Curriculum Vitae

Xiangning Chu

Laboratory for Atmospheric and Space Physics
University of Colorado Boulder
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Education:

Dec 2015	Ph.D. Geophysics and Space Physics	University of California, Los Angeles
	Dissertation: Configuration and Generation of Substorm Current Wedge	
Mar 2012	M.S. Geophysics and Space Physics	University of California, Los Angeles
Jun 2009	M.S. Space Physics	Peking University
Jun 2006	B.S. Space Physics	Peking University

Professional Experience

Jan 2018 – Present. Research Associate,	Laboratory for Atmospheric and Space Physics University of Colorado, Boulder
Jan 2016- Jan 2018. Postdoc fellow,	Department of Atmospheric and Oceanic Sciences University of California, Los Angeles
Sep 2009- Dec 2015. Research Assistant,	Department of Earth, Planetary, and Space Sciences University of California, Los Angeles

First-authored Publications:

1. **Chu, X. N.** et al. (2020), Magnetotail flux accumulation leads to substorm current wedge formation: a case study, J. Geophys. Res. Space Physics, 126, 2020JA028342. https://doi.org/10.1029/2020JA028342
2. **Chu, X. N.** et al. (2020), Morphological Characteristics of STEVE emissions, Geophysical Research Letters, J. Geophys. Res. Space Physics, doi:10.1029/2020JA028110
3. **Chu, X. N.** et al. (2019), Identifying STEVE's magnetospheric driver using conjugate observations in the magnetosphere and on the ground, Geophysical Research Letters, doi:10.1029/2019GL082789
4. **Chu, X. N.** et al. (2017), A neural network model of three-dimensional dynamic electron density in the inner magnetosphere, J. Geophys. Res. Space Physics, 122, doi:10.1002/2017JA024464.
5. **Chu, X. N.**, et al. (2017), Erosion and refilling of the plasmasphere during a geomagnetic storm modeled by a neural network, J. Geophys. Res. Space Physics, 122, 7118–7129, doi:10.1002/2017JA023948.
6. McPherron, R. L., and **X. Chu** (2016), The Mid-Latitude Positive Bay and the MPB Index of Substorm Activity, Space Sci. Rev., 1-32, doi:10.1007/s11214-016-0316-6

7. **Chu, X. N.**, et al. (2015), Magnetic mapping effects of substorm currents leading to auroral poleward expansion and equatorward retreat, J. Geophys. Res., 119, doi: 10.1002/2014JA020596.
8. **Chu, X. N**., et al. (2015), Solar cycle dependence of substorm occurrence and duration: implications for onset, Journal of Geophysical Research: Space Physics, 2015JA021104, doi:10.1002/2015JA021104.
9. **Chu, X. N.**, et al. (2014), Development and validation of inversion technique for substorm current wedge using ground magnetic field data, J. Geophys. Res., 119(3), 1909-1924, 10.1002/2013ja019185.
10. **Chu, X. N.**, et al. (2010), THEMIS observations of two substorms on February 26, 2008, SCIENCE CHINA Technological Sciences, 53(5), 1328-1337, 1315:1303:1300.

Manuscript in preparation:

1. **Chu, X. N.** et al. (2020), Unexpected storm-time plasmaspheric density increase at low L shells on the nightside, J. Geophys. Res. Space Physics, (manuscript ready to submit)
2. **Chu, X. N.** et al. (2019), Identification of kinetic Alfven waves at the plasmapause and associated electron acceleration, Geophys. Res. Lett. Space Physics, (manuscript in preparation)
3. **Chu, X. N.** et al. (2019), Predicting relativistic electron flux in the outer radiation belt using an Artificial Neural Network approach, J. Geophys. Res. Space Weather, (manuscript in preparation)

BOOK CHAPTERS AND REVIEW PAPERS:

1. Bortnik, J., **X. Chu**, Q. Ma, W. Li, X. Zhang, R. M. Thorne, V. Angelopoulos, R. E. Denton, C. A. Kletzing, G. B. Hospodarsky, H. E. Spence, G. D. Reeves, S. G. Kanekal and D. N. Baker (2018). Chapter 11 - Artificial Neural Networks for Determining Magnetospheric Conditions, in Machine Learning Techniques for Space Weather, edited by E. Camporeale, S. Wing and J. R. Johnson, pp. 279-300, Elsevier, doi:https://doi.org/10.1016/B978-0-12-811788-0.00011-1.
2. Liu, J., V. Angelopoulos, Z. Yao, **X. Chu**, X. Z. Zhou, and A. Runov (2018), The Current System of Dipolarizing Flux Bundles and Their Role as Wedgelets in the Substorm Current Wedge, in Electric Currents in Geospace and Beyond, edited, doi:10.1002/9781119324522.ch19.
3. McPherron, R. L., and **X. Chu** (2016), The Mid-Latitude Positive Bay and the MPB Index of Substorm Activity, Space Sci. Rev., 1-32, doi:10.1007/s11214-016-0316-6.

