Interdisciplinary Research – When Miracles Happen

Development of High Performing Collaborative Teams

6th Annual UTEP Interdisciplinary Research and Education Symposium

University of Texas at El Paso

November 6, 2018

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Chair, Division of Engineering
Assistant Professor of Neurosurgery
Co-Director, Neural Engineering Laboratories

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“The best interest of the patient is the only interest to be considered”

William J. Mayo, MD (1910)

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Early Beginnings

- 1864 - Dr. William Worrall Mayo moves to Rochester to examine new recruits for the army

- 1883 and 1888 - Dr. Mayo's two sons, William and Charles, join him in practice after they finish medical school

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Rochester in 1883

- Tornado destroys most of town
- Start of St. Marys Hospital

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Mayo Clinic

Rochester, Minnesota

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Mayo Clinic Facts

- Mayo Clinic is the first and largest integrated, not-for-profit medical group practice in the world
- Doctors from every medical specialty work together to care for patients, joined by common systems and a philosophy that the “Needs of the Patient Come First”
- 3,800 physicians and scientists and 50,900 health staff work at Mayo
- Major locations in Rochester Minnesota (15 million ft^2), Jacksonville, Florida; and Phoenix, Arizona
- Collectively, these locations care for more than 1 million people each year
- Financially our income is $11 billion per year and our net operating income is $700 million per year
- Total Education and Research funding is $1.1 billion

(2017 data)

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Historical Basis of Collaboration

- Founders formed the first group practice of medicine
- Open to new ideas
- Communication systems based on collaboration
  - Expected – every day
- Specific research to match clinical need
- Committee managed and directed
- Salaried
- Required to request funds

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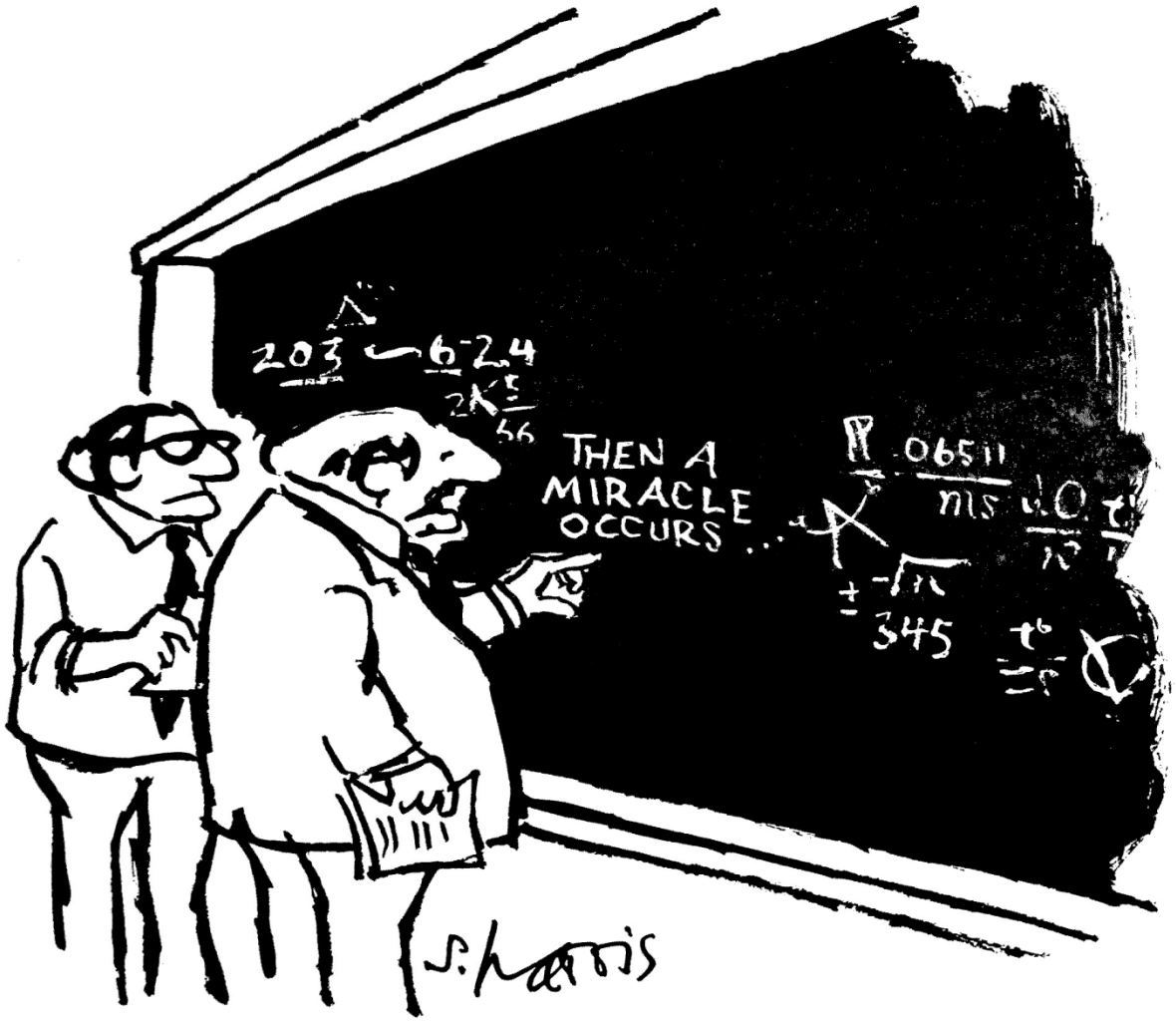

