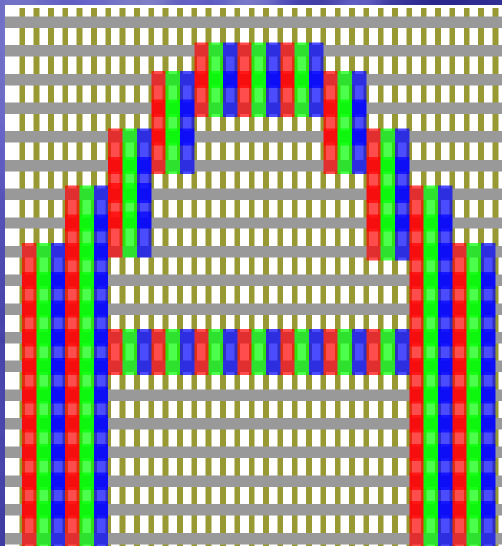
Plasma Displays

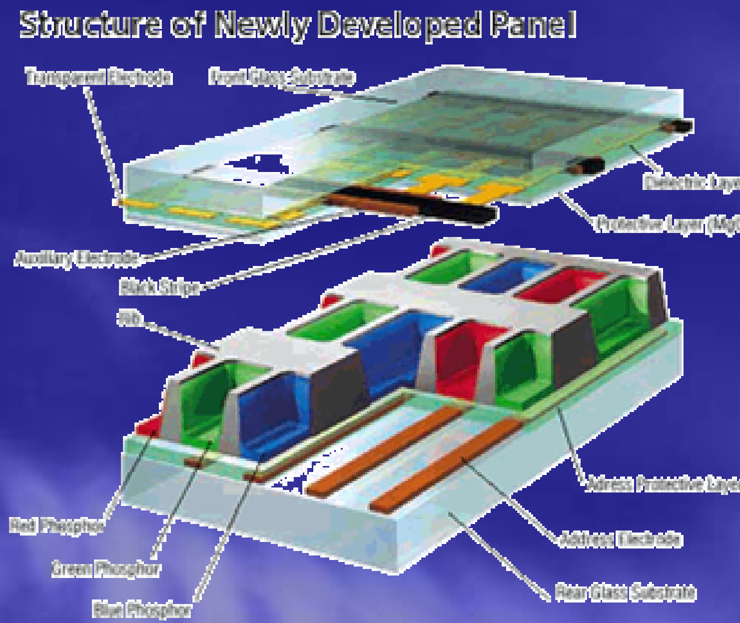




- Note the patterns of the address and display electrodes
- To excite an address, both voltages must be applied

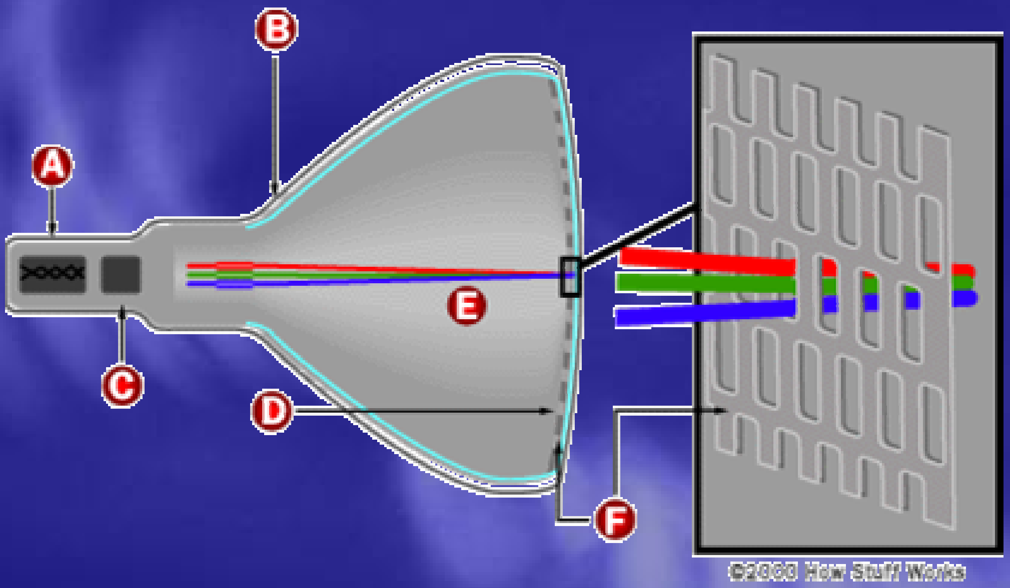
Plasma Displays





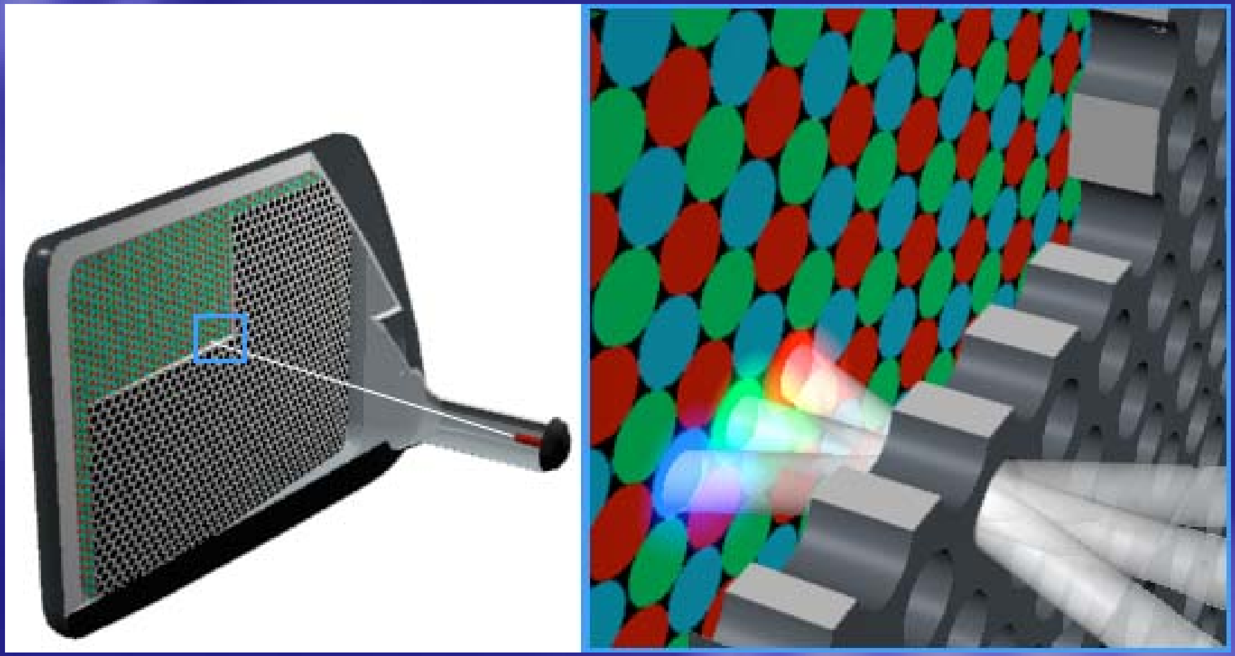
- Fujitsu ALIS display
- More complex electrodes but better use of surface area for display

Displays: CRT



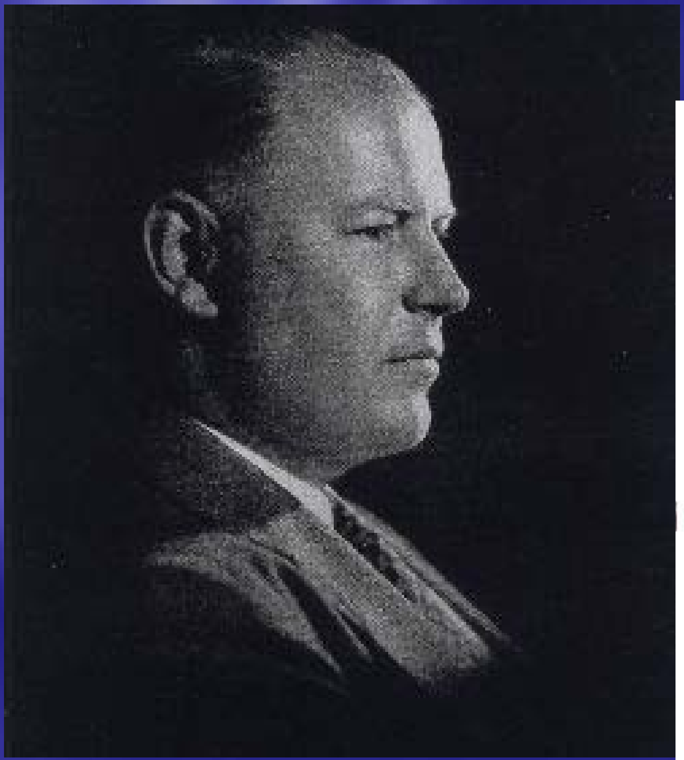
- Three separate electron guns are required to produce a color picture

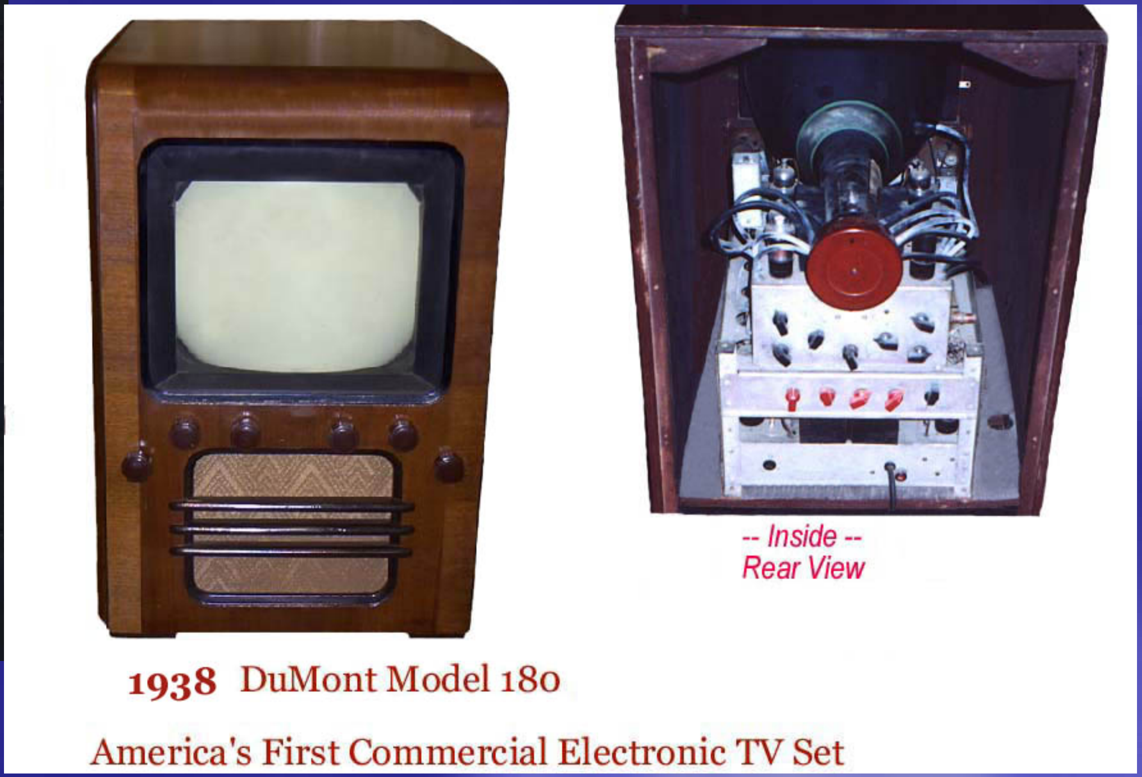
Displays: CRT



- A large variety of configurations are used by manufacturers
- Look carefully at the screen of your TV

Displays: Early TV





Allen Dumont

B.S.E.E. RPI 1924

Displays: Dumont

- Developed the first practical CRT (previous versions lasted only 10s of hours)
- First company to market home TV receiver in 1938 (previous slide)
- Dumont network until 1956 – It could not compete with radio networks (poorly funded)
- Broadcast Jackie Gleason, first sporting events, but shows were bought by big 3 networks
- Dumont was one of broadcastings first millionaires

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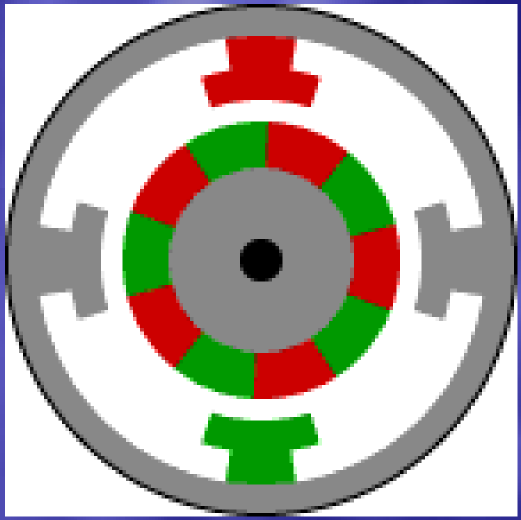
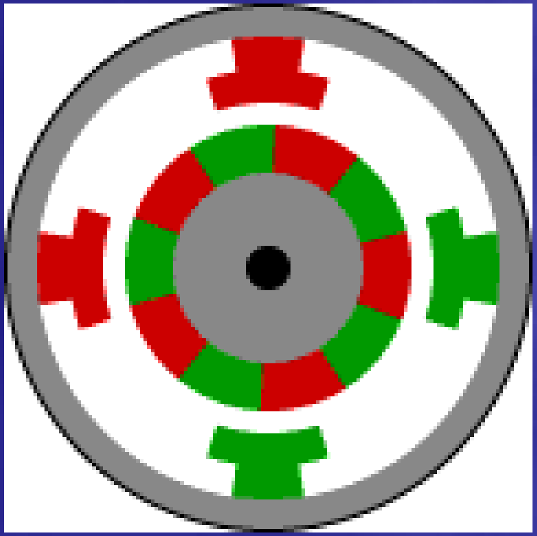
Animal Magnetism

- A frog suspended in an intense magnetic field – all of us are paramagnetic
- Much money is wasted on magnetic therapy

