



## Sigrid Elschot

Professor of Aeronautics and Astronautics

### CONTACT INFORMATION

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### Bio

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#### BIO

Sigrid Elschot is a Professor of Aeronautics and Astronautics and founding director of the Space Environment and Satellite Systems laboratory. Her research focuses on understanding and mitigating the space environment to enable more resilient spacecraft for interplanetary and interstellar exploration. Her work includes space weather detection and modeling, which is central to Space Situational Awareness (SSA) and Space Domain Awareness (SDA), achieved by integrating in situ and remote sensing data with high fidelity simulations to characterize space hazards. Current efforts include experimental and computational studies of hypervelocity dust and debris impacts on spacecraft using dust accelerators, light-gas guns, and Particle-In-Cell simulations, and ground-based radar to remotely characterize space debris and meteoroid populations. Prof. Elschot also leads research programs in hypersonic plasma physics relevant to atmospheric re-entry vehicles, and space energy harvesting for spacecraft power and propulsion. Prof. Elschot has been the recipient of several awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE), NSF CAREER award, DoE CAREER award, Outstanding Mentor Award and Outstanding Professor in Aeronautics and Astronautics.

#### ACADEMIC APPOINTMENTS

- Professor, Aeronautics and Astronautics

#### HONORS AND AWARDS

- Outstanding Mentor Award, Faculty Women's Forum, Stanford University (2025)
- Outstanding Professor in Aeronautics and Astronautics, Stanford University (2021)
- Vance D. and Arlene C. Coffman Faculty Scholar, Stanford University (2020)
- Space Physics and Aeronomy Richard Carrington (SPARC) Award, American Geophysical Union (2017)
- DoE CAREER Award, DoE (2013-2017)
- Outstanding Professor in Aeronautics and Astronautics, Stanford University (2013)
- Presidential Early Career Award for Scientists and Engineers (PECASE), White House (2012)
- NSF CAREER Award, National Science Foundation (2011-2016)
- Hellman Faculty Scholar, Hellman Fellows Program (2010)

- Magazine Cover, IEEE Spectrum (2008)
- Joe D. Marshall Award for Outstanding Technical Briefing, AFTAC (2007)
- 1st Place Student Paper Competition, International Union of Radio Science (2002)

## **BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS**

- National Science, Technology and Security, Hoover Institute (2023 - present)
- AMISR Advisory Panel, AMISR (2020 - present)
- Fusion Energy Sciences Advisory Committee Member, Department of Energy (2017 - present)
- Elected Chair Commission G, URSI (2015 - present)
- Guest Expert, The Weather Channel (2015 - present)
- Guest Expert, PBS Chasing Pluto (2015 - present)
- Scientific Organizing Committee, Meteoroids 2016 (2015 - present)
- Elected Vice Chair Commission G, URSI (2013 - 2015)
- Member, Arecibo Science Advisory Panel (2011 - 2013)
- Co-Host National Geographic Channel, Known Universe (2011 - 2011)
- Guest Expert, PBS, Can We Make it to Mars (2011 - 2011)
- Micrometeoroid and Orbital Debris Panel Member, National Research Council Aeronautics and Space Engineering Board (2011 - 2011)
- Scientific Organizing Committee, Meteoroids 2010 (2010 - 2010)
- NEO Surveys and Hazard Mitigation Strategies Panel Member, National Research Council Aeronautics and Space Engineering Board (2009 - 2010)

## **LINKS**

- Space Environment and Satellite Systems lab website: <http://sess.stanford.edu/>

## **Teaching**

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### **COURSES**

#### **2025-26**

- Classical Dynamics: AA 242A (Aut)
- Fundamentals of Plasmas I : AA 244A (Win)
- Surviving Space: AA 108N (Spr)

#### **2024-25**

- Classical Dynamics: AA 242A (Aut)
- Introduction to Plasma Physics and Engineering: AA 244A (Win)
- Introduction to the Space Environment: AA 251 (Spr)

#### **2023-24**

- Classical Dynamics: AA 242A (Aut)
- Introduction to Plasma Physics and Engineering: AA 244A (Win)
- Introduction to the Space Environment: AA 251 (Spr)