CO-AUTHOR PAPERS:

1. Li, J., **Chu, X.,** Bortnik, J., Weygand, J., Wang, C.-P., Liu, J., et al. (2021). Characteristics of substorm-onset-related and nonsubstorm earthward fast flows and associated magnetic flux transport: THEMIS observations. Journal of Geophysical Research: Space Physics, 126, e2020JA028313.

https://doi.org/10.1029/2020JA028313

2. Ripoll, J. F., M. Denton, V. Loridan, O. Santolík, D. Malaspina, D. P. Hartley, G. S. Cunningham, G. Reeves, S. Thaller, D. L. Turner, J. F. Fennell, A. Y. Drozdov, J. S. Cervantes Villa, Y. Y. Shprits, **X. Chu**, G. Hospodarsky, W. S. Kurth, C. A. Kletzing, J. Wygant, M. G. Henderson and A. Y. Ukhorskiy (2020). "How whistler mode hiss waves and the plasmasphere drive the quiet decay of radiation belts electrons following a geomagnetic storm." Journal of Physics: Conference Series 1623: 012005.

3. Haiducek, J. D., D. T. Welling, S. K. Morley, N. Y. Ganushkina and **X. Chu** (2020). "Using Multiple Signatures to Improve Accuracy of Substorm Identification." Journal of Geophysical Research: Space Physics 125(4): e2019JA027559.

4. C. P. Wang, X. Xing, J. Bortnik, and **X. Chu** (2020), Inward propagation of flow-generated Pi2 waves from the plasma sheet to the inner magnetosphere, Journal of Geophysical Research: Space Physics, https://doi.org/10.1029/2019JA027581

5. J. Liang, E. Donovan, M. Connors, D. Gillies, B, Jackel, J.P. St-Maurice, B. Gallardo-Lacourt, E. Spanswick, and **X. Chu** (2019), On the optical spectra and emission altitudes of STEVE: A case study, Geophysical Research Letters, 46, 13630– 13639. https://doi.org/10.1029/2019GL085639

6. Khoo, L.-Y., X. Li, H. Zhao, **X. Chu**, Z. Xiang and K. Zhang (2019). "How Sudden, Intense Energetic Electron Enhancements Correlate With the Innermost Plasmapause Locations Under Various Solar Wind Drivers and Geomagnetic Conditions." Journal of Geophysical Research: Space Physics 124(11): 8992-9002.

7. Fletcher, A. C., C. Crabtree, G. Ganguli, D. Malaspina, E. Tejero, and **X. Chu** (2019), How sudden, intense energetic electron enhancements correlate with the innermost plasmapause locations under various solar wind drivers and geomagnetic conditions, Journal of Geophysical Research: Space Physics, 124, 8992– 9002. https://doi.org/10.1029/2019JA027412

8. Fletcher, A. C., C. Crabtree, G. Ganguli, D. Malaspina, E. Tejero, and **X. Chu** (2019), Kinetic Equilibrium and Stability Analysis of Dipolarization Fronts, Journal of Geophysical Research: Space Physics, 124, 2010-2028.doi:https://doi.org/10.1029/2018JA026433

9. Camporeale, E., **X. Chu**, O. V. Agapitov, and J. Bortnik (2019), On the Generation of Probabilistic Forecasts From Deterministic Models, Space Weather, 17(3), 455-475, doi:10.1029/2018sw002026.

10. Ma, Q., W. Li, J. Bortnik, R. M. Thorne, **X. Chu**, L. G. Ozeke, G. D. Reeves, C. A. Kletzing, W. S. Kurth, G. B. Hospodarsky, M. J. Engebretson, H. E. Spence, D. N. Baker, J. B. Blake, J. F. Fennell and S. G. Claudepierre (2018). "Quantitative Evaluation of Radial Diffusion and Local Acceleration Processes During GEM Challenge Events." Journal of Geophysical Research-Space Physics 123(3): 1938-1952. doi:10.1002/2017ja025114.

11. McPherron, R. L., and **X. N. Chu** (2018), The Midlatitude Positive Bay Index and the Statistics of Substorm Occurrence, J. Geophys. Res-Space Phys., 123(4), 2831-2850, doi:10.1002/2017ja024766.