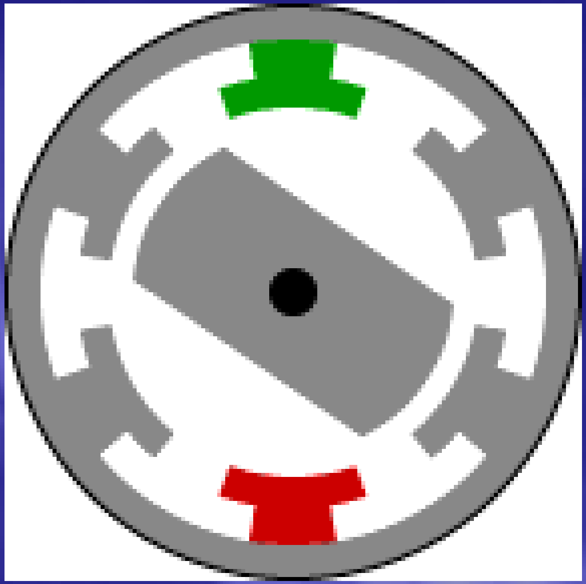
Stepper Motors





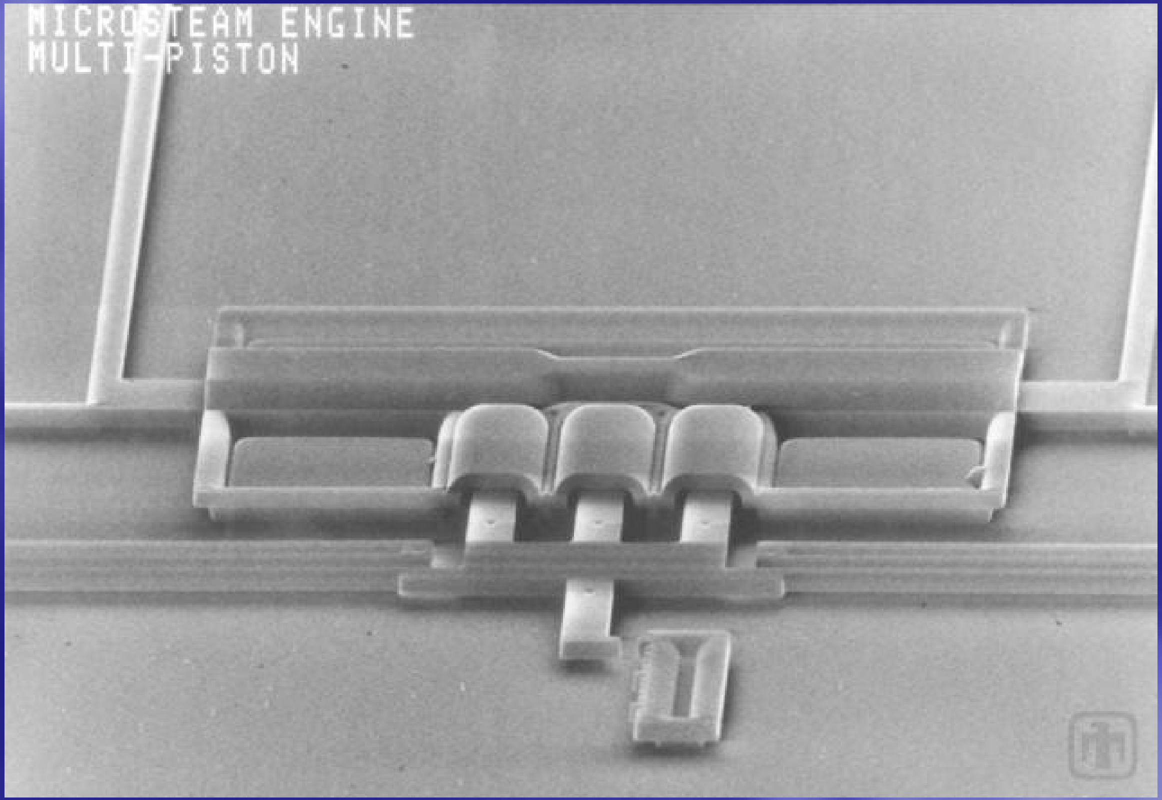
- This stepper motor is very simplified. The rotor of a real stepper motor usually has many poles. The animation has only ten poles, however a real stepper motor might have a hundred. These are formed using a single magnet mounted inline with the rotor axis and two pole pieces with many teeth. The teeth are staggered to produce many poles. The stator poles of a real stepper motor also has many teeth. The teeth are arranged so that the two phases are still 90° out of phase. This stepper motor uses permanent magnets. Some stepper motors do not have magnets and instead use the basic principles of a switched reluctance motor. The stator is similar but the rotor is composed of a iron laminates.

Switched Reluctance Motor



- A switched reluctance or variable reluctance motor does not contain any permanent magnets. The stator is similar to a brushless dc motor. However, the rotor consists only of iron laminates. The iron rotor is attracted to the energized stator pole. The polarity of the stator pole does not matter. Torque is produced as a result of the attraction between the electromagnet and the iron rotor in the same way a magnet is attracted to a refrigerator door. An electrically quiet motor since it has no brushes.

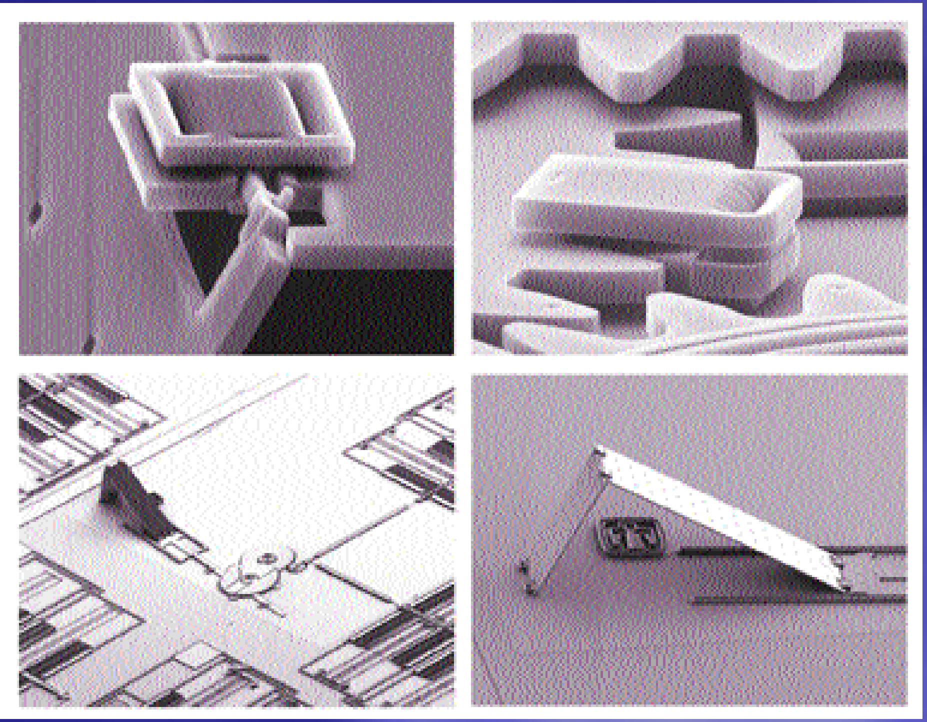
MEMS: Steam Engine



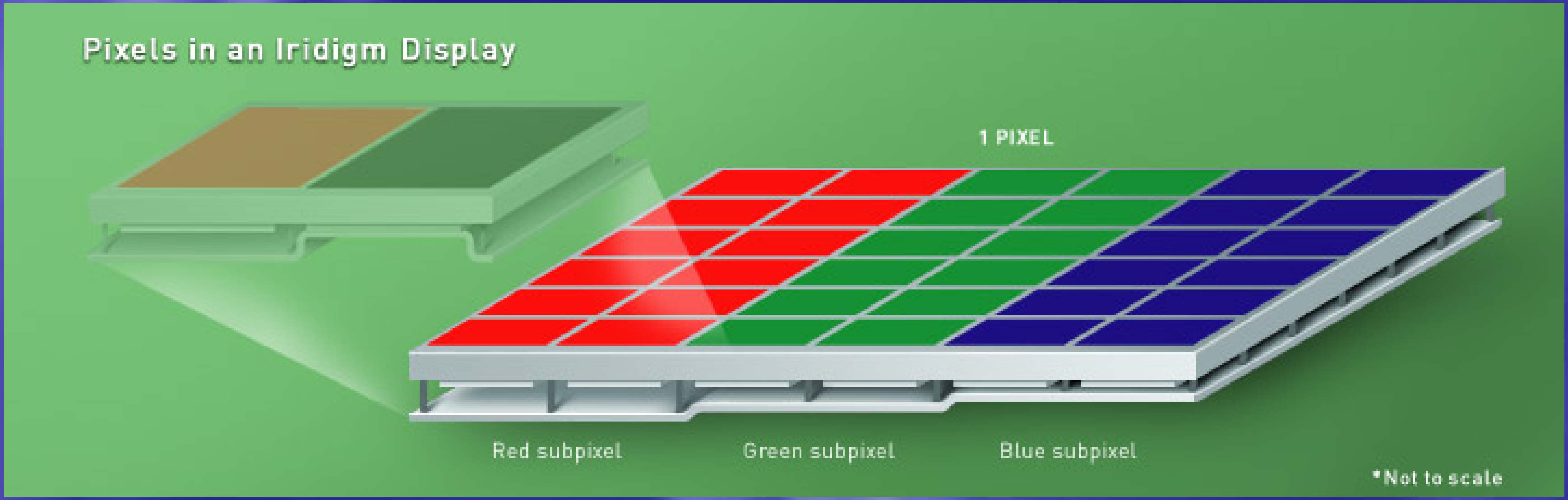
- Water inside of three compression cylinders is heated by electric current and vaporizes, pushing the piston out. Capillary forces then retract the piston once current is removed.

Integrated MEMS

- Types of micromechanical devices that might be used in integrated microsystems of the future [shown clockwise from right] include this gear, pop-up mirror, mirror assembly, and hinge. The gear is part of an assembly that has demonstrated torque ratios of up to 3 million to 1. The silicon mirror is fabricated flat on the silicon wafer, then "popped up" to its raised position using the gear assembly.

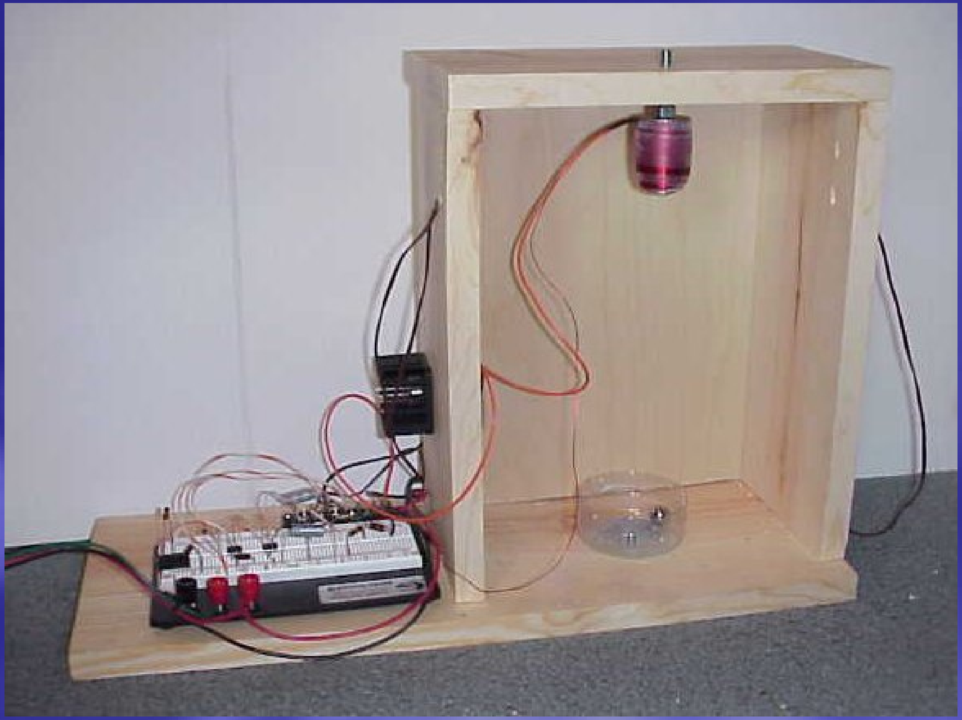


MEMS Displays



- iMoD elements are minuscule, typically 25-60 microns on a side (400-1,000 dots per inch). Therefore, many iMoD elements are ganged and driven together as a pixel, or sub-pixel in a color display. The color of the iMoD element is determined by the size of the gap between the plates. As shown, the blue iMoD has the smallest gap and the red has the largest. To create a flat panel display, a large array of iMoD elements are fabricated in the desired format (i.e. 5" full color VGA) and packaged. Finally, driver chips are attached at the edge to complete the display.

Magnetic Levitation Experiment



- Magnets or magnetic materials can be suspended either using magnetic attraction or repulsion and permanent or electromagnets.

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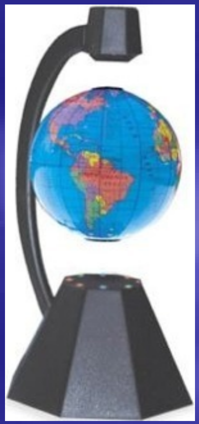
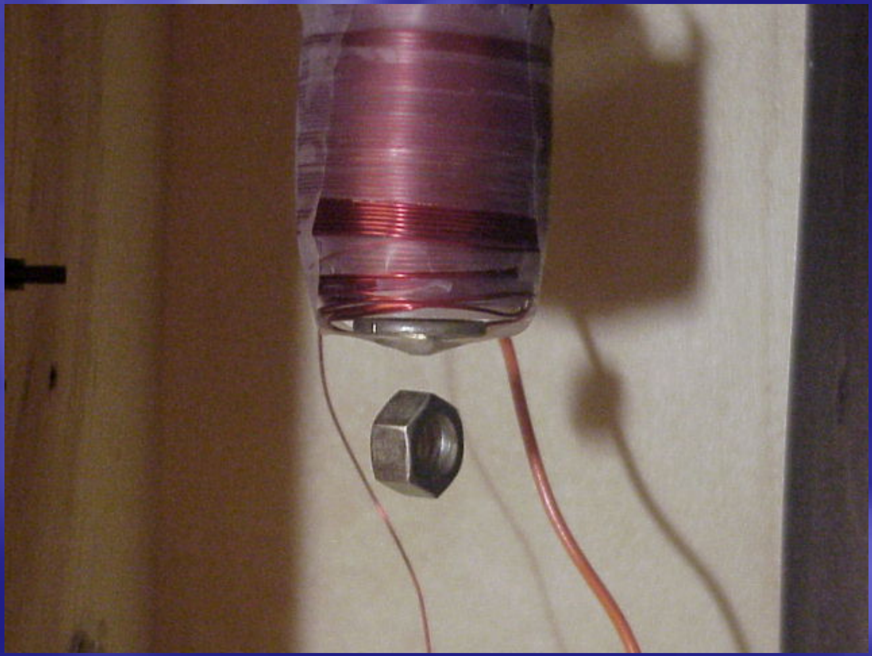
Some Commercial Products

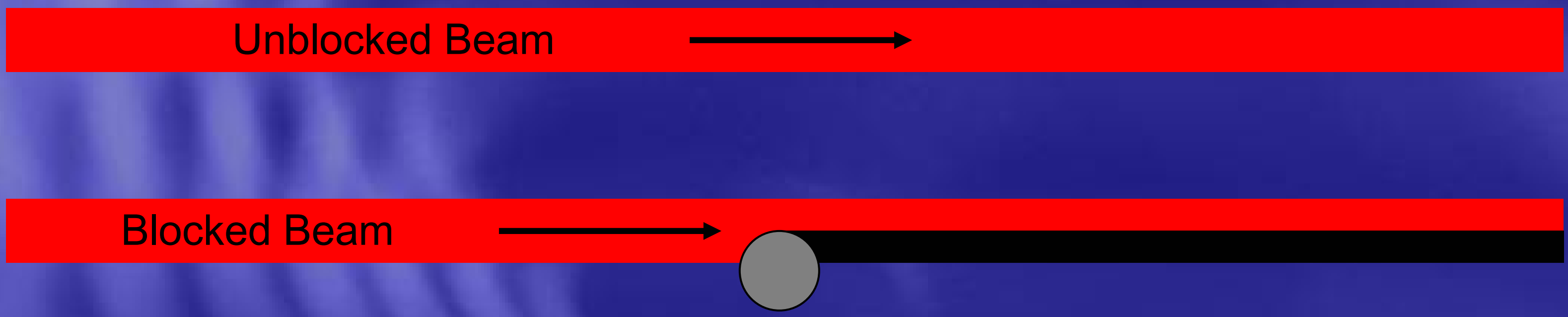


Maglev Experiment



- Close up photos showing levitation of washer and ball bearing with magnet attached. Some preferred orientation is necessary for stability.

