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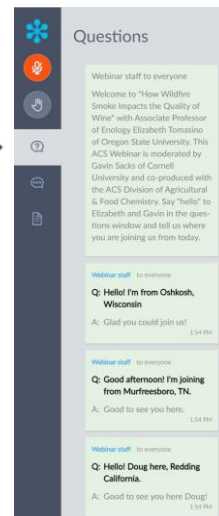


Questions or Comments?

Type them into the questions box!



"Why am I muted?"
Don't worry. Everyone is muted except the Presenter and the Host. Thank you and enjoy the show.



1

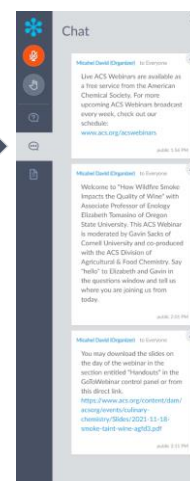
1



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Chat
Announcements and hyperlinks from our team



2

2

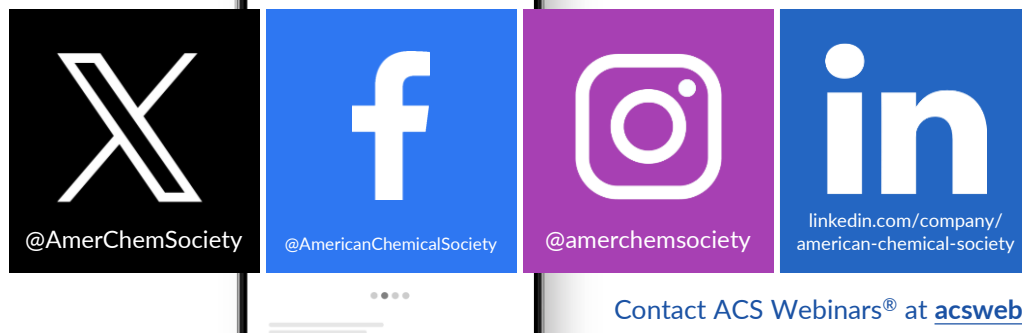


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4

4

A Career Planning Tool For Chemical Scientists



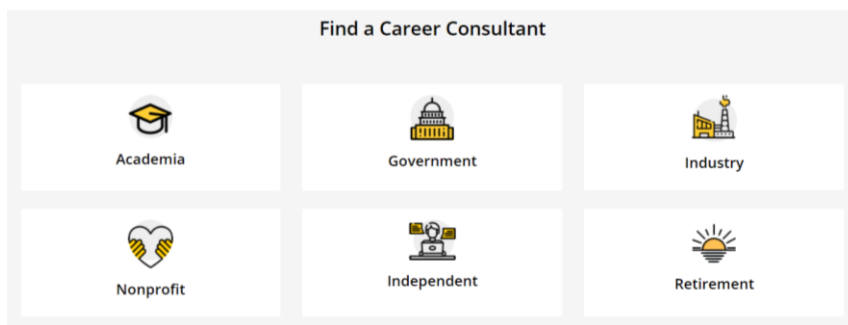
ChemIDP is an Individual Development Plan designed specifically for graduate students and postdoctoral scholars in the chemical sciences. Through immersive, self-paced activities, users explore potential careers, determine specific skills needed for success, and develop plans to achieve professional goals. **ChemIDP** tracks user progress and input, providing tips and strategies to complete goals and guide career exploration.

<https://chemidp.acs.org>

5

5

Career Consultant Directory



- ACS Member-exclusive program that allows you to arrange a one-on-one appointment with a certified ACS Career Consultant.
- Consultants provide personalized career advice to ACS Members.
- Browse our Career Consultant roster and request your one-on-one appointment today!

www.acs.org/careerconsulting

6

6

ACS Bridge Program



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7

7

ACS Scholar Adunoluwa Obisesan

BS, Massachusetts Institute of Technology, June 2021
(Chemical-biological Engineering, Computer Science & Molecular Biology)



"The ACS Scholars Program provided me with monetary support as well as a valuable network of peers and mentors who have transformed my life and will help me in my future endeavors. The program enabled me to achieve more than I could have ever dreamed. Thank you so much!"

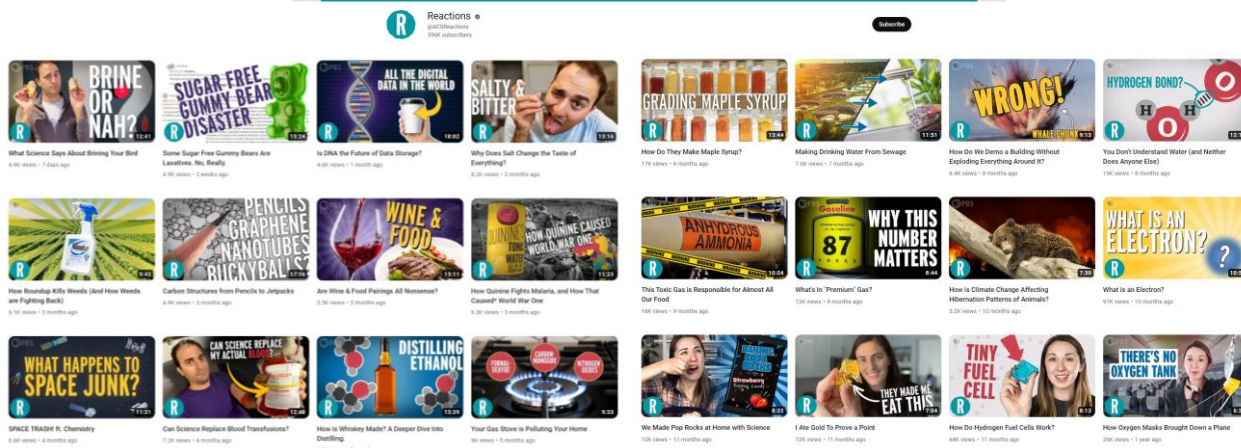
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8

8



<https://www.youtube.com/c/ACSReactions/videos>

9

9



ACS
Chemistry for Life®

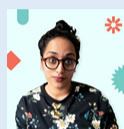
Looking for a new science podcast
to listen to?



Check out Tiny Matters, from the American Chemical Society.



Sam Jones, PhD
Science Writer & Exec Producer



Deboki Chakravarti, PhD
Science Writer & Co-Host

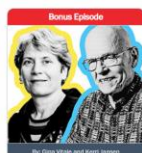
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10

10

c&en's STEREO CHEMISTRY



Bonus Episode
Carolyn Bertozzi and K. Barry Sharpless chat about sharing the 2022 Nobel Prize in Chemistry
December 6, 2022



Bonus Episode
Bioorthogonal, click chemistry clinch the Nobel Prize
October 9, 2022



Episode #40
Lithium mining's water use sparks bitter conflicts and novel chemistry
September 13, 2022



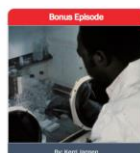
Bonus Episode
Happy 100th birthday, John Goodenough! For John Goodenough's 100th birthday, Stereo Chemistry revisits a fan-favorite interview with the renowned scientist
July 25, 2022



Bonus Episode
Jess Wade on Wikipedia and work-life balance
June 21, 2022



Bonus Episode
The sticky science of why we eat so much sugar
May 31, 2022



Bonus Episode
There's more to James Harris's story
April 27, 2022



Bonus Episode
The helium shortage that wasn't supposed to be
March 24, 2022

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cen.acs.org/sections/stereo-chemistry-podcast.html

11

11

ACS Industry Member Programs

- **ACS Industry Matters**

ACS member only content with exclusive insights from industry leaders to help you succeed in your career. #ACSIndustryMatters

Preview Content: acs.org/indnl

- **ACS Innovation Hub LinkedIn Group**

Connect, collaborate and stay informed about the trends leading chemical innovation.

Join: bit.ly/ACSinnovationhub

12

ACS on Campus is the American Chemical Society's initiative dedicated to helping students advance their education and careers.



Get Results.
Discover how to prepare an effective resume, interview with confidence, pick a graduate or post-doctoral program, and more!

Get Published.
Share your science with confidence - get essential tips for becoming a better writer, reviewer and communicator.

Get Ahead.
Develop your career, network with local professionals, and learn how to leverage your ACS membership.

acsoncampus.acs.org

13

ACS Career Resources



Virtual Office Hours



<https://www.acs.org/careerconsulting.html>

Personal Career Consultations

Jim Tung
Marketing
Lacamas Laboratories
B.S., Biochemistry, University of Oregon
Ph.D., Organic Chemistry, University of Notre Dame

Jim Tung works at Lacamas Laboratories in Portland, OR, currently as a business development manager. He has been with Lacamas for 10 years, working on developing new chemical manufacturing projects. Before that, he was a senior research chemist at Oblet Research in Champaign, IL, performing kilo-scale organic chemistry.

An Oregon native, Jim got his B.S. in biochemistry from the University of Oregon, his Ph.D. in organic chemistry from the University of Notre Dame, with postdoctoral experience at Pfizer's laboratories in La Jolla, CA. He is past chair of the Portland Section of the American Chemical Society and was 2019 general co-chair of NORM 2019. He has interests in process chemistry, labor economics, social media outreach and encouraging career exploration and development for younger chemists.

