

Rui Xue

SOFTWARE ENGINEER · ASTRONOMY

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Skills

General Programming	Python, Git, Bash/C-Shell, LaTeX, reStructuredText, Markdown, HTML/CSS, SQL
OS/Service/Cloud Platform	Linux, macOS, JupyterHub, RESTful API, Amazon Web Services, GitHub, Docker Hub
Scientific Programming/Libraries	IDL, Mathematica , Astropy , VTK , Dask (basics)
Astronomy Software Packages	CASA , MIRIAD , GILDAS , Karma , IRAF , Starlink
Languages	English, Mandarin

Education

Department of Astronomy, University of Illinois at Urbana-Champaign (UIUC)

Urbana, IL

Ph.D. – ASTRONOMY – DISSERTATION: THE RELATION BETWEEN ATOMIC AND MOLECULAR GAS – THE MAGELLANIC CLOUDS AND BEYOND

2008 - 2015

National Astronomical Observatories, Chinese Academy of Science (NAOC)

Beijing, China

M.S. – ASTROPHYSICS – THESIS: PHOTODISSOCIATION REGION LINE DIAGNOSTICS USING CLOUDY

2006 - 2008

Department of Astronomy, Peking University (PKU)

Beijing, China

B.S. – ASTRONOMY – THESIS: A CO/¹³CO/C¹⁸O MAPPING SURVEY OF ULTRA-COMPACT HII REGIONS

2002 - 2006

Work/Research Experience

National Radio Astronomy Observatory

Charlottesville, VA

SOFTWARE ENGINEER IV

2020 - present

- Pipeline software development
- Group lead from May 2023

The University of Iowa

Iowa City, IA

POSTDOCTORAL RESEARCH SCHOLAR (WITH [Hai Fu](#))

2017 - 2020

- Developing a **Python** package to model the line and continuum emission of astronomical sources from terabyte high-resolution radio interferometric data, deployable in an **HPC** environment or as **AWS** instances
- Built computer models to simulate 3D molecular line emission of disc galaxies with arbitrary morphology and kinematics prescriptions
- Used high-resolution **ALMA** spectral line and continuum observations to study gas kinematics and morphology of luminous dusty starburst galaxies in the early universe

Purdue University

West Lafayette, IN

RESEARCH ASSISTANT, POSTDOCTORAL RESEARCH ASSOCIATE (WITH [Kyoung-Soo Lee](#))

2014 - 2017

- Used deep wide-field optical/infrared imaging to study the diffuse neutral hydrogen nebulae through the Ly α emission around high-redshift star-forming galaxies ($z > 2$) in both protocluster and field environments
- Examined how the morphological characteristics of high-redshift circumgalactic Ly α nebulae are related to their host galaxy properties and growth in the early universe
- Developed software algorithms in **Python** and **IDL** to identify high-redshift galaxies from hundreds of gigabyte images and to measure their properties (e.g., shape, size, and brightness) with the presence of image contaminations and artifacts

University of Illinois at Urbana-Champaign

Urbana, IL

RESEARCH ASSISTANT (WITH [Tony Wong](#) AND [Daniel Welty](#))

2008 - 2014

- Developed a data reduction pipeline in **Python** to process multi-terabyte radio interferometer data from **CARMA** and **VLA** for a major nearby galaxy survey
- Wrote a data analysis software library for automated spectral line identifications and measurements in the ultraviolet H₂ Lyman-Werner band
- Built a comprehensive database of ultraviolet molecular hydrogen absorptions found in the Magellanic Clouds
- Studied the interstellar gas cloud formation in low-metallicity extragalactic environments

Combined Array for Research in Millimeter-wave Astronomy (CARMA)

Big Pine, CA

STUDENT ON-SITE OPERATOR

2010 - 2014

- observation planning and 24x7 telescope operation, assistance on instrument maintenance

Teaching Experience

The University of Iowa

GUEST LECTURER

- ASTR 1080 – Exploration of the Solar System

Iowa City, IA

2018

University of Illinois at Urbana-Champaign

TEACHING ASSISTANT

- ASTR 122 – Stars and Galaxies (with Paul Ricker)
- ASTR 404 – Stellar Astrophysics (with Jim Kaler)

