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Zigong Xu

Senior Postdoctoral Scholar, Caltech

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ORCID: 0000-0002-9246-996X

Education

Ph.D. in Space Physics (Dr. rer. nat.), *Kiel University, Germany* — Sep 2018 – Aug 2023
Advisor: Prof. Robert F. Wimmer-Schweingruber

M.S. in Astrophysics, *Nanjing University, China* — Sep 2015 – Jun 2018
Advisors: Prof. Chuan Li and Prof. Mingde Ding

B.S. in Space Science and Technology, *Nanjing University, China* — Sep 2011 – Jun 2015

Research Experience

Senior Postdoctoral Scholar Research Associate in Physics — **Sep 2026 – present**
Postdoctoral Scholar Research Associate in Physics — **Sep 2023 – Aug 2026**
California Institute of Technology; Advisor: Dr. Christina M. S. Cohen — *Pasadena, CA, USA*

- Led the first catalog of solar energetic particle (SEP) events with inverse-velocity-arrival features observed by Parker Solar Probe (A&A 2026).
- Studied SEP composition and its radial and longitudinal variations with PSP, Solar Orbiter, STEREO and ACE (ApJL 2024).
- Contributed to deep-learning SEP prediction with Parker Solar Probe data (JGR: MLC 2026).
- Joined the IMAP/HIT instrument team at launch in 2025 (HIT instrument paper, Space Sci. Rev. 2026).

Research Associate and LND Project Manager — **Sep 2018 – Aug 2023**
Chang'E-4 Lunar Lander Neutron and Dosimetry (LND) experiment
Kiel University; Advisor: Prof. Robert F. Wimmer-Schweingruber — *Kiel, Germany*

- Led LND operations and data analysis as project manager; co-author of the LND instrument paper (Space Sci. Rev. 2020).
- Calibrated the LND instrument response and data products with Geant4 simulations.
- Reported the first solar energetic particle event measured on the lunar far side (ApJL 2020).
- Derived the first primary (GCR) and albedo proton spectra on the lunar surface (Front. Astron. Space Sci. 2022).
- Co-discovered a galactic cosmic-ray cavity in Earth–Moon space (Science Advances 2026, co-first author).

Research Associate — **Sep 2020 – Aug 2023**
Solar Orbiter EPD/High Energy Telescope (HET)
Kiel University; Advisor: Prof. Robert F. Wimmer-Schweingruber — *Kiel, Germany*

- Cross-calibrated HET data with other instruments; presented the HET overview and first data (EGU 2021).
- Made the first observations of anomalous cosmic-ray helium in the inner heliosphere and measured cosmic-ray radial gradients from 0.3 to 1 au (A&A 2026; ESA Science Nugget #95).
- Analyzed widespread SEP events observed by EPD.

Research Assistant — **Sep 2015 – Jun 2018**
Nanjing University; Advisors: Prof. Chuan Li and Prof. Mingde Ding — *Nanjing, China*

- Studied coronal shock waves and SEP production with remote-sensing and in-situ observations (ApJ 2017).

Mission and Instrument Roles

IMAP, High-Energy Ion Telescope (HIT): instrument team member — Sep 2025 – present
Parker Solar Probe, IS⊙IS/EPI-Hi: instrument team member — Sep 2023 – present
Solar Orbiter, EPD/High Energy Telescope (HET): instrument team member — Sep 2020 – Aug 2023
Chang'E-4, Lunar Lander Neutron and Dosimetry (LND) experiment: project manager — Jun 2019 – Aug 2023

Publications

50 journal and proceedings papers, 7 as first or co-first author, including two in Science Advances: the galactic cosmic-ray cavity in Earth–Moon space (2026, co-first author, [3]) and the first measurement of the radiation dose on the lunar surface (2020, [47]). 1,327 citations, h-index 20, i10-index 30 (Google Scholar, Nov 2026). Full list: NASA ADS · Google Scholar · ORCID 0000-0002-9246-996X

First and co-first author

[1] **Z. G. Xu**, C. M. S. Cohen, R. A. Leske, G. D. Muro, et al. (2026), "Parker Solar Probe observations of solar energetic particle events with inverse-velocity-arrival features", A&A, 710, A288

[2] **Z. G. Xu**, R. F. Wimmer-Schweingruber, L. Berger, P. Kühl, et al. (2026), "Anomalous cosmic rays within the inner heliosphere: Observations of helium by the High Energy Telescope on board Solar Orbiter", A&A, 708, A36.

