Curriculum Vitae

Last update: March 19, 2024

Ethan Tsai

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Education

January 2024 | Ph.D. in Geophysics and Space Physics, UCLA

My thesis utilized ELFIN data and large ensemble test particle simulations to explore how various characteristics of non-linear wave particle interactions between whistler-mode waves and energetic/relativistic electrons contribute to radiation belt loss mechanisms.

June 2022 | M.S. in Geophysics and Space Physics, UCLA

June 2017 | B.S. in Physics, UCLA

Did theoretical space physics research between May 2016 – Jan 2017 resulting in a paper about ion dynamics in a thin current sheet under the influence of a polarization electric field.

Work

Feb 2024 – Present | Aerospace Engineer III at EPSS UCLA

Sept 2022 – Jan 2024 | R&D Manager of Experimental Space Physics Group at UCLA

Oversee multiple heliophysics projects, including 2 CubeSat missions, 4 instrument development projects, and various balloon flights. Responsible for mission traceability, often translating science requirements into engineering requirements and overseeing rigorous mission design/development. Currently manage a large team of several staff engineers and over 40 students. Already played either a key or leading role in multiple proposals from the ESP group, including: NASA HPD HITS, HTIDeS, and HFORT; AFRL UNP; DoD DURIP; and NASA STMD TechLeap Prize.

Sept 2018 – Sept 2022 | ELFIN Project Manager at UCLA (flight)

Directed post-launch operations resulting in a highly successful 4-year mission. Managed a team of 15-30 undergraduates to operate 2 satellites, developed + refactored entire ground operations software (resulting in >500000 lines of code, 12 mission critical git repos, and an operational paradigm that allows students to easily perform complex day to day spacecraft operations), maintained 2 LEO uplink/downlink ground stations, oversaw scientific data processing and data distribution pipelines, and designed/upgraded/maintained all lab networking and infrastructure. Led the successful public release of ELFIN data in Aug 2021, supported scientific work/analysis, and represented ELFIN at several conferences. ELFIN has been both a scientific and educational success: 1) 2022 alone saw 15 publications in peer-reviewed scientific journals using ELFIN data, far exceeding even the typical *lifetime* science return of the vast majority of NASA CubeSat

missions and 2) over 350 undergraduates have contributed in some technical capacity to the ELFIN mission which directly helps NASA maintain a talented workforce in both academia and industry.

Jan 2017 – Sept 2018 | ELFIN Project Manager at UCLA (development)

Led an extremely compressed timeline from post-CDR to launch for ELFIN; this included, e.g. 1) mission scope growth from one to two spacecraft <10 months before launch along and 2) 18-month-late delivery of mission critical flight hardware. While managing an undergraduate team of 50-80 students, I led and completed 4 TVAC campaigns, 3 vibe & shock test campaigns, assembly integration and test campaigns for 3 engineering units and 2 flight units, and a variety of other required/self-imposed tests (DITL, range, spin, deployments, etc.). I was responsible for setting mission and technical scope, managing budget, tracking schedule, and mission level risk mitigation while interfacing with vendors, contractors, NASA/LSP, Launch Integrator (Tyvak), FCC, and various funding sources (NASA HQ, NSF, UCLA). I also worked closely in all technical capacities, especially contributing to systems engineering, harnessing, ADCS, flight software, thermal sims/testing, comms/radios, and building GSE. Ultimately, we delivered 2 healthy satellites at cost and on schedule after I spearheaded rigorous and effective external reviews including Pre-Ship Review, Operational Readiness Review, and Mission Readiness Review.

Oct 2014 – Jan 2017 | ELFIN ADCS Lead

Designed the attitude determination and control system on ELFIN. Implemented ground-in-the-loop simulations (including attitude propagator, orbit propagator, and perturbation effects), tuned digital filters for onboard spin control, and devised ground tests to validate attitude control performance. Also, qualified previously-unflown hardware for flight.

Skills

Science: Space Plasma Theory · Magnetospheric/Radiation Belt Physics · Modeling of Wave-Particle Interactions · Parallelized Large Ensemble Particle Simulations · Numerical Methods · Numerical Optimization · Modeling of Dynamical Systems · Data/Statistical Analysis · Spectral Analysis · Instrument Development, Testing, Calibration, and Operations · Academic Writing

Technical: Project management · Process/Configuration Management · Systems Engineering · Embedded Systems · Spacecraft Assembly, Integration, and Testing · Spacecraft Operations · ADCS/GNC/Orbital Mechanics · Communication Systems · Thermal Systems · Proposal/Grant Writing · Technical Writing · Teaching/Pedagogy · IT, Server, and Network Management