Maglev Experiment



- The position of the suspended object (here a ball) is sensed by how much of an IR beam is blocked by the object.
- This requires an IR emitter and an IR detector.

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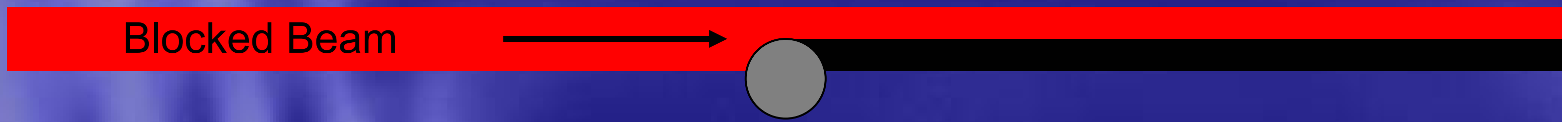
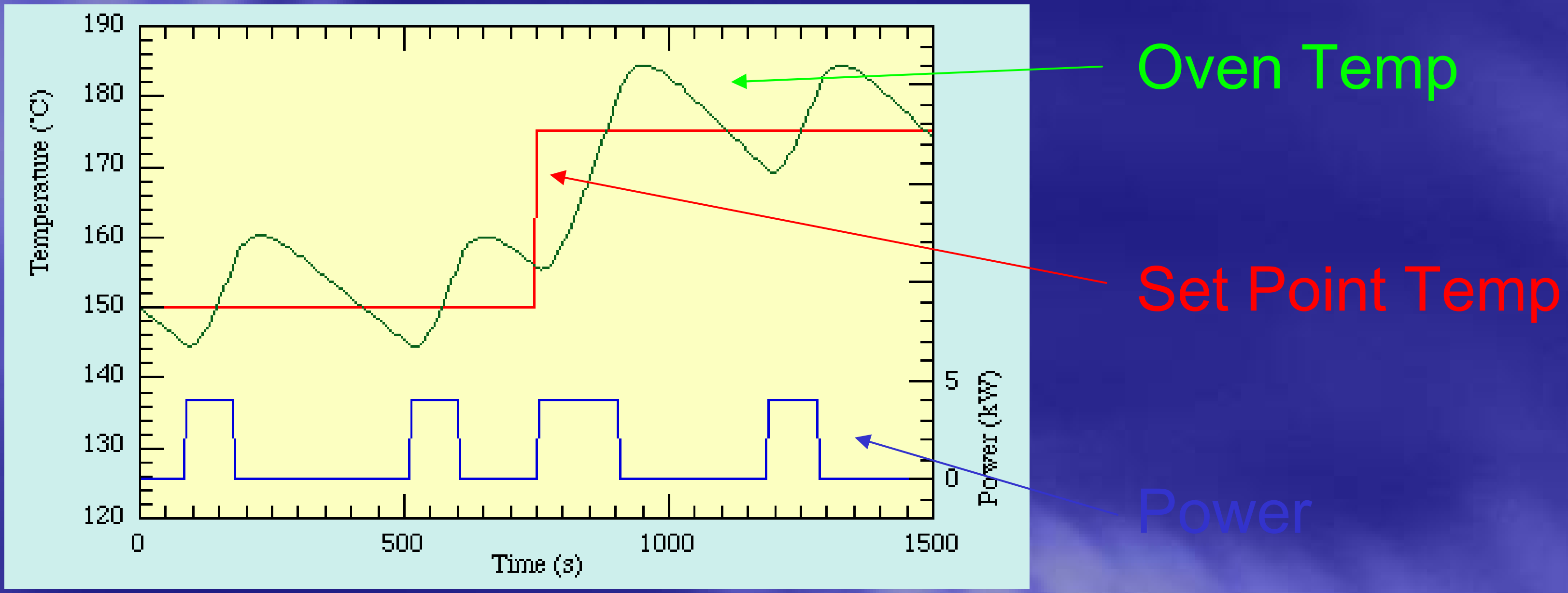
Maglev Experiment



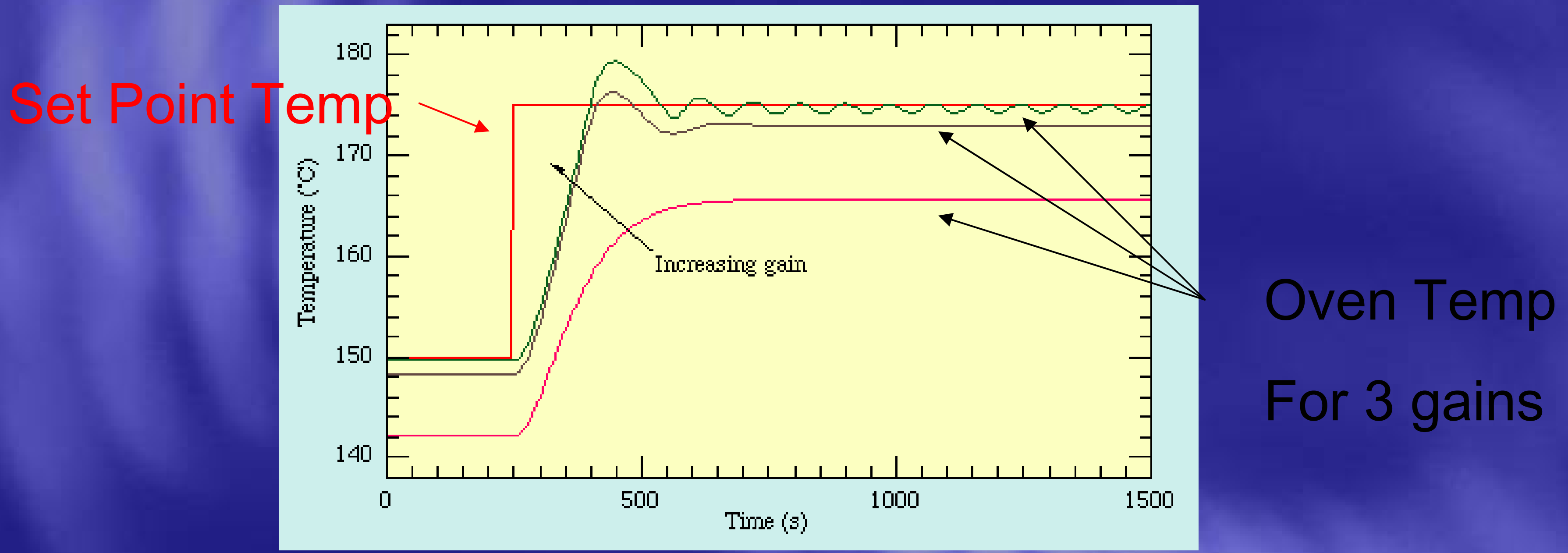
- The emitter puts out a constant light intensity.
- The detector signal is amplified and compared with a reference voltage.
- The output of the comparison drives the electromagnet.
- If the ball is too high (detected IR signal too small), the coil current is reduced.
- If the ball is too low (detected IR signal too large), the coil current is increased.

Maglev: Types of Control



- On-Off Control (also called Bang-Bang)
- Commonly used for thermostats. When the temperature is to low (bang) it is on. When the temperature is too high (bang) it is off.
- Note the large excursions in temperature and that hysteresis is used to delay turn on and turn off.

Maglev: Types of Control

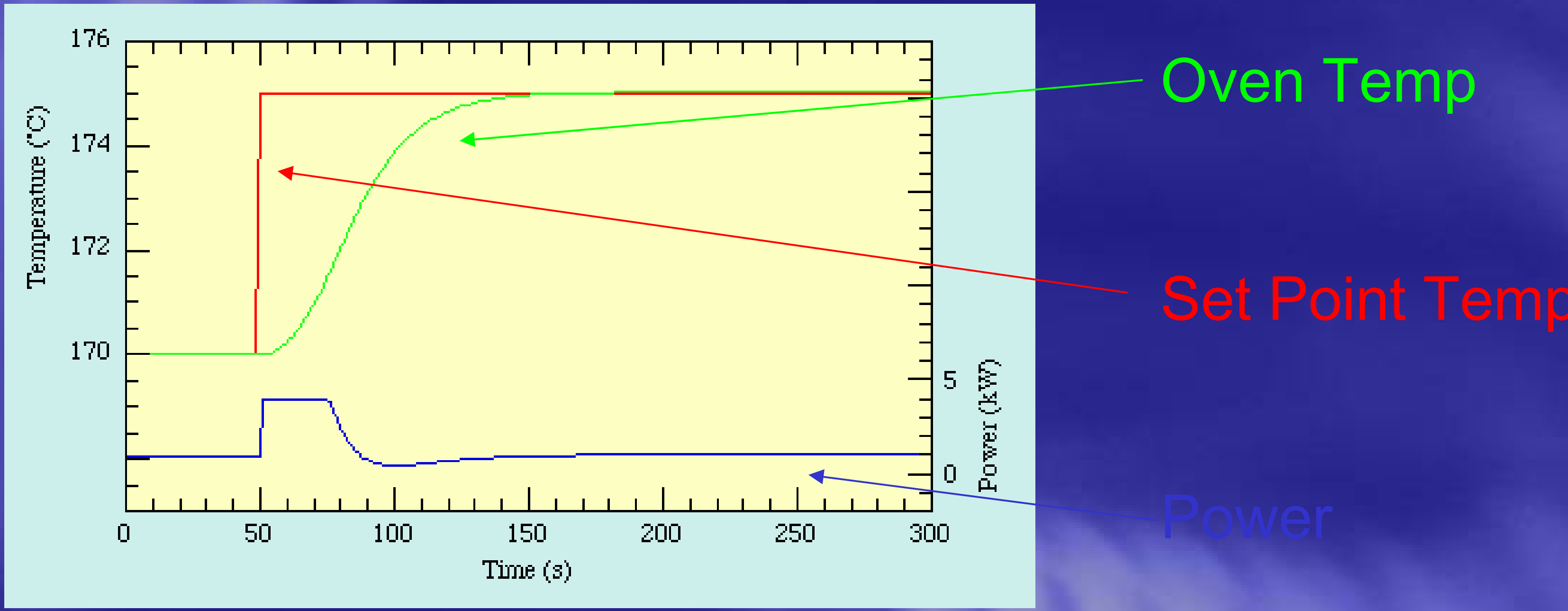


- Proportional Control

$$W = A_P(T_S - T_O)$$

- The power *W* is proportional to the difference in temperature between the set point and the actual temperature. Note as gain increases, the temperature becomes more unstable but can get closer to the set point.

Maglev: Types of Control



- Proportional-Integral-Differential Control (PID)

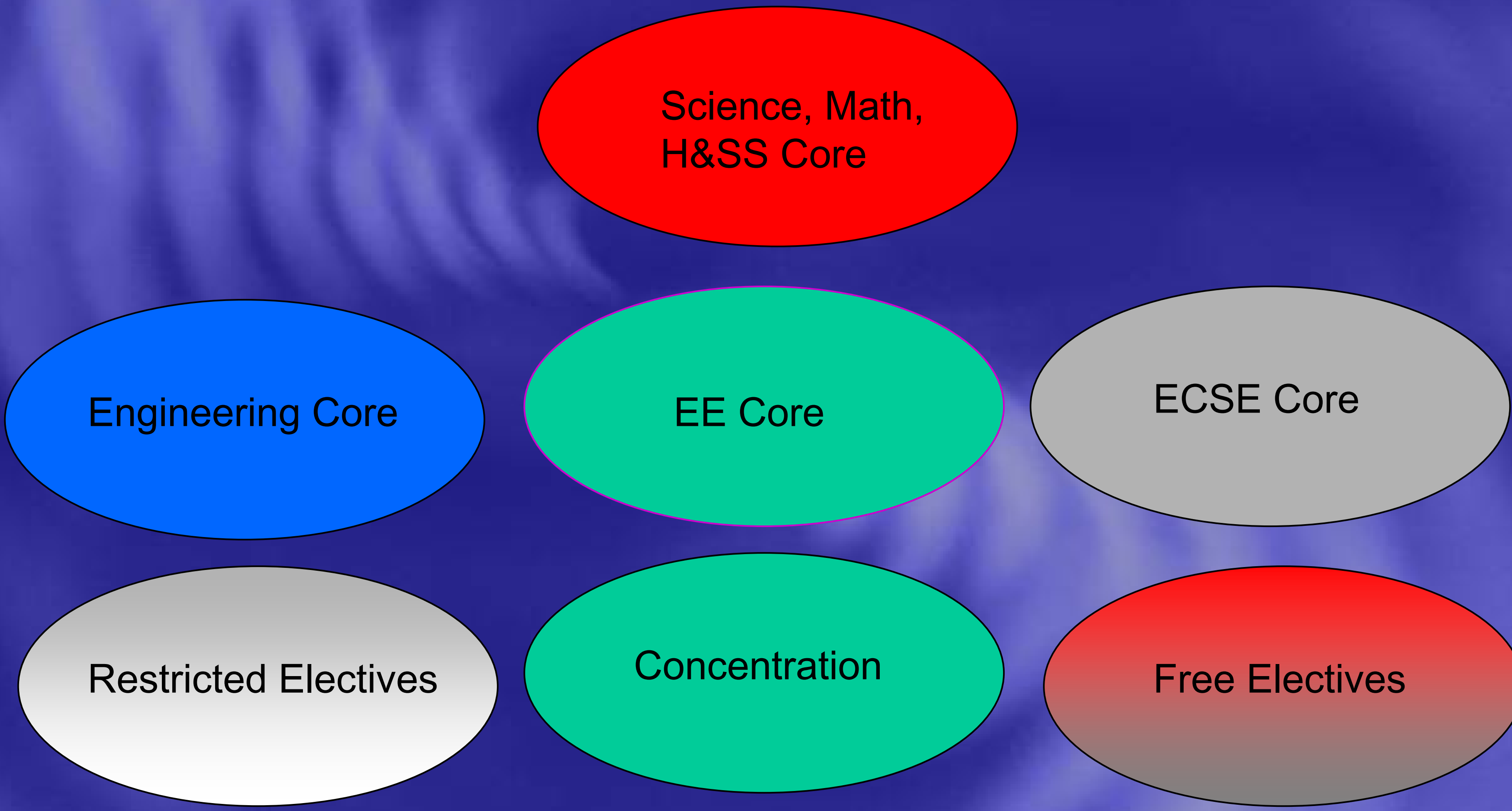
$$W = A_P\left[\left(T_S - T_O\right) + A_D \frac{d\left(T_S - T_O\right)}{dt} + A_I \int \left(T_S - T_O\right) dt\right]$$

- Works the best but is more mathematically demanding since it is 3rd order.

Maglev: Types of Control

- Proportional-Integral Control (PI): In a simple system where noise may be a problem, the derivative term is not used. This is the approach used in the Embedded Control Class.
- More on control can be found at Feedback and Temperature Control from the University of Exeter and the Hacker's Diet (really!) by John Walker.