Ask me about:
Working in industry
Applying for academic jobs
Getting your first job

Contact with Jim

<https://www.acs.org/careerconsulting.html>

LinkedIn Learning



<https://www.acs.org/linkedinlearning>

14

14

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15

15

ACS OFFICE OF DEIR

Advancing ACS' Core Value of Diversity, Equity, Inclusion and Respect



Resources

Inclusivity Style Guide Designed to help staff and members use language and images that respect diversity in all its forms. →	ACS Webinars on Diversity Covering diversity and inclusion at the workplace →
ACS Publications DEIR Hub See what ACS Publications is doing for fostering inclusivity in scholarly publishing →	ACS Volunteer and ACS Meetings Code of Conduct Fostering a positive and welcoming environment for attendees, volunteers and staff. →
C&EN Trailblazers C&EN highlights scientists from different backgrounds who are making an impact in chemistry. →	NEW! Download DEIR Educational Resources Download this educational guide for additional recommendations on videos, articles, books, podcasts, and more on diversity, inclusion, and related topics. →
Quick Guide: Inclusion Moments Learn more about what Inclusion Moments are and see ideas to host them during your meetings. →	Quick Guide: How to host inclusive in-person events Recommendations and best practices to ensure that your events can accommodate everyone. →

Diversity, Equity, Inclusion, and Respect

**Adapted from definitions from the Ford Foundation Center for Social Justice:

Equity**

Seeks to ensure fair treatment, equality of opportunity, and fairness in access to information and resources for all. We believe this is only possible in an environment built on respect and dignity. Equity requires the identification and elimination of barriers that have prevented the full participation of some groups.

Diversity**

The representation of varied identities and differences (race, ethnicity, gender, disability, sexual orientation, gender identity, national origin, tribe, caste, socio-economic status, thinking and communication styles, etc.) collectively and as individuals. ACS seeks to proactively engage, understand, and draw on a variety of perspectives.

Inclusion**

Builds a culture of belonging by actively inviting the contribution and participation of all people. Every person's voice adds value, and ACS strives to create balance in the face of power differences. In addition, no one person can or should be called upon to represent an entire community.

Respect

Ensures that each person is treated with professionalism, integrity, and ethics underpinning all interpersonal interactions.

<https://www.acs.org/diversity>

16

16



ACS Advocacy
See your influence in action!



The impact and results of **ACS member advocacy** outreach and efforts by the numbers!

2439+

Members participated
In Act4Chemistry

Get Involved

1739+

ACS Advocacy
Workshops participants
or enrollees

Enroll in a workshop

49

Years of Public
Policy Fellows

Become a Fellow

2000

Letters sent to
Congress

Take Action

American Chemical Society

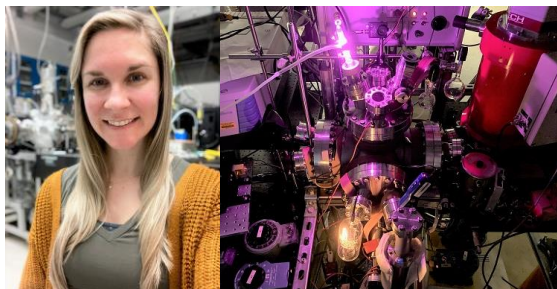
<https://www.acs.org/policy>

17

17

ACS PHYS Astrochemistry Subdivision

Astrochemistry Dissertation Award



Publications drawn upon Dr. Yocum's doctoral research include "Millimeter/Submillimeter Spectroscopic Detection of Desorbed Ices: A New Technique in Laboratory Astrochemistry" (published in *Journal of Physical Chemistry A*) and "Sublimation of Laboratory Ices Millimeter/Submillimeter Experiment (SubLIME): Structure-specific Identifications of Products from UV-photolyzed Methanol Ice" (published in *The Astrophysical Journal*).

Each year the subdivision recognizes an outstanding Ph.D. thesis from within the preceding three calendar years.

Applications are due around February 1. The winner receives a **\$500 prize**, an **invitation to give a talk at a national ACS meeting**, and a **\$500 travel award** provided by ACS Earth and Space Chemistry to attend the meeting.

The recipient and nominators must be members of the Astrochemistry Subdivision, and the Ph.D. must be conferred by the deadline. The 2023 recipient of the award is **Dr. Katarina Yocum**, currently a Postdoctoral Researcher at NASA Goddard Space Flight Center.

American Chemical Society

<http://astro.phys-acs.org>

18

18



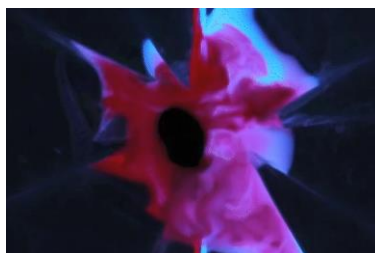
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Thursday, November 9, 2023 | 2-3pm ET

Psychological Safety is Lab Safety: Using RAMP to Assess DEIR Hazards

Co-produced with the Committee on Chemical Safety and
the ACS Division of Chemical Health and Safety



Thursday, November 16, 2023 | 2-3:30pm ET

The Polymer Mechanochemistry of Self-Healing Materials

Co-produced with the ACS Division of Polymer Chemistry



Wednesday, November 22, 2023 | 2-3pm ET

Desafíos y Soluciones a través de la Ecofarmacovigilancia

Co-produced with the Sociedad Química de México

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19

19



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THIS ACS WEBINAR®
WILL BEGIN SHORTLY...

👋 Say hello in the
questions window!

20

20



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The James Webb Space Telescope: Astrochemistry's Exciting New Window!



EWINE VAN DISHOECK, PHD

Professor Molecular Astrophysics,
Leiden University



DAVID E. WOON, PHD

Research Associate Professor,
Department of Chemistry,
University of Illinois Urbana-
Champaign

This ACS Webinar[®] is co-produced with the ACS PHYS Astrochemistry Subdivision.

21

21

The James Webb Space Telescope: Astrochemistry's exciting new window!

Ewine F. van Dishoeck
Leiden Observatory, the Netherlands

ACS Webinar
November 8 2023

22

22

Viewing the night sky is available to all, everywhere in the world



Where do we come from? What is our place in the Universe?

23

23

Our origins start in these dark clouds

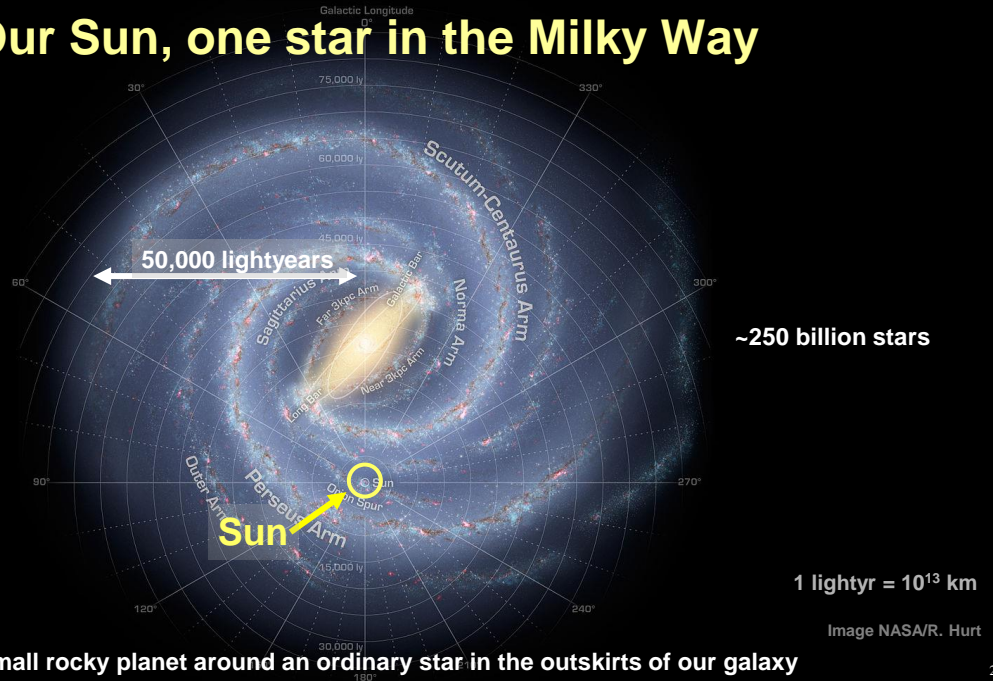


24

©Kiko Fairbairn

24

Our Sun, one star in the Milky Way

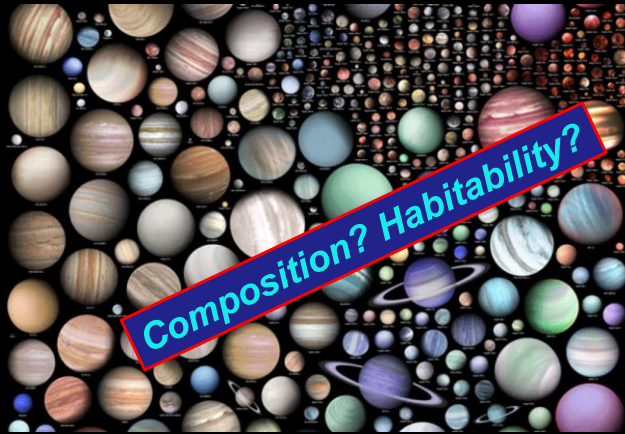


We live on a small rocky planet around an ordinary star in the outskirts of our galaxy

