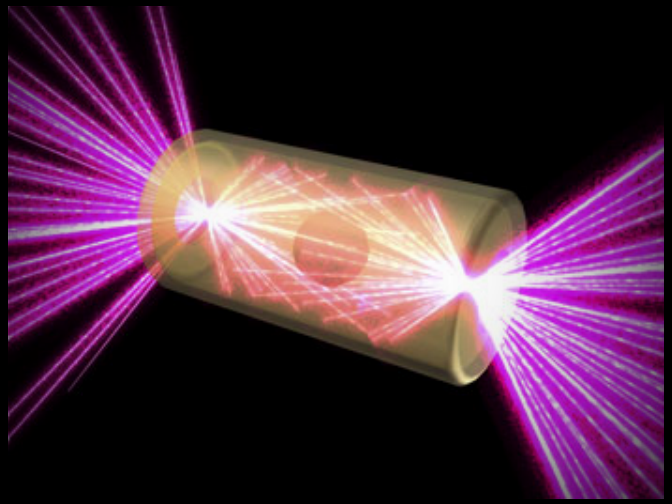
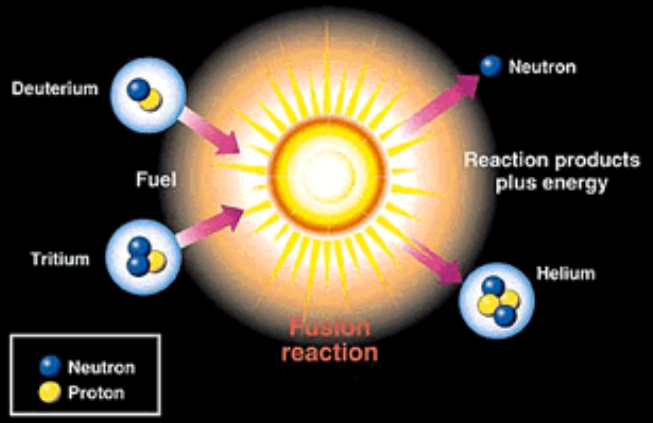
DOE/NV/25946--2229

# My Path to a Career in STEM

## *An unlikely candidate*






This work was done by National Security Technologies, LLC, under Contract No. DE-AC52-06NA25946 with the U.S. Department of Energy

**Michael Cardenas**
Calibration & Applied Analytics Manager
National Security Technologies, LLC
Contractor to the United States Department of Energy

# OVERVIEW

- Current Career
- High Energy Density Physics & ICF
- The Gated X-Ray Detector (GXD)
- My path into the sciences.
- Words of wisdoms/lessons learned from a Delta Alumnus

# NSTEC & LIVERMORE OPERATIONS

- National Security Technologies, LLC (NSTec) was formed in 2006 as a joint venture between Northrop Grumman Corporation, AECOM, CH2M Hill, and Babcock and Wilcox (B&W).

- We design, engineer, field, and calibrate diagnostics throughout their lifecycle in support of science and weapons complex missions.

- Livermore Operations exists to support National Defense.

# OUR PRIMARY MISSION

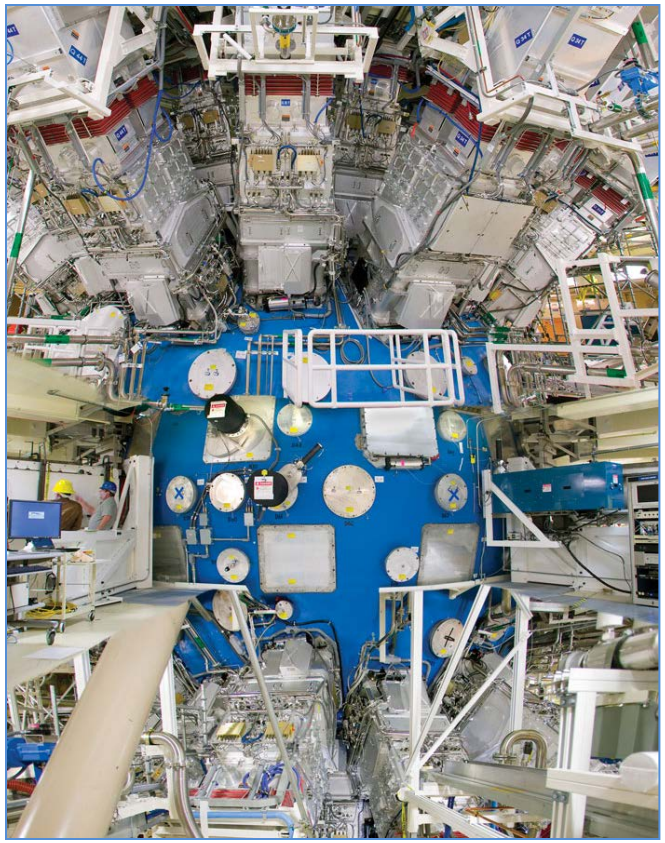
Support National Security and Stockpile Stewardship

1. Stockpile surveillance
2. Assessment and certification
3. Refurbishment or weapon replacement.

Confidence in the performance of weapons is to be maintained on an ongoing process. The stockpile stewardship program consist of the following three areas.

