Promoting Interdisciplinary Research at the Technion

Challenges & Solutions

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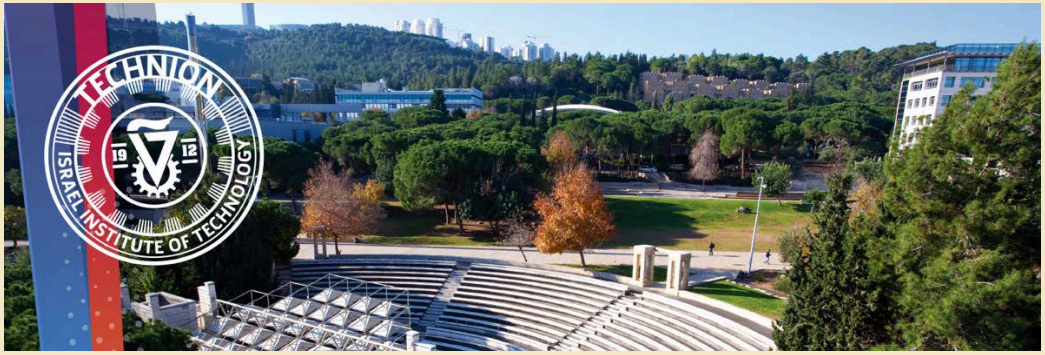
This work is not secret in any way or form. It belongs to God, and **she** says its open domain.

What is the Technion?

- Located on the Carmel Mountain in Haifa
- ~13,500 Students
- 18 Faculties (including the Medical School)
- ~560 Faculty members
- ~100,000 Degrees awarded
- 50+ Undergraduate degree programs
- 80+ Graduate degree programs



1912 Corner Stone Established in Haifa

..... A few years went by.....

