

Exponent®
Engineering & Scientific Consulting

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Professional Profile

Thomas Celenza, Ph.D., CFEI, is a senior Associate in Exponent's Thermal Sciences practice who specializes in aviation and aerospace systems, thermal-fluid engineering, semiconductor fabrication, and mechanical systems. He advises clients on heat transfer analysis, fire and explosion investigation, HVAC and MEP systems, and process safety, with particular expertise in metamaterials. He supports failure analysis, root-cause investigations, intellectual property disputes, construction defect matters, and complex technical litigation.

Dr. Celenza has contributed to matters involving aircraft and spacecraft systems, fire investigations, microelectromechanical systems (MEMS), semiconductor and electronic products, thermal-fluid systems, and building equipment. He provides engineering consulting and litigation support to law firms, manufacturers, insurers, government organizations, and other clients through field inspections, laboratory testing, computational modeling, and technical report development.

Aerospace, Aviation, and Space Systems

Dr. Celenza's aerospace experience includes aircraft accident and incident investigations, satellite anomalies and in-orbit failures, and spacecraft construction and schedule disputes. He evaluates maintenance and operational records, engineering drawings, propulsion and thermal systems, component defects, flight data, regulatory requirements, space-environment conditions, and thermal constraints. His NASA-supported research in rarefied-gas dynamics, heat transfer, photophoresis, and microscale metamaterials provides a distinctive foundation for investigations involving advanced aerospace products.

Fire and Explosion Investigation

As a Certified Fire and Explosion Investigator (CFEI), Dr. Celenza conducts fire origin-and-cause investigations involving electrical infrastructure, gas piping, consumer products, heating equipment, mechanical systems, and industrial facilities. He performs scene documentation, evidence identification and preservation, electrical-system mapping, product examinations, and fire- and arcing-pattern analysis. He also investigates HVAC, plumbing, electrical, controls, and other MEP construction defects through site inspections, code and drawing review, and equipment-performance evaluations.

MEMS, Semiconductors, Electronics, and Intellectual Property

Dr. Celenza's MEMS and semiconductor experience encompasses thin films, microfabrication, lithography, nanotechnology, porous materials, sensors, vacuum systems, and electronic products. He supports intellectual property disputes involving patent infringement and invalidity claims, and he applies

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ANSYS Fluent, COMSOL Multiphysics, and thermal-fluid analysis to complex engineering problems. He is also trained in DNV PHAST for process-hazard and consequence modeling.

Thermal-Fluid Systems, Process Safety, and Mechanical Systems

Dr. Celenza also specializes in thermal-fluid systems analysis and process safety consulting, applying heat transfer theory, fluid mechanics, and thermodynamic modeling to evaluate the performance and failure of mechanical systems across industries. He advises clients on process safety matters involving thermal runaway, overpressure events, heat exchanger performance, and the thermal-mechanical integrity of pressurized and vacuum systems. His background in thermionic energy conversion and photovoltaics also supports consulting in energy systems and renewable technology applications.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering and Applied Mechanics, University of Pennsylvania, 2024

B.S.E., Mechanical Engineering, University of Delaware, 2018

NASA Space Technology Graduate Research Opportunity, 2020-2024

W. Francis Lindell Mechanical Engineering Award to the Distinguished Senior, 2018

W. Francis Lindell Mechanical Engineering Achievement Award, 2017

Licenses and Certifications

Certified Fire and Explosion Investigator (CFEI)

Prior Experience

Graduate Researcher, University of Pennsylvania, Philadelphia, PA, 2020-2024

• Conducted NASA-supported research on photophoretic flight, mechanical metamaterials, atmospheric sensing, rarefied-gas dynamics, thermal-fluid modeling, semiconductor fabrication, and vacuum-system testing.

• Designed, simulated, fabricated, and experimentally tested photophoretic aircraft made from ultralight microscale materials for atmospheric and space-related applications.

Assistant Engineer, Turner Construction, New York, NY, 2018-2019

• Supervised, coordinated, and budgeted construction activities involving HVAC, plumbing, mechanical equipment, carpentry, and other building trades.

• Collaborated with designers, engineers, contractors, and clients to resolve field installation, coordination, constructability, and construction-management issues.

Professional Affiliations

National Association of Fire Investigators, NAFI

Tau Beta Pi Engineering Honor Society, 2018

Publications

Campbell, Matthew F., … Celenza, T., et al. "Experimental demonstration of corrugated nanolaminate films as reflective light sails," Nature Communications 17 (2026): 6874.

Dee S, Faraji S., Celenza T. "Does "Better" Training Data Improve ChatGPT in Process Safety Applications? Beta-Testing Results of a Customized GPT," AIChE Global Congress on Process Safety, 2025.

Celenza, T, Eskenazi, A, Bargatin, I. "Three-dimensional photophoretic aircraft made from ultralight porous materials can carry kilogram-scale payloads in the mesosphere," Physical Review Applied 2024, 22(5), 054081.

Celenza T, Eskenazi A, Lu Z, Mann A, Yao-Bate L, Bargatin I. "Knudsen Pump-and Solar Buoyancy-Based Propulsion for Atmospheric and Martian Exploration," AIAA SciTech 2024 Forum; 1811.

Lu Z, Stern M, Li J, Candia D, Yao-Bate L, Celenza T, Azdi M, Campbell M, Bargatin I. "Minimizing the Ground Effect for Photophoretically Levitating Disks," Physical Review Applied 2023; 19.4:044004.

