Karen Willacy

RESEARCH INTERESTS:

- Chemistry of star formation, including protoplanetary disks and prestellar cores
  - Formation and evolution of complex organic molecules
  - Gas/grain interactions in the interstellar medium
  - Isotope chemistry
- Planetary atmosphere chemistry
- Chemistry of circumstellar envelopes around late-type stars

WORK EXPERIENCE AND SKILLS:

SCIENTIFIC:

- Extensive experience in mathematical modeling, solving problems pertaining to the interstellar medium, protostellar disks and planetary atmospheres (including chemistry, dynamics and radiative transfer)
- Member of Titan NAI (PI Lopes)
- Currently involved in modeling of Pluto, Titan, Venus and Mars atmospheres
- Successful writer of grant and telescope proposals, both as P.I. and as Co.I.
- PI (for 3rd year) of JPL/Strategic RTD "Water in the Universe"
- Modeled Spitzer spectra using Cloudy
- Modeled continuum emission using DUSTY
- Reduced and analyzed data from the Infrared Space Observatory, Spitzer and Herschel Space Observatory
- Developed code to analyze satellite observations of Earth
- NASA Origins of Solar Systems review panel member (2000 – 2001)
- Invited to present at domestic and international conferences
- Advisor to NASA postdoctoral fellows (2005 – 2008, 2017 – 2019), as well as several JPL undergraduate summer interns.
- Ph.D. thesis committee member (Mo Yu, University of Texas)
- Mentor to CSULA Masters student (2017-2019)
- Caltech Lecturer in Physics (Winter Quarter 2007 & 2008)

MISSION WORK:

Uranus Flagship Science Formulation (2022-2023)

- Assisting in defining and clarifying science objectives for future Uranus Flagship Mission

Laser Interferometer Space Antenna (LISA) (Nov 2002 – September 2007):

- Worked on the Science Review document for NRC review of Beyond Einstein missions (BEPAC)
- Assisted in the development of the science content of public outreach materials, including the project website, brochure and exhibition booth
- Constructed a web-based repository of project-related graphics and publications for use by the science team

Space Interferometry Mission (SIM) (Sept 2008 – Nov 2010)

- Member of SIM Science Operations Team
- Supported the SIM Science Studies, including coordinating AAS special session
- Supported the Grid Star Observing program
- Part of the team that compiled the proceedings of the 2009 conference "Pathways towards Habitable Planets"

Mars Science Orbiter (July 2007 – Feb 2008)

- Worked with the MSO team and Mission Scientist to integrate the science goals into the mission design
- Supported the preparation of the Science Definition Team report and Proposal Implementation Package

Earth Science (JASON 2 and EOS/AMSR)

- Development of code to analyze satellite observations of the Earth

Anubis (Astronomical UV Probe Imager and Spectrograph)

- Member of project team

The Astrobiology and Deuterium (ADEX) mission(2011)

- Co.I.

Astrobiology Space Infrared Explorer (ASPIRE)

- Collaborator

Trojan Tour

- Science team member

Team X Science Chair (Feb 2008 – Jan 2009)

PROGRAMMING SKILLS:

- FORTRAN – expert
- IDL – proficient
- Python and MPI – beginner
- Some knowledge of C and MATLAB

SERVICE:

- JPL Astrophysics search committee member
- Referee for MNRAS, A&A, and ApJ
- Reviewer for NASA ROSES proposals
- Royal Astronomical Society Honorary Auditor (1996-1997)

MENTORSHIP:

Postdocs:

- Dr. Paul Woods (NPP fellow at JPL, 2005-2008). Currently Senior Editor at Nature Astronomy, London
- Dr. Liton Majumdar (NPP fellow at JPL, 2017-2019). Currently Reader in Star and Planetary Formation Group, NISER, India
- JPL mentor to Visiting Postdoctoral Associate, Dr. Ellen Price, University of Chicago, (2021- present)
- Mentor to new JPL staff member (2011-2012)

Graduate Students:

- Member of graduate student committee: Mo Yu (University of Texas) 2015
- Mentor to CSULA Masters student (2017-2019)

EDUCATION

1990-1993 Ph.D. Astrophysics, University of Manchester, UK
1989-1990 M.Sc. Radioastronomy, University of Manchester, UK
1985-1988 B.Sc. (Hons) Physics, University of Durham, UK

