

# YAO-LUN YANG

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## CONTACT INFORMATION

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Star and Planet Formation Laboratory  
2-1 Hirosawa, Wako, Saitama 351-0198, Japan

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## RESEARCH INTERESTS

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Astrochemistry, Infall & Outflows, Early Stage Star Formation, Radiative Transfer Modeling, Atomic and Molecular Spectroscopy, and Infrared & Radio Astronomy.

## PROFESSIONAL APPOINTMENTS

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Mar. 2022 – present	Research Scientist ( <i>indefinite term</i> ) Star and Planet Formation Laboratory, RIKEN
Feb. 2022 – Jun. 2022	Visiting Scholar University of Virginia, USA
Feb. 2020 – Feb. 2022	Virginia Initiative on Cosmic Origins (VICO) Postdoctoral Fellow University of Virginia, USA
Aug. 2019 – Jan. 2020	Japan Society for the Promotion of Science (JSPS) Postdoctoral Fellow Host: Nami Sakai; RIKEN, Japan

## EDUCATION

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### 2019 Ph.D. Astronomy

The University of Texas at Austin, U.S.A. Advisors: Prof. Neal J. Evans II and Dr. Joel D. Green  
Dissertation: *The Three-dimensional Structure and Kinematics of Protostellar Envelopes*

### 2015 M.A. Astronomy

The University of Texas at Austin, U.S.A. Advisor: Prof. Neal J. Evans II  
Thesis: *The Class 0 Protostar BHR71: Herschel Observations and Dust Continuum Models*

### 2012 B.S. Physics

National Taiwan University, Taiwan Advisor: Dr. Ciska Kemper  
Project: *Molecular Hydrogen in Diffuse Interstellar Medium of the Large Magellanic Cloud*

## AWARDS, FUNDING (TOTAL: \$550,632 AS PI), AND RECOGNITIONS

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Grants-in-Aid for Scientific Research for Research Activity Start-up (¥2,200,000 as PI)	JSPS 2022
JWST Cycle 1 GO Grant - (\$187,562 as PI)	STScI 2021
SOFIA Cycle 9 GO Grant - (\$134,000 as PI)	SOFIA 2021
Virginia Initiative on Cosmic Origins (VICO) Postdoctoral Fellowship	University of Virginia 2019
Japan Society for the Promotion of Science (JSPS) Postdoctoral Fellowship	Japan 2019
Concentration in Teaching and Mentoring	UT-Austin 2018
Professional Development Award (\$600)	UT-Austin 2018
University Graduate Continuing Fellowship (\$80,000)	UT-Austin 2017–2019
SOFIA Cycle 6 GO Grant - (\$41,000 as PI and \$39,000 as co-I)	SOFIA 2017
Fred T. Goetting, Jr. Memorial Endowed Presidential Fellowship (\$10,000)	UT-Austin 2016
Summer Internship (\$14,120)	STScI 2016
Outstanding Thesis Award (\$1,000)	School of Graduate Studies, UT-Austin 2016
SOFIA Cycle 4 GO Grant - (\$56,000 as PI and \$33,000 as co-I)	SOFIA 2015

## PUBLICATIONS

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### First-Author and Significant Contribution Refereed Journal Articles