Campbell M, Celenza T, Schmitt F, Schwede J, Bargatin I. "Progress toward high power output in thermionic energy converters," Advanced Science 2021; 8.9:2003812.

Cha W, Kasper L, Campbell M, Celenza T, Popov G, Wang J, Sung C, Yim M, Bargatin I. "Carbon fiber–aluminum sandwich for micro-aerial vehicles and miniature robots," MRS Advances 2021; 6.19:477-481.

Presentations

Dee S, Faraji S., Celenza T, “Does ‘Better’ Training Data Improve ChatGPT in Process Safety Applications? Beta-Testing Results of a Customized GPT.” AIChE Global Congress on Process Safety, 2025.

Celenza T, Eskenazi A, Lu Z, Mann A, Yao-Bate L, Bargatin I. Knudsen Pump-and Solar Buoyancy-Based Propulsion for Atmospheric and Martian Exploration. AIAA SciTech Forum, Orlando, FA, 2024

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Bargatin I. Mechanical Metamaterials Enabling Knudsen-Pump-Based Propulsion for Novel Sensor-Based Mesosphere Exploration. MRS Fall Meeting, Boston, MA, 2023

Celenza T, Campbell M, Popov G, Kasper L, Cha W, Sung C, Yim M, Bargatin I. Selective Curing of Carbon Fiber Reinforced Plastics to Fabricate Deployable Folding Structures. MRS Spring Meeting, Virtual, 2021

Celenza T, Lu Z, Campbell M, Azadi m, Bargatin I. Enhancing Photophoretic Lift Force at Low Reynolds Numbers using Three-Dimensional Porous Structures. 1st International Conference on Micromachines and Applications, Virtual, 2021

Posters

Dee S, Faraji S., Celenza T., “AI-Enabled Image Analysis for Process Safety Assessment.” Poster presentation, AIChE Global Congress on Process Safety, 2026.

Celenza T. Knudsen-Pump-Based Propulsion for Atmospheric and Martian Exploration. CEDAR Workshop, San Diego CA, 2023

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Campbell M, Bargatin I. Simulation, Fabrication and Experimentation of Levitating Three-Dimensional Structures. ASME IMECE, Columbus OH, 2022

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Azadi M, Campbell M, Bargatin I. Simulation and Fabrication of 3D Structures for Photophoretic Levitation. SPIE Optical Trapping and optical micromanipulation XIX, San Diego, CA, 2022

Project Experience

Aerospace, Aviation, and Space Systems

- Investigated aircraft accidents and incidents by analyzing maintenance and operational records, regulatory materials, flight data, mechanical systems, and more to support technical reports and litigation strategy.
- Evaluated satellite anomalies, in-orbit failures, and spacecraft development disputes by assessing root- cause analyses, component performance, design requirements, engineering changes, and schedule impacts.

MEMS, Semiconductors, Electronics, and Intellectual Property

- Evaluated patents involving semiconductor displays, electronic products, lithography, manufacturing processes, material properties, and device architecture to support infringement and invalidity analyses.
- Applied MEMS and semiconductor fabrication methods — including thin-film deposition, lithography, and etching — to develop microscale metamaterials and porous structures for aerospace and sensing applications.
- Designed and tested microstructured devices using custom vacuum systems, optical and electrical equipment, instrumentation, and thermal-fluid modeling to assess performance in rarefied-gas environments.

Fire and Explosion Investigation

- Conducted fire origin-and-cause investigations involving electrical infrastructure, gas piping, consumer products, heating equipment, mechanical systems, and industrial facilities.
- Performed scene inspections, photographic documentation, evidence collection and preservation, electrical-system mapping, fire- and arcing-pattern analysis, and product examinations for litigation and insurance matters.

HVAC, MEP Systems, and Construction Defects

- Inspected residential and commercial properties for alleged defects involving HVAC, mechanical, electrical, plumbing, controls, and other building systems.
- Evaluated equipment condition, installation quality, system performance, engineering drawings, construction documents, and applicable codes to assess alleged deficiencies and damages.
- Analyzed boilers, burners, heat exchangers, piping, ventilation systems, and heating equipment, applying construction-management experience to assess installation, constructability, and coordination among trades.

Computational Modeling and Experimental Testing

- Developed computational models using ANSYS Fluent, COMSOL Multiphysics, and MATLAB to analyze heat transfer, fluid dynamics, multi-physics phenomena, and rarefied-gas flow.
- Designed custom vacuum, optical, electrical, gas-flow, and sensor test systems for evaluating microstructured materials, aerospace concepts, and thermal-fluid technologies.

Thermal-Fluid Systems, Process Safety, and Mechanical Systems

- Assessed carbon dioxide removal technologies against system requirements and designed a proof-of-concept direct-air-capture system incorporating sorbent materials, gas-flow equipment, instrumentation, and electronic controls.
- Investigated industrial process incidents involving hydrogen production, anaerobic digestion, combustion equipment, and thermal systems through P&ID review, operating-data analysis, and mechanical evaluation.
- Evaluated the ability of AI to identify and rectify process hazards, hazardous-material releases, dispersion, fires, explosions, and thermal effects.
- Analyzed diesel-engine emissions systems, exhaust-gas-recirculation hardware, software control logic, operating parameters, and regulatory requirements for complex litigation.
- Reviewed MATLAB/Simulink models and technical documentation to compare control strategies, system behavior, parameters, and calibration differences.