2003 Technion launches Israel's first interdisciplinary nanoscience center [RBNI]

2004 Nobel Prize in Chemistry (Hershko and Ciechanover)

2011 Nobel Prize in Chemistry (Shechtman) [Materials Science]

2011 Technion & Cornell win NYC competition to establish the Jacobs Technion Cornell Innovation Institute (JTCII)

2013 Launch of Technion-Guandong Institute of Technology (TGIT)

The Challenge: *Breeching Conventional Science*

Interdisciplinary Technion Research Programs

1+1=17

The Challenge: *Breeching Conventional Science*

Fundamental Science

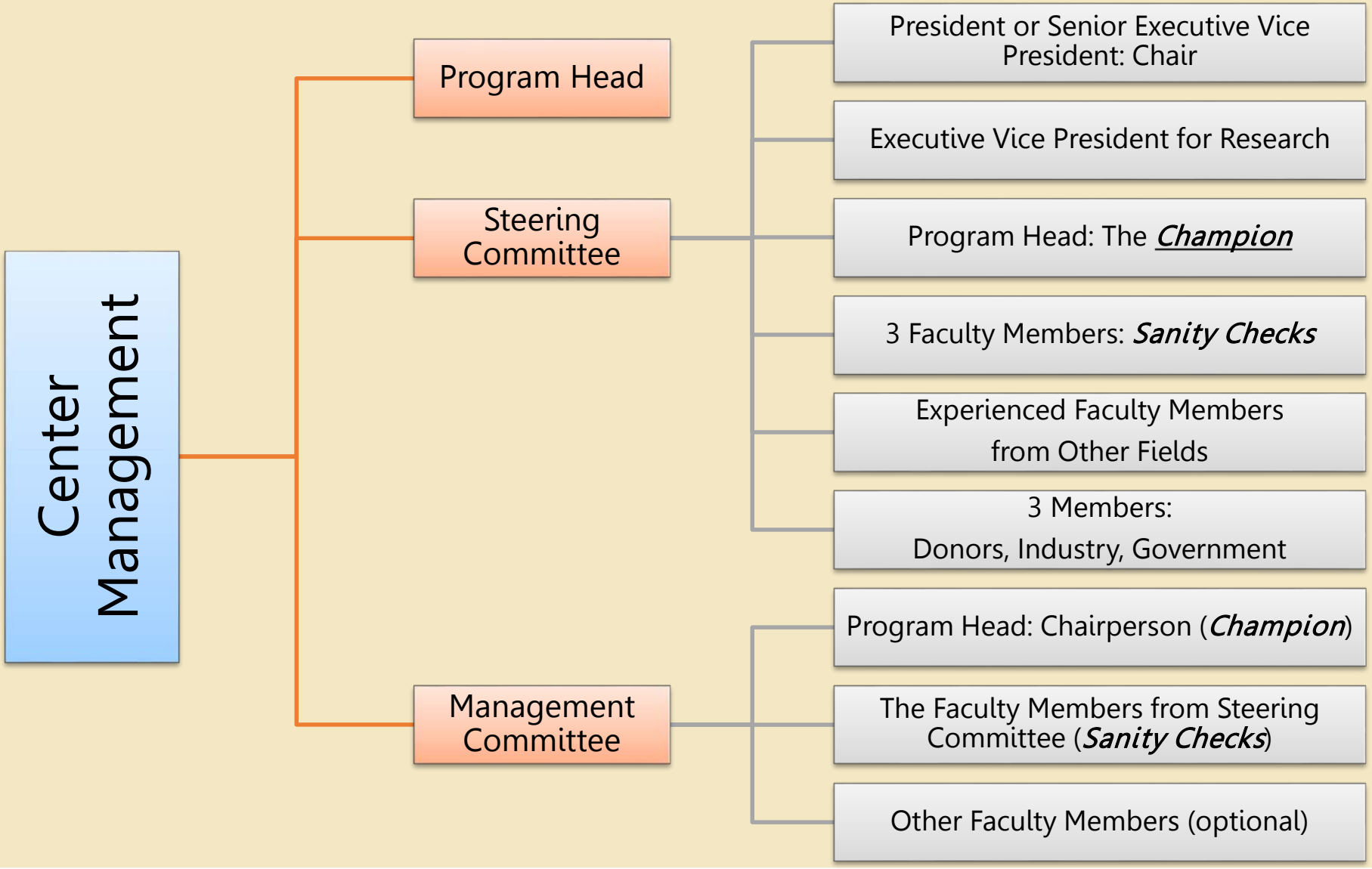
Engineering Projects

Intellectual Property

1+1=17

Resulting from interdisciplinary collaborations

Organizational Structure of an Interdisciplinary Research Program



The Process

- Critical scientific or engineering topics are identified by Technion faculty (not administration: a bottom-up administrative challenge):
  - High scientific impact;
  - Critical for the country.

- Faculty are identified to manage and participate. Managers are always the hardest to find, and participants must be incredibly motivated.

- The core group defines the details of the concept in a written format.

- The concept is reviewed internally, and external opinion is introduced. We are never afraid of criticism. Our internal reviews are direct, honest, and sometimes quite vibrant.

- Senate approval of the program.

- Implementation, including additional faculty defined by their desire to join the group. Internal seed funding requiring collaborative work is the carrot. (There is no stick.)

- Internal and external review of progress and success.

Interdisciplinary Technion Research Programs

RBNI

Nanotechnology = $90M

Head: Prof. Gadi Eisenstein, Electrical Engineering

The Lorry I. Lokey Interdisciplinary Center for Life Sciences and Engineering

Life Sciences and Engineering = $50M

Head: Prof. Yoram Reiter, Biology

GTEP Grand Technion Energy Program — Securing Israel today. Transforming Israel's tomorrow

Energy = $50M

Head: Prof. Gideon Grader, Chemical Engineering

Autonomous Systems = $25M

Head: Dist. Prof. Emeritus Daniel Weihs, Aerospace Engineering

NanoMed

NanoMed = $50M+

Computer Engineering Center = $30M

Head: Prof. Assaf Schuster, Computer Science

RBNI - FTA - Focal Technology Area

Research Topic: *"Nanophotonics for detection and sensing"*

Where nano-optic structures are integrated with new materials and devices to yield significantly more efficient, high resolution photo-detectors to be used for imaging and sensing.

Researchers:
Technion - Asst. Prof. Guy Bartal; Prof. Gad Eisenstein; Assoc. Prof. Gitti Frey; Prof. David Gershoni; Prof. Erez Hassman; Prof. Dan Ritter; Asst. Prof. Carmel Rotschild; Assoc. Prof. Avner Rothschild; Dist. Prof. Moti Segev; Prof. Nir Tessler; Prof. Meir Orenstein.
WIS - Prof. Yaron Silberberg; HUJI - Prof. Uriel Levy; TAU - Prof. Jacob Scheuer

Duration: 5 years (ending September 2016)