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[3] W. Shang*, J. Liu*, **Z. Xu***, et al. (2026), "A galactic cosmic ray cavity in Earth–Moon space", Science Advances, 12, eadv1908. **Co-first authors.*

[4] **Z. G. Xu**, C. M. S. Cohen, R. A. Leske, G. D. Muro, et al. (2024), "Composition variation of the 2023 May 16 solar energetic particle event observed by SolO and PSP", ApJL, 976, L3

[5] **Z. G. Xu**, J. Guo, R. F. Wimmer-Schweingruber, M. I. Dobynde, P. Kühl, S. Khaksarighiri, S. Zhang (2022), "Primary and albedo protons detected by the Lunar Lander Neutron and Dosimetry experiment on the lunar farside", Front. Astron. Space Sci., 9, 974946

[6] **Z. G. Xu**, J. Guo, R. F. Wimmer-Schweingruber, et al. (2020), "First solar energetic particles measured on the lunar far-side", ApJL, 902, L30

[7] **Z. G. Xu**, C. Li, M. D. Ding (2017), "Observations of a coronal shock wave and the production of solar energetic particles", ApJ, 840, 38

In preparation

- **Z. G. Xu**, et al., "Overview of the lunar radiation environment measured by Chang'E-4/LND" (to be submitted)
- **Z. G. Xu**, et al., "Parker Solar Probe observations of the 2025 March 21 nose event" (in preparation)
- **Z. G. Xu**, et al., "Multi-spacecraft observations of a shock at 1 au" (in preparation)

Co-author

[8] A. Kouloumvakos, D. Lario, G. M. Mason, et al., incl. **Z. G. Xu** (2026), "Shock properties for solar energetic particle events with signatures of inverse velocity arrival", ApJ, 1002, 188

[9] C. Han, R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2026), "Solar energetic electron transport across the heliospheric current sheet. A statistical study", A&A, 713, A240

[10] T. Hutchins, S. Kasapis, et al., incl. **Z. G. Xu** (2026), "Solar energetic particle prediction in the inner heliosphere using deep learning and PSP/IS⊙IS data", JGR: Machine Learning and Computation, 3, e2026JH001293

[11] C. M. S. Cohen, G. M. Mason, et al., incl. **Z. G. Xu** (2026), "The 2024 July 23 event: A case study of a multispacecraft, Fe-rich solar energetic particle event", ApJ, 999, 209

[12] E. R. Christian, J. G. Mitchell, et al., incl. **Z. G. Xu** (2026), "The High-Energy Ion Telescope (HIT) for the Interstellar Mapping And Acceleration Probe (IMAP) mission", Space Sci. Rev., 222, 23

[13] R. C. Allen, G. C. Ho, G. M. Mason, et al., incl. **Z. G. Xu** (2026), "Delayed maximum energy solar energetic particle events. Statistical analysis from Solar Orbiter", A&A, 705, A126

[14] G. D. Berland, M. E. Hill, A. Kouloumvakos, et al., incl. **Z. G. Xu** (2026), "Parker Solar Probe observations of suprathermal and energetic particles during orbits 18 and 19", ApJ, 996, 11

[15] X. Chen, C. Li, **Z. G. Xu**, et al. (2025), "Local particle acceleration in an ICME-in-sheath structure observed by Solar Orbiter", ApJ, 994, 211

[16] M. E. Cuesta, F. Fraschetti, G. Livadiotis, et al., incl. **Z. G. Xu** (2025), "Distinct solar energetic particle shock intensity–diffusion coefficient relationships in the inner heliosphere", ApJL, 993, L15