#### **2022-23**

- Air and Space Propulsion: AA 103 (Spr)
- Classical Dynamics: AA 242A (Aut)

- Introduction to Plasma Physics and Engineering: AA 244A (Win)

## STANFORD ADVISEES

### Doctoral Dissertation Reader (AC)

Zahra Ahmed, Toby Bell, Danielle Brown, Andy Castillo, Yu-Fang Lai, Vedanth Sharma, Shigemitsu Suzuki, Daniel Troyetsky

### Doctoral Dissertation Advisor (AC)

Ana Banzer Morgado, Kofi Blake, Nancy Diallo, Dennis Dong, Prachet Jain, Michael Kwara, Casey Lawson, Neil Maitra, Walter Manuel, Xiaohan Mei

### Orals Evaluator

Andy Castillo, Yu-Fang Lai, Daniel Troyetsky

### Master's Program Advisor

Tomas Collado, Somi Eigbe, Cole Robins, Alina Sandra Santander Vinokurova, Maxim Somov, Josephine Zhao

## Publications

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### PUBLICATIONS

- **Characterizing hypervelocity impact-generated dense plasmas via a computational thermodynamic and chemical kinetics analysis** *PHYSICS OF PLASMAS*  
Dong, D., Lau, R., Elschot, S.  
2025; 32 (11)
- **Collisionless electrostatic particle-in-cell simulation of rapid target charging along an unbiased dielectric surface due to hypervelocity impact plasmas** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Diallo, N., Lau, R., Lee, N., Elschot, S.  
2025; 204
- **Self-consistent charging of complex objects in flowing plasma: Implementation and analysis in WarpX** *COMPUTER PHYSICS COMMUNICATIONS*  
Sam, A., Elschot, S.  
2025; 314
- **Nonlinear evolution, propagation, electron-trapping, and damping effects of ion-acoustic solitons using fully kinetic PIC simulations** *PHYSICS OF PLASMAS*  
Sam, A., Kumar, P., Fletcher, A. C., Crabtree, C., Lee, N., Elschot, S.  
2025; 32 (2)
- **A curvature-based mechanism for the spontaneous emission of electromagnetic radiation at curved plasma-vacuum interfaces** *PHYSICS OF PLASMAS*  
Lau, R., Elschot, S.  
2025; 32 (1)
- **COLLISIONLESS ELECTROSTATIC PARTICLE-IN-CELL SIMULATION OF RAPID TARGET CHARGING ALONG AN UNBIASED SURFACE DUE TO HYPERVELOCITY IMPACT PLASMAS**  
Diallo, N., Lau, R., Lee, N., Elschot, S., ASME  
AMER SOC MECHANICAL ENGINEERS.2025
- **Invariant Funnels in the Circular Restricted Three-Body Problem** *JOURNAL OF GUIDANCE CONTROL AND DYNAMICS*  
Blanchard, J. T., Lo, M. W., Anderson, B. D., Landau, D., Lee, N., Elschot, S.  
2024
- **Spatial decay of electromagnetic waves from hypervelocity impact plasmas** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Lau, R., Lee, N., Elschot, S.  
2024; 187