Funding: $11M

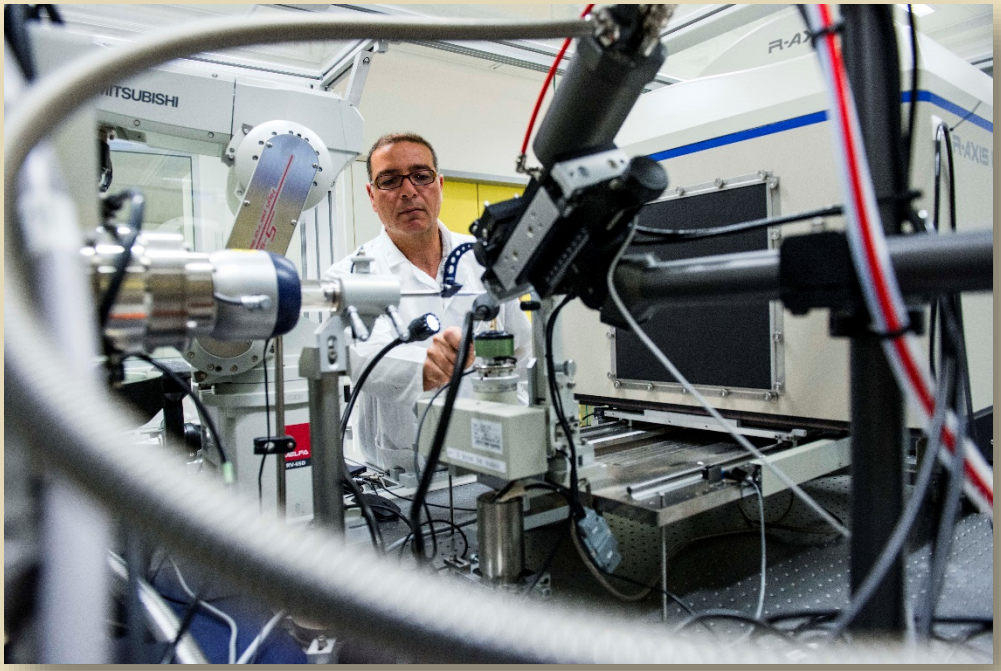
Additional Technion Equipment and Installation Funding: $1M

Advanced Center for Structural Biology

- The LS&E together with the RBNI invested $4 Million to establish the Technion Center for Structural Biology (TCSB), the most advanced of its kind in the Middle East.
  Head: Dr. Hay Dvir

- Will allow for more extensive interdisciplinary biomedical research at the Technion.

- The State-of-the-art Macromolecular Crystallography instrumentation at TCSB allows for biological research at the atomic level.

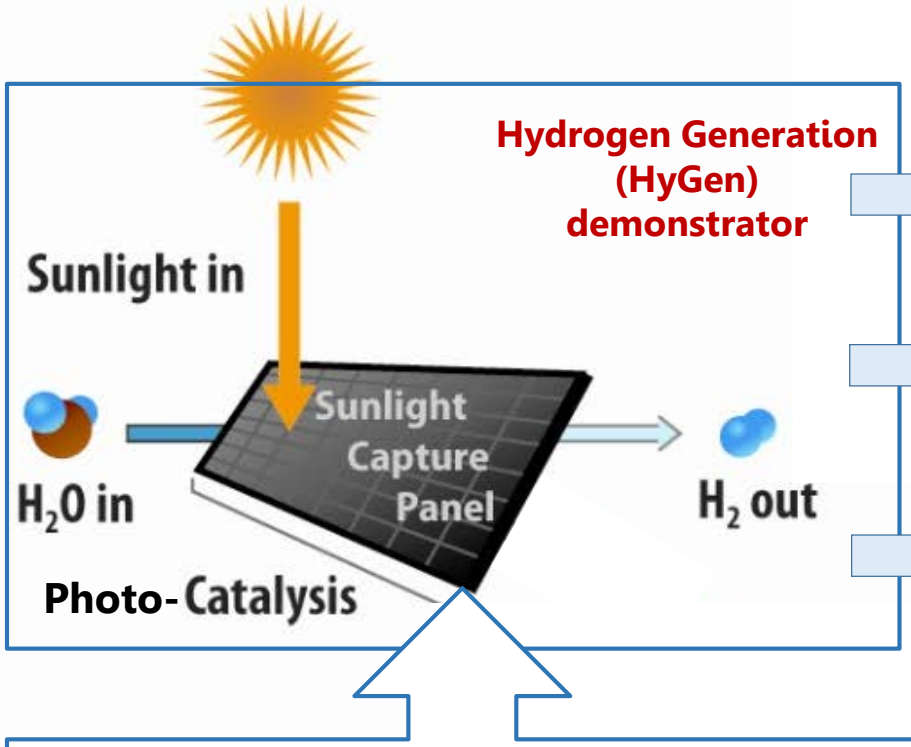


Structural biology is a branch of life science that aims to understand the function of biological macromolecules – such as the tens of thousands of different proteins responsible for most of the biochemical processes in living organisms - by determining their unique three-dimensional structure. The difficulty lies in the tiny dimensions of these molecules which cannot be resolved by visible light rays.