25

25

Diversity of exoplanets



Kepler satellite: Borucki et al. 2011, Batalha et al. 2013



Artist impression

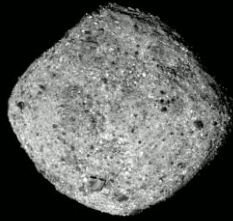
Nobel Prize 2019

Every star has at least one planet
Mostly super Earths, mini Neptunes

26

26

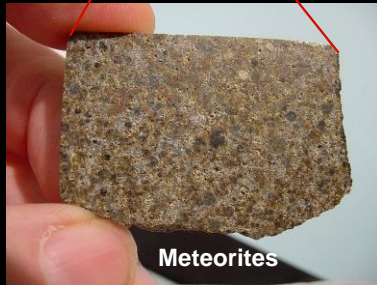
How were 'we' formed 4.6 billion years ago?



Asteroid



Comet



Meteorites



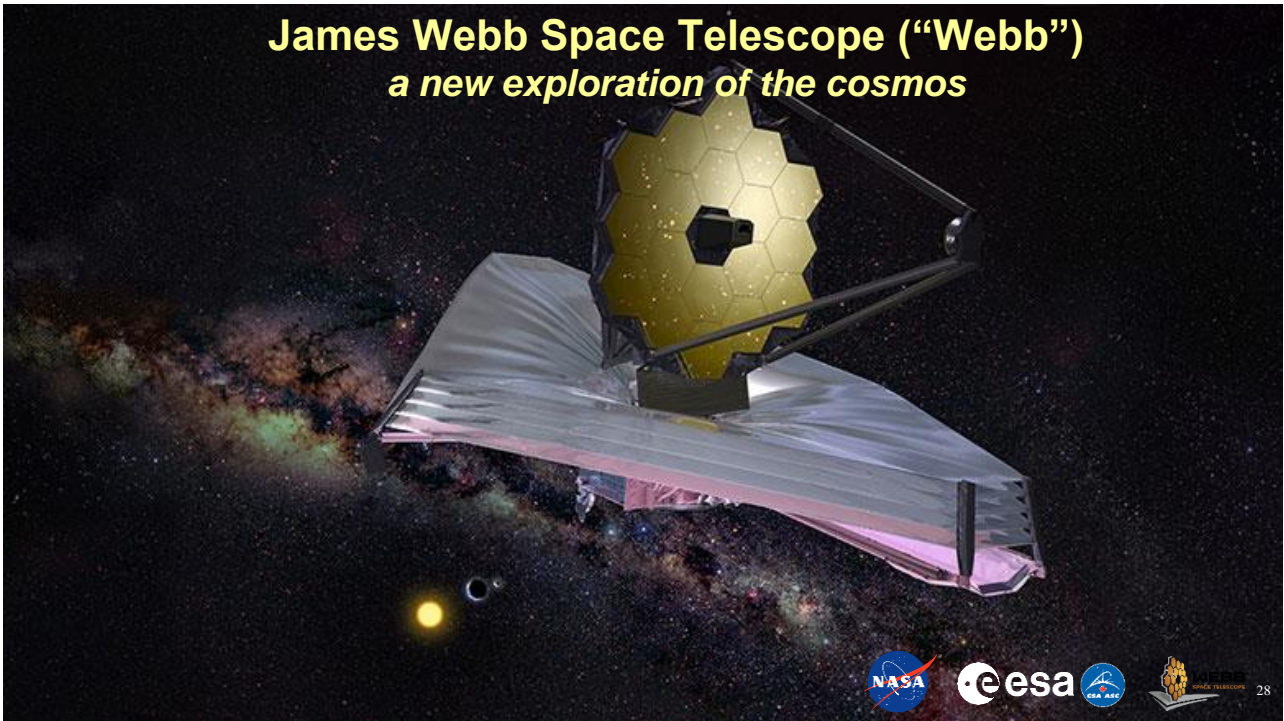
Rosetta

Messengers from the early solar system

27

27

James Webb Space Telescope ("Webb") *a new exploration of the cosmos*



28

28

A 30 year journey...

Planning started in early 1990's
(including my own involvement)

Launch Dec 25, 2021

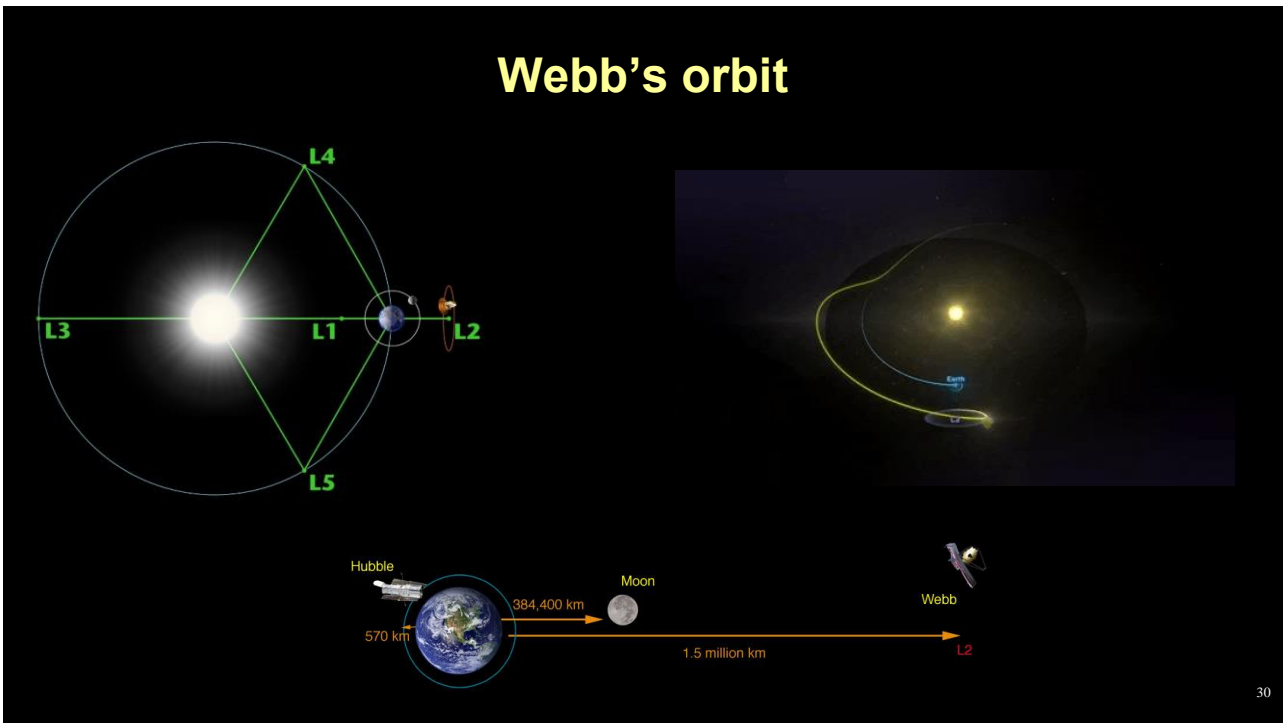
Thanks to thousands of engineers, technicians,
managers, scientists,