Electrical Engineering



Electrical Engineering

Science, Math, H&SS Core

- Chem Mat I
- Calculus I&II
- Differential Eqns
- Physics I&II
- CS I
- H&SS (5) + PD II
- Applied Math Elective

Engineering Core

- IEA
- IEE
- EG&CAD
- IED
- Embedded Control
- PD I&III
- Multidisciplinary Elective

Electrical Engineering

ECSE Core

- Electric Circuits
- Computer Components and Operations
- Signals & Systems
- Probability for Engr. Applications

EE Core

- Analog Electronics or Digital Electronics
- Fields and Waves I
- Microelectronics Technology
- Lab Elective

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Electrical Engineering

Concentration

- Automatic Controls
- Comm & Info Proc
- Computer Hardware
- Electromagnetics
- Electronic Circuits
- Power Electronics
- Manufacturing or Entrepreneurship
- Microelectronics
- Individualized

Specified Electives

- Lab Elective
- Design Elective (no longer included in concentration)

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Electrical Engineering

Restricted Electives

- Any ECSE or EPOW
- Used to satisfy concentration
- Can also include one ENGR course

Free Electives

- Any course at all
- Usually used up for dual degrees
- Most students take additional technical courses
- See undergrad handbook

Computer and Systems Engineering

Science, Math, H&SS Core

Engineering Core

CSE Core

ECSE Core

Restricted Electives

Concentration

Free Electives

Computer and Systems Engineering

Science, Math, H&SS Core	Engineering Core

- Chem Mat I
- Calculus I&II
- Differential Eqns.
- Physics I&II
- CS I&II
- Data Structures & Alg.
- H&SS (5) + PD II
- Applied Math Elective

- IEA
- IEE
- EG&CAD
- IED
- Embedded Control
- PD I&III
- Multidisciplinary Elective

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Computer and Systems Engineering

ECSE Core

- Electric Circuits
- Computer Components and Operations
- Signals & Systems
- Probability for Engr. Applications

CSE Core

- Computer Architecture, Networks and Operating Systems
- Software Engineering Elective

Computer and Systems Engineering

Concentration	Specified Electives

Concentration

- Automatic Controls
- Comm & Info Proc
- Computer Hardware
- Computer Systems
- Manufacturing or Entrepreneurship
- Individualized

Specified Electives

- Software Engineering Elective
- Design Elective (no longer included in concentration)

Computer and Systems Engineering

Restricted Electives

- Any ECSE or CSCI
- Used to satisfy concentration
- Can also include one ENGR course

Free Electives

- Any course at all
- Usually used up for dual degrees
- Most students take additional technical courses
- See undergrad handbook

Electric Power Engineering

Science, Math,
H&SS Core

Engineering Core

EPE Core

ECSE Core

Restricted Electives

Concentration

Free Electives

Electric Power Engineering

Science, Math, H&SS Core

- Chem Mat I&II
- Calculus I&II
- Differential Eqns
- Physics I&II
- C Prog. For Engineers
- H&SS (5) + PD II

Engineering Core

- IEA
- Engr. Proc. Or IEE
- EG&CAD
- IED
- MAU
- Modeling & Control of Dynamic Systems
- Embedded Control
- Electronic Instrumentation
- PD I&III
- Thermal & Fluids Engr.
- Multidisciplinary Elective

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Electric Power Engineering

ECSE Core

- Electric Circuits
- Fields & Waves I
- Signals & Systems

EPE Core

- Power Engineering Fundamentals
- Electromechanics
- Semiconductor Power Electronics
- EPE Lab
- EPE Design

Electric Power Engineering

Concentration

- Not required for EPE degree
- Optional Concentration in Power Electronics Systems -- Includes courses from EPOW, ECSE, & MANE

Specified Electives

- Technical Elective – any course in Engineering or Science above the 2000 level

Electric Power Engineering

Free Electives

- Any course at all
- Usually used up for dual degrees
- Most students take additional technical courses
- See undergrad handbook

Grainger Scholars Program

The Electric Power Engineering Program at Rensselaer has, for several years, operated the Grainger Scholars' program under the auspices of the Grainger Foundation. This program, provides generous awards ($7,500 per year for undergraduates and $10,000 for graduate students) for meritorious US students. The only condition of the awards is that Grainger Scholars attend an annual awards banquet and give a short presentation.

Priority is always given to Electric Power Engineering majors, but the awards can be made to EE students who have demonstrated an interest in electric power. Such interest may be demonstrated in several ways (e.g. electing to take a concentration in electric power or a combination of, for instance, enrollment in EPOW-4010 and other power courses at Rensselaer, involvement with CPES, internships or co-op assignments with power companies, etc.)

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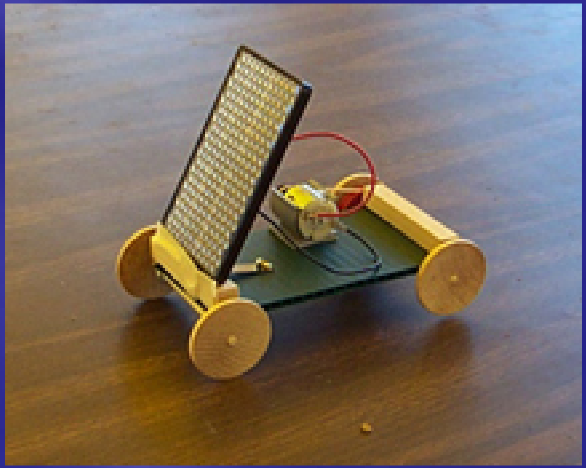
Wind Power

Solar Power



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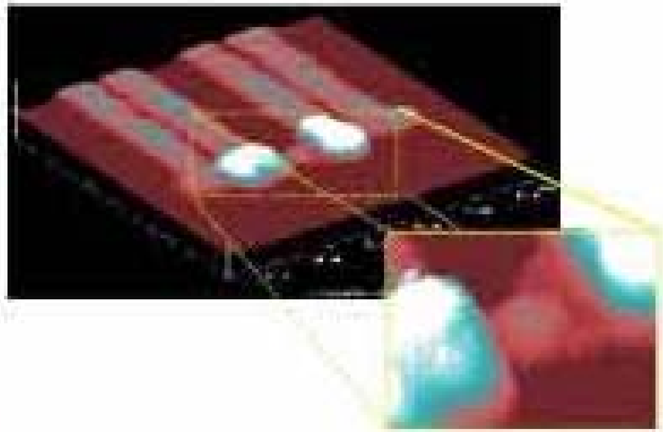
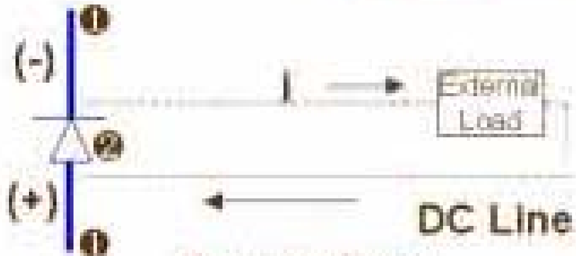
Direct Energy Conversion: Concept

1. Coupling: Absorb Energy- Antenna array efficiently couples to incoming radiation (engineered to frequency)
   - Antenna Scales with Frequency
   - Complex Waveform (Broadband, Dual Polarization, reflected)

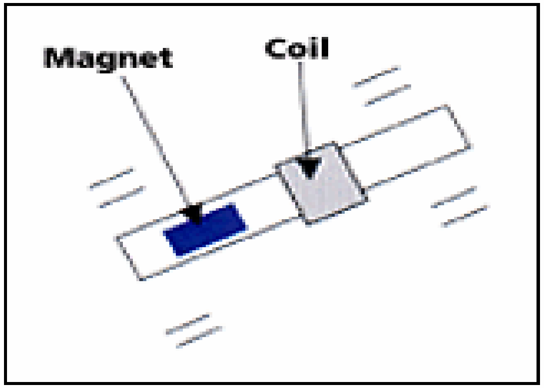


2. Rectification: Convert Energy to DC power-High Frequency Planar MIM Diode (Non-linear)
   - Frequency cutoff dictated by diode area
   - Can act as both a classical and quantum rectifier depending on frequency range

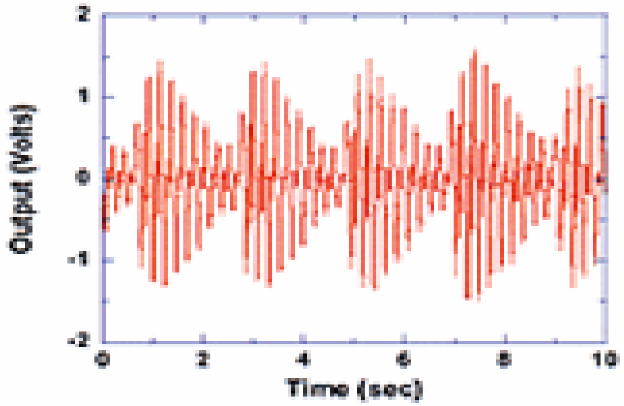


Equivalent Circuit

Rockwell Linear Generator



External motion causes the magnet, under very low friction, to move back and forth, through the coil, producing electrical energy.



Sample electrical output obtained from generator.

Dual Degrees

- EE/CSE – Includes only the CSE concentrations (130 credits)
- CSE/CSYS – Includes all CSE concentrations (131 credits)
- EE/EPE – Includes only the Power Electronics concentration (131 credits)
- EE/Applied Physics – Includes only the Microelectronics concentration (132 credits)

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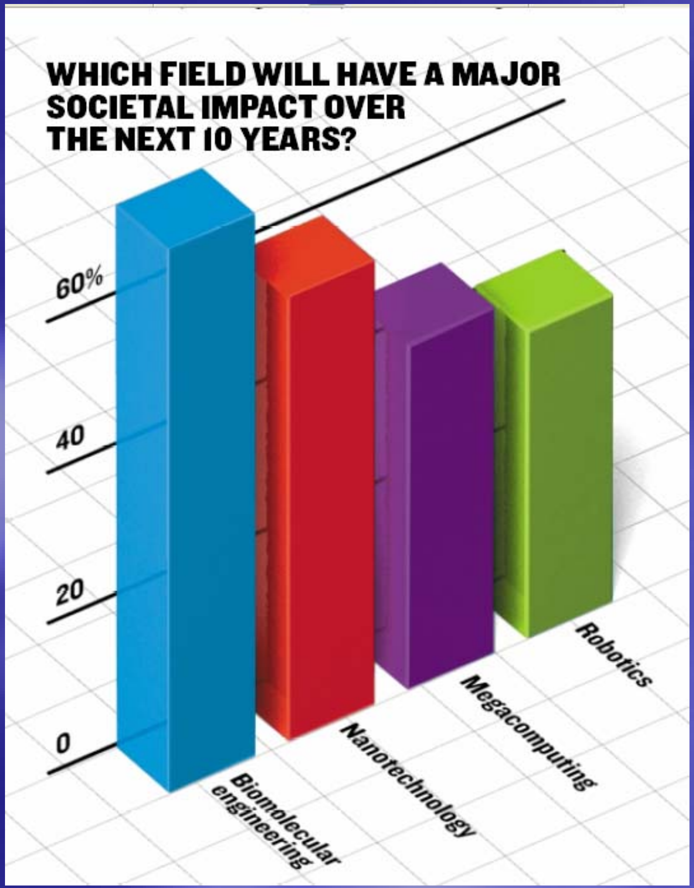
Recent Changes

- Check ECSE webpage during registration period
- New Undergraduate Handbook
- New design course options
  - ECSE Design
  - Control Systems Design
  - Other courses will be changing
- Please check advising information on a regular basis

Where EE Jobs Are – IEEE Spectrum 1/04

- Power
- Communications
- Semiconductors
- Transportation
- Computers
- Bioengineering



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Power

- Winner: Hybrids
- Loser: Fission Breeder Reactor
- Holy Grail: Fusion

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Communications

- Winner: Broadband
- Loser: Smart Dust (GEMS)
- Holy Grail: Fiber to the Home

Semiconductors

- Winner: Gallium Nitride
- Loser: Electron Projection Lithography
- Holy Grail: Semiconductor Lighting

Transportation

- Winner: Superconducting Motors
- Loser: Fuel Cells
- Holy Grail: Hypersonic Flight

Computers

- Winner: Analysis Engine
- Loser: Microsoft SPOT
- Holy Grail: The Infinite Archive

Bioengineering

- Winner: Bioinformatics
- Loser: Carbon Sequestration
- Holy Grail: Genomics

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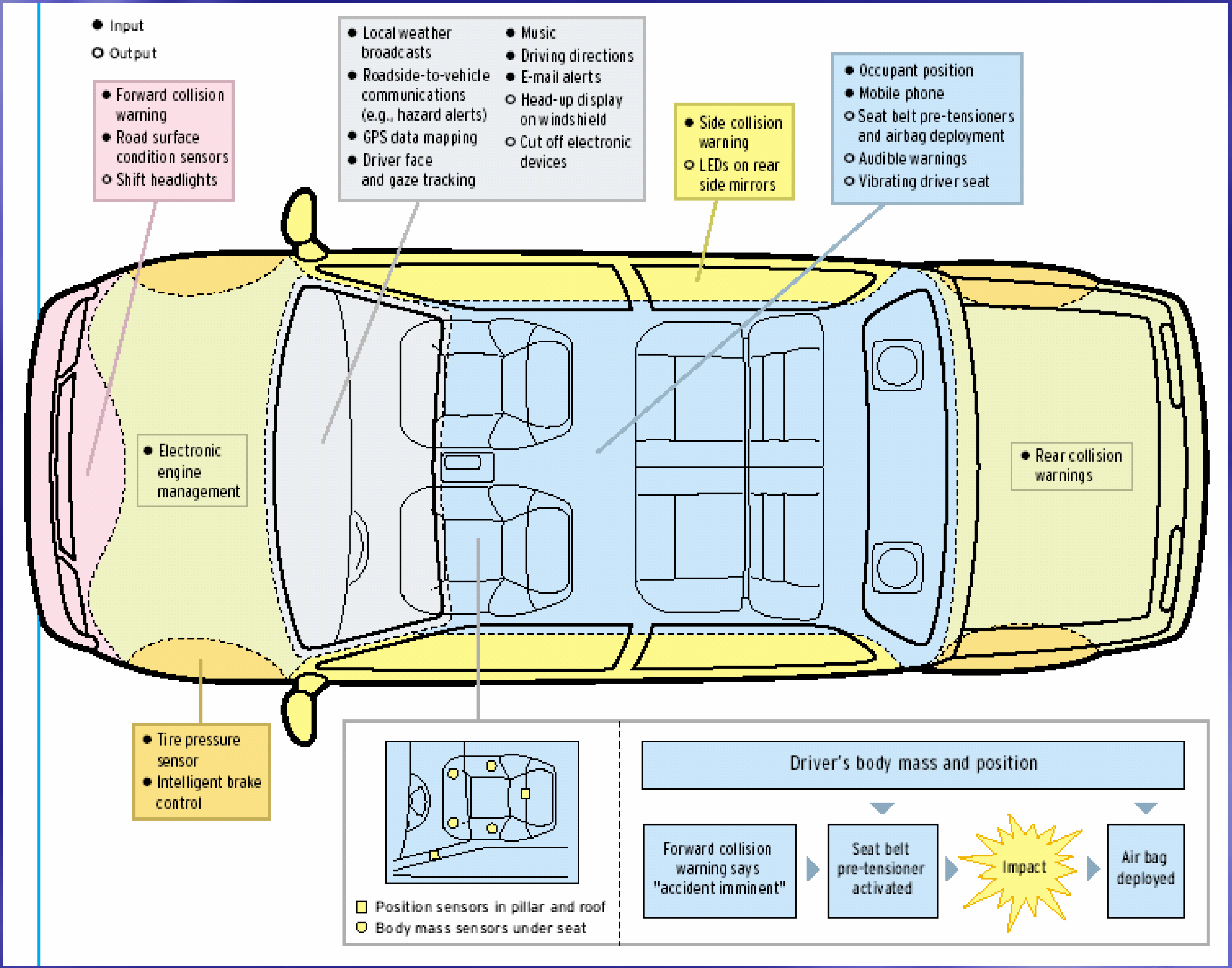
Smarter Cars



