### **R&D INDEX RELEASE + RESEARCHERS TO KNOW 2020**

INDEX







fe Science Center at Lincoln Yards Sterling Bay's Plan

istcoalition.org | @istcoalition | #ILInnoIndex

September 16th, 2020





**Colleen D. Egan** Illinois Science & Technology **Coalition and Institute** President & CEO





### **Dr. James Gillespie**

Executive Director, Prysm Institute



**SEPTEMBER 16, 2020** 



### R&D Index Release + Researchers to Know 2020

Welcome Remarks Dr. James J. Gillespie Director, Scientific Strategies



Our projects are as diverse and unique as the people who interact with them.

Yet one characteristic unites each project we undertake — our unwavering commitment to getting each detail right.

Simply put, we love building. Building trust. Building relationships. Building value — for our partners and for the communities we serve.

# **Building Value.**

# **Sterling Bay**

# We invest in and transform iconic properties.



#### 600 W Chicago

- In 2018 acquired the well-leased,
   1.6 million sq ft creative office complex and adjacent developable land sites
- Repositioning the asset to capitalize on the growing tenant base and upgrade the retail offerings



#### **Prudential Plaza**

- In 2018 acquired the two-tower,
   2.3 million sq ft marquee office complex
- Upgrading the well-leased property with strategic capital and retail repositioning programs



#### **Meier & Frank**

- In 2016, acquired the former Macy's department store and office floors of the historic mixed-use property in downtown Portland, Oregon
- Full renovation of the 191,000 sq ft space is complete and lease-up is well underway with strong tenant demand

### We Are Sterling Bay

Developers, investors, builders, innovators. We are driven by a passion for what we do.





#### OUR HQ PORTFOLIO INCLUDES:



ABOVE Google's Midwest HQ LEFT McDonald's Global HQ

### **Sterling Bay National Presence**



### Why Chicago?



most diversified economy in the United States - Moody's Analytics

#### It's the nation's most livable big city, and boasts a robust economy

With an unrivaled talent pool and a world-class workforce, more than four million employees and 400 major corporate headquarters call Chicago home.

### Chicago is the top destination for Big Ten graduates.

The graduates of highly respected Big Ten Schools flock to Chicago. Northwestern University, University of Illinois, Purdue University, Indiana University and University of Iowa each have at least 10% of their alumni base in the Chicago area according to LinkedIn Economic Graph Initiatives. These schools boast some of the highest rated colleges in the country.

- U.S. News 2018 Rankings

# Chicago is home to culture, diversity and talent.

A magnet for next-generation talent, Chicago is the vibrant home to worldclass museums of art and science, famed architecture and some of the country's best neighborhoods.



Illinois Located Research Universities





















Research universities with over \$2.5B in aggregate academic R&D

55

**SIU** Southern Illinois University

CARBONDALE



### Life Science Success in Chicago



2430 N Halsted, a 120,000 SF laboratory brought to market by Sterling Bay in 2019, is already 51% leased and expected to be fully leased by Fall of 2020

#### **RECENTLY SIGNED TENANTS**

#### Exicure

Biotech company focused on gene therapy relocating from the tech park in Skokie. Publicly traded company.

#### Evozyne

Founded by Jeff Aronin in 2019, Evozyne is a portfolio company of Paragon Biosciences (330 N Wabash) that is combining breakthroughs in computational modeling, artificial intelligence, and machine learning with science that is informed by the laws of nature to create novel, uniquely functioning synthetic proteins with new precision and efficiency.

#### Vanqua Bio

Startup, coming out of Northwestern University labs. "The company is focused on leveraging recent insights from human genetics to develop best-in-class therapeutics for devastating neurological disorders. Vanqua Bio secured Series A funding from OrbiMed, a New York-based firm that invests across the global healthcare industy. "I think there's going to be a big biotech boom in Chicago, and we're happy to be pioneers. The type of space that Sterling Bay is now building is really only available in San Francisco and Boston, those are typically the hotbeds, and Chicago could be the next one. What Chicago has been lacking is not the education or the transportation, but the facilities. If they build it, biotech will come."

- David Giljohann, CEO Exicure



### 600 W Chicago - Tempus HQ



**Riverfront Location** 

**Renovated Lobby** 

Farehouse Market, Lounge and Bar

ABOVE

TOP RIGHT

BOTTOM RIGHT



#### Asset Type

Office/Retail/Lab

Location

**River North** 

#### Approximate Building Size

1.65M SF

Stories

8

> Suite 500N

> Graduation space available 2021

- > Renovated lobby/amenity/outdoor spaces in 2020
- > Farehouse Market and Amazon Go located in lobby
- > Roofdeck with city and river views
- > Revamped river walk
- > Full service gym
- > Immediate proximity to Brown and Purple "L" stops
- > Full service shuttle to Ogilvie and Union Transportation Centers

### Live, work, play, GROW at Lincoln Yards





A transformative development on Chicago's North Side, Lincoln Yards is located between two of the cities most iconic and lively neighborhoods. Built around 21 acres of green space and accessible through every mode of public transit, it will be a lab and office destination unlike anywhere else in Chicago.

#### The Prysm Institute

As part of Lincoln Yards and Sterling Bay's advacement of life sciences in Chicago, a think tank initiative involving media, mentorship, incubator programs, idea exchanges, and various other collaborative efforts.

TOP RIGHT Riverwalk and Pedestrian Corridor BOTTOM RIGHT Parks and Open Space

### An Unbeatable Location

- > Forming a connection between two of Chicago's most iconic neighborhoods
- > 100,000+ residents live within a 1.5 mile radius of Lincoln Yards
- > Directly on the Chicago River
- > 10 minutes to The Loop through various transit options



### Life Sciences at Lincoln Yards

Lincoln Yards South
E1/E2 - 3,000,000 SF of future growth space
Parcel G1 & E1/E2 are part of the innovation district

#### Life Sciences Space

> Approximately 300,000 SF Lab/R&D

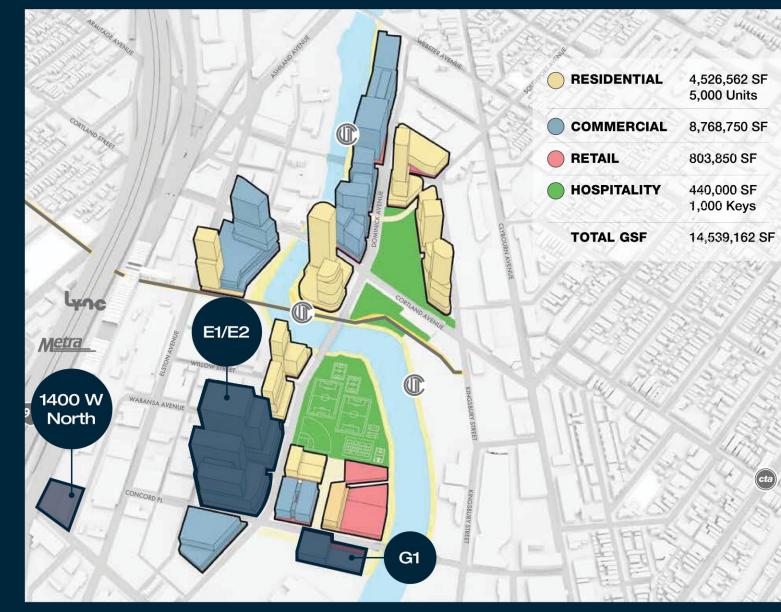
> 36,000 SF floor plate

**Anticipated Completion** 

> Summer 2022

#### Approved Development

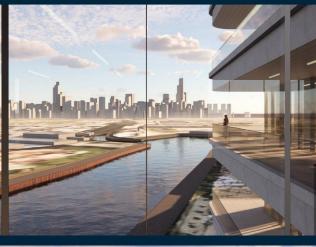
- > 55 acres of prime real estate
- > 21 acres of public open space
- > 100+ new shops and retail
- > 5,000 new residences
- > 1,000 new hotel rooms



### Life Science Cluster at Lincoln Yards



ABOVE Riverfront Location TOP RIGHT Skyline and River View BOTTOM RIGHT Entrance, Riverwalk and Outdoor Plaza





Asset Type Office/Lab/Retail Location Entertainment District at Lincoln Yards Approximate Building Size 320,000 SF Floorplates 30,000 - 35,000 SF Stories

- > 15' slab heights & floor-to-ceiling glass
- > Lab/office flexibility determined by tenant
- > Underground parking for 40+ cars
- > Bike storage 40+ racks

8

- > Ground floor retail, amenity, and fitness center
- > Located directly on Chicago River with 128' of frontage
- > Prominent signage opportunity
- > Gensler designed
- > Private terraces on every floor
- > Tenant conferencing and collaboration spaces



### Private 1,300 SF balconies on every floor

Sweeping horizontal planes echo open space and natural environment

Nautical curved facade design echos fluidity of the Chicago River\_\_\_\_\_



### Open and healthy space design

Circadian rhythm lighting mimics a natural environment Lobby has 15' ceiling height Clean and healthy materialstouchless experience 30' double height lounge

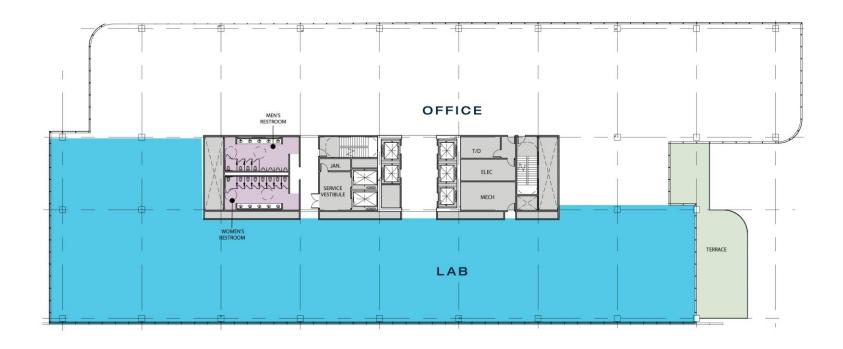
Light, bright and clean materials assist in driving daylight into the spaces

Terrazzo floors

Stone, wood, and minimal fabric wall materials

Healthy Building Design: well certification, LEED Silver minimum

### Floor Plans Designed to Celebrate the Lab/Office Overlap



#### Typical Office/Lab

- > 35,000 SF
- > 11' lab modules
- > Shared office space
- > 50/50 office/lab space flexibility determined by tenant
- Base building is designed to accommodate lab/office flexibility

#### "Celebrate the Overlap"

- The "hard" edge between lab and office is softening
- Finding communal and collaborative spaces in between the two programs
- > Structural grid will be lab standard 11'-0" modules.
- > Core to window is 45', clear span



A Surrounding Neighborhood with Options Unlike Any Other

The Life Science Building at Lincoln Yards will be situated directly across from the Entertainment Hub, a new, all encompassing neighborhood that will bring together a mix of local restaurants and bars, boutique shops, independent retailers and emerging brands, combined with small format music and theater.



### The Entertainment Hub at Lincoln Yards



ABOVE TOP RIGHT BOTTOM RIGHT

Retail and Well-Curated Restaurant Options Street Festival Residential and Amenity View **1 MSF** new development of live, work and play space

- > Curated restaurants & bars and retail
- > Live entertainment
- > Public art
- > Community events for children and adults
- > Open and riverfront space





### Public Plaza Programming



- + + +
- + + + +
- + + + +
- + + + +





### The Park at the Entertainment Hub









Thank you!

Get in touch for more info.

James Gillespie jgillespie@prysminstitute.org 312.480.8499 **Joy Jordan** jjordan@sterlingbay.com 312.566.4988 Russell Cora rcora@sterlingbay.com 312.202.3442

### **R&D INDEX RELEASE + RESEARCHERS TO KNOW 2020**

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September 16th, 2020

Overview



# We measure, connect and advocate for the state's innovation economy.

Overview

## **Our History**

30+

years old

## ISTMember-drivenNon-Profit, Based at 1871

Founded in partnership with the State of Illinois as a technology adviser and economic development partner.





### **A Shared Voice**

Providing a shared voice for the state's R&D community.

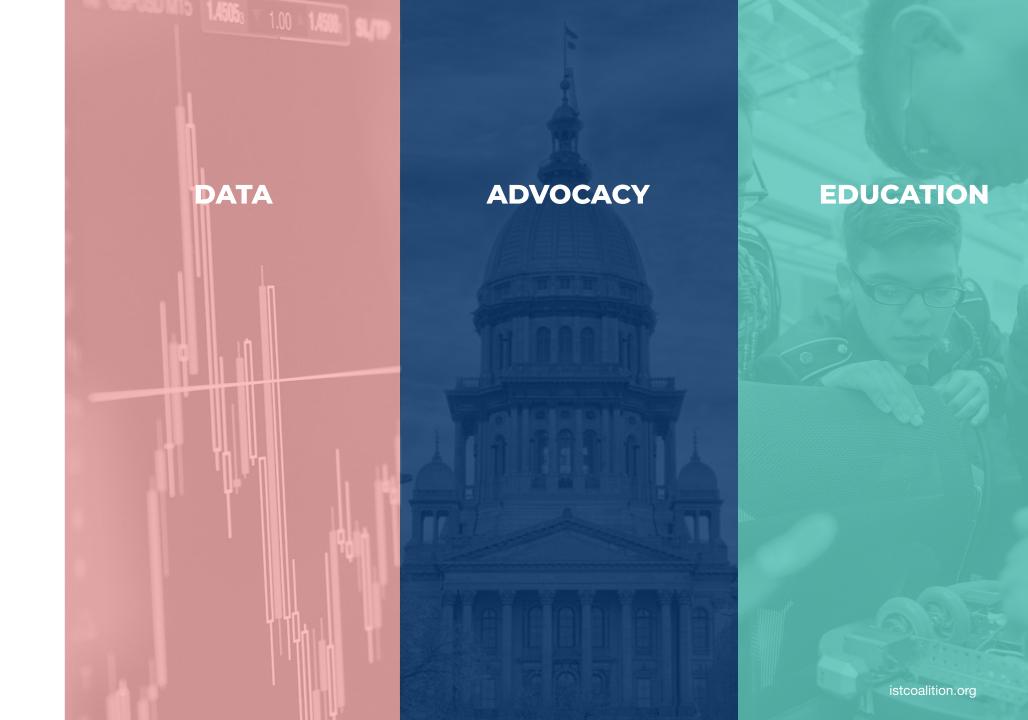
istcoalition.org

ILLINOIS

Overview

**ISTC's** 

**Pillars** 



## State

- $\rightarrow$  Act as a shared voice for members
- → Represent Illinois' innovation community to state lawmakers
- → Advocate for pro-innovation policies that drive economic growth



- → Inform the Illinois delegation on the needs of the innovation community
- → Bring federal funding into the state for technology-based economic development

nications uchin Education



Moulik Shah (Baxter) Emily Cooper (ISTH Emma Niendorf (ISTH Duane Davis (ISTH) Sarah Perret-Goluboff (ISTH) Edelman Communication