29

29

Webb's orbit



Hubble 570 km

384,400 km

Moon

1.5 million km

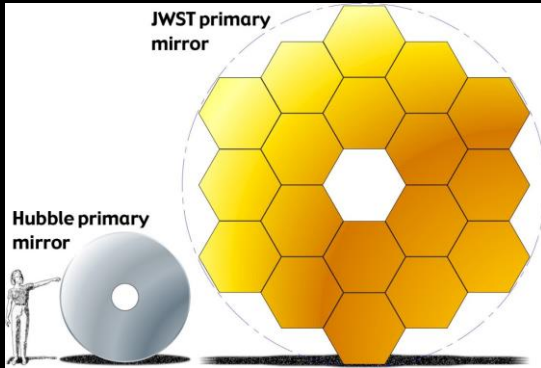
Webb

L2

30

30

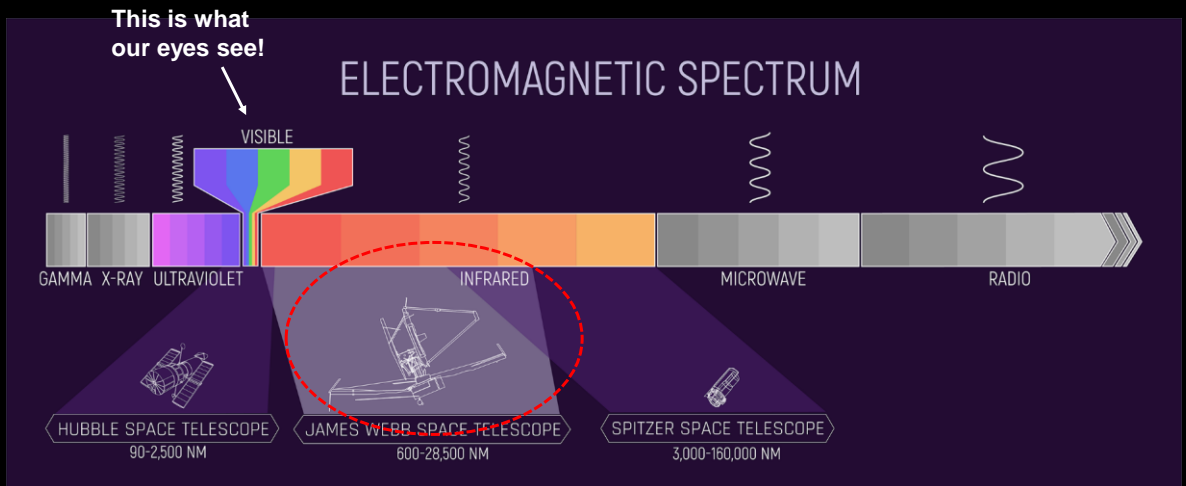
What makes Webb unique?



Webb is big: 6.5m!









Webb's eyes: infrared



Most of infrared obscured by Earth's atmosphere → observe from space!

Instruments on Webb: spectroscopy!

 CAMERAS	Molecules!  SPECTROGRAPHS	 CORONAGRAPHS	Instrument NIRCam Univ. Az/LMATC NIRSpec ESA/Astrium 1-5 μm MIRI ESA/Consortium /UKATC/JPL 5-28 μm FGS/NIRISS CSA	Resolution $R = \lambda / \Delta\lambda \sim 3000$
 MICROSHUTTER ARRAY	 INTEGRAL FIELD UNITS	 APERTURE MASK		

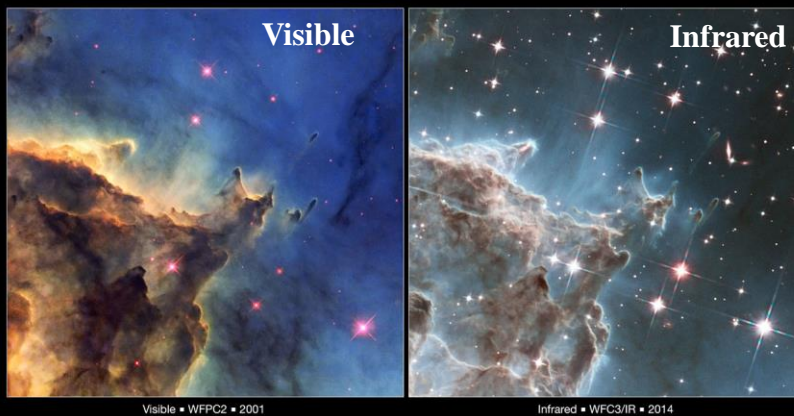
Most of the nice pictures

Sensitivity factor 100-1000 better than earlier instruments
 → *Discovery space!*

33

33

Why infrared? Peer into dust clouds



Visible • WFC2 • 2001

Infrared • WFC3/IR • 2014

Birthplaces of stars and planets

Molecules have their fingerprints at infrared wavelengths

34

34

Beautiful star-forming galaxies with Webb



**M74
Phantom
Galaxy**

NASA/ESA/CSA/STScI
© Robert Eder

35

35

Interacting galaxies: burst of star formation



Cartwheel galaxy

NASA/ESA/CSA/STScI

36

36



37

Molecules form in dark clouds

Extreme Conditions!

NASA/ HST Carina nebula

Density $\sim 10^4$ particles per cm^3
 (million times less dense than ultra-high vacuum on Earth)

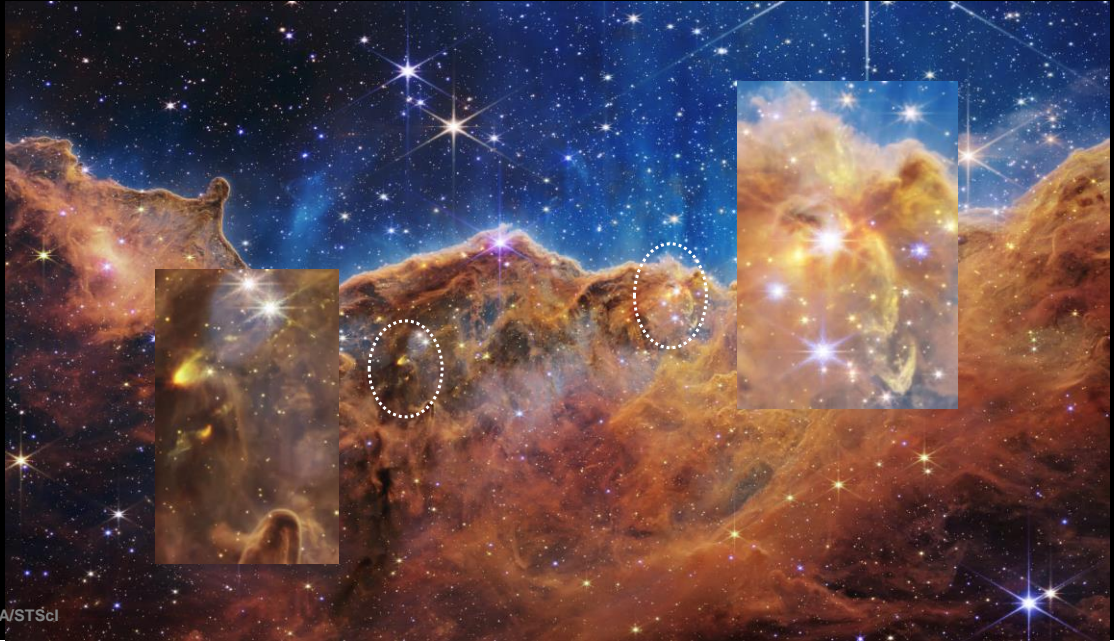
Temperature ~ 10 K (-263° C)

Composition: mostly H, small amounts of C,N,O.... (0.01%)

Dust particles
 ($\sim 0.1 \mu\text{m}$, silicates)

38

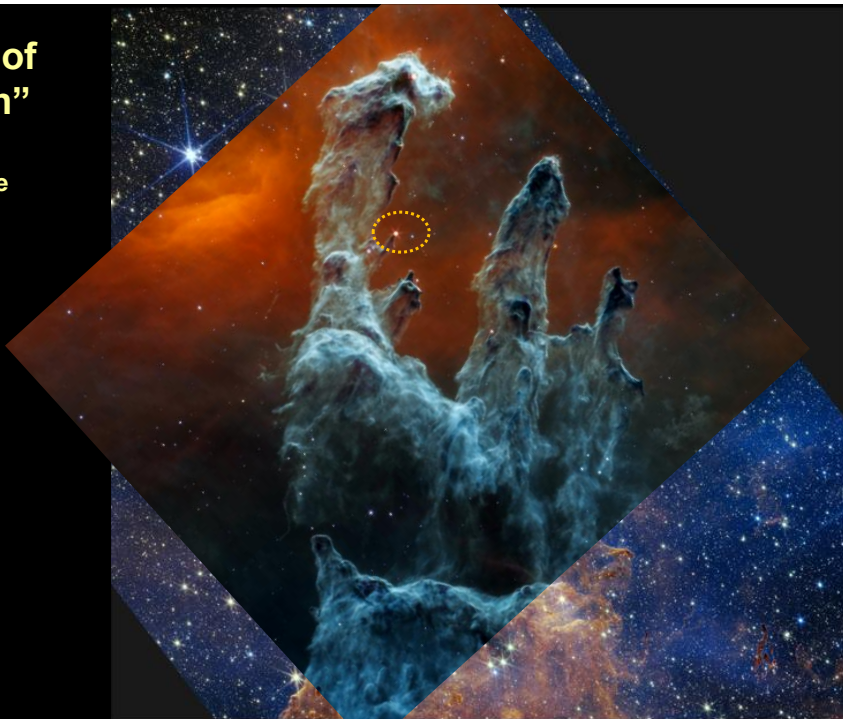
Carina nebula: nursery of new stars and planets



39

“Pillars of Creation”

From Hubble
to Webb
Near-IR
Mid-IR



40

40

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What is the most common molecule in space?