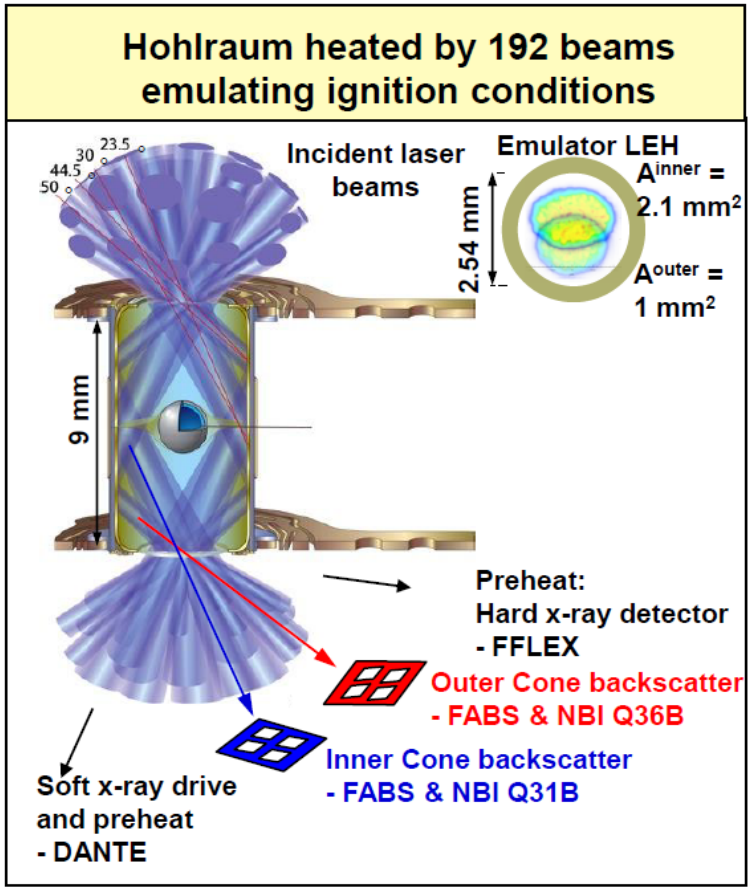
# NATIONAL IGNITION FACILITY

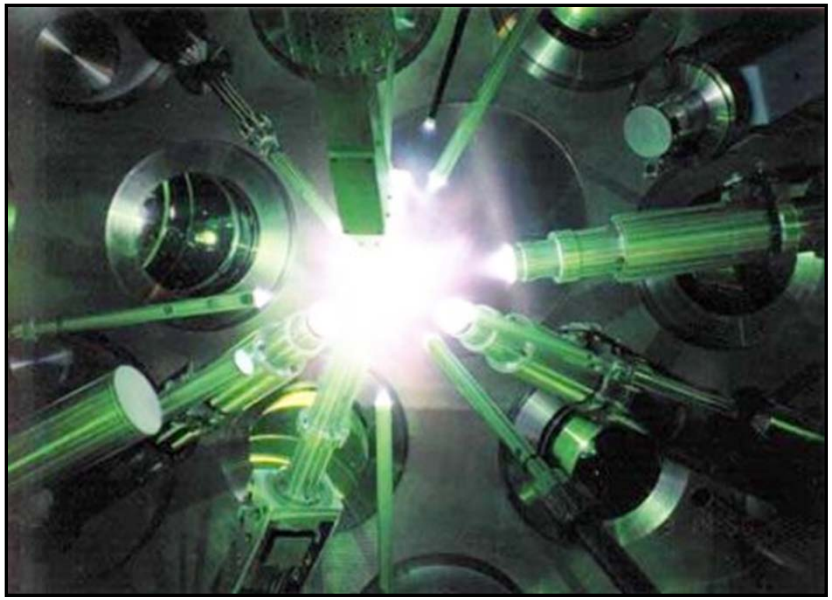
NIF's arena-sized building houses 192 laser beams designed to deliver 1.8 million joules of ultraviolet laser energy and 500 terawatts of power to millimeter-sized targets located at the center of its 10-meter-diameter target chamber.



13.5 TW - *Geo:* average total power consumption of the human world in 2001

# INERTIAL CONFINEMENT FUSION



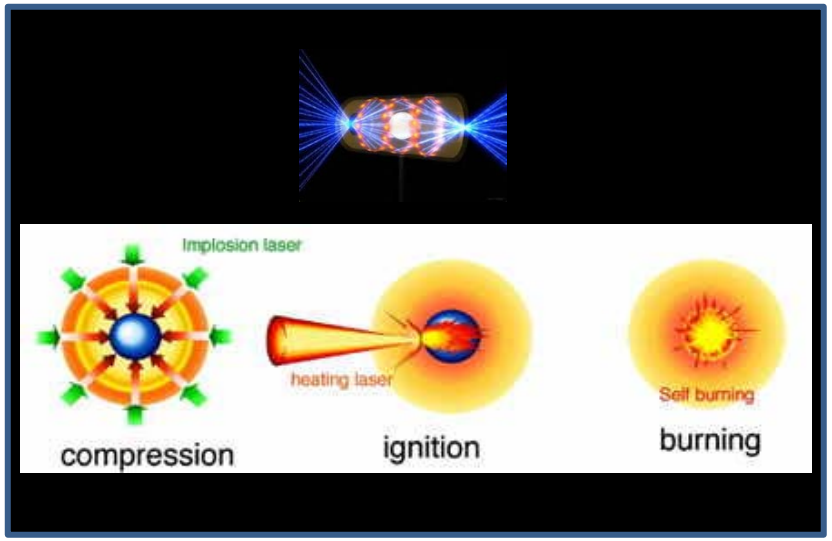



# TIME

~100-400 milli-sec
to blink your eye
(.1 - .4 seconds)


.25 milli-sec

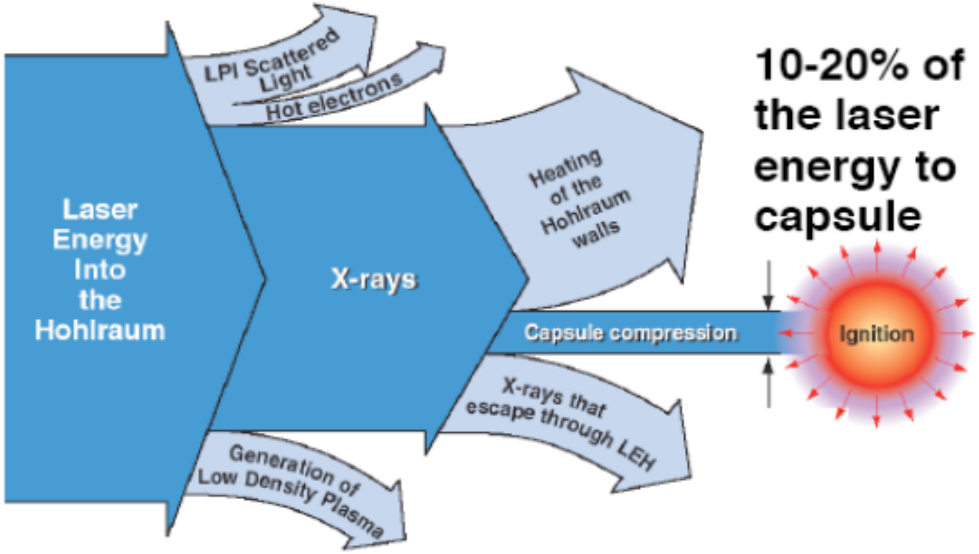
(.00025 seconds)




~20 nano seconds
(.00002 milli-seconds)

| | |
|---|---|
| Milli seconds | 10 ^-3 |
| Micro Seconds | 10^-6 |
| Nano Seconds | 10^-9 |
| Pico Seconds | 10^-12 |

# CHALLENGES & THE IMPORTANCE OF DIAGNOSTICS




| | Au with CH Capsule | Au with Be Capsule | Cocktails - Be Capsule | Cocktails, LEH shields - Be Capsule |
|---|---|---|---|---|
| Laser light (MJ) | 1.45 | 1.2 | 1.0 | 0.85 |
| Absorbed | 1.30 | 1.08 | 0.9 | 0.77 |
| Xrays | 1.10 | 0.92 | .765 | 0.655 |
| Wall loss | 0.68 | 0.58 | 0.425 | 0.295 |
| Hole loss | 0.28 | 0.20 | 0.20 | 0.220 |
| Capsule | 0.14 | 0.14 | 0.14 | 0.14 |
| Efficiency (%) | 9.7% | 11.7% | 14% | 16.5% |

# DIAGNOSTICS (GATED DETECTORS)

Primary HED Diagnostics provide critical data to understanding and overcoming the challenges of target design.