12. McPherron, R. L., B. J. Anderson, and **X. N. Chu** (2018), Relation of Field-Aligned Currents

Measured by the Network of Iridium (R) Spacecraft to Solar Wind and Substorms, Geophys. Res. Lett., 45(5), 2151-2158, doi:10.1002/2017gl076741.

13. Malaspina, D. M., J. F. Ripoll, **X. N. Chu**, G. Hospodarsky, and J. Wygant (2018), Variation in Plasmaspheric Hiss Wave Power With Plasma Density, Geophys. Res. Lett., 45(18), 9417-9426, doi:10.1029/2018gl078564.

14. Malaspina, D. M., A. Ukhorskiy, **X. N. Chu**, and J. Wygant (2018), A Census of Plasma Waves and Structures Associated With an Injection Front in the Inner Magnetosphere, J. Geophys. Res-Space Phys., 123(4), 2566-2587, doi:10.1002/2017ja025005.

15. Li, J., J. Bortnik, W. Li, R. M. Thorne, Q. Ma, **X. Chu**, L. Chen, C. A. Kletzing, W. S. Kurth, G. B. Hospodarsky, J. Wygant, A. Breneman and S. Thaller et al. (2017), Coherently modulated whistler mode waves simultaneously observed over unexpectedly large spatial scales, Journal of Geophysical Research: Space Physics, 122(2), 1871-1882, doi:10.1002/2016JA023706.

16. Liu, J., Angelopoulos, V., Zhang, X.-J., Runov, A., Artemyev, A., Plaschke, F., Fu, F, Lu, S., Liu, Y., **Chu, X.** (2017). Ultralow frequency waves deep inside the inner magnetosphere driven by dipolarizing flux bundles. Journal of Geophysical Research: Space Physics, 122. https://doi.org/10.1002/2017JA024270

17. Wang, C.-P., H.-J. Kim, C. Yue, J. M. Weygand, T.-S. Hsu, and **X. Chu** (2017), Effects of solar wind ultralow-frequency fluctuations on plasma sheet electron temperature: Regression analysis with support vector machine, Journal of Geophysical Research: Space Physics, doi:10.1002/2016JA023746.

18. Liu, J., V. Angelopoulos, **X. Chu**, and R. L. McPherron (2016), Distribution of Region 1 and 2 currents in the quiet and substorm time plasma sheet from THEMIS observations, Geophys. Res. Lett., 43(15), 7813-7821, doi:10.1002/2016GL069475.

19. McPherron, R. L., and **X. Chu** (2016), Relation of the auroral substorm to the substorm current wedge, Geoscience Letters, 3(1), 1-10, doi:10.1186/s40562-016-0044-5.

20. Connors, M., C. T. Russell, **X. N. Chu**, and R. L. McPherron (2015), The February 24, 2010 substorm: a refined view involving a pseudobreakup/expansive phase/poleward boundary intensification sequence, Earth Planets Space, 67, doi:10.1186/s40623-015-0363-3.

21. Yao, Z., J. Liu, C. Owen, C. Forsyth, I. Rae, Z. Pu, H. Fu, X.-Z. Zhou, Q. Shi, A. Du and **X. Chu** (2015). "A physical explanation for the magnetic decrease ahead of dipolarization fronts ", Ann. Geophys.33(10):1301-1309

22. McPherron, R. L., T. S. Hsu, and **X. N. Chu** (2015), An optimum solar wind coupling function for the AL index, J. Geophys. Res-Space Phys., 120(4), 2494-2515, doi:10.1002/2014ja020619.

23. Liu, J., V. Angelopoulos, **X. Chu**, X.-Z. Zhou and C. Yue (2015). Substorm Current Wedge Composition by Wedgelets. Geophysical Research Letters: 2015GL063289.

24. Z. H. Yao, Z. Y. Pu, A. M. Du, V. Angelopoulos, C. J. Owen, J. Liu, **X. N. Chu**, X. Cao, S. Y. Fu, Q. G. Zong, and Y. Wang (2014), Pressure gradient evolution in the near-Earth magnetotail at the arrival of BBFs, Chin. Sci. Bull., 59(34), 4804-4808, doi:10.1007/s11434-014-0618-6.

25. Yao, Z. H., Z. Y. Pu, C. J. Owen, S. Y. Fu, **X. N. Chu**, J. Liu, V. Angelopoulos, I. J. Rae, C. Yue, X. Z. Zhou, Q. G. Zong, X. Cao, Q. Q. Shi, C. Forsyth and A. M. Du (2014). "Current reduction in a pseudo-breakup event: THEMIS observations." Journal of Geophysical Research: Space Physics 119(10): 2014JA020186.