- H_2O
- CO
- H_2
- CO_2

41

41

Protostars and jets

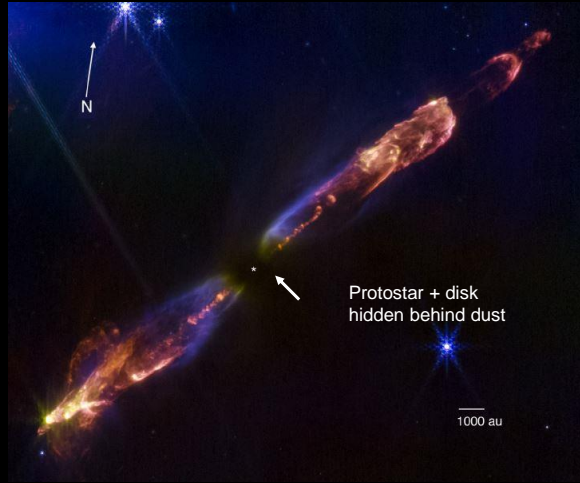


Ophiuchus
July 12, 2023

42

42

Protostar with molecular jet



Protostar + disk
hidden behind dust

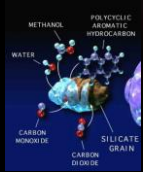
1000 au

JWST-NIRCAM
T. Ray et al. 2023
NASA/ESA PR Sept. 14, 2023
Nature cover Oct 5

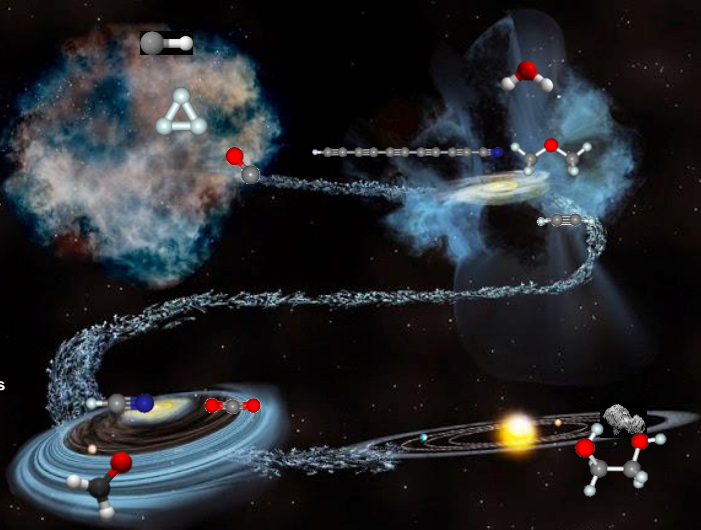
43

43

Rich chemistry from clouds to new planets



Tiny μm -sized dust grains covered with ices



- How are these molecules formed? In gas phase or on dust grains?
- How far does complexity go?
- What is composition new planets?

Molecule images:
Wikipedia,
The Astrochemist

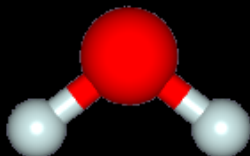
©B. Saxton
NRAO/AUI

44

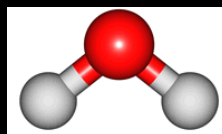
44

How do we observe molecules?

Rotation: millimeter

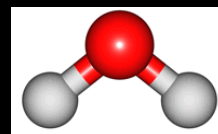


Vibration: infrared: Webb!



Stretch

$\sim 3 \mu\text{m}$
 3750 cm^{-1}



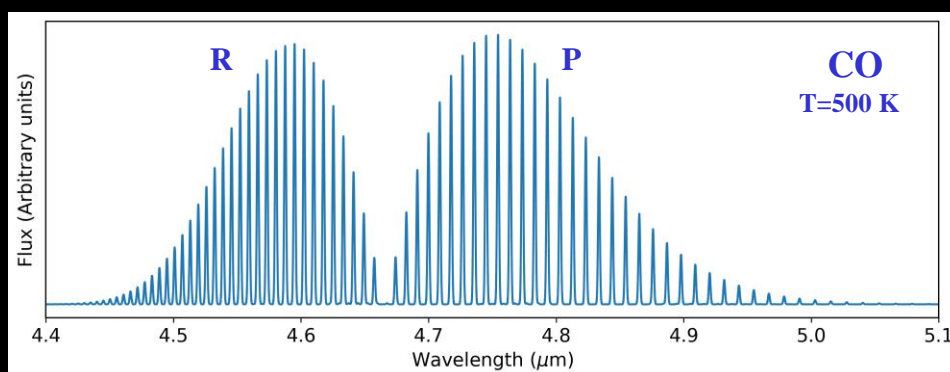
Bend

$\sim 6 \mu\text{m}$
 1600 cm^{-1}

45

45

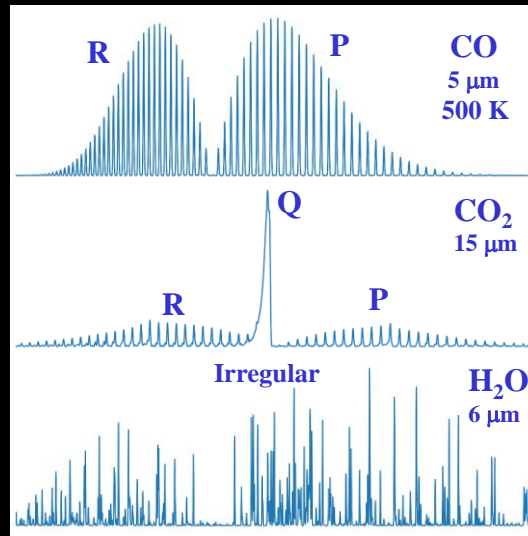
Each molecule has its unique fingerprint



46

46

Each molecule has its unique pattern



47

47

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What forms can water have in space?

- Vapor, liquid and ice
- Vapor and ice
- Vapor and liquid
- Vapor

48

48

In which form is water in space?

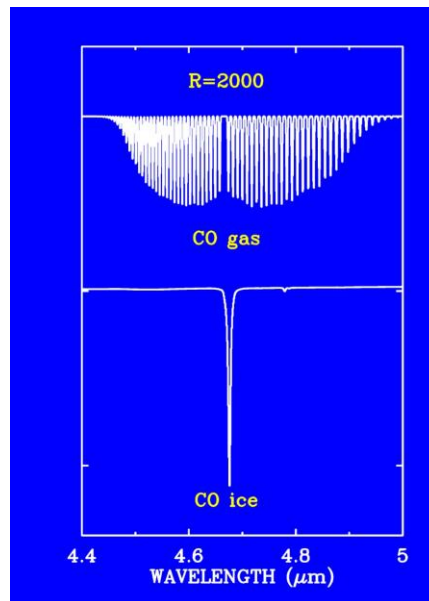
- Gas (water vapor)
- Ice



49

49

How do we distinguish ice from gas?



vD 2004

50

50

Interstellar ices with Webb



IceAge program



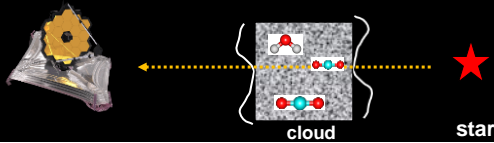
M. McClure



Chamaeleon cloud NIRCAM



Two background stars with $A_V=60$ and 95 mag

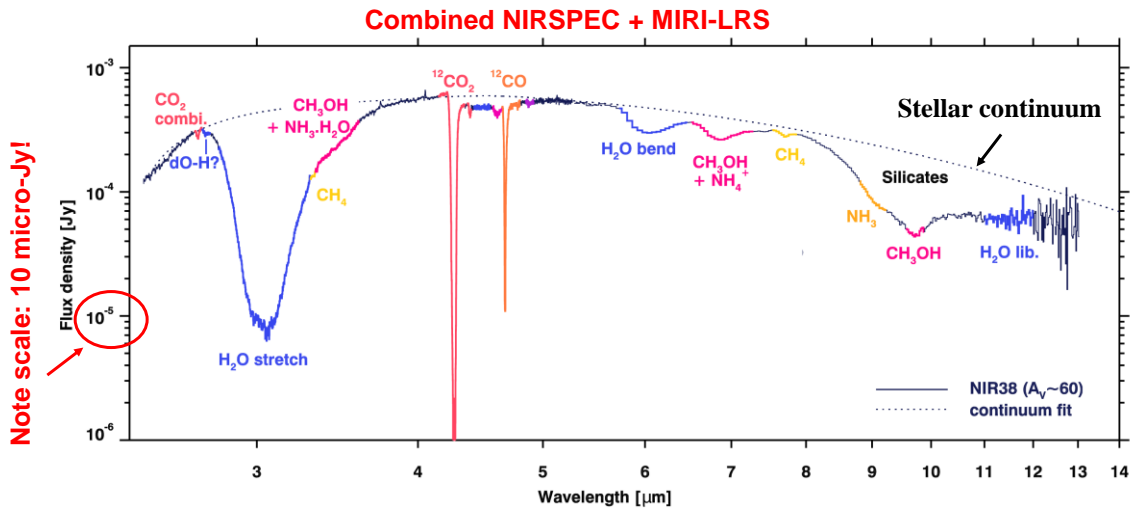


51

51



JWST spectra of “darkest” ices to date!



