TEXAS STATE VITA

I. Academic/Professional Background

A. Name and Title

Name: Dr. Andrea Banzatti Title: Assistant Professor

B. Educational Background

Degree	*Year*	*University*	*Major*	*Thesis/Dissertation*
PHD	2014	ETH Zurich	Science	Water vapor in protoplanetary disks - a probe of physics and chemistry of planet formation conditions
MS	2009	University of Milan	Physics	Evolution of Protoplanetary Disks: first steps toward Planet Formation
BS	2006	University of Milan	Physics	The Sunyaev–Zeldovich effect

C. University Experience

Position	*University*	*Comments*	*Dates*
Assistant Professor, Physics	Texas State University		August 1, 2019 - Present

D. Relevant Professional Experience

Position	*Entity*	*Comments*	*Dates*
Postdoctoral Research Associate	University of Arizona, Tucson, AZ, United States		2016 - 2019
Postdoctoral Fellow	Space Telescope Science Institute, Baltimore, MD, United States		2013 - 2016
Doctoral Student and Advanced Physics Lab Assistant	Swiss Federal Institute of Technology (ETH), Institute for Astronomy, Zurich,		2009 - 2013

Position	*Entity*	*Comments*	*Dates*
Research Intern	Switzerland ALMA Science Division, ESO Headquarters, Garching bei München, Germany		2008 - 2009

II. TEACHING

A. Teaching Honors and Awards:

Award / Honor Recipient: Teaching excellence award, Texas State University. 2023

B. Courses Taught:

Texas State University:

PHYS 2425 - ELECTRICITY AND MAGNETISM

PHYS 4121 - UG RESEARCH

PHYS 4221 - UG RESEARCH

PHYS 4320 - SEL STDS IN PHYS

PHYS 4321 - UNDERGRAD RESEARCH

PHYS 4350F - ASTRO SPECTROSCOPY

PHYS 5199B - THESIS

PHYS 5350H - ASTRO SPECTROSCOPY

PHYS 5370 - PROB ADV PHYS

PHYS 5395 - FUND OF RESEAR

PHYS 5399A - THESIS

PHYS 5399B - THESIS

PHYS 5599B - THESIS

C. Directed Student Learning (i.e. theses, dissertations, exit committees, etc.):

Supervisor / Chair, Master's Thesis, "JWST spectroscopy to study molecular gas depletion through inner disk cavities", Status: In Progress. (September 2023 - Present). Physics, Texas State University.
Student(s): Patrick Mallaney.

Additional Comments: Patrick is working on the analysis of JWST spectra from my program GO-1640 for which we received NASA funding; as part of this work, Patrick has:
- presented a poster at the Texas Section APS meeting in October 2023
- presented a talk at the JWST team meeting we hosted at TXST in December 2023
- presented a poster at the AAS winter meeting in January 2024
- started preparing a paper and thesis on this project

Supervisor / Chair, Master's Thesis, "JWST spectroscopy to study the role of accretion in molecular gas excitation", Status: In Progress. (June 2023 - Present). Physics, Texas State University.
Student(s): Sarah Smith.

Additional Comments: Sarah is working on the analysis of JWST spectra from two collaborative programs for which we received NASA funding; as part of this work, Sarah has:
- presented a poster at the Texas Section APS meeting in October 2023
- presented a talk at the JWST team meeting we hosted at TXST in December 2023
- presented a poster at the AAS winter meeting in January 2024
- started preparing a paper and thesis on this project

Member, Dissertation, "Study of Thermal Properties of Micron-Scale Diamond and the Impact of Oriented Polycrystalline Growth", Status: In Progress. (June 2020 - Present). Texas State University.
Student(s): Anival Ayala, Doctoral.

Supervisor / Chair, Applied Research Project, "An interactive analysis tool for spectroscopy of planet-forming disks with the NASA James Webb Space Telescope", Status: Completed. (January 1, 2023 - February 2024). Physics, Texas State University.
Student(s): Evan Jellison, Graduate.
Matthew Johnson, Undergraduate.

Additional Comments: Evan and Matthew have worked with me on developing an interactive tool for the analysis of molecular spectra taken with the Webb Space Telescope; in February 2024 we have finalized the tool and submitted a paper led by Evan and Matthew, officially launching iSLAT in the community. Upon graduation in December 2023, Matthew received a shoutout from our TXST president on his involvement in this project.

As part of this work, the students have:
- presented a talk at UT Austin in 2023
- presented with me at the Physics Colloquium in our department in Dec 2023
- submitted a paper for publication in ApJ
- set up a GitHub repository to share the tool with the community

Member, Master's Thesis, "Numerical simulations of the evolution of HMXBs", Status: Completed. (January 2023 - July 2023). Physics, Texas State University.
Student(s): Lindsey Diehl, Graduate.

Member, Master's Thesis, "The Nature of X-ray Sources in the Andromeda Galaxy", Status: Completed. (December 2022 - July 2023). Physics, Texas State University.
Student(s): Erika Marentes.

Supervisor / Chair, Applied Research Project, "Multi-dimensional correlation analysis of molecular emission in protoplanetary disks", Status: Completed. (January 2023 - May 2023). Physics, Texas State University.
Student(s): Ikel, Undergraduate, Hernandez.

Additional Comments: As part of this project, Ikel has:
- presented a talk at UT Austin in 2023

Supervisor / Chair, Master's Thesis, "A new survey of near-infrared CO spectra in Protoplanetary Disks using the NASA-IRTF telescope", Status: Completed. (July 2020 - April 2023). Texas State University.
Student(s): Kirsten Abernathy, Undergraduate.

Additional Comments: Kirsten has significantly contributed to the survey of infrared spectra of protoplanetary disks we led at TXST using the NASA IRFT telescope in Hawaii.

As part of this work, Kirsten has:
- presented in a poster at the 237th winter meeting of the American Astronomical Society in January 2021,
- presented in a poster at the 2021 Sagan Exoplanet Summer Workshop.
- published a paper in RNAAS (https://ui.adsabs.harvard.edu/abs/2021RNAAS...5...80A/abstract).
- presented a talk at UT Austin in 2023
- successfully written and defended her Master thesis on the topic in 2023

Kirsten had a big role also in data reduction by reducing a large part of the data that was included in two refereed papers (Banzatti, Abernathy, et al. 2022, and Banzatti et al, 2023a).

Supervisor / Chair, Applied Research Project, "Reduction of M-band spectra from iSHELL on the NASA IRTF telescope", Status: Completed. (January 2023 - March 2023). Physics, Texas State University.
Student(s): Anthony, Graduate, Gobernatz.

Supervisor / Chair, Applied Research Project, "JWST spectroscopy of the EX Lup disk", Status: Completed. (September 2022 - January 2023). Physics, Texas State University.
Student(s): Lindsey Diehl, Graduate.

Additional Comments: In this project, Lindsey worked on the very first spectrum we obtained from the James Webb Space Telescope within an international collaboration, and with my guidance she contributed the analysis of gas emission that was included in one of the earliest papers published with JWST data (Lindsey is the third author):
https://ui.adsabs.harvard.edu/abs/2023ApJ...945L...7K/abstract
As part of this project, Lindsey has:
- presented a poster at the "JWST First Results" conference at the Space Telescope Science Institute in Dec 2022
- contributed to a refereed paper as third author (Kospal et al. 2023)

Supervisor / Chair, Applied Research Project, "3D modeling of Protoplanetary Disks and their winds", Status: Completed. (September 2022 - December 2022). Physics, Texas State University.
Student(s): Ikel Hernandez.

Additional Comments: Ikel worked on building 3D models of Protoplanetary Disks with the software Blender, and presented them in connection to the current knowledge of their structure from the literature.

Supervisor / Chair, Applied Research Project, "Multi-dimensional plotting of stellar data in python", Status: Completed. (September 2022 - December 2022). Physics, Texas State University.
Student(s): Mauro Guerrero.

Supervisor / Chair, Applied Research Project, "Spectroscopy of infrared organic spectra with the NASA JWST telescope", Status: Completed. (September 2022 - December 2022). Physics, Texas State University.
Student(s): Rocio Siegler, Undergraduate.

Additional Comments: Ro contributed to the analysis of the very first JWST spectrum we received in our research group, focusing on emission from organic molecules.

Member, Master's Thesis, "On the Nature of the X-ray Sources of Glimpse C01", Status: Completed. (June 2022 - November 11, 2022). Physics, Texas State University.
Student(s): Erin Eastep, Graduate.

Member, Applied Research Project, "A full L and M band, velocity resolved study of the S CrA N&S disks", Status: Completed. (October 1, 2021 - August 2022). Astronomy, Max Planck Institute, Garching, Germany.

Student(s): Giulio Belloni, Doctoral.
Sierra Grant, Doctoral.

Additional Comments: I co-mentored and supported Giulio and Sierra in the analysis of CRIRES+ data, by providing weekly Zoom sessions to guide them learn the data reduction and analysis. Two scientific papers led by them are in preparation.