"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

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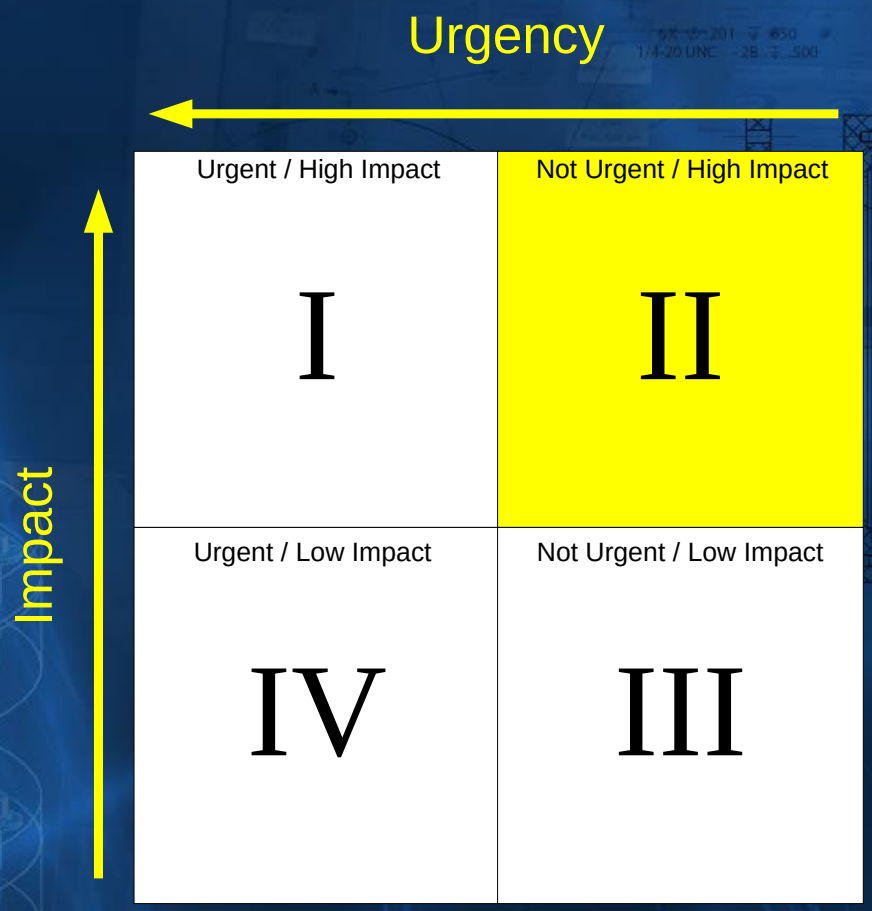
Project Selection

Our charge is to:

- Transform the medical practice
- Improve patient outcomes
- Advance medical research
- Provide economic value



Through:

- Projects that utilize our unique mix of mechanical, electronic, and software skills.

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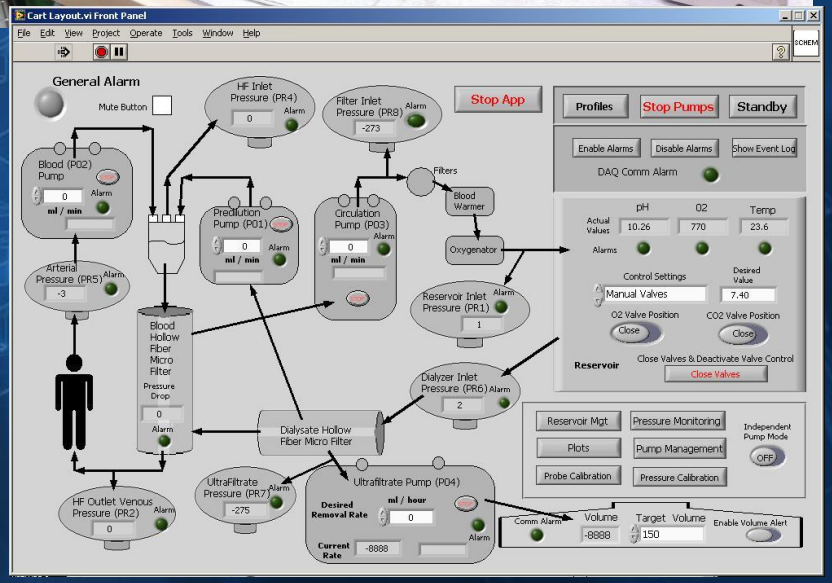
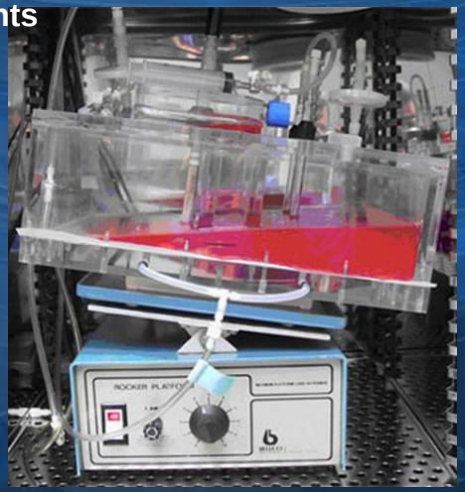
Bio-Artificial Liver