McClure et al. 2023
(Nature Astronomy)

52

52

Building blocks for life: water



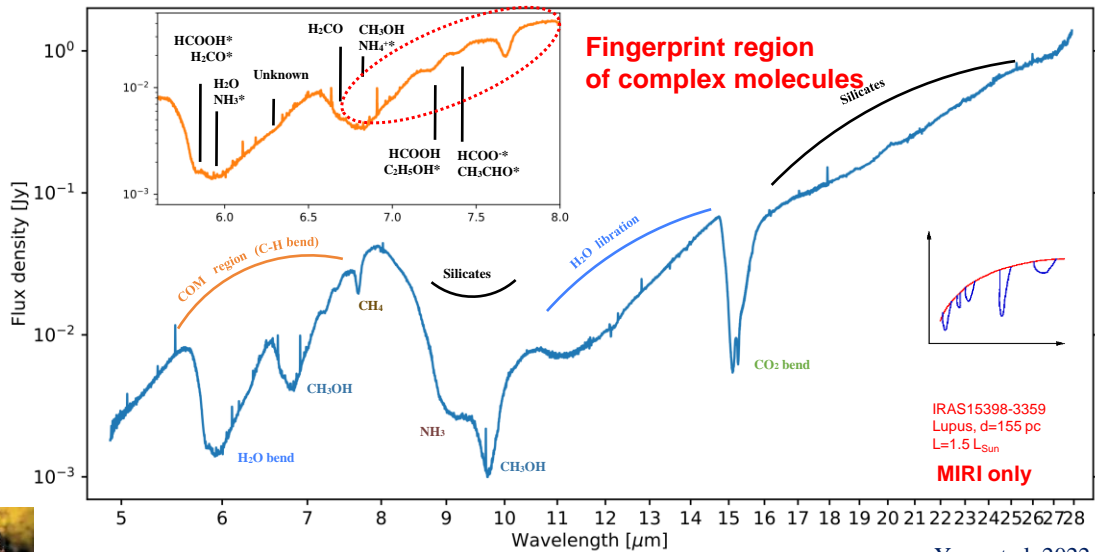
Based on laboratory experiments in Leiden, Paris, Japan
 Cuppen et al. 2010
 Visser et al. 2009,
 Cleaves, Bergin et al. 2015

Most water is formed on dust grains in dense clouds
'Water is older than the Sun itself'

53

53

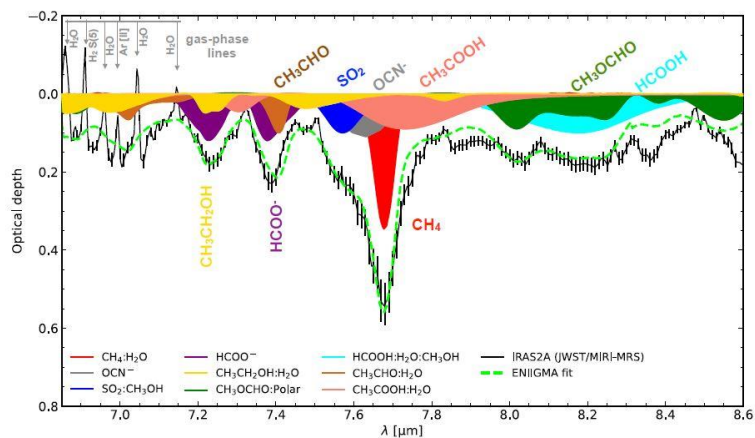
Protostar: hunting for complex molecules



54

54

Complex molecules are formed in ices!



Note also ions:
 OCN^- , HCOO^-

NGC1333
IRAS2A

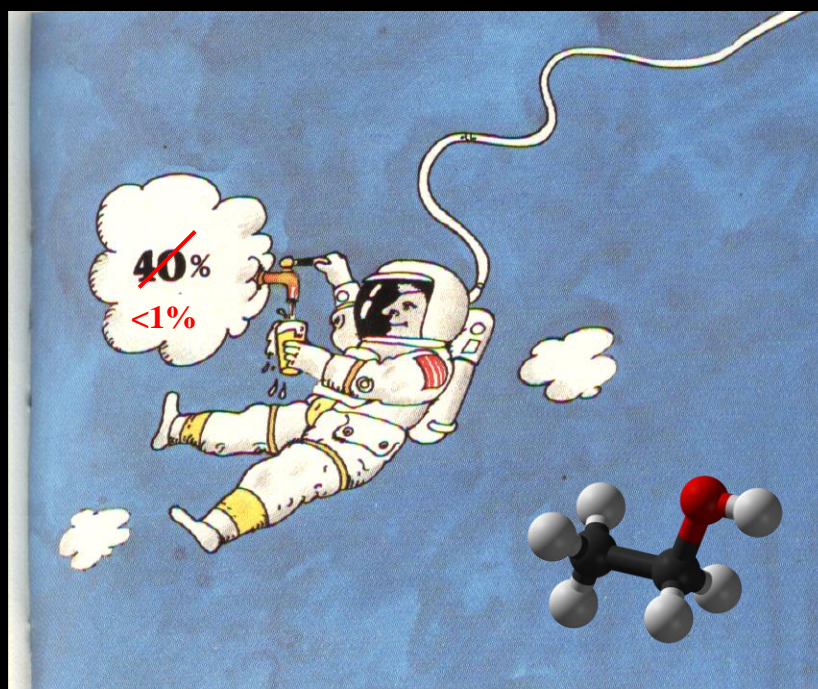
Warning: some fits and detections depend on choice continuum



Rocha, Ressler et al.,
subm.

55

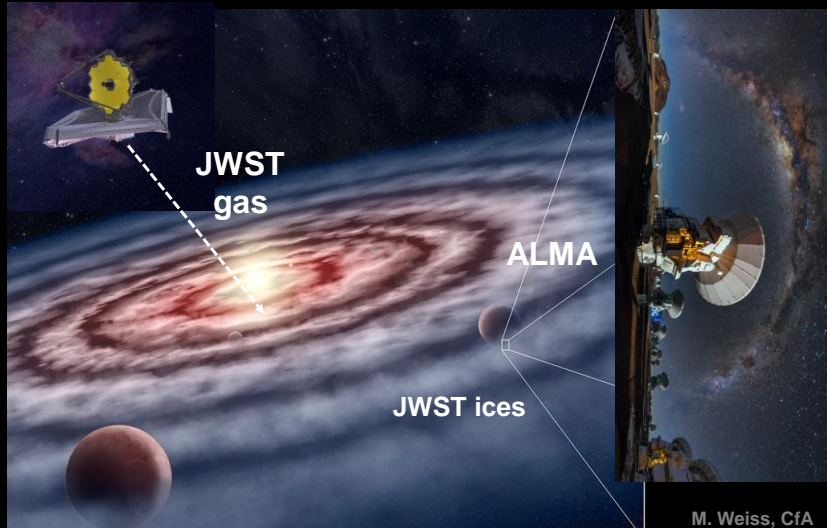
55



56

56

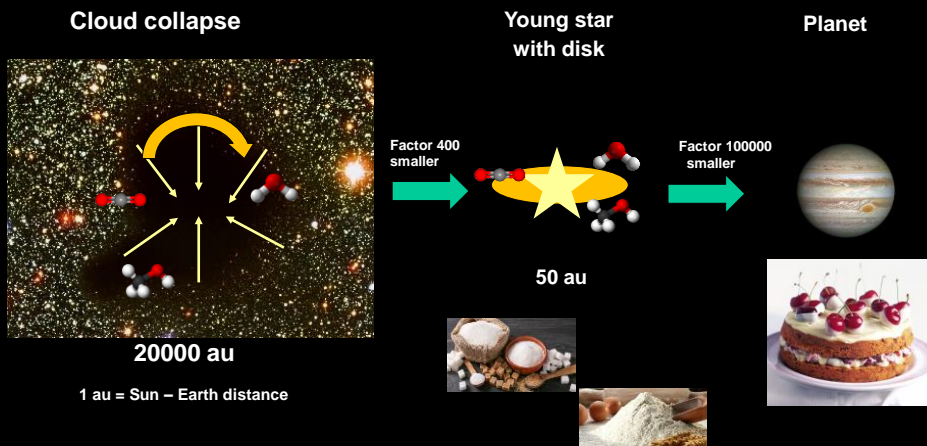
Building planets in disks: composition material?