Member, Applied Research Project, "Inner Disk Water Vapor in Protoplanetary Disks with Multiple Gaps", Status: Completed. (September 2021 - August 2022). Texas State University.
Student(s): Whittney Easterwood, Undergraduate.

Additional Comments: Principal supervisor is postdoctoral researcher Dr. Anusha Kalyaan
As part of this project,Whittney has:
- presented a poster at the 240th AAS meeting in June 2022
- submitted a paper for publication in the ApJ journal in February 2024

Supervisor / Chair, Master's Thesis, "A multi-dimensional study of kinematics and excitation of molecular gas in planet-forming regions", Status: Completed. (January 2021 - July 5, 2022). Physics, Texas State University.
Student(s): Jose Perez Chavez, Graduate, Master.

Additional Comments: Jose worked on developing python code to analyze multi-dimensional data obtained as part of our TXST-led survey of protoplanetary disks.
As part of this project, Jose has:
- given a talk on his research at the 240th American Astronomical Society meeting in June 2022
- contributed to a major paper presenting part of the survey, Banzatti et al. 2023 (Jose is the third author)
- successfully completed and defended his Master's thesis in July 2022

Member, Applied Research Project, "Models of water ice and gas dynamics in Protoplanetary Disks", Status: Completed. (September 2021 - June 2022). Texas State University.
Student(s): Shilo Solis, Undergraduate.

Additional Comments: Principal supervisor is postdoctoral researcher Dr. Anusha Kalyaan

Member, Master's Thesis, "The Nature of X-ray Sources in Nearby Starburst Galaxies", Status: Completed. (December 2021 - June 14, 2022). Texas State University.
Student(s): David Palmore, Graduate.

Member, Applied Research Project, "Forbidden emission lines in protostellar outflows and jets with MUSE", Status: Completed. (November 2021 - April 2022). Astronomy, Max Planck Institut, Heidelberg, Germany.
Student(s): Lizxandra Flores, Doctoral.

Additional Comments: I co-mentored and supported Lizxandra in the analysis of MUSE data, by providing weekly Zoom sessions to guide her learn the data analysis and help with writing a scientific paper (now published as Flores et al. 2023).

Member, Master's Thesis, "Multi-wavelength Analysis of 13 Unknown Galactic Fermi Gamma-Ray Sources", Status: Completed. (December 2021 - April 18, 2022). Texas State University.
Student(s): Brice Williams, Graduate.

Supervisor / Chair, Applied Research Project, "Data reduction of NASA IRTF-iSHELL spectra of Protoplanetary Disks", Status: Completed. (June 2021 - August 2021). Texas State University.
Student(s): Rocio Sigler, Undergraduate.

Additional Comments: This was a Summer project where the student was trained in data reduction and helped reducing some of the data that was later included in a refereed paper (Banzatti et al. 2022).

Supervisor / Chair, Master's Thesis, "A study of protoplanetary disk evolution in infrared CO emission", Status: Completed. (August 2019 - June 23, 2021). Physics, Texas State University.
Student(s): Michael Sanchez.

Additional Comments: Michael led our very first Master's thesis project on molecular spectra in protoplanetary disks.
As part of this project, Michael has:
- presented in a poster at the 237th winter meeting of the American Astronomical Society in January 2021
- published one paper in RNAAS in 2021 (https://ui.adsabs.harvard.edu/abs/2021RNAAS...5...78S/abstract).
- successfully completed and defended his Master's thesis in June 2021

Supervisor / Chair, Applied Research Project, "Retrieval of multi-wavelength datasets for Protoplanetary Disks", Status: Completed. (January 2021 - May 1, 2021). Physics, Texas State University.
Student(s): Erika Merentes, Undergraduate.

Supervisor / Chair, Applied Research Project, "Python tools for the combination of multi-dimensional datasets for Protoplanetary Disks", Status: Completed. (January 2021 - May 1, 2021). Physics, Texas State University.
Student(s): Whittney Easterwood, Undergraduate.

Supervisor / Chair, Applied Research Project, "Synergic analyses of Protoplanetary Disk spectra using SpExoDisks: A case study", Status: Completed. (September 2020 - May 1, 2021). Texas State University.
Student(s): Jose Perez Chavez, Graduate, Master.

Additional Comments: This was the first part of Jose's project that eventually led to his Master's thesis work.
In this part of the project, Jose has:
- presented a poster at the 238th meeting of the American Astronomical Society in June 2021
- presented a poster at the 2021 Sagan Exoplanet Summer Workshop

Supervisor / Chair, Applied Research Project, "JWST proposal for water emission in exoplanet-forming disks", Status: Completed. (September 2020 - December 2020). Texas State University.
Student(s): Andrew Watkins, Undergraduate.
Ivan Vazquez, Undergraduate.

Additional Comments: Project completed with submission of the proposal.

Supervisor / Chair, Applied Research Project, "A study of inner disk cavities using the infrared index n_13-30", Status: Completed. (January 2020 - July 2020). Texas State University.
Student(s): Andrew Watkins, Undergraduate.

Additional Comments: This project contributed to a scientific paper that is now published: The Astrophysical Journal, Volume 903, Issue 2, id.124, 18 pp.

Supervisor / Chair, Applied Research Project, "A correlation study of infrared molecular emission from Protoplanetary Disks", Status: Completed. (January 2020 - June 2020). Texas State University.
Student(s): Ivan Vazquez.

Additional Comments: This project contributed to a scientific paper that is now published: The Astrophysical Journal, Volume 903, Issue 2, id.124, 18 pp.

Supervisor / Chair, Applied Research Project, "Variability of Near-Infrared H2 and CO emission in protoplanetary disks", Status: Completed. (September 2019 - June 2020). Texas State University.
Student(s): Kirsten Abernathy.

Supervisor / Chair, Applied Research Project, "Preparing observations of CO emission from protoplanetary disks with the NASA-IRTF", Status: Completed. (September 2019 - December 2019). Texas State University.
Student(s): Andrew Watkins, Undergraduate.

D. Courses Prepared and Curriculum Development:

Astronomy data activity for Python course, First Time Course Preparation, Texas State University. Taught: October 2022.

Additional Comments: I helped design an astronomy data activity for the Python course taught by Dr. Mastroleo (PHYS-2230); I provided astronomical data for stellar properties and explanations on how to use them for the student activity. In this activity, the students use Pandas to merge astronomical data from different tables (star region, distance, coordinates, temperature, luminosity, and mass estimates from different models) to learn how to handle incomplete data from different sources to study a physical problem (in this case, compare and evaluate stellar mass estimates from different models).

Astronomical Spectroscopy, First Time Course Preparation, Texas State University. Taught: March 2021 - May 2022.

Additional Comments: I prepared and developed a new graduate course for Physics majors: Astronomical Spectroscopy (PHYS 5350H). This course introduces students to spectroscopy in astronomy, with particular emphasis on molecular spectroscopy. The course covers a broad range of aspects including the development of spectroscopy in astronomy, the theory of atomic and molecular spectra, spectra in different astrophysical environments, instrumentation and data reduction. Although this is a lecture-based course, I developed it to include weekly lab-type exercises where students learn to design an experiment, use simulations, test theoretical expectations, and perform data analysis.

Molecular Universe, First Time Course Preparation, Texas State University. Taught: August 2020 - December 2020.

Additional Comments: In Fall 2020 I offered for the first time a course on Molecular Astrophysics, to cover the theoretical background of atomic and molecular spectroscopy, spectroscopy observations at multiple wavelengths, and how and what we learn about a range of astrophysical environments using molecular spectroscopy. Three students took this course, two graduate and one undergraduate.

Spectroscopy lab activity for the new Methods in Observational Astrophysics course, First Time Course Preparation, Texas State University. Taught: April 2020 - May 2020.

Additional Comments: I helped design the spectroscopy lab activity for the new Methods in Observational Astrophysics course taught by Dr. Barringer; I provided synthetic models of infrared spectra of carbon monoxide (CO) and explanations on how to use them for the student activity. In this activity, the students analyze the spectra with a tool known as the “Population Diagram” (from Goldsmith & Langer 1999) to measure the temperature and molecular number density of CO, mimicking conditions that we find in regions where exoplanets are forming around other stars.

F. Other:

Arizona Space Grant Mentor, undergraduate student Madison Victoria Walder, working on high-resolution IR spectroscopy to study exoplanet-forming disks. AZ, United States. (2018).

Additional Comments: University of Arizona

Guest Lecture, Lecture on "Exoplanet detection techniques" - Astrophysics course PHYS 3313. (2019).

Guest Lecture, Lecture on the 2019 Physics Nobel Prize winners - Astronomy Club, Texas State University. (2019).

Guest Lecture, Two lectures on "Stellar evolution" - Astronomy course PHYS 1350. (2019).