Software: Issue tracking software (YouTrack, a Jira equivalent) · Version control (git, svn) · scheduling software (Microsoft Project, Asana) · VPNs (Wireguard) · Identity Management/Auth (FreeIPA, RADIUS, Windows AD) · Automation (Jenkins) · SQL databases (mySQL, PostgreSQL) · Web Interfaces (FastAPI, ZeroMQ, RabbitMQ) · Solidworks · Altium · STK · SDRs and data packetization/demodulation (GQRX, DIREWOLF) · Development Tools (CLI, VS Code)

Programming: Python · Julia · Matlab+Simulink · Mathematica · LaTeX

Awards

2020-2023 | NASA FINESST Scholar ($135k for 3 years)

I developed a low-cost CubeSat-compatible search coil magnetometer capable of measuring magnetospheric whistler emissions in the 10 Hz – 30 kHz range and qualified the sensor to TRL6.

2015-2017 | NASA Space Grant Scholarship ($15k for 3 years)

Publications (Google Scholar link, h-index=12)

1. **Tsai, E.**, et al. (2024). Remote Sensing of Electron Precipitation Mechanisms enabled by ELFIN Mission Operations and ADCS Design. Advances in Space Research: Science and Applied Research with Small Satellites. doi: 10.31224/3487, in review.
2. Bashir, M., Artemyev, A., Zhang, X.-J., Angelopoulos, V., **Tsai, E.**, et al. (2024). First direct observations of relativistic electron precipitation driven by the combined scattering of whistler and EMIC waves. Geophysical Research: Space Physics. Doi: 10.22541/essoar.169111414.40123177/v1, in review.
3. **Tsai, E.,** Artemyev, A., Ma, Q., Mourenas, D., Agapitov, O., Zhang, X.-J., & Angelopoulos, V. (2024). Key factors determining nightside energetic electron losses driven by whistler-mode waves. Journal of Geophysical Research: Space Physics, 129. doi: 10.1029/2023JA032351
4. Wilkins, C., Angelopoulos, V., Runov, A., Artemyev, A., Zhang, X.-J., Liu, J., & **Tsai, E.** (2023). Statistical Characteristics of the Electron Isotropy Boundary. Journal of Geophysical Research: Space Physics, 128. doi: 10.1029/2023JA031774
5. **Tsai, E.**, Artemyev, A., Angelopoulos, V., & Zhang, X.-J. (2023). Investigating whistler-mode wave intensity along field lines using electron precipitation measurements. Journal of Geophysical Research: Space Physics, 128. doi: 10.1029/2023JA031578
6. Angelopoulos, V., Zhang, X.-J., Artemyev, A.V., Mourenas, D., **Tsai, E.**, et al. (2023). Energetic Electron Precipitation Driven by Electromagnetic Ion Cyclotron Waves from ELFIN's Low Altitude Perspective. Space Sci Rev 219, 37. doi: 10.1007/s11214-023-00984-w
7. Zhang, X.-J., Angelopoulos, V., Artemyev, A., Mourenas, D., Agapitov, O., **Tsai, E.**, et al. (2023). Temporal scales of electron precipitation driven by whistler-mode waves. Journal of Geophysical Research: Space Physics, 128. doi: 10.1029/2022JA031087
8. Shi, X., Zhang, X.-J., Artemyev, A., Angelopoulos, V., Hartinger, M. D., **Tsai, E.**, et al. (2022). On the role of ULF waves in the spatial and temporal periodicity of energetic electron precipitation. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030932
9. Shen, Y., Artemyev, A. V., Ma, Q., Zhang, X.-J., Mourenas, D., **Tsai, E.**, Wilkins, C., Wu, J., Angelopoulos, V. (2022). Inner belt wisp precipitation measured by ELFIN: Regimes of energetic electron scattering by VLF transmitter waves. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030968
10. Artemyev, A. V., Angelopoulos, V., Zhang, X.-J., Runov, A., Petrukovich, A., Nakamura, R., **Tsai, E.**, Wilkins, C. (2022). Thinning of the magnetotail current sheet inferred from low-altitude observations of energetic electrons. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030705
11. Grach, V. S., Artemyev, A. V., Demekhov, A. G., Zhang, X.-J., Bortnik, J., Angelopoulos, V., Nakamura, R., **Tsai, E.**, Wilkins, C., Roberts, O. W. (2022). Relativistic electron