- [9] Evans, N. J. II, **Yang, Y.-L.**, Green, J. D., et al. “Models of Rotating Infall for the B335 Protostar”, [arXiv:2212.03746](#), accepted to ApJ
- [8] **Yang, Y.-L.**, Green, J. D., Pontoppidan, K. M., et al. 2022, “CORINOS I: JWST/MIRI Spectroscopy and Imaging of a Class 0 protostar IRAS 15398–3359”, [ApJL](#), **941**, L13
- [7] **Yang, Y.-L.**, Evans, N. J. II, Karska, A., et al. 2022, “Atomic Shocks in the Outflow of L1551 IRS 5 Identified with SOFIA-upGREAT Observations of [O I]”, [ApJ](#), **925**, 93
- [6] **Yang, Y.-L.**, Sakai, N., Zhang, Y., et al. 2021, “The Perseus ALMA Chemistry Survey (PEACHES). I. The Complex Organic Molecules in Perseus Embedded Protostars”, [ApJ](#), **910**, 20
- [5] **Yang, Y.-L.**, Evans, N. J. II, Smith, A. et al. 2020, “Constraining the Infalling Envelope Models of Embedded Protostars: BHR71 and its Hot Corino”, [ApJ](#), **891**, 1
- [4] **Yang, Y.-L.**, Green, J. D., Evans, N. J. II, et al. 2018, “CO in Protostars (COPS): *Herschel*-SPIRE Spectroscopy of Embedded Protostars”, [ApJ](#), **860** 174
- [3] **Yang, Y.-L.**, Evans, N. J. II, Green, J. D. et al. 2017, “The Class 0 Protostar BHR71: *Herschel* Observations and Dust Continuum Models”, [ApJ](#), **835**, 259
- [2] Green, J. D., **Yang, Y.-L.**, et al. 2016, “The CDF Archive: *Herschel* PACS and SPIRE Spectroscopic Data Pipeline and Products for Protostars and Young Stellar Objects”, [AJ](#), **151**, 75
- [1] Larson, R. L., Evans, N. J., Green, J. D., & **Yang, Y.-L.** 2015, “Evidence for Decay of Turbulence by MHD Shocks in the ISM via CO Emission”, [ApJ](#), **806**, 70

### Other Refereed Journal Articles

- [20] Fedriani, R., Tan, J. C., Telkamp, Z., **et al.** “The SOFIA Massive (SOMA) Star Formation Survey. IV. Isolated Protostars”, [ApJ](#), **942**, 7
- [19] Law, C.-Y., Tan, J. C., Gorai, P., **et al.** 2022, “Isolated Massive Star Formation in G28.20–0.05”, [ApJ](#), **939**, 120
- [18] De Simone, M., Ceccarelli, C., Codella, C., **et al.** 2022, “Tracking the ice mantle history in the Solar-type Protostars of NGC 1333 IRAS 4”, [ApJL](#), **935**, L14
- [17] Zhang, Y., Tanaka K. E. I., Tan, J. C., **Yang, Y.-L.**, et al. 2022, “Massive Protostars in a Protocluster – A Multi-Scale ALMA View of G35.20-0.74N”, [ApJ](#), **936**, 68
- [16] Cheng, Y., Tobin, J. J., **Yang, Y.-L.**, et al. 2022, “Disks and Outflows in the Intermediate-mass Star Forming Region NGC 2071 IR”, [ApJ](#), **933**, 178
- [15] Bouvier, M., Ceccarelli, C., López-Sepulcre, A., Sakai, N., Yamamoto, S., & **Yang, Y.-L.** 2022, “The chemical nature of Orion protostars: Are ORANGES different from PEACHES? ORANGES II”, [ApJ](#), **929**, 10
- [14] van Gelder, M. L., Nazari, P., Tabone, B., **et al.** 2022, “Importance of source structure on complex organics emission. I. Observations of CH<sub>3</sub>OH from low-mass to high-mass protostars”, [A&A](#), **A67**, 22
- [13] Hsu, S.-Y., Liu, S.-Y., Liu, T., **et al.** 2022, “ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP): A Hot Corino Survey toward Protostellar Cores in the Orion Cloud”, [ApJ](#), **927**, 218