- **Collisional particle-in-cell investigations of electromagnetic pulses in hypervelocity impact plasmas** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Lau, R., Lee, N., Elschot, S.  
2023; 180
- **Preliminary study of radio frequency waves in hypervelocity impact plasma** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Fereydooni, K., Lee, N., Elschot, S.  
2023; 179
- **Time-Dependent Inversion of Energetic Electron Precipitation Spectra From Ground-Based Incoherent Scatter Radar Measurements** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Juarez Madera, D., Marshall, R. A., Elschot, S., Kaeppler, S., Reyes, P., Varney, R. H., Crew, A. B.  
2023; 128 (5)
- **Experimental evidence of rapid target charging electromagnetic pulse from hypervelocity impact** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Estacio, B., Young, S. A. Q., Lee, N., Elschot, S.  
2023; 173
- **Meteoroid orbit determination from HPLA radar data** *ICARUS*  
Blanchard, J. T., Lee, N., Elschot, S.  
2022; 386
- **Continuum to rarefied diffusive tortuosity factors in porous media from X-ray microtomography** *COMPUTATIONAL MATERIALS SCIENCE*  
Ferguson, J. C., Borner, A., Panerai, F., Close, S., Mansour, N. N.  
2022; 203
- **Theory of Power Generation From Spacecraft Charging** *IEEE TRANSACTIONS ON PLASMA SCIENCE*  
Young, S. A. Q., Stupl, J., Lee, N., Close, S.  
2022; 50 (1): 141-154
- **Microscopic ejecta measurements from hypervelocity impacts on aluminum and powdered regolith targets** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Shohet, G., Estacio, B., Matthews, I., Young, S. A. Q., Lee, N., Close, S.  
2021; 152
- **Dust and atmospheric influence on plasma properties observed in light gas gun hypervelocity impact experiments** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Estacio, B., Shohet, G., Young, S. A. Q., Matthews, I., Lee, N., Close, S.  
2021; 151
- **A thermodynamic analysis of hypervelocity impacts on metals** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Nuttall, A., Close, S.  
2020; 144
- **A technique for inferring lower thermospheric neutral density from meteoroid ablation** *PLANETARY AND SPACE SCIENCE*  
Limonta, L., Close, S., Marshall, R. A.  
2020; 180
- **Dust Charge Modeling and Ejecta Measurements for Hypervelocity Impacts on Aluminum and Powdered Regolith Simulant Targets**  
Shohet, G., Lee, N., Close, S., IEEE  
IEEE.2020
- **Harvesting Electromagnetic Energy from Hypervelocity Impacts for Solar System Exploration**  
Young, S. A. Q., Lee, N., Close, S., IEEE  
IEEE.2020
- **Inference of meteoroid characteristics using a genetic algorithm** *ICARUS*  
Tarano, A., Wheeler, L. F., Close, S., Mathias, D. L.  
2019; 329: 270–81

- **Meteoroid Impact Detection for Exploration of Asteroids: Small Satellites for Asteroid Characterization**  
Lee, N., Close, S.  
AMER INST AERONAUTICS ASTRONAUTICS.2018: 202-13
- **Plasma distributions in meteor head echoes and implications for radar cross section interpretation**  
Marshall, R. A., Brown, P., Close, S.  
PERGAMON-ELSEVIER SCIENCE LTD.2017: 203-208
- **How dust makes radio waves** *ASTRONOMY & GEOPHYSICS*  
Close, S., Fletcher, A.  
2017; 58 (3): 7
- **Particle-in-cell simulations of an RF emission mechanism associated with hypervelocity impact plasmas** *PHYSICS OF PLASMAS*  
Fletcher, A. C., Close, S.  
2017; 24 (5)
- **A CubeSat Platform for Characterizing the Reliability of Electronic Components**  
Tarantino, P., Lee, N., Close, S., IEEE  
IEEE.2017: 75-76
- **Experimental Verification of Pulsed Electrostatic Manipulation for Reentry Blackout Alleviation**  
Steffens, L., Krishnamoorthy, S., Guelhan, A., Close, S., IEEE  
IEEE.2017
- **Detection of hypervelocity impact radio frequency pulses through prior constrained source separation** *RADIO SCIENCE*  
Nuttall, A., Kochenderfer, M., Close, S.  
2016; 51 (10): 1660-1675
- **Mean thermo spheric density estimation derived from satellite constellations** *ADVANCES IN SPACE RESEARCH*  
Li, A., Close, S.  
2015; 56 (8): 1645-1657
- **Simulating plasma production from hypervelocity impacts** *PHYSICS OF PLASMAS*  
Fletcher, A., Close, S., Mathias, D.  
2015; 22 (9)
- **THE SOUTHERN ARGENTINA AGILE METEOR RADAR ORBITAL SYSTEM (SAAMER-OS): AN INITIAL SPORADIC METEOROID ORBITAL SURVEY IN THE SOUTHERN SKY** *ASTROPHYSICAL JOURNAL*  
Janches, D., Close, S., Hormaechea, J. L., Swarnalingam, N., Murphy, A., O'Connor, D., Vandeppeer, B., Fuller, B., Fritts, D. C., Brunini, C.  
2015; 809 (1)
- **An FDTD model of scattering from meteor head plasma** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Marshall, R. A., Close, S.  
2015; 120 (7): 5931-5942
- **Design for CubeSat-based dust and radiation studies at Europa** *ACTA ASTRONAUTICA*  
Goel, A., Krishnamoorthy, S., Swenson, T., West, S., Li, A., Crew, A., Phillips, D. J., Screve, A., Close, S.  
2015; 136: 204-218
- **Design and testing of miniaturized plasma sensor for measuring hypervelocity impact plasmas** *REVIEW OF SCIENTIFIC INSTRUMENTS*  
Goel, A., Tarantino, P. M., Lauben, D. S., Close, S.  
2015; 86 (4)
- **Electrical Anomalies on Spacecraft due to Hypervelocity Impacts**  
Goel, A., Close, S., IEEE  
IEEE.2015
- **Susceptibility of Spacecraft to Impact-Induced Electromagnetic Pulses**  
Fletcher, A., Mathias, D., Close, S., IEEE  
IEEE.2015