Urbana, IL

2009

Scientific/Technical Interests

ASTROPHYSICS

- Radio Interferometry / Synthesis Imaging
- Interstellar Medium in Nearby Galaxies, including the Magellanic Clouds
- Circumgalactic Medium of High-redshift Star-Forming Galaxies
- Star Formation in the Milky Way

TECHNIQUES

- High-performance Computing
- Container Virtualization
- Interactive Visualization of High-dimensional Data

Publication and Proposal

ARTICLES IN REFEREED JOURNALS (PUBLISHED/ACCEPTED/SUBMITTED)

- [1] Y. Huang, K.-S. Lee, O. Cucciati, B. C. Lemaux, M. Sawicki, N. Malavasi, V. Ramakrishnan, **R. XUE**, L. P. Cassara, Y.-K. Chiang, A. Dey, S. D. J. Gwyn, N. Hathi, L. Pentericci, M. K. M. Prescott, and G. Zamorani. Evaluating Ly α Emission as a Tracer of the Largest Cosmic Structure at $z=2.47$. *ApJ*, 941(2):134, December 2022.
- [2] Astropy Collaboration, A. M. Price-Whelan, P. L. Lim, N. Earl, N. Starkman, L. Bradley, D. L. Shupe, A. A. Patil, L. Corrales, C. E. Brasseur, M. Nöthe, A. Donath, E. Tollerud, B. M. Morris, A. Ginsburg, E. Vaher, B. A. Weaver, J. Tocknell, W. Jamieson, M. H. van Kerkwijk, T. P. Robitaille, B. Merry, M. Bachetti, H. M. Günther, T. L. Aldcroft, J. A. Alvarado-Montes, A. M. Archibald, A. Bódi, S. Bapat, G. Barentsen, J. Bazán, M. Biswas, M. Boquien, D. J. Burke, D. Cara, M. Cara, K. E. Conroy, S. Conseil, M. W. Craig, R. M. Cross, K. L. Cruz, F. D'Eugenio, N. Dencheva, H. A. R. Devillepoix, J. P. Dietrich, A. D. Eigenbrot, T. Erben, L. Ferreira, D. Foreman-Mackey, R. Fox, N. Freij, S. Garg, R. Geda, L. Glattly, Y. Gondhalekar, K. D. Gordon, D. Grant, P. Greenfield, A. M. Groener, S. Guest, S. Gurovich, R. Handberg, A. Hart, Z. Hatfield-Dodds, D. Homeier, G. Hosseinzadeh, T. Jenness, C. K. Jones, P. Joseph, J. B. Kalmbach, E. Karamahmetoglu, M. Kałuszyński, M. S. P. Kelley, N. Kern, W. E. Kerzendorf, E. W. Koch, S. Kulumani, A. Lee, C. Ly, Z. Ma, C. MacBride, J. M. Maljaars, D. Muna, N. A. Murphy, H. Norman, R. O'Steen, K. A. Oman, C. Pacifici, S. Pascual, J. Pascual-Granado, R. R. Patil, G. I. Perren, T. E. Pickering, T. Rastogi, B. R. Roulston, D. F. Ryan, E. S. Rykoff, J. Sabater, P. Sakurikar, J. Salgado, A. Sanghi, N. Saunders, V. Savchenko, L. Schwardt, M. Seifert-Eckert, A. Y. Shih, A. S. Jain, G. Shukla, J. Sick, C. Simpson, S. Singanamalla, L. P. Singer, J. Singhal, M. Sinha, B. M. Sipőcz, L. R. Spitler, D. Stansby, O. Streicher, J. Šumak, J. D. Swinbank, D. S. Taranu, N. Tewary, G. R. Tremblay, M. de