- [12] Liu, H. B., Tsai, A.-L., Chen, W. P., **et al.** 2021, “Millimeter-sized Dust Grains Appear Surviving the Water-sublimating Temperature in the Inner 10 au of the FU Ori Disk”, [ApJ](#), **923**, 270
- [11] Yun, H.-S., Lee, J.-E., Evans, N. J. II, **et al.** 2021, “TIMES II: Investigating the Relation Between Turbulence and Star-forming Environments in Molecular Clouds”, [ApJ](#), **921**, 31
- [10] Bouvier, M, López-Sepulcre, A., Ceccarelli, C, **et al.** 2021, “ORion Alma New GEneration Survey (ORANGES) I. Dust continuum and free-free emission of OMC-2/3 filament protostars”, [A&A](#), **653**, A117
- [9] Yun, H.-S., Lee, J.-E., Choi, Y., **et al.** 2021, “TIMES I: A Systematic Observation in Multiple Molecular Lines Toward the Orion A and Ophiuchus Clouds”, [ApJS](#), **256**, 16
- [8] Liu, M., Tan, J. C., De Buizer, J. M., **et al.** 2020, “The SOFIA Massive (SOMA) Star Formation Survey. III. From Intermediate- to High-Mass Protostars”, [ApJ](#), **904**, 75
- [7] Hsu, S.-Y., Liu, S.-Y., Liu, T., **et al.** 2020, “ALMA Survey of Orion Planck Galactic Cold Clumps (ALMASOP) I. Detection of New Hot Corinos with ACA”, [ApJ](#), **898**, 107
- [6] Liu, H. B., Mérand, A, Green, J. D., Pérez, S., Hales, A. S., **Yang, Y.-L.**, et al. 2019, “Diagnosing 0.1-10 au Scale Morphology of the FU Ori Disk using ALMA and VLTI/GRAVITY”, [ApJ](#), **884**, 97
- [5] Yi, H.-W., Lee, J.-L., Liu, T, **et al.** 2018, “Planck Cold Clumps in the  $\lambda$  Orionis complex. II. Environmental effects on core formation”, [ApJS](#), **236**, 2
- [4] Karska, A, Kaufman, M. J., Kristensen, L. E., **et al.** 2018, “The Herschel-PACS Legacy of Low-mass Protostars: Far-IR Gas Properties and Their Origin in FUV-illuminated C-shocks”, [ApJS](#), **235**, 30
- [3] Liu, T, Kim, K.-T., Juvela, M, **et al.** 2018, “The TOP-SCOPE Survey of Planck Galactic Cold Clumps: Survey Overview and Results of an Exemplar Source, PGCC G26.53+0.17”, [ApJS](#), **234**, 28
- [2] Green, J. D., Jones, O. C., Keller, L. D., **et al.** 2016, “The Mid-infrared Evolution of the FU Orionis Disk”, [ApJ](#), **832**, 4
- [1] Naslim, N., Kemper, F., Madden, S. C., **et al.** 2015, “Molecular Hydrogen Emission in the Interstellar Medium of the Large Magellanic Cloud”, [MNRAS](#), **446**, 2490—2504

#### Non-refereed Research Articles

- [7] Sakai, N & **Yang, Y.-L.**, 2021, “Chemical Diversity in Young Protoplanetary Disk”, [ngVLA-J Memo Series](#)
- [6] **Yang, Y.-L.**, Evans, N. J., Smith, A., et al. 2020, “Direct Infall Signatures and Complex Organic Molecules toward an Isolated Embedded Protostar BHR 71”, *Origins: From the Protosun to the First Steps of Life*, Proceedings of the International Astronomical Union, 345, 312. [doi:10.1017/S1743921319001571](#)
- [5] Gutermuth, R., Offner, S., Arce, H., **et al.** 2019, “Dense Cores, Stellar Feedback and the Origins of Clustered Star Formation”, *Astro2020: Decadal Survey on Astronomy and Astrophysics*, science white papers, no. 467, [BAAS](#), **51**, 467
- [4] Green, J., **Yang, Y.-L.**, Megeath, T., et al. 2019, “Variability in the Assembly of Protostellar Systems”, *Astro2020: Decadal Survey on Astronomy and Astrophysics*, science white papers, no. 372, [BAAS](#), **51**, 372
- [3] Tobin, J., Offner, S., Sheehan, P., **et al.** 2019, “Measuring Protostar Masses: The Key to Protostellar Evolution”, *Astro2020: Decadal Survey on Astronomy and Astrophysics*, science white papers,