ILLINOIS SCIENCE & TECHNOLOGY INSTITUTE

## STEM CHALLENGES CHALLENGES MATCHING ENGINE

### facebook.com/theISTI



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Data

# **ILLINOIS INNOVATION INDEX**

#### **University Entrepreneurship**



#### **Research & Development**



#### **Talent Supply & Demand**



# ILLINOIS INNOVATION INDEX

### **R&D INDEX 2020**

Illinois' Capacity for Innovation & Economic Growth

PRESENTED BY Sterling Bay

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Sterling Bay's Planned Life Science Center at Lincoln Yards

### "R&D is the lifeblood of innovation."

### **Businesses**



Create new products, services and process that drive revenue and keep companies competitive in increasingly globalized markets

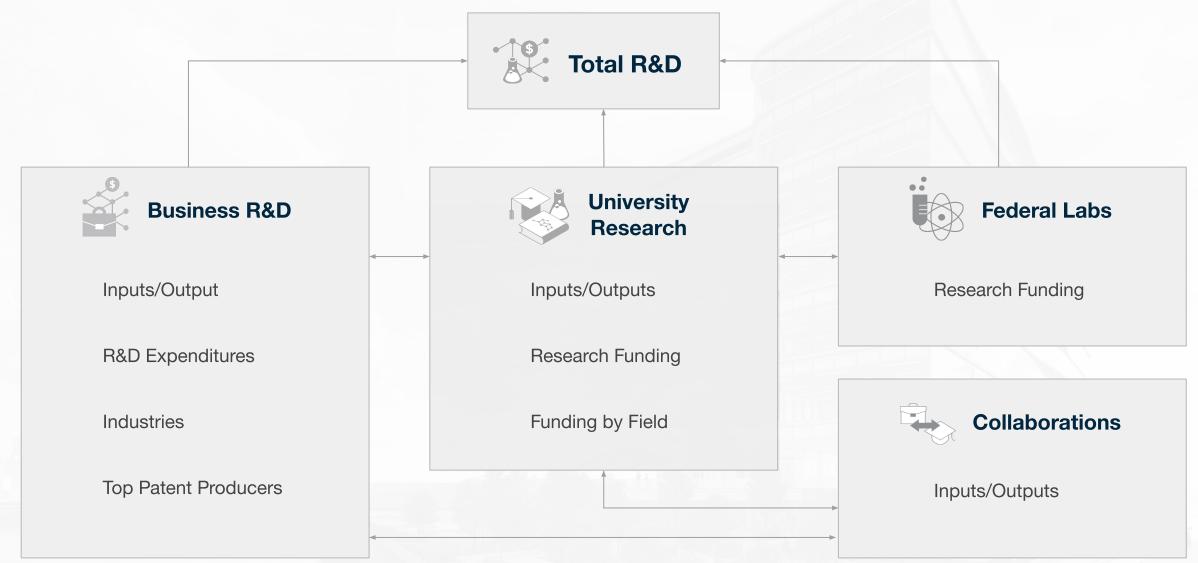
#### Universities

Advancing our understanding of basic science and are increasingly commercializing new technologies

### **Federal Labs**

Discovery and innovation that keep the country ahead of the technology curve

#### 2020 R&D Index



### **Total R&D Activity**

Illinois conducted **\$18.1 billion** in total R&D activity in 2017.

Illinois ranks **9th nationally** in total R&D.

Total R&D increased by more than **\$600 million** between 2016 and 2017.

Despite this uptick, R&D has **grown more slowly** than the national average since 2013 (1.8% annually vs. 4.7%).



-	USA		\$ <b>547.9</b> bln
	CA		\$150.6 bln
1	MA	\$ <b>31.3</b> bin	
- Apr	тх	\$27.1 bin	
	WA	\$25.0 bln	
-	МІ	\$23.9 bin	
A	NY	\$23.6 bln	
J.	MD	\$20.9 bln	
3	ИЈ	\$18.5 bln	
	IL	\$18.1 bin	
-	PA	\$16.0 bln	

#ILInnoIndex



		Value	IL State Rank (5-year change)	Annual Growth Rate					
\$	Business R&D Expenditures 2017	<b>\$14.4</b> bin	8 -1	2.4% ⊥∟	<b>5.5%</b> USA				
	S&E Employment 2018	263,930	<b>7</b> n/c	<b>2.9%</b> ⊫	2.9% USA				
	INPUTS								
OUTPUTS									
	Patents 2019	7,176	7 -1	1.5% ⊫	<b>3.4%</b> USA				
5	Private Industry Output 2017	<b>\$745</b> bln	<b>5</b> n/c	3.0% ⊪	4.0% USA				

2020 R&D Index

### **Business R&D**

#### Inputs:

- \$14.4 billion in expenditures (8th nationally)
- 263,930 S&E employment (7th)

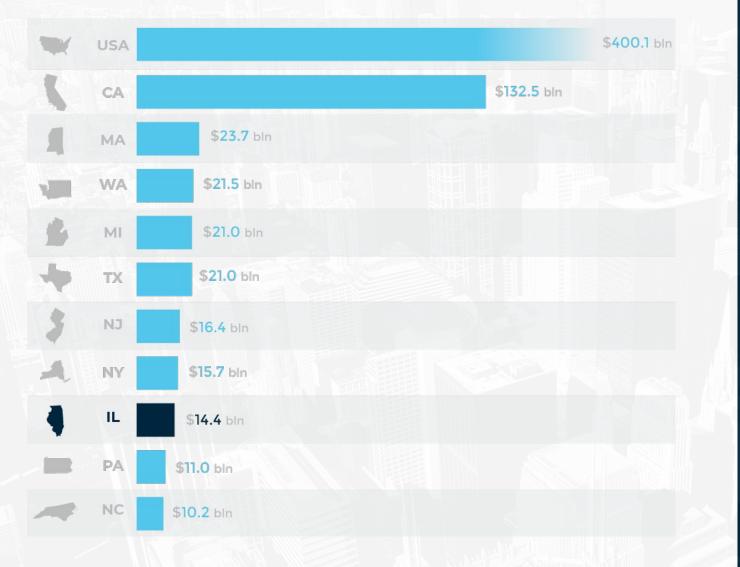
### Outputs:

- 7,176 business patents (7th)
- \$745 billion in private industry output (5th)

#ILInnoIndex



#### Business R&D Expenditures Top 10 States, 2017



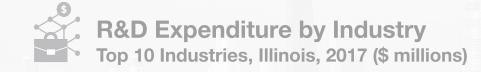
2020 R&D Index

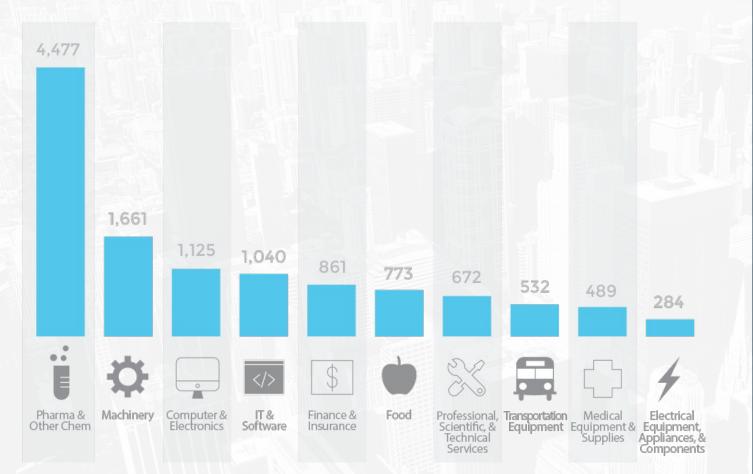
#### **Business R&D**

Business R&D expenditures in Illinois reached **\$14.4 billion** in 2017.

Expenditures increased by more than **\$660 million** between 2016 and 2017.

Business R&D expenditures have **grown more slowly** than the national average since 2013 (2.4% annually vs. 5.5%) #ILInnoIndex





2020 R&D Index

#### **Business R&D**

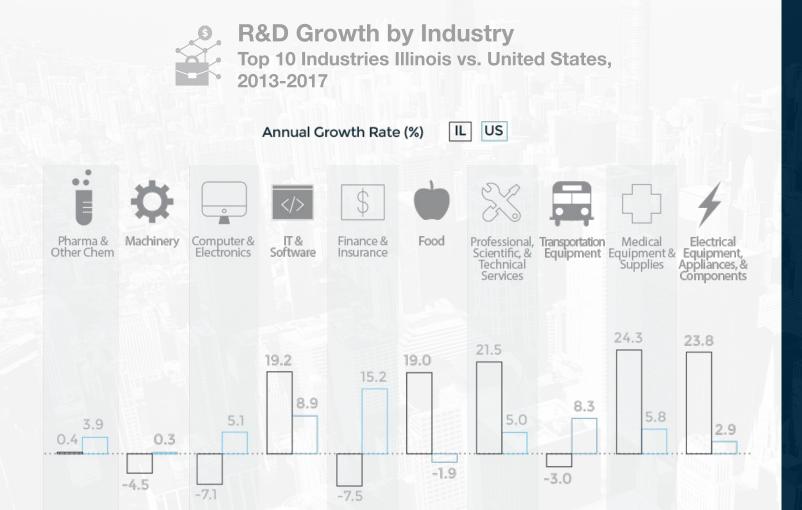
**\$4.5 billion** in pharmaceutical R&D—nearly **3X more** than any other industry.

Illinois ranks **5th nationally** in pharma R&D

State in the top 3 nationally for R&D in **machinery** (2nd), **food** (2nd), and **finance & insurance** (3rd).



2020 R&D Index



#### **Business R&D**

R&D growth in key industries **lags behind the national average**:

- Pharma
- Machinery
- Computer & electronics
- Finance & insurance

## Growth in several top industries has outpaced the national average:

- IT & software
- Food
- Medical equipment
- Electrical equipment
- Professional services

#### #ILInnoIndex



**Top Patent Producing Companies** Illinois, 2019



2020 R&D Index

#### **Business R&D**

Illinois businesses produced **7,179 patents** in 2019, 7th most nationally.

Patent growth among Illinois' businesses lags national growth (1.5% vs. 3.4%)

Leading patent producing companies include industry giants **IBM**, **Caterpillar**, **Motorola**, and **State Farm**.

Other notable Illinois-headquartered companies among the top 25 patent-producers include Allstate, Boeing, Illinois Tool Works (ITW), John Deere, and Molex. 2020 R&D Index

#### **University Research**

#### Inputs:

- \$2.57 billion in research funding (10th nationally)
- **39,208** R&D personnel (7th)
- 9.2 million sq ft (6th)

#### Outputs:

- **13,427** S&E publications (6th nationally)
- 255 patents awarded to universities (9th)

**ILLINOIS INNOVATION INDEX** 

\$295 million in gross licensing income (4th)

#### **University Research Inputs & Outputs**

		Value	IL State Rank (5-year change)	Annual Growth Rate		
5	Research Funding 2018	<b>\$2.57</b> bln	10 -2	<b>2.5% 4.2%</b> IL USA		
ł	R&D Personnel 2018	39,208	<b>7</b> n/c	<b>0.4% 1.3%</b> IL USA		
	S&E Research Space Thousands Sqft 2017	9,194	6 (+1)	<b>2.5%</b> 1.0% IL USA		
INPUTS						
		- I Č	1			
(		OUTPU	TS	)		
	S&E Publications 2018	13,427	<mark>6</mark> n/c	0.7% -0.3% IL USA		
	University Patents 2018	255	9 -1	<b>2.2% 4.7%</b> IL USA		
	Gross Licensing Income 2018	<b>\$295</b> mln	4 -2	<b>-7.3% 1.9%</b> IL USA		

Source: NSF NCSES, Association of University Technology Managers (AUTM)

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#ILInnoIndex

#### **University Research**

Research funding in Illinois reached **\$2.57 billion** in 2018.

Funding increased by **\$67 million** from 2017 to 2018.

Research funding has **grown more slowly** than the national average since 2014 (2.5% annually vs. 4.2%)

State fell **from 8th to 10th** from 2014 to 2018.

University Research Funding Top 10 States, 2018

*	USA		\$ <b>79.4</b> bln
1	CA	\$10.18 bin	
A	NY	\$6.63 bln	
+	тх	\$5.64 bin	
	PA	\$4.41 bin	
J.	MD	\$4.17 bin	
4	MA	\$4.06 bln	
-	NC	\$3.21 bin	
-	MI	\$2.78 bln	
7	FL	\$2.73 bln	
	IL	\$2.57 bln	

#ILInnoIndex

#### **University Research**

Research funding is led by **life sciences (\$1.52 billion** in 2018) more than all other fields combined.

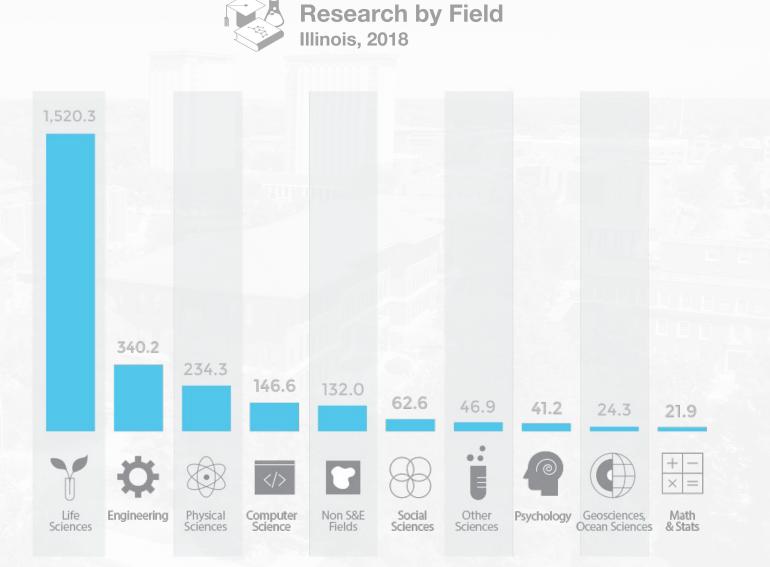
By funding, Illinois ranks...

- 8th in life sciences
- **11th** in engineering
- 8th in physical sciences
- 8th in computer science

By source of funding, Illinois ranks...