In order to rely on the data captured, diagnostic performance and their characteristics must be understood.

Calibration and Applied Analysis team Conducts critical measurements that lead to diagnostic understanding.

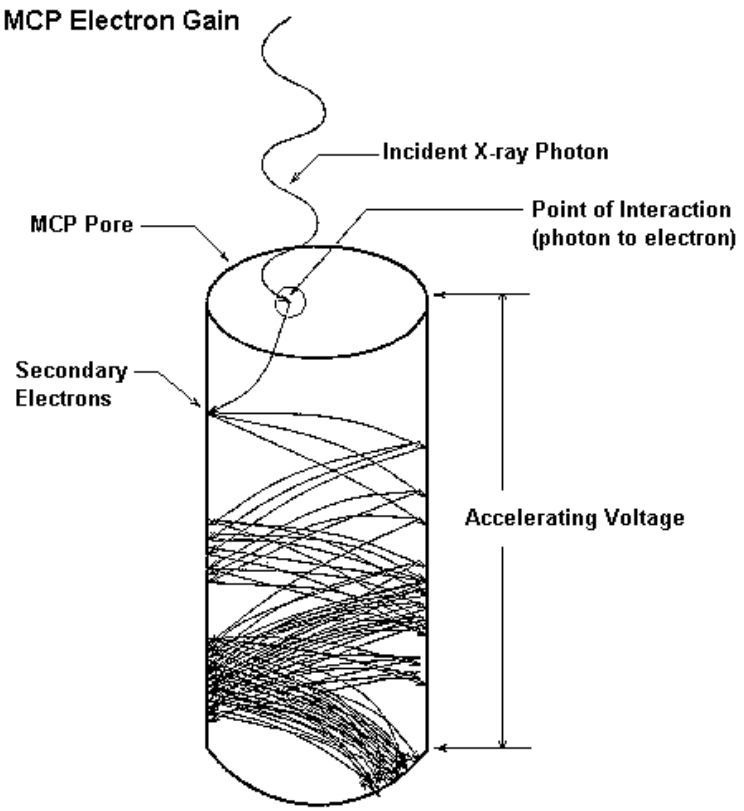
# GATED X-RAY FRAMING CAMERAS

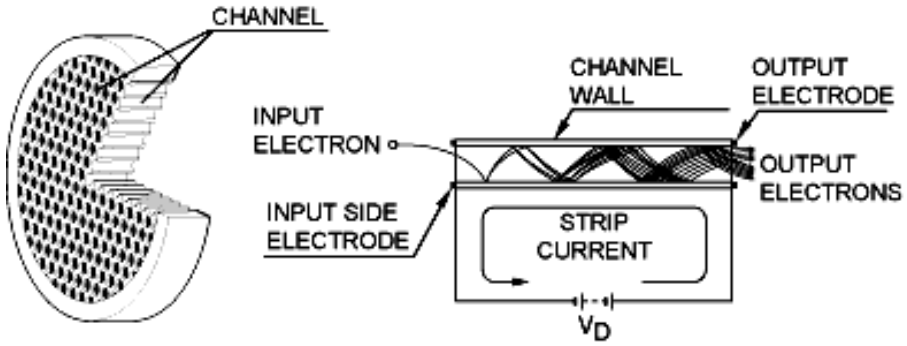
Gated X-Ray Framing Cameras use a strip-line activated Micro-Channel-Plate and phosphor screen followed by CCD camera or film to provide 2D spatially time-resolved frames or 1D spectrally resolved images of target features.

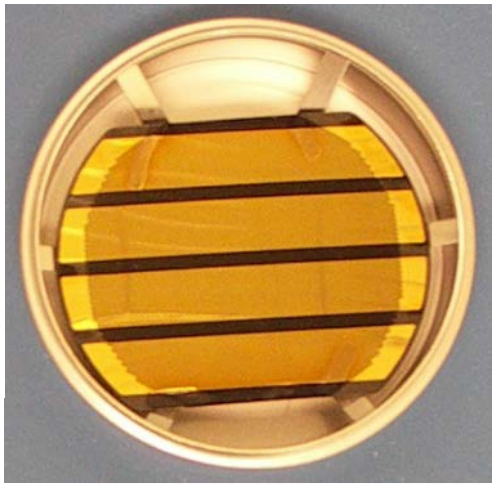
X-ray framing cameras have been the “work horse” diagnostic of all major laser facilities and are used to understand the following:

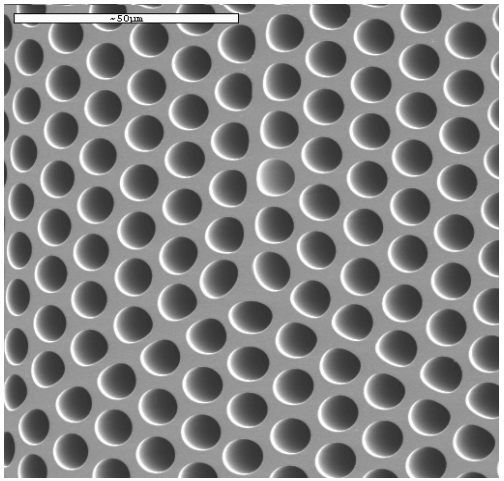
- spectral emission from targets
- spatially resolved foil trajectories
- hydrodynamic instability growth information
- shock front propagation
- x-ray time history for ignition physics