- no. 189, [BAAS](#), 51, 189
- [2] Tobin, J., Kounkel, M., Offner, S., **et al.** 2019, “The Formation and Evolution of Multiple Star Systems”, *Astro2020: Decadal Survey on Astronomy and Astrophysics*, science white papers, no. 187, [BAAS](#), 51, 187
- [1] **Yang, Y.-L.**, Evans, N. J., & Green, J. 2015, “The Structure of Class 0 Protostars: BHR71 in Herschel View”, [Frank N. Bash Symposium 2015 \(BASH2015\)](#), 30

## SELECTED OBSERVING PROGRAMS (AS PI OR SIGNIFICANT CO-I)

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### James Webb Space Telescope (JWST)

- *Blazing the Trails of COMs Ices to Gas*  
Cycle 1 (as PI, 24.6 hrs MIRI MRS)
- *Investigating Protostellar Accretion Across the Mass Spectrum*  
Cycle 1 (as co-I, 65.5 hrs MIRI MRS and NIRSpec IFU)

### Acatama Large Millimeter/submillimeter Array (ALMA)

- *Toward a complete census of methanol budget in isolated protostars*  
Cycle 9 (as PI, 17.8/16.9/44.0 hrs of 12m/ACA/TP)
- *Chemistry of complex organic molecules in isolated protostars*  
Cycle 9 (as PI, 8.4 hrs)
- *Infalling filamentary streamers in an isolated low-mass protostar: dominant or secondary mass transporter?*  
Cycle 9 (as PI, 8.1/14.3 hrs of 12m/ACA)
- *COMPASS: Complex Organic Molecules in Protostars with ALMA Spectral Surveys*  
Cycle 9 Large Program (as co-I, PI: Jes Jørgensen, 125 hrs)
- *Testing the origin of warm carbon-chain chemistry in Perseus protostars*  
Cycle 8 & 9 (as PI, 54.5 hrs of ACA)
- *Directly measuring the progression of infall from the envelope to the disk-forming region of BHR 71*  
Cycle 7 & 8 (as PI, 18.7 hrs)
- *Direct Detection of Infall in a Protostellar System*  
Cycle 4 (as PI, 0.9 hr)
- *Outflow Launching from a Circumbinary Disk*  
Cycle 8 (as co-I, PI: Yichen Zhang, 10.5 hrs)
- *Pinpointing hot methanol transitions with observational and experimental data*  
Cycle 8 (as co-I, PI: Shaoshan Zeng, 32.7 hrs)
- *Formation of complex organics around protostars in isolated cores*  
Cycle 8 (as co-I, PI: Jes Jørgensen, 7.5 hrs)
- *Spatiochemically Profiling the Inner Coma of C/2021 A1 (Leonard)*  
Cycle 8 (as co-I, PI: Maria Drozdovskaya, 45.7 hrs)

### Very Large Array (VLA)

- *Do Twins Always Look the Same?: Testing the Chemical Difference in a Protobinary*  
2021 A (as PI, 15 hrs)

## Stratospheric Observatory for Infrared Astronomy (SOFIA)

- *Probing the Radiative Cooling from Shocks and PDRs in Intermediate- and High-mass Protostars*  
Cycle 9 (as PI, 23.1 hrs FIFI-LS)
- *Exploring Protostellar Winds with [OI]: Constraining models of shocked gas and PDR using L1551-IRS5*  
Cycle 4 & 6 (as PI, 5.3 hrs & 4.1 hrs GREAT)
- *The Evolution of FU Orionis Disks*  
Cycle 4 & 6 (as co-I, PI: Joel Green, 3 hrs & 3.9 hrs FORCAST)