[17] S. Pak, M. E. Cuesta, H. A. Farooki, L. Y. Khoo, **Z. G. Xu**, et al. (2025), "Species-dependent variability in the energy spectra of intense solar energetic particle events observed by PSP/IS⊙IS/EPI-Hi/LET", ApJS, 281, 21

[18] G. D. Muro, C. M. S. Cohen, **Z. G. Xu**, et al. (2025), "Energy-dependent SEP Fe/O abundances during the May 2024 superstorm", Space Weather, 23, e2025SW004604

[19] Z. Ding, R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2025), "Investigation of the inverse velocity dispersion in a solar energetic particle event observed by Solar Orbiter", A&A, 696, A199

[20] G. D. Muro, C. M. S. Cohen, **Z. G. Xu**, et al. (2025), "Radial dependence of ion fluences in the 2023 July 17 solar energetic particle event from Parker Solar Probe to STEREO and ACE", ApJ, 981, 8

[21] M. E. Cuesta, et al., incl. **Z. G. Xu** (2025), "Comparing methods for calculating solar energetic particle intensities: Rebinning versus spectral binning", ApJ, 980, 235

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[22] C. M. S. Cohen, et al., incl. **Z. G. Xu** (2025), "Longitudinal dependence of heavy ion composition in the 2021 October 28 ground level enhancement event", ApJL, 978, L35

[23] L. Yang, et al., incl. **Z. G. Xu** (2024), "Dynamic acceleration of energetic protons by an interplanetary collisionless shock", A&A, 686, A132

[24] M. E. Cuesta, et al., incl. **Z. G. Xu** (2024), "Observations of kappa distributions in solar energetic protons and derived thermodynamic properties", ApJ, 973, 76

[25] G. Livadiotis, et al., incl. **Z. G. Xu** (2024), "Kappa-tail technique: Modeling and application to solar energetic particles observed by Parker Solar Probe", ApJ, 973, 6

[26] C. M. S. Cohen, et al., incl. **Z. G. Xu** (2024), "Observations of the 2022 September 5 solar energetic particle event at 15 solar radii", ApJ, 966, 148

[27] R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2023), "Unusually long path length for a nearly scatter-free solar particle event observed by Solar Orbiter at 0.43 au", A&A, 678, A98

[28] A. Kollhoff, L. Berger, M. Brüdern, N. Dresing, et al., incl. **Z. G. Xu** (2023), "Multi-spacecraft observations of near-relativistic electron events at different radial distances", A&A, 675, A155

[29] N. Dresing, et al., incl. **Z. G. Xu** (2023), "The 17 April 2021 widespread solar energetic particle event", A&A, 674, A105

[30] L. Yang, V. Heidrich-Meisner, L. Berger, et al., incl. **Z. G. Xu** (2023), "Acceleration of suprathermal protons near an interplanetary shock", A&A, 673, A73

[31] J. Guo, X. Li, J. Zhang, M. I. Dobynde, Y. Wang, **Z. G. Xu**, et al. (2023), "The first ground level enhancement seen on three planetary surfaces: Earth, Moon, and Mars", GRL, 50, e2023GL103069

[32] R. Bučík, et al., incl. **Z. G. Xu** (2023), "The first gradual solar energetic particle event with an enhanced ^{3}He abundance on Solar Orbiter", A&A, 669, A13

[33] R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2023), "Advances in energetic particle physics with Solar Orbiter", Proceedings of Science

[34] D. Lario, N. Wijsen, R. Y. Kwon, et al., incl. **Z. G. Xu** (2022), "Influence of large-scale interplanetary structures on the propagation of solar energetic particles: The multispacecraft event on 2021 October 9", ApJ, 934, 55

[35] C. Wang, L. Li, et al., incl. **Z. G. Xu** (2022), "The solar wind and particle radiation environment on the surface of the Moon — New observations from Chang'E-4", Journal of Deep Space Exploration