Val-Borro, S. J. Van Kooten, Z. Vasović, S. Verma, J. V. de Miranda Cardoso, P. K. G. Williams, T. J. Wilson, B. Winkel, W. M. Wood-Vasey, **R. XUE**, P. Yochim, C. Zhang, A. Zonca, and Astropy Project Contributors. The Astropy Project: Sustaining and Growing a Community-oriented Open-source Project and the Latest Major Release (v5.0) of the Core Package. *ApJ*, 935(2):167, August 2022.
- [3] Y. Huang, K.-S. Lee, K. Shi, N. Malavasi, **R. XUE**, and A. Dey. The Role of Dust, UV Luminosity and Large-scale Environment on the Escape of Ly α Photons: A Case Study of a Protocluster Field at $z=3.1$. *ApJ*, 921(1):4, November 2021.
- [4] N. Malavasi, K.-S. Lee, A. Dey, **R. XUE**, Y. Huang, and K. Shi. Ly α Line Properties at $z=3.78$ and Their Environmental Dependence: A Case Study around a Massive Protocluster. *ApJ*, 921(2):103, November 2021.
- [5] J. L. Steffen, H. Fu, J. M. Comerford, Y. S. Dai, S. Feng, A. C. Gross, and **R. XUE**. SDSS-IV MaNGA: The Radial Profile of Enhanced Star Formation in Close Galaxy Pairs. *ApJ*, 909(2):120, March 2021.
- [6] S. Alberts, K.-S. Lee, A. Pope, M. Brodwin, Y.-K. Chiang, J. McKinney, **R. XUE**, Y. Huang, M. Brown, A. Dey, P. R. M. Eisenhardt, B. T. Jannuzi, R. Popescu, V. Ramakrishnan, S. A. Stanford, and B. J. Weiner. Measuring the total infrared light from galaxy clusters at $z=0.5-1.6$: connecting stellar populations to dusty star formation. *MNRAS*, 501(2):1970–1998, February 2021.
- [7] H. Fu, **R. XUE**, J. X. Prochaska, A. Stockton, S. Ponnada, M. W. Lau, A. Cooray, and D. Narayanan. A Long Stream of Metal-poor Cool Gas around a Massive Starburst Galaxy at $z=2.67$. *ApJ*, 908(2):188, February 2021.
- [8] S. Hong, A. Dey, K.-S. Lee, Á. A. Orsi, K. Gebhardt, M. Vogelsberger, L. Hernquist, **R. XUE**, I. Jung, S. L. Finklestein, S. Tuttle, and M. Boylan-Kolchin. Statistics of two-point correlation and network topology for Ly α emitters at $z \approx 2.67$. *MNRAS*, 483(3):3950–3970, March 2019.