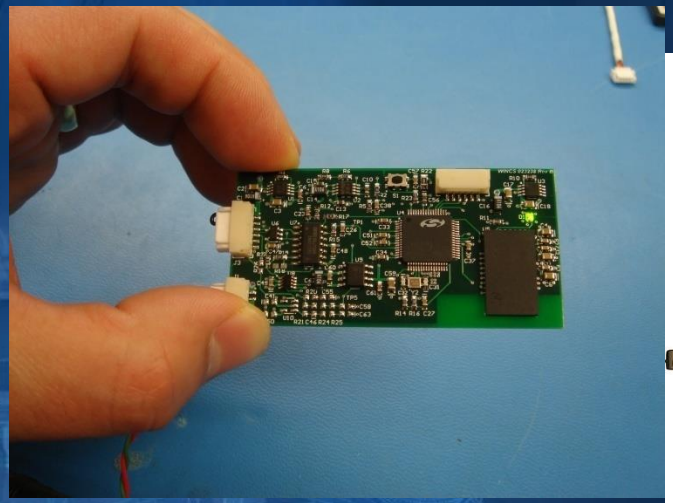
Transplant surgeon
Cell Biologist
External collaborator
Lab technicians
Post doctoral students

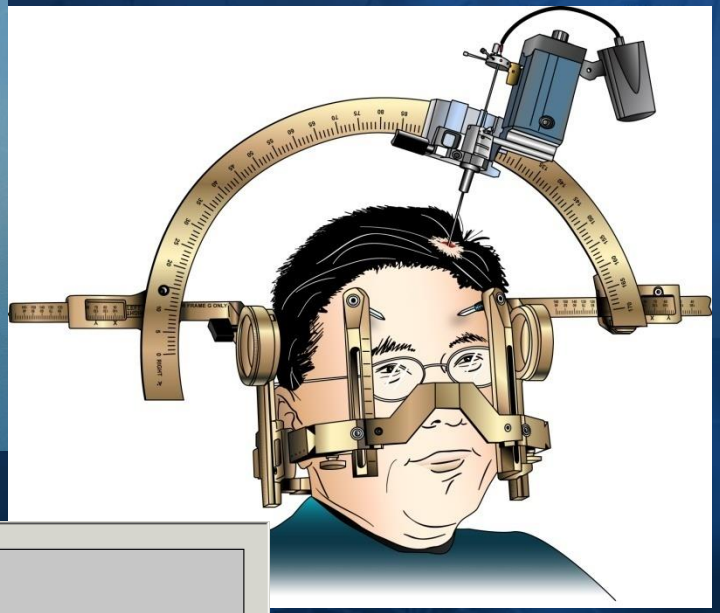


Project manager
Engineers
Programmers
Glassblower
Technicians
Machinists
Designers

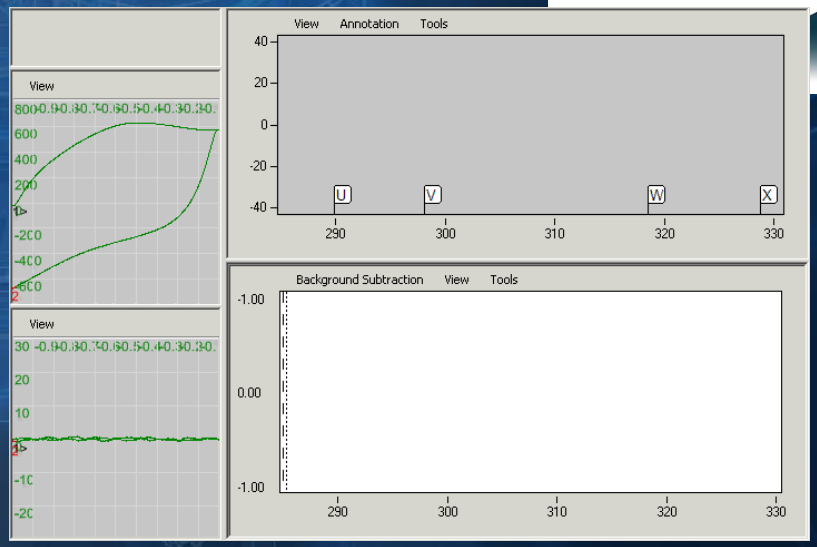
Deep Brain Stimulation
Wireless Control and Feedback

Neurosurgeons
Neuroscientists
Cell biologists
Neurologists
Radiologists
Operating technicians
Electrophysiologist
External collaborators
Lab technicians
Surgical technicians
PhD candidates





Senior Engineering Manager
Project Manager
Engineers
Chemist
Programmers
Technicians
Machinists
Designers
Glassblower
Students



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Deep Brain Stimulation Committee

Tuesdays at 7 AM

Review of patients requesting, referred or recommended for DBS

- Neurosurgeons
- Neurologists
- Radiologists
- Psychiatrists
- Psychologists
- Physical Medicine and Rehabilitation
- Engineers
- Neuroscientists
- Surgical Staff
- Medical and Graduate Students