Guest Lecture, •Guest Lecturer on “The search for life in Solar System moons”, “Exoplanets: detection techniques and populations”, “The light from distant worlds” (in-class lab activity) — tier II undergraduate course “Astrobiology: A Planetary Perspective” by Prof. Ilaria Pascucci, University of Arizona. (2017 - 2018).

Additional Comments: 2 Semesters

Guest Lecture, Guest Lecturer on “The origin of the Solar System”, tier I undergraduate course “The Universe and Humanity: Origin and Destiny” by Prof. Travis Barman (Un. of Arizona). (2017).

Mentoring assistant, “Testing methods to detect the water snow line in protoplanetary disks”, graduate student Nathanial P. Hendler. (2016 - 2017).

Mentoring assistant, “Measurements of water snow lines in classical protoplanetary disks”, graduate student Sandra Blevins. (2013 - 2015).

Additional Comments: mentor: Dr. K. Pontoppidan

Mentoring assistant, “Spectral energy distributions of circumstellar disks”, undergraduate student Patrick Joos, (ETH Zurich. (2009).

Additional Comments: mentor: Prof. M. Meyer

Organizer of extra-credit activities for undergraduate students, tour to the Mirror Lab facility in Tucson AZ. Tucson, AZ, United States. (2017).

Additional Comments: to see the phase of glass loading for the 5th of the 8-m GMT mirrors

Selected panelist, Graduate Student Career Development seminars (LPL and UofA). (2017).

Teaching assistant, advanced physics lab for undergraduate students: Thermionic Emission of Electrons, (ETH Zurich). (2009 - 2013).

Additional Comments: 3 Semesters and 1 semester

Teaching assistant, advanced physics lab: undergraduate projects at the “Astroweek”, a week of astronomical observations in the Swiss Alps with 8”-14” optical telescopes and radio antennas. (2009 - 2013).

Additional Comments: 3 Semesters

Teaching assistant, beginners physics lab, supervision to physics experiments in optics, mechanics, and dynamics, ETH Zurich. Switzerland. (2009 - 2013).

Additional Comments: 2 Semesters

G. Teaching Professional Development Activities Attended

Workshop, "Learning, Teaching, And Transformation For Today's Complex Educational/Organizational Settings and Learner Needs," Department of Counseling, Leadership, Adult Education, and School Psychology - Texas State University. (April 11, 2022).

Additional Comments: The modernization of the world’s higher education system underlines the need to improve the quality and relevance of university and adult education. Special guests Drs. Fedeli and Taylor examine the design and delivery of study programs and address the needs for learning for an ever-increasing diversity of student populations. Their interventions:

- From the Galileo Galilei Podium to Active Learning: An Italian Perspective on Faculty Development

- Empathy: The Stepchild of Critical Reflection and Transformative Learning

Workshop, "2020 Workshop for new Physics and Astronomy faculty," American Physical Society, American Astronomical Society, NSF. (October 15, 2020 - October 17, 2020).

Workshop, "Community Input on "STEM Faculty-Student Communities" Project." (2019).

Workshop, "Building Productive and Ethical Mentoring Relationships," University of Arizona. (2018).

Workshop, "Designing Effective Courses for Diverse Learners workshop," UofA. (2017).

Workshop, "Interactive Teaching workshop with a multi-disciplinary panel of professors," UofA, AZ, United States. (2017).

Additional Comments: including Prof. Ed Prather (Director of Center for Astronomy Education

III. SCHOLARLY/CREATIVE

A. Works in Print (including works accepted, forthcoming, in press):

2. Articles:

a. Refereed Journal Articles:

Jensen, Jr, S. K., Brittain, S. D., Banzatti, A., Najita, J. R., Carr, J. S., Kern, J., … Fung, J. (2023). Spectroastrometric Survey of Protoplanetary Disks with Inner Dust Cavities. *arXiv e-Prints*, arXiv:2312.17218. https://doi.org/10.48550/arXiv.2312.17218

Xie, C., Pascucci, I., Long, F., Pontoppidan, K. M., Banzatti, A., Kalyaan, A., … Collaboration, J. (2023). Water-rich Disks around Late M Stars Unveiled: Exploring the Remarkable Case of Sz 114. *ApJ Letters*, *959*(2), L25. https://doi.org/10.3847/2041-8213/ad0ed9

Grant, S. L., Bettoni, G., Banzatti, A., van Dishoeck, E. F., Brittain, S., Fedele, D., … Whelan, E. (2023). Full L-and M-band high resolution spectroscopy of the S CrA binary disks with VLT-CRIRES+. *arXiv Preprint arXiv:2309.03888*. Published.

Pontoppidan, K. M., Salyk, C., Banzatti, A., Zhang, K., Pascucci, I., Oberg, K. I., … others. (2023). High-contrast JWST-MIRI spectroscopy of planet-forming disks for the JDISC Survey. *arXiv Preprint arXiv:2311.17020*. Published.

Banzatti, A., Pontoppidan, K. M., Carr, J. S., Jellison, E., Pascucci, I., Najita, J. R., … Bruderer, S. (2023). JWST Reveals Excess Cool Water near the Snow Line in Compact Disks, Consistent with Pebble Drift. *The Astrophysical Journal Letters*, *957*(2), L22. https://doi.org/10.3847/2041-8213/acf5echttp://dx.doi.org/10.3847/2041-8213/acf5ec

Cruz-Sáenz de Miera, F., Kóspál, Á., Abrahám, P., Claes, R. A., Manara, C. F., Wendeborn, J., … Kun, M. (2023). Brightness and mass accretion rate evolution during the 2022 burst of EX Lupi. *Astronomy & Astrophysics*, *678*, A88. https://doi.org/10.1051/0004-6361/202347063http://dx.doi.org/10.1051/0004-6361/202347063

Kozdon, J., Brittain, S. D., Fung, J., Kern, J., Jensen, S., Carr, J. S., … Banzatti, A. (2023). Rovibrational Spectroscopy of CI Tau—Evidence of a Multicomponent Eccentric Disk Induced by a Planet. *The Astronomical Journal*, *166*(3), 119. https://doi.org/10.3847/1538-3881/ace903http://dx.doi.org/10.3847/1538-3881/ace903

Kalyaan, A., Pinilla, P., Krijt, S., Banzatti, A., Rosotti, G., Mulders, G. D., … Herczeg, G. J. (2023). The Effect of Dust Evolution and Traps on Inner Disk Water Enrichment. *The Astrophysical Journal*, *954*(1), 66. https://doi.org/10.3847/1538-4357/ace535http://dx.doi.org/10.3847/1538-4357/ace535

Kóspál, Á., Ábrahám, P., Diehl, L. M., Banzatti, A., Bouwman, J., Chen, L., … Rab, C. (2023). JWST/MIRI Spectroscopy of the Disk of the Young Eruptive Star EX Lup in Quiescence. *The Astrophysical Journal Letters*, *945*(1), L7. https://doi.org/10.3847/2041-8213/acb58ahttp://dx.doi.org/10.3847/2041-8213/acb58a

Flores-Rivera, L., Flock, M., Kurtovic, N. T., Husemann, B., Banzatti, A., Ringqvist, S. C., … Aoyama, Y. (2023). Forbidden emission lines in protostellar outflows and jets with MUSE. *Astronomy & Astrophysics*, *670*, A126. https://doi.org/10.1051/0004-6361/202141664http://dx.doi.org/10.1051/0004-6361/202141664

Banzatti, A., Pontoppidan, K. M., Chávez, J. P., Salyk, C., Diehl, L. M., Bruderer, S., … Wheeler, C. (2023). The Kinematics and Excitation of Infrared Water Vapor Emission from Planet-forming Disks: Results from Spectrally Resolved Surveys and Guidelines for JWST Spectra. *The Astronomical Journal*, *165*(2), 72. https://doi.org/10.3847/1538-3881/aca80bhttp://dx.doi.org/10.3847/1538-3881/aca80b

Espaillat, C., Herczeg, G. J., Thanathibodee, T., Pittman, C., Calvet, N., Arulanantham, N., … Banzatti, A. (2022). The ODYSSEUS Survey.

Motivation and First Results: Accretion, Ejection, and Disk Irradiation of CVSO 109. *The Astronomical Journal*, *163*(3), 114.