# THEORY OF OPERATION

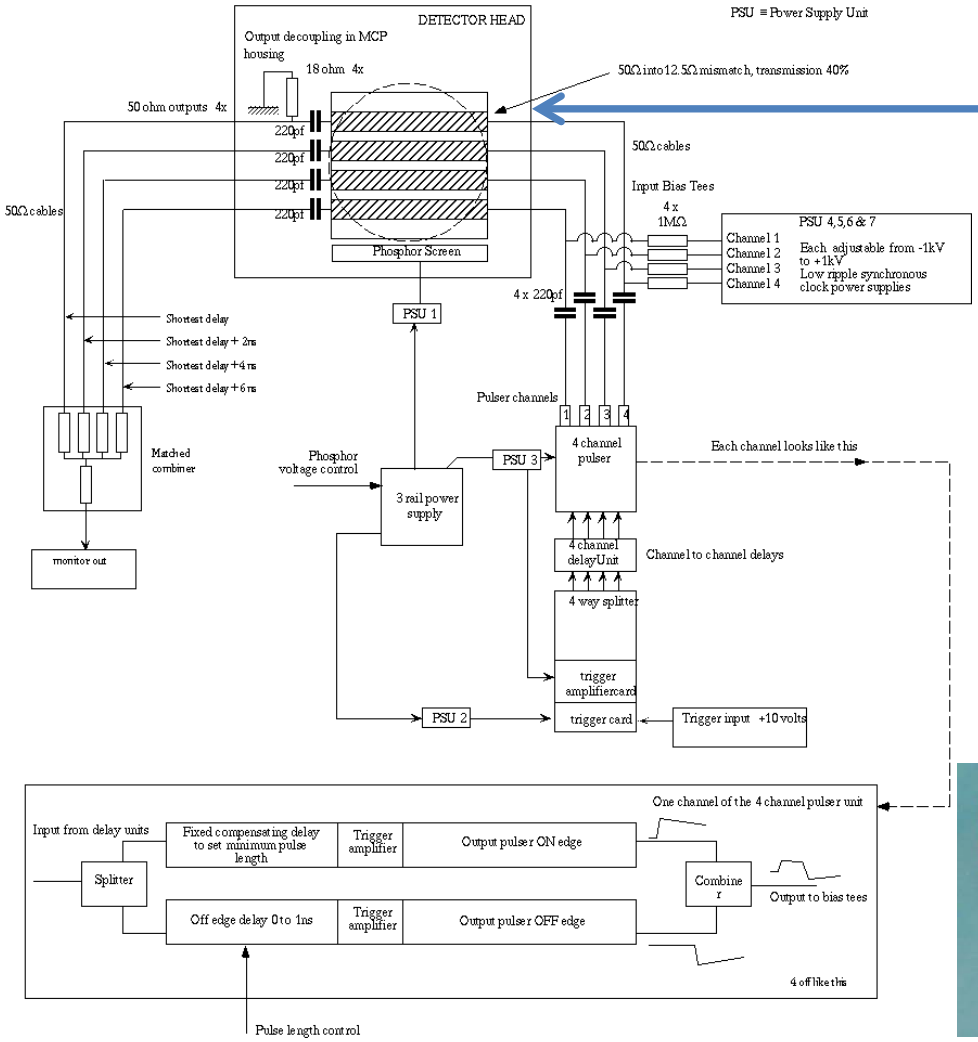


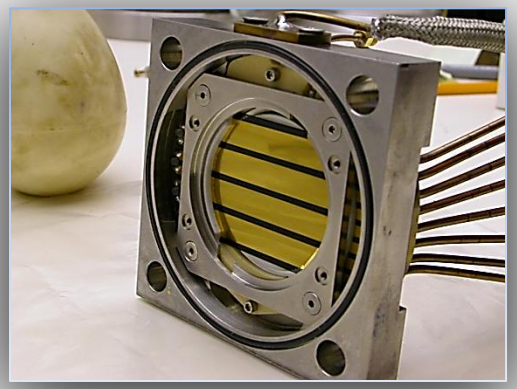



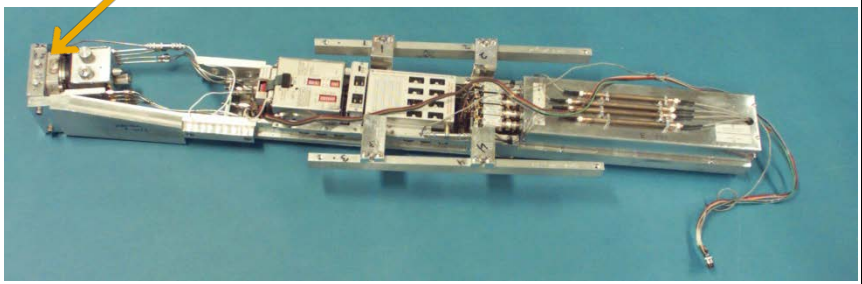





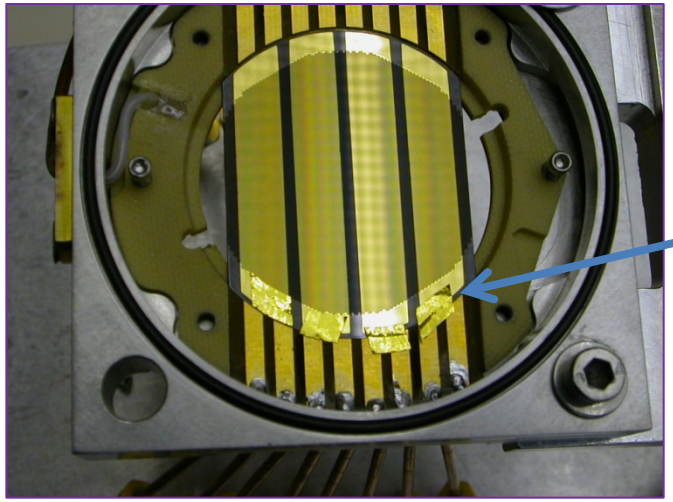
# TYPICAL CONFIGURATION

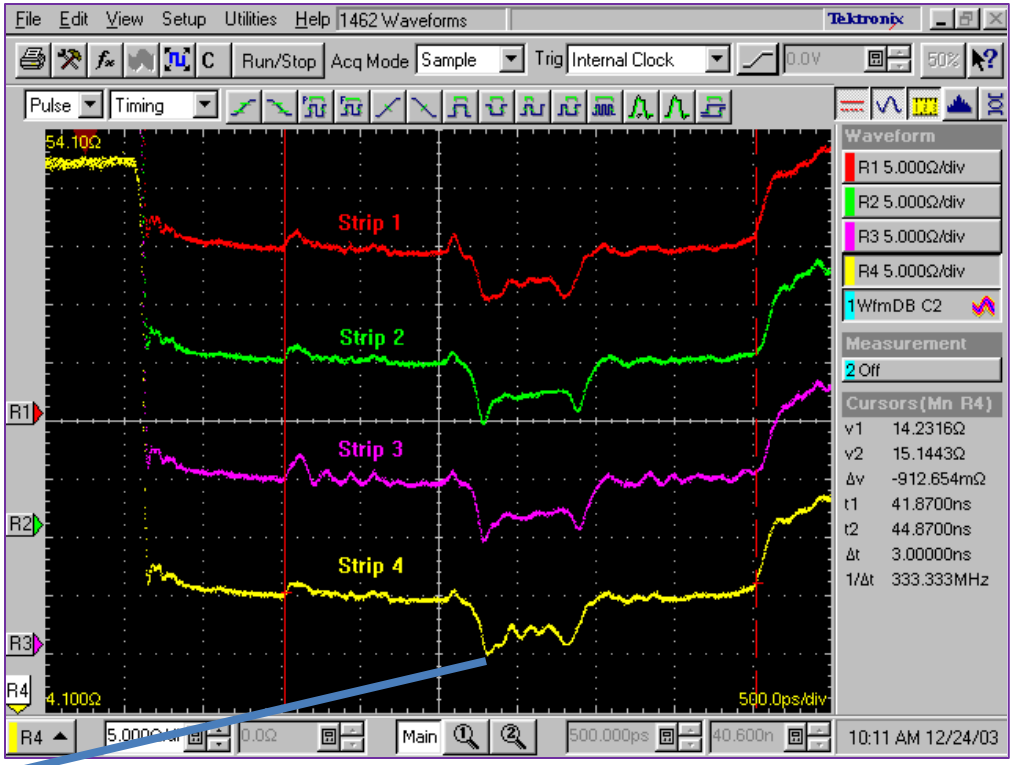


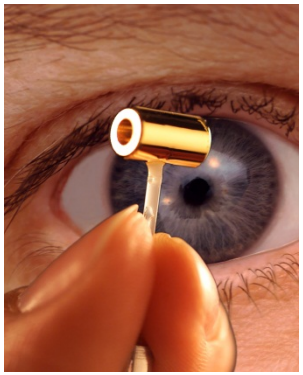


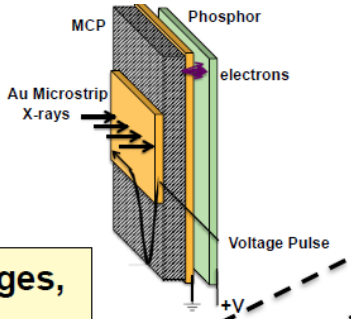
# QUALITY CONTROL

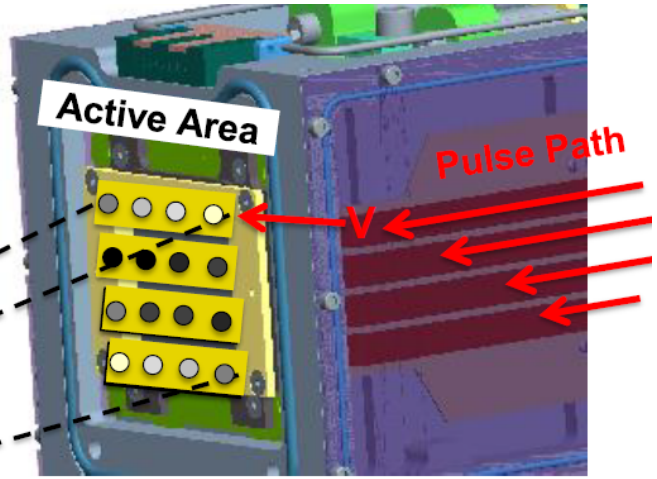




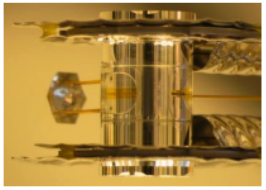
# X-RAY FRAMING CAMERA (USE)