- **3rd** from DOE
- **5th** from NSF
- 7th from DOD
- 8th from HHS (including NIH)

#ILInnoIndex



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#### #ILInnoIndex

#### University-Industry Collaboration



## Collaborations

#### Inputs:

- \$172 million in university R&D funded by industry
  - (8th nationally)
- **29** shared R7D grants (7th)

#### <u>Outputs</u>:

- 62 co-assigned patents (8th nationally)
- 284 co-authored publications (10th)

2020 R&D Index

#### #ILInnoIndex

#### University-Industry Collaboration

	Value	IL State Rank (5-year change)	Annual Growth Rate					
Univ. R&D Funded by Industry 2018	<b>\$172.2</b> mln	<b>8</b> n/c	10.5% ⊫	<b>6.1%</b> USA				
Shared Grants 2018	29	<b>6</b> n/c	17.9% ⊪	5.6% USA				
INPUTS								
OUTPUTS								
Co-assigned Patents 2019	62	8 (+1)	<b>1.2%</b> IL	0.0% USA				
Co-authored Publications 2019	284	10 [-1]	12.4% IL	12.4% USA				

2020 R&D Index

#### Collaborations

#### Inputs:

- \$172 million in university R&D funded by industry
  - (8th nationally)
- 29 shared R&D grants (7th)

#### <u>Outputs</u>:

- 62 co-assigned patents (8th nationally)
- 284 co-authored publications (10th)

2020 R&D Index

#### **Federal Labs**

Argonne and Fermilab conduct more than **\$1 billion** in R&D activity annually.

**R&D activity grew** at both universities in 2018

**User facilities** are growing industry partnerships

 Argonne receives significantly more R&D funding from industry, compared with national average #ILInnoIndex



Federal Lab R&D Activity Illinois, 2018

\$777 million

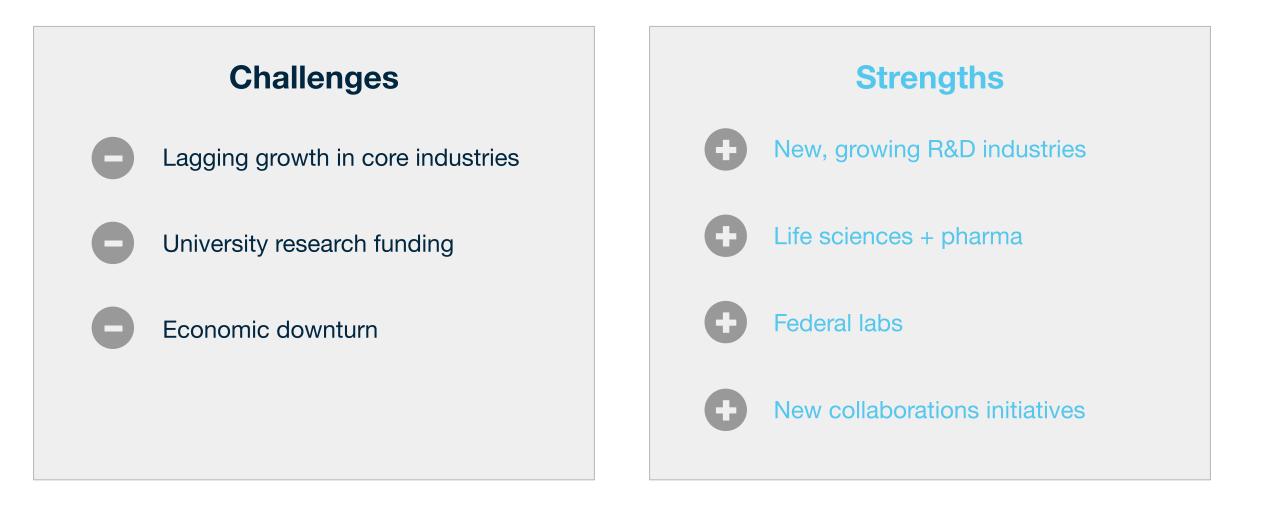
Argonne 📣

\$53 million growth 2017 to 2018

## \$325 million

**Fermilab** 

growth 2017 to 2018





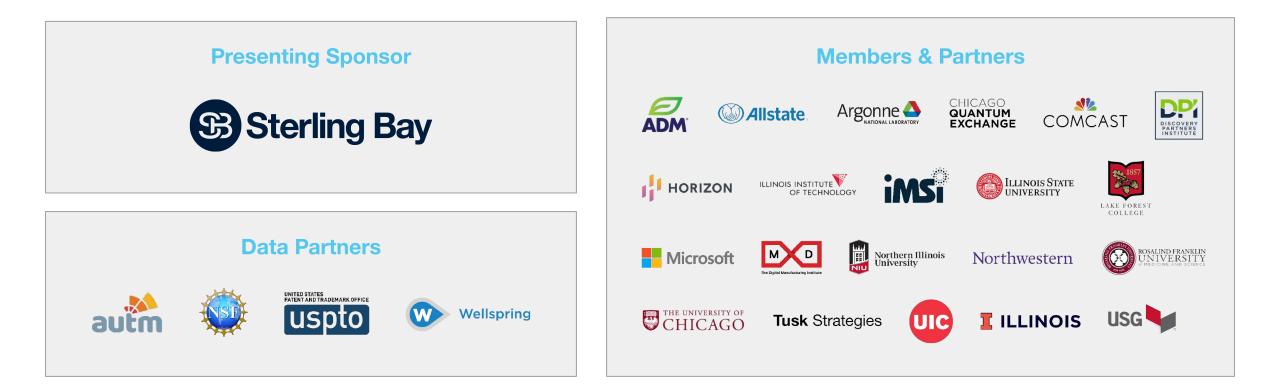
Boosting R&D during a period of economic uncertainty

Supporting the growth of new collaborative R&D initiatives

Creating new collaborations through Illinois Innovation Vouchers



## **Special Thanks**



#### Full Index: istcoalition.com/data



# RESEARCHERS 2020



Full bios: istcoalition.com/data





# TOKNOW 2020

## Vinayak Dravid

#### **Northwestern University**

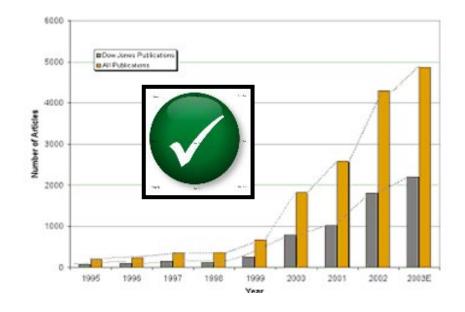
Abraham Harris Professor of Materials Science and Engineering Founding Director, Northwestern University Atomic and Nanoscale Characterization (NUANCE) Center



## Nanotechnology for Environmental Remediation



Hip







Abraham Harris Chaired Professor of Materials Science & Engineering

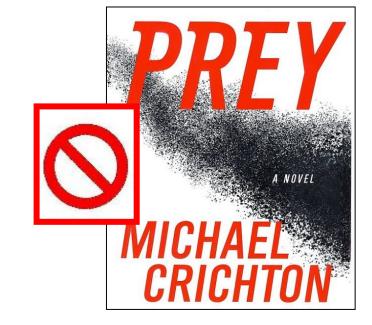
Founding Director; the NUANCE Center, SHyNE Resource – an NSF-NNCI Center of Excellence

Founding member, International Institute for Nanotechnology (IIN)

Northwestern University, Evanston, IL, USA

URL: <u>http://www.nuance.northwestern.edu</u>,

E-mail: v-dravid@northwestern.edu http://www.northwestern.edu/vpdgroup



Hype?

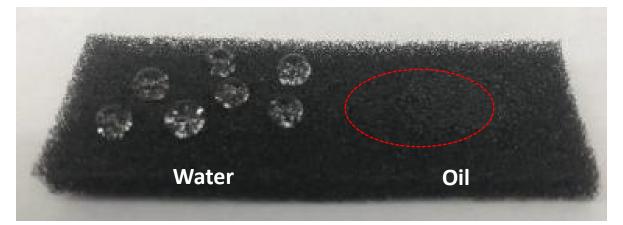
# NSF Video Clip

# https://www.nsf.gov/news/mmg/mmg\_d isp.jsp?med\_id=186525



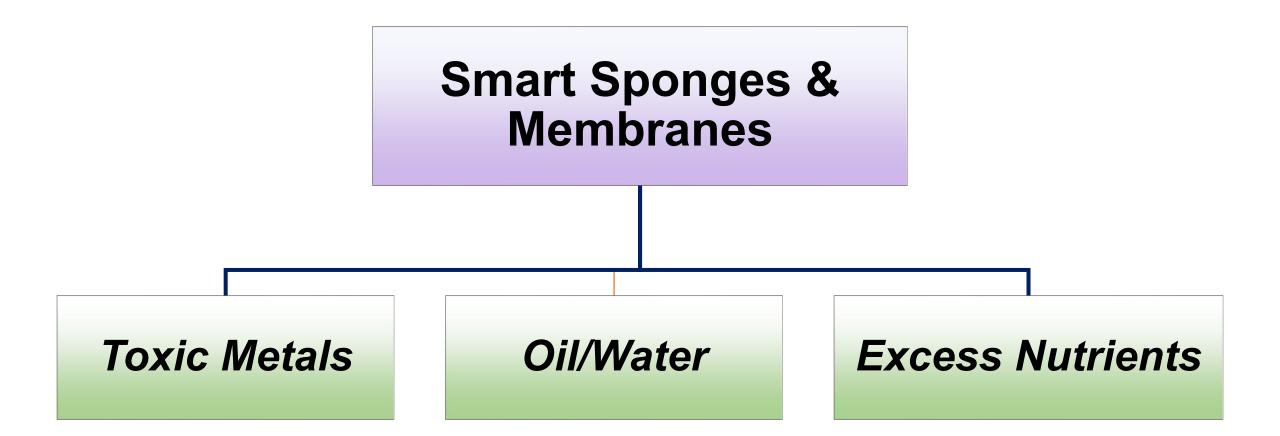
### An oil spill clean-up solution that is:

- Economic (high through-put, cheap raw material, cost-effective)
- Efficient (selective absorption of oil, > 150-200 times self-weight)
- Eco-friendly (green chemistry, reusable, no waste, bio-compatible)
- Effective (selective against oil-water mixture, scalable & deployable)



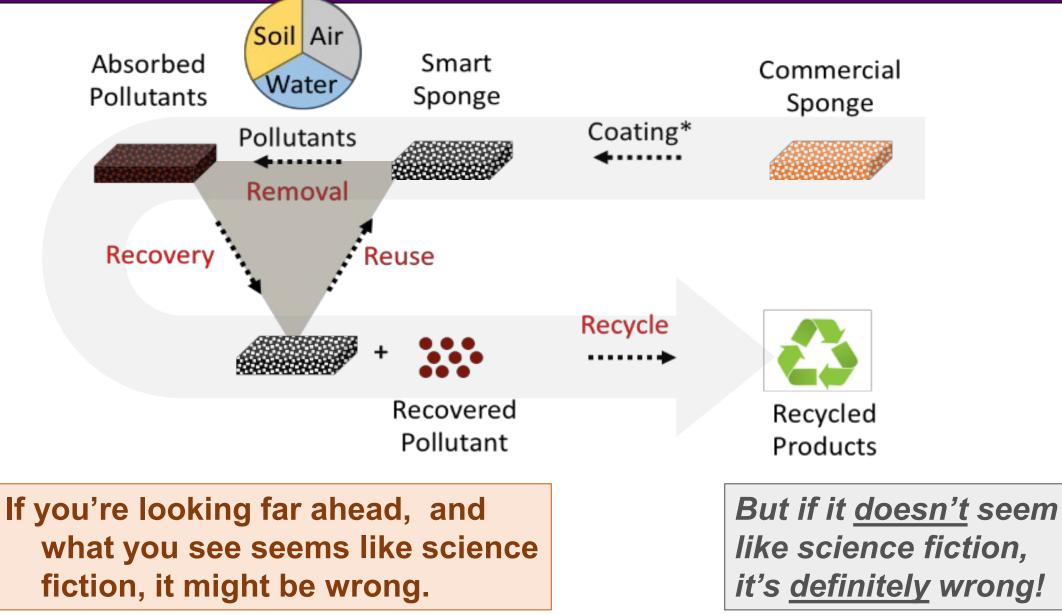
## <u>Oleophilic, Hydrophobic and Magnetic (OHM) Sponge</u>

## **Environmental remediation -** *Beyond Oil Recovery*





## "Sounds like science fiction?!"







# TOKNOW 2020

## **Elizabeth R. Gaillard**

#### **Northern Illinois University**

Distinguished Research Professor, Department of Chemistry and Biochemistry, Biological Sciences



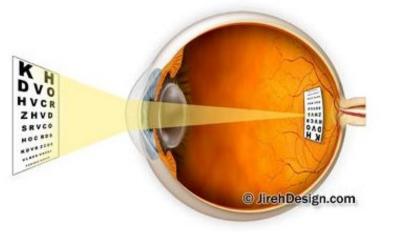


### Northern Illinois University

# Prof. Elizabeth R. Gaillard Dept. of Chemistry and Biochemistry Gaillard@niu.edu



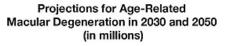




-Most and least metabolically active tissue

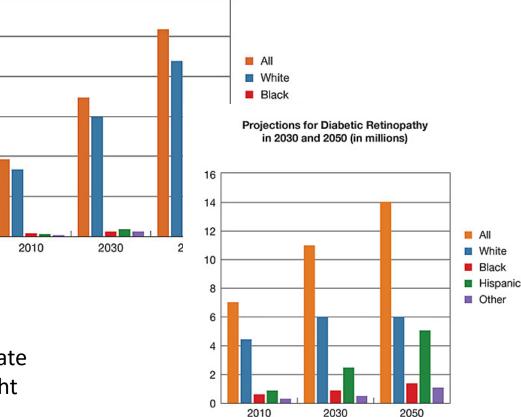
-immune privilege

-highly compartmentalized



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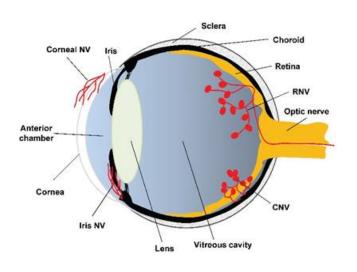
3





Small size, does not regenerate but transparent to visible light

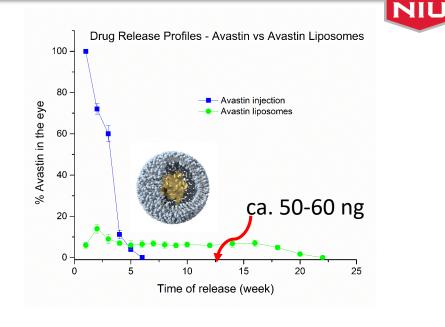
# **Problem and potential solutions**

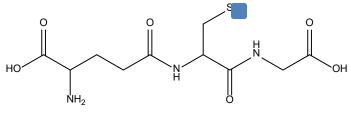




Increased chance of infections due to high frequency of intravitreal injections

Leaking blood vessel





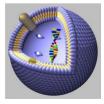
glutathione

- Growth of new blood vessels
- Leaky vessels cause inflammation
- Hallmark of diabetic retinopathy (DR) and "wet" age related macular degeneration (AMD)





Liposomal Drug Delivery



• Biomarkers for inflammation, aging and disease





•

Drug Development; mechanisms of action







# **NIU MAC partnership with SSI**

\*University research resource focused on state-of-the-art mass spectrometry (MALDI TOF, QqQ, QTOF)

\*Grand opening 2019

\*small molecules, biopolymers, large biopolymer complexes, imaging









NORTHERN ILLINOIS UNIVERSITY Division of Research and Innovation Partnerships



**NIU MAC** Molecular

**Analysis Core** 

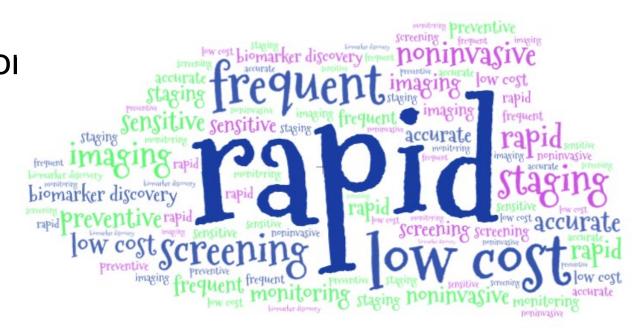
go.niu.edu/NIU-MAC

#### SHIMADZU

# New diagnostic tests

• Expand/build:

age related macular degeneration diabetic retinopathy/diabetes inflammation SARS Co2 and other viruses cancer (ocular melanoma)





### And thanks to my research partners

NIU Research group and MAC facility: Michael Vega Prajkta Chivte Zane LaCasse

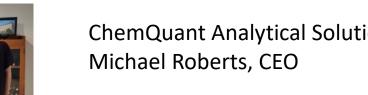
Therome Innovation Partners Dr. Kalyan Karumanchi, co-founder

and CSO

INNOVATION PARTNER

**ChemQuant Analytical Solutions** 

Shimadzu Scientific Instruments **Delano Turner** 

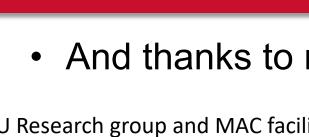




MAP Sciences Professor Ray Iles, CSO Tarek Makzhoumi, CFO







Thank you!