James, M. M., Pascucci, I., Liu, Y., Banzatti, A., Krijt, S., Long, F., & Kamp, I. (2022). Testing the Retrieval of Inner Disk Water Enrichment with Spitzer/IRS and JWST/MIRI. *The Astrophysical Journal*, *941*(2), 187. https://doi.org/10.3847/1538-4357/ac9c61http://dx.doi.org/10.3847/1538-4357/ac9c61

Salyk, C., Pontoppidan, K. M., Banzatti, A., Käufl, U., Hall, C., Pascucci, I., … Kamp, I. (2022). An Unusual Reservoir of Water Emission in the VV CrA A Protoplanetary Disk. *The Astronomical Journal*, *164*(4), 136. https://doi.org/10.3847/1538-3881/ac8878http://dx.doi.org/10.3847/1538-3881/ac8878

Banzatti, A., Abernathy, K. M., Brittain, S., Bosman, A. D., Pontoppidan, K. M., Boogert, A., … Rayner, J. T. (2022). Scanning Disk Rings and Winds in CO at 0.01–10 au: A High-resolution M-band Spectroscopy Survey with IRTF-iSHELL. *The Astronomical Journal*, *163*(4), 174. https://doi.org/10.3847/1538-3881/ac52f0http://dx.doi.org/10.3847/1538-3881/ac52f0

Manara, C., Frasca, A., Venuti, L., Siwak, M., Herczeg, G. J., Calvet, N., … Banzatti, A. (2021). PENELLOPE: The ESO data legacy program to complement the Hubble UV Legacy Library of Young Stars (ULLYSES)-I. Survey presentation and accretion properties of Orion OB1 and σ-Orionis. *Astronomy \& Astrophysics*, *650*, A196.

Kamp, I., Honda, M., Nomura, H., Audard, M., Fedele, D., Waters, L., … others. (2021). The formation of planetary systems with SPICA. *Publications of the Astronomical Society of Australia*, *38*. Published.

Kalyaan, A., Pinilla, P., Krijt, S., Mulders, G. D., & Banzatti, A. (2021). Linking Outer Disk Pebble Dynamics and Gaps to Inner Disk Water Enrichment. *The Astrophysical Journal*, *921*(1), 84. https://doi.org/10.3847/1538-4357/ac1e96http://dx.doi.org/10.3847/1538-4357/ac1e96

White, J. A., Kospal, A, Hughes, A., Abraham, P, Akimkin, V., Banzatti, A., … others. (2020). ALMA and VLA Observations of EX Lupi in its Quiescent State. *The Astrophysical Journal*, *904*(1), 37.

Banzatti, A., Pascucci, I., Bosman, A. D., Pinilla, P., Salyk, C., Herczeg, G. J., … others. (2020). Hints for icy pebble migration feeding an oxygen-rich

chemistry in the inner planet-forming region of disks. *The Astrophysical Journal*, *903*(2), 124.

Pascucci, I., Banzatti, A., Gorti, U., Fang, M., Pontoppidan, K., Alexander, R., … others. (2020). The Evolution of Disk Winds from a Combined Study of Optical and Infrared Forbidden Lines. *The Astrophysical Journal*, *903*(2), 78.

Antonellini, S., Banzatti, A., Kamp, I., Thi, W.-F., & Woitke, P. (2020). Model exploration of near-IR ro-vibrational CO emission as a tracer of inner cavities in protoplanetary disks. *Astronomy & Astrophysics*, *637*, A29.

Long, F., Herczeg, G. J., Harsono, D., Pinilla, P., Tazzari, M., Manara, C. F., … others. (2019). Compact Disks in a High-resolution ALMA Survey of Dust Structures in the Taurus Molecular Cloud. *The Astrophysical Journal*, *882*(1), 49.

Banzatti, A., Pascucci, I., Edwards, S., Fang, M., Gorti, U., & Flock, M. (2019). Kinematic Links and the Coevolution of MHD Winds, Jets, and Inner Disks from a High-resolution Optical [OI] Survey. *The Astrophysical Journal*, *870*(2), 76.

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Bosman, A. D., & Banzatti, A. (2019). The dry and carbon-poor inner disk of TW Hydrae: evidence for a massive icy dust trap. *Astronomy \& Astrophysics*, *632*, L10.

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3. Conference Proceedings:

b. Non-refereed:

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5. Reports:

Oberg, K., Bergin, E., Andrews, S., Banzatti, A., Blake, G. A., Cleeves, L. I., … others. (2019). Astrochemical Origins of Planetary Systems. In *Bulletin of the American Astronomical Society* (3rd ed., Vol. 51).

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7. Essays:

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10. Other Works in Print:

Newspaper Articles:

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B. Works Not in Print:

1. Papers Presented at Professional Meetings:

Banzatti, A., 237th winter meeting of the American Astronomical Society, "A Spitzer + ALMA synergy: a correlation between water emission inside the snow line and the large-scale distribution of disk pebbles," American Astronomical Society, United States. (January 12, 2021).

Banzatti, A., Milan Christmas Workshop on Star and Planet Formation, "Connections between inner disk chemistry & dust drift from the outer disk." (2019).

Banzatti, A., ""Astronomy: why?", an inspiring talk for high-school students (and their parents)," Washington, DC, United States. (2015).

2. Invited Talks, Lectures, and Presentations:

Banzatti, A., Kalyaan, A., Jellison, E., Johnson, M., Physics Colloquium, "TXST and NASA: a story of confirming a fundamental process in planet formation," Texas State University, Physics Department. (November 29, 2023).
Colloquium Announcement 112923-1.pdf

Banzatti, A., Chalmers Astrophysics Colloquium, "From pebbles to water: a long journey from space to Earth and back to space," Chalmers University of Technology, online. (October 11, 2023).

Banzatti, A., Core2disk Conference, "Review on spectral signatures of inner disk winds," University of Paris, Paris, France, Germany. (October 10, 2023).

Banzatti, A., Magnetohydrodynamical flows in young circumstellar disks, "Review on inner disk wind spectroscopic observations," MPIA Heidelberg, Ringberg Castle, Germany, Germany. (October 5, 2023).

Banzatti, A., ODYSSEY Meeting talk, "JWST reveals excess cool water near the snowline in compact disks, consistent with pebble drift," Institute for Planetary sciences and Astrophysics, Grenoble, Grenoble, France, Grenoble. (September 26, 2023).

Banzatti, A., Star and Planet Formation Seminars, "From pebbles to water: a long journey from space to Earth and back to space," ESO - European Southern Observatory, Garching, Garching. (September 19, 2023).

Banzatti, A., The First Year of JWST Science Conference, "JWST reveals excess cool water near the snowline in compact disks, consistent with pebble drift," Space Telescope Science Institute, Baltimore, MD, United States. (September 14, 2023).
2023-JWST-first-year-science-conference-program-1.pdf

Banzatti, A., IWF Colloquium, "The structure of molecular inner disks and winds from infrared spectroscopy," Space Research Institute (Institut für Weltraumforschung, IWF), Graz, Austria. (June 1, 2023).

Banzatti, A., The inner disk of young stars : accretion, ejection, and planet formation, "The structure of molecular inner disks and winds from infrared spectroscopy," Cargèse, Corsica, France. (May 2023).
Affiche-Bouvier-2023-1.jpg

Banzatti, A., IGRINS meeting, "Infrared spectroscopy of planet-forming disks and the SpExoDisks database," UT Austin. (May 4, 2023).

Banzatti, A., Astronomy Colloquium, "Infrared spectroscopy of molecules in planet-forming disks - where we are and where we are going," UT Austin, Austin. (October 18, 2022).

Banzatti, A., Monthly Star Talks, "Infrared spectroscopy of molecules in planet-forming disks - where we are and where we are going," The JEDI (JEts and Disks @INAF) collaboration, Online. (May 4, 2022).
Poster - Star Talk Banzatti-1.pdf
Additional Comments: Talk recorded and available here: https://sites.google.com/inaf.it/jedi/star-talks?authuser=0

Banzatti, A., JWST Cycle 1 Science Sampler, "If you want water, give me pebbles," Space Telescope Science Institute, virtual with live broadcast on Facebook. (November 1, 2021).
JWSTScienceSamplerAd-1.pdf

Banzatti, A., Astronomy Seminars, "Prospects on planet-forming disks and winds from high-resolution M-band spectroscopy," Rice University, Rice University, Houston, TX. (October 20, 2021).

Banzatti, A., 2021 Sagan Exoplanet Summer Workshop on Circumstellar Disks and Young Planets, "Inner disk dust & gas dissipation from multi-tracer studies," NASA EXOPLANET SCIENCE INSTITUTE, CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA, Virtual. (July 20, 2021).
Thank_you_letter_Andrea_Banzatti-1.pdf

Banzatti, A., Planet Formation Research Group Meeting, "Water vapor as a tracer of pebble drift in protoplanetary disks," Rice University, Houston, TX, United States. (January 26, 2021).

Banzatti, A., Planet Formation Research Group Meeting, "Hints for Icy Pebble Migration Feeding an Oxygen-rich Chemistry in the Inner Planet-forming Region of Disks," Lund Observatory, Sweden. (December 2, 2020).

Banzatti, A., 5th Space Settlement Symposium, "Exoplanets: new worlds at the horizon," Texas State University - Department of Philosophy. (September 25, 2020).

Banzatti, A., NMSU Colloquium, "From disks to exoplanets - a journey on the wings of a dragonfly," New Mexico State University. (2019).

Banzatti, A., Texas State Physics Department Colloquium, "From disks to exoplanets - a journey on the wings of a dragonfly," Texas State University. (2019).

Banzatti, A., "Lecture on Newton's law of universal gravitation," University of Mary. (2019).