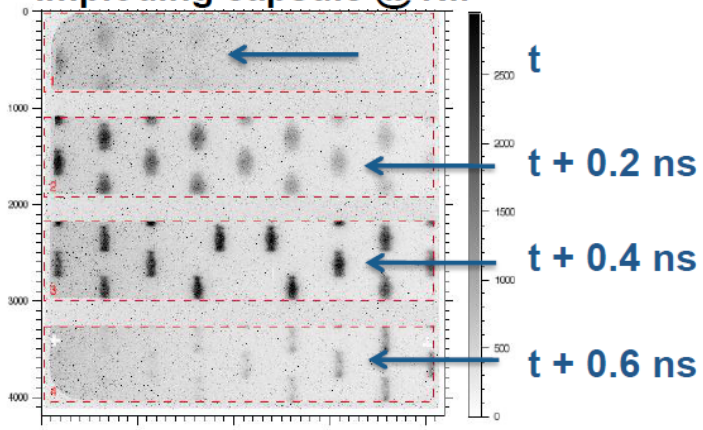




Array of pinholes produces many images, gated at different times- about f/10,000



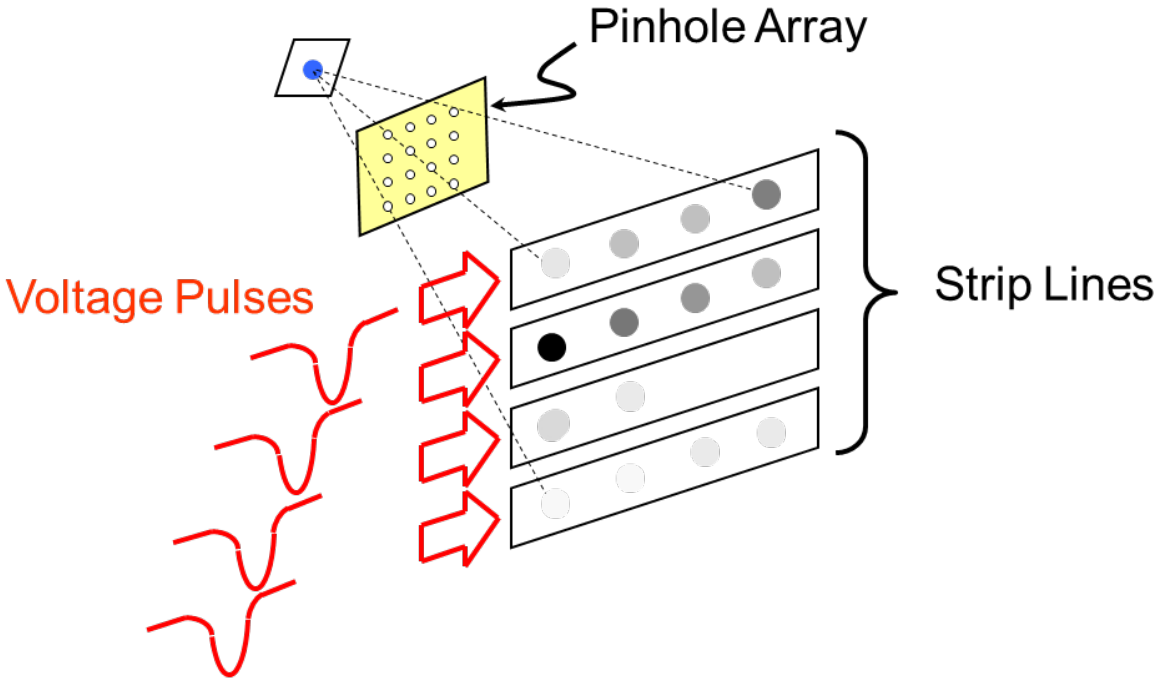


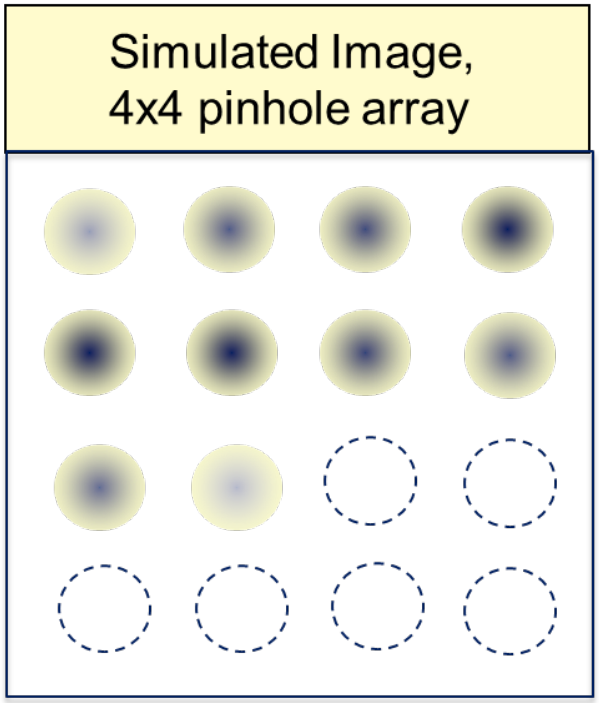
Imploding capsule @ NIF




- Backlighter spot very close and large- needs 3X OMEGA energy to backlight

# PULSING THE STRIP LINES ALLOWS THE TARGET TO BE IMAGED AT DIFFERENT TIMES.



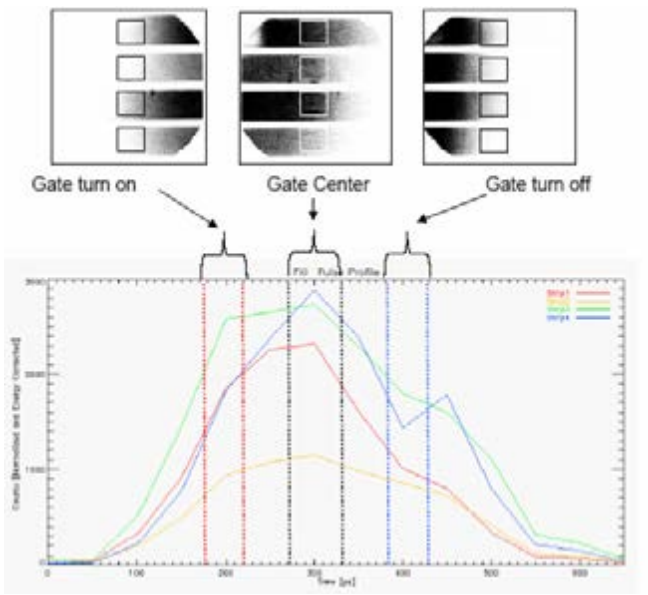




**Pinhole array simultaneously projects multiple images onto MCP. Gate pulses determine time at which signal is integrated on each image.**

Time ⟶

# CALIBRATION & APPLIED ANALYTICS

Calibration of diagnostics provides a better understanding of the characteristics of the device which leads to greater confidence in the data obtained from scientific experiments.