[36] R. F. Wimmer-Schweingruber, N. Janitzek, D. Pacheco, et al., incl. **Z. G. Xu** (2021), "First year of energetic particle measurements in the inner heliosphere with Solar Orbiter's Energetic Particle Detector", A&A, 656, A22

[37] A. Kollhoff, A. Kouloumvakos, D. Lario, et al., incl. **Z. G. Xu** (2021), "The first widespread solar energetic particle event observed by Solar Orbiter on 2020 November 29", A&A, 656, A20

[38] G. M. Mason, C. M. S. Cohen, G. C. Ho, et al., incl. **Z. G. Xu** (2021), "Solar energetic particle heavy ion properties in the widespread event of 2020 November 29", A&A, 656, L12

[39] R. Bučík, G. M. Mason, R. Gómez-Herrero, et al., incl. **Z. G. Xu** (2021), "The long period of ^{3}He-rich solar energetic particles measured by Solar Orbiter 2020 November 17–23", A&A, 656, L11

[40] A. Aran, D. Pacheco, et al., incl. **Z. G. Xu** (2021), "Evidence for local particle acceleration in the first recurrent galactic cosmic ray depression observed by Solar Orbiter. The ion event on 19 June 2020", A&A, 656, L10

[41] R. C. Allen, I. Cernuda, D. Pacheco, L. Berger, **Z. G. Xu**, et al. (2021), "Energetic ions in the Venusian system: Insights from the first Solar Orbiter flyby", A&A, 656, A7

[42] G. M. Mason, G. C. Ho, R. C. Allen, **Z. G. Xu**, et al. (2021), "Quiet-time low energy ion spectra observed on Solar Orbiter during solar minimum", A&A, 656, L5

[43] R. Gómez-Herrero, D. Pacheco, A. Kollhoff, et al., incl. **Z. G. Xu** (2021), "First near-relativistic solar electron events observed by EPD onboard Solar Orbiter", A&A, 656, L3

[44] R. C. Allen, G. M. Mason, G. C. Ho, et al., incl. **Z. G. Xu** (2021), "Suprathermal particles from corotating interaction regions during the first perihelion pass of Solar Orbiter", A&A, 656, L2

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[45] J. L. Freiherr von Forstner, M. Dumbović, C. Möstl, et al., incl. **Z. G. Xu** (2021), "Radial evolution of the April 2020 stealth coronal mass ejection between 0.8 and 1 AU. Comparison of Forbush decreases at Solar Orbiter and near the Earth", A&A, 656, A1

[46] S. Zhang, D. Hou, R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2021), "Radiation dose of LND on the lunar surface in two years", Chinese J. Space Sci., 41, 439

[47] S. Zhang, R. F. Wimmer-Schweingruber, et al., incl. **Z. G. Xu** (2020), "First measurements of the radiation dose on the lunar surface", Science Advances, 6, eaaz1334

[48] R. F. Wimmer-Schweingruber, J. Yu, et al., incl. **Z. G. Xu** (2020), "The Lunar Lander Neutron and Dosimetry (LND) experiment on Chang'E 4", Space Sci. Rev., 216, 104

[49] W. H. Lei, C. Li, F. Chen, S. J. Zhong, **Z. G. Xu**, P. F. Chen (2020), "Do the solar flares originating from an individual active region follow a random process or a memory-dependent correlation?", MNRAS, 494, 975

[50] C. Li, S. J. Zhong, **Z. G. Xu**, et al. (2018), "Waiting time distributions of solar and stellar flares: Poisson process or with memory?", MNRAS, 479, L139

Talks and Presentations

Invited talks

- AGU Annual Meeting 2026, San Francisco, CA, Dec 2026 (upcoming). Session SH014: Dynamics of Shock Waves in the Heliosphere: Synergies of Multi-Spacecraft Observations and Simulations. *Delocalized source of particle acceleration at shocks: low Mach number near-Sun shock and the 2025 March 21 nose event during PSP perihelion 23* (abstract 2063073)
- Solar Orbiter Working Group on Energetic Particles, Shocks and Solar Activity, online, Oct 2026. *Parker Solar Probe observations of solar energetic particle events with inverse-velocity-arrival features*
- AGU Fall Meeting 2025, New Orleans, LA, Dec 2025. *Multi-spacecraft observations of solar energetic particle events with inverse velocity arrival (IVA) features: PSP and SolO*