Banzatti, A., Planet-Forming Disks - A workshop to honor Antonella Natta, "Unveiling the secrets of inner disk winds from a detailed kinematic survey of [OI] optical lines." (2019).

Banzatti, A., California State University Northridge, Colloquium. (2018).

Banzatti, A., University of Nevada, Colloquium, Reno. (2018).

Banzatti, A., NASA JPL, "“Accretion Processes in Planet-Forming Regions” workshop." (2018).

Banzatti, A., "“Protoplanetary disks seen through the eyes of new-generation high-resolution instruments”," Rome, Italy. (2018).

Banzatti, A., "“Take a Closer Look: The Innermost Region of Protoplanetary Discs and its Connection to the Origin of Planets”," Garching, Germany. (2018).

Banzatti, A., TMT talk, ESO Vitacura, "Unveiling the evolution of planet-forming disk regions with velocity-resolved infrared spectroscopy.," Chile. (2017).

Banzatti, A., "“Accretion: building new worlds”," Houston, TX, United States. (2017).

Additional Comments: Revealing the physical and thermo-chemical evolution of planet-forming disk regions

Banzatti, A., "“Molecules in Space: linking the ISM to exoplanets” conference." (2017).

Additional Comments: contributed talk

Banzatti, A., Space Telescope Science Institute. (2016).

Additional Comments: 2014-2016 tow HotSci Seminars

Banzatti, A., NCAD workshops, Carnegie DTM. (2016).

Additional Comments: two contributed talks

Banzatti, A., "IGRINS discussion - disk science with high-resolution near-IR spectroscopy," University of Texas, Astronomy Department. (2016).

Banzatti, A., Astronomy Department, invited talk, "IGRINS discussion - disk science with high-resolution near-IR spectroscopy.," University of Texas. (2016).

Banzatti, A., "Invited talk on Exoplanets and Disks," Sonora Astronomical Society of Arizona. (2016).

Banzatti, A., "Planets and disks: a journey to our origins & Observing inner disks to map the origins of the diverse composition of planets," Clemson University Colloquium. (2016).

Banzatti, A., Protoplanetary Discussions Conference, "The TR diagram - a new empirical tool to reveal disk gaps & Velocity-resolved NIR spectroscopy of disks.," Edinburgh. (2016).

Banzatti, A., Protoplanetary Discussions Conference, "The TR diagram - a new empirical tool to reveal disk gaps & Velocity-resolved NIR spectroscopy of disks.," Edinburgh. (2016).

Banzatti, A., Leiden Observatory, "Witnessing the evolution and depletion of protoplanetary disks from IR gas spectroscopy.." (2016).

Banzatti, A., Leiden Observatory, invited talk, "Witnessing the evolution and depletion of protoplanetary disks from IR gas spectroscopy.." (2016).

Banzatti, A., in middle and high schools, Italy. (2015).

Additional Comments: to present astronomy and research to young students

Banzatti, A., Lowell Observatory Colloquium, invited talk, "Mapping planet-forming regions - from “terra incognita” to expanding frontier.." (2015).

Banzatti, A., California Institute for Technology, "Caught in the act: accretion outbursts depleting gas in protoplanetary disks.." (2014).

Banzatti, A., Hawaii Joint Astronomy Center talk, after an observing run at Gemini North, "Hawaii Joint Astronomy Center talk." (2014).

Banzatti, A., Geneva Observatory, "A tale of water and planet formation.," host: Dr. Didier Queloz. (2013).

Banzatti, A., "The warm molecular gas in protoplanetary disks and the effect of accretion variability.," Goddard Space Flight Center. (2013).

Banzatti, A., "EX Lupi from quiescence to outburst: a study of molecular gas emission affected by stellar variability.," ESO Headquarters, Garching. (2012).

Banzatti, A., Planet Formation and Evolution, "On the role of T Tauri variability in processing the warm molecular gas in young circumstellar disks.," Munich, Germany. (2012).

Banzatti, A., “Planet-Z” meeting, "T Tauri variability and its effect on the molecular gas in the inner regions of protoplanetary disks - Constraints on the building blocks for planets from observations of circumstellar disks: the “small bodies” perspective.," Zurich. (2012).

Banzatti, A., "“Astronomical research: a human adventure - 400 years of telescope observations and the most advanced research on planet formation”," Munich. (2009).

Additional Comments: public meeting for university students during the International Year of Astronomy

5. Other Works not in Print:

c. Other Works Not in Print:

Demonstrations:

Banzatti, A., Wheeler, C., Jaramillo, I., Kunkel, K., Juarez, B., SXSW - South By South West, "SpExoDisks: spectroscopy of exoplanet-forming disks," Austin TX. (March 12, 2023).

Additional Comments: The Texas State University Innovation Lab and Reception is an opportunity for Texas State research teams to showcase their projects to an international audience at SXSW. Our team presented our spectroscopy database SpExoDisks, with a live demonstration on emission line spectra.

Banzatti, A., Wheeler, C., Jaramillo, I., Kunkel, K., Kumar, S., SXSW - South By South West, "SpExoDisks: spectroscopy of exoplanet-forming disks," Austin TX. (March 13, 2022).
Innovation Lab Youre Invited Flyer 2022-1.pdf
IMG_4477-1.jpg
Additional Comments: The Texas State University Innovation Lab and Reception is an opportunity for Texas State research teams to showcase their projects to an international audience at SXSW. Our team presented our newly launched spectroscopy database SpExoDisks.

C. Scholarly / Creative Grants and Contracts:

1. Funded External Grants and Contracts:

Banzatti, Andrea (Principal). JWST-MIRI GO program #3153 in Cycle 2, NASA, Federal, $20,498.00. (Submitted: May 2023, Funded: January 1, 2024 - December 31, 2025). Grant.

Grant Notification - Award of Funds for JWST-GO-03153.007-A-1.pdf

Additional Comments: Program Title:

Why do some 50 Myr old stars still accrete?

Abstract:

The outcome of planet formation is largely determined by how the disk dust and gas evolve. Recent studies have identified a new class of disks that surround late M type stars (>M4.5) at ages of 40-60 Myr and with spectroscopic evidence of active accretion. The strong infrared excess and broad H alpha emission lines are hallmarks of gas-rich primordial disks. Given the typical disk lifetime of 3-5 Myr, surviving for ~10 times longer is very surprising. If these are indeed primordial disks, their survival would revise our understanding of disk dissipation and planet formation around M dwarfs. On the other hand, their infrared excess levels are also consistent with a type of unusually dust-rich debris disks that are believed to have experienced a recent giant collision, along with more compatible ages. We propose to use MIRI/MRS to study the gas and dust content in these peculiar disks and to determine their evolutionary status. The detection of abundant C-bearing molecules with a high C/O ratio, characteristic of young M dwarf disk chemistry, would suggest a long-lived gas-rich disk, while the presence of a large amount of silica dust would point to a recent high-energy collision. Both scenarios will have important implications for planet formation, as the former provides clues for the build-up process of compact systems like TRAPPIST-1, while the latter dives into the active stage of terrestrial planet assembly.

Banzatti, Andrea (Principal). JWST-MIRI GO program #4427 in Cycle 1, NASA, Federal, $34,396.00. (Submitted: May 2023, Funded: June 2023 - May 2025). Grant.

Grant Notification - Award of Funds for JWST-GO-04427.002-A-1.pdf

Additional Comments: Program Title:

The impact of smaller accretion bursts on the planet-forming material in the disk of a young eruptive star

Abstract:

One of the first JWST papers about protoplanetary disks (Kospal et al. 2023) presented a MIRI/MRS study of the young eruptive star EX Lup. The authors discovered cold crystalline silicate grains close to the snowline in the disk, and interpreted it as a long-lasting consequence

of the powerful outburst of EX Lup in 2008. Here we propose an alternative interpretation of the results, raising the possibility that the detected crystalline silicates formed in a very recent smaller burst in 2022 spring. In the present time-critical DD time request, we propose an experiment to discriminate between the two scenarios by taking a new MIRI/MRS 5-27 um spectrum. Comparing the strength of the crystalline silicate features at 16.3, 19.0, 20.0, and 23.5 um with the published JWST observation, we will learn if the features have changed during the 7 months between the two JWST epochs and estimate the timescale of their evolution. Based on models, the constancy (or slow evolution) of the crystalline features points to the 2008 large outburst, while a significant drop implies the 2022 smaller burst as the origin of the crystals. The DD request is justified by the expected rapid evolution of the features in the latter scenario. Waiting for cycle 3 means observations in 2024 Aug, 2.5 years after the small burst, which would not contrain the timescales sufficiently. Proving that the spectral features detected in EX Lup by JWST indeed originate from the 2022 burst would be a paradigm-shifting discovery, implying that not only the rare large outbursts but also the more common smaller bursts can enrich planet-forming disks in crystalline material.