# TOKNOW 2020

### **Boyd Goodson**

#### **Southern Illinois University Carbondale**

Professor of Chemistry and Biochemistry Acting Associate Dean of the College of Agricultural, Life, and Physical Sciences



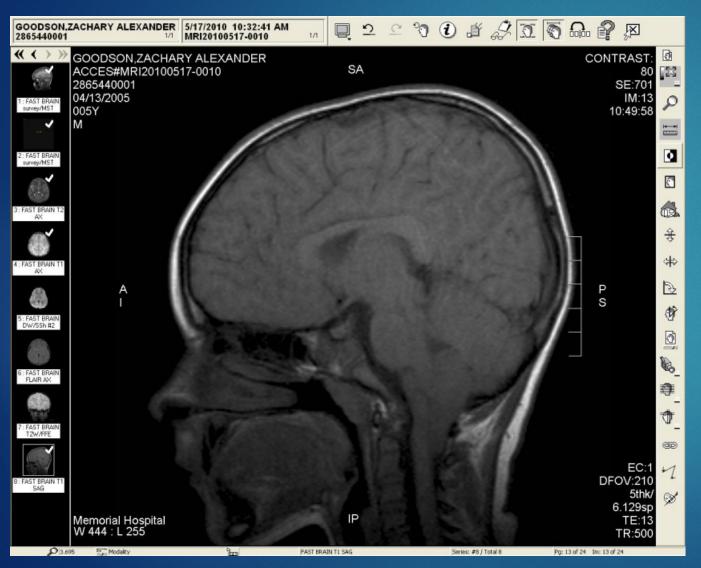
Enhancing Magnetic Resonance Imaging (MRI) with SABRE and Lasers

Boyd Goodson, Ph.D. Department of Chemistry & Biochemistry Southern Illinois University Carbondale XeUS Technologies



ISTC R&D Index + Researchers to Know September 16, 2020





MRI provides unrivaled imaging of the human body...

...but MRI is expensive, slow, and lacks sensitivity to visualize many health indicators.

# WHY MRI SENSITIVITY IS LOW

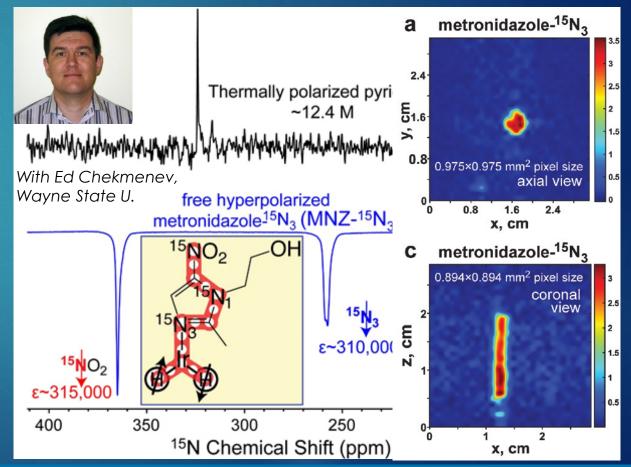
- MRI contrast agents (CAs) enhance tissue signals (mostly water)
- Tumors, abnormalities absorb CAs differently from healthy tissue
   → bright/dark spots
- But agents, tissues aren't very magnetic!
- MRIs have strong magnetic fields
   > Expensive, bulky, confining, slow
   > Limited to mapping highconcentration species: body water



## COMBATING LOW MRI SENSITIVITY: HYPERPOLARIZATION

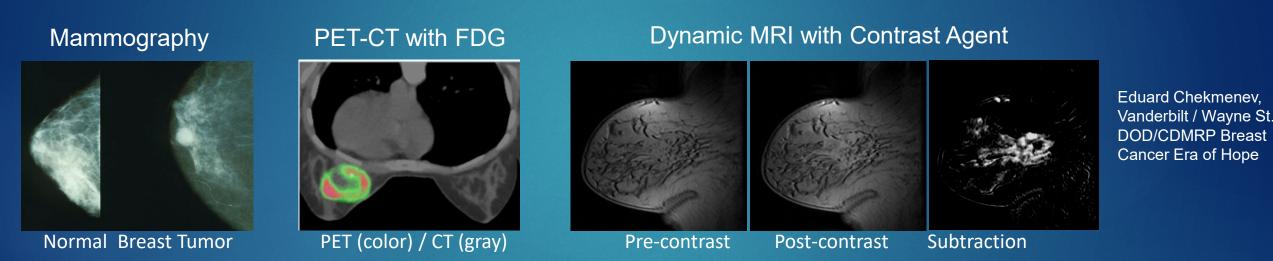
- increases CA magnetism by 1000s of times...
- → Hyperpolarized (HP) CAs: orders of magnitude more sensitive than today's state of the art.
- Our tech harnesses hyperpolarization to safely enhance MRI signals!
- A high resolution, without superstrong magnet
- $\rightarrow$  Low cost
- → High speed (seconds, not 10s of min.)
- → Better patient throughput, amenable to more patients

*300,000-fold MRI signal enhancement of a drug for hypoxia sensing, imaging!* 



## MOLECULAR IMAGING WITH HP AGENTS

- "Molecular Imaging": imaging with molecular "biomarkers" for disease
- Currently uses x-ray/CT/PET (Ionizing radiation, Limited agents)



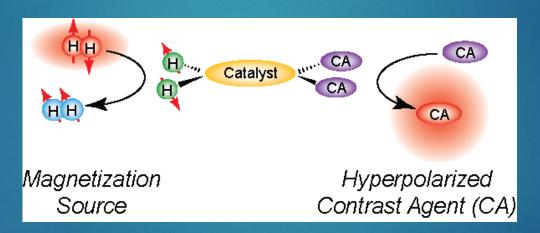
Hyperpolarization 

→ molecular MRI—in seconds!

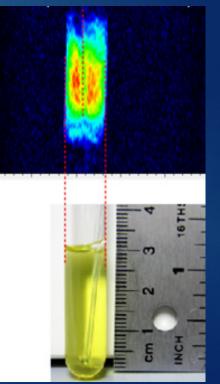
 → Highlights disease states, with no ionizing radiation, no heavymetal agents, improved info content, repeatable, etc.
 → Can watch response to treatment, almost in real time!

## HOW OUR HP TECH WORKS

- Other HP tech exists but has limitations: high cost & low agent throughput
- We have approaches that are much more rapid, cost-effective, and scalable... (1) "SABRE". SABRE uses a catalyst to transfer magnetization from a molecular source to a contrast agent under special conditions

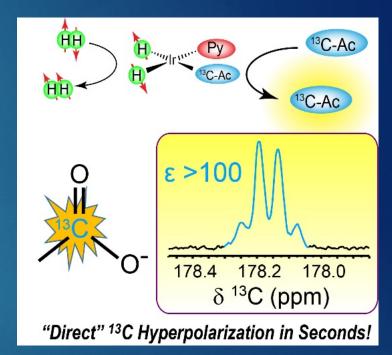


Our SABRE Tech makes HP CAs in water, with purity (no catalyst), high magnetization, and much longer HP lifetimes!



# COMMERCIAL POTENTIAL

- Technology is fast, low-cost, enabling of rapid scans with low-cost imagers...
  - → Large hospitals, small hospitals, clinics, even field hospitals! (potential for expansion in developing countries as well)
- Huge potential market: >38M scans / yr in the US (>\$40B). Lower costs could expand both US, international markets



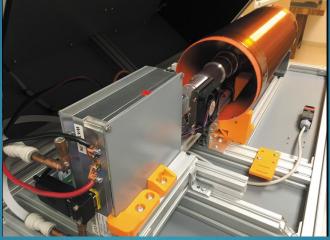
# PROGRESS & CURRENT STATUS

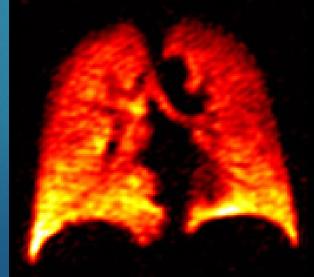
- HP Technique 1 ("SABRE")
  - HP agents with high magnetization (enhanced >300,000-fold), longer life (up to 10 min.), sensitivity to biomarkers (pH, hypoxia, metabolism, etc.)
  - Demonstrated simple, safe agents! (metabolites, drugs, vitamins)
  - Demonstrated catalyst separation to make "pure" agents!
  - 2 full patents + 4 more pending / provisional

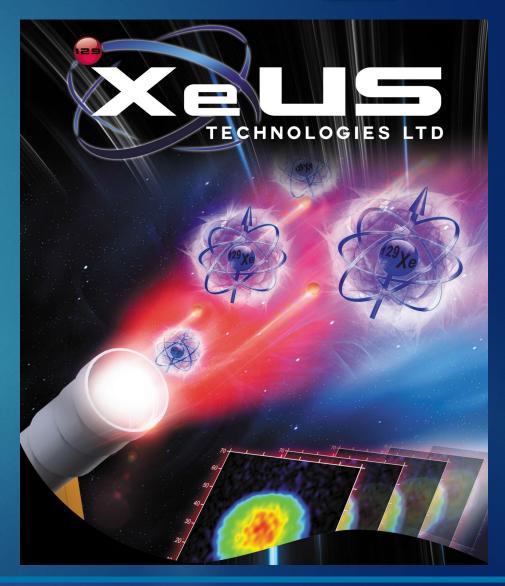


# 3<sup>rd</sup>-GENERATION XENON "HYPERPOLARIZER"









# WE'RE LOOKING FOR...

Licensing (IP) Investment (XeUS Technologies)

R&D Partners Customers (XeUS Technologies)





# THANK YOU

For more information regarding technologies for metabolic imaging, contact **Dr. Boyd Goodson** at bgoodson@chem.siu.edu







# TO KNOW 2020

# Johnny He

#### **Rosalind Franklin University of Medicine and Science**

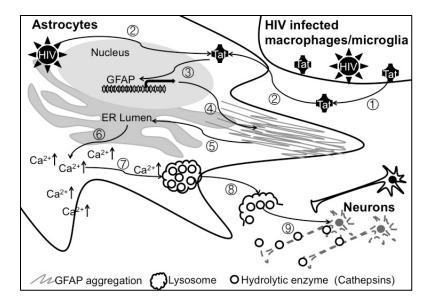
Professor and Chair, Department of Microbiology and Immunology, Chicago Medical School Director, Center for Cancer Biology, Immunology and Infection



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Professor and Chair, Microbiology and Immunology Chicago Medical School Director, Cancer Cell Biology, Immunology and Infection Rosalind Franklin University of Medicine and Science





Johnny He, Ph.D.

- HIV virology
- HIV infection and brain diseases
- HIV infection and substance abuse
- Melanoma and glioma



# RESEARCHERS 2020

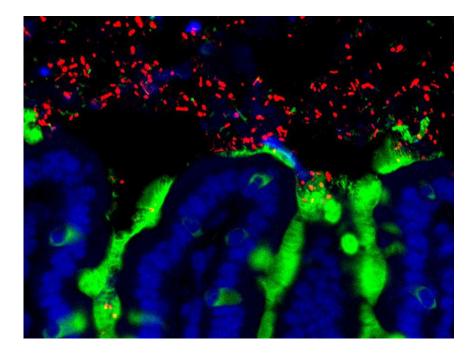
#### **Cathryn Nagler** The University of Chicago

Bunning Family Professor, Biological Sciences Division and Pritzker School of Molecular Engineering



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## Manipulating the Microbiome to Prevent or Treat Food Allergy



## Cathryn Nagler, Ph.D.



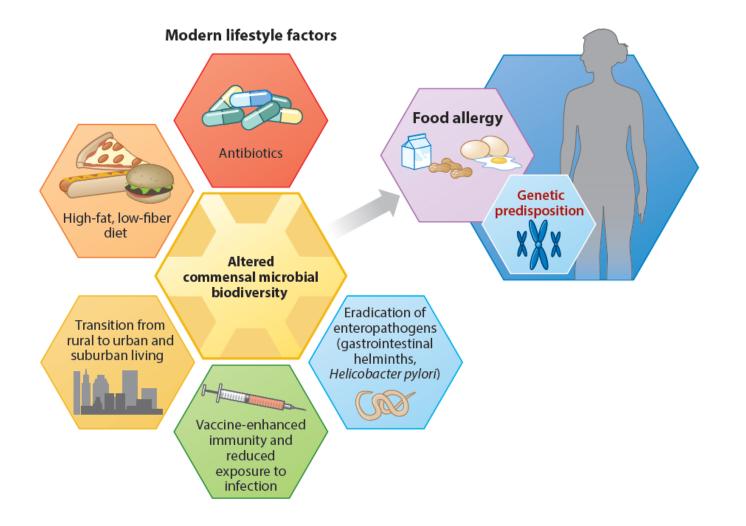


http://naglerlab.uchicago.edu

#### THE FOOD 32 million ALLERGY Americans have food allergies **EPIDEMIC** 1 in 10 1 in 13 children adults More than half of adults with More than 40 percent of children 51% 42% food allergies have with food allergies have experienced a severe reaction. experienced a severe reaction. 377% Claim lines with diagnoses of anaphylactic food reactions increased 377 percent between 2007 and 2016.