Contributed talks and posters

- AGU Fall Meeting 2024, Washington, DC, Dec 2024, poster SH33C-2743. *Inverse velocity arrival (IVA) feature of solar energetic particle events*
- 45th COSPAR Scientific Assembly, Busan, South Korea, Jul 2024, oral. *Composition variations in the May 16, 2023 solar energetic particle event*
- AGU Fall Meeting 2023, San Francisco, CA, Dec 2023, oral. *Combined investigation on solar energetic particle (SEP) events: Insights from SolO, PSP, and observers at 1 au*
- Solar Orbiter Workshop, NASA Goddard Space Flight Center, Greenbelt, MD, Oct 2023, oral. *Solar Orbiter EPD measurements of cosmic rays in the inner heliosphere from 0.3 au to 1 au*
- AGU Fall Meeting 2022, online, Dec 2022, oral. *Solar Orbiter EPD measurements of ACR and GCR in the inner heliosphere from 0.3 au to 1 au*
- 44th COSPAR Scientific Assembly, Athens, Greece, Jul 2022, oral. *Primary and albedo protons measured by the Chang'E-4 Lunar Lander Neutron and Dosimetry (LND) experiment on the lunar far side*
- AGU Fall Meeting 2021, online, Dec 2021, oral P51B-02. *Primary and albedo protons measured by the Chang'E-4 Lunar Lander Neutron and Dosimetry (LND) experiment on the lunar far side*
- EGU General Assembly 2021, online, Apr 2021, oral. *The High Energy Telescope (HET) on the Solar Orbiter mission: Overview and first data*
- AGU Fall Meeting 2020, online, Dec 2020, oral. *First solar energetic particles measured on the lunar far side*
- EGU General Assembly 2020, online, May 2020, oral. *First solar energetic particles measured on the lunar far side*
- AGU Fall Meeting 2019, San Francisco, CA, Dec 2019, poster SH41D-3340. *Energetic particle measurements on the lunar far side by the Lunar Lander Neutron and Dosimetry (LND) experiment*
- 4th Asia-Pacific Solar Physics Meeting (APSPM 2017), Kyoto, Japan, Nov 2017, oral. *Observations of CME shocks and the production of SEPs*

Awards and Honors

- 2026 NASA Group Achievement Award, IMAP Team
- 2023 NASA Group Achievement Award, Parker Solar Probe Team
- 2017 National Scholarship for Graduate Students, Ministry of Education of China

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- 2016 Outstanding Student Leader, Nanjing University
- 2015 Outstanding Graduate Award, Nanjing University

Service, Mentoring, and Outreach

- **Service**
  - Journal reviewer: ApJ, GRL, Space Weather, Planetary and Space Science, Advances in Space Research, Results in Engineering, Scientific Data
  - NASA proposal review panelist: H-TIDeS (Heliosphere In-Situ Sensing – Energetic Particles & Radiation) and Heliophysics Guest Investigators Open (HGIO)
  - Co-convener of Session 13, "Dynamics of Particle Populations Throughout the Inner Heliosphere", SHINE 2026 Workshop, Madison, WI
- **Mentoring**
  - Mentor, Caltech First-Year Success Research Institute (FSRI), summer 2025
  - Mentor, Caltech summer research internship for high-school students: Julian Du (2024, 2025, 2026), Kexuan Wang (2024; now at NYU)
  - Supervised high-school interns from Ricarda-Huch-Schule (2019)
- **Outreach**
  - Translated two popular-science books into Chinese: *The Sun* (Kosmos) and *Traveller's Guide to Mars*
  - Media: cosmic-ray cavity result covered by Live Science, Scientific American, Gizmodo, ScienceAlert and The Naked Scientists (interview), 2026