Banzatti, Andrea (Principal). JWST-MIRI GO program #1584 in Cycle 1, NASA, Federal, $18,091.00. (Submitted: December 3, 2020, Funded: June 2022 - May 2025). Grant.

Additional Comments: Program Title:
A DSHARP-MIRI Treasury survey of Chemistry in Planet-forming Regions

Abstract:
We propose a JWST treasury program to obtain MIRI-MRS spectra of the complete sample of protoplanetary disks from the ALMA-DSHARP survey, which obtained high resolution mm-wave images of disk substructures. With MIRI-MRS data, we can produce gas-phase inventories and radial abundance profiles of molecules in the terrestrial planet-forming regions of the DSHARP disks. With these combined datasets, we create the unique potential to study how global disk evolution and planet formation are interconnected with disk chemistry. Ultimately, the chemical makeup of the disk determines the chemical reservoir out of which planets form, and therefore, the composition of planets. In addition to releasing reduced spectra, our team will produce and release several higher-level data products to the community, including line fluxes, bulk molecular parameters (rotational temperature, column density, and emitting area), and molecular abundance ratios. This combined dataset will have the power to support a broad range of investigations, and will have lasting legacy value for both the planet formation and exoplanet communities.

Banzatti, Andrea (Principal), Kalyaan, Anusha (Supporting). JWST-MIRI GO program #1640 in Cycle 1, NASA, Federal, $285,811.00. (Submitted: December 3, 2020, Funded: June 2022 - May 2025). Grant.

PI Notification of Approved Funding for JWST-GO-01640-1.pdf

Additional Comments: Program Title:

The infrared water spectrum as a tracer of pebble delivery to rocky planets.

Abstract:

The dynamics and accretion of pebbles in protoplanetary disks are currently proposed to be decisive in forming planetary systems and determining their architecture and composition. Pebbles are expected to drift efficiently as soon as they reach mm-cm sizes at orbital radii of ~100 au, therefore feeding the inner disk with planet-building material. Depending on a lower or higher mass-flux of pebbles that makes it into the inner 2-3 au, models propose that systems of terrestrial planets rather than super-Earths would form. ALMA images of disks around 1-3 Myr-old stars have revealed that a range of pebble drift efficiencies exists, with some disks retaining pebbles at 50-200 au in systems of rings. While ALMA observations easily reveal pebbles retained in the outer disk, they cannot inform on the pebble mass flux into the inner rocky-planet-forming disk region. In this program, we will use the infrared water spectrum as a tracer of the inward mass-flux of pebbles that drift into the inner ~3 au in disks, by measuring water columns and their relation to the radial distribution of disk pebbles. While a connection between inner disk water and outer dust disk radius has been found using blended Spitzer spectra, the increased resolution of JWST-MIRI will for the first time separate optically thin from thick emission lines, providing a dramatic improvement in water column density measurements. We will provide estimates of pebble mass-fluxes delivered to inner disks in a luminosity-controlled sample of representative dust disk evolution types, and forward model those into inner disk planetary systems for comparison to ~1-10 Earth-mass exoplanets.

Banzatti, Andrea (Principal). JWST-MIRI GO program #2025 in Cycle 1, NASA, Federal, $27,625.00. (Submitted: December 3, 2020, Funded: June 2022 - May 2025). Grant.

Additional Comments: Program Title:

The Chemistry of Planet Formation: A JWST-ALMA Survey of 4 Planet-Forming Disks

Abstract:

Planets form and obtain their volatile inventories in disks around young stars. ALMA has recently completed a large program on the chemistry of 5 such disks at spatial resolutions of 10-15 au. The gas structure and chemical composition of their outer disk regions (>10 au) have been characterized in exquisite detail, revealing an impressive

chemical and morphological diversity. We propose to use MIRI to obtain the complementary chemical composition of the inner 10 au of 4/5 of these disks (the 5th is part of a GTO program). The resulting data set will provide a complete chemical inventory from the small terrestrial planet-forming scales to the outer disk regions where e.g. comets may assemble. We will use the combined JWST-ALMA data set to retrieve the radial column density profiles of the main carriers of volatile C and O, of probes of the C/N/O/S gas-phase elemental ratios, and of key organic molecules across all planet-forming radii. This legacy data set will enable the best constraints to date on the composition of planet forming material at different disk radii, and on the dynamical and chemical links between different disk regions.

Banzatti, Andrea (Principal). JWST-MIRI GO program #2209 in Cycle 1, NASA, Federal, $32,851.00. (Submitted: December 3, 2020, Funded: June 2022 - May 2025). Grant.

PI Notification of Approved Funding for JWST-GO-02209-1.pdf

Additional Comments: Program Title:

Preparing for planets: the impact of the extraordinary outburst of EX Lup on its circumstellar disk.

Abstract:

The extraordinary outburst of the young eruptive star EX Lup in 2008 offers currently the best and only opportunity to study quantitatively the effect of a pre-main sequence outburst on the circumstellar disk. Mid-infrared spectroscopic observations during the burst revealed the formation of crystalline silicates, as well as drastic chemical changes in the abundances of gas-phase OH, H2O, and organic molecules. Observations suggest, and simulations make predictions for the outward transport of the fresh crystals and for the timescales and intensity of molecular changes. Here we propose to use JWST/MIRI in medium resolution spectroscopy mode to re-discover the lost crystalline grains 15 years after the outburst. We will measure their mass, pinpoint the outward transport trajectory, and learn if the crystals could have reached the comet-forming zone behind the snowline, solving the mystery of the measured high crystallinity in solar-system comets. The spectra will also provide unique information on the time-dependent outburst-induced chemistry, and enables us to decide whether molecular reformation leads to long-term cumulative changes in the chemical content of the inner disk. EX Lup is the only target to answer these questions, because precise observations exist for pre-burst, burst, and - with JWST - the post-outburst phases. The project will close the investigation of the 2008 outburst, and provides a quantitative assessment of the effects of similar outbursts, which the proto-Sun also could have experienced, on the chemical and mineralogical inventory of the inner disk where terrestrial planets and comets form.

Banzatti, Andrea. HST-COS program in Cycle 24, NASA, Federal, $162,000.00. (Funded: 2017 - 2020). Grant.

Additional Comments: Program Title:
Measuring residual H2 gas from small to large gaps in protoplanetary disks: different pathways to planets?

Abstract:
We propose HST-COS far-ultraviolet (FUV) spectra of H2 gas emission (UV-H2) in a representative sample of 8 "transitional" disks around young stars of ~1-2 solar masses. By targeting 0.3-5 au disk gaps revealed from the analysis of infrared CO (IR-CO) emission spectra, the proposed HST observations will allow us to measure the density of residual molecular gas from the onset of the smallest disk gaps to the development of large gaps that can be directly imaged. The sensitive measurements of H2 residual gas vs CO disk gap size obtained in this program will constrain gap-formation processes and reveal if all gap sizes belong to a common, sequential evolutionary path or to different paths that affect the orbital distribution and composition of forming planets. This is essential to validate and improve all current theories of planet formation in dispersing disks, extending observations to small disk radii well beyond the angular resolution limits of current imaging techniques. This program takes immediate advantage of recent results finding new gas emission tracers of disk evolution in the UV (with HST-COS, by Hoadley, France, et al. 2015) and in the IR (with VLT-CRIRES, by Banzatti & Pontoppidan 2015), and joins them together into a new, panchromatic view of gas dispersal in planet-forming regions.

2. Submitted, but not Funded, External Grants and Contracts:

Banzatti, Andrea. Sloan Research Fellowships, Sloan Foundation, Private / Foundation / Corporate, $75,000.00. (Submitted: September 15, 2023). Grant.

Banzatti, Andrea. Toward a global view of exoplanet chemistry, Welch Foundation, Private / Foundation / Corporate, $300,000.00. (Submitted: January 30, 2023). Grant.

Banzatti, Andrea. Building a worldwide laboratory for exoplanet chemistry, Welch Foundation, Private / Foundation / Corporate, $300,000.00. (Submitted: January 31, 2022). Grant.

Additional Comments: Abstract:
This research program will build a worldwide online laboratory for the chemical analysis of young protoplanetary disks, the environments where exoplanets are assembling and inheriting their chemical inventory. With the Welch award, our Texas State team will set a new standard in the field by: 1) performing and combining spectroscopic

observations of the most abundant molecules that can be observed in planet-forming regions (including H2O, CO, HCN, C2H2, CO2, NH3), 2) building advanced tools for multi-dimensional data exploration and synergic chemical analyses across molecular spectra, and 3) building a global framework for exoplanet chemistry as a function of stellar irradiation, orbital distance, and time. This program will provide fundamental input to disk models that solve for the global chemistry of planet-forming regions and to exoplanet models that simulate planet chemical compositions emerging from disks. It will also stimulate fundamental research into the chemistry that can be supported in diverse environments, putting Earth-like habitable planets into context. Our Texas State team is a worldwide leader with more than 10 years of experience in planet formation research, continued awards of observations with the best infrared observatories (including the recently launched James Webb Space Telescope), and the conception, design, and development of www.spexodisks.com, our new tool at the forefront of fundamental research in exoplanet chemistry and big data science. SpExoDisks will revolutionize the study of the chemical makeup of exoplanets and make Texas a central hub for the worldwide astrochemical community. The Welch award will support a postdoctoral researcher and master students, which will all be trained in fundamental chemistry and spectroscopy in space.