# TESTING LABORATORIES

## Long Pulse Lab (150fS)

Nd: YAG-based Class IV Laser System
10-100 ns Flat Top Laser Pulse, adjustable
1064, 532, 355, 266, and 213 nm Wavelengths

## Short Pulse Lab

Ti: Sapphire-based Class IV Laser System
150 fs Temporal Laser Pulse
800, 400, 266, and 200 nm Wavelengths

## ESPL:

Ti Sapphire-chirped Pulse Amplifier, Class IV Laser System (<90fs @ 800nm)
(800nm @ 25 milli-joules, 400nm @ 4milli-joules, 200nm @500 micro-joules)

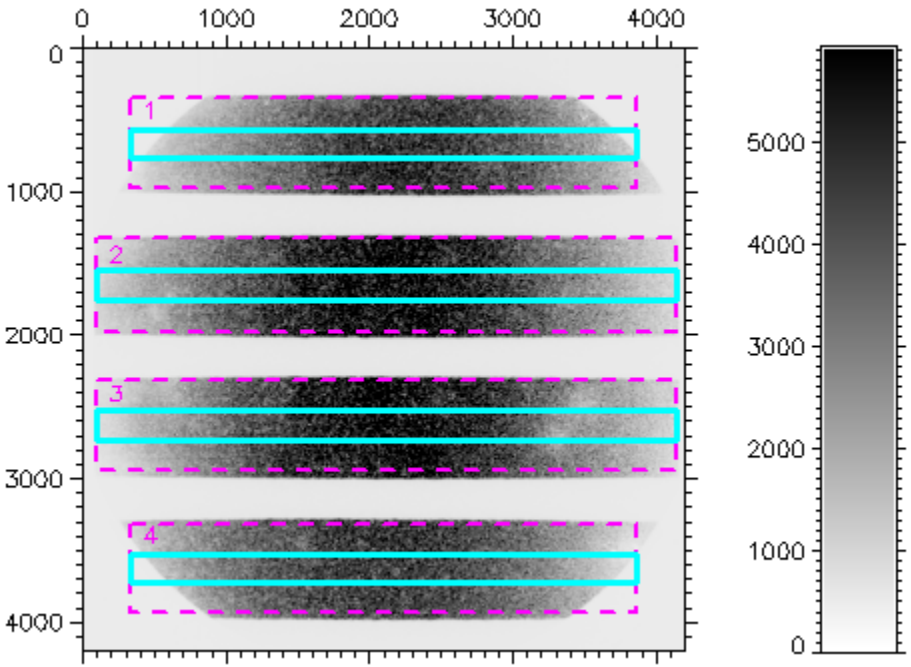
OCC: Dual Grating Monochromator System 200–1100 nm Wavelength Range
CCD: Cameras Tested at 460 and 545 nm Wavelengths

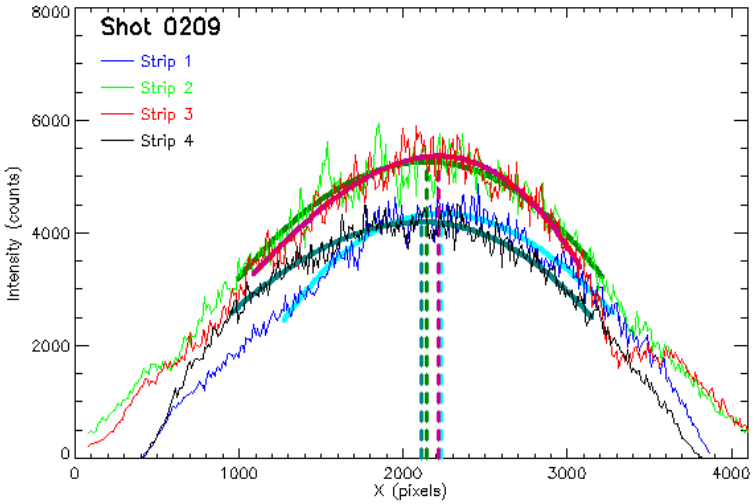
SXL: 277eV-8638eV
Manson: 450eV-9keV
HENKE: Monochromatic Henke Source 450 eV–17 keV
HEX: Variety of metallic fluorescers generate energy from 8 to 100 keV