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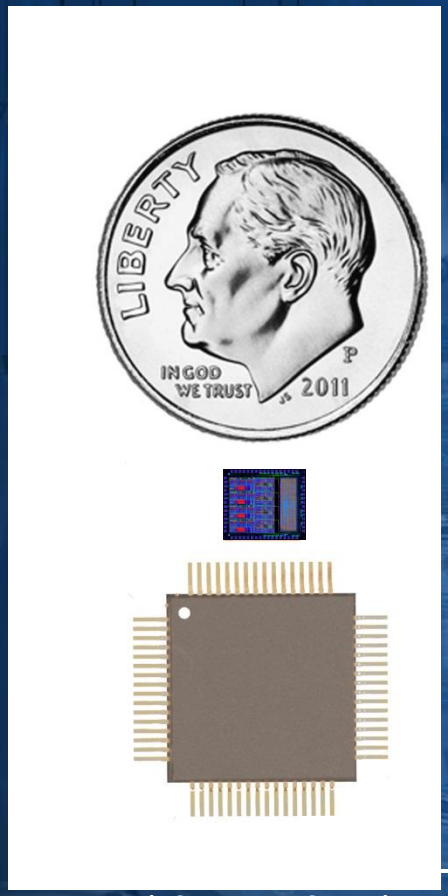
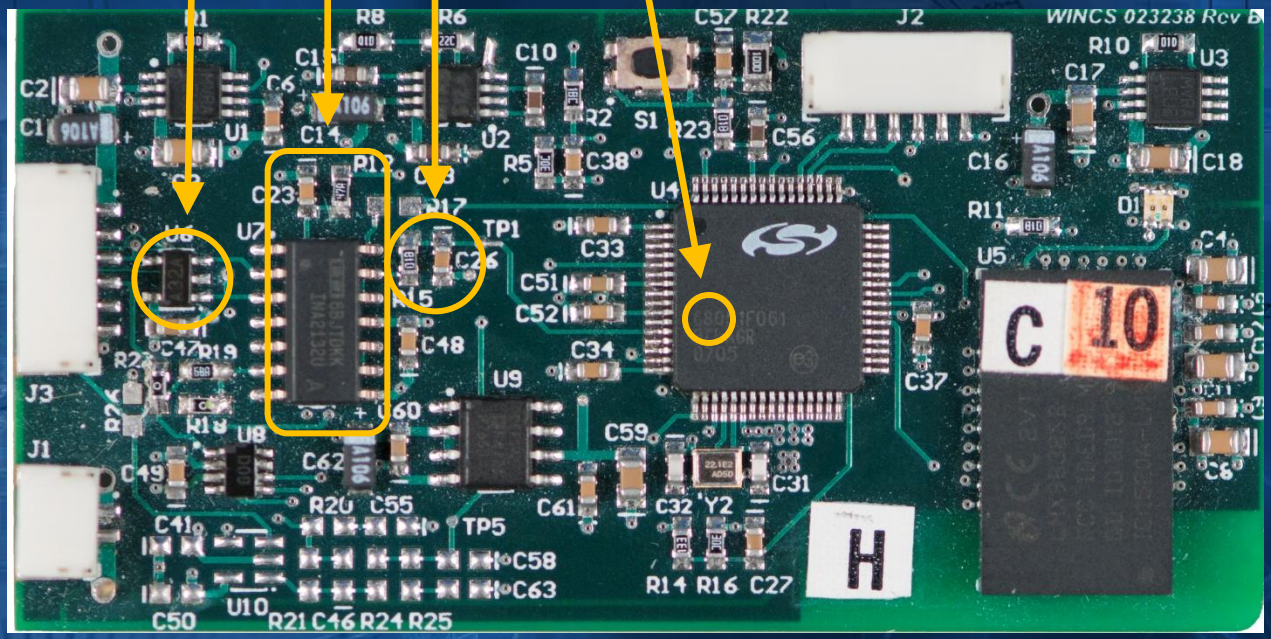
Wireless Instantaneous Neurotransmitter Concentration Sensor System



(10 mm x 10 mm)