Prevalence and Severity of Food Allergies Among US Adults. JAMA Network Open 2019 The Public Health Impact of Parent-Reported Childhood Food Allergies in the United States. Pediatrics 2018 Food Allergy in the United States: Recent Trends and Costs – An Analysis of Private Claims Data. FARE Health White Paper, November 2017.

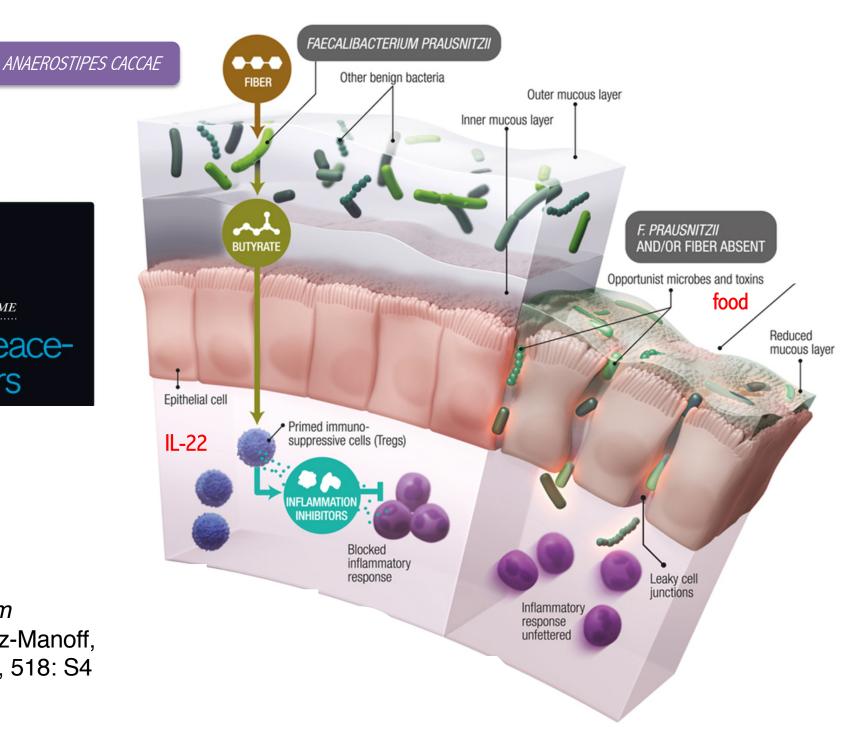
# Modern industrialized lifestyle factors trigger shifts in the commensal microbiota



Iweala and Nagler, Annu. Rev. Immunol. 2019, 37: 377



*modified from* M. Velasquez-Manoff, *Nature* 2015, 518: S4





Microbiome-modulating therapeutics to prevent or treat food allergy







Cathryn Nagler, PhD Co-founder & President Bunning Food Allergy Professor University of Chicago Jeffrey Hubbell, PhD Co-founder

Eugene Bell Professor of Tissue Engineering University of Chicago John Flavin, MBA Executive Chairman CEO, Portal Innovations



Center for Entrepreneurship and Innovation

THE UNIVERSITY OF CHICAGO



# TOKNOW 2020

## Leon Shaw

#### **Illinois Institute of Technology**

Rowe Family Endowed Chair Professor in Sustainable Energy Professor of Materials Science and Engineering, Department of Mechanical, Materials & Aerospace Engineering

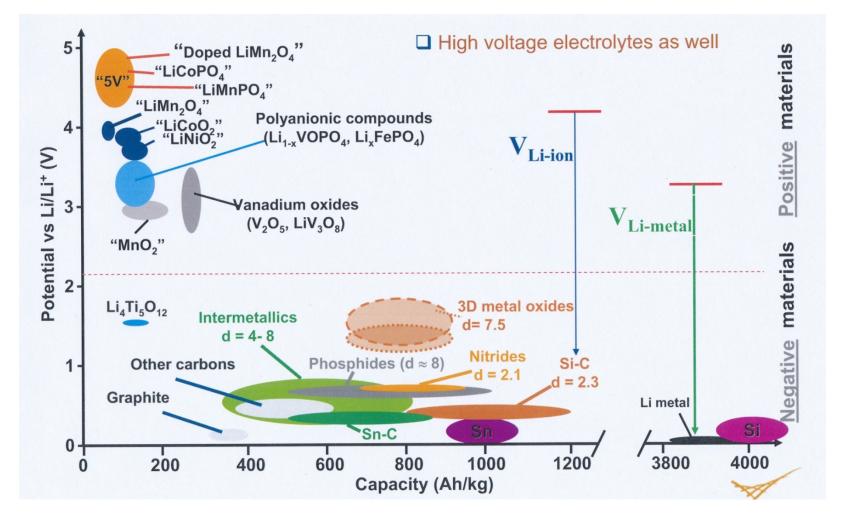


# Advanced Materials Synthesis and Processing for Energy Storage

Leon Shaw Illinois Institute of Technology

- □ Li-ion Batteries (Si anode, NMC cathode)
- Na-ion Batteries (NaCrO<sub>2</sub> cathode, phosphorus anode)
- Redox Flow Batteries (Na-based flow batteries)
- Hydrogen Storage Materials (LiBH<sub>4</sub>, MgH<sub>2</sub>, LiNH<sub>2</sub>-LiH)

## Si has potential to serve as high specific energy anodes for Li-ion batteries

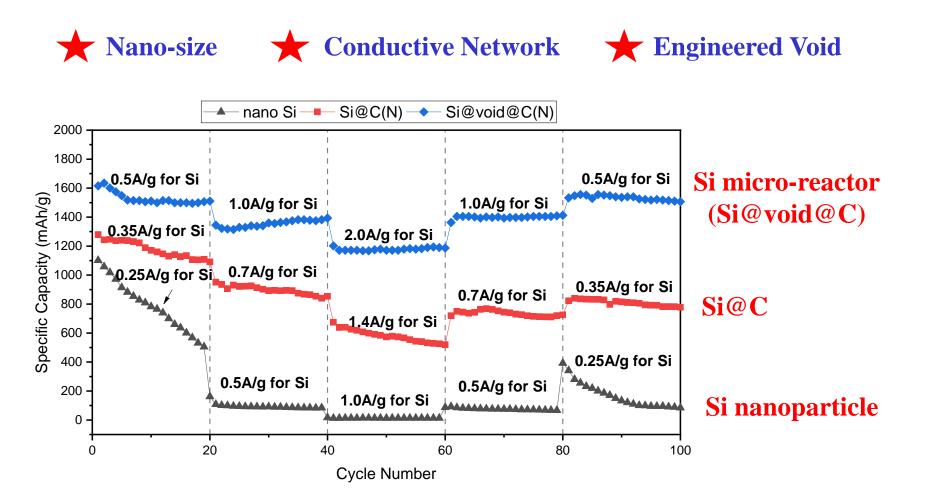


Tarascon, J.-M., M. Armand, M., Issues and challenges facing rechargeable lithium batteries, Nature, 414, 359-367 (2001).

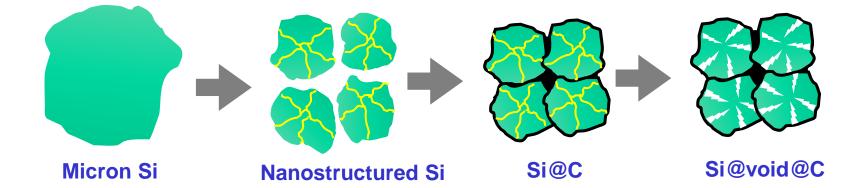
### **Challenges Faced by Si Anodes**

(i) large volume change (~300%) during lithiation and delithiation
(ii) low intrinsic electrical conductivity

(iii) instability of the solid electrolyte interphase (SEI)



### Our Approach in Synthesizing Si@void@C Micro-Reactor Particles

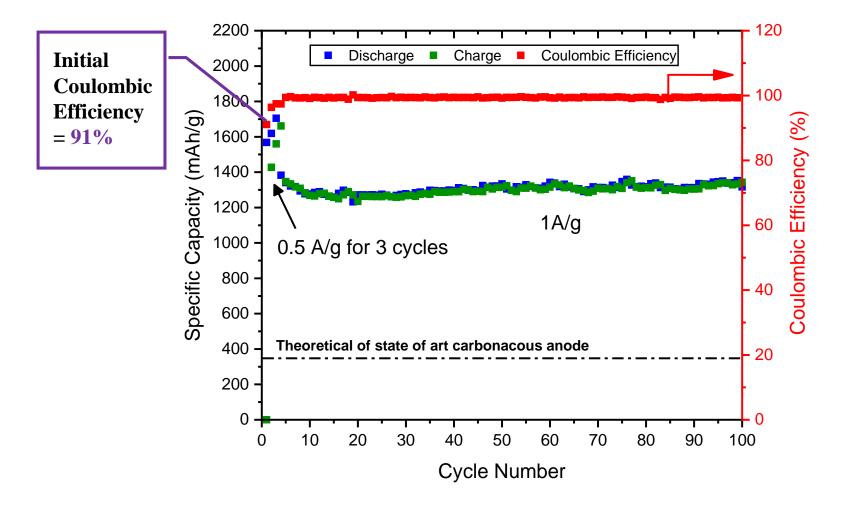


#### Eco-friendly and industrially scalable synthesis at low cost

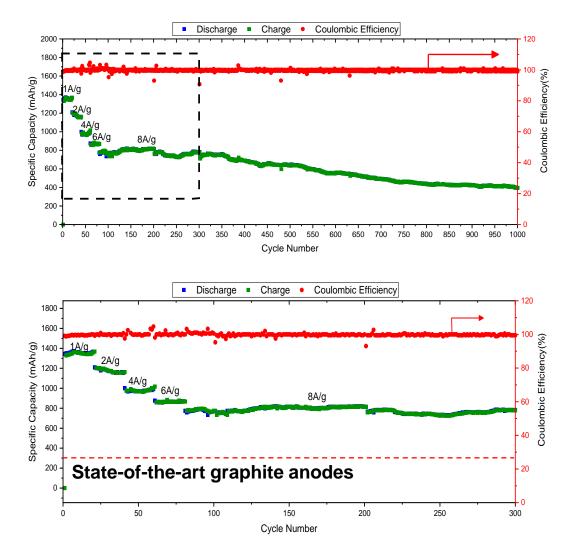
- □ Start with micron-sized Si powder (low cost material)
- High-energy ball milling to produce nanostructured particles (industrially scalable manufacturing)
- NaOH etching to create engineered voids inside the carbonencapsulated Si core (environmentally benign solution)

PATENT PENDING, U.S. Provisional Patent #62/617903 and PCT International Patent # PCT/US 19/13261.

#### Specific Capacity of Si@void@C Micro-Reactors as a Function of Cycle Numbers



### Specific Capacity of Si@void@C Micro-Reactors as a Function of Cycle Numbers



#### **1000 cycles**

Si@void@C micro-reactors can be charged to the full capacity in 3 to 6 minutes with 1000 cycle stability and still possess specific capacity higher than that of the state-of-the-art graphite anodes which require ~3 hours to be fully charged with ~330 mAh/g capacity.

# Zoomed plot for First <u>300</u> cycles



# TOKNOW 2020

### **Andres Vidal-Gadea**

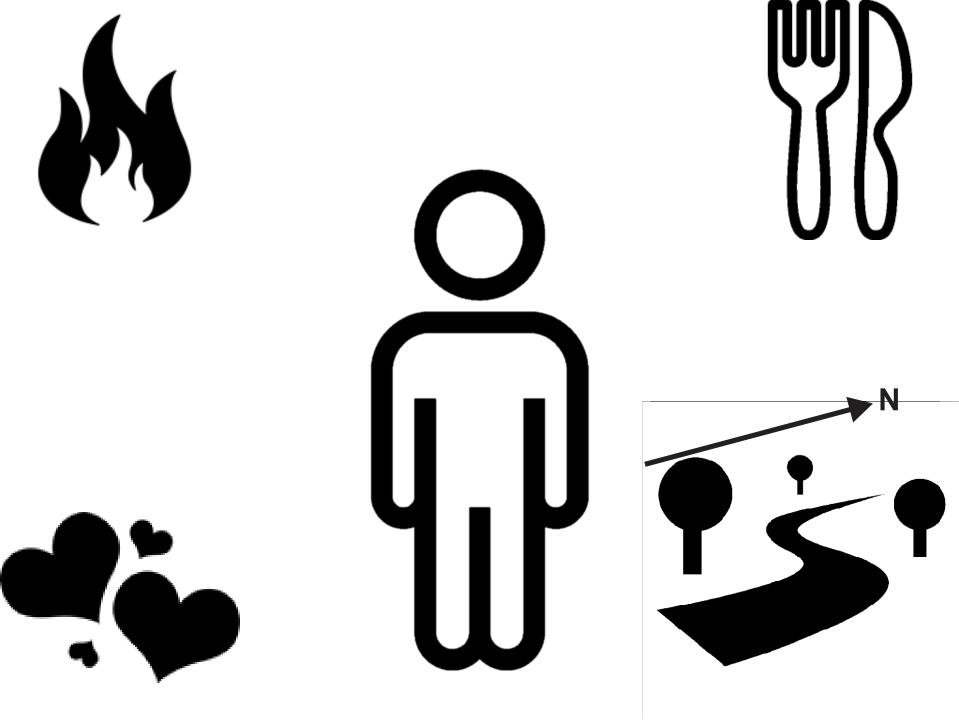
#### Illinois State University

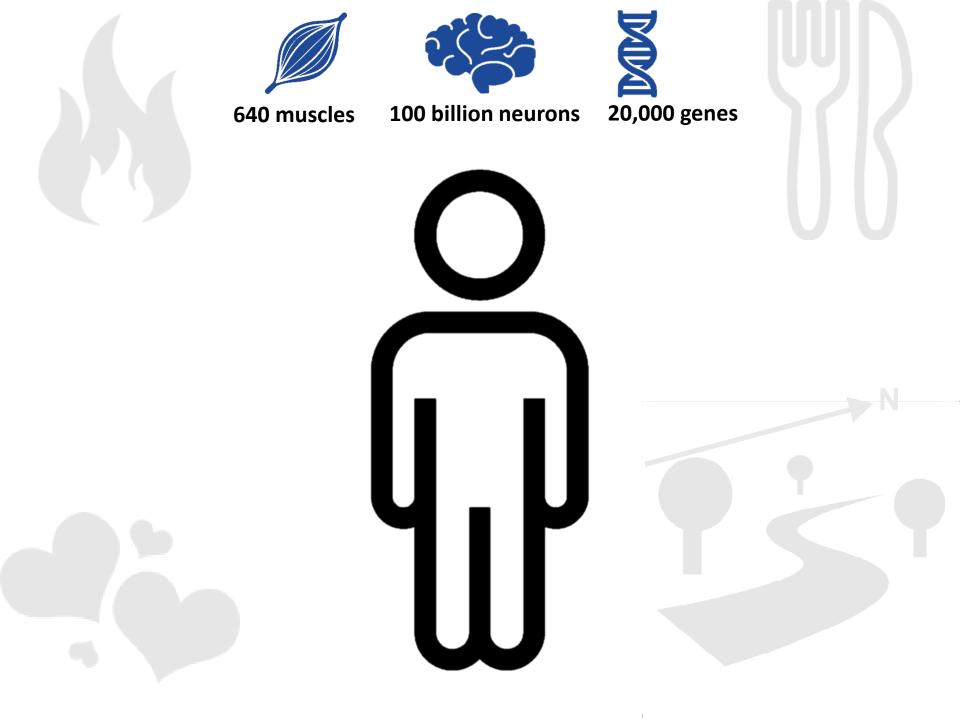
Assistant Professor of Molecular Neuroethology