26. Connors, M., R. L. McPherron, B. J. Anderson, H. Korth, C. T. Russell, and **X. N. Chu** (2014), Electric currents of a substorm current wedge on 24 February 2010, Geophys. Res. Lett., 41(13), 4449-4455, doi:10.1002/2014gl060604.

27. Yao, Z., W. J. Sun, S. Y. Fu, Z. Y. Pu, J. Liu, V. Angelopoulos, X. J. Zhang, **X. N. Chu**, Q. Q. Shi, R. L. Guo and Q. G. Zong (2013). "Current structures associated with dipolarization fronts." Journal of Geophysical Research: Space Physics 118(11): 2013JA019290.

28. Yao, Z. H., V. Angelopoulos, Z. Y. Pu, S. Y. Fu, M. Kubyshkina, J. Liu, **X. N. Chu**, T. Nishimura, X. Cao, A. M. Du, C. Yue, Q. Q. Shi and Y. Wei (2013). "Conjugate observations of flow diversion in the magnetotail and auroral arc extension in the ionosphere." Journal of Geophysical Research-Space Physics 118(8), 4811-4816, doi:10.1002/jgra.50419.

29. McPherron, R. L., D. N. Baker, T. I. Pulkkinen, T. S. Hsu, J. Kissinger, and **X. Chu** (2013), Changes in solar wind–magnetosphere coupling with solar cycle, season, and time relative to stream interfaces, Journal of Atmospheric and Solar-Terrestrial Physics, 99(0), 1-13, doi:10.1016/j.jastp.2012.09.003.

30. Hsu, T. S., R. L. McPherron, V. Angelopoulos, Y. S. Ge, H. Zhang, C. Russell, **X. N. Chu**, and J. Kissinger (2012), A statistical analysis of the association between fast plasma flows and Pi2 pulsations, J. Geophys. Res., 117, doi:10.1029/2012ja018173.

31. Kissinger, J., R. L. McPherron, T. S. Hsu, V. Angelopoulos, and **X. Chu** (2012), Necessity of substorm expansions in the initiation of steady magnetospheric convection, Geophys. Res. Lett., 39(15), L15105, doi:10.1029/2012GL052599.

32. McPherron, R. L., T. S. Hsu, J. Kissinger, **X. Chu**, and V. Angelopoulos (2011), Characteristics of plasma flows at the inner edge of the plasma sheet, J. Geophys. Res., 116, doi:10.1029/2010ja015923.

33. Pu, Z. Y., **X. Chu**, X. Cao and et al. (2010), THEMIS observations of substorms on 26 February 2008 initiated by magnetotail reconnection, J. Geophys. Res., 115(A2), A02212, doi:10.1029/2009JA014217.

34. Wei, Y., Z. Pu, M. Hong, Q. Zong, Z. Ren, S. Fu, L. Xie, S. Alex, X. Cao, J. Wang and **X. Chu** (2009). "Westward ionospheric electric field perturbations on the dayside associated with substorm processes." Journal of Geophysical Research (Space Physics) 114, doi:10.1029/2009ja014445.

Invited Talks:

Chu, X. N. et al. (2017), Learning plasmaspheric dynamics using neural network based empirical models, University of Colorado Boulder, Boulder, CO

Chu, X. N. et al. (2016), Erosion and refilling of the plasmasphere during a geomagnetic storm modeled by a neural network, University of Calgary, Calgary, Canada

Chu, X. N (2012), Introduction to high latitude electrodynamics, GEM student tutorial, Snowmass, CO

Honors and Awards:

NASA Earth and Space Sciences Fellowship NASA 2014
Outstanding Student Presentation Award Geospace Environment Modeling Workshop 2014
Harold and Mayla Sullwold scholar Department of Earth, Planetary, and Space Sciences (UCLA) 2014
Harold and Mayla Sullwold scholar Department of Earth, Planetary, and Space Sciences (UCLA) 2015
President's Undergraduate Research Fellowship Peking University 2004
The Freshman Scholarship Peking University 2002

Teaching and Mentoring Experience

Mentor for an undergraduate thesis Winter 2020 and Spring 2021
University of Vermont

- Mentor an undergraduate student in analyzing the total plasma density in the ionosphere and inner magnetosphere
- Guided the student to develop a machine learning based model for the plasma density in the ionosphere and magnetosphere

Mentor for NSF Research Experiences for Undergraduates Summer 2020
University of Colorado, Boulder

- Mentor an undergraduate student in analyzing the total plasma density in the inner magnetosphere
- Guided the student to develop a machine learning based empirical model for the plasma density