PCB Analog Components and ADC for Single eChem Channel



4 Channel ADC Die with eChem and ePhys Modes
(4.0 mm x 3.4 mm)

MAYO CLINIC

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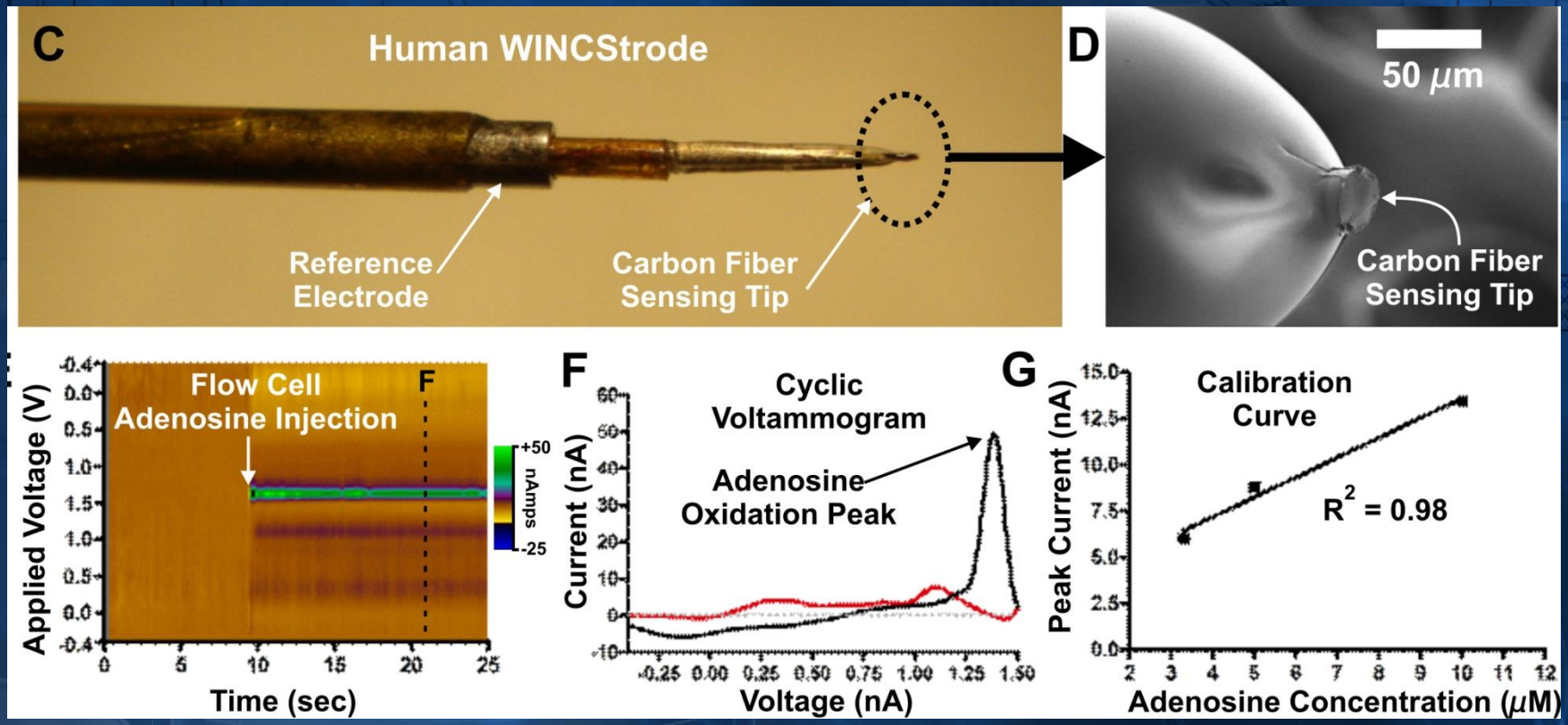
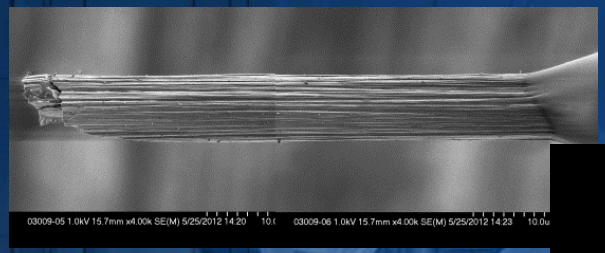
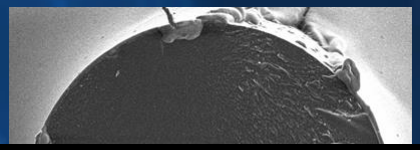
Neurotransmitter Detection Electrode Development