- **Numerical Modeling of Radio Wave Scattering from Meteor Head Plasma**  
Marshall, R. A., Close, S., IEEE  
IEEE.2015: 254
- **Plasma turbulence of nonspecular trail plasmas as measured by a high-power large-aperture radar** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*  
Yee, J., Close, S.  
2013; 118 (24): 13449-13462
- **Impact-Induced ESD and EMI/EMP Effects on Spacecraft-A Review** *IEEE TRANSACTIONS ON PLASMA SCIENCE*  
Garrett, H. B., Close, S.  
2013; 41 (12): 3545-3557
- **First Preliminary Results from US Round-Robin Tests** *IEEE TRANSACTIONS ON PLASMA SCIENCE*  
Vayner, B. V., Ferguson, D. C., Hoffmann, R. C., Wheelock, A. T., Likar, J. J., Prebola, J. L., Crider, D. H., Schneider, T. A., Vaughn, J. A., Hoang, B., Steele, K., Close, S., Goel, et al  
2013; 41 (12): 3310-3322
- **Detection of electromagnetic pulses produced by hypervelocity micro particle impact plasmas** *PHYSICS OF PLASMAS*  
Close, S., Linscott, I., Lee, N., Johnson, T., Strauss, D., Goel, A., Fletcher, A., Lauben, D., Srama, R., Mocker, A., Bugiel, S.  
2013; 20 (9)
- **Curved pleat folding for smooth wrapping** *PROCEEDINGS OF THE ROYAL SOCIETY A-MATHEMATICAL PHYSICAL AND ENGINEERING SCIENCES*  
Lee, N., Close, S.  
2013; 469 (2155)
- **The Meteoroid Input Function and predictions of mid-latitude meteor observations by the MU radar** *ICARUS*  
Pifko, S., Janches, D., Close, S., Sparks, J., Nakamura, T., Nesvorny, D.  
2013; 223 (1): 444-459
- **Theory and experiments characterizing hypervelocity impact plasmas on biased spacecraft materials** *PHYSICS OF PLASMAS*  
Lee, N., Close, S., Goel, A., Lauben, D., Linscott, I., Johnson, T., Strauss, D., Bugiel, S., Mocker, A., Srama, R.  
2013; 20 (3)
- **Plasma Turbulence of Non-Specular Trail Plasmas as Measured by a High Power Large Aperture Radar** *US-National-Committee-of-URSI National Radio Science Meeting*  
Yee, J., Close, S.  
IEEE.2013
- **Theory and experiments characterizing hypervelocity impact plasmas: Toward weatherproof spacecraft systems** *US-National-Committee-of-URSI National Radio Science Meeting*  
Lee, N., Close, S.  
IEEE.2013
- **Clustering and Confidence Intervals for Radar Target Identification and Estimation** *US-National-Committee-of-URSI National Radio Science Meeting*  
Volz, R., Close, S., Erickson, P. J.  
IEEE.2013
- **Inverse filtering of radar signals using compressed sensing with application to meteors** *RADIO SCIENCE*  
Volz, R., Close, S.  
2012; 47
- **Determining meteoroid bulk densities using a plasma scattering model with high-power large-aperture radar data** *ICARUS*  
Close, S., Volz, R., Loveland, R., Macdonell, A., Colestock, P., Linscott, I., Oppenheim, M.  
2012; 221 (1): 300-309
- **Measurements of freely-expanding plasma from hypervelocity impacts** *INTERNATIONAL JOURNAL OF IMPACT ENGINEERING*  
Lee, N., Close, S., Lauben, D., Linscott, I., Goel, A., Johnson, T., Yee, J., FLETCHER, A., Srama, R., BUGIEL, S., Mocker, A., Colestock, P., Green, et al