M. Weiss, CfA
MAPS Öberg et al. 2021

Synergy observations mm and infrared

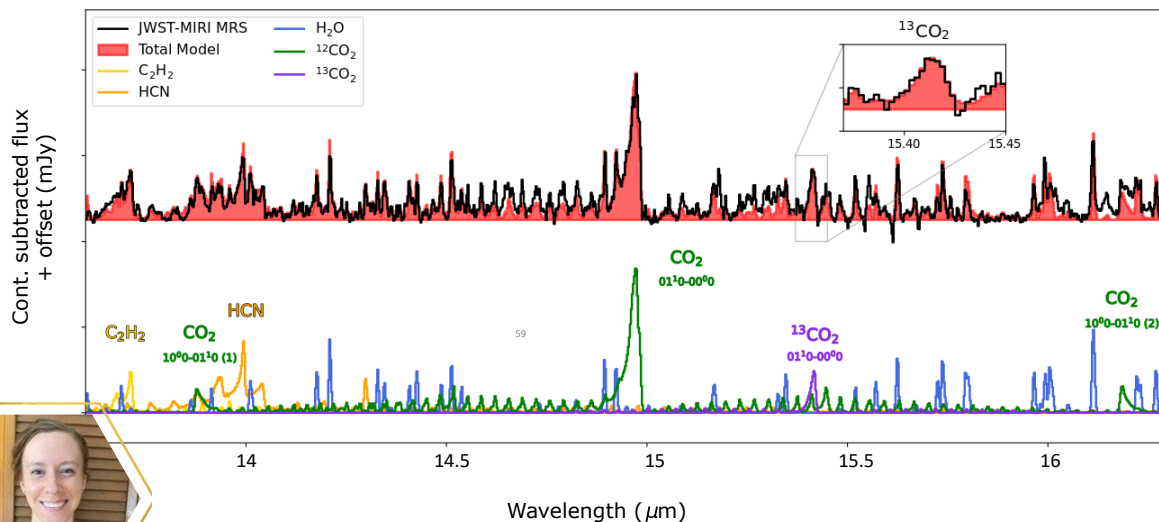
Formation of stars and planets



What are the ingredients for making new planets?



Abundant warm CO₂ in a planet-forming disk



Grant, MINDS et al. 2023

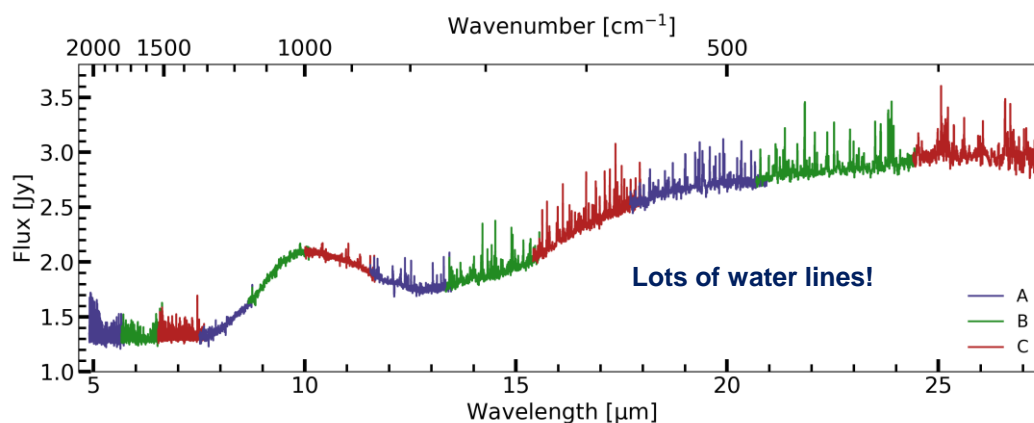
CO₂/H₂O much higher than previously thought

59

59

Not all disks are the same

DR Tau: Very rich in H₂O!



Temmink et al. in prep.
Gasman et al. 2023

Van Dishoeck et al. 2023, Faraday Discussions
EX Lup: Kospal et al. 2023
Banzatti et al. 2023

60

60

CO₂ vs H₂O



Who does OH react with?

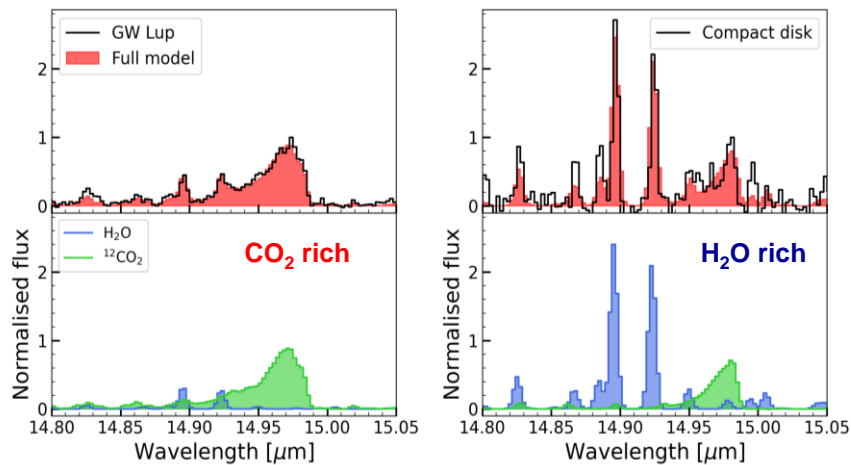
- **Low $T < 250$ K** $\text{OH} + \text{CO} \rightarrow \text{CO}_2 + \text{H}$
- **High T** $\text{OH} + \text{H}_2 \rightarrow \text{H}_2\text{O} + \text{H}$

61

61

Chemistry as probe of disk structure

Zoom-in: CO₂ vs H₂O normalized



Small cavity (~2 au)?

Enriched by icy pebbles?



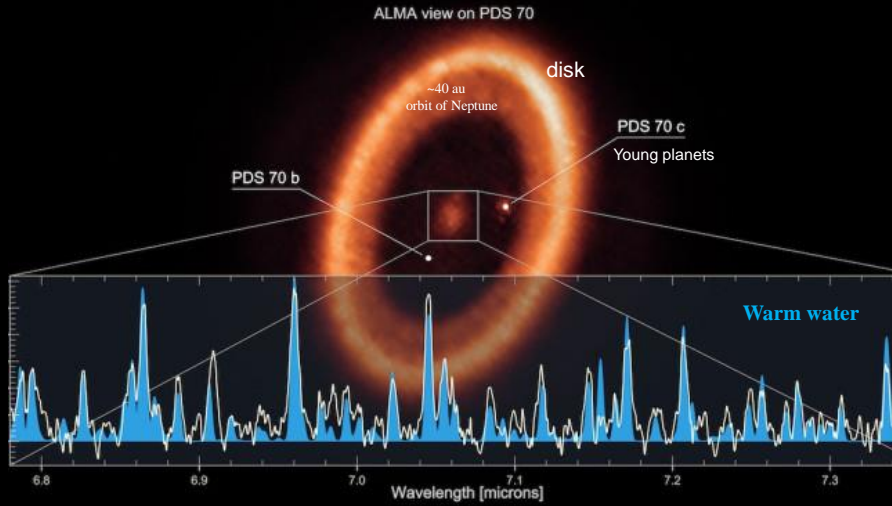
Models: Vlasblom et al. subm.
vD et al. 2023

62

62

Water in the terrestrial planet-forming zones of disks

NASA-ESA press release July 24, 2023



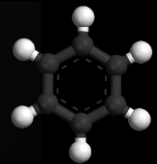
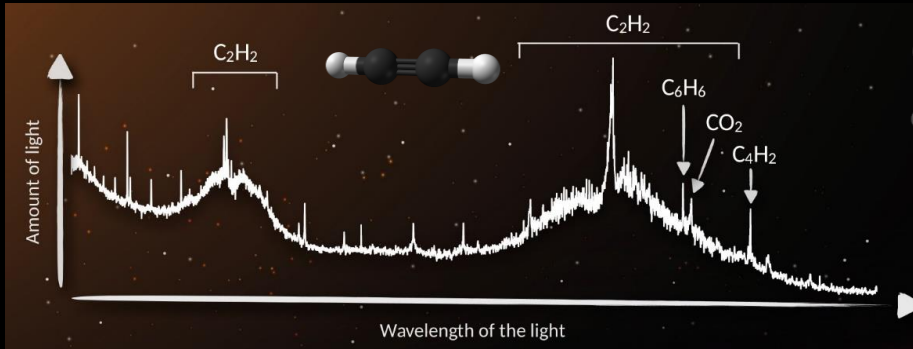
Perotti et al. 2023

63

63

Diverse chemistry: some disks are carbon-rich

Very low mass star
J160532
<0.2 M_{Sun}



No H₂O!