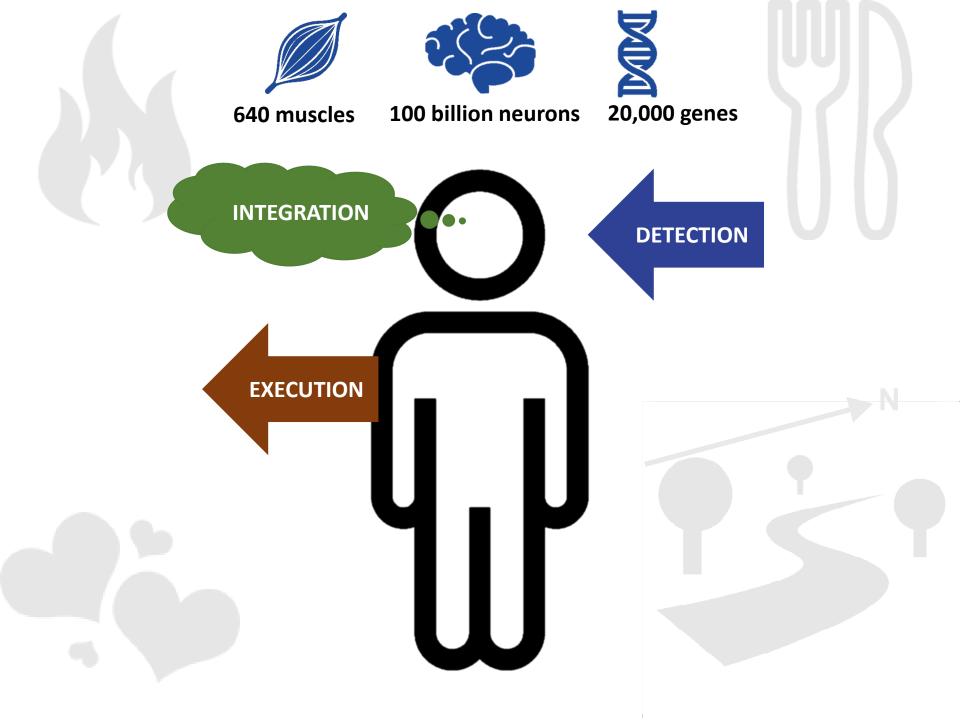


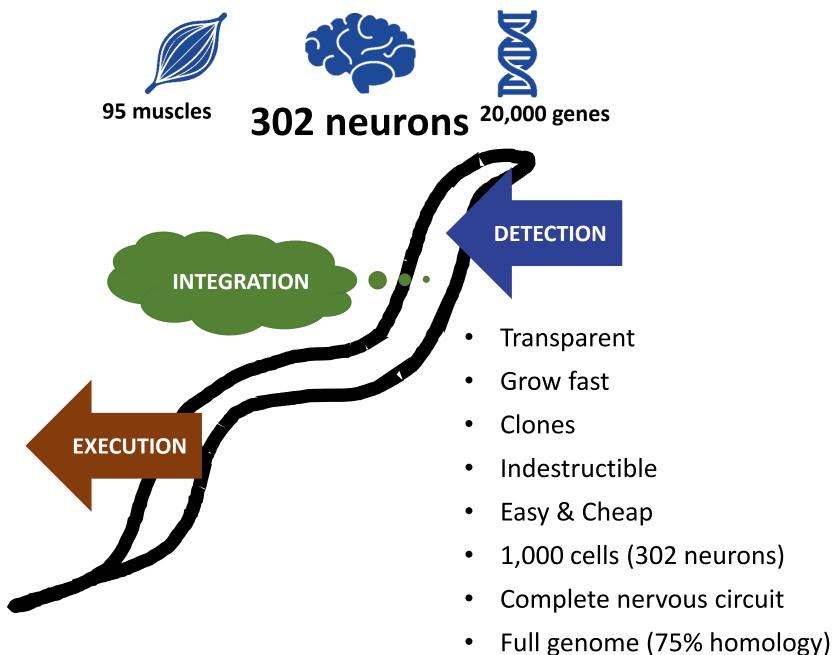
#### Using the nematode *C. elegans* to model Duchenne muscular dystrophy

Andrés Vidal-Gadea, Illinois State University









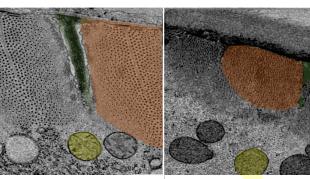
### Caenorhabitis elegans

<u>Everyone can contribute</u>

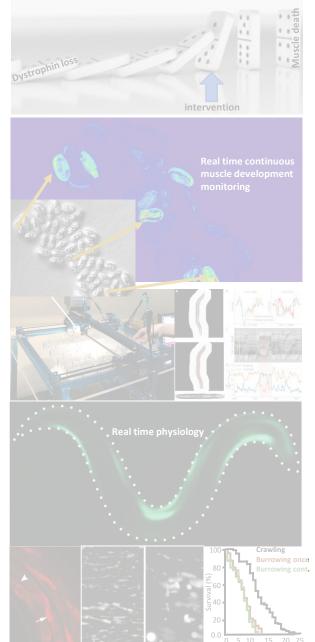
# **Duchenne Muscular Dystrophy**



1 in 3,000 males born with DMD Mutation in dystrophin gene Loss of muscle and mobility Death by late 20s-early 30s <u>Most DMD animal do not get very ill</u> There is no cure for DMD



Healthy muscle Dystrophic muscle



Effect of exercise on dystrophic muscles

Reverse and forward genetic screens

Non-invasive treatment approaches

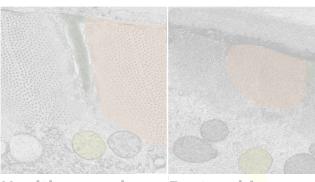
High throughput personalized medicine



# **Duchenne Muscular Dystrophy**

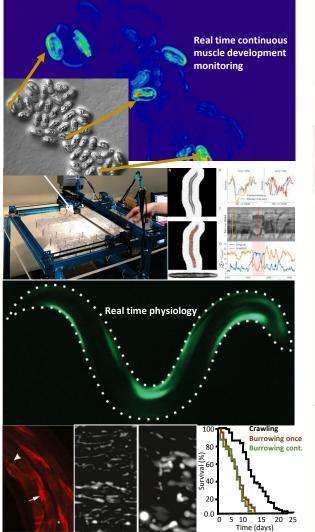


1 in 3,000 males born with DMD Mutation in dystrophin gene Loss of muscle and mobility Death by late 20s-early 30s <u>Most DMD animal do not get very ill</u> There is no cure for DMD



Healthy muscle Dystrophic muscle





Effect of exercise on dystrophic muscles



Non-invasive treatment approaches

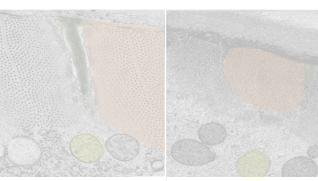
High throughput personalized medicine



# **Duchenne Muscular Dystrophy**

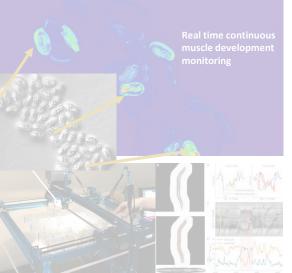


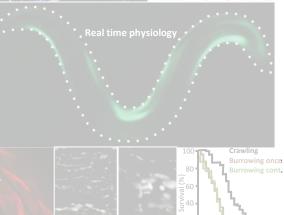
1 in 3,000 males born with DMD Mutation in dystrophin gene Loss of muscle and mobility Death by late 20s-early 30s <u>Most DMD animal do not get very ill</u> There is no cure for DMD



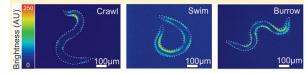
Healthy muscle Dystrophic muscle







#### Effect of exercise on dystrophic muscles



#### **Reverse and forward genetic screens**

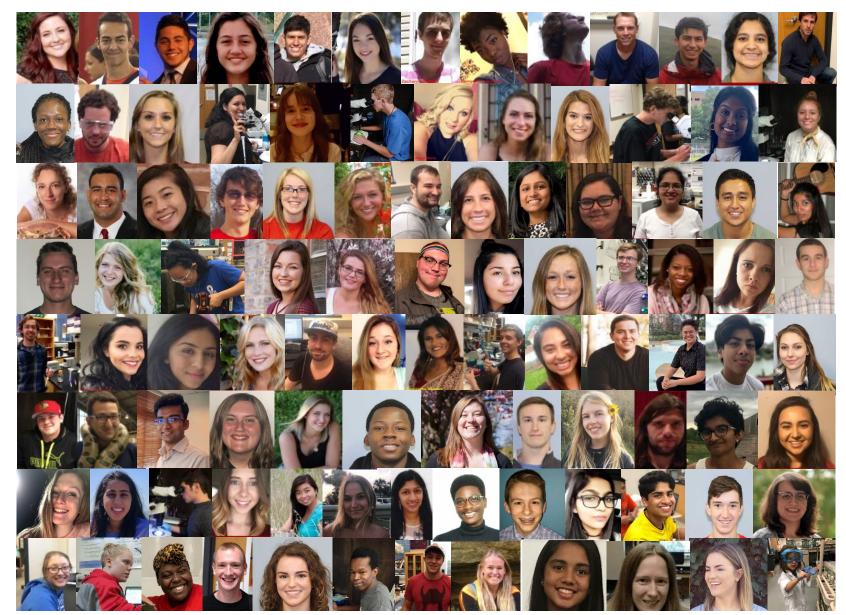
#### Non-invasive treatment approaches



#### High throughput personalized medicine









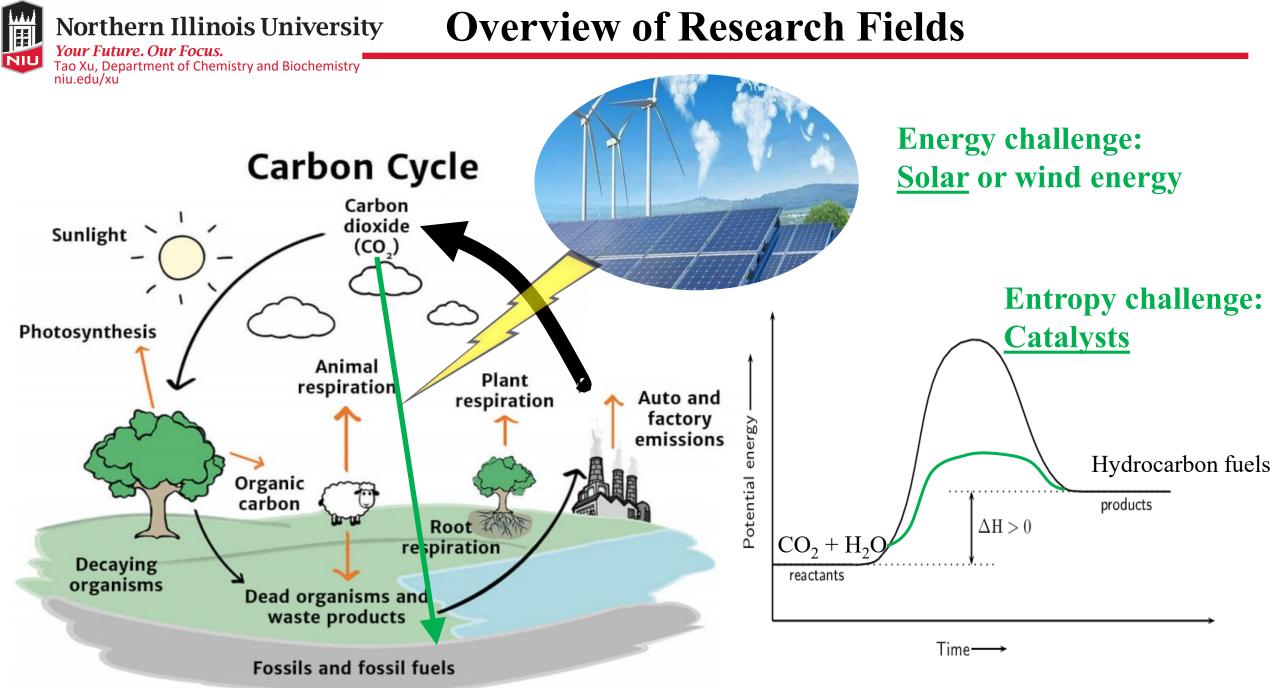
# TOKNOW 2020

# Tao Xu

#### **Northern Illinois University**

Presidential Research Professor, Department of Chemistry and Biochemistry

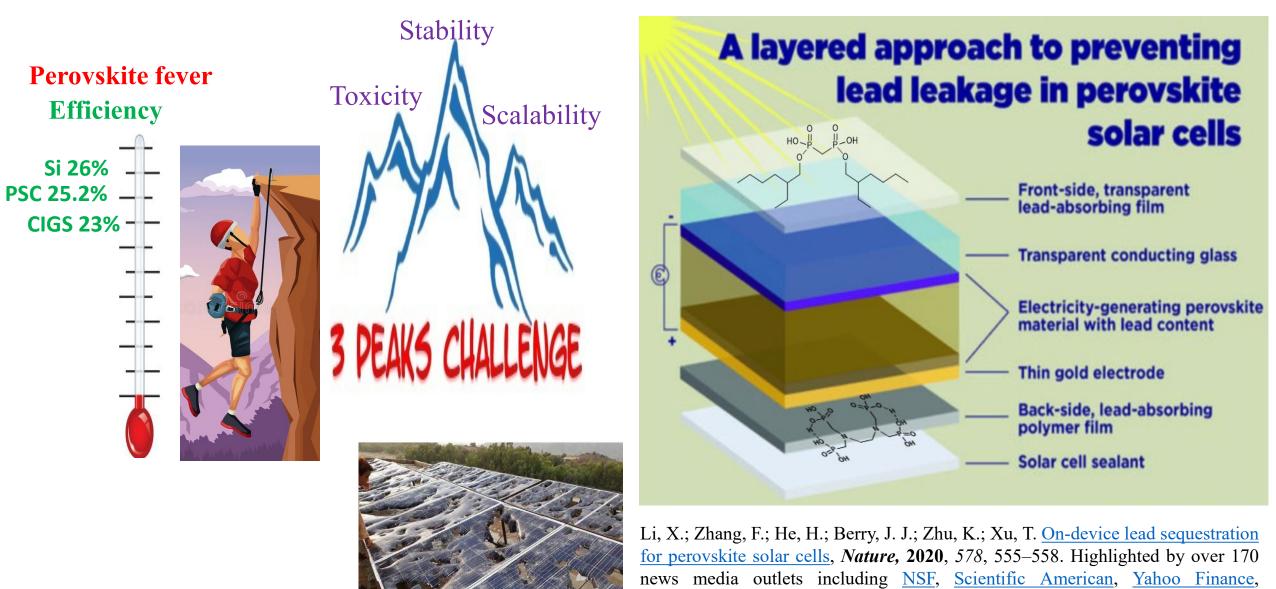




#### Northern Illinois University

## Perovskite solar cells (PSC)

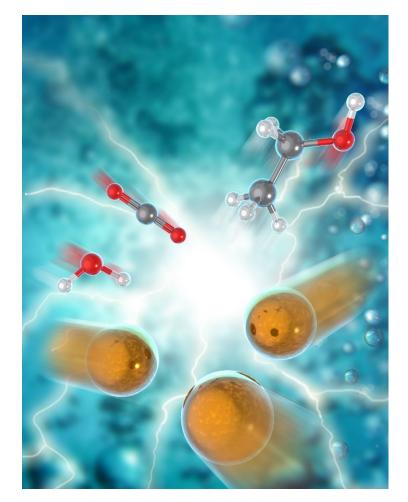
Your Future. Our Focus. Tao Xu, Department of Chemistry and Biochemistry niu.edu/xu