- [9] K. Shi, K.-S. Lee, A. Dey, Y. Huang, N. Malavasi, C.-L. Hung, H. Inami, M. Ashby, K. Duncan, **R. XUE**, N. Reddy, S. Hong, B. T. Jannuzi, M. C. Cooper, A. H. Gonzalez, H. J. A. Röttgering, P. N. Best, and C. Tasse. A Census of Galaxy Constituents in a Coma Progenitor Observed at $z > 3$. *ApJ*, 871(1):83, January 2019.
- [10] J. W. Isbell, **R. XUE**, and H. Fu. The Evolution of Molecular Gas Fraction Traced by the CO Tully-Fisher Relation. *ApJ*, 869(2):L37, December 2018.
- [11] **R. XUE**, H. Fu, J. Isbell, R. J. Ivison, A. Cooray, and I. Oteo. Flat Rotation Curves Found in Merging Dusty Starbursts at $z = 2.3$ through Tilted-ring Modeling. *ApJ*, 864(1):L11, September 2018.
- [12] K.-S. Lee, A. Dey, T. Matheson, K. Shi, C.-L. Hung, **R. XUE**, H. Inami, Y. Huang, K.-G. Lee, M. L. N. Ashby, B. Jannuzi, N. Reddy, S. Hong, W. Mo, and N. Malavasi. Discovery of a Very Large (≈ 20 kpc) Galaxy at $z = 3.72$. *ApJ*, 862(1):24, July 2018.
- [13] H. Fu, J. L. Steffen, A. C. Gross, Y. S. Dai, J. W. Isbell, L. Lin, D. Wake, **R. XUE**, D. Bizyaev, and K. Pan. SDSS-IV MaNGA: Galaxy Pair Fraction and Correlated Active Galactic Nuclei. *ApJ*, 856(2):93, April 2018.
- [14] Y. Cao, T. Wong, **R. XUE**, A. D. Bolatto, L. Blitz, S. N. Vogel, A. K. Leroy, and E. Rosolowsky. CARMA Survey toward Infrared-bright Nearby Galaxies (STING). IV. Spatially Resolved ^{13}CO in Spiral Galaxies. *ApJ*, 847(1):33, September 2017.
- [15] **R. XUE**, K.-S. Lee, A. Dey, N. Reddy, S. Hong, M. K. M. Prescott, H. Inami, B. T. Jannuzi, and A. H. Gonzalez. The Diversity of Diffuse $\text{Ly}\alpha$ Nebulae around Star-forming Galaxies at High Redshift. *ApJ*, 837(2):172, March 2017.
- [16] D. Rebolledo, T. Wong, **R. XUE**, A. Leroy, J. Koda, and J. Donovan Meyer. Scaling Relations of the Properties for CO Resolved Structures in Nearby Spiral Galaxies. *ApJ*, 808(1):99, July 2015.
- [17] K. Yim, T. Wong, **R. XUE**, R. J. Rand, E. Rosolowsky, J. M. van der Hulst, R. Benjamin, and E. J. Murphy. The Interstellar Medium and Star Formation in Edge-On Galaxies. II. NGC 4157, 4565, and 5907. *AJ*, 148(6):127, December 2014.
- [18] I. W. Stephens, J. M. Evans, **R. XUE**, Y.-H. Chu, R. A. Gruendl, and D. M. Segura-Cox. Spitzer Observations of Dust Emission from H II Regions in the Large Magellanic Cloud. *ApJ*, 784(2):147, April 2014.
- [19] T. Wong, **R. XUE**, A. D. Bolatto, A. K. Leroy, L. Blitz, E. Rosolowsky, F. Bigiel, D. B. Fisher, J. Ott, N. Rahman, S. N. Vogel, and F. Walter. CARMA Survey toward Infrared-bright Nearby Galaxies (STING). III. The Dependence of Atomic and Molecular Gas Surface Densities on Galaxy Properties. *ApJ*, 777(1):L4, November 2013.
- [20] N. Rahman, A. D. Bolatto, **R. XUE**, T. Wong, A. K. Leroy, F. Walter, F. Bigiel, E. Rosolowsky, D. B. Fisher, S. N. Vogel, L. Blitz, A. A. West, and J. Ott. CARMA Survey Toward Infrared-bright Nearby Galaxies (STING). II. Molecular Gas Star Formation Law and Depletion Time across the Blue Sequence. *ApJ*, 745(2):183, February 2012.
- [21] D. E. Welty, **R. XUE**, and T. Wong. Interstellar H I and H_2 in the Magellanic Clouds: An Expanded Sample Based on Ultraviolet Absorption-line Data. *ApJ*, 745(2):173, February 2012.
- [22] A. J. Kemball, P. J. Diamond, L. Richter, I. Gonidakis, and **R. XUE**. Electric Vector Rotations of $\pi/2$ in Polarized Circumstellar SiO Maser Emission. *ApJ*, 743(1):69, December 2011.
- [23] N. Rahman, A. D. Bolatto, T. Wong, A. K. Leroy, F. Walter, E. Rosolowsky, A. A. West, F. Bigiel, J. Ott, **R. XUE**, R. Herrera-Camus, K. Jameson, L. Blitz, and S. N. Vogel. CARMA Survey Toward Infrared-bright Nearby Galaxies (STING): Molecular Gas Star Formation Law in NGC 4254. *ApJ*, 730(2):72, April 2011.
- [24] Y. Wu, S.-L. Qin, X. Guan, **R. XUE**, Z. Ren, T. Liu, M. Huang, and S. Chen. Properties and Gravitational Collapse of the Core in G19.61 - 0.23. *ApJ*, 697(2):L116–L121, June 2009.
- [25] S.-L. Qin, M. Huang, Y. Wu, **R. XUE**, and S. Chen. High-Resolution Observations of Molecular Lines toward the Hot Core G28.20-0.04N. *ApJ*, 686(1):L21, October 2008.
- [26] **R. XUE** and Y. Wu. A Multiwavelength Study of the Massive Star-forming Region S87. *ApJ*, 680(1):446–456, June 2008.
- [27] Y. Wu, C. Henkel, **R. XUE**, X. Guan, and M. Miller. Signatures of Inflow Motion in Cores of Massive Star Formation: Potential Collapse Candidates. *ApJ*, 669(1):L37–L40, November 2007.