precipitation by EMIC waves: Importance of nonlinear resonant effects. Geophysical Research Letters, 49. doi: 10.1029/2022GL099994
12. Shen, Y., Artemyev, A. V., Zhang, X.-J., Angelopoulos, V., Vasko, I. Y., Turner, D. L., **Tsai, E.**, et al. (2022). Tens to hundreds of keV electron precipitation driven by kinetic Alfvén waves during an electron injection. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030360
13. Artemyev, A. V., Zhang, X.-J., Zou, Y., Mourenas, D., Angelopoulos, V., Vainchtein, D., **Tsai, E.**, et al. (2022). On the nature of intense sub-relativistic electron precipitation. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030571
14. Mourenas, D., Zhang, X.-J., Nunn, D., Artemyev, A. V., Angelopoulos, V., **Tsai, E.**, Wilkins, C. (2022), Short Chorus Wave Packets: Generation within Chorus Elements, Statistics, and Consequences on Energetic Electron Precipitation. Journal of Geophysical Research: Space Physics, 127. doi: 10.1029/2022JA030310
15. **Tsai, E.**, Artemyev A. V., Zhang, X.-J., Angelopoulos, V. (2022). Relativistic electron precipitation driven by non-linear resonance with whistler-mode waves. J. Geophys. Res., 127. doi: 10.1029/2022JA030338
16. Zhang, X.-J., Angelopoulos, V., Mourenas, D., Artemyev, A. V., **Tsai, E.**, Wilkins, C. (2022). Characteristics of Electron Microburst Precipitation based on High-Resolution ELFIN Measurements. J. Geophys. Res., 127. doi: 10.1029/2022JA030509
17. Zhang, X.-J., Artemyev, A., Angelopoulos, V. **Tsai, E.**, et al. (2022). Superfast precipitation of energetic electrons in the radiation belts of the Earth. Nat. Comm. 13, 1611. doi: 10.1038/s41467-022-29291-8
18. Chen. L., Zhang, X.-J., Artemyev, A. V., Angelopoulos, V., **Tsai, E.**, Wilkins, C., Horne, R. (2022). Ducted Chorus waves Cause Sub-Relativistic and Relativistic Electron Microbursts. Geophys. Res. Lett., 49. doi: 10.1029/2021GL097559
19. Mourenas, D., Artemyev, A. V., Zhang, X.-J., Angelopoulos, V., **Tsai, E.**, Wilkins, C. (2021). Electron Lifetimes and Diffusion Rates inferred from ELFIN Measurements at Low Altitude: First Results. J. Geophys. Res., 126. doi: 10.1029/2021JA029757
20. Artemyev, A. V., Demekhov, A. G., Zhang, X.-J., Angelopoulos, V., Mourenas, D., Fedorenko, Y. V., Manninen, J., **Tsai, E.**, et al. (2021). Role of ducting in relativistic electron loss by whistler-mode wave scattering. J. Geophys. Res., 126. doi: 10.1029/2021JA029851
21. Angelopoulos, V., **Tsai, E.**, et al. (2020). The ELFIN Mission. Space Sci Rev 216, 103, doi: 10.1007/s11214-020-00721-7
22. **Tsai, E.**, A. V. Artemyev, V. Angelopoulos. (2017). Ion motion in a polarized current sheet. Phys. Plasmas, 24 (1): 012908. doi: 10.1063/1.4975017

Talks

July 2024 | 45th Scientific Assembly of COSPAR in Busan, South Korea

Will present an **invited talk**: "Remote Sensing of Electron Precipitation Mechanisms with ELFIN"

April 2023 | The 5th COSPAR Symposium in Singapore

Presented an abridged version of "Key insights from ELFIN: using particle precipitation measurements to remotely sense radiation belt dynamics"

March 2023 | Space Plasma Seminar at Dartmouth

Presented an **invited seminar talk**: "Key insights from ELFIN: using particle precipitation measurements to remotely sense radiation belt dynamics"

July 2022 | 44th Scientific Assembly of COSPAR in Athens, Greece

Presented: "Relativistic electron precipitation driven by non-linear resonance with whistler-mode waves" and "An update on the ELFIN mission: Calibration, Data Sets, and Mission Ops"

August 2021 | URSI GASS in Rome, Italy

Presented "ELFIN: Investigating Energetic Electron Losses due to Non-Linear Resonant Scattering by Chorus Waves"

November 2019 | The 4th COSPAR Symposium in Herzliya, Israel

Presented "ELFIN mission overview and first results"

June 2019 | NASA SmallSat Mission Technical Interchange Meeting at Ames Research Center in Mountain View, CA

Invited to serve on the "Flight System Development" panel

May 2019 | CubeSat Developer's Workshop in CalPoly in San Luis Obispo, CA

Presented "Lessons learned from ELFIN"