2012; 44: 40-49

- **Analysis of electromagnetic and electrostatic effects of particle impacts on spacecraft** *ADVANCES IN SPACE RESEARCH*  
Kelley, M. C., Pancoast, S., Close, S., Wang, Z.  
2012; 49 (6): 1029-1033
- **Targeted Parameter Inflation Within Ground-Based Augmentation Systems to Minimize Anomalous Ionospheric Impact** *JOURNAL OF AIRCRAFT*  
Seo, J., Lee, J., Pullen, S., Enge, P., Close, S.  
2012; 49 (2): 587-599
- **Meteoroid head echo polarization features studied by numerical electromagnetics modeling** *RADIO SCIENCE*  
Vertatschitsch, L. E., Sahr, J. D., Colestock, P., Close, S.  
2011; 46
- **Coherent matched filter signal-processing algorithms for probing the ionosphere using broadband RF data** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Close, S., FLETCHER, A., Dunham, M., Linscott, I.  
2011; 116
- **A medium-scale traveling ionospheric disturbance observed from the ground and from space** *RADIO SCIENCE*  
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2011; 46
- **Analysis of ALTAIR 1998 meteor radar data** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Zinn, J., Close, S., Colestock, P. L., MacDonell, A., Loveland, R.  
2011; 116
- **Comparison of methods of determining meteoroid range rates from linear frequency modulated chirped pulses** *RADIO SCIENCE*  
Loveland, R., MacDonell, A., Close, S., Oppenheim, M., Colestock, P.  
2011; 46
- **Development and error analysis of nonlinear ionospheric removal algorithm for ionospheric electron density determination using broadband RF data** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Lay, E. H., Close, S., Colestock, P., Bust, G.  
2011; 116
- **Polarization and scattering of a long-duration meteor trail** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Close, S., Kelley, M., Vertatschitsch, L., Colestock, P., Oppenheim, M., Yee, J.  
2011; 116
- **Electromagnetic pulses generated by meteoroid impacts on spacecraft** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*  
Close, S., Colestock, P., Cox, L., Kelley, M., Lee, N.  
2010; 115
- **Dependence of radar signal strength on frequency and aspect angle of non-specular trails** *J. Geophys. Res.*  
Close, S., Hamlin, T., Oppenheim, M., Cox, L., Colestock, P.  
2008; 113: A06203
- **Meteor head echo radar data: Mass-velocity selection effects** *Icarus*  
Close, S., Brown, P., Campbell-Brown, M., Oppenheim, M., Colestock, P.  
2007; 186: 547-556
- **A new method for determining meteoroid mass from head echo data** *J. Geophys. Res.*  
Close, S., Oppenheim, M., Durand, D., Dyrud, L.  
2005; 110: A09308
- **A technique for calculating meteor plasma density and mass from radar head echo scattering** *Icarus*  
Close, S., Oppenheim, M., Hunt, S., Coster, A.  
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- **Scattering characteristics of high-resolution meteor head echoes detected at multiple frequencies** *J. Geophys. Res.*  
Close, S., Oppenheim, M., Hunt, S., Dyrud, L.  
2002; 107: 1295
- **Analysis of Perseid meteor head echo data collected using the Advanced Research Projects Agency Long-Range Tracking and Instrumentation Radar (ALTAIR)** *Radio Sci.*  
Close, S., Hunt, S., Minardi, M., McKeen, F.  
2000; 35: 1233-1240