## Submillimeter Telescope (SMT)

- *Surveying the Chemical Diversity toward Taurus Embedded Protostars*  
2022A (as PI, 40 hrs) & 2020B (as PI, 60 hrs)

## Gemini-South

- *High Velocity Jets in the Outflow of BHR 71*  
2020A (as co-PI, 6 hrs IGRINS)

APEX/FLASH<sup>+</sup>, 7.5 hrs (as PI)

Harlan J. Smith Telescope/DIAFI, 4 nights (as on-site observer)

IRTF/TEXES, 2014–2016, 4 nights (as Co-I & on-site observer)

## INVITED TALKS

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Japan Geoscience Union Meeting 2023 (scheduled),	Chiba, Japan 2023
EA-ALMA Science Workshop 2023 (scheduled),	New Taipei City, Taiwan 2023
Colloquium,	ASIAA, Taipei, Taiwan 2023
Dust, Ice, and Gas (DIG) Astrochemistry Meeting,	IASES ( <i>virtual</i> ), India/Japan 2022
Colloquium,	Chalmers University of Technology ( <i>virtual</i> ), Sweden 2022
<a href="#">SOFIA tele-talk</a> ,	SOFIA ( <i>virtual</i> ), USA 2022
SMA Seminar,	SAO/CfA ( <i>virtual</i> ), USA 2021
Astrochemistry Seminar,	NAOJ ( <i>virtual</i> ), Japan 2020
Colloquium,	NTHU, Hsinchu, Taiwan 2020
Seminar at Center of Astronomy and Gravitation,	NTNU, Taipei, Taiwan 2020
Colloquium,	ASIAA, Taipei, Taiwan 2020
ZUNA talk,	NRAO, VA, USA 2020
APEC Seminar,	IPMU, Chiba, Japan 2019
Star Formation Mini Symposium,	Kyung Hee University, Suwan, South Korea 2019
Colloquium,	NTHU, Taiwan 2019
Review talk, From Star to Planet Formation II,	Göteborg, Sweden 2019
CAS seminar,	Center for Astrochemical Studies, MPE, Germany 2019

## SELECTED CONTRIBUTED TALKS

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First Science Results of JWST,	STScI, Baltimore, USA 2022
Next Generation Astrochemistry,	University of Tokyo, Tokyo, Japan 2022
Molecules in Extreme Environments: Near and Far,	NAOJ, Tokyo, Japan 2022

From Clouds to Planets II: The Astrochemical Link,	Berlin, Germany 2022
240 <sup>th</sup> AAS Meeting,	Pasadena ( <i>hybrid</i> ), CA 2022
NBIA Workshop on Radiation Transfer in Astrophysics,	Copenhagen ( <i>hybrid</i> ), Denmark 2022
Workshop on Interstellar Matter 2021,	Hokkaido ( <i>hybrid</i> ), Japan 2021
Astrochemistry in the JWST Era,	Leeds ( <i>virtual</i> ), UK 2021
2021 COSPAR,	virtual space, Earth 2021
Astrochemical Frontier,	virtual space, Earth 2020
2019 ALMA EA Development Workshop,	NAOJ, Tokyo, Japan 2019
Early Planet Formation in Embedded Disks,	University of Tokyo, Tokyo, Japan 2019
2018 ALMA EA Science/Development Workshop,	Osaka Pref. University, Osaka, Japan 2018
TUNA Talk,	NRAO/UVa, VA 2018
6 <sup>th</sup> GMT Science Meeting: Stars Birth & Death,	Honolulu, HI 2018
72 <sup>nd</sup> International Symposium on Molecular Spectroscopy,	UIUC, IL 2017
Star Formation 2016, Splinter session,	Exeter, UK 2016
Workshop on Dense Cores,	Monterey, CA 2014
Seminars at UT-Austin, NRAO/UVa, ASIAA, Subaru Telescope, IfA/U of Hawaii, Leiden Observa-	
tory, ESO-Garching, MPIA, STScI, East Asia Observatory, CfA/Harvard, U of Arizona, Kyung Hee	
University, Osaka University, and Osaka Prefecture University	