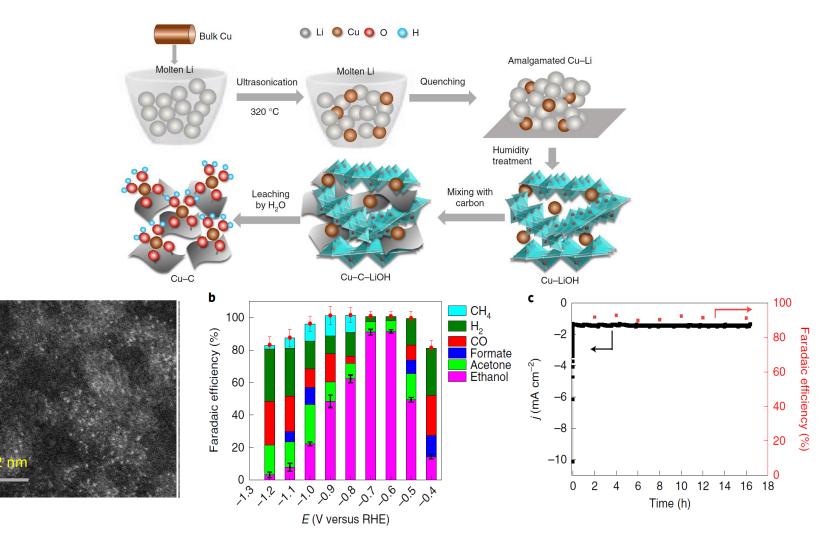


ScienceDaily. Patented

# Northern Illinois University Novel Catalysts for CO<sub>2</sub> Conversion to Fuels

Tao Xu, Department of Chemistry and Biochemistry niu.edu/xu





Highlighted by <u>Argonne News</u>, <u>Popular</u> <u>Mechanics</u>, <u>Science Daily</u>, <u>University of Chicago</u>, <u>Earth.com</u>, <u>News Break</u>

Xu, H.; Rebollar, D.; He, H.; Chong, L.; Liu, Y.; Liu, C.; Sun, C.-J.; Li, T.; Muntean, J. V.; Winans, R. E.; Liu, D.-J.; Xu, T.; <u>Highly selective electrocatalytic CO<sub>2</sub> reduction to ethanol by metallic clusters dynamically formed from atomically-dispersed copper</u>, *Nature Energy*, **2020**, 5, 623-632. Patented.

Northern Illinois University

# **Contributors**

Your Future. Our Focus. NIU ao Xu, Department of Chemistry and Biochemistry niu.edu/xu

Graduate Students: Ihor Kulchytskyy (BioVantage Fuels); Chi-Kai Lin, (post-doc at ANL, now at Apple Inc.); Lauren Grastanowicz (now Alcoa); Zhenzhen Yang (post-doc at ANL, now chemist at ANL); Dean Walters (Engineer at ANL); Qinglong Jiang (now AP at U of AR, Pine Bluff); Heather M. Barkholtz (post-doc at SNL, now at Wisconsin DOT); Jue (Jason) Gong (Pos-doc at Brown); Vivian Zeng (post-doc at ANL); Dominic Rebollar (Ph.D graduated); Haiping Xu (now post-doc at ANL);



**Undergraduates:** Zachary Liveris(graduate student at Loyola Univ.); Jordan Rucinski; Savannah E. Benjamin (REU) student, graduate student at Notre Dame), Kate Powers (graduate school at Alberta Univ, now a STEM educator); Robert Rickard (Chemist, PQ Corp.); Nick Barone (Chemist, Deibel Laboratory)

#### **Collaborators:**

Drs. Di-Jia Liu, Cong Liu Jeffery T. Miller (now at Purdue) at Argonne-CSE; Dr. Kai Zhu at National Renewable Energy Lab; Drs. Richard Schaller, Peijun Guo (now at Yale), Yuzi Liu at Argonne-CNM; Dr. Chao Wang Argonne-MSD (now at Johns Hopkins); Prof. Haiying He at Valparaiso University; Drs. . Dale L. Brewe, , Chengjun Sun, Randy E. Winans, Tao Li at Argonne-APS.





Energy Efficiency & **Renewable Energy** 





# TOKNOW 2020

## Jeremy Amiel Rosenkranz

#### **Rosalind Franklin University of Medicine and Science**

Professor in the Department of Cellular and Molecular Pharmacology Director, Brain Science Institute



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Significant health issue

# More than 2 billion people are affected by brain disorder

~1 in 5 people in US have a mental health disorder ~1 in 6 people in US have a neurological disorder

### A cost of >1 trillion dollars in US + social and personal impact





**BRAIN SCIENCE INSTITUTE** 

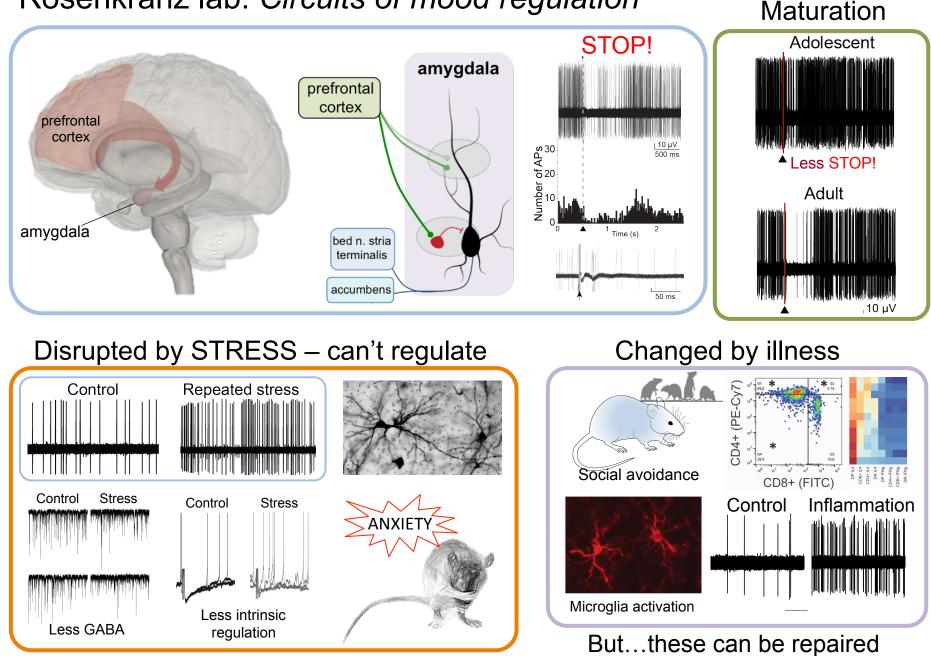


# RFUMS has world-class expertise in several areas of **brain research**

- >50% of RFUMS researchers involved in neuroscience
- Need to convey and promote expertise to potential research collaborators, pharmaceutical partners, donors, alumni and students

GOAL: leverage our strengths and flexibility to pursue partnerships and collaborations that will increase innovative research and excellence in education

#### The BRAIN SCIENCE INSTITUTE



### Rosenkranz lab: Circuits of mood regulation

### Our lab at Chicago Medical School Rosalind Franklin University of Medicine and Science

### Lab members

Amiel Rosenkranz, PhD

Mallika Padival Nicole Ferrara, PhD Maxine Loh Alexandra Ritger Jaime Vantrease, PhD Estella Tcaturian Meghna Yalamanchi

### Recent lab members

Robert Twining, PhD Shannon Blume-Rice, PhD Soumya Munshi, PhD Andrea Hetzel, PhD Wei Zhang, PhD Thomas Adams, MD Eliska Mrackova Hannah Samberg Juan Zuniga Kirin Tiwary Lucy Yao Rabail Hussain William McMichael

### Funding



### Thank you! Illinois Science & Technology Coalition



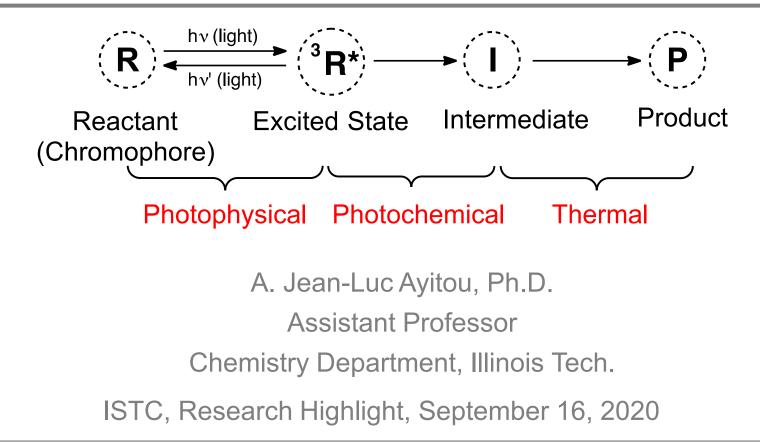
# TOKNOW 2020

### Jean-Luc Ayitou Illinois Institute of Technology Assistant Professor, Department of Chemistry



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## Exploring Triplet Photochemistry in Non-Classical Aromatic Chromophores & Related Materials



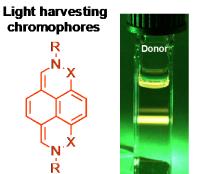




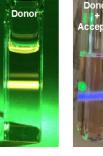
### **NOVEL ORGANIC MATERIALS FOR PHOTONIC/ENERGY APPLICATIONS**

### **ORGANIC ENERGY MATERIALS**

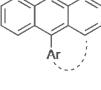
Photon Upconversion (Amplification)



Donor (D)

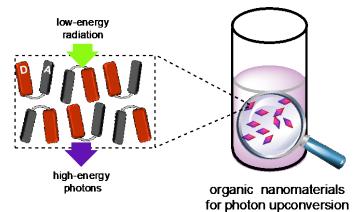


Light emitting chromophores



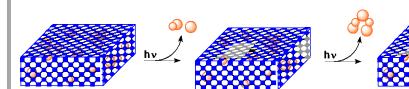
Acceptor (A)

**Exploring** "non-linear" photonfrequency amplification in the solid state

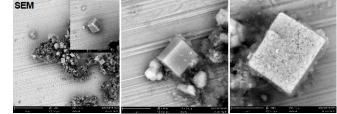


### 2D/3D ORGANIC POLYMERIC MATERIALS

**Covalent Organic Polymers** "On-demand" Photorelease of Chemicals

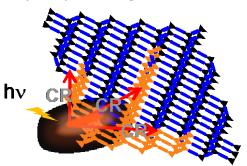


E.g. of  $\bigcirc$ : SH<sub>2</sub> NO<sub>3</sub>, NH<sub>3</sub> and other volatiles including drugs molecules



Representative SEM of our 2D Organic Polymers

Dynamics & kinetics of photo-chain reactions (CR) in organic materials



Exploring the dimensionality of CR in 2D/3D **Organic Polymeric Materials** 

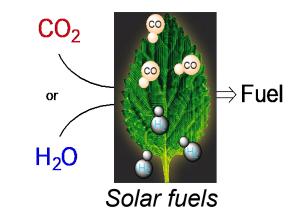
### Why do we care about triplet chromophores?

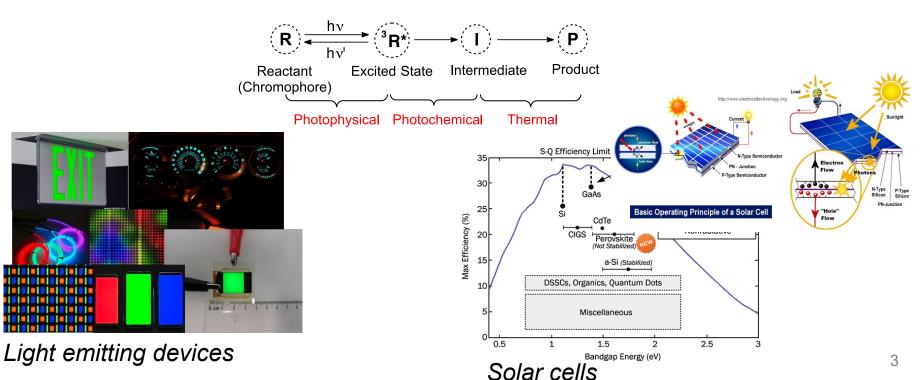


Photochemistry Photo(redox) catalysis



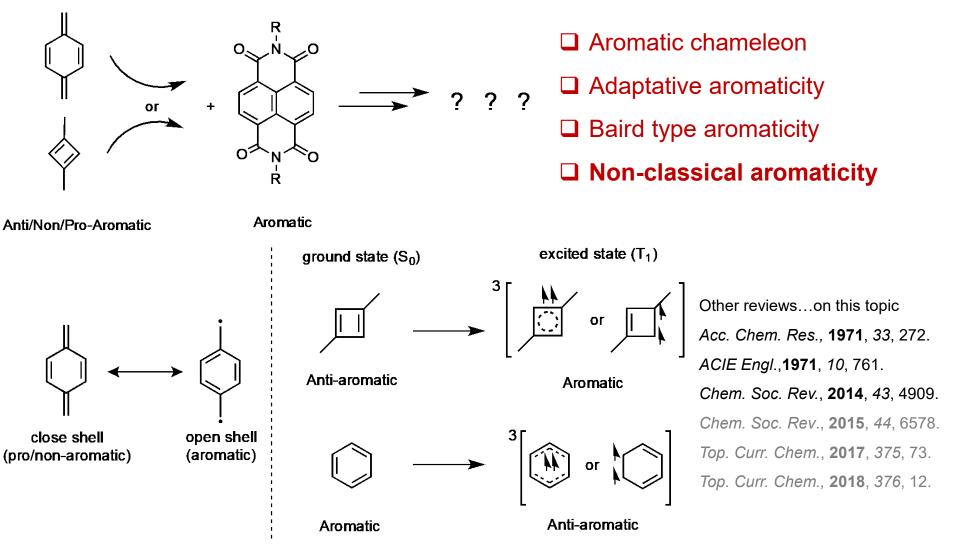
Photodynamic therapy





### Our approach to design new triplet chromophores

Perturbing the GS aromaticity of NDI & other rylene/acene derivatives...