MOL: Detailed Time and Frequency Domain Testing (30 kHz–26.5 GHz)

# SHORT PULSE UV LASER TESTING

**Framing Camera image from SPL**




**Data of image**

# UNLIKELY CANDIDATE

**Slightly more than 15% of the San Joaquin workforce has achieved at least a Bachelor's degree.**

***Eberhardt School of Business, 2009 Regional Report**

# UNLIKELY CANDIDATE

*"If you don't know where you're going, any road will take you there"*
–George Harrison

*"If you fail to plan you are planning to fail"*
-Benjamin Franklin

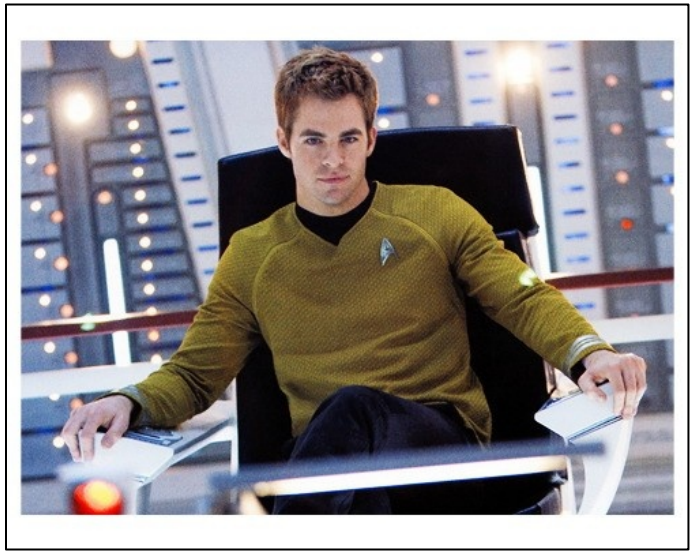
# EARLY LIFE AMBITIONS

**Goal-1 Become a Marine.**

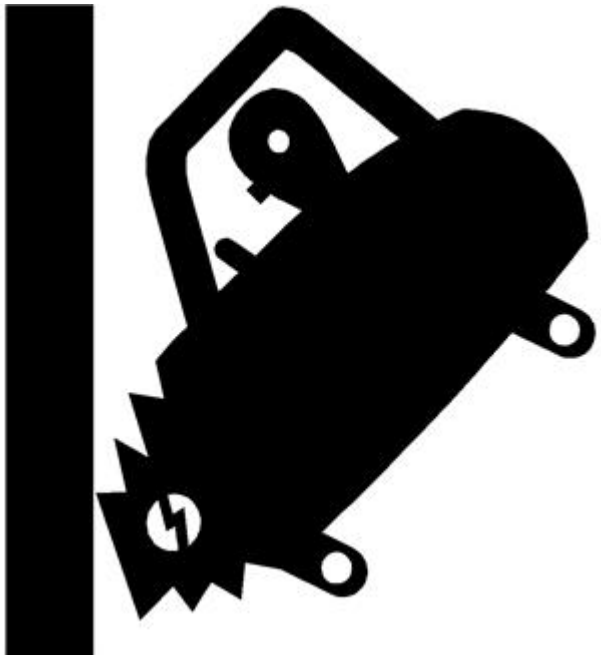
**Goal-2 Become a Marine.**

**Goal-3 Become Captain Kirk!**

**Goal-4 Party**



# FIRST ROAD BLOCK TO GOAL#1



Diagnosed with Epilepsy

# NOW WHAT?

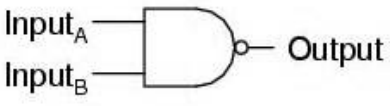
Work

College

Do Nothing

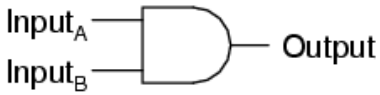
# A REALIZATION OF HOW LIFE REALLY WORKS

*NAND gate*




| A | B | Output |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

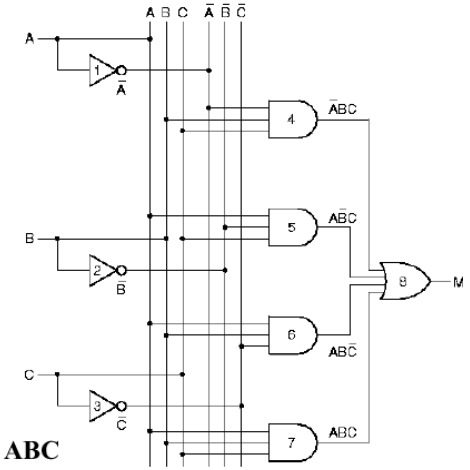
*2-input AND gate*




| A | B | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

$M = f(A, B, C)$

| A | B | C | M |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |




$$M = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

# COLLEGE? A TIME FOR CHANGE!

**Delta College:**
A Place were dreams can become a reality for those willing to do the work.

# COMMUNITY COLLEGE MAJORS?

**Fire Science**

**Physical Education**

**Electrical Technology**

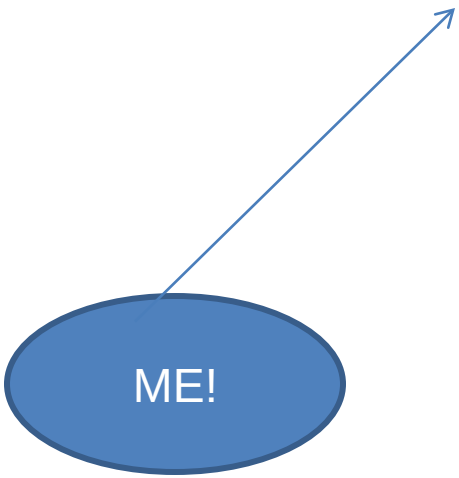

# MURPHY'S LAW

***"If anything can go wrong, it will"***

**Capt Edward A. Murphy's Original law:**

***"If there is anyway to do it wrong he'll find it"***

***-E. A. Murphy, Edwards AFB 1949***




FACT #1:Not prepared for college!

# THE HONEST TRUTH

Assessment Results by Date

| Date Taken | Subject | Level |
|---|---|---|
| **1/4/1994** | Composition | 3 |
| **2/27/1992** | Mathematics | 3 |
| **3/30/1990** | Reading | 2 |
| | Composition | 2 |
| | Mathematics | 1 |

Academic Assessment Levels

| Subject | Level | Date |
|---|---|---|
| Reading | 3 | 11/17/2005 |
| Mathematics | 4 | 5/1/1994 |
| Composition | 4 | 5/1/1994 |

Started Delta College, Rough Start in my academic journey!