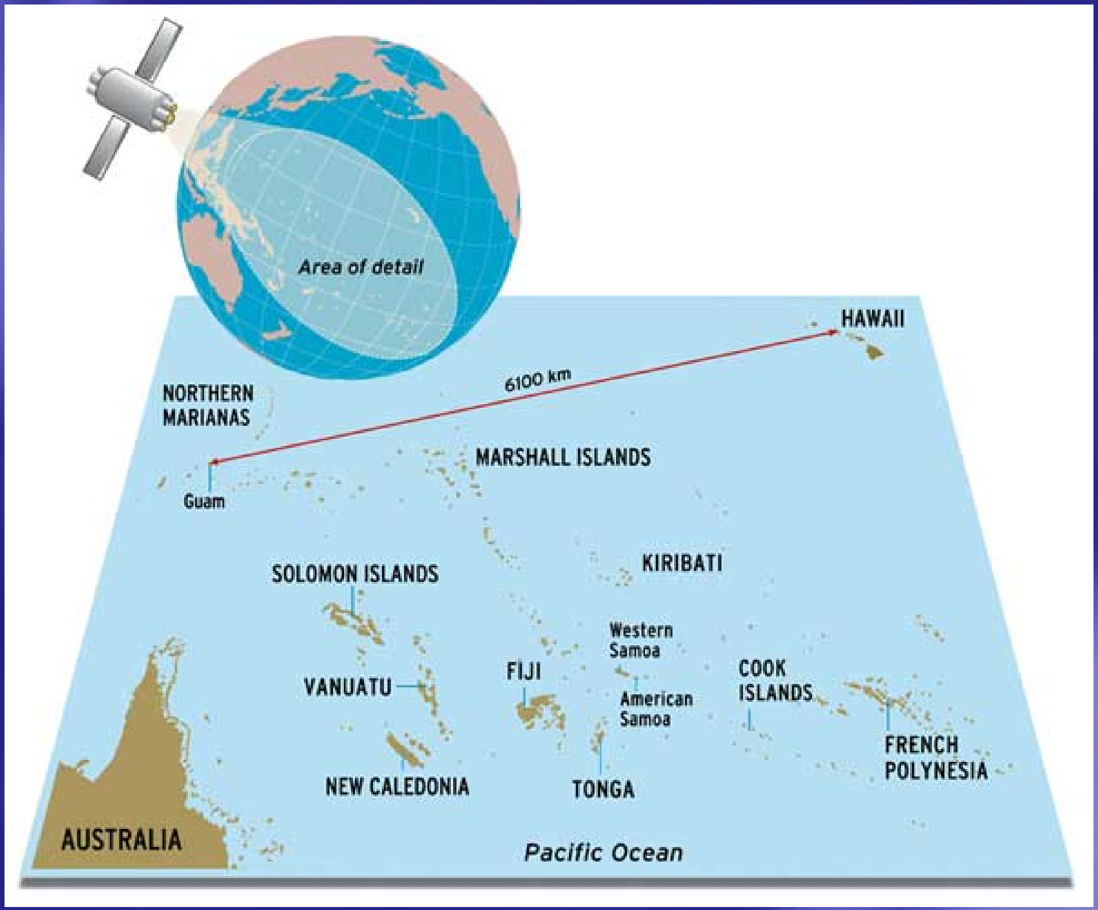
Wireless Networking

- The range of a wireless network can be extended using an antenna made from a Pringles can (now being done by ECSE students) http://www.oreillynet.com/cs/weblog/view/wlg/448

Robotic Surgery

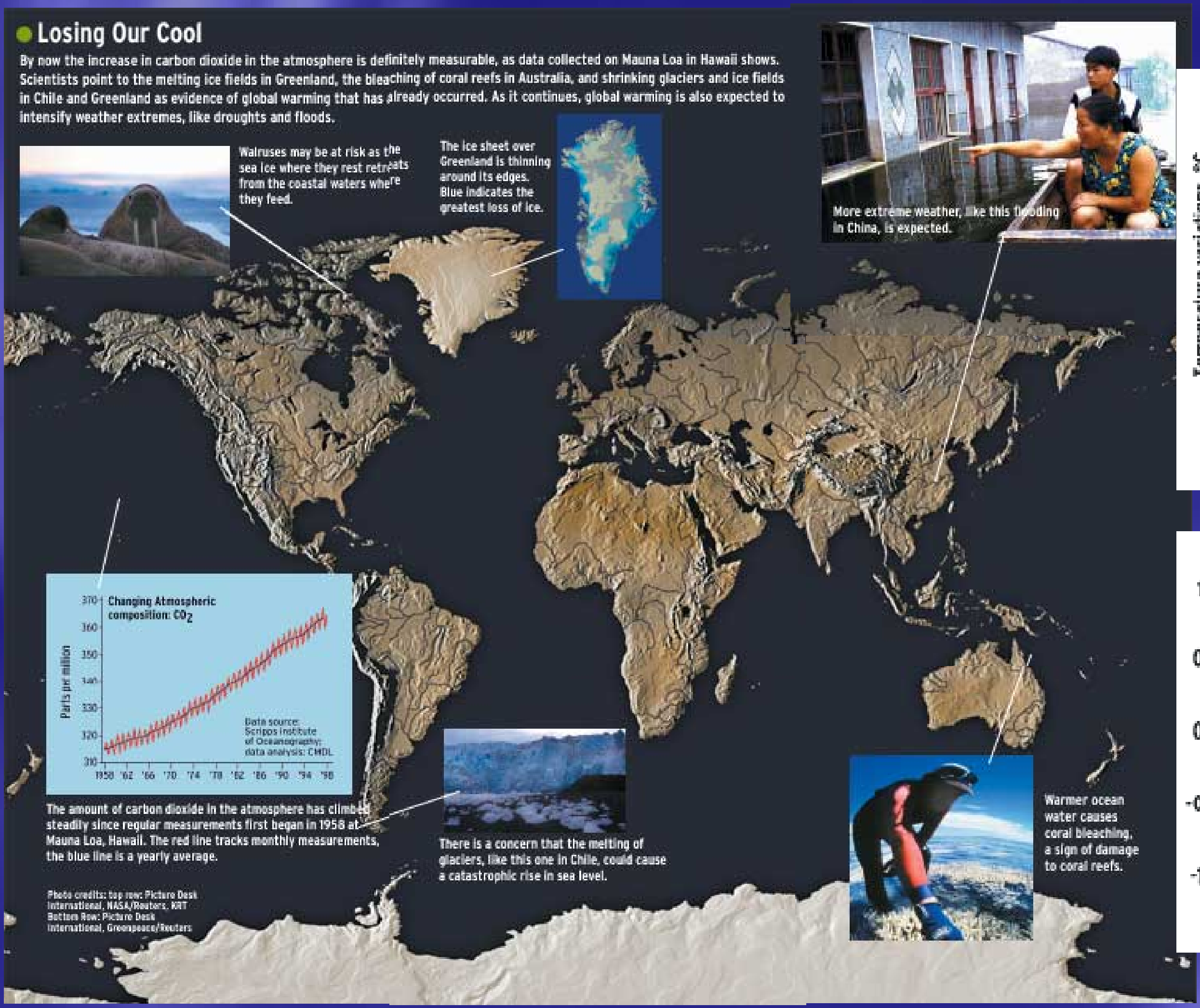
- A doctor in New York removing a woman's gallbladder in France.

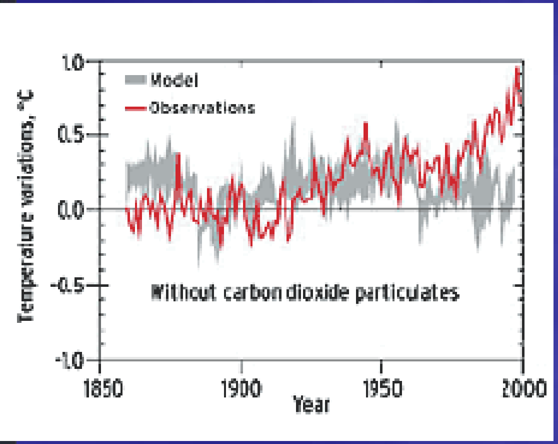
Telemedicine Hub

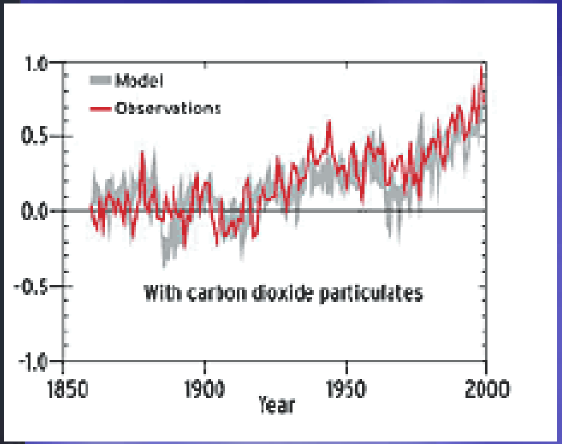


- Retired satellites have new uses

Climate Changes





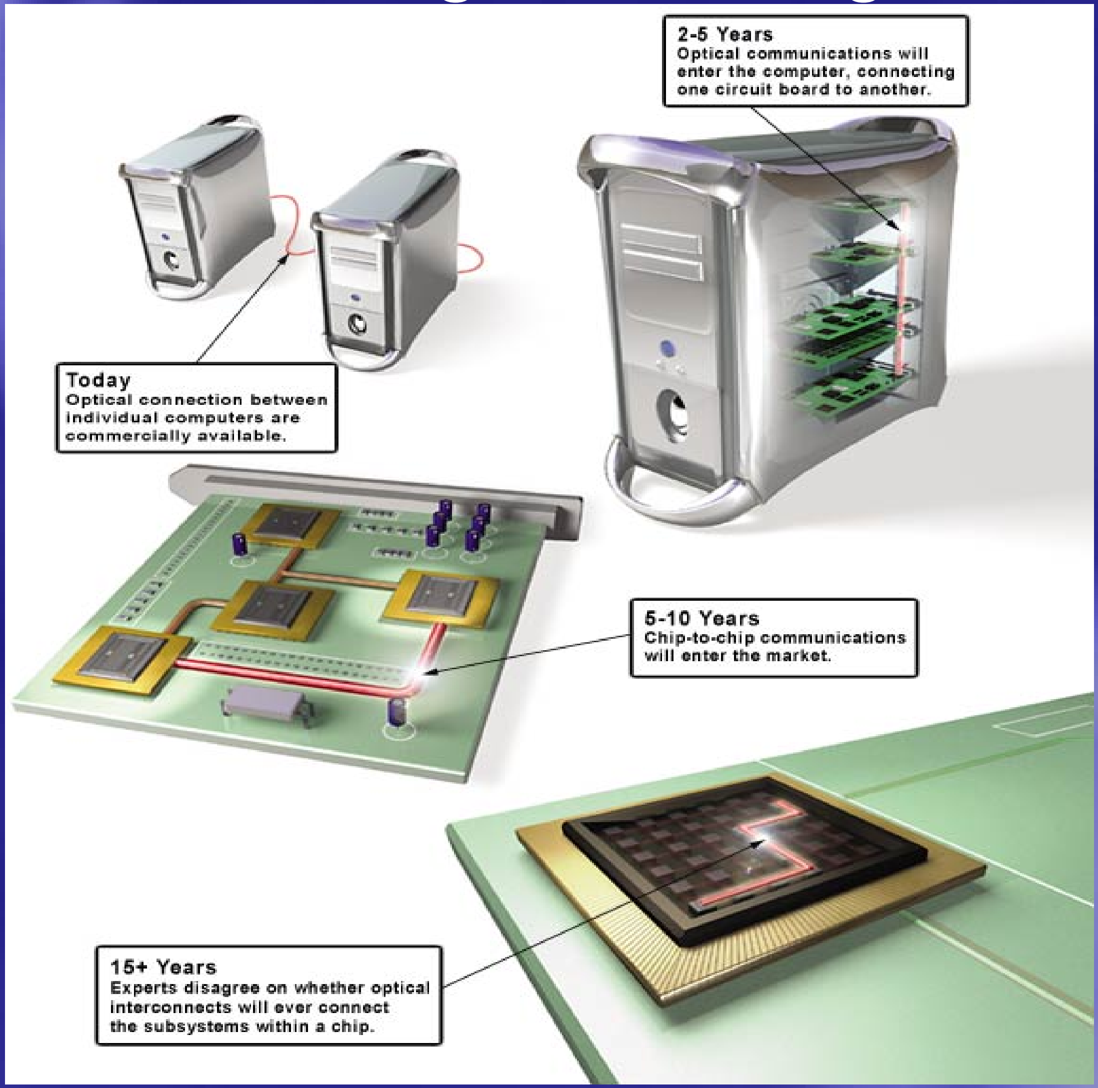


Development of Accurate Modeling Tools

Fuel Cell Power

- Toyota Fuel Cell Hybrid Vehicle

Linking With Light



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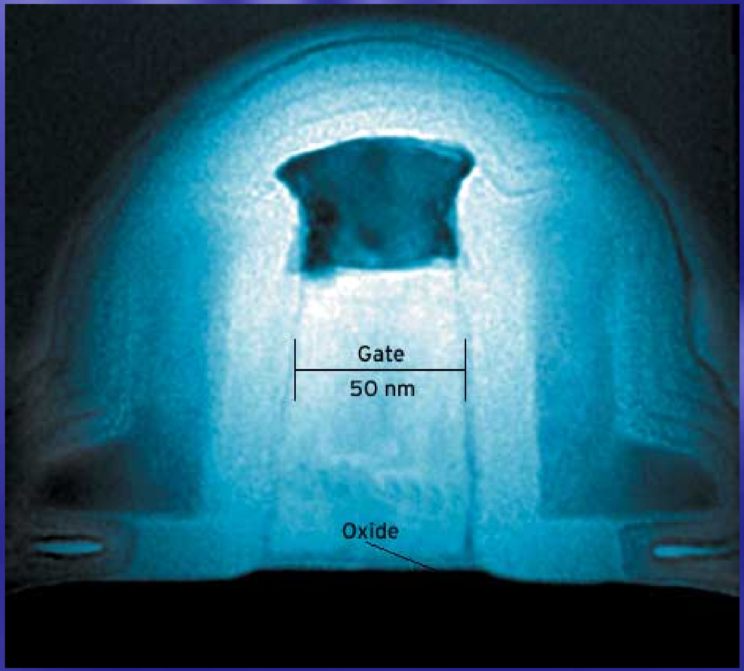
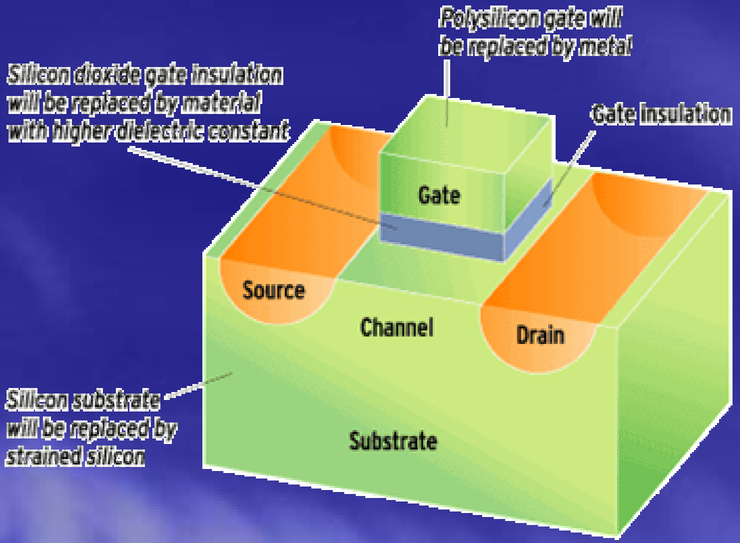
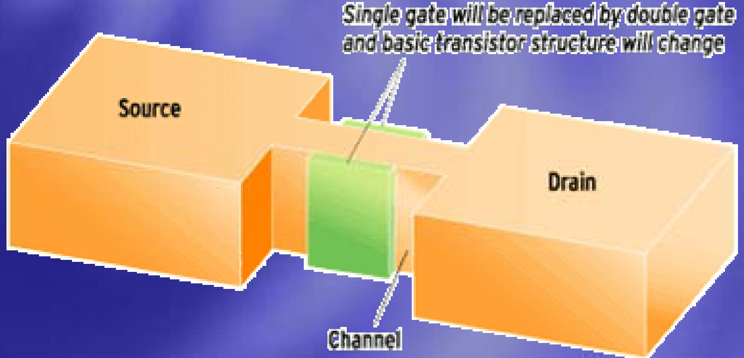
The Shrinking Transistor







- Intel Transistor

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Additional Information on History, the Profession, Etc.