Grand Technion Energy Program (GTEP)

Hydrogen Generation by Solar Powered Water Splitting

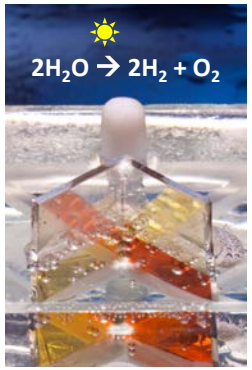
Assoc. Prof. Avner Rothschild, Materials Science & Eng.



- CO_2 conversion to methanol
- Hydrogen storage
- Fuel cell electric vehicles

Technion inventions:

- New tandem cell design:
  → higher efficiency
- New generator concept:
  → lower cost, scalable process



Technion Autonomous Systems Program (TASP)

Autonomous Ground Vehicle for a Smart Stretcher

Asst. Prof. Amir Degani & Prof. Emeritus Itzhak Shmulevich, Civil & Environmental Eng.

- Medical UGV, for a smart stretcher.
- An integrated system under tough environment conditions, using the Grizzly electrical platform.
- Prototype, a platform based on a commercial articulated wheeled field loader, with integrated sensing and control.
- Performance testing on-road and off-road.

Small Autonomous Underwater Vehicle (AUV)

Assoc. Prof. Reuven Katz, Mechanical Eng.

- Conducting tasks such as oceanographic data measurements, bottom imagery, collecting Intelligence, Surveillance and Reconnaissance (ISR), mine-detection, and more.
- Goal: develop and produce a small, modular, autonomous marine underwater vehicle, research platform. Designed to demonstrate two capabilities:
  - Operation from, and communication with, a manned or unmanned surface vessel;
  - Accurate placement of a prescribed payload at seabed.

Autonomous Landing of a small UAV on moving platforms (land or sea)

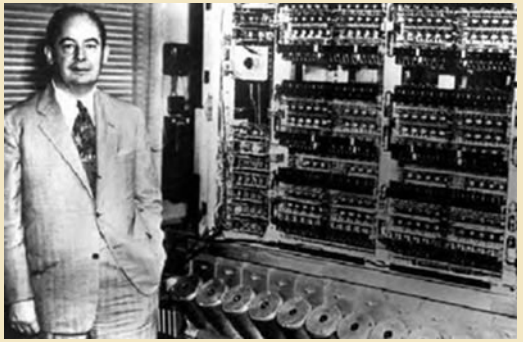
Prof. Ehud Rivlin, Computer Science

- Existing marine platform (boat and quad-copter), extend the sensor range of the surveillance boat.
- Boat carries the quad-copter to the surveyed area and the quad-copter launches and patrols that vicinity.
- Quad-copter returns to the boat and performs an automated landing.

Technion Computer Engineering Center (TCE)

Computer Processors for a Parallel, Cyber Era

Asst. Prof. Etsion Yoav, Electrical Eng.



- **Trend #1:** In the evolving cyber world, our reliance on computers increases in tandem with the number of security threats that affect them
- **Trend #2:** Technological and power constraints leave parallelism as the only viable means for continued performance scalability
- **Problem:** Modern computer processors still operate based on the principles laid out by John von Neumann in the late 1940s
  - Practically security oblivious and sequential

- Our broad research objective is to examine this anachronism and build processors that are tuned for a cyber, parallel world
  - Re-evaluate fundamental practices in the design of computer processors
  - Integrate data security at the processor level
  - Redesign processors for novel parallel execution models
  - Cut through hardware and software layers to examine the system as a whole

Challenging Issues (I face)

- We are quite good at fundamental science, and very (VERY) fast at implementing engineering concepts into marketable IP.
- There are often concepts which nearly reach the IP stage, but are not quite mature enough, and are not picked up by mechanisms which can implement them.
- We need a mechanism which can assist faculty in identifying and pushing forward potential IP, and we need to do this in-house. To do this, we are in midst of establishing an accelerator on campus, fully funded by the Technion.


Thank You for Your Attention!