EMPLOYMENT

2000-present Research Scientist, JPL
2007-2008 Lecturer in Physics, Winter Quarter, Caltech
1998-2000 NRC Research Associate, JPL
1995-1998 Postdoctoral research associate, UMIST, UK
1993-1995 Postdoctoral research associate, University of Edinburgh, UK
1988-1989 Computer programmer, Logica Energy & Industry Systems Ltd, UK

PROFESSIONAL MEMBERSHIP

- Fellow of the Royal Astronomical Society
- Member of the American Astronomical Society
- Member of the American Geophysical Society

CITIZENSHIP: US Citizen/UK Citizen

AWARDS:

NASA Exceptional Scientific Achievement Medal (2021)

JPL Team Awards

NASA NAI Titan Team (2018)
Mars Science Orbiter Project Team (2008)

NASA Honor: Group Achievement Awards

Galactic observations of terahertz C^+ science team (2017)
SIM Science Office Team (2011)

INVITED CONFERENCE AND MEETING TALKS

International Cometary Workshop Comets as Tracers of Star Formation and Evolution (Toulouse, France) 2014 "The composition of the presolar nebula"

Lorentz Center Workshop Isotopes in Astrochemistry (Leiden, Netherlands) 2011 "Models of Fractionation in Disks"

Workshop on Disks, Meteorites and Planetesimals (New York) 2010 "The chemical environment of planetesimals"

PUBLICATIONS LIST (REFEREED)

Willacy, K., Chen, S., Adams, D, Yung, Y. (2022) *Vertical distribution of cyclopropenlidene and propadiene in the atmosphere of Titan* ApJ, **933**, 230-265, https://doi.org/10.3847/1538-4357/ac6b9d

Dash, S., Majumdar, L. **Willacy, K.,** Tsai, S.-M., Turner, N. J., Rimmer, P., Gudapati, M. S., Lyra, W., Bhardwaj, A. (2022) *Linking atmospheric chemistry of the hot Jupiter HD 209458b to its formation location through infrared transmission and emission spectra*, ApJ, **932**, 20-41, https://doi.org/10.3847/1538-4357/ac67f0

Willacy, K., Turner, N., Bonev, B., Gibb, E., Dello Russo, N., DiSanti, M., Vervack, R.J. Jr. & Roth, N. X. (2022) *Comets in context: Comparing comet compositions with protosolar nebula models*, ApJ, **931**, 164-186, https://doi.org/10.3847/1538-4357/ac67e3

Tritsis, A., Federrath, C. **Willacy, K.** & Tassis, K. (2022) *Non-ideal MHD simulations of subcritical prestellar cores with non-equilibrium chemistry,* MNRAS, **510,** 4420-4435, https://doi.org/10.1093/mnras/stab3740

Flores-Rivera, L., Terebey, S., **Willacy, K.,** Isella, A., Turner, N. & Flock, M. (2021) *Physical band chemical structure of the disk and envelope of the Class 0/I protostar L1527,* ApJ, **908**, 108-126, https://doi.org/10.3847/1538-4357/abd1db

Scowen, P., Morse, J., Ardila, D., Balasubramanian, B., Bally, J., Devereux, N., Dyster, J., Figer, D., Finkelstein, S., France, K., Gavilan, L., Gorjian, V., Green, J., Grillmair, C., Hartigan, P., Hendrix, A., Howk, C., Hu, R., Hutchings, J., Jansen, R., Kafka, S., Kasting, J., Larruquert, J., Matthews, G., McCandliss, S., McGrath, M., Nikzad, S., Raymond, J., Sahai, R., Siegmund, O., Shkolnik, E., Stahl, P., Tripp, T., Turner, N., **Willacy, K.,** Williams, B., Windhort, R. &Yanatsis, D. (2019) Astro2020: Decadal Survey on Astronomy and Astrophysics Science White Papers. *ANUBIS – A probe-class UVO space observatory (AstroNomical Uv probe Imager & Spectrograph)*, BAAS, **51**, 132-146, https://baas.aas.org/pub/2020n7i132/release/1

Gudipati, M., Milam, S., Hendrix, A., Henderson, B., Linnartz, H., Majumdar, L., Nuevo, M., Paardekooper, D., Sciamma-O'Brien, E., Smith, R., Turner, N. & **Willacy, K**. (2019) Astro2020: Decadal Survey on Astronomy and Astrophysics Science White Papers. *From interstellar ice grains to evolved planetary systems: The role of laboratory studies*, BAAS, **51**, 518-529, https://baas.aas.org/pub/2020n3i518/release/1