Banzatti, Andrea. Study of Forming Planets Orbiting Herbig Ae/Be Stars, NASA, Federal, $58,555.00. (Submitted: 2020). Grant.

Additional Comments: Abstract:
We propose an observational and theoretical study of warm gas in disks around intermediate mass stars. Our objectives are to
1. Continue a survey of ro-vibrational CO and OH emission of transition disks around intermediate mass stars. We will acquire high resolution ($\Delta v \sim 4$ kms^{-1}) spectra and milliarcseond (mas) spectroastrometric measurements of these species from the inner $\sim$10 au of circumstellar disks. We will assess the line profiles, spectroastrometric signals, and extent of variability of the CO and OH emission from each source.
2. Conduct a hydrodynamical modeling study of planet-disk interactions and use the results from these studies as well as studies of disk winds to produce synthetic spectra of rovibrational emission lines and their spectroastrometric signal to guide the interpretation of the observational data

3. Funded Internal Grants and Contracts:

Banzatti, Andrea. Building an online laboratory for planet formation, Texas State University, $16,000.00. (Funded: January 1, 2023 - June 1, 2024). Grant.

Additional Comments: Abstract:
In the era of transformative exoplanet discoveries, our view of the

Solar System and our place in the universe has changed in a fundamental way. The next milestone for the worldwide community is to determine how the thousands of planets detected around other stars map into a variety of chemical environments and potential suitability for life. Our only way towards a comprehensive view of exoplanet chemistry is to have large-scale coordinated efforts to combine and jointly analyze a growing amount of data from multiple observatories. This research program is to build an online laboratory for the chemical analysis of young protoplanetary disks, the environments where exoplanets are assembling and inheriting their chemical inventory. With the REP award, our Texas State team will develop fundamental tools for www.spexodisks.com, the multi-observatory spectroscopic database we launched online in the fall of 2021. *SpExoDisks*will make Texas State a central hub for the worldwide astrochemical community. The REP award will support two students to: 1) develop interactive analysis tools for the identification and measurement of molecular lines in all the spectra in the database, 2) develop interactive visualization for stellar parameters to support the interpretation of spectral data, and 3) develop data download infrastructure. This synergic program between Astronomy and Computer Science will provide fundamental input to disk models that solve for the global chemistry of planet-forming regions and to exoplanet models that simulate planet chemical compositions emerging from disks.

Banzatti, Andrea (Principal), Percent Contribution: 70%, Lehr, Theodore Franklin (Co-Principal), Percent Contribution: 10%, Juarez, Benito (Supporting), Percent Contribution: 10%, Jaramillo, Isaac (Supporting), Percent Contribution: 10%. Building an online laboratory for planet formation, https://www.txst.edu/research/oera/rep.html, Institutional (Higher Ed), $16,000.00. (Submitted: October 6, 2022, Funded: January 1, 2023 - December 30, 2023). Grant.
Science_narrative-1.pdf

Banzatti, Andrea. Swiss Astronomical Society travel funding. (Funded: 2011). Grant.

Banzatti, Andrea. ESO Research scholarship for CASA, the data reduction and analysis tool for ALMA. (Funded: 2009). Grant.

4. Submitted, but not Funded, Internal Grants and Contracts:

Banzatti, Andrea. Run to R1 Postdoctoral Researcher Catalyst Program, Texas State University, Texas State University, $110,000.00. (Funded: September 1, 2023 - August 1, 2025). Grant.
submitted-1.pdf

D. Scholarly / Creative Fellowships, Awards, Honors:

Fellowship Recipient: Postdoctoral Fellow, Space Telescope Science Institute.
2013 - 2016

Additional Comments: Baltimore, USA

E. Scholarly / Creative Professional Development Activities Attended:

"Scholarship and Teaching Excellence Program (STEP)," Texas State University. (2019 - 2020).
STEP_completion-1.pdf

Workshop, "CoSE workshop for startup funding." (2019).

Workshop, "Effective Strategies for Finding Funding." (2019).

Workshop, "Tenure and Promotion to Associate Professor: Advice for Assistant Professors." (2019).

Additional Training, "Bringing Out the Best: Diversity, Equity and Inclusion in Action," University of Arizona, AZ, United States. (2018).

Additional Comments: with Dr. Carolyn Brinkworth, Chief Diversity, Equity & Inclusion Officer for UCAR

Workshop, "Ethics, Integrity, and the Handling of Research Misconduct workshop," UofA, AZ, United States. (2018).

Workshop, "Women in Academia: Strategies for Success workshop," UofA. (2018).

"Production of a new pipeline for high-quality reduction of high-resolution mid-infrared echelle & long-slit spectra, designed for VISIR 2.0 at the VLT." (2016 - 2018).

"Testing and development of the ESO pipeline for reduction of VLT-VISIR data, in support to the ESO Software Development Division." (2012).

"Saas-Fee School “From Planets to Life”, Villars-sur-Ollon, Switzerland." (2011).

Additional Comments: (with Prof. Jonathan Lunine, Prof. Jim Kasting, and Prof. John Baross)

"Testing and development of the CASA software for reduction of ALMA data." (2008 - 2009).

F. Media Recognition:

Internet, Nature Japan. (December 1, 2023).
nature-digest-2023-12-12-1.pdf
Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b(ApJ Letters), have been featured in an article on Nature: https://www.natureasia.com/ja-jp/ndigest/v20/n12

Internet, universetoday.com. (November 15, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on universetoday.com: https://www.universetoday.com/164249/jwst-shows-ice-covered-pebbles-delivering-water-to-new-planets/

Internet, thedebrief.org. (November 9, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on thedebrief.org: https://thedebrief.org/clues-to-the-riddle-of-planet-formation-are-revealed-in-latest-james-webb-space-telescope-breakthrough/

Internet, universemagazine.com. (November 9, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on universemagazine.com: https://universemagazine.com/en/sensational-discovery-james-webb-clarified-the-process-of-formation-of-rocky-planets/

Internet, astrobiology.com. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on astrobiology.com: https://astrobiology.com/2023/11/webb-findings-support-a-long-proposed-process-of-planet-formation.html

Internet, NASA.gov. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in a press release: https://www.nasa.gov/missions/webb/nasas-webb-findings-support-long-proposed-process-of-planet-formation/

Internet, phys.org. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in a press release: https://phys.org/news/2023-11-webb-long-proposed-planet-formation.html

Internet, scienmag.com. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on scienmag.com: https://scienmag.com/nasas-webb-findings-support-long-proposed-process-of-planet-formation/

Internet, TXST Newsroom. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in a press release: https://news.txst.edu/research-and-innovation/2023/telescope-planet-formation.html

Internet, webbtelescope.org. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in a press release: https://webbtelescope.org/contents/news-releases/2023/news-2023-144

Internet, Nature News. (September 20, 2023).
How worlds are born_ JWST reveals exotic chemistry of planetary nurseries-1.pdf
Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b(ApJ Letters), have been featured in an article on Nature News: https://www.nature.com/articles/d41586-023-02922-w

Internet, San Marcos Corridor News. (March 14, 2022).

Additional Comments: News coverage of the Big Ideas podcast: https://smcorridornews.com/andrea-banzatti-discusses-james-webb-space-telescope-with-big-ideas-txst/

Internet, Big Ideas TXST Podcast. (March 8, 2022).

Additional Comments: I was interviewed by Jayme Blaschke and Prof. Daniel Seed on my research program with the James Webb Space Telescope:

https://news.txstate.edu/inside-txst/big-ideas-podcast/episode-26-james-webb-telescope-with-andrea-banzatti.html

Internet, Texas State University Newsroom. (January 2022).

Additional Comments: My approved program with JWST was highlighted in an article here:

Texas State physicist to use James Webb Space Telescope to study water delivery to exoplanets

https://news.txstate.edu/research-and-innovation/2022/texas-state-physicist-to-study-water-delivery-to-exoplanets.html

Magazine, skyandtelescope.org. (November 13, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an article on skyandtelescope.org: https://skyandtelescope.org/astronomy-news/webb-shows-planets-really-do-start-with-pebbles/

Newspaper, Scientific American. (November 27, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an interview for Scientific American (interviewer: Shannon Hall, Award-Winning Freelance Science Journalist - http://hallshannonw.com).

Newspaper, The University Star. (November 27, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an interview with The University Star (interviewer: Marisa Nunez).