OBSERVING PROPOSALS (AS P.I. OR COLLABORATION MEMBERS)

- [1] C. Yang, S. Eales, I. Smail, E. Gonzalez-Alfonso, R. Ivison, Y. Gao, S. Dye, A. Cooray, E. Ibar, M. Lehnert, H. Messias, R. Gavazzi, A. Beelen, A. Omont, D. Riechers, M. Swinbank, H. Nayyeri, P. Cox, H. Fu, M. Michalowski, J. Nightingale, P. van der Werf, C. Yang, A. Baker, L. Barcos-Munoz, I. Perez-Fournon, R. Neri, **R. XUE** and M. Negrello. Resolving into clump scales in a redshift 3.6 hyper-luminous gas-rich merger. **ALMA CYCLE 8**
- [2] H. Fu, J. Prochaska, D. Narayanan, A. Stockton, J. Hennawi, A. Cooray, A. Gross, J. Isbell, and **R. XUE**. A Dusty Starburst Galaxy Caught in a Heavy Bombardment? **ALMA CYCLE 7**
- [3] K. Lee, A. Dey, **R. XUE**, K. Shi, N. Reddy, and H. Inami. The Origin and Fate of $\text{Ly}\alpha$ Photons at High Redshift. **NOAO/MAYALL 4-METER (MOSAIC3)**, April 2016.
- [4] C. Williams, K. Lee, M. Giavalisco, **R. XUE**, and K. Shi. The First Systematic Search for Protoclusters at $z > 3$ to Study Galaxy Evolution in Dense Environments. **NOAO/MMT (HECTOSPEC)**, April 2015.

- [5] **R. XUE**, T. Wong, and A. Bolatto. High-resolution HI Mapping to Complement the CARMA STING Survey. **NRAO/VLA**, February 2013.
- [6] D. Welty, T. Murphy, **R. XUE**, and T. Wong. Absorption from Diffuse Molecular Gas in the LMC. **ATNF/ATCA**, April 2011.
- [7] T. Wong, **R. XUE**, A. Hughes, M. Filipovic, J. Ott, J. Dickey, L. Staveley-Smith, E. Muller, R. Braun, E. Crawford, J. Pineda, S. Kim, and D. Welty. HI Absorption near High-Brightness Emission in the LMC. **ATNF/ATCA**, April 2010.
- [8] A. Bolatto, T. Wong, L. Blitz, J. Ott, D. Calzetti, F. Walter, E. Rosolowsky, A. West, S. Vogel, A. Leroy, F. Bigiel, **R. XUE**, N. Rahman, and R. Herrera. Completing the CARMA Survey Toward IR-bright Nearby Galaxies. **CARMA**, September 2009.
- [9] Y. Wu, **R. XUE**, T. Wong, C. Henkel, X. Guan, and Y. Wang. Search for Massive Pre-Stellar Cores in MSX Infrared Dark Clouds. **ATNF/MOPRA**, April 2006.

CONFERENCE ABSTRACT/PROCEEDINGS

- [1] T. Wong, **R. XUE**, B. Whitney, F. Heitsch, A. Hughes, A. D. Bolatto, T. Robitaille, and MAGMA Team. Spitzer $8\mu\text{m}$ Emission as a Tracer of Neutral Gas in the Large Magellanic Cloud. In *American Astronomical Society Meeting Abstracts #223*, volume 223 of *American Astronomical Society Meeting Abstracts*, page 454.45, January 2014.
- [2] **R. XUE**, D. Welty, and T. Wong. Rotationally Excited H_2 in the Magellanic Clouds. In T. Wong and J. Ott, editors, *Molecular Gas, Dust, and Star Formation in Galaxies*, volume 292 of *IAU Symposium*, pages 255–255, March 2013.