Feb 20-26 2005

- http://ieee-virtual-museum.org/ The IEEE Virtual Museum
- http://www.eweek.org/ National Engineers Week

Career Information

IEEE Careers for [ELECTRICAL ENGINEERS & COMPUTER SCIENTISTS]

- IEEE http://www.ieee.org/organizations/eab/studentcareers_text.htm
- Engineering Resources (Purdue) https://engineering.purdue.edu/ENE/ResourcesFor/students/resources
- About Electrical and Computer Engineering (Discover Engineering Online) http://www.discoverengineering.org/Engineers/electrical_engineering.asp
- GradNet http://gradnet.iec.org/index.asp
- IEEE Spectrum Careers

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More Career Information

- National Society of Professional Engineers

http://www.nspe.org/students/

- National Action Council for Minorities in Engineering

http://www.nacme.org/

- Society of Women Engineers

http://www.swe.org/

- National Society of Black Engineers

http://www.nsbe.org

- Society of Hispanic Professional Engineers

http://www.shpe.org/

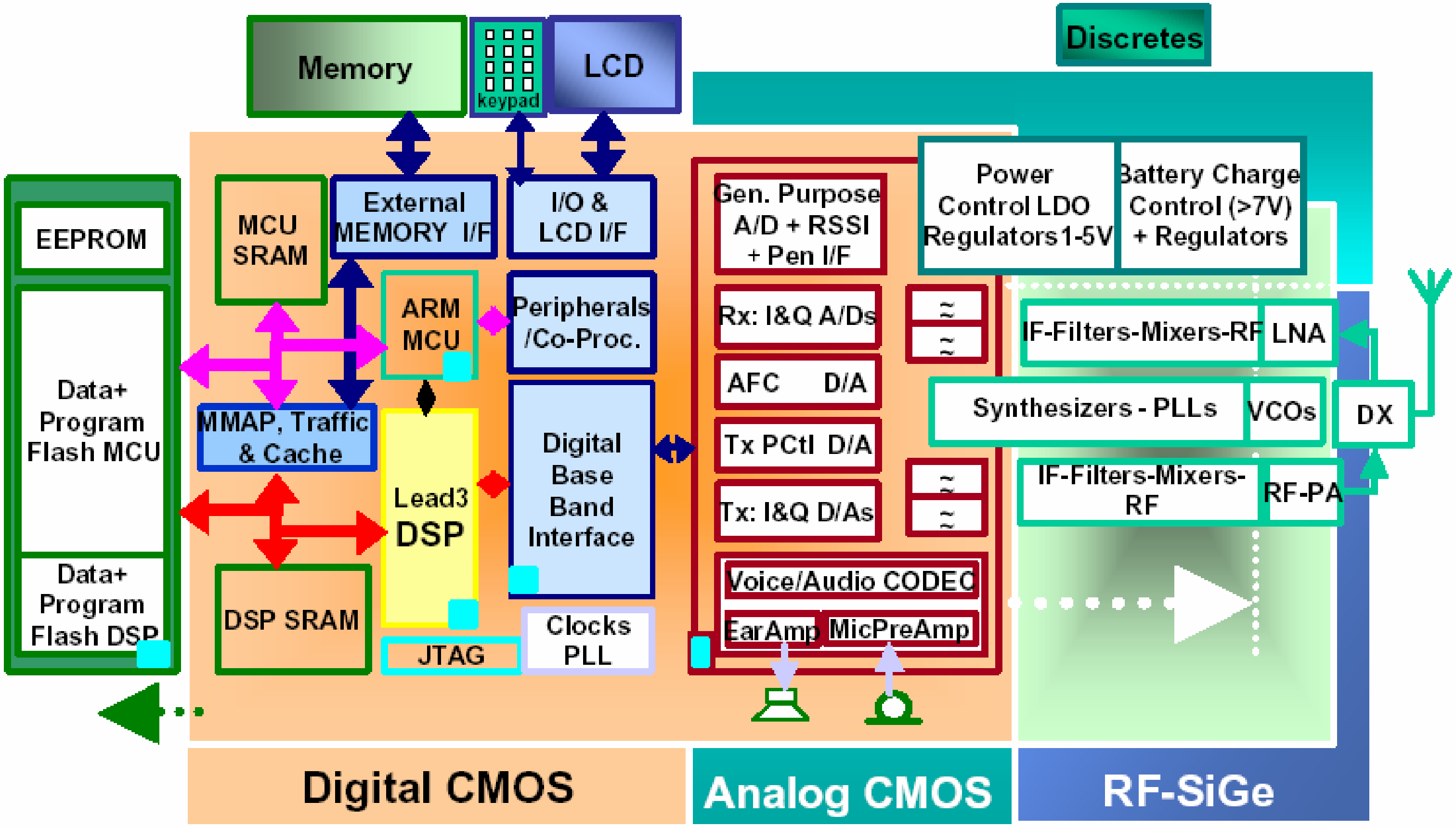
Job Descriptions from Company Websites

- Analog Devices http://www.analog.com/Analog_Root/static/corporate/jobs/index.html
- Intel http://www.intel.com/jobs/index.htm?iid=Homepage+IntelLinks_jobs&
- BAE Systems http://www.baesystems.com/careers/index.htm
- Texas Instruments http://www.ti.com/recruit/index.htm
- Motorola http://motorolacareers.com/index.cfm
- Maxim http://www.maxim-ic.com/AboutMaxim/Jobs/StartPage.htm

Job Search Sites

- Engineering Center
  http://www.engcen.com/

Wireless IC Technologies



Recommended Courses/Topics

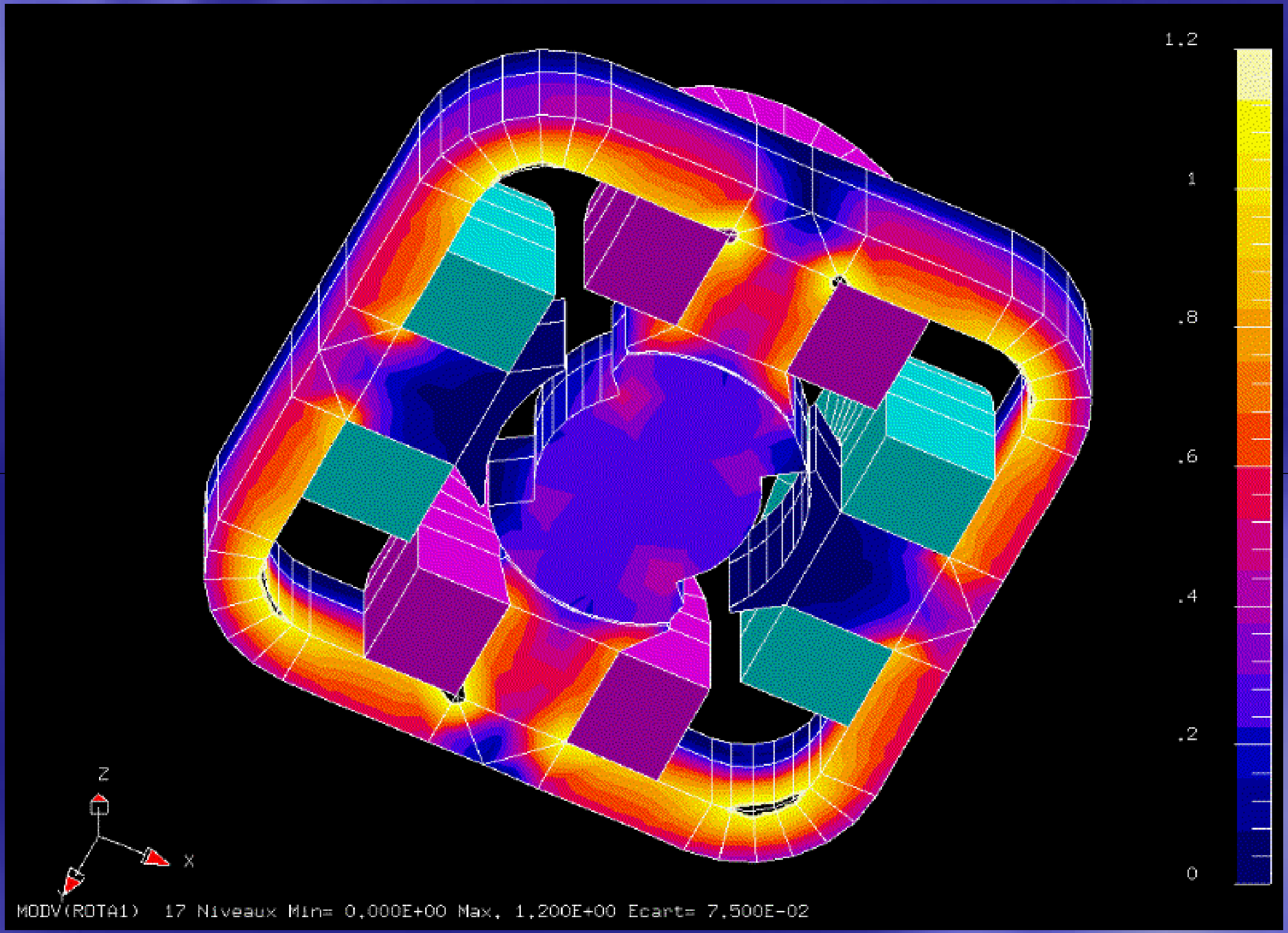
Theory

- Discrete Systems
- Linear Systems & Transforms
- Signal & Systems
- Digital Signal Processing
- Communication Systems

Hands-On

- Real-time DSP Lab
- Communications Design Laboratory
- Signal & Systems Lab
- Capstone Design
- Presentation Skills
- Technical Writing

Reluctance Motor



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Additional Information

- How Stuff Works – Started by ECSE grad Marshal Brain http://www.howstuffworks.com/
- How Things Work from the University of Virginia http://howthingswork.virginia.edu/
- The Straight Dope http://www.straightdope.com

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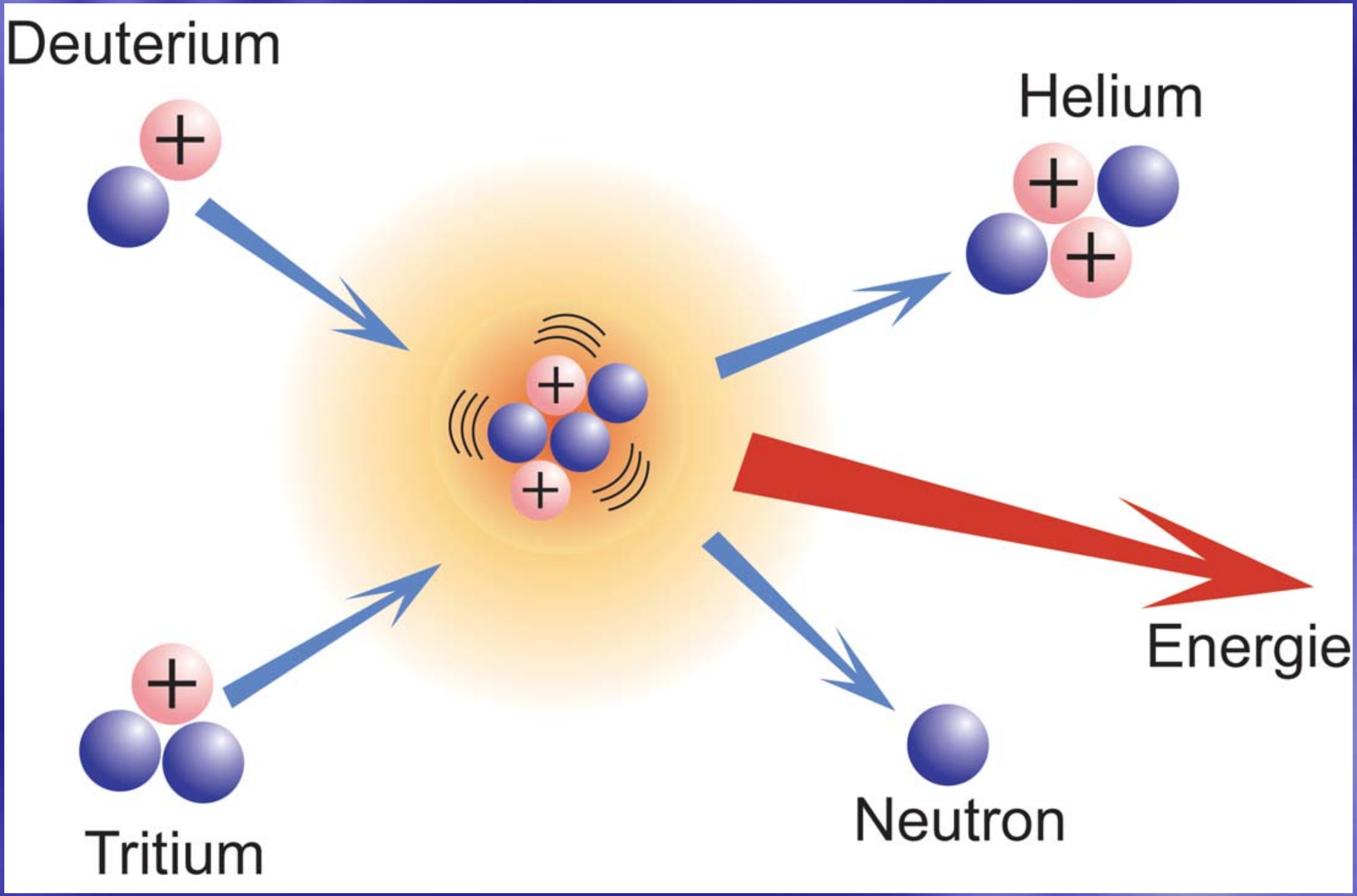
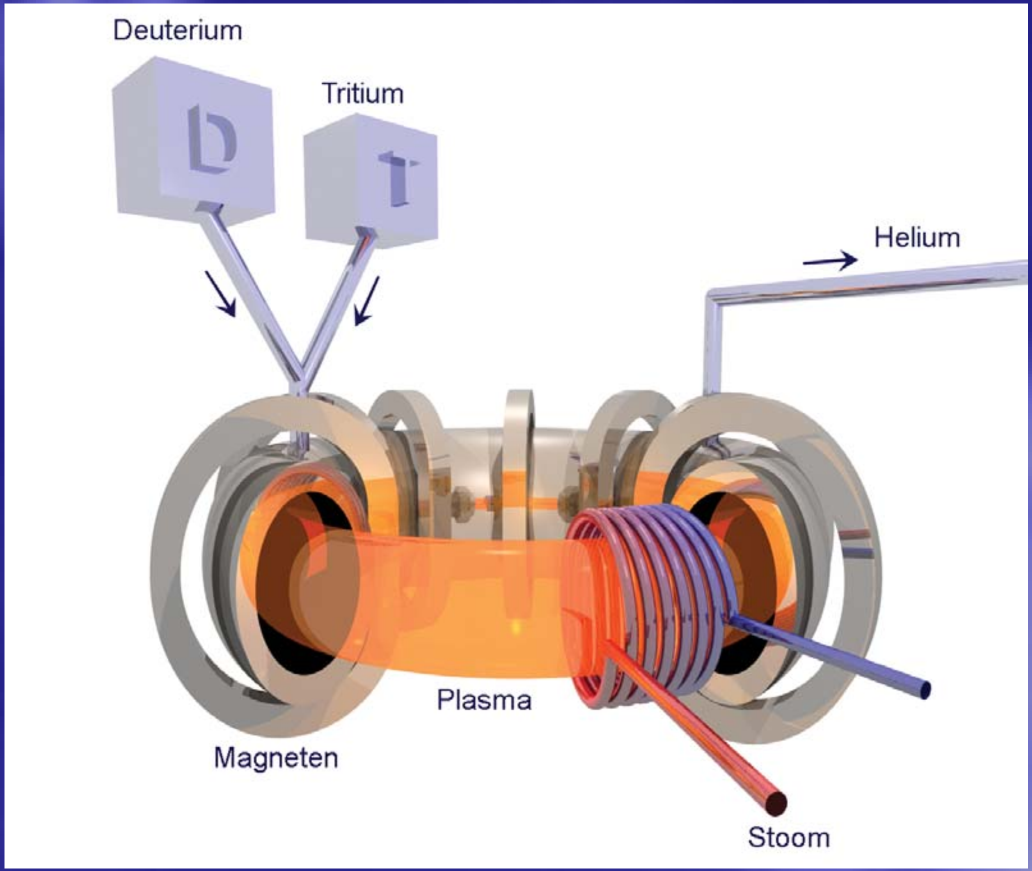
Thermonuclear Fusion

- RPI has been engaged in Nuclear Fusion related research for over 30 years.
- What is Fusion and why is it relevant to EE, CSE and EPE students?