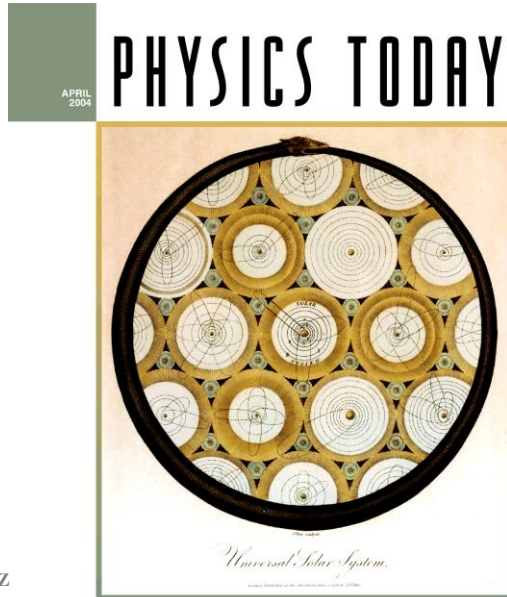
Press release May 11, 2023

Tabone, Bettoni, vD et al. 2023

64

64

Diversity of Planetary Systems



APRIL 2004

PHYSICS TODAY

English print
John Wilkes, ~1798

Collection EvD+TdZ

Special issue:
Planetary diversity

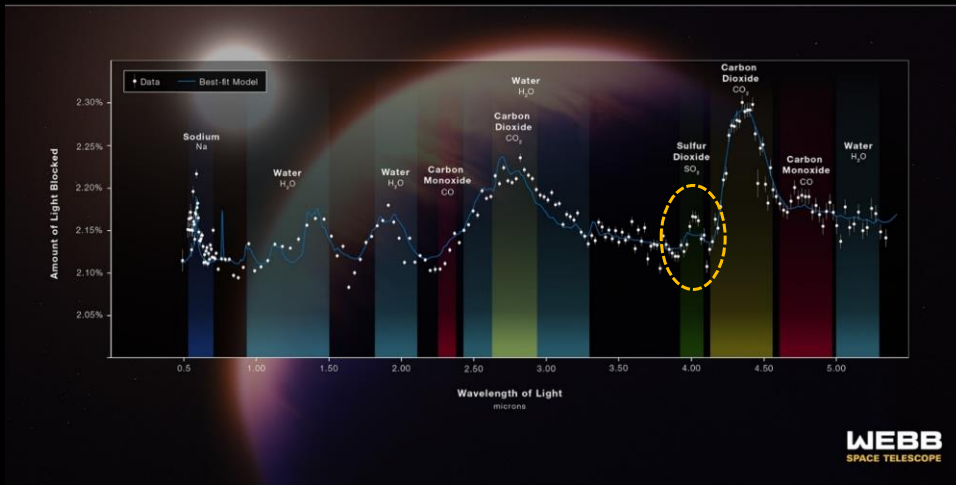
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H₂O, CO₂ and SO₂ in exoplanet atmosphere

HOT GAS GIANT EXOPLANET WASP-39 b
ATMOSPHERE COMPOSITION

NIRSpec PRISM

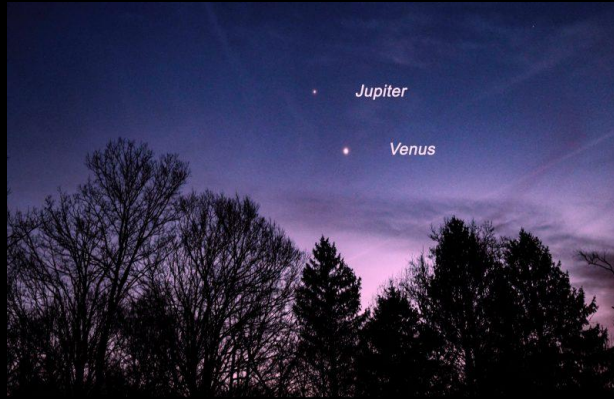


WEBB
SPACE TELESCOPE

67

67

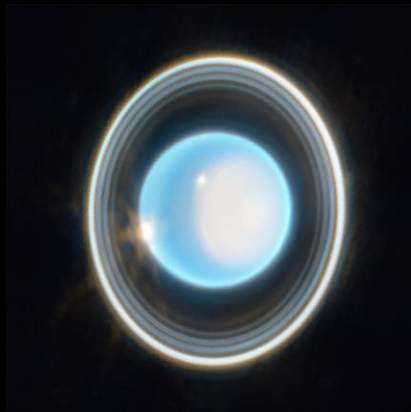
Our own solar system: two well-known planets



Feb 25, 2023
© Chuck Reinhart

Conjunction 2023 March 1-2

Uranus and Saturn with Webb



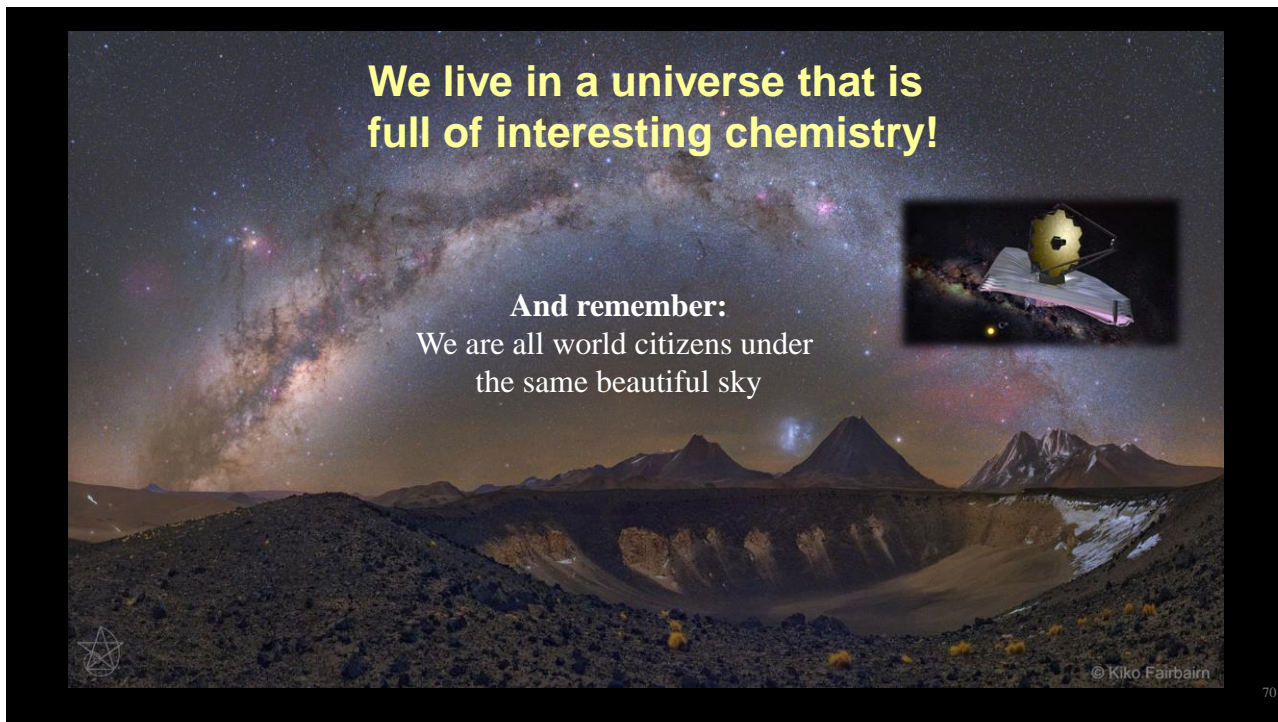
©NASA/ESA/CSA/StScI
J. dePasquale

Saturn
JWST NIRCam F323N
June 25, 2023

Dione
Enceladus
Tethys



©NASA/ESA/CSA/StScI
Tiscareno et al./J. dePasquale



70

The Astrochemistry Subdivision of the American Chemical Society

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archives | PHYS | ACS

Registration is now open for the Laboratory Astrophysics Workshop (ICE 2024) to be held on Kauau, Hawaii in February 2024. Click [here](#) to register.

Subdivision members Partha Bera and Xander Tielens are organizing a symposium at the APS March Meeting in Minneapolis (3-8 March) entitled, "Molecular astrophysics: Linking interstellar molecules with the organic inventory of (exo)-Planets and the Solar System. Click [here](#) for more information.

If you're not a member of the Subdivision, you can still receive news about AstroCheminars and other Subdivision activities by subscribing to our mailing list [here](#).

<http://astro.phys-acs.org>

Olivia Wilkins profile

C&E News interviewed Dr. Olivia Wilkins of NASA-GSFC, Subdivision member and co-organizer of the Astrochemistry symposium at the Fall 2023 national meeting. Click [here](#) to read the interview.

Objectives of the Astrochemistry Subdivision

Astrochemistry is one of the most interdisciplinary fields of modern science. The purpose of this subdivision is to promote work in this field.

[read more](#)

Additional Activities

The AstroCheminar series will return on November 8 in the form of an ACS Webinar by Prof. Ewine F. van Dishoeck cosponsored by the Subdivision. Click [here](#) to register and for more information.

71

Astrochemistry Subdivision Officers – 2023–24



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72

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**THE LIVE Q&A IS
 ABOUT TO BEGIN!**

Keep submitting your questions
 in the questions window!

73

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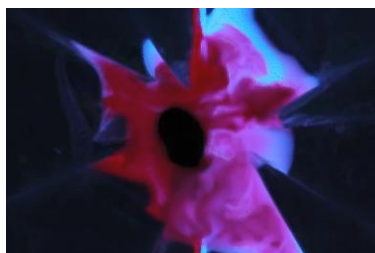
www.acs.org/acswebinars



Thursday, November 9, 2023 | 2-3pm ET

Psychological Safety is Lab Safety: Using RAMP to Assess DEIR Hazards

Co-produced with the Committee on Chemical Safety and the ACS Division of Chemical Health and Safety



Thursday, November 16, 2023 | 2-3:30pm ET

The Polymer Mechanochemistry of Self-Healing Materials

Co-produced with the ACS Division of Polymer Chemistry



Wednesday, November 22, 2023 | 2-3pm ET

Desafíos y Soluciones a través de la Ecofarmacovigilancia

Co-produced with the Sociedad Química de México

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