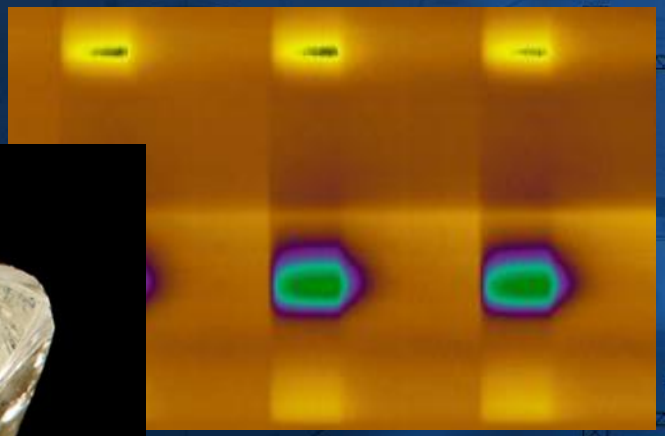


Carbon Fiber Electrode Stability

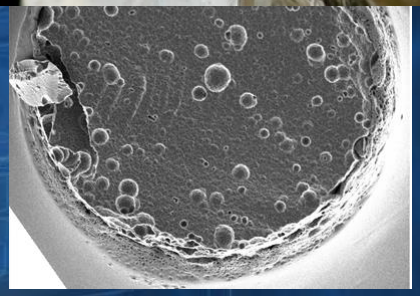
Day 1

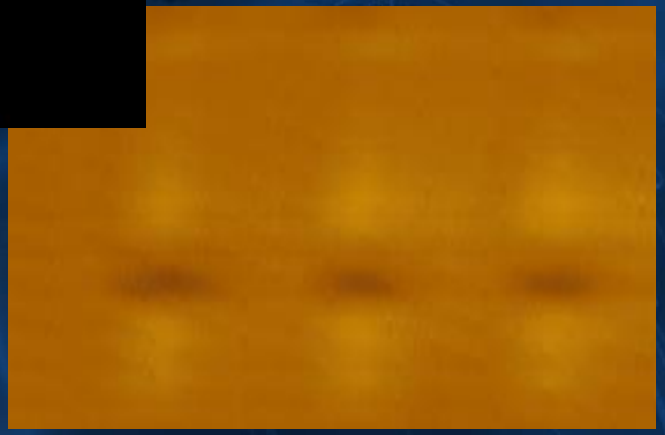




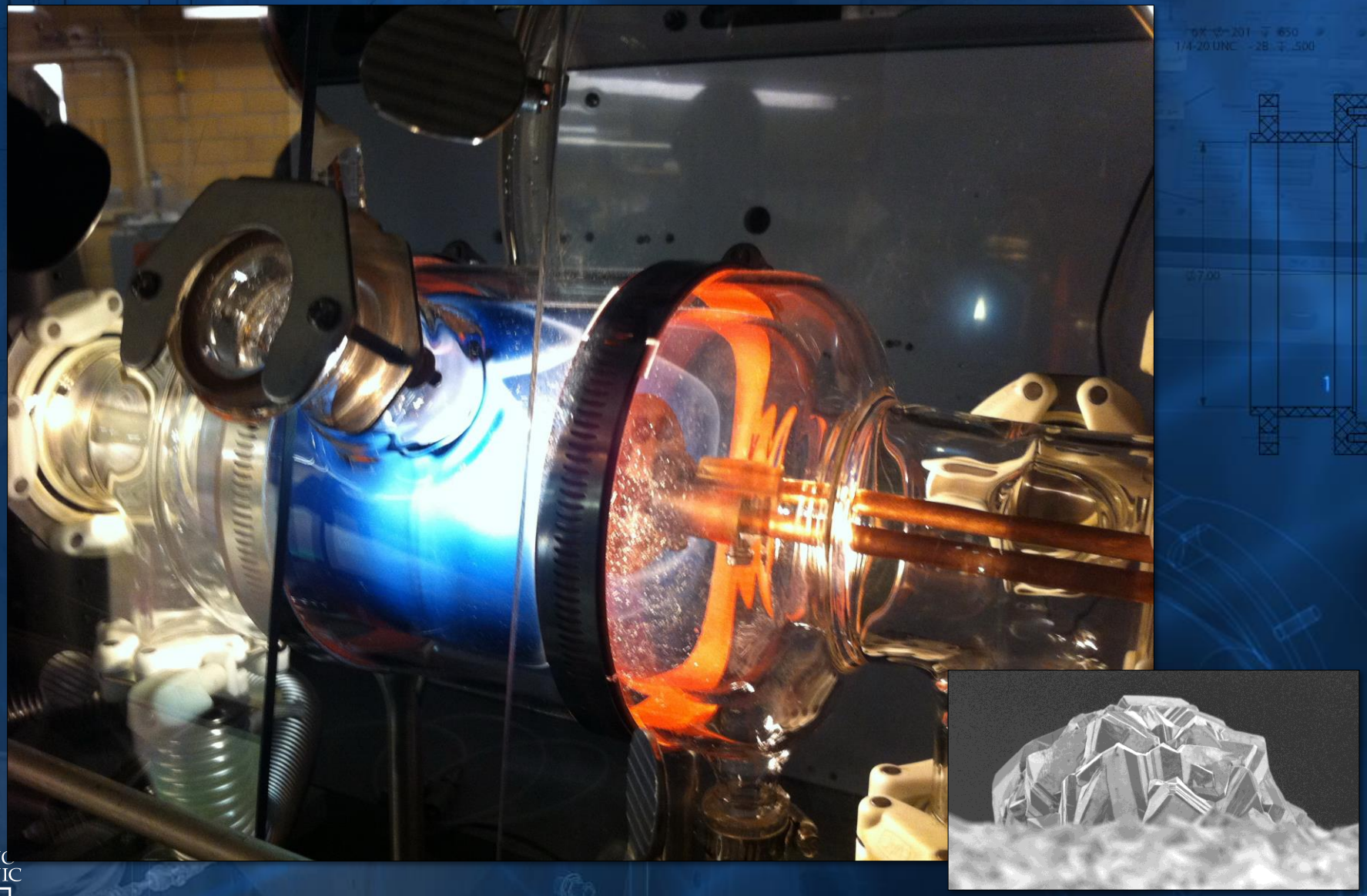


Day 3





Mayo Diamond Reactor



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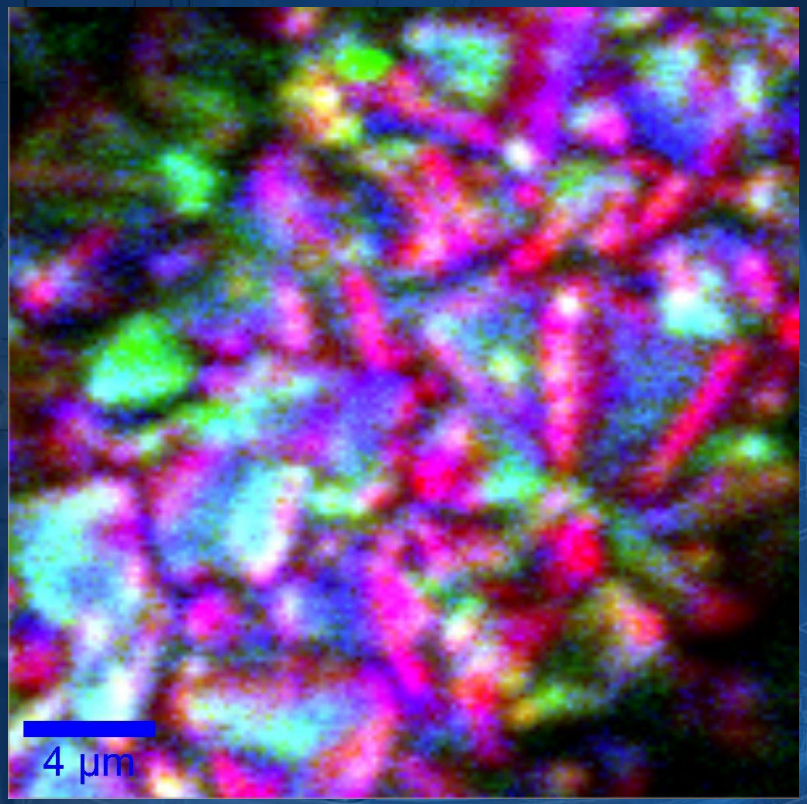
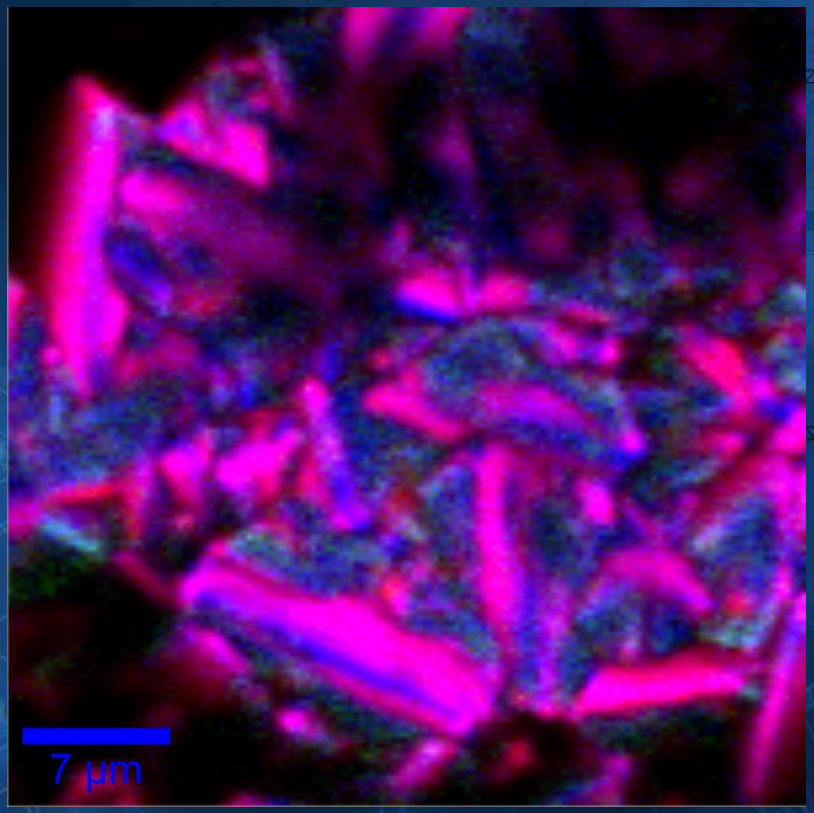
Raman Mapping



Academic source



Mayo Clinic Division of Engineering

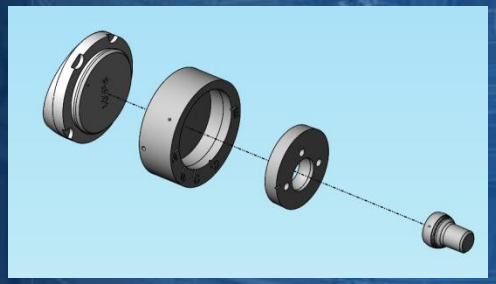
Red = Diamond, Blue = Boron doped diamond Green = amorphous carbon

Dr. Felicia Manciu - UTEP

MAYO CLINIC

Anatomical Humeral Implants

- Orthopedic implants for total shoulder arthroplasty
  - Adjustable Humeral Head Tray for Reverse Shoulder Arthroplasty
  - Stemless Humeral Implant
  - Fracture Stem Implant
- Implants designed and fabricated with 3D Printing for cadaveric testing
- Currently evaluating for licensing



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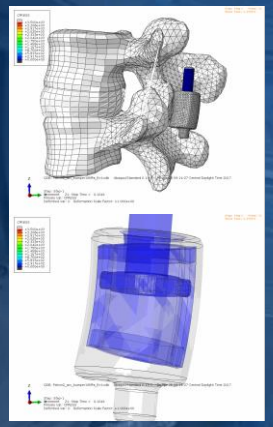
Facet Joint Replacement

- Reduce back pain caused by degenerative spinal disease
- Prototype testing restores spinal stability and preserves natural biomechanical range of motion
- Prototypes were 3D printed in titanium
- Two patent applications filed



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Administrative Paths for Interdisciplinary Research