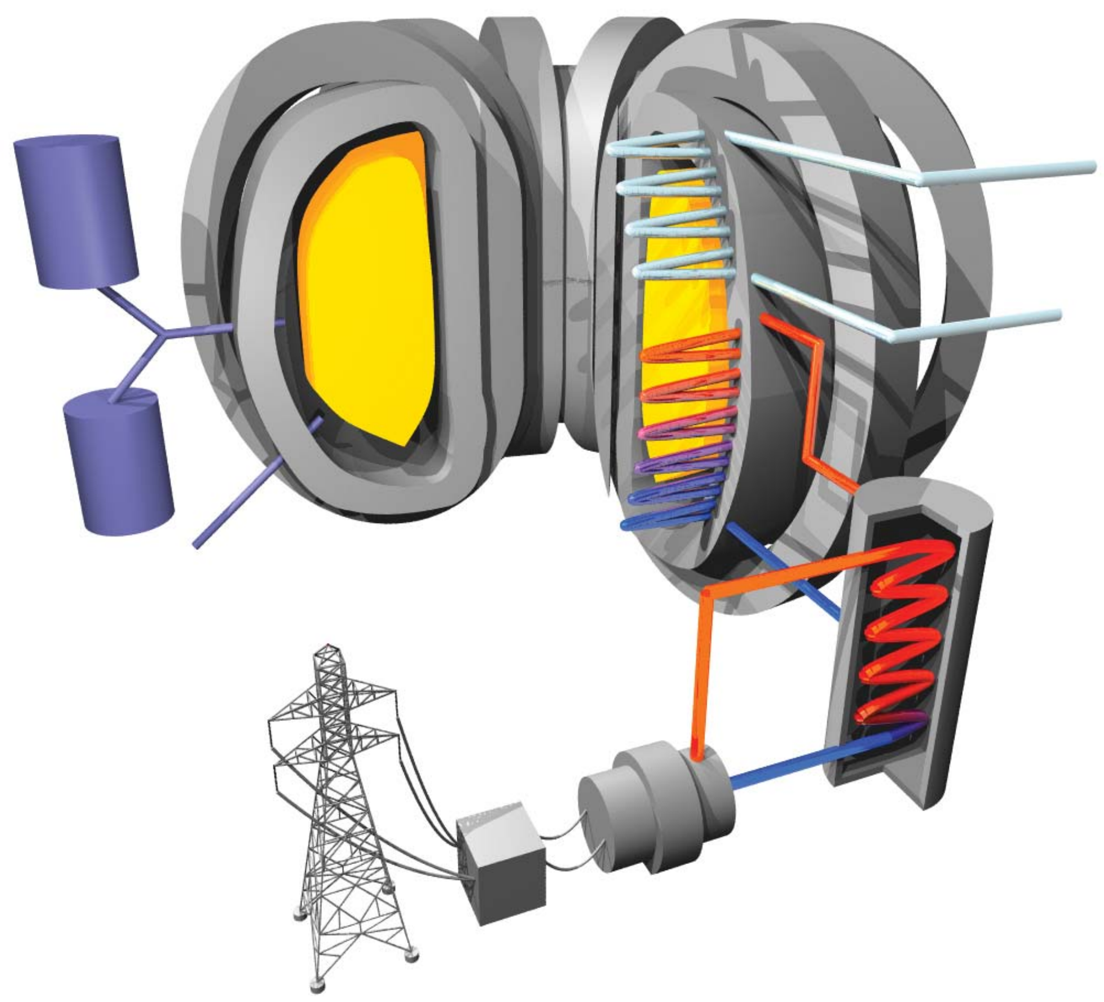
Fusion



Magnetic Confinement



Fusion Power



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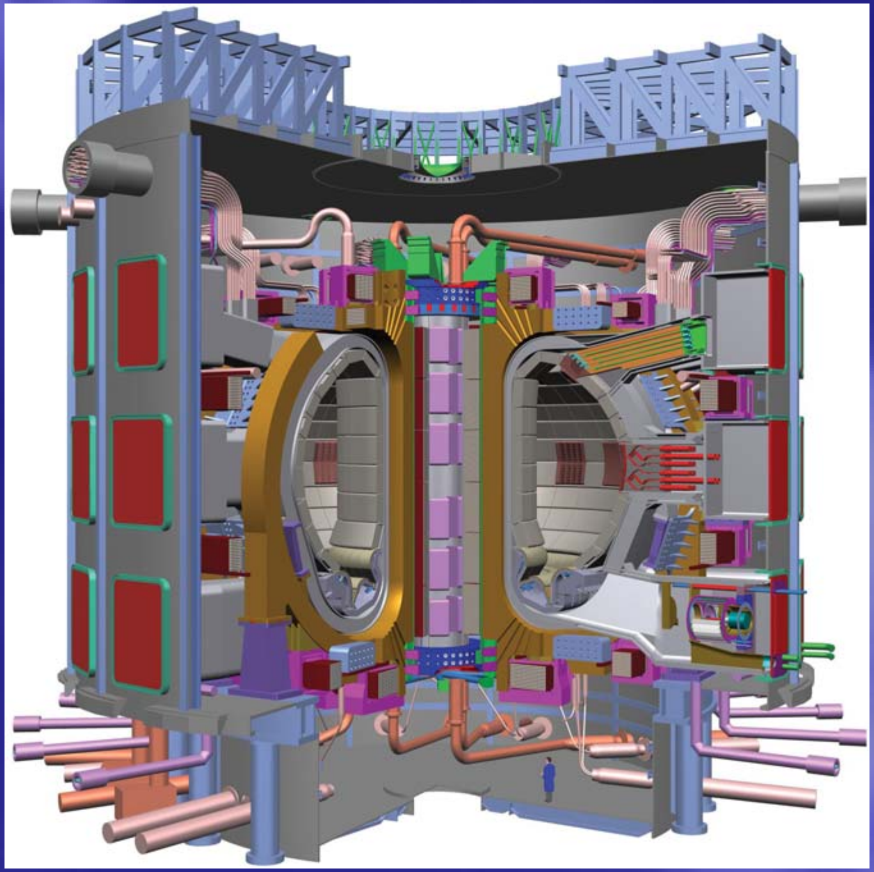
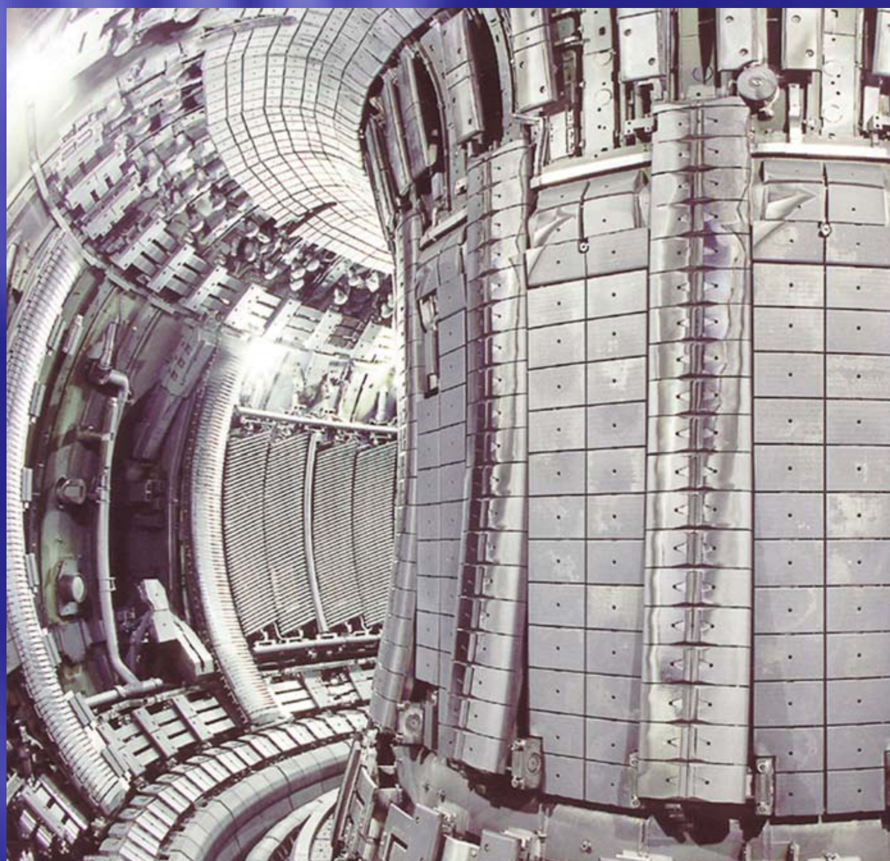
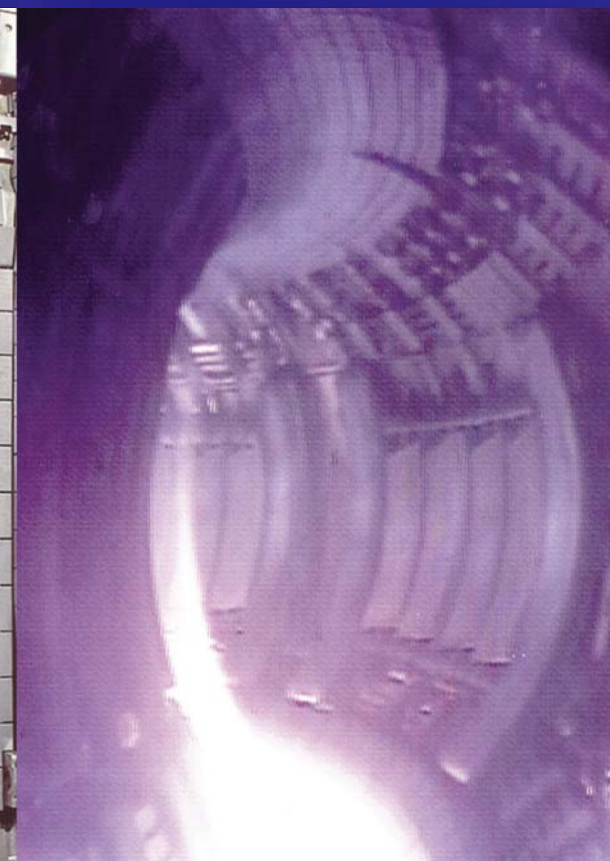
ITER