Mentor for an undergraduate student Summer 2019
University of Colorado, Boulder

- Mentor an undergraduate student in analyzing the auroral data collected from citizen scientists and calibrating skymaps of photographs
- Guided the student to obtain properties of newly discovered STEVE phenomenon

Mentor for an undergraduate student Summer 2018
University of Colorado, Boulder

- Mentor an undergraduate in data collection and analysis to obtain the plasma density from Van Allen Probe satellite
- Guided the undergraduate student to identify plasmapause and dipolarization front in Earth's magnetosphere

Mentor for a high school student Summer 2015
University of California, Los Angles

- Mentor a high school student to build a database of the newly developed mid-latitude positive bay index to measure geomagnetic activity level

Mentor for a high school student Summer 2010
University of California, Los Angles

- Mentor a high school student to develop a procedure to remove solar quiet variation from magnetic field data from ground magnetometers

Organizer of a summer school and teaching Olympic physics Summer 2006
Huangshi, Hubei, China

- Organizing a summer school to tutor twenty high school students
- Teaching the physics of Olympics

Grants Received:

Principle Investigator, NASA Heliophysics **Early Career Investigator Program** 2018
Title: Coupling Machine Learning Models of Multi-Instrument Spacecraft Data and Physics-Based Simulations: Applications to Study and Forecast Ultra-Relativistic Electron Flux
Total efforts: 10 months/year for 3 years
Total amount: $446,836

Co-investigator, NASA Heliophysics Supporting Research 2019
Title: Quantitative assessment of effects of the broadband electrostatic turbulence in the inner magnetosphere
Total efforts: 3 months/year for 3 years
Total amount: $255,000

Co-Investigator, NASA Heliophysics Heliophysics Living With a Star Science 2019
Title: Quantifying Wave-Induced Relativistic Electron Flux Variations in Earth's Radiation Belts Driven by Solar Wind Structures
Total efforts: 4 months/year for 4 years
Total amount: $261,988

Co-Investigator, NASA Heliophysics Space Weather Operations to Research 2018
Title: A machine learning based specification and forecast model of the inner magnetospheric radiation environment
Total efforts: 2.4 months/year for 2 years
Total amount: $82,533

Co-Investigator, NASA Heliophysics Supporting Research 2017
Title: Quantifying the response of ionospheric currents to substorm-time and non-substorm fast flows
Total efforts: 6 months/year for 3 years
Total amount: $165,828

Co-Investigator, NASA Earth and Space Science Fellowship 2014
Title: What process creates the substorm current wedge? A study using observations from space, ionosphere, and ground
Note: I wrote the full proposal, I was a co-I and my Ph.D. advisor is the PI due to solicitation requirements

Proposal pending and declined:

Principal investigator, NASA Heliophysics Guest Investigators 2018 (declined)
Title: Evaluating the effects of radial diffusion and local acceleration processes on relativistic electron acceleration and loss using a machine learning technique

Principal investigator, NASA Heliophysics Supporting Research 2018 (declined)
Title: Studying temporal and spatial evolutions of pitch angle distribution of relativistic electrons using machine-learning-aided physics-based simulation

Principal investigator, NASA Heliophysics Living With a Star Science 2019 (declined)
Title: Studying the response of energetic electrons to different solar wind driving conditions and geomagnetic activity using machine learning
Note: Rated VG, E/VG, but not funded due to limited funding.

Co-Investigator, NASA Heliophysics Space Weather Operations to Research 2018 (declined)
Title: Modeling Radiation Belt Electron Dynamics Using Plasma Wave Distributions Constructed from Empirical Model and Machine Learning Technique

Principal investigator, NASA Heliophysics Supporting Research 2019 (declined)
Title: Studying the spatiotemporal correlations between hiss and chorus waves using a ray tracing model and machine learning techniques

Co-Investigator, NASA Heliophysics Theory, Modeling, and Simulations 2019 (declined)
Title: Dynamic modeling of the Van Allen radiation belts using AI-based emulator functions

Professional experience:

Panelist, NASA Living With a Star

Panelist, NASA Heliophysics Guest Investigators

Mail-in Panelist, NASA Heliophysics Supporting Research

Outstanding Student Poster Judge, AGU and GEM conferences, 2016-present

Manuscript Peer Review: three AGU Book chapters, Journal of Geophysical Research, Geophysical Research Letter, Journal of Ambient Intelligence and Humanized Computing, Philosophical Transactions A, Annales Geophysicae, Journal of Atmospheric and Solar-Terrestrial Physics, Geoscience Letters