- Mayo Institutional
  - Division of Engineering
  - Discovery Translation Program
  - Innovation Loan Program
  - Transform the Practice Program
  - Centers
    - Center for Individualized Medicine
    - Center for Regenerative Medicine
    - Center for Science of Health Care Delivery
  - Departmental Awards
    - Surgery
    - Cardiology
- Inter-Institutional Programs
  - University - Karolinska, Arizona State, Illinois, Minnesota, Deakin, etc.
  - Various companies – Collaboration and Grants
- Not including: Federal Programs, Conventional medical/scientific/engineering collaborations, Donations, Mayo Clinical Practice/Research/Administration/Board of Trustees

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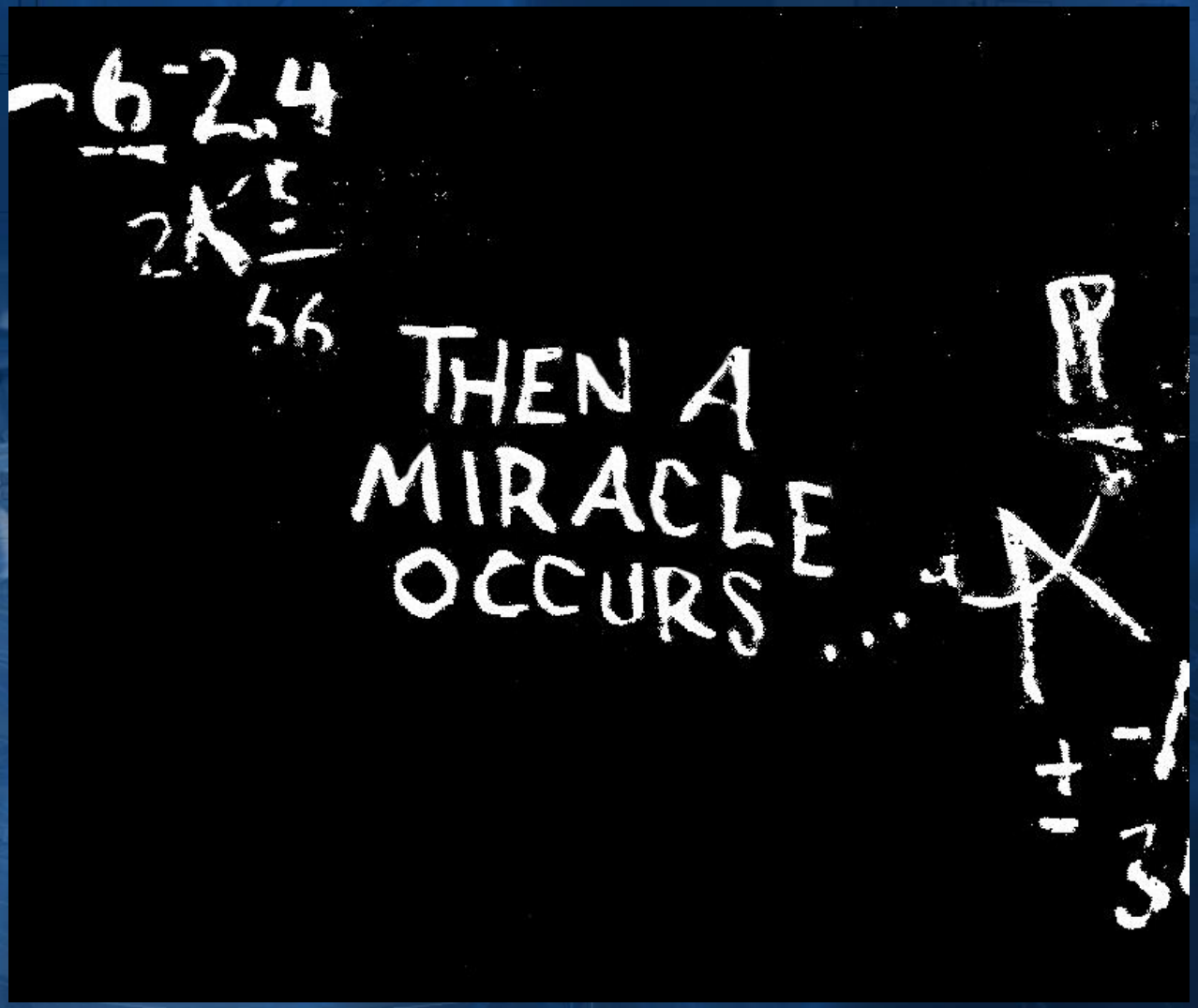
Collaboration

- Similar Working Style
- Similar Purpose
- High Energy
- Available
- Convergence of Goals
  - Application
  - Publication Expectation
  - Intellectual Property Expectation

Entrepreneurial Student

- Ability and Interest in Lifelong Learning
- Depth and Breadth of Knowledge
- Creative/Collaborative
- Economic and Business oriented
- Judgment/Reliability
- Communication (written/spoken)


THEN A
MIRACLE
OCCURS...

It takes teams…

Division of Engineering (67 staff)
Kevin E. Bennet, PhD

Neural Engineering Laboratory (35 staff)
Kendall H. Lee, MD, PhD
Kevin E. Bennet, PhD

University of Texas El Paso
Felicia Manciu, PhD
Department of Physics

Yonsei University, S. Korea (8 staff)
Dong-Pyo Jang, PhD
Yoonbae Oh, PhD

MAYO CLINIC

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Assistant Professor, Neurosurgery

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