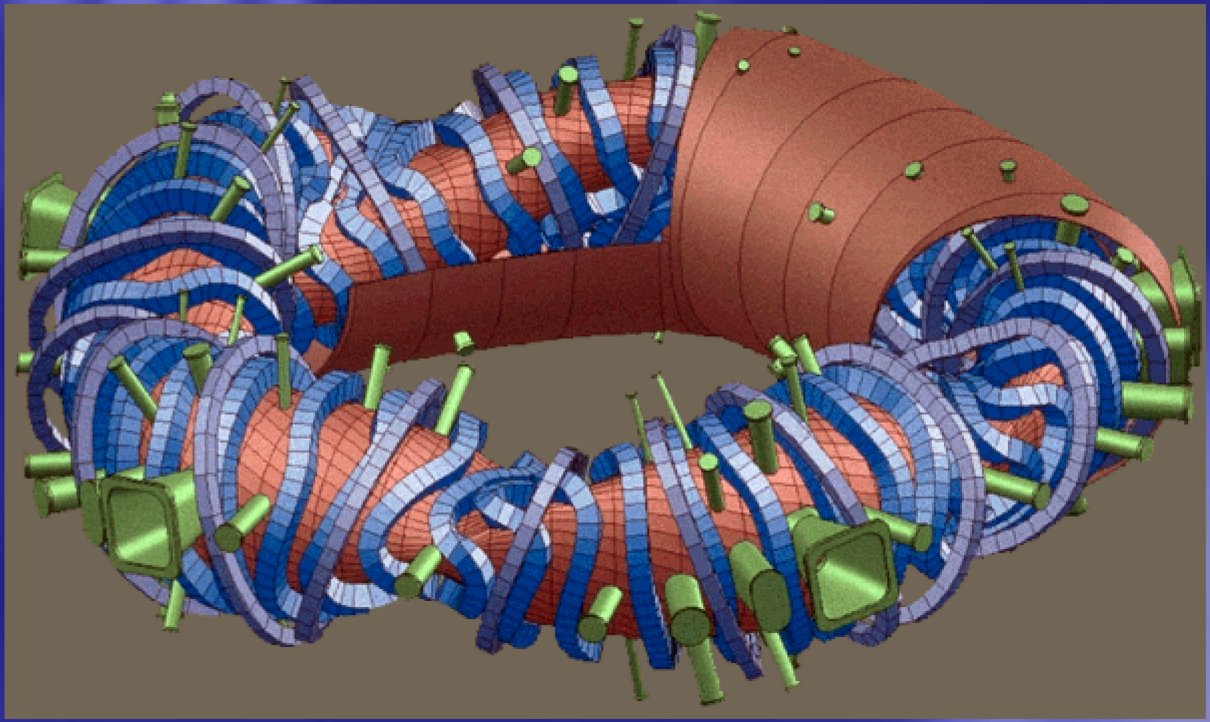


JET

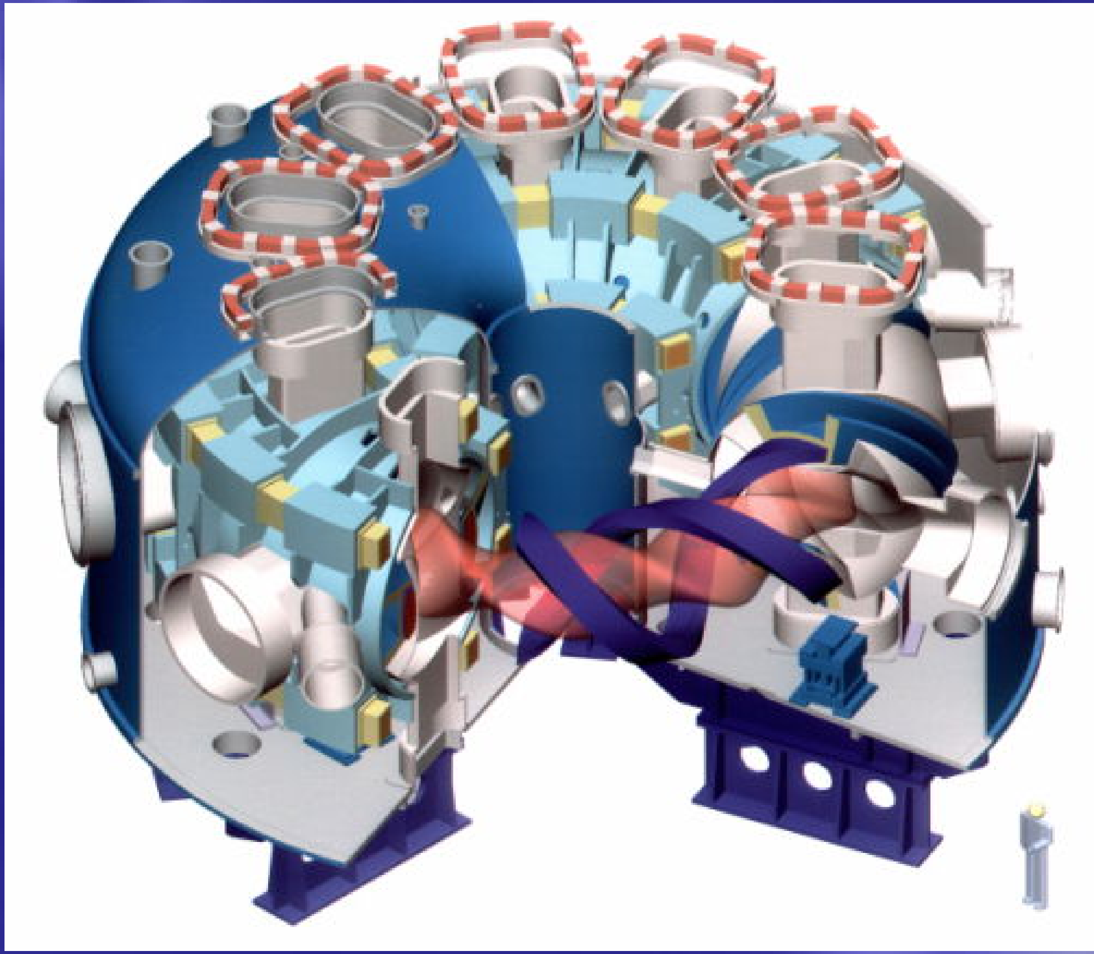




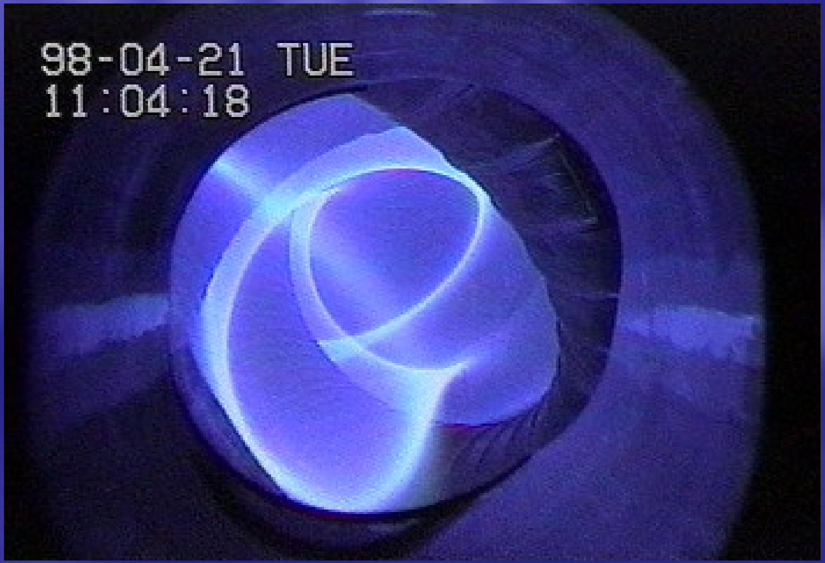
Wendelstein W7-X



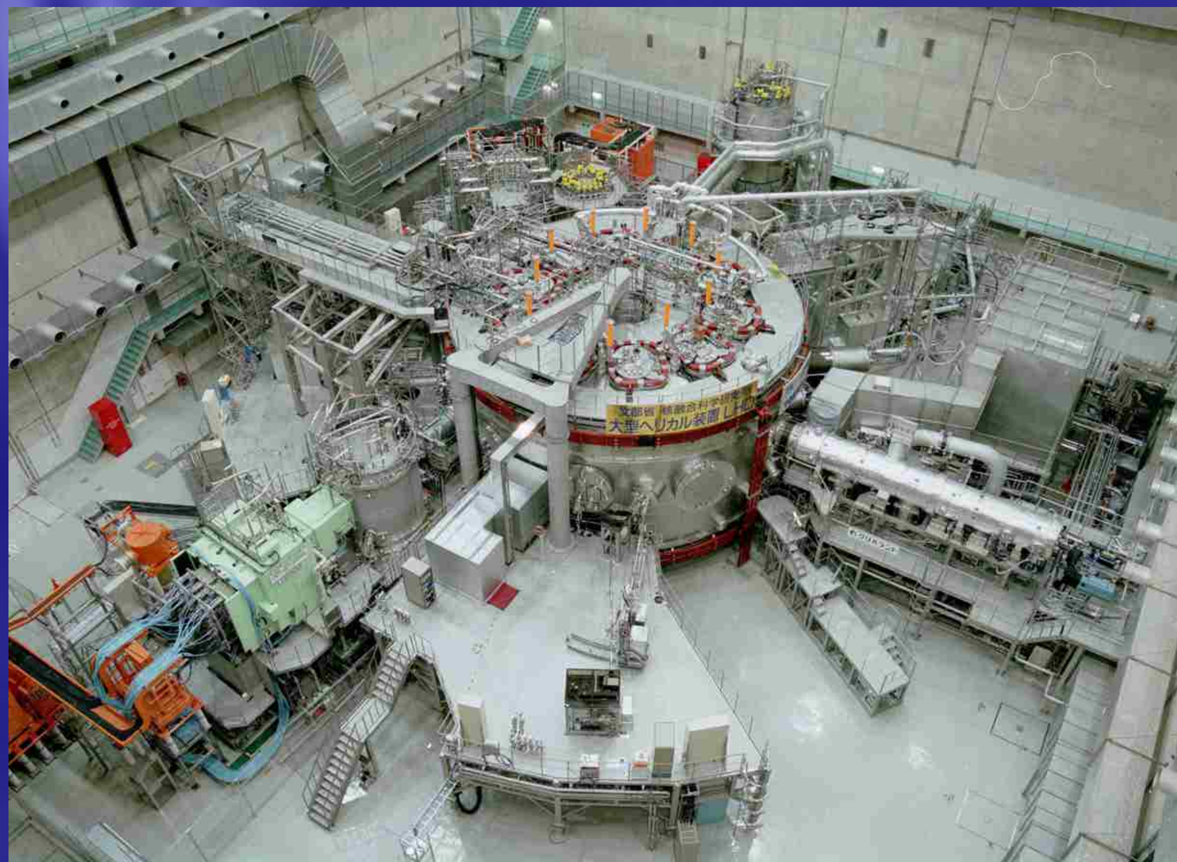
LHD



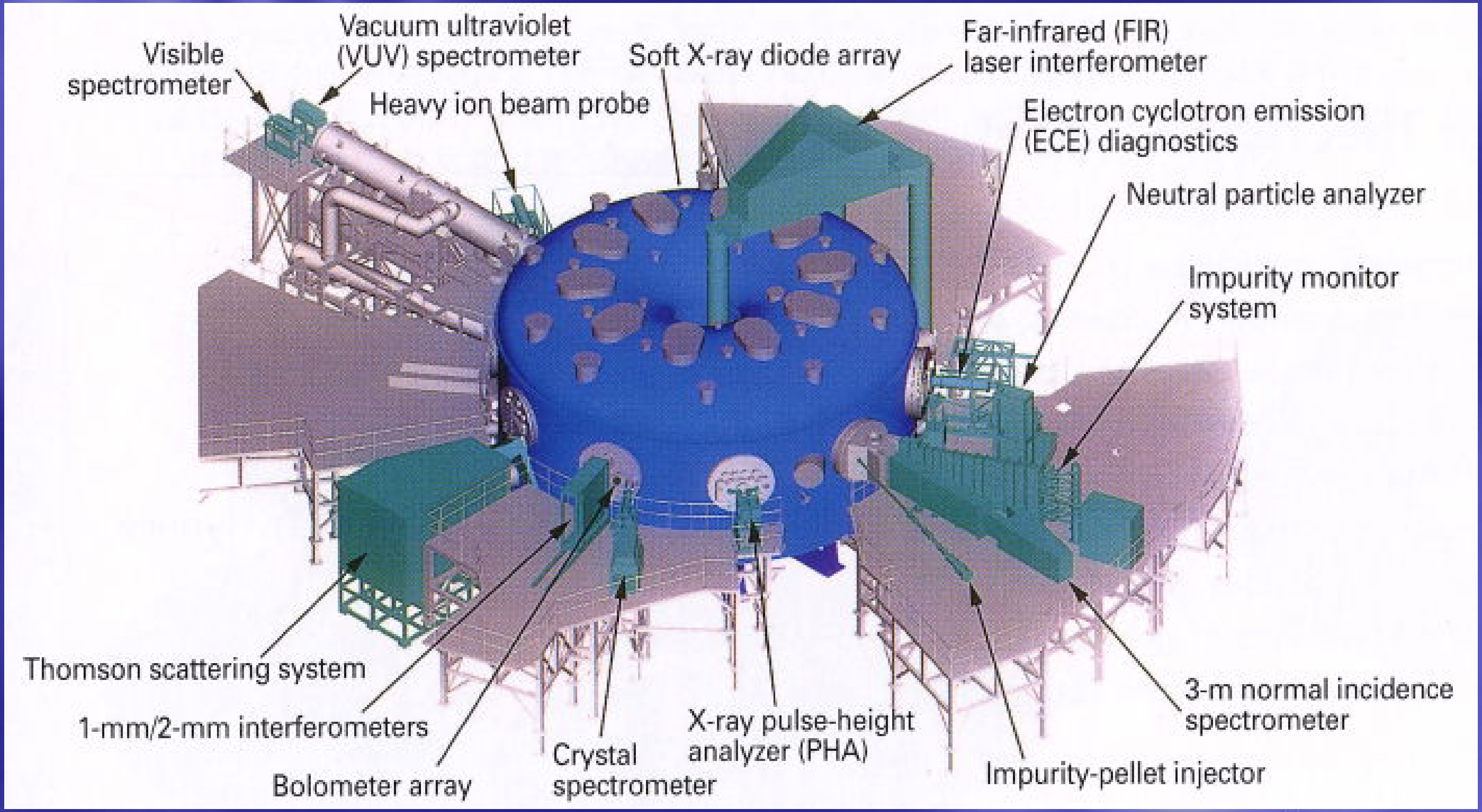
LHD



LHD



LHD


Visible
spectrometer
Vacuum ultraviolet
(VUV) spectrometer
Heavy ion beam probe
Soft X-ray diode array
Far-infrared (FIR)
laser interferometer
Electron cyclotron emission
(ECE) diagnostics
Neutral particle analyzer
Impurity monitor
system
Thomson scattering system
1-mm/2-mm interferometers
Bolometer array
Crystal
spectrometer
X-ray pulse-height
analyzer (PHA)
Impurity-pellet injector
3-m normal incidence
spectrometer

Electrical, Computer, and Systems Engineering Department

@Rensselaer

why not change the world?sm

Madison Symmetric Torus

University of Wisconsin Department of Physics

- Rensselaer Polytechnic Institute is a world leader in the development and application of the Heavy Ion Beam Probe Diagnostic (HIBP).
- The HIBP makes local, time resolved measurements of the potential in fusion relevant plasma, as well as simultaneous measurements of density and potential fluctuations.
- Multipoint measurements or scanning the sample location results in measuring the electric field. The electric field is strongly correlated with transport in many plasma confinement devices, particularly for enhance confinement regimes.

Heavy Ion Beam Probe on Madison Symmetric Torus, primary beamline

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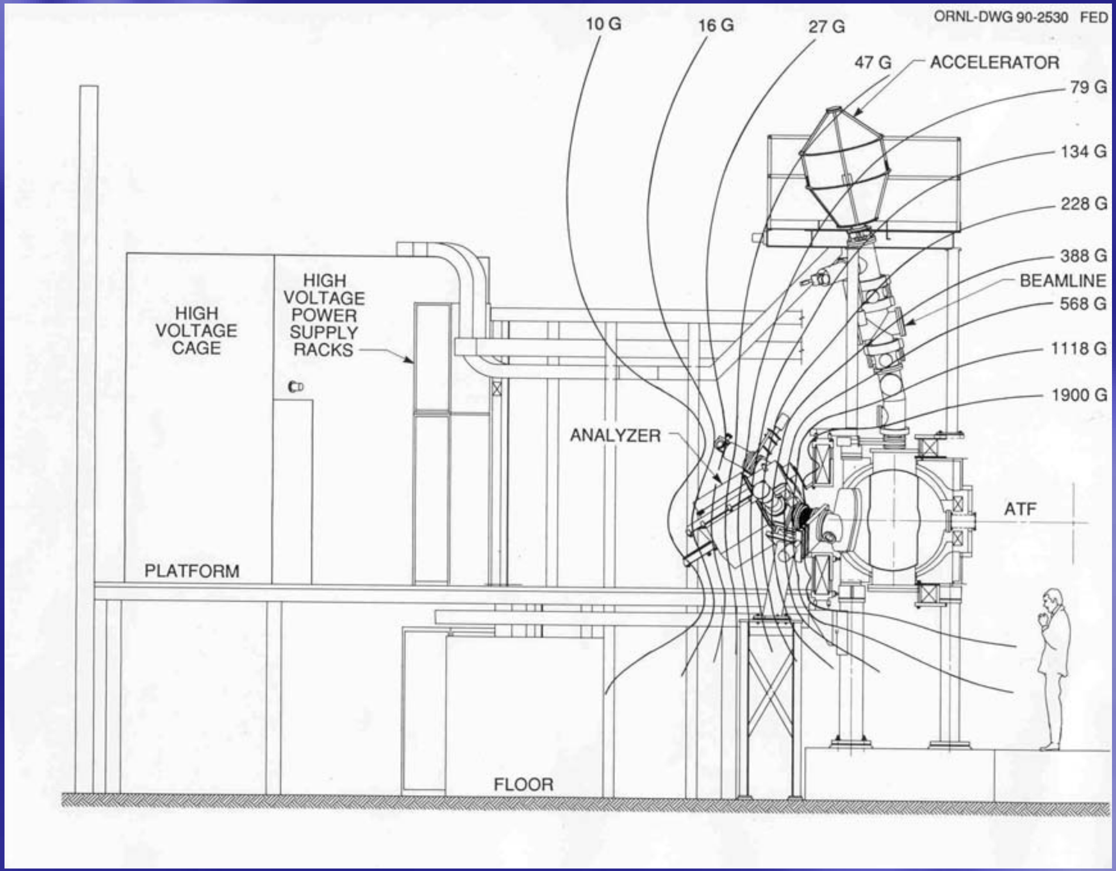
ATF HIBP


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

Fusion and Plasma Info

- Coalition for Plasma Science
- Plasma Science and Technology
- GAT Fusion Education
- PPPL Fusion Education

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