## STUDENTS MENTORING

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- Lianis Reyes Rosa (graduate student, UVA, 2021–present, co-advised with Prof. Jonathan Tan): Investigate the feedback of massive protostars from emission of shocks and PDRs
- Jenny Margot Ramos Lázaro (CASSUM summer student, National University of San Marcos, Peru, 2021–present): Characterize the carbon-chain chemistry in Taurus embedded protostars using SMT observations.
- Neha Bagalkot (undergraduate, UVA, 2021–2021, co-advised with Prof. Zhi-Yun Li): Continuum and line radiative transfer calculations of star-forming cores.
- Pichaya Tositrakul (undergraduate, UVA, 2021): Characterize the impact of dust optical depth to measurements of molecular abundance.
- Eva Greco (CASSUM summer student, UVA, 2020): Study ALMA observations of CO outflows associated with a clustered massive star-forming regions, involving ALMA imaging and spectral analyses.
- Alyssa Ramos (undergraduate, UT-Austin, 2018): Exploratory study on the complex organic molecules at the early phase of star formation, involving an archival study using the ALMA archive and simulating synthetic spectra of COMs.
- Rebecca Larson (undergraduate, UT-Austin, 2014–2016): Constrain the decay of turbulence shocks with *Herschel* observations of starless molecular clouds. This project results in a publication on ApJ.

## SERVICE AND PROFESSIONAL SOCIETY MEMBERSHIP

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- Referee for ApJ, ApJS, MNRAS, and Nature Astronomy
- Subject-matter expert reviewer in NASA peer reviews (2021×2, 2022)
- Member of the ISSI International Team “Provenances of our Solar System’s relics”
- Affiliate of the eDisk ALMA Large Program
- SOC of [Astrochemistry Discussions](#)
- Organizer of astro-ph and astrochem-ph discussion at UVA, 2020–2022



- Organizer of UVA/NRAO Star Formation Group Meeting, 2021–2022
- Member of the Astronomical Society of Japan, 2022–present
- Member of the American Astronomical Society, 2017–present
- AAS Meeting Chambliss Judge, 2019

## PRESS RELEASES

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- CORINOS I paper by Seoul National University (*Korean*)
- CORINOS I paper by RIKEN, (*Japanese*)
- Nature Astronomy, “*JWST takes stock of the freezer*”, Nov. 2022
- New Scientist, “*JWST reveals young star that may be about to give birth to a planet*”, Aug. 2022
- UVA Today, “*UVA Astronomers Will Map the Unmapped in Outer Space*”, Apr. 2022
- UVA Arts & Sciences Magazine March-April 2022, “*Mapping the Unmapped in Outer Space*”, Mar. 2022
- UVA Today, “*Like Peas in a Pod: UVA Astronomer’s Survey of Young Stars Published*”, Apr. 2021
- RIKEN, “*Amounts of organic molecules in planetary systems differ from early on*”, Apr. 2021

## OUTREACH ACTIVITIES

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- Talk, “*Snow-covered Baby Stars and NASA’s Next Generation Space Telescope*”, Science on Screen, The Gem Theater, Mar. 2022
- Talk, “*JWST and Snow-covered Baby Stars*”, Massanutten Regional Library, Nov. 2021
- Organizer & Presenter, Astronomy on Tap ATX, Austin, TX, 2016–2019  
*Monthly astronomy talk held in a local bar joined by more than 250 audience*
- Guest Host & Presenter, Astronomy on Tap Taipei, Taipei, Taiwan, 2019, 2020
- Talk, “*How to Make A Star*”, Westcave Preserve, Jan. 2015

(Last update on February 1, 2023)