Open-Source Contributions

ads2bibdesk

<https://www.github.com/r-xue/ads2bibdesk>

2019 - present

- A macOS tool helps you add journal articles listed on NASA/ADS to your local BibDesk database, using the ADS Developer API

ism3d (in development, pastime)

<https://github.com/r-xue/ism3d>

2019 - present

- A user-friendly **PYTHON** package for simulating and modeling astronomical sources from radio interferometric observations
- Distributed as a tradition **PYTHON** package or in a **DOCKER** image built upon *casa6-docker*
- Includes adaption layers of off-the-shelf CPU or GPU NUFFT libraries as imaging gridded and degridder
- Includes general utility toolkits for data analysis and visualizations of spectral-cube and multi-band visibility

ngECT (archived)

https://gitlab.nrao.edu/rxue/ngect_api

2022

- A prototype backend for **ngECT** (ngVLA Sensitivity Calculator), constructed from **PYTHON/FASTAPI**, OAS3-compatible, offering a RESTful API for web-based use
- Provides a CLI light-weight tool for array performance calculations.
- Packaged as a standard Python library for interactive use, or, being incorporated into Python scripts/programs.
- Documentation is available for deployment (e.g., as Docker instances), production use, and further development.

casa6-docker/install (archived)

<https://github.com/r-xue/casa6-docker>

2020

- *casa6-docker*: a build tool to create **DOCKER** images which contain a working data analysis and code development environment with pre-installed modular **CASA6** and other common Python packages (e.g. **ASTROPY**, **JUPYTER**, etc.); suitable for **SINGULARITY**-based HPC deployment.
- *casa6-install*: a **PYTHON**-based command-line tool to help install **CASA6** under Py37/38 on macOS or Linux (only for experimental use). The building process of *casa6-docker* requires *casa6-install*.

htau (archived)

<https://github.com/r-xue/htau>

2012 - 2014

- An optical depth template library for simulating the ultraviolet HI/ H_2 absorption lines in the Lyman-Werner Band
- The calculation source code is available in both **IDL** and **PYTHON**

idl_mommaps (major contributor)

https://github.com/tonywong94/idl_mommaps

2014 - 2015

- An **IDL** package for generating moment maps from radio spectral cubes

xlib (archived)

<https://github.com/r-xue/xlib>

2013 - 2015

- An general-purpose **IDL** utility library for astronomy data analysis and astrophysical modeling

casapy-xlib (archived)

<https://github.com/r-xue/casapy-xlib>

2013 - 2015

- A **CASA**-based data reduction pipeline for the **CARMA STING** $\text{CO}/^{13}\text{CO}$ J=1-0 survey and the ancillary VLA HI 21cm dataset

others (minor contributor)

BUG FIXES, NEW FEATURES

2015 - present

GitHub: [astropy/astropy](#), [wlandsman/IDLAstro](#), [crpurcell/friendlyVRI](#), [telegraphic/hickle](#), [dfm/emcee](#), [tonywong94/maskmoment](#), [linetools/linetools](#), [jonathansick/ads_bibdesk](#), [spack/spack](#), [jobovy/sphinx-astrorefs](#), [jobovy/galpy](#), [jobovy/Torus](#), [TimothyADavis/KinMSpy](#), [andycasey/ads](#), [pympler/pympler](#), [lofar-astron/PyBDSF](#), [conda-forge/casacore-feedstock](#)

Observing Experience

Keck II 10-meter

Waimea, HI

NIRES (NEAR-INFRARED ECHELLETTE SPECTROMETER), VISITING ASTRONOMER

2 nights, 2018

Mayall 4-meter, National Optical Astronomy Observatory (NOAO)

Kitt Peak, AZ

MOSAIC3 & NEWFIRM (EXTREMELY WIDE-FIELD INFRARED IMAGER), VISITING ASTRONOMER

13 nights, 2015-2016

Combined Array for Research in Millimeter-wave Astronomy

Big Pine, CA

STUDENT OPERATOR

63 days, 2010-2014

Mopra 22-meter Radio Telescope, Australia Telescope National Facility (ATNF)

Narrabri, Australia

MOPS (MOPRA SPECTROMETER), VISITING ASTRONOMER

2 days, 2006

Delingha 14-meter Millimeter Telescope, Purple Mountain Observatory (PMO)

Delingha, China

STUDENT INTERN

14 days, 2005

Awards

2017 \$10,000, ALMA Ambassadors Postdoctoral Program

Charlottesville, VA

2012 \$1,700, AAS Travel Grant to IAU XXVIII General Assembly

Beijing, China

Workshop Attendance

2010 NRAO Synthesis Imaging Summer School

Socorro, NM

2009 CARMA Summer School

Big Pine, CA