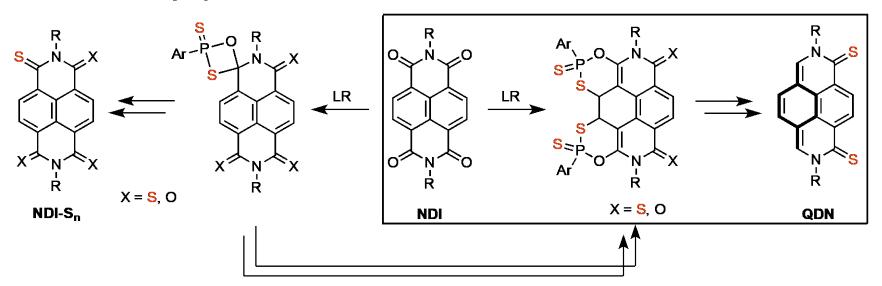


Baird, N. C., *J. Am. Chem. Soc.* **1972**, *94* (14), 4941. Rosenberg, M.; Ottosson, H., et. al., *Chem. Rev.* **2014**, *114* (10), 5379.

### Modified thionation/quinoidization reaction of NDI

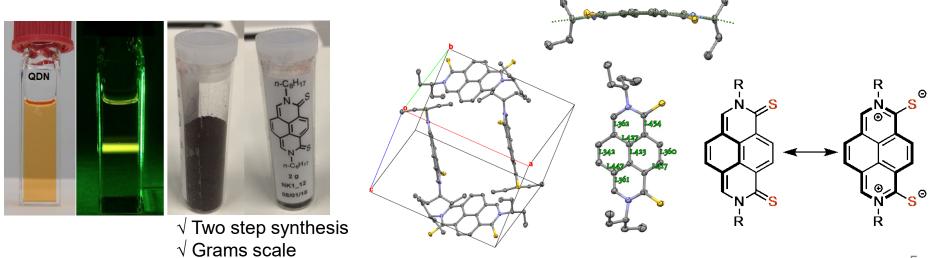
Previously reported

New reaction from our lab

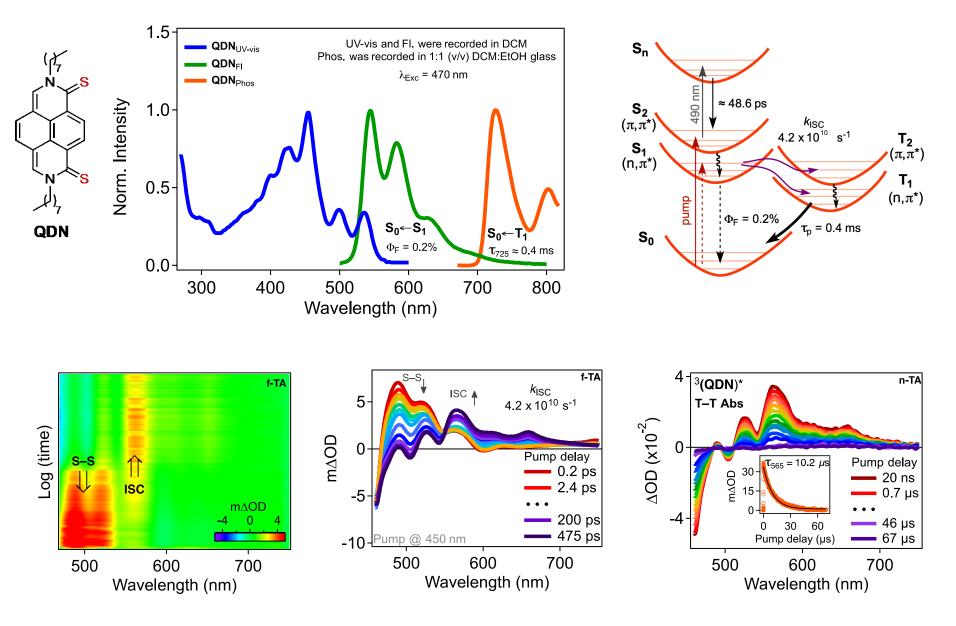


Seferos *et. al., J. Mater. Chem. C* **2015**, *3*, 11505. Zhang *et. al., J. Mater. Chem. C* **2015**, *3*, 8219.

Ayitou et. al., J. Org. Chem., 2017, 82, 10167.

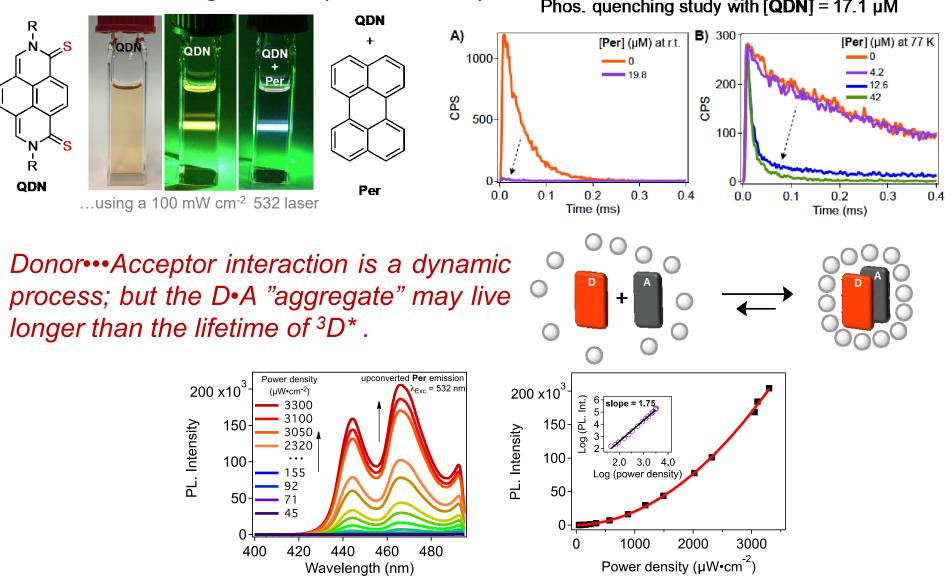


### Key photophysical properties of QDN chromophore



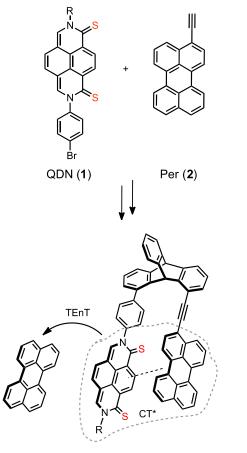
$$\Phi_{\rm ISC}$$
 = 98% and  $\Phi_{\Delta}$  = 67%

### TTA-UC using QDN (sensitizer) and PAH (Acceptors) Phos. quenching study with [QDN] = 17.1 µM

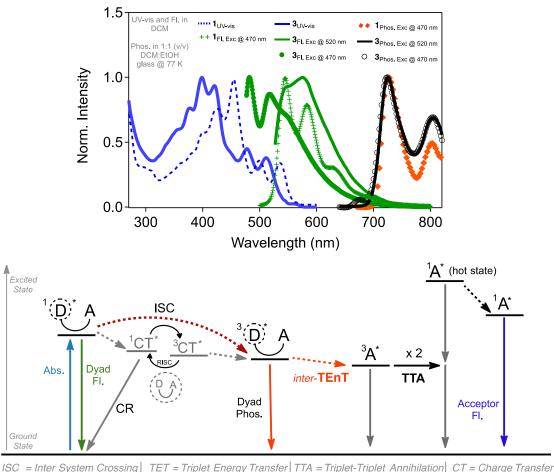


Shokri, S.; Ayitou, A. J.-L. *et. al., J. Phys. Chem. C*, **2017**, *121*, 23377. Shokri, S.; Ayitou, A. J.-L. *et. al., Chem. Commun.*, **2018**, *54*, 5809. Yun, Y. J.; Kamatham, N.; Ayitou, A. J.-L. *et. al. J. Phys. Chem. C* **2020**, *124* (33), 12205.

# Intra-dyad CT, intermolecular TET, bimolecular TTA–UC in/with QDN-Per dyad



QDN-Per (3)



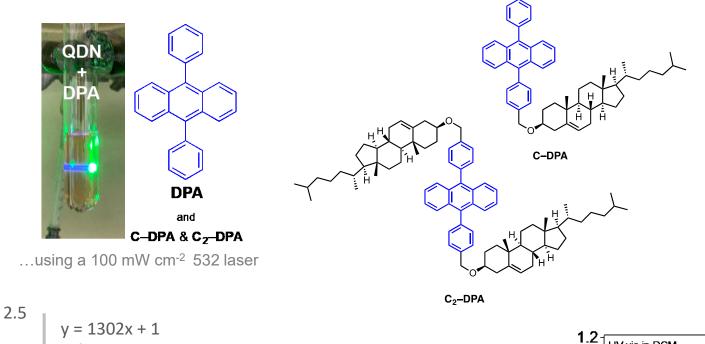
### □ No intramolecular upconversion in the D-A dyad

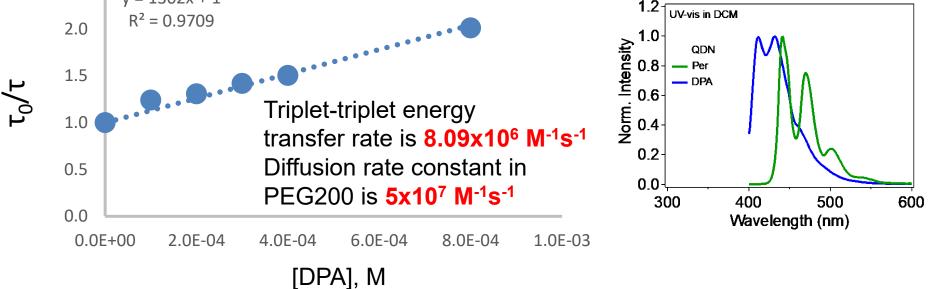
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### But, intermolecular upconversion was observed!

Yun, Y. J.; Kamatham, N.; Ayitou, A. J.-L. et. al. J. Phys. Chem. C 2020, 124 (33), 12205.

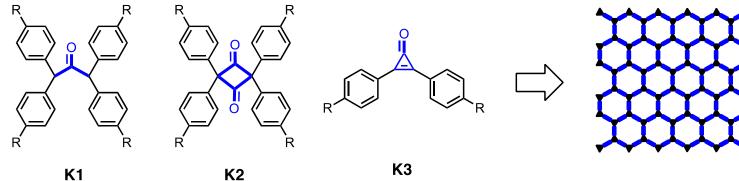
### Ongoing TTA-UC work using other PAH



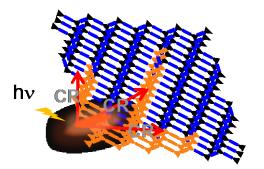


Yun, Y. J.; Ayitou, A. J.-L.; Durandin, N., in preparation

- 1) Diabatic & adiabatic photo-reactions in 2D/3D
- 2) uncaging CO and other adsorbates from 2D/3D porous materials

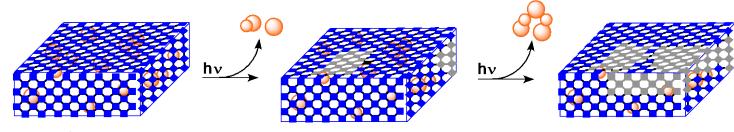


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2D porous polymer
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Using time resolved transient absorption microscopy to probe photo-chain reaction in the 2D/3D polymeric materials.

#### "On-demand or Ampplified" Photorelease of Chemicals



E.g. of  $\bigcirc$ : SH<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and other volatiles including drugs molecules

Jomana Hatahet (B. Sc., 2017)

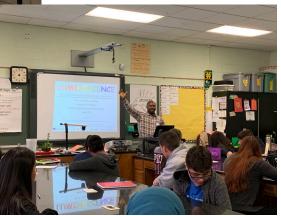


Alysia Desimone (IIT ELEVATE Scholar)

- 1) Chicago SPARKS Program
- 2) VISCUS: <u>Vi</u>vifying the <u>S</u>cientific <u>C</u>uriosity for <u>U</u>nderrepresented <u>S</u>tudents
- 3) STEAMing Dialogue Lectures at K-12 Schools
- 4) ACS Project SEED to support economically disadvantaged HS students

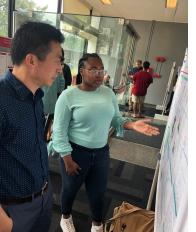


**Summer 2019** 









### AJA Lab members

### PhD Students

- Young Ju Yun, PhD Candidate (Kilpatrick & Starr-Fieldhouse Fellow)
- Guang Yang, PhD Candidate
- Samjhna Maharjan (new)

### M. Sc. Students

- Jayla Morgan
- Joe O'Shea
- William Blodgett
- Ismael Sanchez

### Group Alumni

- Dr. Nareshbabu Kamatham (Scientist, Takeda)
- Dr. Manoj K. Manna (Univ. North Texas)
- Siamak Shokri (PhD, 2018, Scientist)
- Yuxin Ye (M. Sc., 2019, Scientist)
- Zhengyu Hu (M. Sc., 2019, Scientist, China)
- Kuo-Hao Chen (M. Sc., 2017, PhD, Butler Univ.)
- Jomana Hatahet (B.Sc., 2017, Pharmacy School)
   www.jeanluc-group.com

### Collaborators

- Prof. Andrey Rogachev, IIT
- Prof. Heng Wang, IIT
- Prof. Yang Qin, UConn
- Prof. Gonzalo Jiménez-Osés, Univ. of La Rioja, Spain
- Dr. Steffen Jockusch, Columbia University
- Dr. Gary Wiederrecht, CNM-ANL
- Dr. David Gosztola, CNM-ANL





ILLINOIS INSTITUTE

- IREF Fund
- Fanta Award (Students)

### Outreach

- VISCUS
- STEAMing Dialogue Lectures at K-12 Schools 12



# TOKNOW 2020

### **Thank You!**







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