Newspaper, Austin American-Statesman. (November 18, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an interview by Lily Kepner with the Austin American-Statesman:

https://www.statesman.com/story/news/education/2023/11/18/texas-state-professor-nasa-find-support-for-planet-formation-theory/71582308007/

Newspaper, San Marcos Records. (November 15, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an interview with San Marcos Records: https://www.sanmarcosrecord.com/news/new-research-points-origin-planet-formation

Radio, BBC News - Today. (November 8, 2023).

Additional Comments: My research findings with the James Webb Space Telescope, published in Banzatti et al. 2023b (ApJ Letters), have been featured in an interview with BBC.

Radio, Texas State Network. (January 26, 2022).

Additional Comments: Interview with Russell Scott about my JWST program to observe water delivery to exoplanets.

TV, KHOU 11. (January 24, 2022).

Additional Comments: I was video interviewed for a broadcast on my approved research program to use JWST. The broadcast is available at this link: Texas State University researchers eagerly await data from NASA's new $10 billion telescope:
https://www.khou.com/video/news/local/video/researchers-using-nasa-telescope-in-deep-space-to-study-how-water-is-delivered-to-exoplanets/285-665c1bbc-2982-43d7-8a9e-95bfb17dab5b

IV. SERVICE

A. Institutional

1. University:

Member, CoSE Postdoc Development Working Group. (February 2023 - March 2023).

Organizer, Star and Planet Formation Seminar Series at STScI and of Origins Seminars at the University of Arizona. (2018).

2. College:

Round Table Discussion leader, STEP program for new tenure-track faculty members. (August 19, 2020).
Andrea Banzatti-1.pdf

SOC, “Planet-Z” initiative between the University of Zurich and the ETH. (2012 - 2013).

Additional Comments: to combine the efforts of researchers in planet formation from the fields of astronomy, Earth and planetary sciences, and numerical simulations

3. Department/School:

Library Representative for Physics, Texas State Library. (September 2021 - Present).

Member, Undergraduate Program Committee. (September 2020 - Present).

Member, Presidential Awards Committee. (November 2022 - December 2022).

Physics Representative, Bobcat Day. (April 9, 2022).

Additional Comments: To this Bobcat Day, I brought equipment from our department for a spectroscopy demonstration: I used spectral lamps of hydrogen and neon and diffraction glasses to show visiting students and parents the dispersion of light into the rainbow and specific spectra of different elements. I used the demonstration as a simple illustration of research that we do at our department, in material physics and astrophysics.

Physics Representative, Bobcat Day. (November 20, 2021).

Additional Comments: To this Bobcat Day, I brought and set up a simple experiment of electromagnetism from my 2425 class: a homopolar electric motor made with a battery, magnets, and a copper wire. I used this fun demonstration to show something we learn in class about the magnetic force.

Organizer, “The PhD work-in-progress meeting” at the Institute for Astronomy. (2012 - 2013).

Additional Comments: an initiative for PhD students across fields of research in astrophysics; this successful initiative still continues today.

B. Professional:

Reviewer / Referee, Nature Astronomy. (January 2023 - Present).

Additional Comments: Papers refereed:
- 2023: 1 paper

Reviewer / Referee, The Astrophysical Journal Letters. (January 1, 2023 - Present).

Additional Comments: Number of papers refereed:
- 2023: 1 paper

Reviewer / Referee, Astronomy & Astrophysics Journal. (2021 - Present).

Additional Comments: Papers refereed:
2023 - 1 paper
2021 - 1 paper

Reviewer / Referee, Monthly Notices of the Royal Astronomical Society. (2020 - Present).

Additional Comments: Papers refereed:
2020 - 1 paper
2022 - 1 paper

Reviewer / Referee, The Astrophysical Journal. (2015 - Present).

Additional Comments: Papers refereed:
2022 - 2 papers
2021 - 1 paper
2019 - 1 paper
2018 - 1 paper
2016 - 1 paper
2015 - 1 paper

Coordinator / Organizer, First meeting for the JDISCS collaboration, San Marcos, TX. (December 6, 2023 - December 8, 2023).
IMG_8235-1.jpg
James Webb Space Telescope Flyer-1.pdf
Additional Comments: We hosted at TXST the first meeting of JDISCS, a collaboration of 40+ scientists from 20+ institutions across the world working on planet formation chemistry with the NASA James Webb Space Telescope. Seventeen team members participated in person (attached picture), including four students and one postdoc from our research group at TXST.

As part of this meeting, Dr. Klaus Pontoppidan from NASA JPL gave a public lecture to our TXST community (flyer attached), that was attended by ~150 people between in person and online.

Reviewer / Referee, NASA peer review panel (confidential). (April 2023).

Additional Comments: NASA requested to not disclose the name of the program and keep my participation confidential, but allowed me to include it in my CV in this generic way.

Chair, Review panel on Planets and Planet Formation - NASA James Webb Space Telescope Cycle 2 observations, Baltimore, MD, United States. (March 1, 2023 - April 28, 2023).

Additional Comments: As Chair of one panel, I was also part of the Executive Committee meeting in Baltimore for a second week of work after the panel review work the first week.

Coordinator / Organizer, First Science Results from the James Webb Science Telescope. (December 12, 2022 - December 14, 2022).

JWST_firstresults-1.pdf

Additional Comments: The James Webb Space Telescope was launched successfully on December 25, 2021. Following the commissioning of the telescope and its instruments, the first science observations started in late June and its spectacular first images were revealed to the world on July 12, 2022. STScI, the science and operations center for JWST, hosted a science conference in December to highlight the first scientific results from NASA's newest Great Observatory. The conference was organized around the four science themes: the Early Universe, Galaxy Assembly, Stellar and Planetary Lifecycles, and Other Worlds.

https://www.stsci.edu/contents/events/stsci/2022/december/first-science-results-from-jwst

Andrea Banzatti was part of the Science Organizing Committee

Reviewer / Referee, NASA Hubble Space telescope Time Allocation Committee. (April 2021 - June 2022).

Additional Comments: Committee member for 2 consecutive cycles, 29 and 30 (2021 and 2022). These are yearly cycles of observations with the NASA Hubble Space Telescope, where telescope time is requested through a highly competitive process. This panel reviews proposals and decides on telescope time to award to research teams from around the world.

I reviewed about 35 proposals each cycle, totaling about 70.

Member, "Formation of Planetary Systems" science working group for the SPICA space telescope. (2019 - 2020).

Member, scientific exhibit on Exoplanets promoted by the Euresis Association, Italy. (2018).

Additional Comments: the exhibit had > 10,000 visitors from all ages (kindergarten to senior).

Reviewer / Referee, ALMA grants for the “Development of Chilean Astronomy” (CONICYT). (2017 - 2018).

Reviewer / Referee, NOAO Time Allocation Committee. (2016 - 2018).

Additional Comments: 5 Semesters

Reviewer / Referee, NASA Keck Time Allocation Committee. (2016 - 2017).

Additional Comments: 3 Semesters

Curator, STScI Science Blog “An eye on the Universe”. (2014 - 2016).

Additional Comments: with Dr. Mario Livio, and Dr. Amaya Moro-Martin

Member, three scientific exhibits, including “Why so many lights? The Milky Way in science, history, and art”, Italy. (2006 - 2008).

C. Community:

Speaker, Society of Physics Students. (November 16, 2023).

Additional Comments: I was invited by SPS to present the discovery made with JWST observations that was featured in the NASA press release: https://www.nasa.gov/missions/webb/nasas-webb-findings-support-long-proposed-process-of-planet-formation/

Speaker, Astronomy Club, Texas State University, San Marcos, TX. (October 5, 2022).

Speaker, S.Orsola high school, Rome, Rome. (September 26, 2022).

Additional Comments: Zoom lecture on "Observation in science" as a contribution to a 3-day study retreat on the role of observation across disciplines (art, literature, and science). Organized by S.Orsola high school in Rome, Italy.

Speaker, Society of Physics Students professional development seminar. (April 7, 2022).

Speaker, Society of Physics Students professional development seminar. (March 2020).

Judge, Judge for 8th grade student projects at the annual meeting of SARSEF (Southern Arizona Research, Science, and Engineering Foundation), supporting underrepresented groups into STEM fields. (2018).

Chair, STScI workshop “Linking Exoplanets and Disks Compositions”. (2016).

Judge, Chambliss Astronomy Achievement Student Awards, 223rd AAS winter meeting, Washington, DC. (2014).

SOC, STScI spring symposium “Habitable worlds across Time and Space”. (2014).

LOC, Swiss Astronomical Society annual meeting, Zurich. (2012).

G. Service Professional Development Activities Attended:

Seminar, "Who Fixes Broken Systems? Undoing Legacies of Exclusion in Colleges and Universities," Texas State University. (February 15, 2022).

Additional Comments: Seminar given by Dr. Sirry Alang, Associate Professor of Sociology and Health, Medicine and Society at Lehigh University. Her research explores the role of social structures and institutions in creating and undoing inequities.

Workshop, "Mental Health Concerns at Texas State University," Texas State University. (2019).