Davidsson, B., Husseini, S., Choukroun, M., Gronoff, G., Sahai, R., Turner, N., West, R. & **Willacy, K**. (2019) Astro2020: Decadal Survey on Astronomy and Astrophysics Science White Papers. *Deciphering the protostellar disk evolution recorded by cometary deuterated water*, BAAS, **51**, 182-193 https://baas.aas.org/pub/2020n3i182/release/1

Seo, Y., Majumdar, L., Goldsmith, P., Yancy, S., **Willacy, K.** et al. (2019) *An ammonia spectral map of the L1495-B218 filament in the Taurus molecular cloud. II. CCS and HC_7N chemistry and three modes of star formation in filaments,* ApJ, **871**, 134-158, https://doi.org/10.3847/1538-4357/aaf887

Dodson-Robinson, S. E., Evans, N. J., Ramos, A., Yu, M. & **Willacy, K.** (2018) *Ionization-driven depletion and redistribution of CO in protoplanetary disks,* ApJ, **868**, L37-L43, https://doi.org/10.3847/2041-8213/aaf0fd

Kleinböhl, A., **Willacy, K.**, Friedson, A. J., Chen, P. & Swain, M. (2018) *Buildup of abiotic oxygen and ozone in moist atmospheres in temperature terrestrial exoplanets and its impact on the spectral fingerprint in transit observations,* ApJ, **862**, 92-104, https://doi.org/10.3847/1538-4357/aaca36

Majumdar, L., Gratier, P., Wakelam, V., Caux, E., **Willacy, K.** & Ressler, M. (2018) *Detection of $HOCO^+$ in the protostar IRAS 16293-2422,* MNRAS, **477**, 525-530, https://doi.org/10.1093/mnras/sty703

Douglas, K., Blitz, M. A., Feng, W., Heard, D. E., Plane, J. , Slater, E., **Willacy, K.** & Seakins, P. (2018) *Low temperature studies of the removal reactions of $^1CH_2$ with particular relevance to the atmosphere of Titan,* Icarus, **303**, 10-21, https://doi.org/10.1016/j.icarus.2017.12.023

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Chapman, J.W., Zellem, R.T., Line, M.R., Vasisht, G., Bryden, G., **Willacy, K.** et al. (2017) *Quantifying the impact of spectral coverage on the retrieval of molecular abundances from exoplanet transmission spectra,* PASP, **129**, 104402-104212, https://doi.org/10.1088/1538-3873/aa84a9

Yu, M., Evans, N.J. II, Dodson-Robinson, S.E., **Willacy, K.** & Turner, N. J. (2017) *Disk masses around solar-mass stars are underestimated by CO observations,* ApJ, **841**, 39-57, https://doi.org/10.3847/1538-4357/aa6e4c

Frankland, V.L., James, A.D., Sanchez, J.D.C., Mangan, T.P., **Willacy, K.**, Popper, A.R. & Plane, J.M.C. (2016) *Uptake of acetylene on cosmic dust and production of benzene in Titan's atmosphere,* Icarus, **278**, 88-99, https://doi.org/10.1016/j.icarus.2016.06.007

Willacy, K., Allen, M. & Yung, Y. (2016) *A new astrobiological model of the atmosphere of Titan,* ApJ, **829**, 79-90, https://doi.org/10.3847/0004-637X/829/2/79

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Langer, W. D. & **Willacy, K**. (2001) *Protostellar core properties from far infrared observations,* ApJ, **577**, 714-726, https://doi.org/10.1086/322257

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Willacy, K., Langer, W. D. & Velusamy, T. (1998) *Dust emission and molecular depletion in L1498,* ApJ Letters, **507**, L171-L175, https://doi.org/10.1086/311695

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Willacy K. & Cherchneff, I. (1998) *Silicon and sulphur chemistry in the inner wind of IRC+10216,* A&A, **330**, 676-684, https://articles.adsabs.harvard.edu/pdf/1998A%26A...330..676W

Willacy, K. & Millar, T. J. (1997) *Carbon chemistry in oxygen-rich circumstellar envelopes*, A&A, **324**, 237-248, https://articles.adsabs.harvard.edu/pdf/1997A%26A...324..237W

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Willacy, K., Williams, D. A. & Minh, Y. C. (1993) *Gas-grain interactions and the E/A ratio of methyl cyanide in TMC-1,* MNRAS **263** L40-L42, https://doi.org/10.1093/mnras/263.1.L40

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