# “THE ADVERSITY EFFECT”

**“Adversity has the effect of eliciting talents, which in prosperous circumstances would have lain dormant.”**

**-Horace**

# WORDS OF WISDOM FROM MY HERO

***"Anything is possible and we can do anything anyone else can, it just may take us a little longer"***

***"People who tough it out, who suffer the most, achieve the most."***

**-In Memory: Mel Cardenas (1940-2011)**

# DEVINE INTERVENTION & SELF REFLECTION

***Applied Science, Business and Technology Department***

*Lyle Buckley: Electronics Instructor*

*Bill Harper: Electrical Instructor*

*Dr. Dokey Philosophy Instructor*

*"Success is not final, failure is not fatal: it is the courage to continue that counts."*

-Winston Churchill

# WHAT DOES IT TAKE TO SUCCEED?


* 95 percent of the population scores an IQ between 70 and 130

# NEW GAME PLAN


**Making academia work for me and my preferred learning style.**

Adversity builds character. The challenges we face teach us resourcefulness & self- reliance

# HARD WORK & DETERMINATION

**“Failure is the condiment that gives success its flavor.”**

**-Truman Capote**

San Joaquin Delta College Accomplishments

| | | |
|---|---|---|
| **SJDC**<br>*Electrical Technology*<br>*Certificate*<br>1994 | **SJDC**<br>*Electronics Technology*<br>*Certificate*<br>1995 | **SJDC**<br>*Associate Arts Degree*<br>*Technical Education*<br>1995 |

# LIFE SUCCESSES SINCE DELTA

B.S. Electronics Engineering

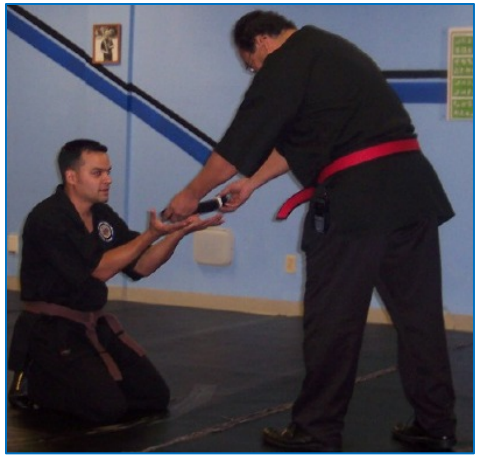
B.S. Management & Leadership

M.A. Teaching & Learning with Technology

Graduate Certificate In Leadership

M.S. Organizational Leadership (*In Progress*)

Recipient of the DOE/ National Nuclear Security Administration, 2006 Defense Programs Award of Excellence

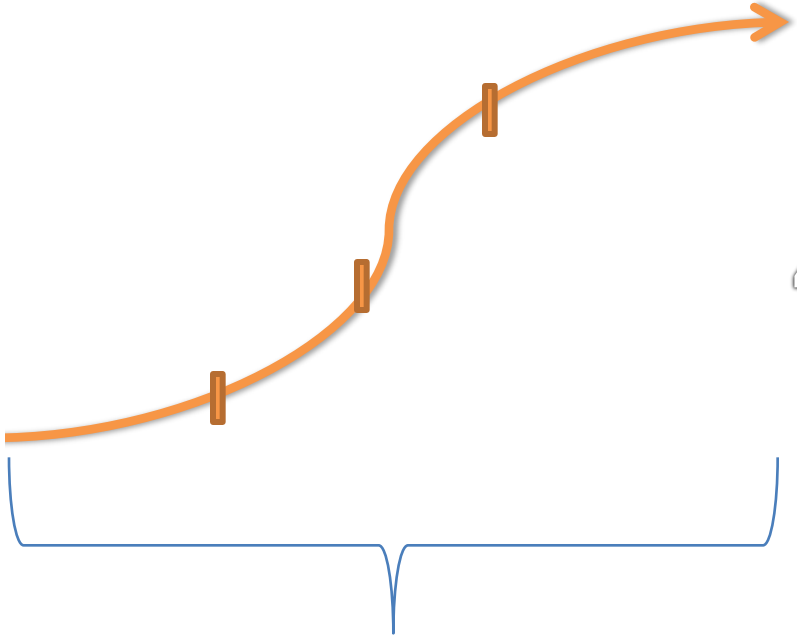



# AWARDS & CERTIFICATIONS

- **National Instruments: LABVIEW certified, Basics I & II, March 1, 2002**
- **ETA Certified: Fiber Optic Installer, Issued September 2000.**
- **ISCET Certified: CET No. AC28428**
- **National Association of Radio and Telecommunication Engineers: Member No. T3-08067**
- **UCLA: Charge Coupled Devices, Cameras and Applications , CA. Oct 25-29, 1999**
- **University of California Los Angeles: Technical Management Workshop, Sept 15-20, 2002 & Sept 19-24, 2004**
- **University of the Pacific: Supervisory Certificate Program**

# GETTING FROM HERE TO THERE?

4 Year Degree!



LIFE

Preparation + Perseverance = Success

# THE SUCCESS PLANNING MATRIX (*PLANNING TOOL*)

| Career Choices | Academic Requirements | Tools available for success | Sacrifices | My strengths & weaknesses | Primary Goal |
|---|---|---|---|---|---|
| Technical Engineering | Math | Teachers, mentors, books, video tutorials, Classes | Reduce parties, Dojo time | Determination<br><br>Poor time management skills, low math scores. | B.S. Engineering |
| Teacher | | | | | |
| Electrician | | | | | |
| | | | | | |

# LESSONS TO SHARE

Never conclude that a stumble towards your goal equals game over.

Surround yourself with positive people who share your positive ambitions.

Plot the trajectory to your goal and constantly monitor the trajectory.

Don’t be afraid to ask for help or admit deficiencies.

Use Every resource at your disposal.

If a method for learning isn’t working try something new.

# RECOMMENDED BOOKS

## To prepare yourself for the challenges that lie ahead

**“Drive” The Surprising Truth about what motivates Us, By Daniel Pink**

**“Linchpin” By Seth Godin**

**“As a Man Thinketh” By James Allen**

**“Outliers, The Story of Success” By Malcolm Gladwell**

**“Emotional Intelligence” By Daniel Goleman**

**“The Fred Factor” By Mark Sanborn**

**“Who Moved My Cheese” By Spencer Johnson**

**“The Leadership Challenge” By Kouzes & Posner**

# PARTING COMMENTS

**The investment you make in yourself today will determine what kind of life you will live tomorrow!**

**Captain James T. Kirk**

**NSTec Halloween Party!**

Life is made up of a series of decisions, both good and bad, make sure yours are well thought out. And its never to late to be that person you dreamed of becoming!